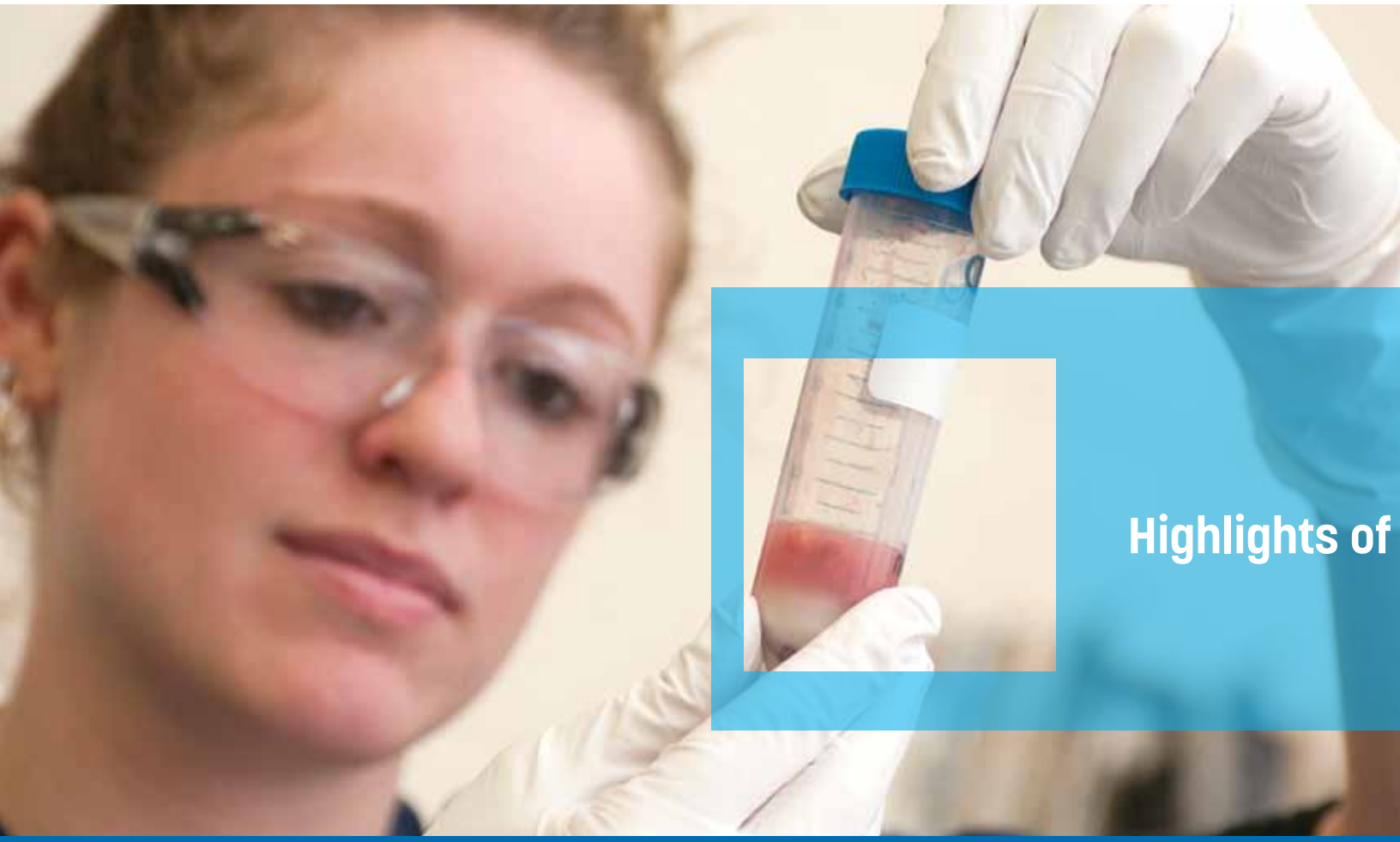
University of Connecticut
College of Agriculture and Natural Resources

2011

HIGHLIGHTS *of* RESEARCH

AND THE STORRS AGRICULTURAL EXPERIMENT STATION



Highlights of

MESSAGE FROM THE DEAN of the College of Agriculture and Natural Resources

Gregory Weidemann
Dean and Director
College of Agriculture
and Natural Resources

As Dean of the College of Agriculture and Natural Resources at the University of Connecticut, I am pleased to present highlights of our research conducted through the Storrs Agricultural Experiment Station for the Governor's Office and the Connecticut General Assembly (per State Statute Ch. 426, Sec. 22-102). As Connecticut's Land Grant Institution, we have a federally charged responsibility to educate the next generation of students, conduct fundamental and translational research to address the needs of Connecticut's $3.5 billion agricultural economy and associated natural resources, improve human health, and provide non-credit education and outreach to Connecticut's citizens through the Cooperative Extension System. All three missions are fully integrated within the College as one seamless organization with many of our faculty and staff contributing to all three mission areas. Our research is fully integrated with our academic programs, and undergraduate and graduate students are directly engaged with our faculty as we train the next generation of scientists and leaders. Likewise, our research discoveries are delivered directly to those who can benefit from those discoveries through our Cooperative Extension System. This report provides a brief overview of our research enterprise and provides a few selected highlights.

"As Connecticut's Land Grant Institution, we have a federally charged responsibility to educate the next generation of students, conduct fundamental and translational research to address the needs of Connecticut's $3.5 billion agricultural economy and associated natural resources, improve human health, and provide non-credit education and outreach."

VISION The vision of the College of Agriculture and Natural Resources is to be one of the highest quality institutions that generates new knowledge, disseminates knowledge in formal and informal settings, engages societal needs, provides leadership for problem solving, improves the quality of life for all people of the State of Connecticut, and participates in global citizenship.

Research and the Storrs Agricultural Experiment Station

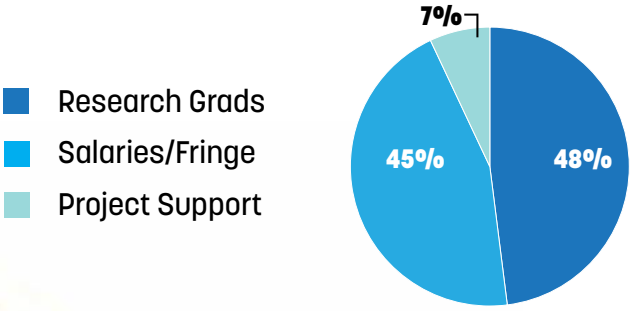
MISSION The role of the land-grant university is to develop knowledge and disseminate it through the three academic functions of teaching, research, and outreach education. This role is based in historic federal legislation, including the Morrill, Hatch, Smith-Lever, McIntire-Stennis, and Animal Health acts, and enabling state statutes.

INTRODUCTION The University of Connecticut's College of Agriculture and Natural Resources (CANR) is committed to research that solves problems and investigates new areas relevant to agriculture, food, forestry, the environment, and human health. The Office of Research and Graduate Education is responsible for facilitating the CANR's research effort, which is supported by capacity and competitive funds. Capacity research funding is provided through the federal-state partnership managed by the Storrs Agricultural Experiment Station (SAES). Competitive funds are obtained from a variety of federal and non-federal sources through the independent initiative of CANR's faculty and staff. We encourage fundamental research to gain knowledge in relevant agriculture fields, and multidisciplinary collaborations between institutions, agencies, and fields of study to advance national goals established by the United States Department of Agriculture National Institute of Food and Agriculture (USDA NIFA). The implementation of results is critical and we equally value applied research approaches.

The College of Agriculture and Natural Resources comprises eight departments that are home to 139 faculty members and 151 staff. These individuals all contribute in some way to the discovery of new knowledge and its communication to the broader population of the state, region, and nation. An essential part of the CANR research mission is to provide a framework for graduate student training. As such, we perform a critical function in ensuring the next generation of scientists prepared for solving the state's, region's, and nation's challenges.

Storrs Agricultural Experiment Station Fund Allocation

Figure 1

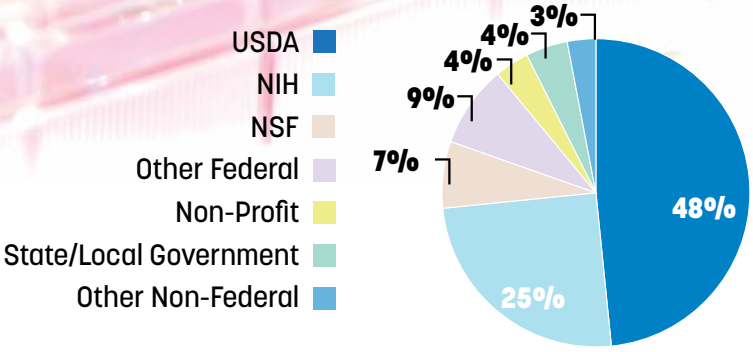


The Storrs Agricultural Experiment Station and Research

The Storrs Agricultural Experiment Station (SAES) receives capacity funding from the USDA each year and a 1:1 state match is provided through the University's block grant from the state legislature. For FY2011, funding in the amount of $1.35 million was received to support independent investigator and multi-state research in the broad fields of agricultural sciences, forestry, and animal health. The allocation of those funds is indicated in Figure 1. Ninety-three percent of the budget was used to fund graduate students, faculty, and staff that contributed to research associated with USDA-approved capacity projects.

The investment provided by the federal-state SAES partnership is leveraged considerably by the creative and scholarly efforts of CANR's faculty and staff. This is done primarily through pursuit of competitive extramural funding in the form of single or multiple year grant awards. In FY 2011, CANR faculty and staff members were engaged in research supported by more than 300 active or approved grants, 58 of which were supported directly by the USDA capacity funds.

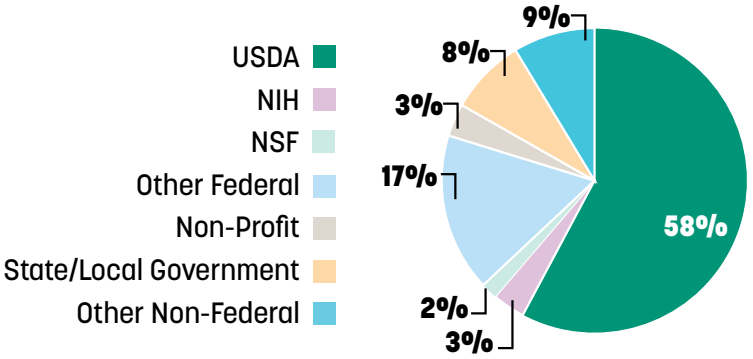
In FY 2011, CANR researchers applied for a total of $49.9 million in extramural funding. Proposals were submitted to a variety of federal and non-federal sources. Federal agencies were approximately 90 percent of the destinations for grant submissions while non-federal sources were targeted by approximately 10 percent of proposals submitted (see Figure 2).



Proportion of funding requests by agency, FY 2011

Source: Office of Vice President for Research

Figure 2



Proportion of funding awards by agency, FY 2011

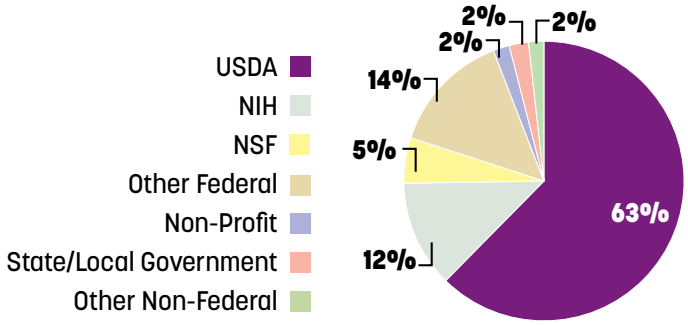
Source: Office of Vice President for Research

Figure 3

Proportion of research expenditures by agency, FY 2011

Source: Office of Vice President for Research

Figure 4



Funding awards amounted to just over $16 million in FY 2011. More than one-half of all funding awards were received from USDA, with other federal agencies (e.g., DOC, DOE, EPA) providing the next greatest source of monies (see Figure 3).

Approximately $17 million was spent in support of research activities in FY 2011. These funds were derived primarily from awards received in preceding fiscal years. Expenditures derived from USDA funding composed 63 percent of the total with NIH and other federal agencies providing 12 percent and 14 percent of the total, respectively (see Figure 4).

The application for and acquisition of funding is a common metric used to gauge research activity. While it communicates the value of a research idea/mission as judged by qualified peer scientists and agencies, it represents only the input side. The outputs that are realized from research funding are measured in terms of scholarship and the number of scientists (i.e., MS and PhD students; postdoctoral fellows) trained.

Scholarly Productivity

Scholarly Product/Indicator	Number
Peer-reviewed journal articles	211
Books authored	7
Books edited	2
Book chapters	22
Published conference proceedings	30
Technical reports	110
Patents	2
Presentations at meetings	290
Editorships of major journals	9
Associate editorships	23
Member of federal peer review committees	31
Member of other national/international peer review committees	26
Member of state or regional peer review committees	15
Ad hoc reviews for granting agencies	355

Source: Annual reports of CANR departments.

MS • PhD • Postdoctoral fellows

Training the next Generation of research scientists

Human capacity development in the agricultural sciences

is necessary for our state and nation to remain competitive in the global marketplace. A critical element of the CANR research mission is the training of MS, PhD, and post-doctoral scientists for the purpose of meeting this need. The U.S. Department of Labor's Bureau of Labor Statistics recently noted in its *2010-11 Career Guide to Industries* that research scientists will continue to be in high demand with PhD-trained individuals enjoying the greatest opportunities.

In FY 2011

- 21 PhD candidates graduated
- 39 MS candidates graduated
- 20 predoctoral students received support from national competitions
- 15 postdoctoral fellows worked under the direction of CANR faculty members.

PhD Degrees conferred FY 2011

Alexandre Nunes De Almeida	ARE	Boris E. Bravo-Ureta	Three Essays in Agricultural Development in Central America: Semiparametric Analyses Using Panel Data
Luz Marelvis Londono Diaz	ARE	Robert J. Johnson	The Recreational Value of Coral Reefs: Classical and Bayesian Meta-Analytic Approaches to Benefit Transfer
Shadab Qaiser	ARE	Rigoberto Lopez	Nonlinearities between Financial Development and Economic Development
Tammy Elizabeth Warner	ARE	Robert S. Pomeroy	Marine Conservation in Developing Countries: The Economics of Marine Managed Areas
Mary Anne Roshni Amalaradjou	ANSC	Kumar S. Venkitanarayanan	Investigating the Antimicrobial Potential of Trans-Cinnamaldehyde for Controlling *Cronobacter sakazakii* Infections
Chih-Jen Lin	ANSC	Xiuchun C. Tian	Studies of Nuclear Reprogramming: DNA Replication, Therapeutic Cloning and Improvements of Tetraploid Complementation
Ebenezer Out-Nyarko	ANSC	Michael J. Darre	The Effect of Stress on the Vocalizations of Captive Poultry Populations
Satyender Rao Valipe	ANSC	Jenifer Nadeau	Investigating the Antimicrobial Effect of Caprylic Acid and Its Derivatives on *Dermatophilus congolensis* and Developing a Species Specific PCR to Detect *Dermatophilus congolensis*
Yoichiro Kanno	NR	Jason Vokoun	Brook Trout Populations in Headwater Stream Networks: Reproductive Biology, Riverscape Genetics and Climate Change Impact on Abundance
Howard Joseph Kilpatrick	NR	John S. Barclay	An Assessment of Suburban Deer Management
Vincent Allen Webb	NR	Mark Rudnicki	A Theoretical and Experimental Investigation of Crown Collisions in a Forest Canopy
Mariana Cecilia Calle	NUSC	Maria-Luz Fernandez	Inflammatory Markers are Modulated by Diet in Latinos with Type 2 Diabetes and by Resistance Exercise in a Healthy Population
Tina Marie Checchio	NUSC	Maria-Luz Fernandez	Development of Mathematical Models to Assess the Effects of Carbohydrate Consumption and Fluctuations in Insulin on HDL Cholesterol
Min-Yu Chung	NUSC	Richard S. Bruno	Hepatoprotection of Vitamin E and Green Tea on Oxidative Stress and Inflammatory Responses in Animal Models of Obesity-Triggered Nonalcoholic Fatty Liver Disease
RoseAnna Boyle Holliday	NUSC	Ann M. Ferris	Anemia Prevention: Development of a Theory-Driven Nutrition Education Measurement Instrument
Kavitha Sankavaram	NUSC	Hedley C. Freake	The Effects of Zinc on Homeostasis, Growth and Oxidative Stress Responses in Cultured Cells
Sankhiros Babapoor Dighhaleh	Patho	Mazhar I. Khan	Studies on Nanoparticle Based Avian Influenza Vaccines to Present Immunogenic Epitopes of the Virus with Concentration on Ectodomain of Matrix 2 (M2e) Protein
Boris Krasimirov Gavrilov	Patho, Virology	Guillermo Risatti	Studies on Classical Swine Fever Virus Structural and Non-Structural Proteins: Immunogenicity of Envelope Proteins and NTPase Activity of NS4B Protein
Akinyi Carol Nyaoke	Patho	Salvatore Frasca, Jr.	*Exophiala* Species Infection in Aquaria: Identification, Environmental Study and Challenge Experiments
William A. Smith	PS, Horticulture	Mark H. Brand	Development of Novel Breeding Stock in *Buddleja davidii* through Mutation Breeding and Haploid Induction
Collin W. Ahrens	PS, Plant Environment	Carol A. Auer	Ecological Risk Assessment of *Agrostis stolonifera* and Its Relatives

**ARE: Agricultural and Resource Economics; ANSC: Animal Science; NR: Natural Resources: Land, Water, Air; NUSC: Nutritional Sciences; Patho: Pathobiology; PS: Plant Science*

Pathobiology Grad Student Making Waves

Based on an article by Sheila Foran published Ocotober 13, 2011 in UConn Today (http://today.uconn.edu)

Pathobiology and veterinary science doctoral student Andrea Bogomolni is the epitome of a busy graduate student. With a penchant for, in her words, "just making things happen," this native Californian has learned to juggle academic, professional, and personal interests in a way that not only rewards her quest for knowledge through the pursuit of challenging long-term research objectives, but that also makes a difference in the lives of others.

During the past year, Bogomolni was awarded a highly competitive Robert & Patricia Switzer Foundation fellowship for her pursuit of a degree that will lead to positive environmental change. In announcing the names of this year's 20 fellowship winners, board chair Jen Sokolove said, "The heart of the Switzer Foundation is about supporting environmental leaders who are able to think across traditional disciplinary boundaries and shape the future of environmental science, policy, and study."

Bogomolni's interest in marine sciences developed while she was a child and led her to pursue a BS in wildlife fisheries and conservation biology at the University of California-Davis. But because she also had an interest in biological illustration, she stayed on an extra year to complete a BA in studio art. Her studies continued in a three-year research master's at Boston University and began working with the Cape Code Stranding Network (now the International Fund for Animal Welfare/Marine Mammal Rescue) as the necropsy coordinator, which led to a research associate position at the Wood's Hole Oceanographic Institution focusing on zoonotic diseases in marine vertebrates. That's when she first began working with UConn associate professor of pathology Salvatore Frasca and associate professor and director of the Connecticut Sea Grant College Program Sylvain DeGuise. It was their encouragement that led her to consider UConn's pathobiology PhD program in the College of Agriculture and Natural Resources, with a concentration in marine science.

"The marine mammal side of things wasn't necessarily where I thought I'd end up," she says, "but they're such great sentinels. They're such great communicators of what's happening in our marine environment. People really begin to listen when you start talking about seals and dolphins rather than microscopic organisms such as algae. They're animals the average person can relate to."

"The marine mammal side of things wasn't necessarily where I thought I'd end up, but they're such great sentinels. They're such great communicators of what's happening in our marine environment. People really begin to listen when you start talking about seals and dolphins rather than microscopic organisms such as algae. They're animals the average person can relate to."

– Andrea Bogomolni

Bogomolni's work at Woods Hole led to her involvement with the Eastern Caribbean Cetacean Network, a regional volunteer network that records sightings and strandings of marine mammals in the eastern Caribbean. Bogomolni and the network's founder and director, marine biologist Nathalie Ward, work with individuals based on about a dozen eastern Caribbean islands, including Guadeloupe, Barbados, St. Lucia, and Trinidad and Tobago, to gain community support for the

protection of resident and migratory whales and dolphins and their marine habitat through research and education.

Bogomolni has combined the study of public health, marine sciences, and pathology in her degree program. And her "can do" attitude has again led her in a direction she did not anticipate. With an increasing population of gray and harbor seals around Cape Cod, there is an inevitable clash between fisheries and those interested in pinniped conservation. The Cape Cod Commercial Hook Fishermen's Association contacted Bogomolni for assistance and with funding provided through Woods Hole Bogomolni helped organize a conference dealing with the issues of disease and health, population dynamics and behavior, and human interactions. The conference attracted fishermen, students, and researchers, as well as NGO and government representatives, from both Canada and the U.S. It was so successful that another conference is in the works focusing on fishery interactions and integrated research.

As to what she will do once she has completed her PhD, Bogomolni isn't sure yet. "I just know it will be something involving an understanding of human and animal disease transmission and marine health," she says. "I also want to bring science to the public so that everyone can understand and relate to both the problems and opportunities that exist in our environment."

"I want to bring science to the public so that everyone can understand and relate to both the problems and opportunities that exist in our environment." – Andrea Bogomolni

Research Features

The research enterprise of any entity is only as good as its scientists.






Our focus has always been on hiring talented researchers to help advance the CANR research mission and solve real-world problems. The following articles provide brief summaries of the research activities of selected faculty and staff.

Impact of Green Tea on Obesity-Related Liver Disease

Based on an article by Elizabeth Omara-Otunnu published February 9, 2009 in UConn Today (http://today.uconn.edu)

Two-thirds of Americans are currently overweight or obese, and the incidence of nonalcoholic fatty liver disease – which is very common in people who are obese or diabetic – has risen in parallel with the rates of obesity. "About 40 million people in the U.S. are estimated to have fatty liver disease," says Richard Bruno, associate professor in the Department of Nutritional Sciences and a registered dietitian, "and unless the obesity epidemic that's underway is corrected, or we develop new dietary strategies, we should expect the incidence of this disease to increase dramatically."

Obesity often causes insulin resistance, which results in the alteration of the body's fat metabolism and leads to excess storage of fat in the liver. The fat-engorged liver increases in size - possibly up to two or three times its normal size – resulting in liver injury or abnormally high liver function tests. Eventually this may lead to liver failure or death.

"Nonalcoholic fatty liver disease is quite serious," says Bruno, "yet there are currently no pharmacological therapies for it, only recommendations to lose weight and exercise more."

A study led by Bruno has found that green tea can help mitigate the impact of nonalcoholic fatty liver disease. His research team and colleagues in the Department of Nutritional Sciences found that the daily ingestion of green tea blocks the amount of fat stored in the livers of obese mice that otherwise develop severe fatty liver disease; improves liver function; and reverses declines in antioxidant defenses in the liver.

Bruno says that although green tea had previously been found to have benefits for those with heart disease, and lowers cholesterol and triglycerides, both risk factors in both heart and fatty liver disease, prior to his study "no one knew whether green tea could protect the liver against fatty liver disease." Bruno's research was catalyzed by a two-year, $458,000 grant from the U.S. Department of Agriculture. The initial study, which was featured on the cover of the *Journal of Nutrition* in February 2008, showed clearly that green tea reduces fat accumulation in the liver and protects against liver injury. The USDA award has supported research into the mechanisms by which green tea protects against fatty liver disease and how a reduction in liver fat content improves liver function.

Possible avenues the team has been exploring are whether green tea interferes with fat absorption, whether it enhances the rate at which fat is used for energy by the liver, and whether it blocks fat synthesis in the liver. "There are data to support all three," says Bruno. "Possibly it affects all of these systems simultaneously."

He says that although the beneficial impact of green tea is clear from the mouse model, it may not be possible to carry out a human trial, because that would require taking multiple liver biopsies from healthy people as well as those with liver disease, raising ethical issues.

Bruno says green tea is different from other types of tea, even though they come from the same plant. When it is harvested, the leaves are immediately steamed and withered, and this preserves certain compounds known as catechins that are thought to exert beneficial effects on human health. In the processing of oolong and black tea, however, these compounds are largely destroyed. In future research, Bruno hopes to discover whether the catechins are indeed the part of green tea that is effective, and to analyze each of the four major catechins it contains.

Bruno says he would recommend green tea as part of a weight loss program, but its effects are limited. "Green tea could be a critical component of a lifestyle change, but it is not a magic bullet," he says. "The number one recommendation for losing weight is to exercise, and work with a dietitian to develop a structured program to modify your lifestyle."

Study Shows Not Everyone Has the Same Reaction to Salt

Based on an article by Colin Poitras published June 14, 2010 in UConn Today (http://today.uconn.edu)

How much salt people eat is important. Diets high in salt can increase the risk of high blood pressure and stroke. The National Institutes of Health and the American Heart Association recommend a diet for most adults containing no more than 2,400 mg (approximately one teaspoon) of sodium per day. But the recommended amount is much lower – 1,500 mg – for specific groups such as individuals with high blood pressure, African-Americans, and those over 40 years of age. With the average daily sodium intake in the U.S. currently hovering around 3,500 mg, the Food and Drug Administration recently launched a campaign to encourage commercial food manufacturers to reduce sodium in their products.

More than 75 percent of sodium in our diet comes from packaged, processed, and restaurant foods, according to the Centers for Disease Control and Prevention (CDC). Only about 5 percent comes from salt added during cooking and about 6 percent comes from being added at the table. About 12 percent is naturally occurring or from other sources, according to the CDC.

But some individuals may find this recent push by the federal government to reduce salt in processed foods hard to swallow.

That's not because those individuals simply enjoy the salty taste of certain foods. A new study by Professor Valerie Duffy in the Department of Allied Health Sciences and her graduate students shows that some individuals need a higher degree of salt in their foods in order to block the unpleasant tastes they get from some of the things they eat.

These individuals – called "supertasters" – experience tastes more intensely, something that may be influenced by their individual genetics, the study says.

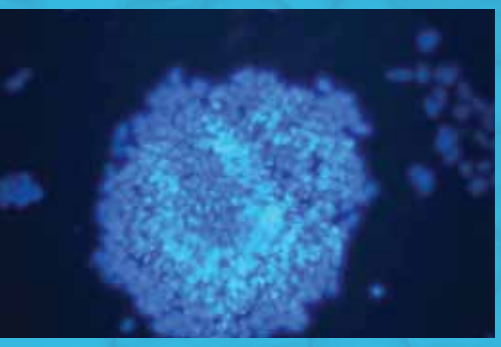
"Supertasters like snack foods, and these snack foods have saltiness as their dominant flavor," says Duffy. "However, supertasters also need that salt to block unpleasant bitter tastes in foods like cheese. Cheese is a wonderful blend of dairy flavors from fermented milk, but it also has bitter tastes from ripening that are blocked with added salt. A supertaster finds low-salt cheese unpleasant, because the bitterness is too pronounced."

One of the primary goals of Duffy's research is to understand how chemosensory variation influences our ability to follow a healthy diet. Her latest findings are important because they increase our understanding of salt preference and consumption and help explain why some people find low-salt foods less satisfying than others.

"Response to bitter compounds is one of many ways to identify biological differences in food preference, because supertasting is not limited to bitterness. Individuals who experience more bitterness from PTC and PTU also perceive more saltiness in table salt, more sweetness in sugar, more bitterness in coffee and grapefruit juice."

– Valerie Duffy

Research by chemist Arthur Fox and geneticist Albert Blakeslee more than 75 years ago proved that genes play a role in dictating a wide range in individual taste acuity, just as they do in personal variations in eye or hair color. Supertasters, for example, describe bitter compounds like phenylthiocarbamide (PTC) and proplythiouracil (PTU) as being extremely bitter, while others, dubbed "nontasters," find these compounds to be tasteless or



only weakly bitter. This distinction is mainly due to each individual's genetic make-up.

"Response to bitter compounds is one of many ways to identify biological differences in food preference, because supertasting is not limited to bitterness," says Duffy. "Individuals who experience more bitterness from PTC and PTU also perceive more saltiness in table salt, more sweetness in sugar, more bitterness in coffee and grapefruit juice."

"Supertasters live in a "neon" food world," Duffy says. "Nontasters, on the other extreme, live in a "pastel" food world. Interestingly, nontasters may be more likely to add salt to foods because they need more salt to reach the same level of salt as a supertaster."

The salt study, "Explaining variability in sodium intake through oral sensory phenotype, salt sensation and liking," published in *Physiology and Behavior* in June 2010, tested 87 healthy adults (45 men, 42 women) who ranged in age from 20 to 40 years. The participants sampled regular and low-salt versions of such foods as chips, pretzels, cheese, soy sauce, and chicken broth. Data was collected in three laboratory sessions, usually one week apart. The testers used a standard scientific taste scale to differentiate degrees of taste from "barely detectable" to "very strong."

"Currently, U.S. citizens consume two to three times the amount of salt recommended for health. Lower your salt intake by reading the food label and looking for products that are lower than 480 mg per serving."

– Valerie Duffy

"Currently, U.S. citizens consume two to three times the amount of salt recommended for health," says Duffy. "Lower your salt intake by reading the food label and looking for products that are lower than 480 mg per serving."

Duffy's research is funded in part by the National Institutes of Health, the U.S. Department of Agriculture, and the American Diabetes Association.

Plant Scientist Develops Sterile Variety of Commercially Important But Invasive Plant

Based on an article by Colin Poitras published August 19, 2011 in UConn Today (http://today.uconn.edu)

Burning bush is a top cash crop for the $16 billion ornamental plant industry. Also known as "winged euonymus" for its distinctive winged branches, it is an extremely popular ornamental plant for landscapers and gardeners because of its intense red autumn foliage and ability to grow in a wide range of soils and environmental conditions. In addition, the plant has very few pest or disease problems. It is especially popular in New England, where the shrub is used for foundation plantings and hedges and along highways and commercial strips.

National sales of burning bush top tens of millions of dollars each year. The plant, however, spreads aggressively and has been listed as an invasive species in 21 states. It has already been banned in Massachusetts and New Hampshire, and is on an invasive plant "watch list" in many other states, including Connecticut. The economic cost of invasive plants is estimated at more than $40 billion per year in the U.S.

Burning bush's invasive characteristics stem from its prodigious seed production. Each plant produces tens of thousands of seeds that are transported by rainwater and birds to other sites, especially open woodlands, where they create dense thickets that displace native vegetation. The plant's root system forms a tight mat below the soil surface and its broad profile (it averages 6 to 9 feet in height and is capable of reaching 15 feet) creates heavy shade that threatens the survival of plants living beneath it.

Recognizing the plant's popularity among consumers and its economic importance to the ornamental plant and landscape industries, Professor Yi Li in the Department of Plant Science and Landscape Architecture obtained a grant from the U.S. Department of Agriculture in 2003 to work on the development of a non-invasive variety of burning bush. The New England Invasive Plant Center has provided additional funding for the research since 2006. The invasive plant center was made possible through the support of Connecticut Rep. Rosa DeLauro (D-3rd District). DeLauro helped secure federal funding to launch the center, which aims to develop strategies and methods to address invasive plant problems.

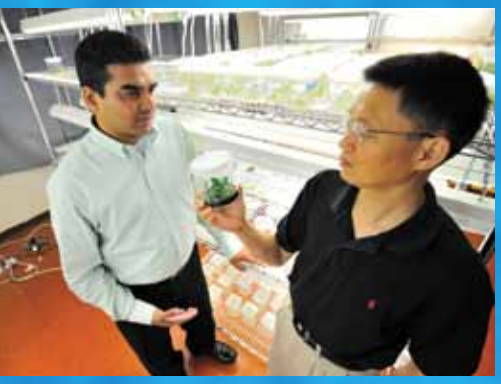
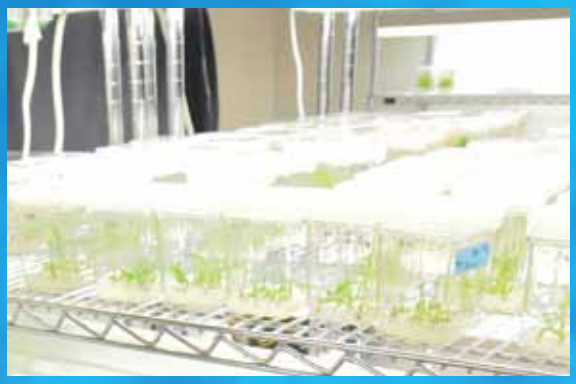
Li's laboratory has developed a seedless variety of burning bush that retains the plant's brilliant foliage yet eliminates its ability to spread and invade natural habitats. The research team reports that it successfully produced 12 independently regenerated triploid plants of burning bush. Triploid plants are sterile due to uneven chromosome division as cells multiply.

"Finding the right combination of plant growth regulators and repeatedly testing and re-testing the process to validate its success was a lengthy, yet ultimately rewarding, process."

– Yi Li

The new lines of sterile non-invasive burning bush–which were derived from a popular dwarf variety known as (*E. alatus*) 'Compactus'–took years to develop. Members of Li's research team painstakingly removed immature and mature endosperm from deep inside thousands of seeds under sterile conditions and treated them with plant growth regulators. The team maintained endosperm tissue explants in petri dishes so that a callus, bud, seedling, and ultimately a new triploid seedless variety were grown.

"Finding the right combination of plant growth regulators and repeatedly testing and re-testing the process to


validate its success was a lengthy, yet ultimately rewarding, process," Li says.

The process to produce triploid plants from endosperm tissues is so difficult that since endosperm regeneration of plants was first reported in the early 1950s, it has been successful in only 32 plant species. Li praises his research team's persistence, dedication, and passion, which, he says, carried them through the long hours of separating thousands of mature and immature endosperms once the plants went to seed in the fall.

"The availability of a triploid seedless, non-invasive variety of burning bush creates a win-win situation for both consumers and commercial nurseries," says Li, head of UConn's Transgenic Plant Facility and director of the New England Invasive Plant Center at the Storrs campus. " He is working with UConn's Office of Technology Commercialization to patent the process used to regenerate the burning bush triploid and bring the new plant variety to the commercial horticulture industry.

"This sterile cultivar of burning bush could not come soon enough. This plant is a very important part of my business. We love working with UConn. I think this shows how very important it is for industry and academia to work together."

– Mark Sellew, the owner of Prides Corner Farms of Lebanon

Mark Sellew, the owner of Prides Corner Farms of Lebanon, one of the largest wholesale nurseries in the eastern U.S., also praised Li's success in developing a sterile variety of burning bush. "This sterile cultivar of burning bush could not come soon enough," says Sellew. "This plant is a very important part of my business. We love working with UConn. I think this shows how very important it is for industry and academia to work together."

Green Industries lead Connecticut's $3.5 Billion Agricultural Economy

Adapted from an article by David Baumann published September 27, 2010 in UConn Today (http://today.uconn.edu)

Agriculture is a $3.5 billion industry in Connecticut, providing more than 20,000 jobs and significant social and ecosystem benefits, according to a University of Connecticut study – the first comprehensive research to assess agriculture's contribution to the state's economy.

"The estimated impact [of $3.5 billion] is significantly higher than the $2 billion figure used in political circles in the Connecticut legislature," conclude the authors of the study, *Economic Impacts of Connecticut's Agricultural Industry*. "On a per capita basis, the agricultural industry generates approximately $1,000 in sales per Connecticut resident."

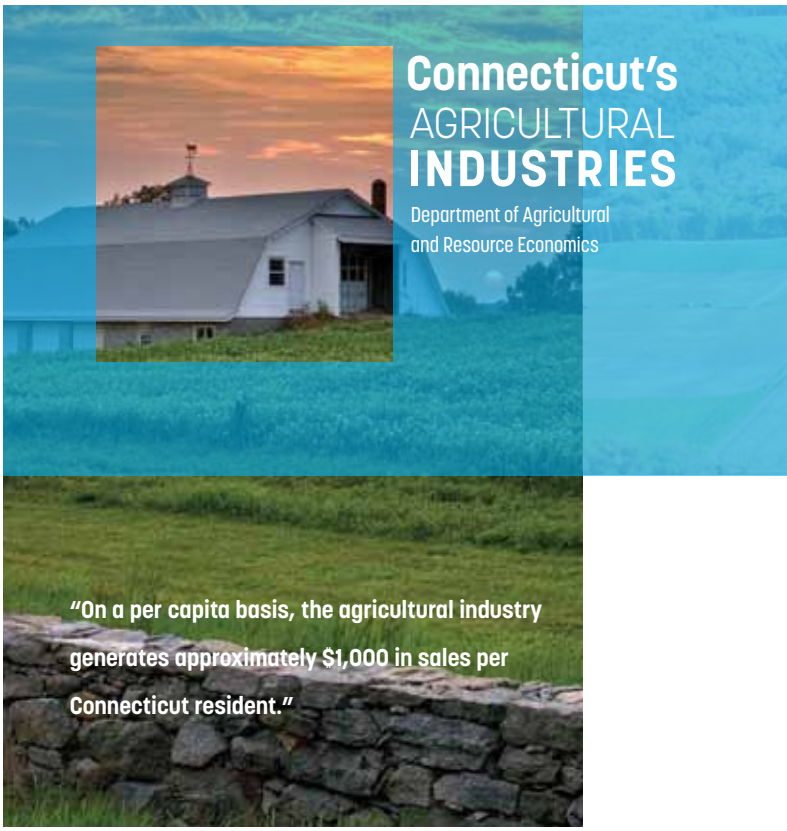
Included in the estimated total is a figure of $1.7 billion in value-added impact, the difference between the value of agricultural output and the cost of raw materials, or the money left in the hands of residents of the state which they can then spend buying goods and services in Connecticut.

The study, conducted and authored by a group of agricultural economists led by Professor Rigoberto Lopez in the Department of Agricultural and Resource Economics in cooperation with the Connecticut Center for Economic Analysis, used direct agricultural sales generated in 2007 to calculate the industry's $3.5 billion contribution to Connecticut's total gross product of $212 billion that year, which was roughly the size of the economy of Ireland or Israel.

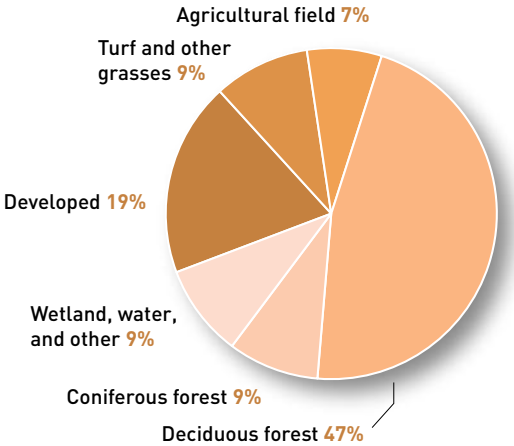
Although Connecticut is the third smallest state in the nation, agriculture is a vital sector in its economy, according to the study. Farmland accounts for 405,616 acres – slightly more than 13 percent – of the state's 3.18 million acres; and Connecticut's 4,916 farms (which average 82 acres in size) rank first in New England in terms of market value per farm and per acre.

"Because the agricultural industry purchases goods and services from other industries and hires local labor, its economic impact cascades throughout the state's economy," the study notes. "In sharp contrast to agriculture nationwide, field crops comprise a minor share of agricultural sales [in Connecticut], while the largest agricultural sectors are 'green' industries [nursery, greenhouse, floriculture, and sod production], dairy farming, and tobacco."

Specifically excluded were secondary sectors such as landscaping and grounds-keeping, as well as food processing that does not use Connecticut agricultural products, such as bakeries and distilleries. These, although economically



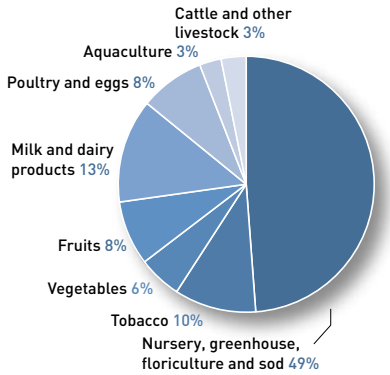
Total Land Cover in Connecticut (2006)



Total area = 3.18 million acres

Source: Center for Land Use Education and Research (2006)

Taken from and published in the 2010 "Economics Impacts of Connecticut's Agricultural Industry Report"

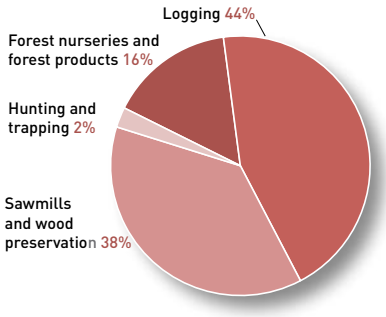


2007 Sales of Agricultural Products by Commodity Groups

Total sales = $551.6 million

Source: USDA (2007), page 9, table 2

Taken from and published in the 2010 "Economics Impacts of Connecticut's Agricultural Industry Report"



2007 Sales of Forest Products and Related Sectors

Total sales = $131.5 million

Source: Federal government data as reported in IMPLAN (2007)

Taken from and published in the 2010 "Economics Impacts of Connecticut's Agricultural Industry Report"

important, "would overstate the projected output and job impacts attributable directly to the state's agriculture," the study reported.

Some highlights of the study include:

- Each dollar in sales generated by the agricultural industry creates up to an additional dollar's worth of economic activity statewide, a significant "multiplier" by the industry for the state.
- The agricultural production sector generates between 13 and 19 jobs per million dollars in sales, more than twice the jobs generated by agricultural processing.
- The highest job creators per million dollars in sales are support activities for agriculture; the greenhouse, nursery, and floriculture industries; tobacco farming; animal production; and commercial fishing.
- The greenhouse and nursery industries are the largest agricultural production sector in the state and account for nearly half of the state's agricultural product sales.
- The highest job generator is the greenhouse, nursery, floriculture, and sod production sector (nearly 7,000 jobs); followed by cheese manufacturing; animal slaughtering and processing; fruit and vegetable canning, pickling, and drying; tobacco farming; forestry; fruit farming; and fluid milk manufacturing.

"The estimated impact [of $3.5 billion] is significantly higher than the $2 billion figure used in political circles in the Connecticut legislature. On a per capita basis, the agricultural industry generates approximately $1,000 in sales per Connecticut resident."

Lopez says that along with the sales, employment, and value-added impacts the agricultural industry provides, there are significant non-market social benefits and ecosystem services, whose estimation was beyond the scope of the study.

Connecticut cropland, pasture, wetlands, and woodlands provide aquifer recharge areas and habitats for many land and aquatic species, and breeding areas for local bird populations, Lopez says. Working farms also are integral to the state's tourism industry – another major employer – by maintaining the rural and historic New England landscape that visitors find so attractive.

"With destinations such as wineries, pick-your-own orchards, pumpkin patches, and corn mazes helping to attract tourists," notes Lopez, "farmers' markets, farm stands, and farm-to-table events can boost sales for area business."

NEMO Marks 20 years of Educating Municipal Land Use Decision Makers

By Kim Markesich with excerpts from an article by Sheila Foran, published September 20, 2010 in UConn Today (http://today.uconn.edu)

NEMO (Nonpoint Education for Municipal Officials) was created in the early 1990s to provide research-based education and assistance to local land use boards and commissions on ways to accommodate growth while protecting natural resources and community character. The program was built on the basic belief that the future of our communities and environment depend on land use, and that, since land use is decided primarily at the local level, education of local land use officials is the most effective, and most cost-effective, way to bring about positive change.

In 2002, the Center for Land Use Education and Research (CLEAR) (http://clear.uconn.edu/) was developed as a formal expansion of NEMO and its partner projects. CLEAR is a partnership between the Department of Natural Resources and the Environment and Department of Extension, both in the College of Agriculture and Natural Resources, and the Connecticut Sea Grant Program. NEMO continues to function within the CLEAR umbrella.

The common feature of all CLEAR programs is the use of remote sensing and geographic information systems (GIS) satellite-based technologies to research and generate information on the changing landscape and the use of this information to develop outreach programs for land use decision makers.

To reach their audience, CLEAR educators communicate directly with town officials. They answer questions from planning and zoning boards and development officials and hold workshops through their Connecticut Land Use Academy (http://clear.uconn.edu/lua/index.htm). They offer webinars and develop Web tools that local officials can use to understand their landscape as they address issues such as storm water runoff, open space planning, or downtown revitalization. For example, CLEAR educators have worked with these Connecticut groups to address particular land use issues:

- The Town of Waterford created a plan to manage runoff from large commercial developments.
- The Candlewood Lake Authority developed a Lake Protection Zone for land use immediately around the lake.
- To help the Town of Kent update its comprehensive plan, NEMO is conducting a buildout analysis for the Planning and Conservation Commissions showing potential areas of new development.

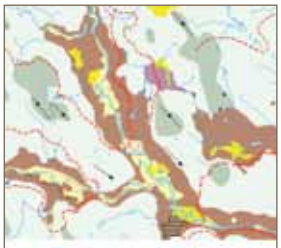
"We expect that members of the USDA's National Integrated Water Quality Program from around the nation will create new Web sites that more easily and intuitively relate their project results to the public and other stakeholders." – Chet Arnold

Other tools for municipalities include NEMO's Low Impact Development Inventory, an online resource that provides real-life examples of low-impact development practices in Connecticut towns; and Web-based mapping tools like CT ECO, which was developed in partnership with the Connecticut Department of Energy and Environmental Protection (DEEP) and contains much of the natural resource information available for Connecticut.

NEMO is also addressing the environmental impacts of homes and small businesses through hands-on training on how to build rain gardens, which are small, vegetated depressions that collect runoff and allow infiltration of the runoff into the ground. Rain gardens are well suited for managing storm water in urban and suburban landscapes. NEMO has conducted four two-day rain garden workshops for contractors and city employees in Hartford and Bridgeport,

building functional rain gardens at Bridgeport's Beardsley Zoo and the Classical Magnet School in Hartford, among other places.

Another new project, Support of National Integrated Water Quality Program Research, Education and Extension Outreach Through Geospatial Technology Training, will provide information and training on the newest geospatial technologies for water quality researchers, educators and extension agents across the country. A particular focus will be on "mashup" technologies that allow researchers and others to display their data on the Web through an "earth browser" site like Google Earth or Google Maps. This project builds on the USDA-funded National NEMO Network, a group of projects in 30 states, all patterned after the Connecticut NEMO model and coordinated by CLEAR.



Quaternary Geology
(glacial geology)

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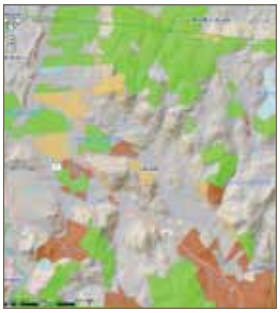
"We expect that members of the USDA's National Integrated Water Quality Program from around the nation will create new Web sites that more easily and intuitively relate their project results to the public and other stakeholders," says Chet Arnold, CLEAR's associate director.

In the coming years, CLEAR will continue to provide essential data and local assistance to better protect our state's natural resources, while accommodating economic growth.



How Trees Withstand a Storm

Based on articles by Brian Zahn (published September 9, 2011) and Elizabeth Omara-Otunnu (published January 29, 2010) in UConn Today (http://today.uconn.edu)

In August 2011, Hurricane Irene's high winds left behind toppled trees, leaving millions without power and costing Connecticut residents millions of dollars.

"If you want to understand how trees fall over, you have to understand their mechanical properties and the wind loads they experience," says Mark Rudnicki, associate professor of forest ecology in the Department of Natural Resources and the Environment. While many trees fell during Irene, the vast majority didn't "because trees have a lot of ways to stay up," he says. Rudnicki's research includes studying some of the mechanisms by which trees resist being blown down.

Inside a forest, the main way trees withstand heavy wind loads is by colliding with nearby trees, explains Rudnicki. Trees also streamline – adapt their shape to the wind flow and effectively have a smaller sail – and thus decrease their risk of falling. Another, more permanent strategy to streamline is to shed branches in the wind. "After Irene, I noticed stiffer trees such as oaks lost branches, but I did not see many completely fail," Rudnicki says.

It is fortunate that Irene had become a tropical storm by landfall, adds Rudnicki. The 1938 hurricane that hit Connecticut was a category 3 storm and retained hurricane force winds all the way to Quebec. A repeat of that would cause unprecedented tree-related power outages and would take much longer to clean up, he says.

While arborists and urban foresters take a rigorous approach to assessing hazardous tree defects, it is difficult to predict the failure of an individual tree. Trees with no hazardous defects still fail, says Rudnicki, and we need to make progress in this area.

Progress in this as well as several other areas may come from a project funded by an $832,000 collaborative research grant from the National Science Foundation that involves both atmospheric studies and forest ecology.

Rudnicki notes that the atmosphere in and just above the forest canopy is the least-understood layer of the earth's atmosphere, yet it is the site where the exchange of chemicals, particles, and energy from the earth's surface takes place and is the gateway to exchanging and storing carbon from the atmosphere. He hopes the current research will ultimately contribute to a better understanding of the impact of forest clearing on climate and the potential role of forest canopy motion in slowing or adapting to climate change.

"While arborists and urban foresters take a rigorous approach to assessing hazardous tree defects, it is difficult to predict the failure of an individual tree. Trees with no hazardous defects still fail, and we need to make progress in this area." – Mark Rudnicki

In addition, he says, a better understanding of how trees sway and interact with the lower atmosphere can assist in developing better strategies for managing forests to minimize the vulnerability of trees to catastrophic winds.

The interdisciplinary study combines cutting edge wind flow computer models (known as large eddy simulation) and a large field experiment. The models are being developed by colleagues at East Carolina University, with computers and personnel at the National Center for Atmospheric Research.



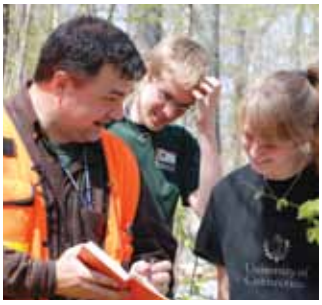
The field experiment is led by Rudnicki, together with co-principal investigator David Miller, professor emeritus from the Department of Natural Resources and the Environment, and April Hiscox of Louisiana State University, who holds a PhD from UConn. They are working with personnel from the University of Maine and the U.S. Forest Service.

The field experiment, located in the Howland Forest in Maine, involves measuring the motion of trees in a 150-meter-diameter plot and the wind turbulence from two meteorological towers in their midst, enabling researchers to use patterns of tree displacement to visualize and quantify wind gusts moving through the forest canopy. Measuring tree sway and wind simultaneously will enable understanding of how tree sway dynamics are related to wind gust statistics.

The tree sway data is gathered from tilt-sensors half way up each tree. Together with the wind data, it is collected 10 times per second around the clock, 365 days a year.

"Global climate change makes the project more urgent. The risk that trees will blow down is of increasing concern, as global warming is expected to increase the intensity and frequency of catastrophic winds." – Mark Rudnicki

Global climate change makes the project more urgent, says Rudnicki. The risk that trees will blow down is of increasing concern, as global warming is expected to increase the intensity and frequency of catastrophic winds. There is also growing pressure on forests, he adds, both for storing carbon and for their potential as a source of lumber and biofuel.



Food Scientist's Research Helps Make Animal Food Products Safer

By Kim Markesich

According to the Centers for Disease Control, foodborne diseases cause up to 81 million illnesses and as many as 9,000 deaths each year in the United States. It is difficult to pinpoint the actual number of illnesses, as most cases of food poisoning go unreported.

Kumar Venkitanarayanan, professor in the Department of Animal Science, has been involved in multiple research projects focusing on food safety, specifically, using food-grade plant compounds to reduce bacterial threats.

Salmonella enteritidis is a major foodborne pathogen, causing more than a million cases of food poisoning each year in the U.S., with chicken and eggs serving as the most common vehicles of infection. The disease is spread when *Salmonella* bacteria colonize within the chicken intestine and ovaries, and subsequently contaminate the eggs and meat.

Venkitanarayanan is working on two USDA-funded projects focusing on *Salmonella* infection, one concentrating on broiler chickens and the other on layer chickens. Two plant compounds, trans-cinnamaldehyde, a product derived from cinnamon, and caprylic acid, a natural fatty acid found in coconut oil and goat's milk, have shown efficacy against *Salmonella*. These plant molecules interact by blocking expression of specific genes necessary for *Salmonella* colonization within the chicken gastrointestinal tract. When chicken feed is supplemented with these plant extracts, there is a reduction of *Salmonella* in the chicken intestine, which in turn reduces the contamination in meat and eggs.

His research has also addressed mastitis, a major economic concern for the dairy industry, costing approximately two billion dollars annually. Traditionally, mastitis is treated with intramammary infusions of antibiotics. However, with the emergence of drug-resistant pathogens, antibiotic cure rates are decreasing. And, consumers do not want antibiotic residues in their food. Venkitanarayanan is investigating the potential of caprylic acid and trans-cinnamaldehyde for treating and controlling mastitis in cows. Laboratory results have shown that these plant molecules are effective against mastitis, and continued research may lead to new antimicrobial tools for controlling the disease.

Clostridium difficile is a major cause of intestinal disease in humans and is usually found in hospital patients undergoing long-term antibiotic therapy, which reduces natural gut microflora. With fewer good bacteria in the gut, the *Clostridium* bacteria overtake the intestines, causing inflammation and tissue death. There have been several recent studies that suggest the possibility of *Clostridium's* presence in our food supply. Venkitanarayanan is involved in a USDA-supported

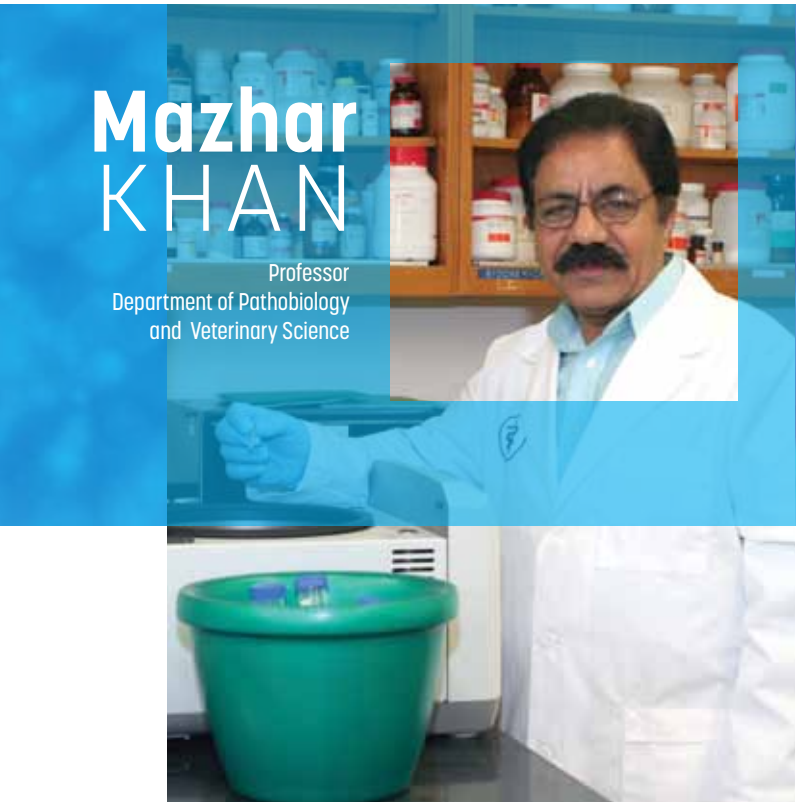
multi-state project to examine ground beef, pork, and chicken for sale in retail stores for evidence of *Clostridium* contamination. Because this pathogen produces spores that are heat resistant, the study will also consider new time and temperature cooking conditions for ground beef.

.Says Venkitanarayanan, "Many bacteria are gaining resistance to antibiotics. There are a number of genes in the bacteria that are involved in making them resistant to antibiotics. We are finding that some of the plant molecules make the bacteria sensitive to antibiotics by turning down or switching off those antibiotic-resistant genes, making the antibiotics more effective against these resistant bacteria."

While he is very focused on researching foodborne pathogens, Venkitanarayanan also points out that we all are responsible for preparing our food properly. He says, "It's not easy to produce bacteria-free foods. There are a lot of sources of bacteria – from the environment, from the animal's intestine, from the human hands touching the food, and water we use to wash the products, so people need to be careful consumers. They have to cook food properly and prepare it properly to avoid cross contamination. Use safety measures at home. You cannot fully rely on the industry to produce bacteria-free food. It is not possible."

Diagnostic Testing and Vaccines for Avian Influenza

By Kim Markesich



By January 2012, the State of Connecticut will be home to more than three million laying hens, as well as a significant broiler, turkey, and small flock industry. With each bird consuming a quarter pound of feed per day, the trickle-down effect is evident for feed stores, farm suppliers, and even the rail industry. "Connecticut is a significant player in the egg industry," says Michael Darre, professor and poultry specialist in the Department of Animal Science.

Avian influenza poses a serious economic risk to the poultry industry. Exposed flocks must be quarantined, and if the virus is detected, the entire flock is destroyed. Heat destroys the virus, so humans are not at risk for contracting the virus through properly cooked meat or eggs. However, consumers are wary of purchasing poultry products during a quarantine or outbreak.

The avian influenza virus can present as low pathogenic, where the birds do not appear ill, or high pathogenic, causing severe illness and loss of a flock. The virus can also evolve from a low-pathogenic form of the disease into a highly pathogenic form. Avian influenza subtype H5N1, also called bird flu, can spread from bird to human, but only where there is direct contact with infected birds, usually affecting poultry workers. Once contracted, avian influenza has a 50 percent mortality rate in humans, although it cannot be spread from human to human.

Mazhar Khan, professor in the Department of Pathobiology and Veterinary Science, has focused his research on the development of diagnostic testing and vaccines for avian influenza. He recently received a $499,943 grant from USDA entitled Peptide Nanoparticles as Novel Immunogens: Design and Analysis of Avian Influenza Vaccine.

Developing an effective vaccine for avian influenza is a challenge, because just like human flu viruses, the avian influenza virus mutates, which requires continued assembling of vaccines, a costly and time-consuming task. Khan is working and collaborating on a universal vaccine that uses peptide nanoparticle technology. Khan identified immunogenic genes from the virus to create a peptide nanoparticle-based vaccine that when injected into the birds will create an immune response against all avian influenza viruses. The development of a universal influenza vaccine will save time by eliminating the need for vaccine reassembling, allowing for a more efficient and cost effective vaccine program.

Khan was involved in the development of two avian influenza diagnostic tests in a joint venture with Guangxi Veterinary Research Institute in China. The first uses PCR (polymerase chain reaction) technology with an assay that simultaneously differentiates between the H5, H7, and H9 subtypes. Test results are available in as little as three to four hours. Because the H5 and H7 low-pathogenic variants are extremely important in poultry and the most likely to become highly pathogenic, subtype identification is crucial in controlling the spread of H5 and H7 influenza viruses.

Khan has also recently developed an RT-LAMP (reverse transcription loop-mediated isothermal amplification) test which is a simple, sensitive, rapid result diagnostic method that does not require sophisticated instruments. During the LAMP test, the virus is visible to the naked eye or under ultraviolet light reflections. The LAMP test can be used in a small laboratory facility or even a simple farm lab, revolutionizing onsite testing for avian influenza.

Says Khan, "In the USA under current regulations, drastic measures are followed to control avian influenza outbreaks by identification of the highly pathogenic viruses, quarantine and depopulation of the entire poultry flocks. Developing simple, rapid diagnostics and a universal avian influenza vaccine are realistic approaches to protect poultry flocks from highly pathogenic viruses, so these drastic measures will be unnecessary. This will prevent huge economic losses."

2011 HIGHLIGHTS of RESEARCH

AND THE STORRS AGRICULTURAL EXPERIMENT STATION

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