UF | UNIVERSITY of FLORIDA







2010 ANNUAL RESEARCH REPORT

FLORIDA AGRICULTURAL EXPERIMENT STATION

INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES

Note from the Dean for Research

THE RESEARCH ENGINE OF IFAS is alive and well and partnering with Extension more and more to ensure that the mission of the Experiment Station — captured in our tag line, *Discovery, Innovation and Application* — is applied to the needs of the citizens of Florida.

In seeking solutions, we often find ourselves without answers; hence the need to explore and develop new knowledge sources. The exploration and development of new data is a critical step in our **Discovery** of new knowledge.

In seeking solutions, we also often study known information to see if we can derive a new way to apply the data. Like a forester using a wedge prism, we sometimes need to look at our data sets using innovative techniques to derive new understandings from our world of knowledge. This **Innovation** effort is a critical step to finding solutions.

Much of our research can best be described as *translational science*, — efforts that drive the data towards useful applications. Our translational efforts keep communications open between our research explorers and our research application. Our commitment to **Applications** keeps us connected to the citizenry and committed to establishing solutions that work, solutions that make a difference and solutions that help agriculture and our environment. Our partnership with Extension helps us hear the needs, and then deliver the solutions.

In this issue of our annual report, we are excited to reflect on the extraordinary success of our scientists as we note their world-class publications featured in Science Magazine, Nature Magazine and the Proceedings of the National Academies of Science. These publications are among the most influential in our sciences and reflect a respect and awareness of our faculty's achievements.

We will be focusing on our research in response to the Gulf oil spill with discussion of issues related to seafood, the coastal environment and the toll on Gulf Coast residents. In this issue we will also step back and look at climate, not from the perspective of who caused what, but rather that climate does change — sometimes very severely — and we must respond to that change. In our continued effort to look at bioenergy, we will not only discuss conversion technology but also feed stock issues.

The challenges of agricultural production in our semi-tropical environment will be the subject of discussions about new threats, such as citrus black spot, laurel wilt and citrus tristeza virus. We will also focus on the critical work being accomplished with T-STAR funding where we place competitive and targeted emergency funding against many invasive plants, microbes, insects, and plant and animal disease issues.

In a year of increasingly difficult competition for funds to support research, our faculty continue to be successful in creating a case for investment in their research programs. They are applying best practices to their grantsmanship and succeeding in a world of diminished resources. In a word, our faculty rock when it comes to making a case for their science as a path to solutions!

Mark R. McLellan
Dean for Research, IFAS
Director, Florida Agricultural
Experiment Station

UF UNIVERSITY of FLORIDA
IFAS Research
Florida Agricultural Experiment Station

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Florida panther kitten PHOTO COURTESY OF THE FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

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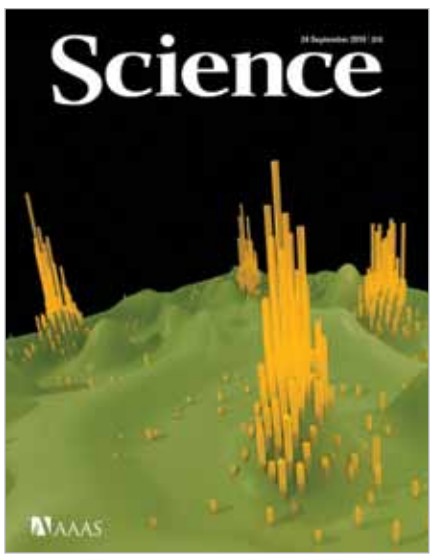

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Researchers discover new role for folate

BY CALEB SHEAFFER

Left to right: Jim Rocca, senior chemist, Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS); Art Edison, associate professor of Biochemistry & Molecular Biology; Andrew Hanson, Griffin Eminent Scholar, Department of Horticultural Sciences and Jeff Waller, post-doctoral associate, Department of Horticultural Sciences, with the NMR instrument used to acquire the critical folate-binding data.

IT IS no secret that the vitamin folate plays a vital part in good health.

Pregnant women take folate supplements to aid in their babies' development, and it is recommended that all women take folate supplements even before conception to lessen the risk of spina bifida and other birth defects. In the U.S., grain foods are enriched with folic acid, a synthetic version of folate, to help individuals get the recommended amount in their diets.

Scientists have known for years that folate aids in various aspects of cell growth, especially the correct replication and stability of DNA.

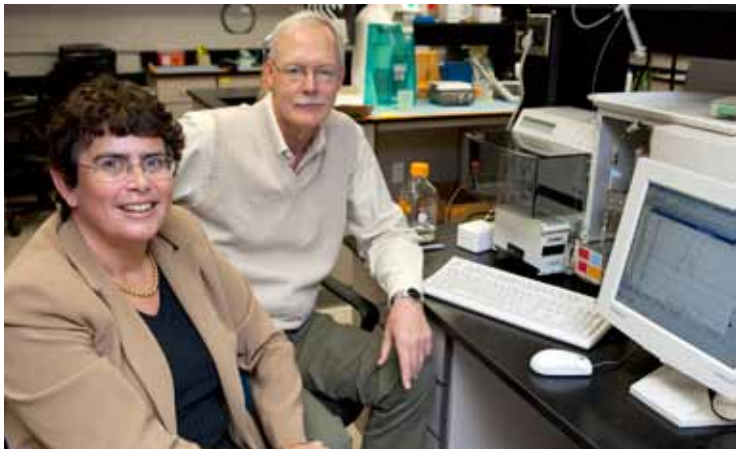
But this summer an article published in *Proceedings of the National Academy of Sciences* by researchers at UF's Institute of Food and Agricultural Sciences unveiled a new part folate plays in preserving good health. The article, "A Role for Tetrahydrafolates in the Metabolism of Iron-Sulfur Clusters in all Domains of Life," shows that through folate's relationship with a newly discovered protein, it moderates the oxidative stress levels in organisms.

"We thought everything was known about why humans need folic acid as a vitamin. But this is a folate-dependent protein that wasn't known about — so we've found another vital thing that folate does in the body, and yet one more reason we require folate," said Andrew Hanson, C.V. Griffin Sr. Eminent Scholar in the horticultural sciences department. "It is another justification for taking your vitamins, if you want to put it that way."

Hanson directed the study with IFAS colleagues Valérie de Crécy-Lagard, Jesse Gregory, and Jeffrey Waller. Their research examined folate's interaction with compounds called iron-sulfur clusters through a protein family called COG0354, which the team discovered occurs in all forms of life. Iron-sulfur clusters appear in nearly every organism, and are part of how cells produce energy and carry out important reactions.

> "We thought everything was known about why humans need folic acid as a vitamin."
>
> ANDREW HANSON

Iron-sulfur clusters are often chemically unstable, and during metabolic processes, produce free radicals and molecules that damage components of cells. This damage, called oxidative stress, is a major factor in aging and many diseases, including Parkinson's disease, Alzheimer's disease and heart disease. The team found that folate is linked to the production or repair of these iron-sulfur clusters, because of folate's interaction with the COG0354 protein family.



Drs. Valérie de Crécy-Lagard (left), associate professor, Department of Microbiology and Cell Science and Jesse Gregory, professor, Department of Food Science and Human Nutrition.

A crucial piece of the research occurred at UF's McKnight Brain Institute and the National High Magnetic Field Laboratory, involving collaboration with Art Edison, the NHMFL's director of chemistry and biology and associate professor in UF's biochemistry and molecular biology department, and Jim Rocca, senior chemist and nuclear magnetic resonance applications specialist. Using nuclear magnetic resonance analysis, the team observed folate directly interacting with the COG0354 protein.

Hanson's team is continuing to research the role of folate and the COG0354 protein in oxidative stress repair. The findings may have future implications for understanding oxidative stress, and may lead to new medicines.

He emphasized that this research highlights IFAS' strength in encouraging faculty collaboration. This study combined knowledge from three departments — microbiology and cell science, food science and human nutrition, and horticultural science.

"There is great intellectual strength in the different parts of IFAS," Hanson said.

The project was funded by the U.S. Department of Energy and National Science Foundation.

Waller, J. C., S. Alvarez, V. Naponelli, A. Lara-Nuñez, I. K. Blaby, V. Da Silva, M. J. Ziemak, T. J. Vickers, S. M. Beverley, A. S. Edison, J. R. Rocca, J. F. Gregory, III, V. de Crécy-Lagard and A. D. Hanson. 2010. "A Role for Tetrahydrofolates in the Metabolism of Iron-sulfur Clusters in all Domains of Life." *PNAS*. 107(23):10412-10417.

Genetic rescue boosts odds for endangered Florida panther

BY AMANDA AUBUCHON

Dr. Madan Oli (left), professor, Department of Wildlife Ecology and Conservation, and graduate student Jeff Hostetler led the population ecological study of the Florida panther as part of a long-term, multiagency collaborative project.

INBREEDING WAS leading the Florida panther to the brink of extinction when eight female Texas pumas were introduced in 1995 as a way to stabilize the population. Since then, University of Florida researchers have been studying the population ecology of Florida panthers to determine if the increase in panther numbers is a direct result of that genetic rescue, known as introgression.

The Florida panther population has been isolated for well over 100 years because of human encroachment and land development, said Madan Oli, a UF population ecologist and professor of wildlife ecology and conservation. Inbreeding was causing morphological defects, such as kinked tails, heart conditions and reproductive dysfunction. If nothing was done, all indications were that the population would go extinct in a fairly short period of time.

"Either you let this population go extinct or do something about that. And because the Texas puma is the closest living relative of this particular population, the proposal was to bring in some females and let them breed with the Florida panther males," Oli said.

> "Our conclusion is that genetic introgression worked, and the way it worked is by improving the survival of panthers." MADAN OLI

The Florida Fish and Wildlife Conservation Commission has been studying the Florida panther population since the early 1980s, capturing and radio-tagging individual Florida panthers and collecting blood and tissue samples to be sent for genetic

A radio-collared male Florida panther in the Fakahatchee Strand Preserve State Park. **PHOTO CREDIT: GLENN STACELL/FWC.**

analysis to the National Cancer Institute, a study collaborator. The use of genetic markers known as microsatellites helped researchers determine which panthers were native Florida panthers (known as canonical panthers), which were from the first group of kittens (known as F1s) born of canonical panthers and the Texas puma females, and which were other admixed individuals, meaning their parentage included any other mix of canonical panther and Texas puma genes. The original eight Texas pumas were eventually removed from the population to prevent their genes from swamping the Florida panther genes. Most Texas pumas produced at least one litter of kittens with canonical panthers before their removal, and some produced more.

"We were able to estimate and model survival and reproductive rate for panthers of different ancestry categories, and we could statistically test for who survives better or worse compared to whom, so the results were very clear," Oli said. "Generally, admixed individuals survived better, but F1s clearly survived better than anybody else."

The kinked tails, low-quality sperm and other morphological defects that are indicative of inbreeding depression were rare or nonexistent in the F1 panthers. Over time, these abnormalities decreased in frequency and eventually disappeared in admixed panthers as well, Oli said. The population has increased from about 25 panthers in the early 1990s to more than 100 today.

"Essentially, our conclusion is that genetic introgression worked, and the way it worked is by improving the survival of panthers. Interestingly, introgression did not have any positive impact on reproduction, meaning that admixed females did not reproduce better than the canonical panther," Oli said.

The study was funded by the Florida Fish and Wildlife Conservation Commission via Florida panther license plate sales, Everglades National Park, the BCNP, U.S. Fish and Wildlife Service, National Cancer Institute, National Institutes of Health, and University of Florida. It was supported in part by the Intramural Research Program of NIH, National Cancer Institute, Center for Cancer Research and the Florida Panther Research and Management Trust Fund.

Johnson, W. E., D. P. Onorato, M. E. Roelke, E. D. Land, M. Cunningham, R. C. Belden, R. McBride, D. Jansen, M. Lotz, D. Shindle, J. Howard, D. E. Wildt, L. M. Penfold, J. A. Hostetler, M. K. Oli and S. J. O'Brien. 2010. "Genetic Restoration of the Florida Panther." *Science*. 329:1641-1645.

Ubiquitin pathway research shows similarity between lineages of life

BY ROBERT WELLS

NEW RESEARCH at the University of Florida is helping to explain the complexities of the ubiquitin pathway, a process critical in cell function and important in the field of drug design.

Ubiquitin is a protein, found in all eukaryotes (cells with nuclei and other organelles), that regulates cell function, including the recycling of other proteins. Ubiquitin "tags" unneeded proteins and sends them on a pathway to the proteasome, a cell organelle that degrades (breaks down) and recycles proteins. Since the ubiquitin pathway has an intimate link with cell growth and cell functioning, understanding it may allow researchers to design drugs that not only control cell growth but also target specific functions, such as regulating inflammation.

"Ubiquitin is so critically involved in cell cycle control that we want to know even at the most fundamental level how it functions," says Julie Maupin-Furlow, a professor in the University of Florida's microbiology and cell science department.

Dr. Julie Maupin-Furlow, professor, Department of Microbiology and Cell Science, researching the distribution and function of proteasomes and ubiquitin-like protein conjugation system.

Maupin-Furlow has discovered two ubiquitin-like proteins in archaea that conjugate (form covalent bonds) to target proteins. The archaeal ubiquitin-like proteins appear to be the evolutionary precursor to the ubiquitin pathway of eukaryotic cells.

Archaea and eukarya are two of the three lineages of life on earth. Since archaea have deep evolutionary roots with eukaryotes, studying ubiquitin-like proteins in archaea might be the key to understanding the ubiquitin pathway.

Maupin-Furlow named the ubiquitin-like molecules small archaeal modifier proteins, or SAMP1 and SAMP2. The journal *Nature* published her research in January 2010.

Maupin-Furlow discovered the SAMPs in the archaeon species *Haloferax volcanii*. Archaea do not contain ubiquitin protein sequences like eukaryotes do. However, SAMPs have a similar structure to ubiquitin, conjugate with other proteins, and appear to regulate cell function, including protein degradation.

Maupin-Furlow found a variety of proteins were conjugated to the SAMPs, including some possibly related to sulfur metabolism as well as ones that function in stress response and gene expression.

To demonstrate a true ubiquitin-like nature of the SAMPs, Maupin-Furlow determined sites where isopeptide bonds formed between SAMP2 and its protein targets. With the help of a mass spectrometer, she found 11 instances of SAMP2 forming covalent bonds.

> **"Ubiquitin is so critically involved in cell cycle control that we want to know even at the most fundamental level how it functions."**
>
> JULIE MAUPIN-FURLOW

She also compared the SAMPs' characteristics with similar proteins in other archaea and suggested that SAMPs are widespread in this domain.

Future research includes determining other functions the SAMPs perform, as well as understanding the roles of enzymes aiding the SAMPs.

Funding sources included the Department of Energy and the National Institutes of Health.

Humbard, M. A., H. V. Miranda, J. Lim, D. J. Krause, J. R. Pritz, G. Zhou, S. Chen, L. Wells and J. A. Maupin-Furlow. 2010. "Ubiquitin-like Small Archaeal Modifier Proteins (SAMPs) in *Haloferax volcanii*." *Nature*. 463:54-60.

Team studies tree genome as a means to boost wood production

BY SUSAN GILDERSLEEVE AND TOM NORDLIE

IFAS RESEARCHER Matias Kirst studies genes and genetic expression in poplar trees, investigating how they control wood composition and growth. Funded by the U.S. Department of Energy and the National Science Foundation, Kirst and his colleagues have discovered genes and gene regulation mechanisms that help poplars survive drought and climate change. Now, the team is learning to control the amounts of cellulose and lignin contained in poplar cells, to emphasize certain traits and produce higher quality biomass and wood.

Dr. Matias Kirst, associate professor, School of Forest Resources and Conservation, evaluating plants genetically modified for a key regulator of a network of genes involved in wood formation.

Trees are good candidates for genomics research because they possess high levels of genetic diversity. When the project began in 2006, poplar was the only tree species with a fully sequenced genome. The tree's extensive geographic range, from Texas to Virginia, permitted the team to study crosses between specimens adapted to widely different climates.

As part of that research, the team grew 2,400 poplars in greenhouses under controlled conditions so that each tree experienced the same environment. When it came time to collect samples — and there were dozens taken from each of the 2,400 trees — they all had to be taken at once.

"We had an army of graduate students," Kirst recalls. "Over six days we got everything sampled and organized."

With co-researchers Gary Peter, Tim Martin, Catherine Benedict and Derek Drost, Kirst searched within poplar chromosomes for genomic regions called eQTL (expression quantitative trait locus) hotspots. These hotspots direct the expression of large numbers of genes, thus controlling traits such as lignin and cellulose production, drought resistance and leaf shape. To identify eQTL hotspots, the team recorded the expression of all genes in the poplar genome using a microarray, a thin glass or plastic tile with the sequences of all known genes printed on it.

The analysis of eQTL and search for points of regulation in the poplar's gene-expression network led the team to discover a gene that controls how cells assign carbon to either cellulose or lignin production. They patented the gene in 2009.

"If you want to burn the wood for steam you want more lignin because there is more energy packed in it," Kirst said. Conversely, for paper or ethanol, it's better to have less lignin and more cellulose in the tissue. So far, the patented gene has only been studied in poplar, but it could be present in many tree species and offer vast opportunities for development of improved varieties. From eQTL analysis, a useful but low-resolution method, the team is segueing into a new strategy called association genetics, which should allow them to identify specific nucleotides that control gene expression networks and traits of interest. They hope eventually to use the knowledge to learn how plants adapt to climate change.

> **"We had an army of graduate students. Over six days we got everything sampled and organized."**
>
> MATIAS KIRST

"We want to know the specific nucleotides involved in adaptation, growth and biomass properties so that when we do breeding we can tell whether a seedling will be a productive, well-adapted tree, based only on its DNA," he said. "Ultimately, this will allow us to grow the same amount of wood on less land."

The research was funded by the U.S. Department of Energy and National Science Foundation.

Drost, D. R., C. I. Benedict, A. Berg, E. Novaes, C. R. D. B. Novaes, Q. Yu, C. Dervinis, J. M. Maia, J. Yap, B. Miles and M. Kirst. 2010. "Diversification in the Genetic Architecture of Gene Expression and Transcriptional Networks in Organ Differentiation of Populus." *PNAS*. 107(18):8492-8497.

IFAS RESPONDS TO THE GULF OIL SPILL

Pilot research study examines the human cost of Gulf oil spill

BY AMANDA AUBUCHON

Dr. Glenn Morris, director, Emergining Pathogen Institute.

WHILE THE Deepwater Horizon disaster was unfolding in the Gulf of Mexico, causing widespread environmental damage, economic loss and disruption of families and communities, UF's Emerging Pathogens Institute was teaming up with IFAS extension to conduct an early assessment of the psychosocial and neurotoxicologic impacts of the oil spill.

Glenn Morris, director of the Emerging Pathogens Institute (EPI) and a professor of infectious diseases at UF, led a series of pilot research studies in Franklin County, Fla., and Baldwin County, Ala., in July, administering a one-hour standardized test to nearly 100 residents. UF/IFAS extension and community organizers recruited participants.

"Our concern was to go in there and find out what was happening," Morris said. "It's one thing to talk about it or see it on the TV news, but you really need data. You've got to get in on the ground and talk to people. Thanks to the excellent network that the extension service has and the work by county extension folks, we were able to make contacts with key components of the community to go in and do a very early assessment to try to get a feel for what was happening within these coastal communities."

Results of the research indicated that members of both communities displayed high levels of clinically significant depression and anxiety, which are considered psychosocial impacts, even though there was no oil in Franklin County, he said. No evidence of neurotoxicologic impacts — in which the brain or nervous system is physically affected by oil, dispersants or other chemicals — was observed.

"The effects were fairly profound, particularly on the psychosocial side, in these communities, but what was interesting to us was the fact that it wasn't so much the presence of oil," Morris said. "It was more the financial loss and the overall impact on the community, which was generated because of the oil spill, that was having the impact on the individuals."

The research revealed that resilience — the ability of an individual to bounce back from a traumatic event — is beginning to weaken, he said, but a follow-up study after some time has passed is necessary to determine the true impact of the oil spill on resilience. A multidisciplinary consortium from UF/IFAS, EPI, the University of West Florida and the University of Maryland is applying for a grant from the National Institutes of Health to continue the study and devise a plan to help people recover on a psychological level from the impact of the oil spill, Morris said.

> "It's one thing to talk about it or see it on the TV news, but you really need data."
>
> GLENN MORRIS

"The pilot studies are an example of a way the university gives back to the community," he said. "This was direct community involvement through the university, using university resources to try to identify specific problems. However, to keep it going, we're going to have to find external funding."

Besides Morris, the research team included Florida Sea Grant Extension specialist Steve Otwell and Franklin County Extension Director and Florida Sea Grant agent Bill Mahan. UF, IFAS and EPI funded the research.

Documenting oyster reef declines in the Big Bend

BY SUSAN GILDERSLEEVE

Dr. Peter Frederick, research professor, Department of Wildlife Ecology and Conservation, reads a laser level to establish elevation profiles on oyster reefs near Cedar Key, Florida.

OYSTER REEFS are one of the world's most important marine habitats — and one of the most endangered, having declined by more than 90 percent from historical levels. The Gulf of Mexico supports more than 60 percent of the healthy oyster reefs in the world. Along the "Big Bend" area of Florida's Gulf coast, oysters provide habitat for fish and wildlife and support commercial fisheries and related jobs.

Those resources were threatened in 2010 by contamination from the Deepwater Horizon oil spill, but favorable wind and water currents kept the oil away from this pristine area.

IFAS researchers Peter Frederick and Bill Pine have been studying risks to Big Bend oysters from numerous threats, including climate change and rising sea levels. Oysters are beneficial to coastal ecosystems and human communities, shielding homes from storm surge, mitigating erosion, filtering seawater and creating essential marine habitats. Despite their importance, we know little about what makes oyster reefs healthy.

"Many aspects of the ecology of the Gulf of Mexico are not well studied, and if you don't know how a system works, it's very hard to restore it once it's damaged," Frederick said.

Frederick and Pine were interested in reports of changes in oyster distribution along the undeveloped Big Bend coastline in the last 50 years and earlier research suggesting that reduced Suwannee River freshwater flow could threaten oysters.

Using Florida Sea Grant funds, the wildlife ecology and conservation researchers began in February 2009 to map Big Bend oyster bed distribution using high-resolution aerial imagery. By linking the new imagery to mapping efforts in recent decades, the pair began to understand the timing, location and extent of reef changes. They recruited postdoctoral fellow Jennifer Seavey to help assemble the photographic evidence and began to zero in on a possible reason for the reef changes: rising sea levels.

> "We'd like to see community restoration going, to involve people who are normally fishing and working here [Big Bend]." PETER FREDERICK

The team's plans changed abruptly when the Deepwater Horizon oil platform exploded in April and it became clear that their data would be invaluable in assessing the impacts if oil reached the Big Bend. On the other hand, if the area were spared, the data would provide reference sites for comparison to impacted areas. With funding from IFAS, Florida Sea Grant and

Dr. Bill Pine, assistant professor, Department of Wildlife Ecology and Conservation, counts and measures oysters in a one quarter square meter to calculate how many, both alive and dead, are on the reef. The data will be used to help Florida's oyster industry.

the U.S. Fish and Wildlife Service, the team worked with local fishermen to complete on-the-ground surveys of oyster health, growth, abundance and distribution during the critical period before the spill was capped and the oil's immediate impact on the Gulf of Mexico was known. The scientists say IFAS' involvement left the university in an excellent position to assist with future oyster reef threats nationwide.

Pine and Frederick hope to expand the community partnerships formed during the study.

"We'd like to see community restoration going," Frederick said, "we'd like to involve people who are normally fishing and working here."

Pine added: "I have young children and my hope is that in 50 years they can still eat Cedar Key oysters. I think that by working now to understand what's going on in these ecosystems and protect them, we'll be able to do that."

Besides Fredrick and Pine, the research team included Leslie Sturmer, multi-county aquaculture extension faculty in the School of Forest Resources and Conservation; Jennifer Seavey, postdoctoral fellow in the Department of Wildlife Ecology and Conservation; and Mark Berrigan of the Florida Division of Agriculture and Consumer Services. The research was funded by UF's Institute of Food and Agricultural Sciences, Florida Sea Grant, and the U.S. Fish and Wildlife Service.

IFAS research sheds light on Gulf Coast seagrass beds

BY MICKIE ANDERSON

Dr. Tom Frazer, professor and associate director, School of Forest Resources and Conservation, collects seagrass along Florida's Gulf coast in an effort to better understand the effects of excess nutrients and other contaminants on their health

FLORIDA'S BIG Bend is home to the second largest contiguous seagrass habitat in North America, making it a vital resource not only for the state, but also for the nation and the world.

These seagrass beds support Florida's multibillion dollar recreational and commercial fishing industries by providing habitat for everything from bay scallops to grouper. Seagrasses also represent an important food resource for endangered green sea turtles and manatees, and they generate oxygen, dampen wave energy, stabilize sediments to reduce shoreline erosion, sequester carbon and enhance water clarity. In sum, seagrasses are essential to the integrity, health and value of the state's estuarine and nearshore coastal ecosystems.

Unfortunately, seagrasses are among the most threatened ecosystems on the planet. Around the globe, seagrass beds have disappeared at the alarming rate of about 100 square kilometers per year since the 1980s. Improved record-keeping since the 1990s allows scientists to track losses in areal extent; the data show losses of about 7 percent a year.

> "We seek a mechanistic understanding of seagrass performance and how that performance responds to changes in water quality." TOM FRAZER

Tom Frazer, associate director of the University of Florida's School of Forest Resources and Conservation, has led UF seagrass research on the Big Bend and Florida's Gulf Coast for the last 15 years. A vital base for this work is Project COAST (Coastal Assessment Team), with its network of fixed sampling stations and monitoring of water quality factors, especially nutrients and planktonic algae.

From 2010 through 2012, Project COAST will be augmented with a study characterizing the species composition of seagrass communities; quantifying areal cover, biomass and shoot density; measuring potentially stressful algal burdens on seagrasses; and documenting macroalgae as potential competitors for light and space needed by seagrasses.

"Seagrasses are relatively light-hungry organisms," Frazer said. "When excess nutrients cause excessive algal growth, less light reaches the seagrass, and it suffers and declines."

Seagrasses provide valuable habitat for marine organisms that support Florida's multibillion dollar recreational and commercial fishing industries.

The value of Frazer's long-term work was demonstrated after the Deepwater Horizon oil spill that began in April 2010. He was well-positioned to expand ongoing studies — with additional funding from Florida Sea Grant's Rapid Response Program — and begin documenting changes following the spill.

All of this work is important, Frazer says, because once damaged, seagrass beds don't recover readily.

"If you lose seagrasses, they can take decades to recover," he said. "We seek a mechanistic understanding of seagrass performance and how that performance responds to changes in water quality. If we can predict or garner an early warning of a decline in (seagrass) performance before there's a collapse, we'll be in a better position to do something about it.

"The ultimate goal of my individual and collaborative research is to develop new and robust ecological insights and translate them into sustainable management of the Big Bend's natural resources and similar resources in estuaries and near-shore coastal waters around the world," he said.

Besides Frazer, other researchers on the project include Chuck Jacoby, an environmental scientist at the St. Johns River Water Management District and a courtesy professor in UF's soil and water science department; and scientists from the Florida Department of Environmental Protection, Southwest Florida Water Management District and the Florida Fish and Wildlife Conservation Commission. SWFWMD, FWC and Florida Sea Grant funded the research.

ADAPTING TO CLIMATE CHANGE: IFAS ANSWERS THE CALL

PHOTO BY ARPAT OZGUL

Florida Climate Institute aims to translate research in timely fashion

BY TOM NORDLIE AND TRAVIS PRESCOTT

Dr. James W. Jones (right), director, and Dr. Eric Chassignet (left), co-director, Florida Climate Institute, presided over the kickoff event for the Florida Climate Institute on November 16, 2010. The Institute joins faculty from the University of Florida and Florida State University. Research, teaching, and outreach programs of the institute will help reduce climate risks to the economy, natural and managed ecosystems, and the built environment.

EACH YEAR, more studies show that climate variability and climate change pose significant economic and environmental threats worldwide. So it's more important than ever to translate this research into meaningful, timely information for farmers, policymakers and the public.

To meet this challenge, the newly established Florida Climate Institute (FCI) has embarked on a mission to provide science-based outreach activities and decision-making tools to residents of the southeastern U.S. and beyond.

"There exists a real need for this kind of information at local to regional levels and at shorter time scales," said FCI Director Jim Jones, a distinguished professor with the University Florida's Institute of Food and Agricultural Sciences.

Formally launched in July 2010 after a suggestion from IFAS Research Dean Mark McLellan about expanding Jones' already-successful climate and agriculture programs, the institute is a co-venture between UF and Florida State University. It includes more than 100 affiliates from around the state and nation, all working to provide region-specific information to help stakeholders evaluate options for climate change mitigation and adaptation.

> "There exists a real need for this kind of information at local to regional levels and at shorter time scales."
>
> JIM JONES

Some of the issues the institute will address include: the effects of land-use changes on a community's carbon footprint, altered disease patterns caused by climate changes and the need for reliable water supplies in the face of drought.

FCI affiliates, many of whom have worked on climate change for decades, are already pursuing numerous projects.

One study investigates the hypothesis that climate disturbances in reef areas can boost populations of dinoflagellates responsible for ciguatera poisoning, a major human health concern in tropical and subtropical coastal areas. The dinoflagellates produce toxins that are transmitted through the food chain to large, edible reef fish species.

Another study focuses on developing web-based tools that provide producers with climate forecast information and risk-management decision aids. The target audiences include southeastern foresters, peanut, potato and tomato farmers, and the extension agents who serve them.

A third study explores the potential energy that could be generated by offshore wind farms in the northern Gulf of Mexico. Using data recorded at U.S. Air Force towers in the Apalachicola Bay area, researchers found that wind speed was higher than expected, suggesting that wind power might provide several thousand megawatts of electricity to Florida residents.

For more information, visit http://FloridaClimateInstitute.org.

In addition to support from UF/IFAS, the Florida Climate Institute is supported by grants from the New Florida Initiative, a multiyear endeavor launched in 2010 by the Florida Board of Governors for the State University System to promote the creation of high-wage jobs in science, technology, engineering and mathematics. Other multidisciplinary projects are funded by agencies including the National Science Foundation, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration and the U.S. Department of Agriculture.

Research shows connection between El Niño and nutrient runoff

BY ROBERT H. WELLS

Dr. Victoria Keener, framed by images of Lake Okeechobee and figures of wavelet analysis results showing strong relationships between ENSO and nitrate pollutant loads in the watershed.

THE EL Niño/La Niña-Southern Oscillation (ENSO) climate event doesn't only cause strange weather around the globe, it can also affect local water quality, researchers are learning.

The research finding shows the immediate and local environmental effects of ENSO, which can cause seasonal patterns of strange weather around the world. ENSO appears to be cyclical and occurs over a span of three to seven years, with a warming period over the equatorial Pacific Ocean known as El Niño, a cooling period known as La Niña and a neutral period.

Victoria Keener, a postdoctoral research associate in the agricultural and biological engineering department, looked at the environmental effects of ENSO on two watersheds in the Southeast — Lake Okeechobee in Florida and the Little River watershed in Georgia. She conducted the research for her doctoral dissertation.

In the Lake Okeechobee study, she used data from the South Florida Water Management District (SFWMD) to show relationships between ENSO and increased phosphorus runoff in streams. Her study focused on basin S-191, an area northeast of Lake Okeechobee. The SFWMD data was inserted into the Watershed Assessment Model (WAM). Input data included daily precipitation, temperatures, solar radiation and wind speed. Keener looked at simulated nutrient loads into the lake for 36 years, from 1965 to 2001, which included nine El Niño years, 10 La Niña years and 17 neutral years. The assessment model demonstrated that ENSO causes significant phosphorus loading (nutrient seepage into streams) in El Niño springs and La Niña summers, and that higher precipitation was associated with higher phosphorus loading.

> "This model could tell farmers and ranchers ... when it would be beneficial to store more water in retention ponds to remove nutrients."
>
> VICTORIA KEENER

To look at the environmental effects of ENSO on the Little River watershed, Keener used a method known as wavelet analysis.

Wavelet analysis finds frequency relationships, or how often something occurs within a particular time and in association with other events. Using this method, Keener found that ENSO periods are connected to changes in precipitation, the amount of water flowing, and nitrogen fertilizer concentration and load. For instance, El Niño periods were associated with increased nitrogen content in the stream flow.

Keener was also able to use data from her wavelet research to develop a model to forecast nitrate loads, allowing land managers to better predict nutrient runoff.

"This model could tell farmers and ranchers what their high-risk months are for nutrient loading in a predicted ENSO phase and when it would be beneficial to store more water in retention ponds to remove nutrients," Keener said.

Research collaborators included U.S. Department of Agriculture-Agricultural Research Services in Tifton, Ga., Barry Jacobson with Soil Water Engineering Technology in Gainesville, distinguished professor Jim Jones in the agriculture and biological engineering department, and the Earth Institute at Columbia University. The research was funded by the National Oceanic and Atmospheric Administration Climate Program Office and the USDA Cooperative State Research, Education and Extension Service.

Strawberry growers get help with critical decisions

BY TRAVIS PRESCOTT

Drs. Natalia Peres, assistant professor of plant pathology, UF's Gulf Coast Research and Education Center, and Clyde Fraisse, assistant professor, Department of Agricultural and Biological Engineering, collaborated to develop the Strawberry Advisory System (SAS) implemented on AgroClimate.org.

RESEARCHERS AT UF's Institute of Food and Agricultural Sciences have developed a decision-support system featuring an innovative tool that helps strawberry growers assess the risk of plant disease epidemics on their farms in real-time. With this tool, growers are now able to time fungicide applications more accurately and reduce production costs — as well as the potential environmental impact — without compromising disease control, fruit quality or crop yield.

This is especially good news for growers in Florida, where about 8,000 acres of land represent nearly 100 percent of the U.S. production of winter strawberries. But while strawberries tend to thrive in Florida's mild winters, so do two of the most menacing fungal diseases — anthracnose fruit rot, caused by *Colletotrichum acutatum*, and Botrytis fruit rot, caused by *Botrytis cinerea*. Both are difficult and expensive to control.

"The effects of either…can be devastating," said Clyde Fraisse, assistant professor with the department of agricultural and biological engineering, whose expertise includes agroclimatology and soil and water engineering. "Timing is everything."

Since 2004, Fraisse has been a driving force in the development of AgroClimate.org, an open-source web-based decision support system hosted by UF/IFAS extension.

> "The climate program at UF is working really hard to translate climate information and forecasting in such a way that the translation can then trigger a decision or an adaptation."
>
> CLYDE FRAISSE

"We knew that plant disease would be a strong candidate for being part of this decision-support system, particularly given the nature of the environment here in the Southeast with conditions

that are often warm and humid," Fraisse said. "We have some very interesting climate patterns here that are driven by the El Niño Southern Oscillation (ENSO) phenomenon."

Because ENSO relates to temperature and moisture, it has implications for plant diseases. Many plant diseases thrive in moist conditions, so during an El Niño year, winter crops in the southeastern U.S. can be more susceptible. So when Fraisse was approached by plant pathologist Natalia Peres of the UF/IFAS Gulf Coast Research and Education Center — who had been looking at weather variability models in relation to fungicide application timing — the two worked together to understand strawberry growers' decision-making process. Drawing upon current and historic data provided by the Florida Automated Weather Network (FAWN) and simulation models provided by Peres, Fraisse developed the web-based strawberry diseases decision-aid tool to help growers time their fungicide applications. Field tests proved that fungicide applications could be reduced by half in some years, and without loss in fruit yield or quality, by following the system's recommendations.

The online decision-support system and the strawberry disease tool can be found at http://agroclimate.org/tools/strawberry/. Using the tool, growers answer a simple series of questions about treatments they have already applied and the developmental stage of their crop. They are then given spray recommendations and a list of possible products. A mobile application is available for smart phones and similar tools for other crops are being developed.

"I think that when we look at sustainability of intensive agriculture, these sorts of decision-support tools are the way to go in the future. The climate program at UF is working really hard to translate climate information and forecasting in such a way that the translation can then trigger a decision or an adaptation," Fraisse said. That makes it useful and adds value."

Funding for the strawberry advisory system was provided by the USDA Risk Management Agency. Open-source Agr-Climate is funded by the USDA National Institute of Food and Agriculture.

Study reveals marmot population increase linked to climate change

BY AMANDA AUBUCHON

Arpat Ozgul, ecologist and former graduate student of Madan Oli, holds a yellow bellied marmot during research on the animals in the Colorado Rocky Mountains. The research revealed that climate change has contributed to a substantial increase in the size and number of the mountain-dwelling rodents.
PHOTO BY ARPAT OZGUL

A BURGEONING YELLOW-BELLIED marmot population in the high elevations of the Rocky Mountains is a response to climate change, according to a long-term collaborative research effort involving six universities in the U.S. and U.K. The study is the first of its kind to demonstrate this linkage.

"Since about 2000, the population has increased really rapidly," said Madan Oli, a UF professor of population ecology. "The question is, 'Why?' For over 40 years, the population has been fairly stable, more or less, fluctuating around some average value, but all of a sudden the population is increasing rapidly. One suspect

> "There is a lot of evidence that climate change influences the phenology — the timing of important life events for plants and animals."
>
> MADAN OLI

has been climate change, which is most obvious at higher altitudes."

Researchers have been capturing yellow-bellied marmots in the population four times a year, on average, and keeping track of each animal's body mass, hibernation schedule, survival and reproductive success since the study was started by Ken Armitage of the University of Kansas in 1962. Researchers at the University of Florida and Imperial College of London began applying population modeling techniques to those data to get a clearer picture of population ecology and dynamics and how they are influenced by climate change.

Based on extensive survival and reproductive data collected from 1976 to 2008, Oli and his collaborators have determined that the average annual growth rate of the marmot population is normally close to 2 percent. In the past 10 years, however, that number rose to 18 percent. Marmots are also emerging from hibernation earlier and are larger. On average, adult marmots are now about half a kilogram bigger than they were in the years prior to 2000. Fatter marmots have a better chance of surviving winter and are physiologically in better condition to reproduce, Oli said. Shorter winters are believed to be responsible for the marmots' early emergence and increased survival and reproduction.

"There is a lot of evidence that climate change influences the phenology — the timing of important life events for plants and animals, like flowering, hibernating schedule, migration and reproduction," Oli said.

To help them understand the underpinnings of this rapid population increase, Oli and his colleagues used several modeling techniques to analyze the long-term field data, including mark-recapture models to estimate survival rate, generalized linear and additive models to estimate demographic and transition functions, integral projection equation models to estimate population growth rate, and the age-structured price equation to determine if changes in body mass were due to evolution or environmental variation.

"The response of a population to climate change was mediated through phenological change, which influenced a quantitative trait — in this case, body mass — and that influenced survival and reproduction, which led to increases in population size," Oli said.

The marmot population explosion is not considered to be a long-term environmental concern, he said. Marmots require high-quality shelter to survive the winter, and there is not much of it in their habitat.

"It gets really, really cold, and if they don't have high-quality hibernacula [shelter], they lose their fat reserve really, really quickly," Oli said. "They can't survive."

Besides Oli, the research team included Arpat Ozgul and Tim Coulson, Imperial College of London; Dylan Z. Childs, University of Sheffield; Kenneth B. Armitage, University of Kansas; Daniel T. Blumstein and Lucretia E. Olson, UCLA; and Shripad Tuljapurkar of Stanford University.

The research was supported by UF and funded by the National Science Foundation, University of Kansas, UCLA and Imperial College.

ADVANCING THE DEVELOPMENT OF BIOENERGY

Genetic research improves sweet sorghum biofuel possibilities

BY ROBERT WELLS

Dr. Wilfred Vermerris, associate professor, Department of Agronomy, performs detailed compositional analyses of improved bioenergy sorghums using a mass spectrometer in his laboratory at the University of Florida Genetics Institute.

A MINOR FLORIDA crop, sweet sorghum, could have a positive impact on biofuel production if University of Florida research can adapt it to grow better in the state.

Wilfred Vermerris, an associate professor in UF's agronomy department, is leading research into the plant's potential.

Producers sometimes grow sweet sorghum for silage, but they mostly grow grain sorghum for animal feed. Compared to grain sorghums, sweet sorghums have taller stems full of sugar and typically produce less grain. Sugar from the stems can be easily converted into ethanol, making the crop a renewable fuel resource, or biofuel. Now Vermerris is developing varieties optimized for Florida.

"The sweet sorghums that do exist come from Texas, Louisiana or Kentucky," Vermerris said. "They are not necessarily adapted to Florida in terms of climate and tolerance to pests and diseases."

Vermerris is crossing UF-developed grain sorghums with sweet sorghums to identify genes responsible for resistance to the common and destructive disease anthracnose. He is also screening varieties for pest resistance, such as plants that are physically harder for worms to chew through. The ability to produce a good crop on Florida's limited-organic-matter soils with relatively low water and fertilizer input is being screened for as well.

Sugar content is also important, and to expedite breeding efforts, Vermerris and his research team are combining genetic mapping with high-throughput gene expression profiling. This enables them to identify genes that control stem sugar accumulation in sorghum families that are genetically similar but differ in their stem sugar concentration and juice volume. High-throughput sequencing technology makes it possible to quickly assess the expression of many genes at the same time.

> "The sweet sorghums that do exist come from Texas, Louisiana or Kentucky."
>
> WILFRED VERMERRIS

Vermerris is also studying the brown midrib (*bmr*) trait, which changes the color and chemical composition of the vascular tissue and can result in higher sugar yields when processing the crushed stems. The crushed stems remain after stem juice extraction and offer an additional energy feedstock from the same crop.

The researchers have classified a new population of *bmr* mutants in allelic groups based on cell wall chemistry and allelism tests, which rely on crosses among *bmr* mutants to determine which mutants are unique. Using these techniques, they discovered four novel *bmr* genes different from the three known previously.

Comparisons between the chemical composition of *bmr* mutants and normal control plants provide information on the role of each of the individual *bmr* genes. Combining genetic mapping, current information on cell wall biosynthesis genes, and the sorghum genome sequence has enabled researchers to identify and

clone the genes mutated in the three original *bmr* mutants, making it easier to develop new *bmr* germplasm.

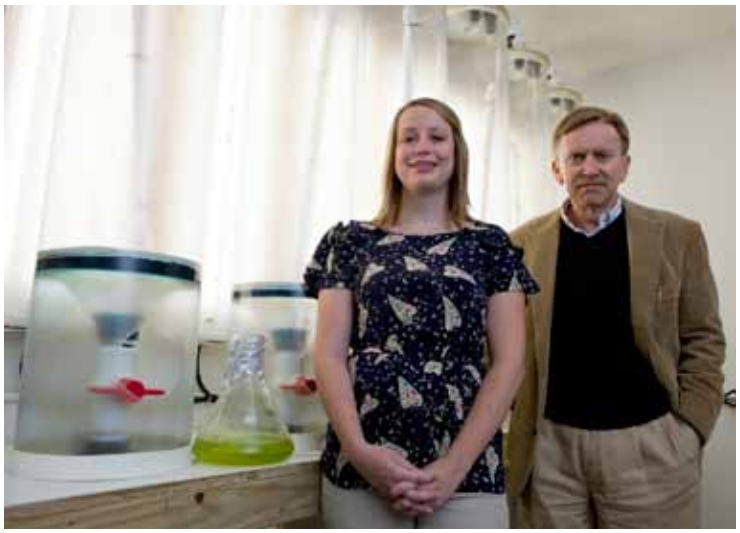
Sugarcane is projected to be a main sugar source for biofuel processing plants in South Florida. However, Vermerris said during gaps in the sugarcane season, sweet sorghum can be harvested as a substitute, allowing processors to operate practically year-round. In addition, a resin biopolymer byproduct of processing may eventually have applications in medicine for improved drug delivery.

The research team includes postdoctoral research associates Ana Saballos and Hector Caicedo; materials science and engineering associate engineer Amelia Dempere; assistant professor of agronomy John Erickson and researchers with Texas A&M University, Cornell University and the U.S. Department of Agriculture.

The U.S. Department of Energy, IFAS and USDA fund the research.

Unique traits in some algae make them a possible biofuel

BY ROBERT WELLS



PhD student Bailey Trump and professor Edward Phlips, School of Forest Resources and Conservation, shown in front of algae bioreactors. Shown in foreground is a flask of the hydrocarbon-producing algae *Botryococcus braunii*, a prime candidate for biofuels production.

THE UNIVERSITY of Florida is exploring the potential of algae as a biofuel, or fuel from renewable resources.

Algae include species with traits like fast growth and high hydrocarbon or fatty acid content. Hydrocarbons are almost directly convertible into high-quality diesel fuels, whereas fatty acids are convertible into diesel with additional processing and expense.

"If everything is optimized, per-hectare production rates of oil from algae are theoretically higher than most land plants," said Ed Phlips, a professor in the fisheries and aquatic sciences program leading the research.

The problem is that current algae species do not have all the traits needed for viable biofuel production. For example, algae like *Botryococcus braunii* produce large amounts of hydrocarbons but are not fast growing or tolerant of extreme environments. In contrast, *Dunaliella salina* is fast growing but does not produce fatty acids that are highly valued in biofuel production. To solve this, Phlips is proposing to genetically alter algae using mutagenesis and genetic transformation.

> "If everything is optimized, per-hectare production rates of oil from algae are theoretically higher than most land plants."
>
> ED PHLIPS

Mutagenesis is accomplished by exposing organisms to mutagens, such as ultraviolet light or chemicals. The mutants are then screened for desirable traits. Genetic transformation involves the transfer of genes from one organism to another, also known as recombination.

Phlips has more than 100 different algae strains to use as source material. These include *Botryococcus*, *Dunaliella*, *Synechococcus* and *Spirulina*.

Dunaliella is a proposed target for mutagenesis. The algae grow quickly at high salt concentrations, but produce low-quality fatty acids in terms of biofuel production. To improve the organisms,

genes involved in fatty acid formation will be targeted for better quality production, including negative regulators that prevent biosynthesis of less desirable fatty acids. To detect these gene alterations, researchers will use degenerate primers from *Dunaliella* and other published gene sequences to design new primers, or starting points, for each gene. Degenerate primers are mixtures of similar primers from different organisms and allow researchers to amplify genes. Genes must be amplified, or reproduced in a greater number, for trait detection.

Researchers will use *Synechococcus* and *Spirulina* as host organisms for recombinant hydrocarbon production capabilities, and they have identified the genes targeted for transformation. The algae are fast growing and tolerant of extreme environmental conditions. *Botryococcus* will be the primary source of hydrocarbon production genes. Researchers will also target *Botryococcus* for transformation by inserting intracellular sodium level reduction gene constructs to express improved salinity tolerance in the organism.

Possible algae production systems include open ponds and bioreactors. If algae are grown primarily for fuel, open-pond systems are the simplest, most cost-effective production choice. These pond systems would most likely use seawater to avoid competing with drinking and irrigation water use. Self-contained, cylindrical bioreactors are expensive and complex but could become more economical if the algae provide dual services, such as waste water treatment or the production of valuable biochemicals, in addition to producing biofuels.

The Fisheries and Aquatic Sciences program is part of UF's Institute of Food and Agricultural Sciences' School of Forest Resources and Conservation (SFRC).

Besides Ed Phlips, the research team includes Department of Agricultural and Biological Engineering assistant professor Pratap Pullammanappallil, Florida Institute for Sustainable Energy associate professor Ann Wilkie, Environmental Horticulture Department professor Charles Guy, SFRC associate professor Matias Kirst and Department of Medicinal Chemistry associate professor Hendrik Luesch. An IFAS Research Innovation Grant funds the research.

Tropical plant may become biofuel crop

BY ROBERT WELLS

Dr. Wagner Vendrame, associate professor of environmental horticulture, Tropical Research and Education Center (TREC) at the Jatropha germplasm collection in TREC, Homestead, FL.

THE TROPICAL ornamental *Jatropha curcas* is more than just a pretty plant.

The small, flowering tree produces seeds with high-quality oil directly usable in diesel engines and, because of its low temperature stability, capable of powering jet planes as part of a 50/50 mix with jet fuel. Major airlines have tested it successfully, as has the Department of Defense in unmanned drone aircraft. It is a perennial, favors Florida's climate and has relatively low water and fertilization requirements.

Jatropha curcas' potential even has the attention of NASA, which, since February, has used the International Space Station to test microgravity's effects on the plant's cell growth, development, structure and gene expression.

> "Everybody understands the end product is a good product, but we still don't have enough of it."
>
> WAGNER VENDRAME

Wagner Vendrame, an associate professor of environmental horticulture at the Tropical Research and Education Center (TREC) in Homestead, Florida, is assessing the biofuel potential of the plant for the University of Florida.

Although *Jatropha curcas* has great potential, the plant has never been domesticated, and oil needed for fuel tests is in low supply.

"It's still a wild species; there are no commercial cultivars," Vendrame said. "Everybody understands the end product is a good product, but we still don't have enough of it, so we need to work on crop development."

Vendrame is examining plant genetic variability and best management practices like fertilization, irrigation and pruning. The researcher planted *Jatropha curcas* in test plots in June 2010. The plots contain 17 plant accessions representing 12 countries. The seeds were germinated in trays in April 2009 and grown in containers before being planted in the field. Soil used was Krome very gravelly loam — plowed to four to seven inches deep — with a pH of 7.4 to 8.4, low water-holding capacity, 3 to 10 percent organic matter content and low inherent nutrient content. Plants were fertilized monthly with 100 — 200 grams of 6N-5P_2O_5-15K_2O and irrigated every other day using a micro-sprinkler. No micronutrients or pruning were applied.

From the plots, the researcher found differences in leaf shape, plant size, architecture and fruit shape and size. After seven months, accessions known as Indonesia and Costa Rica had the tallest plants, while accessions known as Brazil-EPB and Tanzania had the smallest. After five months, percent increase in trunk diameter was greatest for the accession known as Brazil-UFPR, while it was the least for the accessions known as Brazil Plain and Indian. Accessions Indonesia, Indian and Brazil Plain produced the most seeds, while accessions Ethiopia and Mozambique produced the least. For total seed dry weight per plant, Indian, Indonesia and Brazil Plain accessions were the heaviest; Ethiopia, Mozambique and Indian AAF were the lightest.

Further research should reveal genetic variability's effect on seed yield and oil content. Vendrame is also developing protocols for clonal propagation for multiple plant production.

A surprise in the research was the plants' ability to recover from last winter's below-freezing temperatures. The plants are not cold tolerant, but with insulating overhead irrigation, they reemerged after the cold spell greener and more luscious.

The research team includes Jonathan Crane, horticultural sciences professor and associate TREC director; Edward Evans, a food and resource economics assistant professor and TREC associate director; Kimberly Moore, an environmental horticulture associate professor at the Fort Lauderdale Research and Education Center; visiting researcher Edson Leite; and Ann Wilkie, a soil and water science associate professor. The work is funded by Vecenergy, the Florida Department of Agriculture and Consumer Services, the University of Colorado's BioServe Center and EMBRAPA, Brazil's agricultural research department.

Research examines woody biomass energy for Florida

BY ROBERT WELLS

ELECTRIC POWER generation from woody biomass can increase economic activity and raise state government revenues but must be produced sustainably, University of Florida research has found.

Woody biomass, such as urban wood waste, logging residue and harvestable timber, is a renewable resource that can be burned to produce electricity or processed to produce liquid biofuels.

In response to growing interest in renewable energy, the 2008 Florida Legislature mandated a research effort to evaluate its potential impact to the state. Two studies by UF researchers were commissioned — one examining the impact on Florida's economy, was led by Alan Hodges, an Extension scientist in the food and resource economics department, and a second examining the impact on forest resources, was led by Douglas Carter, a professor in the school of forest resources and conservation.

A starting point for the research was a proposal by the Florida Public Service Commission for a 20 percent renewable portfolio standard (RPS), which means that renewable energy would be required to generate 20 percent of Florida's electricity. To produce this level of electricity would require to up to

> "Our model found that the use of woody biomass for renewable power generation would have a significant positive impact on the state's economy."
>
> ALAN HODGES

Drs. Douglas Carter (right), professor, School of Forest Resources and Conservation, and Alan Hodges, Extension scientist, Food and Resource Economics, display a sample of shredded wood suitable for use as a solid biofuel for electric power generation.

70 million tons of green (undried) woody biomass by the year 2040.

Hodges examined the economic impact using a computable general equilibrium (CGE) model of Florida's economy, which describes the economy in transactions between industries, households and the government. It can adjust for economic changes and allows for the computation of gross domestic product (GDP), employment, income and output of each sector. Hodges simulated the model over a range of 1 to 80 million green tons of wood biomass annually for electricity at $30 per ton and also for various state and federal incentives.

"Our model found that the use of woody biomass for renewable power generation would have a significant positive impact on the state's economy," Hodges said. His mid-range estimate of 40 million tons of green biomass for power generation would increase Florida's GDP by about $2 billion. Employment would also increase, particularly in the forestry sector.

Carter looked at the forest resources impact by using the Subregional Timber Supply model to predict effects on timber prices, harvests and inventories. Carter examined the effects of a 20, 12 and 7 percent RPS using different woody biomass sources.

"We found that a 20 percent RPS would have a deleterious impact on both forest sustainability and inventory and on the existing forest products industry," Carter said. "Forest resources would not even be able to supply what is required under a 20 percent RPS because of the effect of the decline on inventory over time."

However, Carter said a 7 percent RPS is more feasible. This RPS would mainly use urban woody waste and logging residues, along with forest inventory reserves, to meet the demand without hurting forest sustainability. Short-rotation energy crop production could also emerge to meet demand.

"We recommended that a 7 percent RPS be considered at least to begin with," Carter said. "We felt like that could be a feasible starting point for setting a mandatory RPS."

Fred Rossi, a postdoctoral research associate in the SFRC; and Bob Abt, a professor in the Department of Forestry and Environmental Resources at North Carolina State University assisted Carter in the research. Assisting Hodges was Thomas J. Stevens, postdoctoral associate; and Mohammad Rahmani, coordinator of economic analysis, both with FRED. The Florida Department of Agriculture and Consumer Services Division of Forestry and IFAS funded the research.

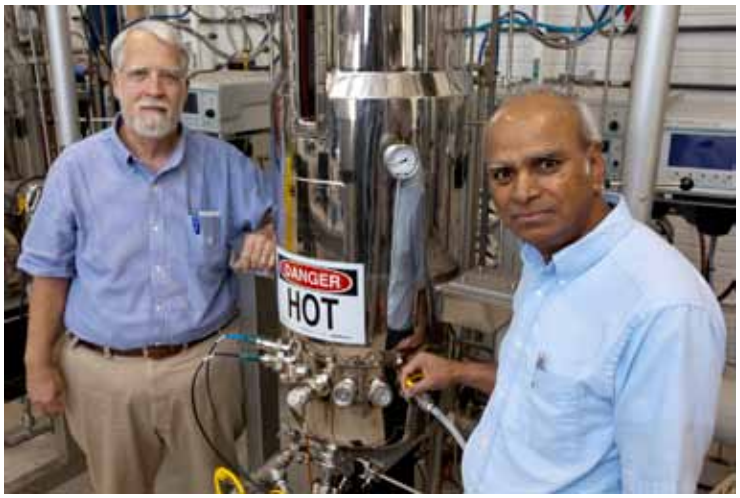
New acid for cellulosic ethanol production has multiple benefits

BY ROBERT WELLS

UNIVERSITY OF Florida researchers are improving cellulosic ethanol processing by introducing a different acid into the mix, an innovation that could lead to lower equipment costs, higher efficiency and useful agricultural byproducts.

Cellulosic ethanol is a biofuel produced by saccharifying (breaking down) plant biomass like stalks, sugarcane bagasse and wood chips, from polysaccharides into simple sugars — or monosaccharides — that are then fermented into ethanol fuel. Bagasse is woody waste from sugarcane processing.

Lonnie Ingram, a professor of microbiology and cell science, leads the cellulosic ethanol research.



Lonnie Ingram (left), professor and director, Florida Center for Renewable Chemicals and Fuels (FCRC) and K. T. Shanmugam, professor, Department of Microbiology and Cell Science, examining a fermenter used to convert woody biomass into ethanol for fuel.

"Most other processes for breaking down woods with acids have used sulfuric acid, which is a very strong acid — so strong that you have to use very exotic and expensive steel alloys or even zirconium in order to conduct the reactions," he said. "But with the acid we use, which is primarily phosphoric, it is a much gentler acid, and we can use less expensive stainless steel equipment."

Ingram and his team tested using phosphoric acid and compared the results with bagasse samples solubilized with sulfuric acid and analyzed using U.S. National Renewable Energy Laboratory (NREL) procedures.

The researchers dissolved bagasse samples with dilute phosphoric acid to estimate structural, or nondissolved, carbohydrates and sugar yields. They soaked the samples in phosphoric acid in 250-milliliter flasks for three hours and autoclaved them, for sterilization, for one hour. After adjustment for evaporative losses, they measured soluble sugars and hemicellulose (insoluble) sugars. Average monosaccharide yield was comparable to yield from using sulfuric acid in the NREL method.

They also tested solubilizing phosphoric-acid-soaked bagasse with fungal cellulases to release more sugars. They placed bagasse in flasks and autoclaved it along with 2 percent phosphoric acid for one hour at 145 degrees Celsius. After cooling and adjustment with 45 percent KOH to pH 5.0, the team added thymol, cellulase enzymes Biocellulase W and Novozyme-188 b-glucosidase and water to adjust the contents to 100 grams. Cellulose digestion was 72 hours at 50 degrees Celsius. They found that cellulase enzymes in small doses effectively solubilized the bagasse.

Overall processing efficiency improved as lower levels of fermentation-inhibiting products from sugar destruction, such as furfural, existed as compared to when sulfuric acid was used.

Saccharification using phosphoric acid also yields useful byproducts that can help offset production costs. In Ingram's process, about 80 percent of phosphate can be recovered in solid form. That and the remaining mineral solution can be used for crop fertilization.

"We would like everything that comes in the front door to leave out the back packaged as a commodity that is useful," Ingram said. "The main components in fertilizer are nitrogen, phosphorus, iron, magnesium, potassium, trace metals. Those are exactly the compounds we use in our cellulosic ethanol process."

> **"We would like everything that comes in the front door to leave out the back packaged as a commodity that is useful."** LONNIE INGRAM

Future research includes continuing to increase ethanol concentration achieved per unit of biomass. The team has achieved nearly 3.5 percent concentration, with a goal of more than 4 percent.

In addition to Ingram, the research team includes senior industrial process engineers Claudia Geddes and Ismael Nieves, senior microbiologist Mike Mullinnix, and Microbiology and Cell Science Department professor K. T. Shanmugam.

Funding sources include industries licensing Ingram's technology, the state of Florida, the U.S. Department of Agriculture and the U.S. Department of Energy.

ATTACKING FLORIDA'S EMERGING PATHOGENS

Responding to the threat of citrus black spot

BY AMANDA AUBUCHON

Dr. Megan Dewdney, assistant professor of plant pathology, UF's Citrus Research and Education Center, changing the week's tubes on the cyclone spore trap so that her lab can measure the proportion of *Guignardia citricarpa* and *G. mangiferae* spores that are ejected in a day. These fungi cannot be distinguished by morphology but one causes citrus black spot and the other is not pathogenic on citrus.

CITRUS BLACK spot, a formerly exotic fungal disease, became a threat to Florida citrus when it was discovered in the state in March 2010. A team of IFAS researchers has been working to determine how to contain and manage the disease before it spreads further.

Citrus black spot is caused by the nonnative fungus *Guignardia citricarpa*, which reproduces in leaf litter and inoculates trees by spread of its ascospores, usually during rains or irrigation. While not fatal to the tree, the disease can cause significant fruit drop and render portions of a crop unusable. Fruits that do survive to maturity can have lesions, making them unsuitable for export, though internal quality is not affected and they can still be processed for juice. Citrus black spot is particularly problematic for late-harvested sweet oranges, such as Valencia, said assistant professor and plant pathology Extension specialist Megan Dewdney.

"They tend to have two ages of fruit on the tree at the same time," Dewdney said. "They'll have mature fruit, and then they'll have the next year's fruit on the tree. Spores form on mature fruit that then can drip down onto the immature fruit and infect them."

So far, the disease's distribution is limited in the state, possibly thanks in part to treatments already in place for citrus canker, a disease that is well established in Florida. Treatment of citrus canker includes the spraying of copper fungicides, which have also proven effective against citrus black spot in other countries, Dewdney said.

Applied fungicide trials have yet to begin, but tests are being conducted in petri dishes at the Gulf Coast Research and Education Center in Balm to establish a baseline for strobilurin fungicides, another class of fungicides that has proven effective in managing citrus black spot in other countries. They are also investigating the efficacy of new compounds. Dewdney and fellow researchers are trying to determine the potential for the disease to develop resistance to strobilurin fungicides.

> "Citrus black spot is particularly problematic for late-harvested sweet oranges, such as Valencia."
>
> MEGAN DEWDNEY

Spore-trapping studies are also under way to track how often the ascospores of *G. citricarpa* are ejected from the leaf litter and in what quantity. To do this, a machine sucks air from the leaf litter at a very precise rate, depositing spores on a tape spool with a clock. The tape is collected weekly and examined under a microscope. *G. citricarpa* spores, however, look identical to the spores of a native, harmless fungus known as *G. mangiferae*. To distinguish harmful spores from harmless ones, a molecular technique known as quantitative PCR is used to determine the proportion of spores of each type.

Dewdney and her colleagues will soon be working on leaf litter degradation studies as well, determining how they can encourage leaf litter to degrade more quickly and whether quicker degradation could impact the fungus's maturity, pushing it forward

in its life cycle so that it misses the susceptible fruit and leaves. Leaf litter degradation has been useful in managing citrus black spot in other countries, Dewdney said.

Dewdney's team includes senior biological scientist Sachindra Mondal, research associate Nan-Yi Wang, postdoctoral associate Jiahuai Hu, assistant professor of plant pathology Natalia Peres, associate professor Mark Ritenour and program assistant Jamie Yates. The project is funded by APHIS and the Institute of Food and Agricultural Sciences.

IFAS team works to save state's avocado industry from laurel wilt

BY AMANDA AUBUCHON

Faculty at TREC-Homestead who work on laurel wilt of avocado: (left to right) Jonathan Crane, professor of horticultural sciences; Jorge Peña, professor of entomology; Edward "Gilly" Evans, associate professor of agricultural economics; and Randy Ploetz, professor of plant pathology.

RESEARCHERS AT UF's Institute of Food and Agricultural Sciences, the University of Minnesota, and the USDA are collaborating to save the state's avocado industry and several species of landscape and native trees from the advancing threat of laurel wilt, a virulent and fast-acting fungal disease spread by the invasive redbay ambrosia beetle.

The disease is caused by a fungus that attacks trees in the Lauraceae family, which includes bay laurel and avocado, causing them to wilt and die within months. Jonathan Crane, a tropical fruit crop specialist at the Tropical Research and Education Center (TREC) in Homestead, said the beetles carry the fungus with them and inoculate trees, where the fungus serves as their food source.

Randy Ploetz, a plant pathology professor at TREC, has been screening avocado cultivars for their susceptibility to the pathogen. A variety called Simmonds, which makes up 33 percent of Florida's commercial avocado acreage, has been consistently susceptible. The state's avocado crop earns about $30 million a year.

> **Beetles carry the fungus with them and inoculate trees, where the fungus serves as their food source.**
>
> JONATHAN CRANE

Ploetz has also been studying how the disease moves through an area. So far, laurel wilt has spread as far south as Martin County, about 100 miles north of the state's primary commercial avocado-growing areas in south Miami-Dade County.

Dr. Jason Smith, assistant professor of forest pathology, Forest Resources and Conservation, examines redbay trees being used to elucidate the host-pathogen interaction in Laurel wilt disease.

Ploetz has tested different fungicides and fungicide application methods to determine how best to protect the trees. Macroinfusion, in which trees are injected with large volumes of fungicide, has shown good results, but is too time-consuming and expensive to be a viable option for avocado growers, he said. So alternative injection technologies, application methods and fungicides are being explored.

Jorge Peña, an entomologist at TREC, has been studying beetle behavior and biology, as well as repellents and pesticides. Some pesticides delay disease incidence, mostly by killing the beetle, and a repellent known as BeetleBlock has shown promise in reducing the number of beetles boring into avocado logs, though tests have yet to begin on live trees, he said.

Jason Smith, a UF assistant professor of forest pathology in the School of Forest Resources and Conservation, has been studying whether pruning equipment can transmit the disease and if the beetle and pathogen can survive in mulch made from infected trees. Smith and his graduate students have used conventional tools, such as chainsaws and hand saws, to cut first into infected trees and then into healthy trees to see if they become infected. So far, the pathogen has not been transmitted via tools and has not survived long in wood chips.

"It's just not the type of pathogen that's able to live on tools and debris for very long," Smith said. "It needs to be in a host to survive for very long."

Smith has been developing a molecular diagnostic tool to identify the pathogen without having to await the results of cultures, which can take three to four weeks. Using 454 DNA sequencing, Smith is working to identify microsatellites — short sequences of DNA that are specific to a particular organism — to quickly and accurately detect the pathogen without the need for a culture.

Smith is also exploring the possibility of naturally resistant redbay trees, taking cuttings from surviving redbay trees in hard-hit areas and propagating them for artificial inoculation experiments.

Smith, Ploetz and collaborators at the University of Minnesota are exploring how laurel wilt kills trees. Recent results indicate that the pathogen colonizes the water-conducting tissue of trees and induces blockage in these tissues, which are both typical of other vascular wilt diseases. Smith is studying whether the rapid wilting and death associated with these events is due to the pathogen's production of a toxin.

Besides Crane, Ploetz, Peña and Smith, the research team includes John Capinera and Gurpreet Brar of the UF entomology department and Edward Evans, an agricultural economist at TREC. The research is funded by the University of Florida, the U.S. Department of Agriculture and the Avocado Administrative Committee.

Enemy may be important ally in fight against citrus greening

BY CALEB SHEAFFER

Drs. William Dawson, Eminent Scholar and professor of plant pathology and Svetlana Folimonova, research assistant scientist, UF's Citrus Research and Education Center, Lake Alfred, FL.

IN THE war against citrus greening, UF researchers may have found an ally in an old enemy, citrus tristeza virus (CTV).

Citrus greening, also known as Huanglongbing (HLB), poses a formidable threat to Florida's $9.3 billion citrus industry.

The rapid spread of the bacterial disease, combined with the effect of hurricanes, citrus canker and suburban development, have reduced the number of productive trees in Florida. If a

solution isn't found fast, it may have irreparable consequences for the industry.

This has led to much research about ways to combat citrus greening disease. Two IFAS research teams, led by William Dawson and Svetlana Folimonova, are searching for a way to deliver a cure using citrus tristeza virus as a vector — in a sense, inducing resistance in citrus trees by introducing genes carried by the tristeza virus.

Dawson, eminent scholar and J.R. and Addie S. Graves Chair at the Citrus Research and Education Center, has been researching viral vectors in plants and trees throughout his career. Nearly two decades ago, Dawson's team manipulated tobacco mosaic virus to express a foreign gene before he was able to do the same with CTV.

Dawson's team discovered it could manipulate the T36 strain of CTV to express a foreign gene by inserting it in a precise section of the virus. These genes could in turn express favorable traits such as disease resistance in citrus trees, but only for a limited amount of time and without passing it on to subsequent generations. His team found that the CTV vectors are stable compared to other vectors. In lab trials, the CTV vectors have expressed the foreign genes for more than six years.

"As a guess, if you put the virus with a gene that would control citrus greening into young plants in the field, we think somewhere around 80 percent of the plants would have the gene after 10 years, but some of them would lose it," Dawson said.

At this point, the CTV vector tool could be used to express genes in young citrus trees in the field. But for the tool to work against citrus greening, researchers must find a gene that expresses a resistance to HLB.

Using the vector tool in the field would be a stopgap until other measures are found to fight citrus greening. UF's Office of Technology and Licensing has applied for several patents related to Dawson's use of CTV vectors.

Dawson's team is screening genes for one that could be used in the CTV vector to make citrus trees in the field HLB-resistant. Folimonova's team is researching ways to use the vector in trees already infected with CTV, since it is endemic in Florida.

The team will start field testing soon because it received USDA and EPA approval. Finding a gene that resists HLB may take significant time, and if a gene is found, it must undergo rigorous health and environmental tests before it is in production.

"Obtaining proof that this approach is safe and for it to be approved for use in a food crop is a costly hurdle, which will be the focus of other entities of the citrus industry, and will take considerable time," Dawson said. "So it is important that we move as fast as possible to bring it to the next steps so that it will become available for growers in a few years."

> **"So it is important that we move as fast as possible to bring it to the next steps so that it will become available for growers in a few years."**
>
> WILLIAM DAWSON

The project was funded by the Citrus Research and Development Foundation, Inc., an endowment from the J.R. and Addie S. Graves family, and partially funded by the citrus growers and other competitive grants.

T-STAR'S RESPONSE TO EMERGING PATHOGENS

Researchers working to reduce orange rust losses in sugarcane

BY AMANDA AUBUCHON

Dr. Richard Raid, professor of plant pathology, UF's Everglades Research and Education Center, Belle Glade, FL, examines sugarcane leaves for orange rust, caused by *Puccinia kuehnii*.

ORANGE RUST, an airborne fungal disease of sugarcane previously known only in Southeast Asia and Australia, arrived in Florida in 2007, causing yield losses as high as 53 percent in one susceptible cultivar. Since then, University of Florida and USDA researchers have been collaborating to find effective ways to manage the disease.

"It spread pretty much throughout the entire Florida industry within the space of that first year, and because we're growing sugarcane all year round, the fungus is here to stay," said Richard Raid, professor of plant pathology for UF/IFAS.

The fungus, *Puccinia kuehnii*, is an obligate parasite, meaning it requires a living host in order to complete its life cycle and reproduce.

"It takes nutrients that the plant would be utilizing to produce sugar, and it uses those nutrients to produce spores. Eventually, the pathogen kills the leaf tissue and reduces the amount of sugar that forms in the stalk," Raid said.

Researchers have discovered that some sugarcane varieties are more susceptible to orange rust than others. However, because sugarcane is a perennial crop and is replanted only once every three or four years, changing to a more resistant variety is a slow process.

Almost 71 percent of Florida sugarcane acreage is currently planted with cultivars that are susceptible to orange rust. Fortunately, only one, called CL85-1040, is highly susceptible. Through variety trials, during which each variety is rated in terms of its reaction to orange rust, Raid and his colleagues have been trying to ascertain which varieties are more resistant so that growers will know what to plant in the future and whether they need to try to control the rust with low-risk fungicides.

"The growers know they've got a problem, but they don't know the extent of that problem. By quantifying yield loss, growers can then decide how to best manage the disease," Raid said.

> "It spread pretty much throughout the entire Florida industry within the space of that first year . . ." RICHARD RAID

Raid has also been researching chemical control methods that can limit the scope of an outbreak and possibly preserve susceptible varieties until they can be replaced with more resistant ones. Fungicide trials have involved pyraclostrobin and metconazole, compounds recently registered for sugarcane based upon UF research.

"Sugarcane is a resilient crop and doesn't typically require much in the way of chemical intervention," Raid said. "However, since growers cannot switch out varieties in a single year, these registrations have allowed the industry to negate some of the significant losses that would have occurred in their absence."

Raid has been encouraging growers to diversify the varieties they plant to decrease yield loss due to potential new variants of the fungus.

Both now and going forward, the major focus is developing a comprehensive management program that concentrates on resistant varieties, the use of fungicides where warranted, and cultivar diversification, Raid said.

Besides Raid, collaborators on the project include, Jack Comstock, Research Plant Pathologist, USDA and Neil Glynn, Molecular Biologist, USDA, Sugarcane Field Station at Canal Point; and the sugarcane industry. The project is funded through a T-STAR grant, the sugarcane industry and the USDA.

Protecting Florida bromeliads from the Mexican Bromeliad Weevil

BY SUSAN GILDERSLEEVE

Left to right: research associate Teresa Cooper, assistant professor Ronald Cave, and senior bioscientist Bradley Smith, UF's Indian River Research and Education Center, Ft. Pierce, FL, hanging a box of sentinel pineapple tops in a tree at the Oxbow Ecocenter in Port St. Lucie to detect establishment of the parasitic fly *Lixadmontia franki*.

THE INVASIVE Mexican bromeliad weevil, *Metamasius callizona*, arrived in Florida 1989 on an ornamental bromeliad imported from Mexico. Since then, the weevil has crept through southern Florida, from Broward to Volusia, Hillsborough and Pinellas counties, feeding on 12 of our 16 native bromeliad species, in some cases so voraciously that it destroyed local populations. To salvage what remains of the state's bromeliads, researchers Ronald Cave and Teresa Cooper of the Indian River Research and Education Center in Fort Pierce developed a way to mass-rear a natural enemy of the weevil. They are now investigating ways to establish and monitor populations of the weevil's natural enemies in the environment.

Pesticides control the weevil well in nurseries and small, controlled environments, but are useless in the wild. Chemical controls are illegal for use in the parks where bromeliads are under attack. They're also ineffective, Cooper said.

To work, pesticides must be introduced into the center of each bromeliad. Dusted over a large area, chemicals will adhere to the plant's outer parts and never reach the larval weevils gnawing at their hearts. With funding from the Florida Department of Agriculture and Consumer Services and Tropical and Subtropical Agricultural Research program (T-STAR) and with support from the Florida Council of Bromeliad Societies, Cave and Cooper are developing methods to control the weevil in wild landscapes. In 1993 in the cloud forests of Honduras, Cave discovered *Lixadmontia franki*, a new and then-undescribed parasitic fly species. The fly, which Cave named after fellow UF/IFAS researcher Howard Frank, only parasitizes bromeliad-eating weevils. That makes it safe to use because it will not attack beneficial organisms.

> "We can use something that exists in nature to solve a man-made problem."
>
> RONALD CAVE

"We can use something that exists in nature to solve a man-made problem," Cave said.

The work to develop natural enemy populations becomes increasingly crucial as the weevil continues to creep through Florida. It has already encroached upon the Big Cypress National Preserve and Fakahatchee Strand Preserve State Park, two areas with the greatest diversity of bromeliads in the United States. Rare species, some that were once so common they epitomized the subtropical environment of South Florida, are at risk of extirpation. If the bromeliads continue to be decimated, the

state also stands to lose several animal species dependent upon them for habitat, water, and food.

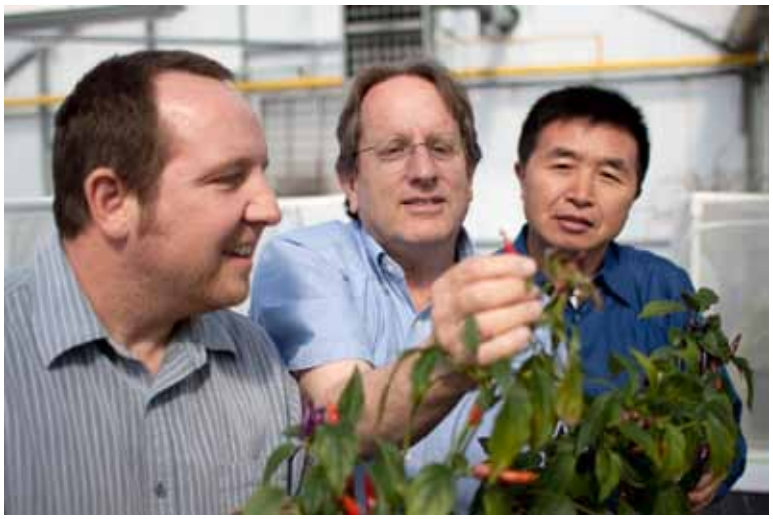
Cooper's laboratory work has revealed much about *L. franki's* biology and life cycle. After it hatches, the fly larva sets off in search of larval weevils nestled inside the bromeliad. When it finds a weevil larva, the immature fly bores into its body and taps into its respiratory ducts to steal air from its host's respiratory system. The weevil dies when the maggot emerges to pupate. Cooper has developed rearing techniques to produce large numbers of the parasitic fly in the lab; now she is working to translate those successes to the field.

The ongoing development of management practices using *L. franki* should allow managers to establish viable populations of these beneficial natural enemies in the field and suppress the weevil sufficiently to allow Florida bromeliads to flourish once again.

Besides Cave and Cooper, other researchers who helped conduct the work included Howard Frank, Barbra Larson, Alonso Suazo and Jorge Salas. The research was funded by T-STAR, the Department of Environmental Protection, Florida Park Service, South Florida Water Management District and the Florida Council of Bromeliad Societies.

Apopka team works to thwart invasive chilli thrips in peppers

BY SUSAN GILDERSLEEVE



Left to right: Drs. Steven Arthurs, assistant professor of entomology; Lance Osborne, professor of entomology; and Jianjun Chen, professor of environmental horticulture, UF's Mid-Florida Research and Education Center, evaluate pepper plants for damage from chilli thrips.

RESEARCHERS AT UF's Mid-Florida Research and Education Center in Apopka have discovered new methods to manage the chilli thrips, *Scirtothrips dorsalis* (Hood), a tiny invader with big potential to threaten crops in Florida. With funding from the Tropical and Subtropical Agricultural Research program (T-STAR), Jianjun Chen, associate professor of plant physiology and a team of researchers are developing new ways to target this pest. The Apopka team's Integrated Pest Management (IPM) toolkit will enable producers to supplement recommended pesticides with improved biological control methods, better breeding techniques to heighten natural resistance and, possibly, cultural practices to enhance pest resistance in greenhouse and field crops.

The chilli thrips is a voracious feeder with an array of hosts, including peppers, strawberries and other food crops, ornamentals like roses, and commodities like cotton. Additionally, chilli thrips may vector viruses destructive to peanut and tobacco. According to a 2006 USDA estimate, the species could cause $3 billion in damage in the United States. Its potential range extends as far as Oregon, and entomologist Steven Arthurs said reports from landscapers indicate the pest is spreading northward within Florida. Entomology professor Lance Osborne added that it is already established on roses growing outdoors in Louisiana. "It can invade fields only in the southern tier states, but in protected agriculture chilli thrips can range across the globe," he said.

> "Chilli thrips is a big issue to the agricultural industry."
>
> JIANJUN CHEN

Chen sums it up succinctly: "Chilli thrips is a big issue to the agricultural industry."

Alternatives to pesticides are desperately needed to prevent their overuse and the associated risk of pesticide resistance.

Seeking new sustainable management strategies, Chen's group screened 158 pepper cultivars and discovered 14 with resistance to chilli thrips.

In pursuit of effective cultural practices for peppers, the team experimented with silicon, an element that strengthens plant cell walls. They discovered that pepper readily bioaccumulated silicon applied to the soil or leaves and showed a slight, though at present inconclusive, increase in resistance.

Research into biological control methods yielded the most promising results. Pirate bugs, *Orius insidiosus*, are the primary biological control in use to combat thrips in Florida's peppers, but the Apopka team found that two species of predatory mites, *Neoseiulus cucumeris* and *Amblyesius swirskii*, also thrive on thrips. They discovered that *A. swirskii* provided better control than *N. cucumeris*, and further determined that *A. swirskii* coexisted well with pirate bugs.

Among the team's innovations is an apparatus invented by post-doctoral research associate Mahmut Dogramaci to transport thrips and mites during controlled experiments from plant to plant. His mini-aspirator moves the insects on a breath of air, greatly improving efficiency and accuracy and leaving the study subjects unharmed. The old way, plucking them up on the tip of a moist watercolor brush, was labor-intensive and harmful to the insects. The mini-aspirator appears poised to become state-of-the-art equipment for any research involving the transport of small arthropods.

Next the team will integrate its discoveries in each aspect of pest management to determine the best combinations of biological control methods, resistant cultivars and cultural practices to control chilli thrips in pepper effectively and sustainably.

Protecting Florida crops from the Red Palm Mite

BY SUSAN GILDERSLEEVE

Dr. Jorge E. Peña, professor of entomology and nematology and Ph.D. student Daniel Carrillo, UF's Tropical Research and Education Center, Homestead, FL evaluating infestations of the red palm mite.

RESEARCHERS WITH UF's Institute of Food and Agricultural Sciences were working to defend Florida crops from the red palm mite for years before the pest even appeared in Florida. The red palm mite, *Raoiella indica*, infests palms, gingers, bananas and several ornamental plant species. Researchers Jorge Peña and Daniel Carrillo, both of the Tropical Research and Education Center in Homestead, worried that an uncontrolled infestation could harm Florida's ornamental plant industry and damage the state's iconic palm trees.

"I knew eventually the mite would get here," Peña said.

To prepare, he traveled to the Caribbean and other areas the pest was already established to find the best way to detect mite populations and estimate population size. In a project funded by the Tropical and Subtropical Agricultural Research program (T-STAR), Peña and his team cooperated with the University of Puerto Rico and the USDA's Animal and Plant Health Inspection Service to develop a procedure standardizing the selection of palms, fronds, and pinnae (the individual leaflets on a palm frond) to examine for mites and quickly find infestations. The new method makes it possible to estimate mite populations accurately from a relatively small

> "We knew what was happening in palms in relation to biological control agents two years before the mite's arrival." JORGE PEÑA

amount of data, reduces the margin of error and allows managers and producers to spot mite infestations early on.

Before the first mite was discovered in a West Palm Beach nursery in late 2007, Peña and colleagues had spent many days in the field combing through the fronds of various species of palms in search of a natural defense against the pest. Fortunately, they found natural enemies already thriving.

"We knew what was happening in palms in relation to biological control agents two years before the mite's arrival," Peña said.

In tropical countries, where infestations can be devastating, rumors of the red palm mite's destructive powers spread as quickly as the mite itself. Soon, an improbably wide range of crops ranging from beans to basil were said to be threatened. To develop an accurate description of the pest and its eating habits, the researchers surveyed palm collections in botanical gardens of Florida and the Caribbean and sorted out which plants were in the pest's host range. They found that thatch palms and many other prized Florida native plants are safe from the mite. And many of the food crops rumored to be vulnerable were not affected: The mite does not feed on beans, basil or durian.

The research findings will assist producers and managers not only in Florida but in other countries battling the pest, indicating where to look for the mite and which crops to protect.

Researchers continued testing and learned that the most effective among the red mite's natural enemies is a phytoseiid mite, *Amblyseius largoensis*.

Now the research has reached the last and most challenging stage: testing *Amblyseius largoensis* under field conditions. Peña and Carrillo are experimenting with pollen, a food source for *A. largensis* that increases its fecundity. They hope to boost populations of the native natural enemy for better red palm mite control in the future.

Besides Peña and Carrillo, the research team included Jose C.V. Rodrigues of the University of Puerto Rico and Amy Roda and Divina Amalin of the USDA's Animal and Plant Health Inspection Service. The research was funded by T-STAR and APHIS PPQ.

UF researchers fight crop-destroying late blight

BY AMANDA AUBUCHON

Dr. Pamela Roberts, professor of plant pathology, UF's Southwest Florida Research and Education Center, Immokalee, FL. prepares tomato tissue to isolate *Phytophthora infestans*, the pathogen causing late blight.

A LONG-ESTABLISHED AND devastating plant disease is taking new forms to survive, and researchers at UF and several institutions in the U.S. and around the world are collaborating to combat it.

In Florida, late blight, caused by the fungal-like organism *Phytophthora infestans*, occurs on tomatoes and potatoes during winter and leads to decay and crop loss. An outbreak and subsequent epidemic in 2005 led to the discovery that novel genotypes had emerged, resulting in new efforts to control the disease.

> "Literally millions of dollars are spent to control [late blight] worldwide."
>
> — PAM ROBERTS

"Historically, it's probably one of the most important plant diseases in the world because of its destructiveness to plants and the devastation in crop losses that it causes," said Pam Roberts,

a professor with UF's plant pathology department. "It's so very important in today's market. Literally millions of dollars are spent to control it worldwide."

Collaborating with fellow researchers from the USDA, Cornell University, North Carolina State University, the Scottish Crop Research Institute and Glades Crop Care, Inc., Roberts and her colleagues are working on several approaches to control the latest incarnations of the disease. The group began by using DNA fingerprinting and other techniques to characterize the new genotypes and to document that the pathogen is changing.

"We've had three major genotype changes since 2005, and we're also detecting some smaller unique genotypes in the populations," Roberts said.

Researchers are also working to understand the epidemiology of the disease, trying to determine where the inoculum is coming from, why the blight occurs regularly every winter, and what the driving forces are behind the new genotypes, she said. Researchers will conduct spore-trapping experiments in hopes of detecting the disease early and tracking sporangia movement.

"A number of different plants have been reported to be infected by *P. infestans*, including petunia and weeds, such as nightshade," Roberts said. "We're looking at some of those sources to see if we can detect it and see if they're an important source of inoculation."

Fungicides and fungicide regimes are also undergoing testing. Fungicide must be applied before late blight is present to be effective, she said. Fungicide use on U.S. potato crops costs more than $75 million a year, and chemical control for tomato crops can cost up to $150 per acre. To help producers know when to apply fungicide, Roberts will be working with Cornell to adapt its Web-based decision support model to Florida conditions.

Roberts and her colleagues have also been observing late blight in tomato lines with documented resistance genes to see if the plants would be resistant to late blight in Florida. They'll soon be studying resistant potato varieties as well.

"The important thing is that, even though it's an old disease, it's still very economically important," Roberts said. "It's still a major problem in terms of control under certain situations. The pathogen's dynamic. It's changing. We're trying to develop all of this information to develop new management tools and reduce the cost of inputs, such as fungicide applications, every year."

Besides Roberts, the research team includes Glades Crop Care , Inc.; Shouan Zhang, assistant professor in Plant Pathology at Tropical REC in Homestead; Ken Deah of USDA Maryland; Jean Ristaino of North Carolina State University; Bill Fry of Cornell University and David Cooke of the Scottish Crop Research Institute.

The research has been funded by the Tomato Committee, T-STAR, a Specialty Crop Block Grant and Northeastern IPM. The team has applied for a USDA grant.

University of Florida Research Foundation Professors (UFRF)

MADAN OLI, PH.D.

Associate Professor of Wildlife Ecology and Conservation

MADAN OLI seeks to understand factors and processes that influence the dynamics, regulation, and persistence of wildlife populations. His research addresses both theoretical questions and practical solutions to ecological problems using a combination of ecological theory, mathematical/statistical models, and field data.

The Florida panther is one of the most endangered species of mammals in the US and a flagship conservation species in Florida. By the 1990s, the panther population was reduced to 20-25 adults, with strong evidence of inbreeding depression. To address this problem, 8 Texas puma females were released into the Florida panther habitat. Oli and his collaborators are investigating the effects of this genetic introgression on the panther population, and evaluating the viability of the Florida panthers.

Using the Florida black bear and the Asian elephant as model systems, Oli is also investigating how human-caused loss and habitat fragmentation influence the dynamics and genetic structure of wildlife populations. Oli's findings suggest that habitat fragmentation reduces genetic variability, gene flow, and population growth rates of the Florida black bears. Oli and his colleagues are also investigating environmental causes and population dynamic consequences of declines in a population of northern bobwhite quail. Results show that hunting is the most important cause of bobwhite mortality, and suggest that excessive hunting is likely an important cause of bobwhite population declines.

Population dynamics are driven by demographic variables, and many studies have sought to quantify how population growth rates respond to naturally occurring or human-caused perturbations. Oli and his collaborators have discovered the important role of some key demographic variables to population growth rates, and have devised a method that allows identification of demographic parameters that should be targeted for conservation purposes based on minimal data.

There are some striking similarities between processes governing the growth, dispersal, and persistence of natural populations and the initiation and progression of cancers such as brain tumors. Oli is collaborating with UF neuroscientist Dr. Brent Reynolds to understand the population ecology of brain tumors. The ultimate goal of the proposed project is to develop tolerable, non-toxic interventions that allow control of brain tumor growth using an ecologically-based adaptive therapeutic approach.

MICHAEL DUKES, PH.D.

Associate Professor of Agricultural and Biological Engineering

MICHAEL DUKES' research focuses on the development and evaluation of the best technologies for irrigation control for optimum crop yield or high landscape quality while achieving maximum water conservation. Dukes and his research group have been investigating irrigation control technologies that deliver irrigation water in the right amount and at the right time based on measurements of soil moisture content or weather variables such as temperature, humidity, rainfall, etc.

Dukes found that during normal Florida rainfall periods, landscape irrigation can be reduced by as much as 72%, and up to 54% during very dry periods when most water needs are supplied by irrigation. In addition, Dukes and his group have shown that soil-moisture-sensor-based irrigation on homes in southwest Florida irrigated 65% less than their neighbors without any adverse effect on their landscape quality. The success of these "smart" controllers at conserving water has led to the passage of Florida Senate Bill 494 into law in 2009, which promotes incentives for "smart" irrigation technologies.

Under vegetable production, Dukes' research has shown that irrigation can be reduced up to 50% while maintaining or increasing crop yield. In addition, he has shown that allowing the plants to control the irrigation leads to much more efficient use of fertilizers and less fertilizer lost to the environment. This finding will become even more important in the future as environmental regulations increase and impact agricultural practices.

Dukes' research has been supported by $6.2 million in external research funding over the last five years. The projects led to the mentoring and education of 14 graduate students, six of them at the Ph.D. level. In addition, he has been serving on nine other graduate committees. This research has also led to 39 peer-reviewed journal publications, 95 other publications, 48 invited lectures, and 148 contributed talks in the past five years. Dukes regularly speaks throughout the U.S. and internationally as a recognized expert on the state of the art in irrigation scheduling and control.

SABINE GRUNWALD, PH.D.

Professor of Soil and Water Science

SABINE GRUNWALD'S current research is focused on carbon dynamics and modeling of terrestrial carbon at various spatial scales. The overall goal is to assess the effects of land use and climate change on soil carbon stocks, giving special attention to translating site-specific carbon pools to large landscape scales. Historic, current, and future carbon stocks are predicted using a combination of soil and remote sensors field sampling, geostatistical, and geospatial upscaling methods.

Quantifying carbon sources/sinks and ecosystem processes that modulate the global carbon cycles are critical to identifying imbalances and counteracting global climate change. Soil organic carbon (SOC) patterns are dynamic in space and dependent on a system of environmental and anthropogenic drivers. Grunwald's research is focused to identify both the critical points at which SOC predictions shift from linear to non-linear process behavior and the soil and environmental factors and spatial distribution patterns that are causing such behavior to occur.

In Grunwald's research of the Santa Fe River Watershed (SFRW), spatially-explicit relationships between soil carbon and labile, recalcitrant, and mineralizable carbon, nitrogen (N) and fractions, phosphorus (P) and fractions, and numerous environmental landscape properties (e.g., land use, spectral indices, topography, climate, and hydrology) were modeled to better understand interactions between C, N and P biogeochemical cycles and ecosystem processes. A remote-sensing-based land use change trajectory analysis, coupled with a carbon-landscape model, assessed the impact on carbon storage across the watershed.

Grunwald's research team assessed spatial patterns of various biophysical soil properties including P, N, and metals in various aquatic and mixed land use systems impacted by multiple stressors causing soil and water quality degradation. Pedometric methods, geographic information systems (GIS), and remote sensing were used to model spatio-temporal patterns. In addition, her team developed and validated a mechanistic model (OntoSim) to simulate water flux and P transport using an ontology-based modeling approach.

KEVIN FOLTA, PH.D.

Associate Professor of Horticultural Sciences

KEVIN FOLTA'S laboratory activities extend from two broad research interests. The first is how light interacts with plants to tailor development and physiology to best match environmental conditions. The second derives from the newly emerging analysis of the strawberry (*Fragaria* spp.) genome.

Folta's work specifically addresses how green light signals, thought to be developmentally benign, steer a specific suite of plant responses that govern acclimation to ambient conditions. The work is performed using LED lighting modalities that permit precise mixing of various light qualities, coupled to powerful imaging technology. The goal is to define how these signals are transduced and integrated to control plant responses to the environment.

A separate program studies strawberry genomics. The strawberry genome is relatively small (on par with Arabidopsis), the plant cycles from seed to seed rapidly, can be easily transformed and will be fully sequenced in 2010 via a consortium led in part by UF. A major goal of Folta's project is to functionally characterize novel genes from strawberry and the Rosaceae family, which includes valuable fruit, nut, ornamental, and lumber crops. The hypothesis is that these highly cultivated plants maintain novel regulators that support the traits of economic interest. Currently, new genes affecting root growth, flowering time, flower structure, and leaf development have been identified and are being further characterized.

Both major projects are supported by the NSF, with other work previously supported by the USDA and strawberry growers' organizations. Folta has brought in over $2 million in extracurricular funding over the past five years.

Folta has been recognized with a Howard Hughes Medical Institute Distinguished Mentor of Undergraduate Research award (2007) and the National Science Foundation early faculty CAREER award (2008). He has supported many visiting international scientists, postdoctoral students, and graduate students, and maintains a special emphasis on undergraduate research efforts.

University of Florida Research Foundation Professors (UFRF)

JULIE MAUPIN-FURLOW, PH.D.

Professor of Microbiology and Cell Science

JULIE MAUPIN-FURLOW has an internationally recognized research program that addresses both fundamental and applied processes of archaea, using genetics, proteomics, and biochemistry. Most recently, her lab group is examining how the proteasome-ubiquitin system functions in protein quality control and the regulation of cellular processes in archaeal cells. She is also working on the metabolic engineering of archaea to produce useful chemicals and fuels from renewable resources including the metabolism of biodiesel waste and lignocellulosics, as well as the biochemistry and synthesis of industrially relevant enzymes such as alpha-keto acid decarboxylases and multicopper oxidases. These studies are funded through NIH and DOE research grants.

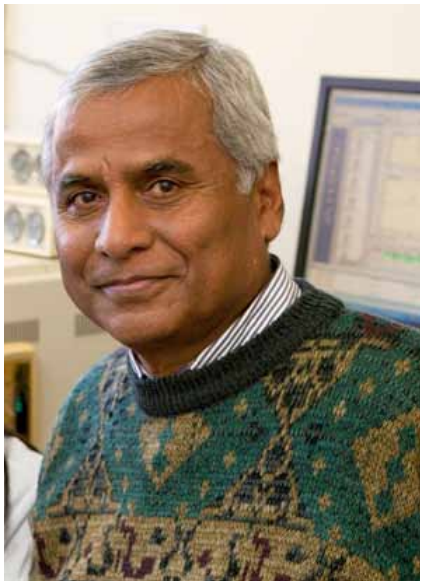
Maupin-Furlow was co-chair of the 2009 Gordon Research Conference Archaea: Ecology, Metabolism & Molecular Biology and is a member of the UF Florida Center for Renewable Chemicals and Fuels; Genetics Institute; Center for Structural Biology; Mass Spectrometry Users Group; Signaling, Apoptosis, & Cancer Program; and the Science for Life Howard Hughes Medical Institute Team.

Maupin-Furlow is involved in research focused on microbial cells and the structure and function of their enzymes. Grants and contracts from NIH and DOE awarded to Maupin-Furlow over the last five years total over $3 million. Maupin-Furlow has also served as a member of review panels, including those for NSF, DOE, NIH, NASA, and USDA NRI and has served as panel manager for the USDA NRI, Biobased Products, and Bioenergy Production Research Program 71.2 (2007 and 2008).

She has reviewed manuscripts for 29 research journals and now serves as member of the editorial boards for the Journal of Bacteriology and Saline Systems, as well as guest editor for a special issue of *Archaea*. She is recognized for her outstanding mentorship of undergraduate and graduate students, including Dr. Aaron Kirkland's and Dr. Matthew Humbard's receipt of the IFAS Award of Excellence for Best Doctoral Dissertation (2007 and 2009, respectively). Maupin-Furlow has 45 peer-reviewed publications, 87 research abstracts, 41 invited lectures and 2 patents (one issued and one pending) on microbial biochemistry and physiology. Her recent discovery of small archaeal protein modifiers (SAMPs) of the ubiquitin/beta-grasp fold superfamily, published in Nature, provides new insight into the origins of ubiquitin-conjugation systems and their association with proteasomes.

K. RAMESH REDDY, PH.D.

Professor of Soil and Water Science



K. RAMESH REDDY conducts research on biogeochemical cycling of nutrients in wetlands and aquatic systems. Reddy's areas of expertise and research include biogeochemistry, wetlands and aquatic systems, soil and water quality, and ecosystem restoration. Reddy is a Graduate Research Professor and Chair of the Soil and Water Science Department at UF.

As department chair, Reddy provides leadership to faculty, staff, and students in carrying out the UF/IFAS mission in light of the Land Grant philosophy, developing a set of policies, and promoting department programs in instruction, research, extension, and service. Reddy conducts research on coupled biogeochemical cycling of carbon, nitrogen, phosphorus, and sulfur in natural and managed ecosystems as related to water quality, carbon sequestration, and greenhouse gas emissions. His early research as a biogeochemist focused on the fate of nutrients in flooded rice paddies, followed by applying biogeochemical principles to study nutrient/contaminant behavior in various ecosystems, including freshwater and coastal wetlands and lakes, as related to water quality and eutrophication.

Reddy has served on numerous advisory committees at state, national, and international levels. Reddy's select awards and honors include UF Doctoral Dissertation Advisory/Mentoring Award (2005); Fellow, World Innovation Foundation (2004); Environmental Quality Research Award, American Society of Agronomy (2002); Sigma Xi Senior Faculty Research Award (2002); Soil Science Applied Research Award, Soil Science Society of America (2001); Fellow, American Association for the Advancement of Science (2001); Florida Research Foundation Professor (1999-2002); Fellow, Soil Science Society of America (1988); Fellow, American Society of Agronomy (1988); and Gamma Sigma Delta International Award (2006).

Reddy's long-term goals are to develop biogeochemical indicators for routine use to evaluate pollutant impacts in wetlands and aquatic systems, develop tools to extrapolate process-level information to a wide range of spatial and temporal scales for use in restoration and management of wetlands and aquatic systems, integrate process level information into policy development and regulation, and promote interdisciplinary teaching, research, and extension programs with other disciplines.

Richard L. Jones New Faculty Research Awardees

Dr. Richard Jones

We hold our future in the energy, commitment and dreams of our youngest faculty. To honor them, UF/IFAS presented the third annual Richard L. Jones Outstanding New Faculty Research Award at the May 20, 2010 Florida Agricultural Experiment Station Awards ceremony. This competitive research award is presented to untenured faculty who have begun developing a distinguished record of research. The purpose of this award is to recognize research program development and recent contributions, and to provide incentives for continued excellence in research.

DR. RICHARD JONES served as Dean for Research from 1995 to 2004. In recognition of his outstanding service to the Experiment Station and to UF/IFAS, the award was endowed and initiated in his name. This year's awardees were Dr. Bielinski Santos and Dr. Matthew Cohen.

Dr. Bielinski Santos

DR. BIELINSKI SANTOS is an assistant professor in the Department of Horticultural Science located at the Gulf Coast Research and Education Center. Santos' research program ensures that Florida has a future in sustainable crop production. His research is off to an excellent start with graduate students and over $1 million dollars in grants. Since arriving at the University of Florida, he has 33 publications to his credit in a variety of refereed journals ranging from *Crop Protection* to the *Journals of Agronomy and Horticultural Science*.

His research areas include:

- Commercial vegetable production
- Small fruit production systems
- Fertilization and water management
- Soil fumigation

Some recent projects:

- Determining irrigation volumes and frequencies and N fertilization
- Reducing water consumption in mulched tomato and pepper fields
- Application efficiency of drip-applied methyl bromide alternatives
- Characterizing N fertilizer usage and leaching in tomato fields

Dr. Matthew Cohen

DR. MATTHEW COHEN is an assistant professor in the School of Forest Resources and Conservation. Cohen represents the leading edge of UF/IFAS research in ecosystems hydrology and water quality — critical areas where UF/IFAS science makes a difference. He has garnered nearly $5 million dollars in grants, currently mentors 9 graduate students, and has published in prestigious journals such as *Forest Science*, *Ecological Modelling* and the *Journal of Environmental Quality*.

His research areas include:

- Watershed science and water quality
- Ecosystems ecology in springs and wetlands
- High-resolution measurement technology

Some recent projects:

- Monitoring and assessment plan for the greater Everglades wetlands
- Seasonal controls for stream-riparian groundwater exchange in headwater catchments
- Spatial nutrient loading in the Newnans Lake watershed
- Determining the age of Ichetucknee Springs water

Florida Foundation Seed Producers, Inc. welcomes new executive director

John C. Beuttenmuller

IN JULY 2010, John Beuttenmuller was named executive director of the UF direct-support organization and not-for-profit corporation, Florida Foundation Seed Producers Inc., or FFSP.

Beuttenmuller continues his earlier work as the germplasm manager and director for the marketing and licensing of new UF/IFAS plant and crop varieties developed and released by the Florida Agricultural Experiment Station. In the new role, he oversees breeding programs for more than 40 crops and a 750-acre seed stock farm and seed processing facility in Marianna.

FFSP seeks patents for UF/IFAS cultivars through the U.S. Patent and Trademark Office and plant variety protection certificates through the USDA's Plant Variety Protection Office. It also works with UF's Office of Licensing and Technology to manage technologies protected under utility patents and incorporated in new plant varieties.

"Our goal is to take new plant varieties from the breeding programs at UF/IFAS, and to increase stocks of those varieties so there are commercially available quantities for Florida growers," Beuttenmuller said.

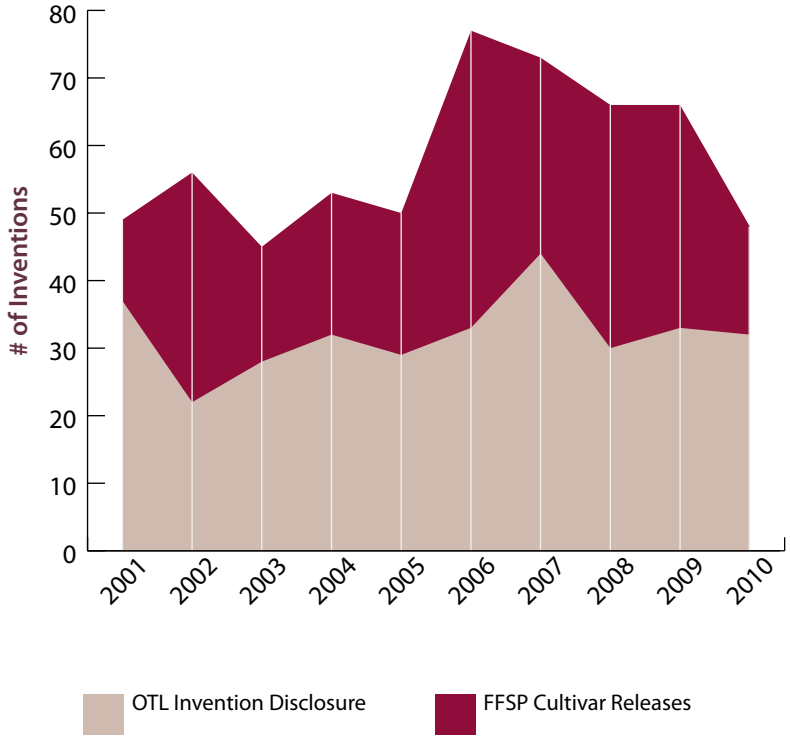
While some universities are scaling down plant breeding, the IFAS program remains on an upward track. Licensing revenues increased to $3.78 million in 2009-2010, a $200,000 jump from the year before. This year, FAES released 16 cultivars, and the Office of Licensing and Technology had 32 invention disclosures from IFAS. Since 2001, IFAS inventions and cultivars have generated more than $37 million in license revenues. In the case of license revenues generated by FFSP, 70 percent of royalties go back into research, fueling the IFAS breeding program's success.

Before a variety enters the marketplace, researchers rigorously test its performance in different climates and soil types. If a cultivar proves successful, it must be approved by multiple committees before it is released to FFSP. Once released, FFSP files for intellectual property protection. If a cultivar may be of interest to a single entity, FFSP leads an Invitation to Negotiate (ITN) process, which ensures that all exclusive licensing decisions are made in the best interest of the state of Florida and its people, UF/IFAS and the developing breeding program.

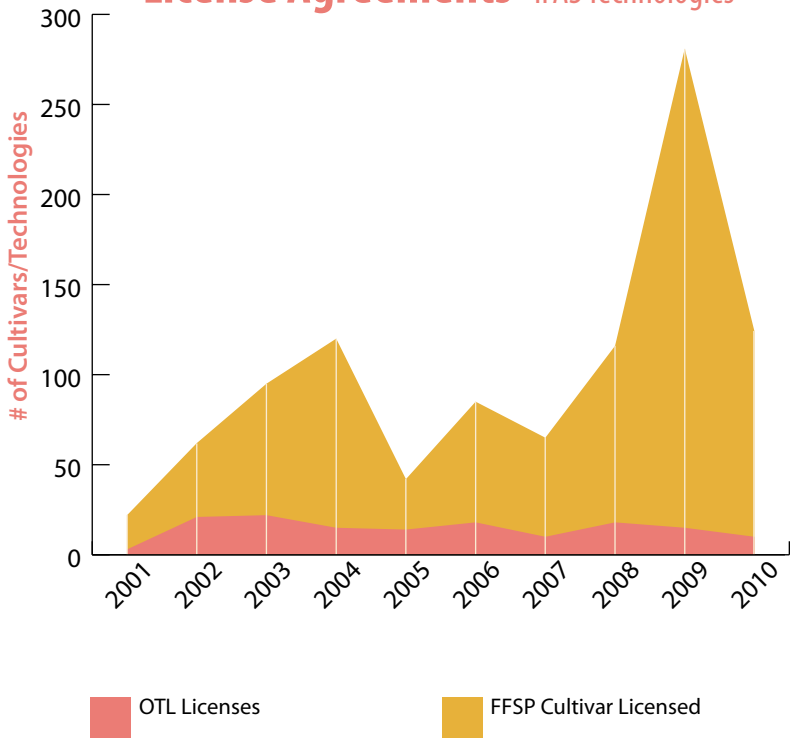
Significant FFSP releases this year include six varieties of powdery mildew-resistant gerbera daisy developed by Zhanao Deng at the Gulf Coast Research and Education Center and a new, low-chill southern highbush blueberry cultivar, Meadowlark FL01-173, developed by plant breeder Paul Lyrene. Deng, who also patented three caladium cultivars this year, said patenting cultivars benefits researchers as well as producers and consumers.

IFAS Patents and Licenses

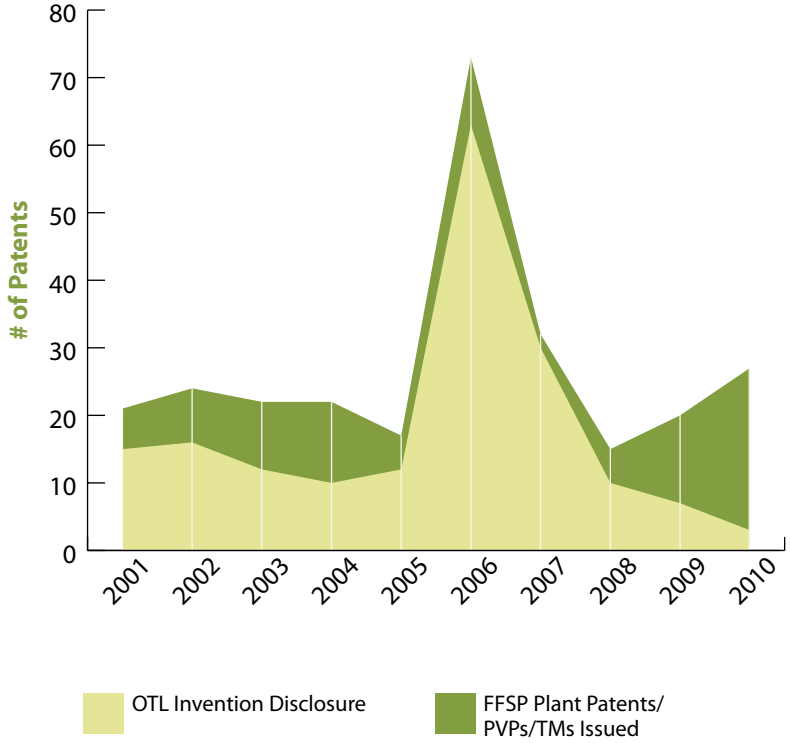
IFAS Inventions



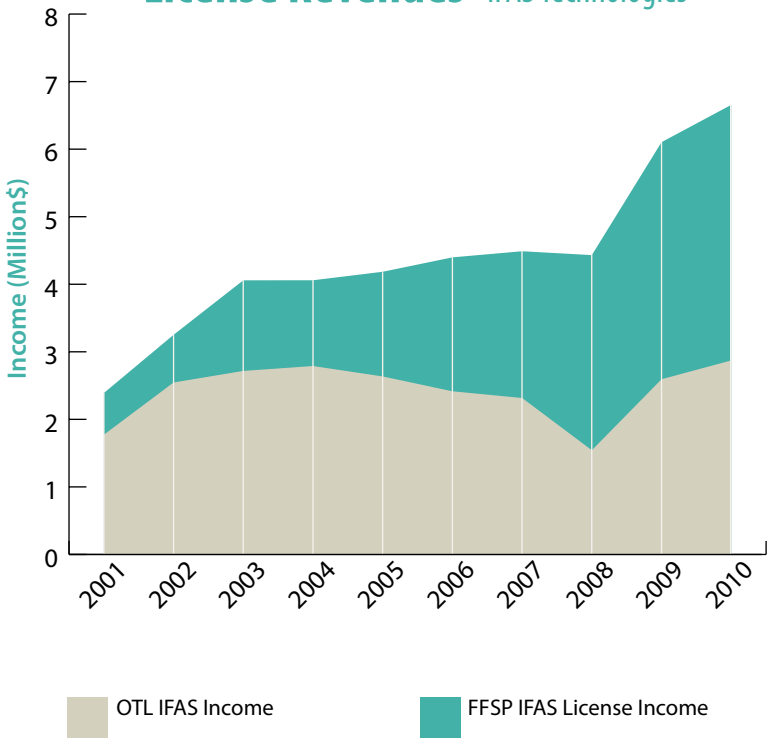
License Agreements - IFAS Technologies



IFAS U.S. Patents Issued



License Revenues - IFAS Technologies



Welcome New IFAS Research Faculty

NEW FACULTY IN THEIR AREA OF EXPERTISE

Calvin Odero

Lincoln Zotarelli

Susan Cameron

DAMIAN ADAMS
Assistant Professor
Forest Resources and Conservation
SPECIALTY: Nature resource economics and policy

BARRY ALTO
Assistant Professor of Entomology
Florida Medical Entomology Lab
SPECIALTY: Mosquito ecology, arbovirology

SENTHOLD ASSENG
Assistant Professor
Agricultural and Biological Engineering
SPECIALTY: Crop modeling

DONALD BEHRINGER
Assistant Professor
School of Forest Resources and Conservation
SPECIALTY: Marine ecology and diseases

SUSAN CAMERON
Assistant Professor
Wildlife Ecology and Conservation
SPECIALTY: Climate change ecology, reserve design and conservation planning, GIS and spatial modeling, tropical biodiversity and biogeography

SOONKYU CHUNG
Assistant Professor
Food Science and Human Nutrition
SPECIALTY: Obesity and inflammation in human adipose tissue

NICHOLAS DILORENZO
Assistant Professor of Animal Sciences
North Florida Research and Education Center
SPECIALTY: Beef cattle nutrition

PETER DITTMAR
Assistant Professor
Horticultural Sciences
SPECIALTY: Weed science

NEW FACULTY CONT'D

NICHOLAS DUFAULT
Assistant Professor
Plant Pathology
SPECIALTY: Vegetable and agronomic plant pathology

STEFAN GERBER
Assistant Professor
Soil and Water Science
SPECIALTY: Landscape biogeochemistry

SAMUEL HUTTON
Assistant Professor of Horticultural Sciences
Gulf Coast Research and Education Center
SPECIALTY: Vegetable breeding

HAYK KHACHATRYAN
Assistant Professor of Food and Resource Economics
Mid-Florida Research and Education Center
SPECIALTY: Economics of renewable energy, transportation economics, regional planning, marketing, as well as spatial econometrics and industrial organization

BRYAN KOLACZKOWSKI
Assistant Professor
Microbiology and Cell Science
SPECIALTY: Computational biology

KAI LORENZEN
Professor
Forest Resources and Conservation
SPECIALTY: Integrative fisheries sciences

HUANGJUN LU
Assistant Professor of Horticultural Sciences
Everglades Research and Education Center
SPECIALTY: Genetic improvement of lettuce and development of St. Augustine grass cultivars

ERIC MCLAMORE
Assistant Professor
Agricultural and Biological Engineering
SPECIALTY: Physiological sensors for bioenvironmental, agricultural, and biomedical research

ROBERT MCCLEERY
Assistant Professor
Wildlife Ecology and Conservation
SPECIALTY: Conservation and ecology of mammals, urban ecology, wildlife management

D. CALVIN ODERO
Assistant Professor of Agronomy
Everglades Research and Education Center
SPECIALTY: Weed Science

MATHEWS PARET
Assistant Professor of Plant Pathology
North Florida Research and Education Center
SPECIALTY: Vegetable and ornamental plant production diseases

DIANE ROWLAND
Associate Professor
Agronomy
SPECIALTY: Physiology

RONALD SCHNELL
Associate Professor of Agronomy
West Florida Research and Education Center
SPECIALTY: Cropping systems

HUGH SMITH
Assistant Professor of Entomology
Gulf Coast Research and Education Center
SPECIALTY: Integrated pest management of vegetable and ornamental crops, biological control, Hispanic outreach for IPM

ZHAOHUI TONG
Assistant Professor
Agricultural and Biological Engineering
SPECIALTY: Bioenergy

DIEGO VALDERRAMA
Assistant Professor
Food and Resource Economics
SPECIALTY: Environmental and natural resource economics, fisheries and aquaculture economics

JIANPING WANG
Assistant Professor
Agronomy
SPECIALTY: Genomics

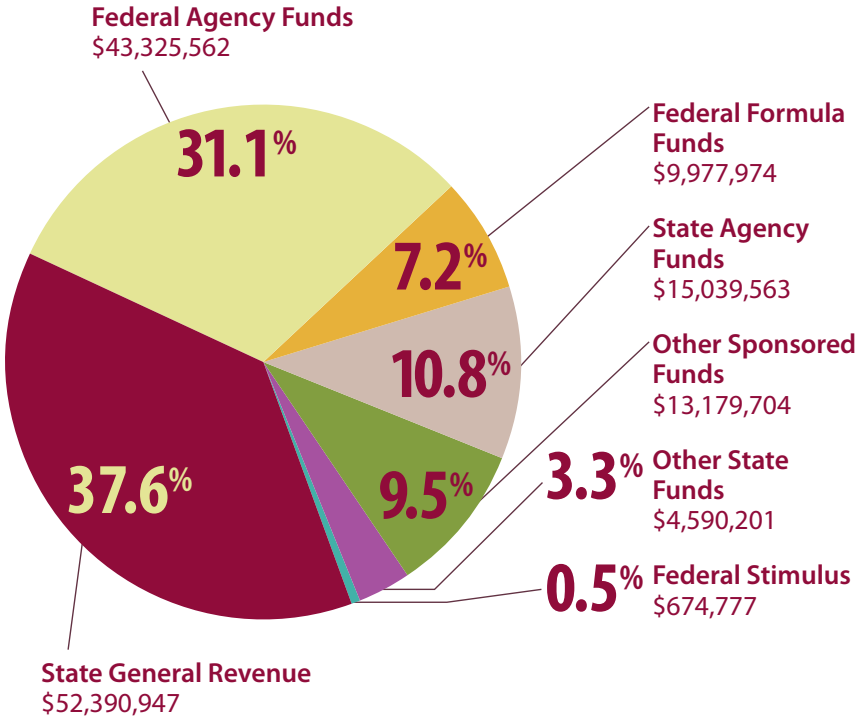
STEPHANIE WOHLGEMUTH
Assistant Professor
Animal Sciences
SPECIALTY: Cellular quality control mechanisms and mitochondrial bioenergetics

LINCOLN ZOTARELLI
Assistant Professor
Horticultural Sciences
SPECIALTY: Vegetable Production

Research Expenditures by Source of Fund

State Fiscal Year 2009-2010

(NOTE: This is not an accounting document)



SOURCE OF FUNDS	EXPENDITURE	TOTAL
Federal Formula Funds		
Hatch	$3,094,764	
Smith Lever	$5,818,859	
Multi-State	$937,716	
McIntire-Stennis	$126,635	
		$9,977,974
Federal Stimulus	$674,777	
		$674,777
State General Revenue		
General Revenue	$52,390,947	
		$52,390,947
Federal Agency Funds		
Federal Flow Through — State of Florida Agencies	$223,271	
National Aeronautics and Space Administration (NASA)	$833,112	
National Institute of Health (NIH)	$4,400,116	
National Science Foundation (NSF)	$3,580,478	
U. S. Army	$3,046,469	
U. S. Department of Agriculture (USDA)	$21,974,777	
U. S. Department of Commerce	$1,447,977	
U. S. Department of Energy	$1,860,452	
U. S. Department of Interior	$3,419,593	
U. S. Environmental Protection Agency (EPA)	$1,771,186	
All Other Federal Agencies	$768,131	
		$43,325,562
State Agency Funds		
Florida Department of Agriculture and Consumer Services (FDACS)	$5,332,152	
Florida Department of Citrus (FDOC)	$6,179,401	
Florida Department of Environmental Protection (FDEP)	$1,516,755	
Florida Department of Transportation	$306,311	
Florida Fish and Wildlife Conservation Commission	$1,681,093	
All Other State Agencies	$23,851	
		$15,039,563
Other State Funds		
Water Management Districts	$3,193,701	
Other	$1,396,500	
		$4,590,201
Other Sponsored Funds		
Counties	$2,224,443	
Foreign Governments	$61,604	
Foreign — Other	$682,640	
Foundations	$1,556,596	
Corporations	$3,082,888	
Miscellaneous — Other	$2,572,442	
Non-Profit Organizations	$1,895,826	
University of Florida Research Foundation (UFRF)	$1,103,265	
		$13,179,704
GRAND TOTAL		**$139,178,728**

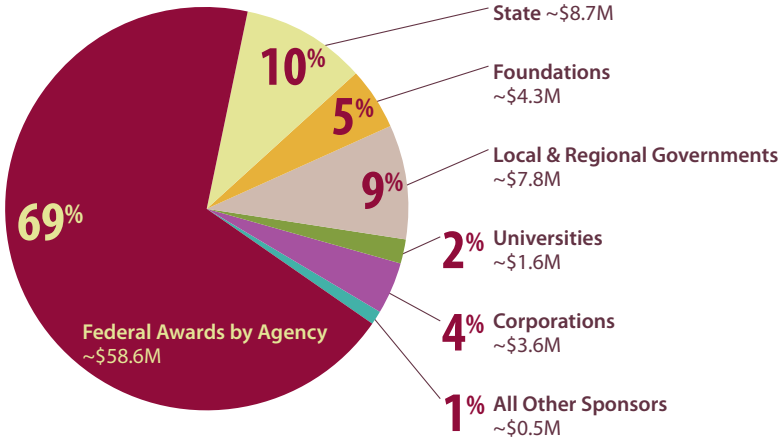
Summary of IFAS Sponsored Research Activity

Total Sponsored Research Funding FY 09-10

~$85.29M

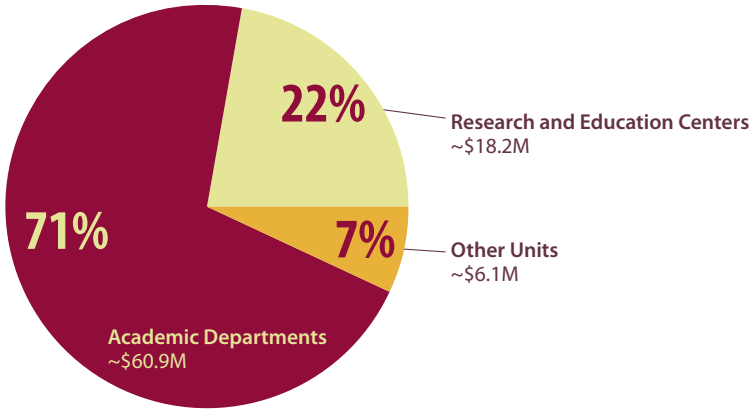
Awards Received	962
New Awards	724
Renewals	9
Continuations/Supplementals	229

IFAS Research Awards by Sponsors



IFAS Sponsored Research Awards by Unit

(~$85.29M)



Federal Awards by Agency

~$58.6M , 69%

National Aeronautics and Space Administration	$1.51M
National Science Foundation	$4.43M
U. S. Department of Energy	$3.16M
U. S. Environmental Protection Agency	$1.87M
U. S. Department of Agriculture	$33.62M
U. S. Department of Interior	$3.66M
U. S. Department of Commerce	$1.49M
U. S. Department of Health and Human Services	$6.32M
U. S. Department of Defense	$1.50M
Other Federal Agencies	$1.09M

Academic Departments

$~60.9M, 71%

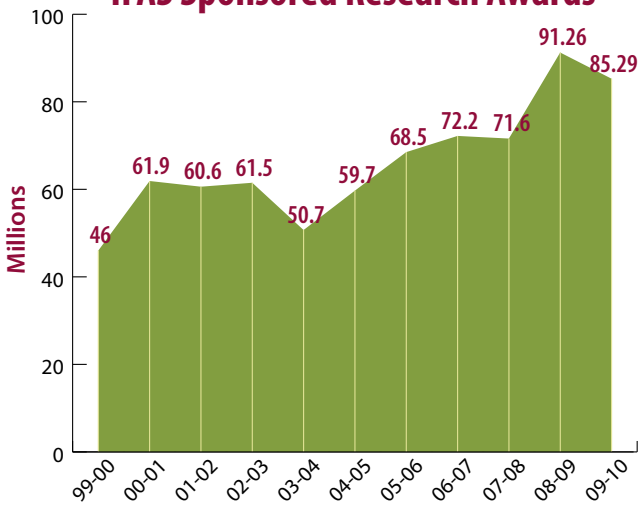
Agricultural and Biological Engineering	$5.12M
Agricultural Education and Communication	$0.58M
Agronomy	$2.22M
Animal Science	$2.17M
Aquatic and Invasive Plants	$1.38M
Entomology and Nematology	$3.53M
Environmental Horticulture	$1.38M
Family, Youth and Comm. Science	$5.25M
Food and Resource Economics	$0.74M
Food Science and Human Nutrition	$9.18 M
Forest Resources and Conservation	$9.02M
Horticultural Sciences	$6.74M
Microbiology and Cell Science	$5.20M
Plant Pathology	$2.14M
Soil and Water Sciences	$2.47M
Statistics	$0.59M
Wildlife Ecology and Conservation	$3.21M

Research & Education Centers

$~18.2M, 22%

Citrus	$4.81M
Everglades	$0.99M
Florida Medical Entomology	$0.23M
Ft. Lauderdale	$1.85M
Gulf Coast	$0.82M
Indian River	$2.27M
Mid Florida	$0.80M
North Florida	$1.38M
Range Cattle	$0.13M
Southwest Florida	$1.50M
Tropical	$3.00M
West Florida	$0.46M

IFAS Sponsored Research Awards



UF/IFAS Statewide Research and Education Network

ACADEMIC DEPARTMENTS (GAINESVILLE, FL)

Agricultural and Biological Engineering
Agricultural Education and Communication
Agronomy
Animal Sciences
Entomology and Nematology
Environmental Horticulture
Family, Youth and Community Sciences
Food and Resource Economics
Food Science and Human Nutrition
Horticultural Sciences
Microbiology and Cell Science
Plant Pathology
Soil and Water Science
Statistics
Wildlife Ecology and Conservation

ACADEMIC SCHOOLS

School of Forest Resources and Conservation
School of Natural Resources and Environment (SNRE)

GRADUATE RESEARCH PROGRAMS

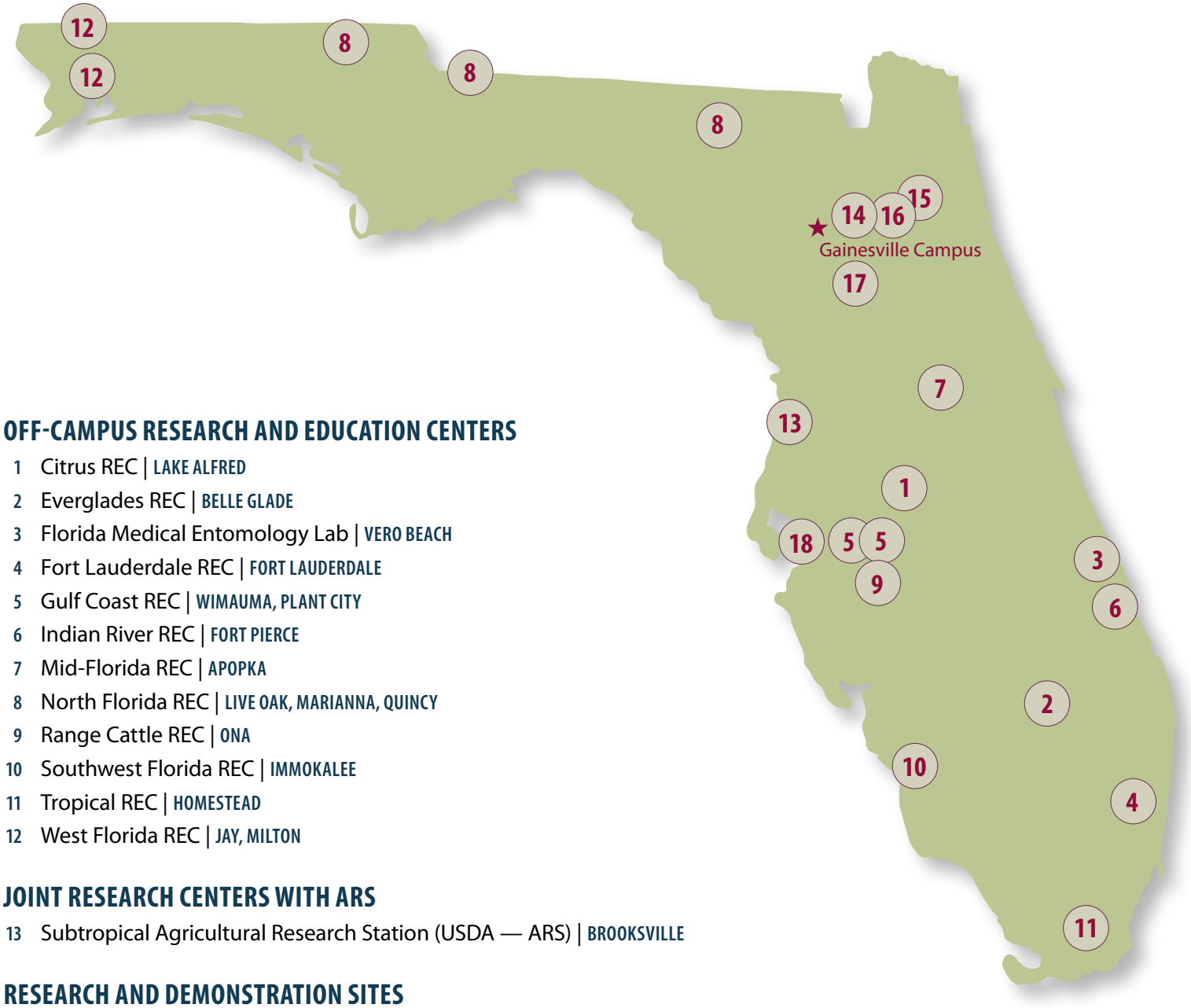
Plant Molecular and Cellular Biology Graduate Program
Animal Molecular and Cellular Biology Graduate Program

MULTIDISCIPLINARY PROGRAMS (GAINESVILLE, FL)

Carbon Resources Science Center
Center for Agricultural and Natural Resource Law
Center for Aquatic and Invasive Plants
Center for Cooperative Agricultural Programs | FAMU
Center for Food Distribution and Retailing
Center for Nutritional Sciences
Center for Organic Agriculture
Center for Remote Sensing
Center for Renewable Chemicals and Fuels
Center for Subtropical Agroforestry
Center for Tropical Agriculture
Energy Extension Service
The Florida Climate Institute
Florida Organics Recycling Center for Excellence | FORCE
Florida Sea Grant
Interdisciplinary Center for Biotechnical Research | ICBR
International Agricultural Trade and Policy Center
International Programs
Program for Resource - Efficient Communities
Tropical and Subtropical Agriculture | T-STAR
UF Juice and Beverage Center
UF Herbarium | FLAS
Water Institute
Wedgworth Leadership Institute for Agriculture and Natural Resources

SUPPORTED COLLEGES (GAINESVILLE, FL)

College of Agricultural and Life Sciences
College of Veterinary Medicine



OFF-CAMPUS RESEARCH AND EDUCATION CENTERS

1 Citrus REC | LAKE ALFRED
2 Everglades REC | BELLE GLADE
3 Florida Medical Entomology Lab | VERO BEACH
4 Fort Lauderdale REC | FORT LAUDERDALE
5 Gulf Coast REC | WIMAUMA, PLANT CITY
6 Indian River REC | FORT PIERCE
7 Mid-Florida REC | APOPKA
8 North Florida REC | LIVE OAK, MARIANNA, QUINCY
9 Range Cattle REC | ONA
10 Southwest Florida REC | IMMOKALEE
11 Tropical REC | HOMESTEAD
12 West Florida REC | JAY, MILTON

JOINT RESEARCH CENTERS WITH ARS

13 Subtropical Agricultural Research Station (USDA — ARS) | BROOKSVILLE

RESEARCH AND DEMONSTRATION SITES

14 Austin Cary Memorial Forest
15 Florida Partnership for Water, Agricultural and Community Sustainability | HASTINGS
16 Ordway-Swisher Biological Station (OSBS)
17 Plant Science Research and Education Unit | CITRA
18 Tropical Aquaculture Laboratory | RUSKIN

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