INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES

2006 Annual Research Report

FLORIDA AGRICULTURAL EXPERIMENT STATION

UF | UNIVERSITY of FLORIDA

The Foundation for The Gator Nation

NOTE FROM THE DEAN FOR RESEARCH

Welcome to Florida's Agricultural Experiment Station. With almost 1000 faculty across 17 disciplines, 13 Research and Education Centers and 67 counties, we offer an extraordinary breadth of science for agricultural, natural resources and human systems. Our faculty is at the core of this science—together, they define our capacity, our vision and our direction. This annual report is a collection of articles reflecting some of the groundbreaking accomplishments of our faculty's programs.

With strong programs in the core agricultural sciences, we are working with the private sector to implement discoveries for floriculture, grains and forages, cattle, aquaculture, fruit and vegetables, and landscaping—all supported by a team of over 20 breeders pushing the limits on new cultivars and germplasm to feed Florida, the United States and the world. In this report, you will read about new peaches that can aggressively compete on the market and new Pothos varieties resistent to pathogens.

We are discovering answers in support of Florida's natural resources and with our research we endeavor to support the best partnership between agriculture, natural resources and society. Whether it be with forests, panthers, fisheries, soil or water—IFAS faculty are involved. We put our discoveries, our innovations and our applications to work preserving and enhancing Florida's natural resources and our environment. Follow some of these natural resource discoveries in stories on the science of clean water, helping farmers and their environment, and preserving endangered plant species.

As a relative newcomer to Florida, I can attest that it doesn't take long to become acquainted with the issues of pests and invasives. Whether they are the six legged kind, the microbial kind or the growing vine—Florida is the U.S. capital for invasives. For IFAS scientists, this means their work is a constant battle requiring vast resources and continued awareness and scrutiny of our environment. Read as our scientists chronicle their battles against tomato diseases and tree termites as well as their quest to convert invasive lantana into a beautiful Florida-friendly plant.

Among the issues that IFAS faculty conduct research on, some focus on our diet and health, others on our food system and still others on our society from family to community. These are subjects near to our hearts, close to our homes, and critical to our future. We are committed to pushing our research to unveil new levels of understanding, incorporating the social science along with the laboratory science. Join our faculty in their search for new answers while reading about black mold in our homes, beautiful lakes where contamination means no fishing and no swimming, or how beach mice are struggling to live together with people.

As we build teams to solve problems, we often need to bring unique and disparate disciplines together. This requires innovative science and creative leaps in technology. This year, the State of Florida committed to UF an unprecedented allocation of $50 million for a new Emerging Pathogens Center. Bringing together plants, animals, microbes and man—this center will be a magnet for disease research, challenging some of UF's best researchers on critical issues concerning food, agriculture, natural resources and our environment.

The faculty and staff of the Florida Agricultural Experiment Station are proud to serve our state, and we believe the quality of our science delivers solutions for our lives. Through discovery, innovation and application, we can make a difference. We hope you enjoy this brief glimpse into our world of research.

Mark R. McLellan

Dean and Director
Florida Agricultural Experiment Station
Institute of Food and Agricultural Sciences

dean's note

Contents

MARK R. McLELLAN
Dean for Research and Director,
Florida Agricultural Experiment Station

MARY L. DURYEA
Associate Dean for Research

GEORGE J. HOCHMUTH
Associate Dean for Research

DOUGLAS L. ARCHER
Associate Dean for Research

PRODUCER Marzinnia Dean
WRITER Cindy Spence
PHOTO EDITOR Thomas S. Wright
DESIGNER Tracy D. Zwillinger
PHOTOGRAPHERS Thomas S. Wright, Josh Wickham
COPY EDITORS Darryl Palmer, Nicole Sloan
PRINTED BY StorterChilds Printing

RESEARCH REPORT is published by the University of Florida's Institute of Food and Agricultural Sciences and is produced by IFAS Communication Services (Ashley M. Wood, Director).

To change an address, request extra copies of RESEARCH REPORT, or to be added to the mailing list, e-mail **research@ifas.ufl.edu** or write to Research Administration, P.O. Box 110200, University of Florida, Gainesville, Fla. 32611-0200.

RESEARCH REPORT is available in alternative formats. Visit our Web site: **http://research.ifas.ufl.edu**

Gardening in Space

When Melanie Correll was a child, she visited Walt Disney's Experimental Prototype Community of Tomorrow—EPCOT—where her favorite attraction was a people-mover ride that took her past a scene of orange trees growing on Mars.

Today, as a University of Florida scientist in agricultural and biological engineering, the International Space Station and shuttle launches are key components of her work, and exploration of Mars is no longer a Disney fantasy.

Correll is studying the way plants grow in space, specifically how they respond to light and gravity, and designing hardware that allows plants to grow at the Space Station. Since 2001, she has been working with Miami University plant physiologist John Kiss. The first half of their experiment went up on the Space Shuttle Discovery on July 4, 2006 and the second half went up on the Space Shuttle Atlantis on Sept. 9. December's shuttle mission brought back the first half of the experiment.

The years since 2001 have been packed with research to perfect an experiment suitable for space travel. *Arabidopsis thaliana*, or thale cress, was chosen as the plant because it is small, has a short life cycle and its genome is entirely mapped, making it possible to assess the genetic

"SOMETHING ALWAYS HAPPENS THAT YOU DON'T EXPECT, BUT OUR KNOWLEDGE IS GROWING WITH EACH MISSION."

— MELANIE CORRELL

Assistant Professor Melanie Correll examines hardware containing frozen seedlings that were grown on the International Space Station.

Photo courtesy of NASA

Artist rendition courtesy of NASA

effects of space on the plants. Designing the hardware has been a challenge. On the International Space Station, every inch is premium property, so the research has been an exercise in miniaturization.

"First, we needed to design little, tiny greenhouses," Correll said. "And we needed something that wouldn't use much of the astronauts' time or the Space Station's power."

Correll and her colleagues designed tiny cassettes, about 2 inches long and ½ by ½-inch square on the ends, made with stainless steel and polycarbonate plastic. The seeds, 14 per cassette, were glued onto a strip of blotter paper. Openings in the bottom allowed water to be placed onto the paper, which filtered the water and hydrated the seeds. In trials on earth, the moisture caused condensation on the clear plastic. So a tiny heater was inserted to prevent condensation from blocking the view of a video camera, which kept watch, filming the growth of the plants through the plastic window. Watering was automated, so the astronauts only had to load and unload the cassettes and replace the videotape.

The design went through many trials on the ground to be sure it had a good starting point for space, Correll said.

"NASA is looking for low-input experiments," Correll said. "With only two astronauts, it takes a lot of time just to keep the Space Station afloat, so they can't spend a lot of time watering plants or monitoring their growth."

In all, 120 cassettes carrying 1,680 thale cress seeds went up. And in spite of the years of planning, some things were beyond control. In one group, there was a power outage. In another, there was a leak that led to 10 times the amount of carbon dioxide needed. Back on earth, Correll said, the best the scientists can do is try to replicate what happened in space and then compare the earth-grown and space-grown plants. Everything that happens, however, generates information to analyze.

"Something always happens that you don't expect, but our knowledge is growing with each mission," Correll said.

Kiss has sent two experiments into space. In one, ethylene gas got into the plant chamber, causing the plants to grow in crazy directions. From that experience, Correll said, the team knew to include ethylene scrubbers in future experiments.

"We're building up our knowledge, sharing it throughout the community, and some of our studies are already helping the people who will send up experiments after us," Correll said. "For example, we're the first to use the European Modular Cultivation System. We're the guinea pig."

Correll was in Trondheim, Norway, monitoring the experiment from the Norwegian User Support and Operations Center, when the first batch of plants landed at Kennedy Space Center in December. The plants were brought to UF for analysis both at the Agricultural and Biological Engineering Department and at the Interdisciplinary Center for Biotechnology Research. Scientists are assessing how well the engineering design and watering systems worked and looking at how the light and gravity in space affected the plant's genetics.

The future applications of her research range from practical to aesthetic, Correll said. Growing crops for long-term space missions is an obvious goal. But plants are useful for waste recovery, fuel, and air and water purification. Eventually, space-grown plants might yield new pharmaceutical products. For the astronauts, miles from home, tending "gardens" offers a huge psychological benefit, helping them feel less homesick.

Correll worries that reduced funding for basic research in life sciences will force scientists away from the field and hopes that NASA and government agencies will begin to direct funding back into fundamental science in space. Education, she says, is the reason for the Space Station, and the investment in the science thus far has yielded a good foundation.

"We've built up a knowledge base that will be lost if we don't continue to fund it," Correll said. "To get to all the things plants can do for us in space will take years of research."

For Correll, who says she has always liked plants and fixing things, a career in agricultural and biological engineering was a natural fit. She may not ever really see orange trees on Mars, but with the end of her scientific journey decades away, she's not ruling it out.

IN LORI WARREN'S RESEARCH, NOTHING GOES TO WASTE

In University of Florida Professor Lori Warren's research, nothing need go to waste—not even horse manure. In fact, Warren believes horse manure can be an asset, rather than an expense.

Warren's expertise is in equine nutrition, and until a few years ago she never thought of investigating ways to manage manure.

"How do you explain to people that you work with horse poo?" Warren smiled. "But what goes in, must come out, and we can manage manure to make it more useful."

There's no need to explain the horse manure issue to the owners of Florida's 500,000 horses. Each year, those horses generate 4.5 million tons of manure and soiled bedding, which can be an economic problem for the owners and an environmental problem for the state. Warren and her graduate researchers visited more than 125 horse operations—evenly divided between north, central and south Florida—to do on-site evaluations of their manure management practices. She found a wide variety of disposal methods, and an equally wide range in horse owners' awareness of the impact of their actions on the environment.

The issue is timely, Warren says. From a regulatory standpoint, the federal government has turned attention from industrial sources of water pollution to agricultural sources, especially livestock. Regulations also define horses as livestock, equating one horse to two cows, something Warren hopes will change following her research.

"Equating one horse with two cows isn't a data-based decision," Warren said. "The average horse weighs about as much as the average cow and the amount of manure they excrete is similar."

Dr. Lori Warren (right) and graduate students Drew Cotton and Sarah Dilling monitor the progress of horse manure and bedding materials that are undergoing composting.

To determine the risk horse manure poses, Warren realized she would need to answer the most basic question of all: What does horse manure contain?

"So few people are working in this area that we really don't have a good idea what makes horse manure a risk for pollution. Is it the phosphorus? Is it the nitrogen? That data is not available," Warren said.

And although the composition of horse manure varies depending on what the animals are fed, the biggest variable of all, Warren said, is the bedding that gets mixed in with the manure. Warren found that more than 75 percent of Florida horse owners were using wood shavings. Many of these owners were spreading the manure/bedding mix on pastures as fertilizer, thinking the nitrogen in the manure would foster plant growth. What they didn't realize is that the carbon in the wood shavings actually suppresses plant growth.

Then there were operations, such as boarding stables and racetracks, without the option of spreading the waste on pastureland. As Florida grows, horses are being kept on increasingly smaller properties to incorporate them into the urban scene, leaving fewer alternatives for manure disposal.

"If there's no pasture—and that's more and more common—that's a big challenge," Warren said. "There's this great volume of manure, but no land base. It's a real problem, and some owners pay very large amounts of money to have the manure hauled away. Only now, more and more landfills are not accepting it. What are they supposed to do with it?"

At UF's 65-acre Horse Teaching Unit south of campus, Warren is researching whether composting might be the answer. The manure and stall materials generated

from the university's horses are deposited in specially built composting bins, so the composting process can be studied. The horse teaching unit makes an ideal demonstration site because it operates as a typical horse farm with 20-40 horses at any time.

"We're working at farm scale, not lab scale, so it's more representative of the conditions the average horse owner would have to contend with," Warren said.

One of the biggest limitations in composting horse stall materials seems to be the high carbon content of the wood bedding. The microorganisms that break down manure require a specific ratio of carbon to nitrogen. Too much carbon can slow the composting process. Warren has addressed this issue by adding varying amounts of nitrogen to determine its effect on how well and how fast the materials break down. She also has experimented with slow-release ureas, which may prove to be a better nitrogen amendment for composting horse stall materials.

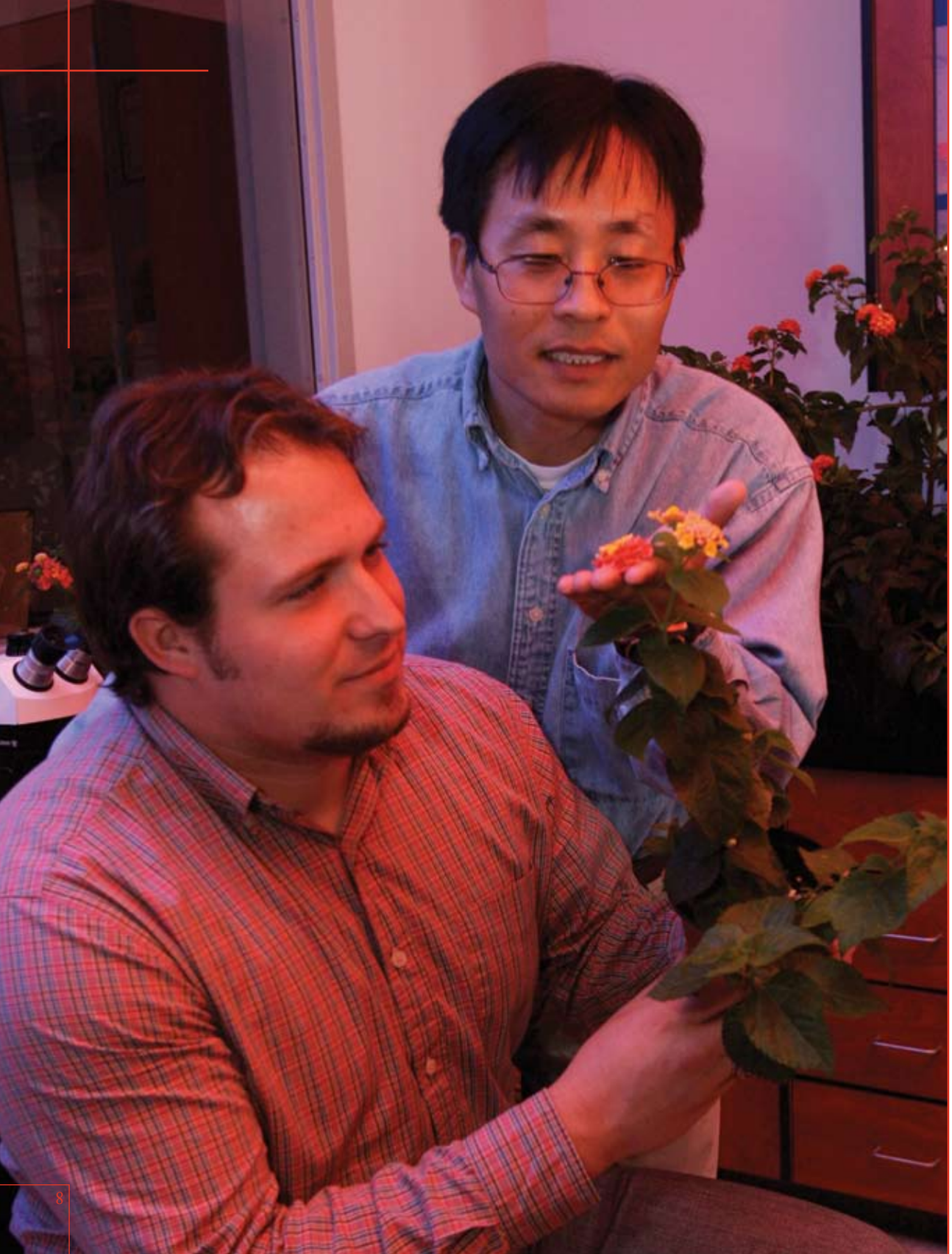
"In the future, we also hope to look at different aeration systems and reducing overall particle size, which could improve composting," Warren said. Her goal is to come up with guidelines flexible enough that any horse owner can compost effectively. Equine-related research sometimes is overlooked by other agencies, Warren said, so she particularly appreciates the support she gets from the Florida Department of Agriculture and Consumer Services.

Arriving at an inexpensive composting formula that works would be a huge benefit to horse owners.

"Ultimately, we can create a better product that is possibly marketable," Warren said. "Rather than pay to have manure hauled away, horse owners can make money by selling it. It might be possible to match those who have manure with those who have a use for it. We can reduce the environmental risk of manure and market this byproduct, too."

"WHAT GOES IN, MUST COME OUT, AND WE CAN MANAGE MANURE TO MAKE IT MORE USEFUL."

– LORI WARREN



MAKING THE LANTANA FLORIDA-FRIENDLY

It takes a lot to impress a floricultural scientist, but when Zhanao Deng saw a lantana blooming in 116-degree heat in Las Vegas, it got his attention.

The hardy lantana is drought-tolerant, heat-tolerant and salt-tolerant. It blooms year-round and attracts butterflies. It is low-maintenance and easy to grow. Its plentiful blooms come in a variety of colors. There is just one problem: *Lantana camara* is listed as a category I invasive plant by the Florida Exotic Pest Plant Council, making it a public enemy of some magnitude. Its crime? Contaminating the gene pool of Florida's own native lantana species, *Lantana depressa*.

That's why Deng and Brent Harbaugh, floriculturists from the University of Florida's Environmental Horticulture Department, have teamed up with soil scientist Craig Stanley. Working at UF's Gulf Coast Research and Education Center in Hillsborough County, the researchers are trying to develop sterile lantana to protect Florida's native species, *Lantana depressa*. Many commercial lantana varieties are particularly good at hybridizing with the native lantana because the commercial varieties produce an abundance of pollen, so the focus has been on producing sterile varieties that do not produce pollen.

"Lantana in Florida is an important nursery and landscape plant," Deng said. "The industry is interested in using this valuable plant but wants to be good environmental stewards."

Left to right: Graduate student David Czarnecki and Dr. Zhanao Deng examine new lantana plants they developed.

Keeping the popular lantana on nursery shelves would be a boost to the industry. There are as many as 5,000 nurseries in Florida. A recent survey showed that some 20 percent of Florida nurseries grow lantana, which is valued at $20 million a year in nursery sales.

"The bottom line is, if Zhanao can do what he proposes to do, this will offer an alternative to growers," said Stanley, who also is associate director of the research center. "Growers will have something compatible with the environment, and we can protect the native lantana."

The project started two years ago and has several years to go. Deng and his colleagues have developed new lantana that is now being evaluated. In addition to making sure the new variety does not produce pollen or seeds, it will be evaluated to be sure it keeps all the characteristics that made lantana so popular in the first place. Stanley, the soil scientist, is evaluating water usage by the plant, and Harbaugh, a production expert, is evaluating the growth characteristics of the new variety.

Doing the work at the 475-acre research center near Wimauma is a plus, Stanley said.

"The big advantage of a research center is that all of us, of different disciplines, are across the hall from each other. We don't have to go across campus to find a soil scientist or a plant breeder," Stanley said. "And this fits with the thrust of our center now, landscape management for the urban environment."

Deng said getting to the point of evaluating plants has been a long road, and he has just about lived in the greenhouse.

"It has been tough to get to where the plant won't produce seeds, because first you need it to produce lots of seeds," Deng said. The payoff, however, will be worth it if it protects the Florida environment from an invader.

Deng said as awareness has grown of the problem invasive plants and animals pose for Florida's ecosystem, more people are becoming interested in protecting the environment. Desirable commercial plants will not pose a threat if plant breeders can successfully manipulate them.

"We want to be sure this plant is sterile, that it doesn't breed, and the consumer won't see much of a difference," Deng said.

"THE INDUSTRY IS INTERESTED IN USING THIS VALUABLE PLANT (LANTANA), BUT WANTS TO BE GOOD ENVIRONMENTAL STEWARDS."

— ZHANAO DENG

RESEARCHING THE MYSTERIES OF RIVERS

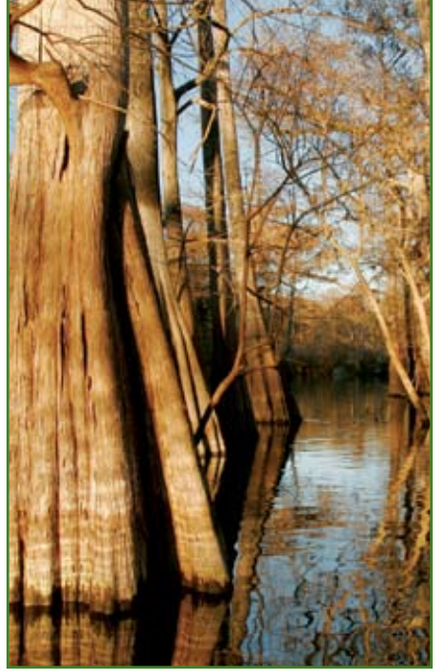
The romance of rivers runs through American culture—like Huckleberry Finn rafting down the mighty Mississippi. But the science of rivers is more elusive, and that's where University of Florida aquatic scientist Bill Pine and his Florida Rivers Laboratory come in.

"Everybody can tell you the name of a river," Pine said. "But rivers are really an aquatic system we don't understand very well. What fish are there and how do they use the river? Is the river more similar to a lake or an estuary, or is it totally its own environment?"

Pine's expertise with rivers has taken him from the Grand Canyon to Hawaii and back to Florida, where the focus of his research now is the Apalachicola River in the Panhandle. The Apalachicola isn't just a Florida river, though. Its waters start in Georgia and run through Alabama as part of the Apalachicola-Chattahoochee-Flint river system before crossing the Florida border and draining into the Gulf of Mexico. For more than a decade, the three states have been in disputes about allocation and management of water in the Apalachicola River and its tributaries.

The Apalachicola River supports a variety of freshwater recreational fisheries, several species of threatened or endangered fish and freshwater mussels, and contributes most of the fresh water to Apalachicola Bay, one of Florida's most ecologically and economically important estuaries.

Dr. Bill Pine, Assistant Professor, Fisheries and Aquatic Sciences, demonstrates the use of a radio receiver to monitor a section of the Santa Fe River for tagged fish.



"Florida is at the end of the chain for water allocation, so we need to make sure there is enough water in the system to keep the Apalachicola River and estuary healthy," Pine said. "We need to answer what is the minimum flow and water level for the river. That's a big question for Florida. How much river water can be used so that there's no negative impact to the aquatic species that live in the river?"

Pine has been working with state and federal agencies on studies to determine how changes in water flow affect fish populations. One project examined the movements and spawning locations of Gulf sturgeon, a threatened species. Pine and fellow researchers tagged fish and tracked their movements to find out how they use the river and its tributaries.

"We tag fish to create sub-populations that we know something about. We know at least 500 were present in a location at one time, because we tagged 500 animals in that area," Pine said. "We also use smaller numbers of telemetry tags that emit a unique signal from each animal and allow us to follow an animal's movement patterns. This allows us to really examine fine-scale movement and habitat use patterns."

The research so far has revealed two sturgeon spawning locations, one of which was previously unknown. It also has shown that spawning goes on for a longer period of time in the Apalachicola than previously documented, from at least April to May, and that the sturgeon travel widely up and down the Apalachicola and its tributaries and into the estuary. The study also revealed that fish found in other Panhandle rivers came to the Apalachicola to spawn, indicating the sturgeon are moving between river systems as part of their life cycle of moving from the ocean to the estuary to the river to their spawning grounds, and then repeating that cycle.

Pine said identifying the spawning sites and time periods has implications for fisheries managers, who would want to be sure there is enough water flow during the spring to allow the sturgeon to swim to spawning grounds.

Rivers are like conduits, Pine said. Along with the water itself, they carry fish, other animals, people, nutrients, and pollutants. Events upstream affect what happens downstream. The Apalachicola's headwaters are in northeast Georgia, near the metropolis of Atlanta. The city's need for water and possible plans to build more reservoirs to meet the needs of rapid population growth will affect how much water reaches the mouth of the Apalachicola at the Gulf of Mexico. The Apalachicola River system is also impacted by other dams and dredging operations that affect downstream fish habitats.

"The big debate is between what is more valuable: meeting human needs for explosive growth or meeting ecosystem and habitat needs for fish populations. Is water only important for human use?"

"Florida is at the end of the chain for water allocation, so we need to make sure there is enough water in the system to keep the Apalachicola River and estuary healthy."

— Bill Pine

Pine said. "We need to look at river systems collectively as a unit. Fish probably see rivers this way, so it's important to know how extensively they move, where they move, and why they use the types of habitats they are found in. We've found a variety of habitats that fish use at all times.

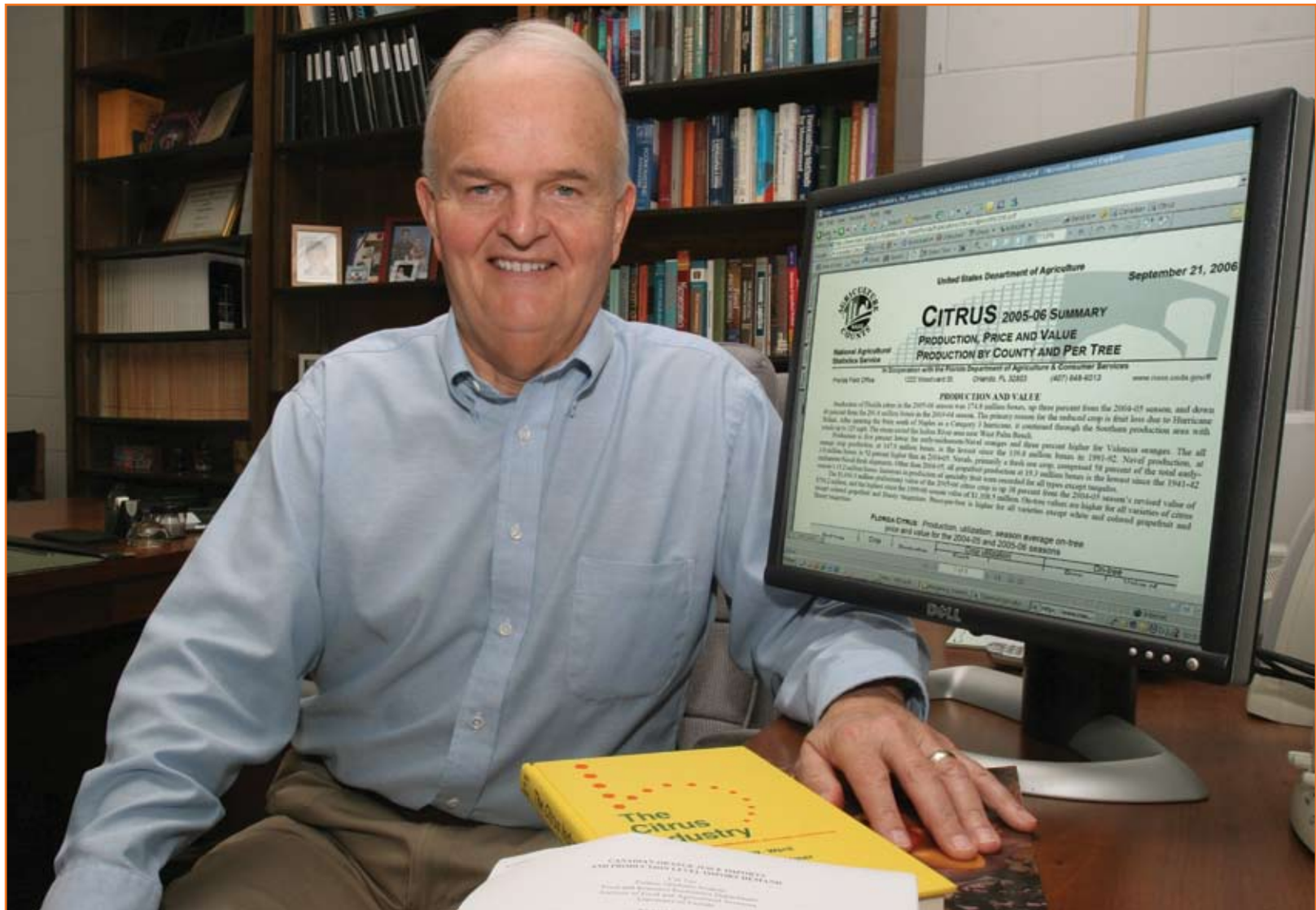
"The big issue is how humans use river systems," Pine said, "and how fish populations respond to that."

MODELS FOR BOOSTING U.S. ORANGE JUICE IMPORTS TO CANADA

"We're in a world where advertising matters. Juice is part of the beverage market, and just think of all the advertising that goes into colas."

— Richard Kilmer

Dr. Richard Kilmer, Professor, Food and Resource Economics



Canada is already a loyal customer when it comes to buying orange juice from the United States, University of Florida Food and Resource Economics Department researcher Richard Kilmer says.

But orange juice producers always like to boost sales and gain market share, so Kilmer and graduate researcher Yan Liu applied econometric models to find out the best way to achieve those goals.

The models explored which of two ways—dropping prices or using advertising—would be the best way for the United States to increase its share of the Canadian orange juice market. Although U.S. citrus producers have not been advertising in Canada in the last several years, the value of U.S. orange juice sold in Canada has been increasing in comparison to other competitors, Kilmer said.

Brazil, the largest orange juice producer in the world, is the United States' main competitor, but it has been losing market share in Canada.

Using a variety of econometric models, Liu and Kilmer plugged in data provided by Statistics Canada, International Trade Division. The data covered the period from the first half of 1990 through the second half of 2005 and provided details on orange juice import quantities and values from different countries and regions. Data were provided for U.S. imports, Brazilian imports, Mexican imports, and imports from the rest of the world.

While neither a drop in price nor an increase in advertising amounted to big percentage gains, the United States benefited more from advertising than Brazil did, Kilmer said.

A U.S. price drop of 1 percent, for instance, increased the quantity of U.S. juice sold in Canada by 0.17 percent. Likewise, a Brazilian price drop of 1 percent increased the quantity of Brazilian juice sold in Canada by 0.17 percent, the same as the U.S.

Advertising, however, had a bigger impact. A 1 percent increase in imported gallons of orange juice due to advertising will increase U.S. imports by 1.2 percent and Brazilian imports by 0.6 percent, the study found.

"We're in a world where advertising matters," Kilmer said. "Juice is part of the beverage market, and just think of all the advertising that goes into colas. People now drink cola at breakfast rather than orange juice, in fact."

Other factors, too, likely affect Canadian imports of U.S. orange juice, Kilmer said. For one, the juice the United States sends to Canada is not-from-concentrate. The orange juice Brazil sends to Canada is from concentrate.

"People seem to like not-from-concentrate better; it's never frozen, just kept cold and shipped. People in the United States like it better, too," Kilmer said. "But to ship not-from-concentrate from Brazil would be cost-prohibitive."

Although U.S. citrus processors have done well without advertising in Canada for the last several years, if they want to do better, advertising, appears to be the best marketing strategy, Kilmer said.

"An expansion of total Canadian orange juice import gallons, using advertising favors the United States much more than it does other countries," Kilmer said.

Meeting the Need for Protein

It may not sound appetizing, but the parts of a fish that you normally don't eat are as good for you as the parts you enjoy in a nice seafood dinner.

And with the efforts of researchers like University of Florida food biochemist Hordur Kristinsson, you soon may be dining on this high-quality protein or using it as a nutritional supplement.

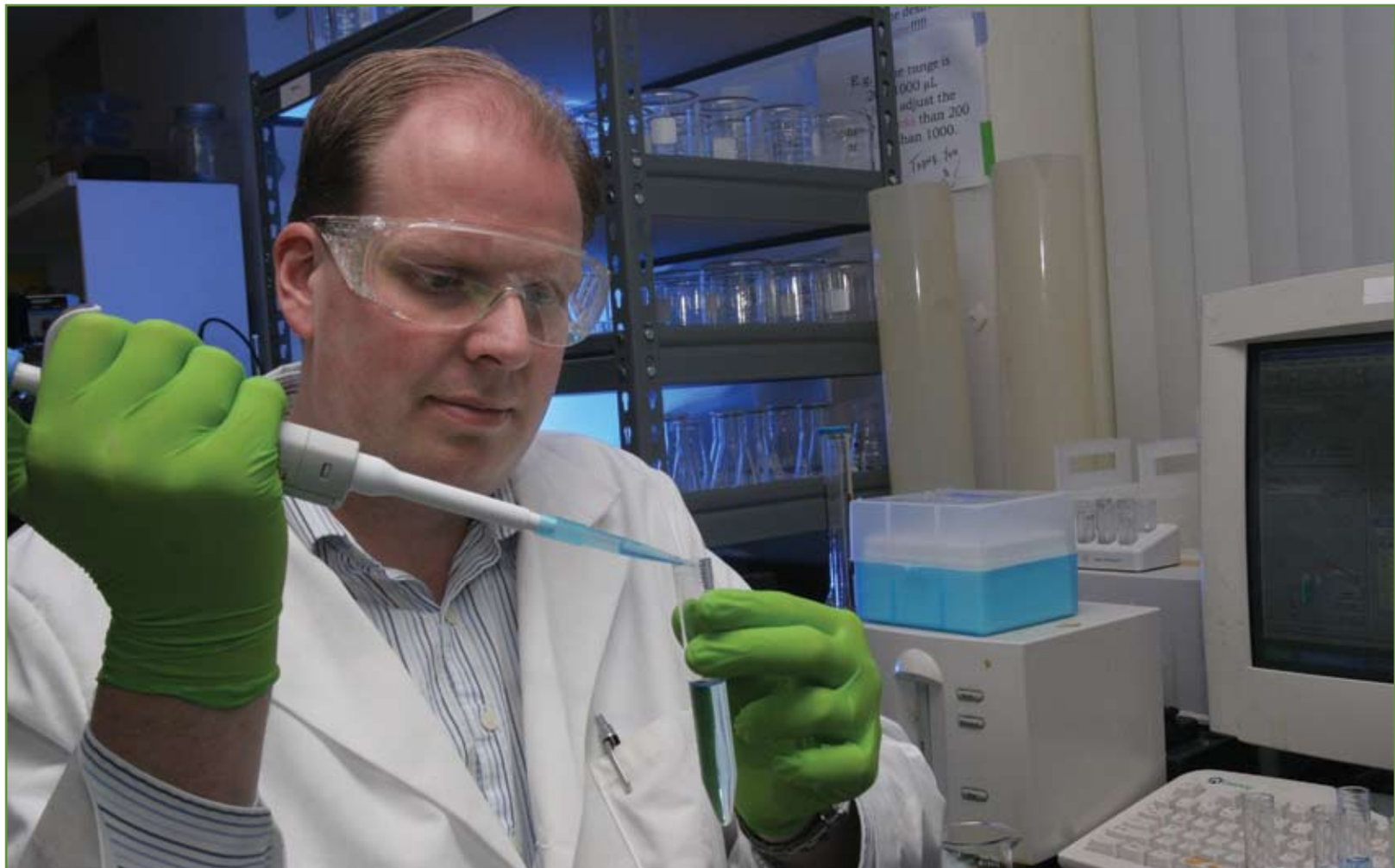
"A very large amount of byproducts remain unutilized after fish processing," Kristinsson said. "We can take these byproducts and recover the proteins, which are extremely functional and powerful antioxidants, and make them more usable."

As fish are filleted for market, the byproducts often are discarded or used in animal feed. These leftovers—bones, heads, fins and chunks of meat left on the bone—can be reprocessed to extract protein of a very high purity for human consumption, Kristinsson said.

The technology to isolate and recover the protein already has been commercialized, so the next step for Kristinsson and his colleagues is taking that protein and breaking it down. By using enzymes, the protein

"We can meet the demand for protein by using more of the fish. Many byproducts are high in quality protein, but often poorly utilized."

— Hordur Kristinsson



Dr. Hordur Kristinsson, Assistant Professor, Food Science and Human Nutrition

can be divided into smaller fragments with various uses. The result is a pure protein that can be used to fortify food or as a nutritional supplement.

"It amounts to predigesting it," Kristinsson said, "like what happens in the stomach."

Kristinsson recently teamed up with the UF College of Medicine Department of Aging to explore the health benefits of the protein. In one upcoming study, the researchers will use human white blood cells, apply stress to the cells, then see if the protein reduces the stress.

The researchers' recent studies show that the protein could have therapeutic use in reducing high blood pressure or relieving the effects of oxidative stress. The studies also indicate the protein could be useful to improve food quality by extending the shelf life of seafoods, mainly by reducing rancidity. Kristinsson also is collaborating with researchers in Sweden and Iceland who are studying the protein on a molecular level.

Kristinsson said making the most of seafood as a food resource for humans is becoming more important as the world supply of protein declines.

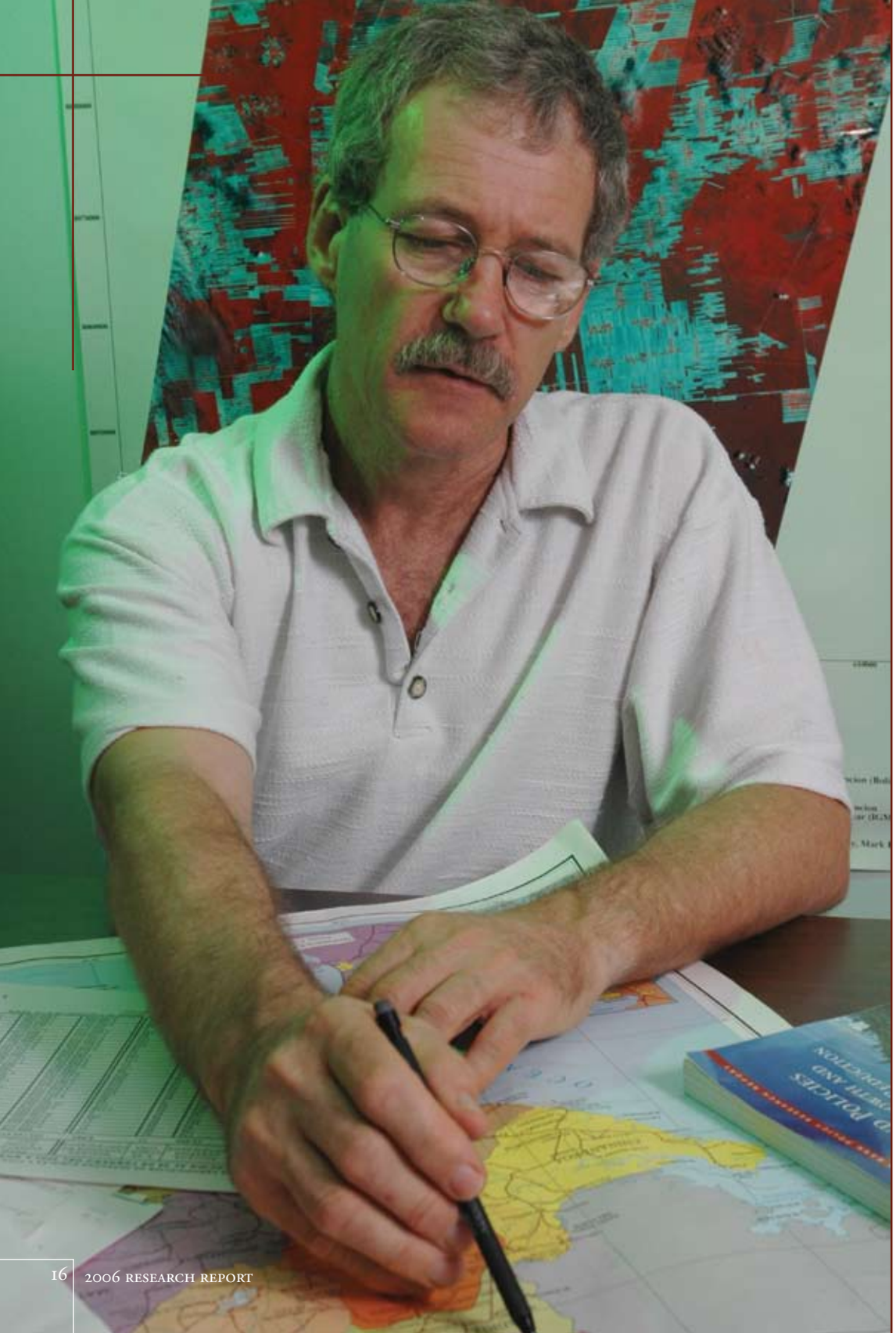
"Demand on fish stocks has increased, but the stock of fish is declining," Kristinsson said. "We can meet the demand for protein by using more of the fish. Many byproducts are high in quality protein, but often poorly utilized."

Environmentally, there's a benefit as well. In areas where the bones, fins and heads legally can be dumped back into the water, they can become sources of water pollution. Seafood processors who legally cannot dump the byproducts often send them to landfills, usually at considerable expense. Soon, instead of spending money to get rid of the byproducts, they will be able to make money by selling them.

"This can certainly help to reduce some of the pollutants in areas where this is thrown back into the water," Kristinsson said. "For the processors who send it to landfills, now they have the option of making money on it."

The three-year project will run through 2009 and is funded by a $355,000 grant from the USDA National Research Initiative.

"Our goal is the purest, most functional protein," Kristinsson said. "The value of it is several magnitudes higher than what it is used for now."



TRADITIONS OF LAND OWNERSHIP

For Americans, the details of a deed to land are specific: you know your lot's section, township and range, even which page inside a plat book records the details of your ownership. Chances are, you can click on your property appraiser's web site and view online the dimensions of your patio or garage. Land sales are accompanied by legal experts and a mountain of documents.

But what if your land is in the middle of a rain forest? What if it has never been bought or sold, but has been handed down for centuries. What if you share ownership with hundreds of neighbors? How do you protect your "title" to the land in these circumstances?

University of Florida researchers Grenville Barnes and Tom Ankersen have been examining the communal property rights of indigenous and traditional people of Latin America and the role of secure land rights in easing poverty and protecting the environment. Barnes, of UF's School of Forest Resources and Conservation, and Ankersen, of UF's Levin College of Law, are working with a $100,000 grant from the John D. and Catherine T. MacArthur Foundation to study the evolution of communal property systems.

"The Amazon is not a forest without people," said Barnes, who has traveled to more than 20 countries for research and consulting work. "Indigenous and small farmer communities have land. They just don't have the deed that proves it, so they do not have legal protection of their land rights."

For his research, Barnes often begins in the capital of a country, where he reads the property laws and interviews key government officials to understand the formal "de jure" property system. When he heads out into the field, he said, he often finds a striking mismatch between

Dr. Grenville Barnes, Associate Professor,
Forest Resources and Conservation

the legal system and the reality of what is happening deep in the countryside or rain forest. While land policies tend to favor individual property rights, large chunks of land in Latin America—including 20 percent of the Brazilian Amazon—are owned communally, making use of the land and its resources a complex matter.

Barnes said that land policy makers face three often competing values: economic, environmental and social. A policy that is good for the people economically could be detrimental to the environment. Policies that favor the environment may keep the people impoverished. Similarly, socially responsible policies may not fully tap the land's economic potential.

Barnes said some Westerners might suggest just dividing up all the land and giving each person a slice and a title. The impact of this on the environment and on the social structure of the community could be disastrous.

Communal land ownership systems that have thrived have balanced economics, environmental and social values, Barnes said.

In Mexico, 80 percent of the forests are owned communally under a communal property regime called an *ejido*. Several communities in southeast Mexico have pursued communal forestry, boosting economic development while protecting the environment and culture. Closer to Mexico City, the world's second-largest city, these communities are under pressure to sell off their land for urban development.

The push to formalize indigenous people's title to land has increased internationally in the last 10 years, partly because these people are pushing for it and partly because of a dawning recognition of the human right to property. In land disputes, international courts increasingly are ruling on behalf of indigenous people, further pushing governments to title indigenous territories.

"Development banks like the World Bank and the Inter-American Development Bank are funding titling projects because they believe private property will kick-start development in the third world," Barnes explained. "This approach recognizes that land is often the biggest asset poor people possess, and by titling it they will be able to access credit and ultimately work their way out of poverty." Given available empirical evidence, Barnes is skeptical of this reasoning because many poorer landholders do not manage to fight their way out of poverty even though they have a title.

Barnes grew up in South Africa, where he became sensitized to the connection between land and wealth. His research is interdisciplinary, drawing on knowledge of anthropology, engineering and law to reconcile the contradictions between western legal concepts of land ownership and land ownership as practiced by people with a rich, centuries-old way of dealing with property.

"They don't just see property as a commodity. It doesn't just belong to them," Barnes said. "It belongs to all their forefathers, and to everyone who follows them and is the glue that holds their culture together."

"Communal land ownership systems that have thrived have balanced economics, environmental and social values."

– Grenville Barnes

A VIRTUAL COLLECTION OF FLORIDA'S ENDANGERED PLANT SPECIES

Whether you're a botanist in Germany, a graduate student in South America or a homeowner in Miami with a mystery plant growing in your back yard, the resources of the University of Florida Herbarium are at your disposal. And you don't have to travel to Gainesville—with a few clicks of a keyboard, you can take a virtual look at the plants you want to see.

The herbarium began working with the UF Libraries Digital Library Center in 2001 to digitize its collections. With more than 430,000 specimens, this is a huge undertaking, said collections manager Kent Perkins. Label data from 45,000 specimens have been computerized, and 5,000 specimens have been imaged and made available online. The process could be expedited, he said, with more money.

"At the current rate of computerization, we are keeping up with new additions—3,000 specimens per year on average—and slowly working on the existing backlog," Perkins said. "This virtual collection is especially important for land managers, researchers and people doing surveys to have something to look at. A lot of times you don't see the same details in a photo that you see in a pressed specimen."

The herbarium, part of the Florida Museum of Natural History on UF's campus, started its digital collection with its type specimens, pressed plants that serve as the standard for identifying other plants in a group. From there, it added invasive plant species listed by the Florida Exotic Pest Plant Council, insectivorous plants, samples from

Endangered species imaging project team (left to right): Stephanie Hass, Assistant Director, Digital Library Center, George Smathers Libraries; Kent Perkins, Manager of the Collection; Norris William, Curator, UF Herbarium, Florida Museum of Natural History.

Gainesville's Kanapaha Botanical Gardens, and selected poisonous plants of Florida. The collection catalog and digital images are accessible at: http://www.flmnh.ufl.edu/herbarium.cat/.

The next collection to be digitized—Florida's endangered and threatened plants—is of special importance.

"The specimens of endangered and threatened plants stored in the herbarium are fragile and degrade from handling," Perkins said. "These species are no longer readily collected, due to their protected status, so it's important to preserve the existing specimens."

The state lists 421 endangered plant species (44 are also federally listed) and 114 threatened (11 are also federally listed). The ability to identify and recognize these plants is the key to discovering them in the landscape and then protecting them. However, field workers and even citizens typically are not easily able to visit the herbarium to inspect a specimen when they find a plant of interest.

High-quality digital images are the next best thing to actual specimens for identifying and studying a plant, Perkins said. Specimens are pressed and mounted on archival paper with attention to identifying characteristics that reveal aspects of a plant not easily seen in drawings or photographs. Once a specimen is digitized, a viewer can zoom in for more detail to view the veins of a leaf or details of flowers and fruit. Using digital images also protects the brittle specimens from overhandling, Perkins said.

The herbarium also participates in loans and exchanges with other institutions. Since specimens may be out on loan for years—Perkins knows of one loan that lasted 20 years—each specimen is data-based before it is sent out. Selected specimens are also imaged, contributing to the growth of the digital collections.

Digital images also are added to the collection by the herbarium's Plant Identification and Information Service provided by UF's Institute of Food and Agricultural Sciences. Florida is one of the most botanically rich states—only Texas and California have more species—and farmers, students, researchers, and natural resource managers all come across plants that need to be identified.

In one case, a researcher at the UF/IFAS Indian River Research and Education Center collected a plant of the genus *Mansoa*, but couldn't identify the species. The herbarium's staff pressed the specimen, digitized it and put it on the web, then located an expert in Brazil, who pulled up the image and identified the species as *Mansoa lanceolata*.

"This was an example of something being cultivated in Florida, but we had no specimens here in the herbarium. So we added this to our collection," said Perkins, noting that the herbarium identifies more than 1,000 plants per year.

"We can find an expert, put up an image and get an ID," Perkins said. "This allows us to consult with experts throughout the world."

The herbarium began in 1891 as part of Florida Agriculture College in Lake City and was moved by covered wagon to Gainesville in 1906 to become part of UF. It includes specimens that date back to the 1840s.

"This collection documents the presence of plants in areas of Florida where they no longer occur," Perkins said. "It provides a historic record, and when it comes to the endangered and threatened plants, we can't go back and get more."

"THESE SPECIES ARE NO LONGER READILY COLLECTED, DUE TO THEIR PROTECTED STATUS, SO IT'S IMPORTANT TO PRESERVE THE EXISTING SPECIMENS."

– KENT PERKINS

FLORIDA PEACHES ARE GROWN AROUND THE WORLD

When Jose Chaparro walks the furrows on the University of Florida campus farm, he walks in the footsteps of a favorite professor as he charts a course for research aimed at producing the perfect subtropical peach.

Chaparro is building on a foundation laid by UF peach pioneers Ralph Sharp and Wayne Sherman. Strides in technology have advanced fruit-breeding science by leaps and bounds, but the work still ends up in the same place, rooted in the soil of the campus farm, where Chaparro and UF horticultural scientist James Ferguson evaluate the trees and fruit in hopes of developing a niche peach crop for subtropical Florida. They are well on their way—since 2005, UF has released three peach varieties: UFSharp, Flordabest and UFRoyal.

Chaparro is an experienced fruit breeder. He worked for the U.S. Agricultural Research Service before the opportunity to combine teaching with research lured him back to UF. As a student, Chaparro worked with Sherman and became familiar with the stone fruit breeding program. He knows how much cold the ideal peach needs and the right balance between sugar and acidity. He can visualize its shape and color. He knows what the growing cycle should be and when it should be harvested for maximum value.

And when consumers taste it?

"If you bought this peach in a supermarket," Chaparro says, "you'd go back and buy a couple of pounds."

But breeding peaches is a balancing act. He can produce a peach with firm flesh for shipping, but will it ripen during the best market

Left to right: Drs. Jim Ferguson and Jose Chaparro, Horticultural Sciences, examine the growth of peach crops.

window? He can produce a peach with a melt-in-your-mouth taste, but will it be firm enough for shipping?

For Florida's subtropical climate, the tree would need less chilling than varieties grown in Georgia and other regions, and research is under way to understand the genetic basis for the chilling requirement in peaches. The ideal tree would bloom after the risk of a freeze has passed, but ripen before the start of the rainy season, which brings plant diseases. To give growers the highest return, ripening would occur after peaches from Chile have left the market but before peaches from Texas and California hit the market.

The early-ripening peaches develop very rapidly and contain seed with immature embryos that require in vitro embryo rescue for germination. The breeding program has focused on non-melting flesh peaches, which have a firmer flesh texture that allows the growers to keep the fruit on the tree and market a sweeter, more ripe fruit.

"We want to have the fruit picked and packed and off to the supermarket in the right market window," Chaparro said. "By producing varieties adapted to Florida, we can supply that market window. The product going to the supermarket shelf is better and has higher value."

Ferguson said freezes in the 1980s and competition from other production areas reduced Florida peach acreage, which peaked at about 2,000 acres in the 1960s, primarily in Panhandle counties. A recent informal survey by Ferguson showed orchards more scattered today, but only about 400 total acres planted in peaches, nectarines and plums. The researchers see the potential for peaches to move south, spreading to about 10,000 acres eventually, especially with some canker-weary citrus growers showing an interest in peaches.

Research and extension faculty have planted demonstration plots of subtropical peaches at UF research centers in Quincy, Live Oak, Hastings, Citra, Winter Haven, Immokalee and Fort Pierce to show how the crop can be grown in the state's different agricultural zones. Although peaches would not be a high-volume crop, Chaparro said, manipulating the growth cycle to get ripe peaches during the right market window could make it a high-value, high-quality crop.

The rest of the world already is familiar with Florida peaches, Chaparro said. Flordaprince and other varieties developed for Florida are not household names here, but they are important cultivars in low-chill production areas of Morocco, Sicily, Egypt, Australia, India and South Africa. Licenses on past varieties provide key funding for further research.

"In April or May, if you eat a peach in Europe, or pretty much worldwide, it's a Florida variety," Chaparro said. "Our biggest clients for our germplasm are overseas, and they generate the income for the breeding program. UF trains students from all over the world, and our varieties are grown in subtropical climates worldwide. We're providing a worldwide service."

Even with the advances of science, the work can be time-consuming. Thousands of seedlings are planted, then plowed under, as trials continue. Chaparro says it's common for only one tree in 200 seedlings to be worth saving for the genetic traits it might pass on. Molecular markers are being developed to assist in the selection process.

"Wayne Sherman made a new industry here, building on work by Ralph Sharp, and now UF is one of the top three programs in peaches," Chaparro said. "When you think peaches, you wouldn't think Florida, but it's fulfilling to see the impact of UF varieties grown in other countries."

"If you bought this peach in a supermarket, you'd go back and buy a couple of pounds."

— Jose Chaparro

Black Mold in the Environment

Previous studies into toxic black mold that colonizes moist areas inside a home have been limited to the indoors. But mold can travel widely in the air before taking up residence indoors, so University of Florida mycologist James Kimbrough and doctoral researcher Sarah Clark Selke decided to take a new approach and look for the mold outdoors.

They found what they were looking for.

A few dozen fungi form a black mold growth, but one, *Stachybotrys chartarum*, produces some of the most potent mycotoxins known to science, and it is all around us. Selke designed a two-year ecological study to find out the range of habitats that might support the fungus in an effort to determine how much is out there and what times of year it is most common.

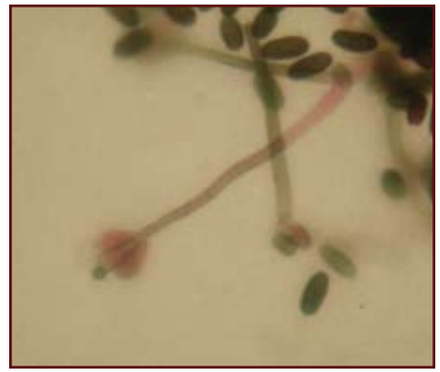
"You see lots of reports of people finding *S. chartarum*, but all the studies were done on indoor samples," Selke said. "This is the first outdoor sampling, the first environmental study of this nature."

S. chartarum likes cellulose, common in most building materials, and moisture, all too common in hurricane-battered Florida homes. So Selke

"There are 90,000 species of fungi described, but we think there may be 1.5 million out there."

— James Kimbrough

Dr. James Kimbrough and graduate student Sarah Clark Selke examine a culture plate of molds isolated with an Aerotech Spore Sampler.



cut drywall into 4-by-8-inch strips and placed the strips upright in plastic containers of water as a kind of bait. She chose four North Central Florida habitats, placing sampling strips in a citrus grove, a pine grove, a weedy lakeshore and a mature hardwood forest.

As she recovered the strips, she tested for *S. chartarum*. Her preliminary results show that the black mold is present at detectable levels from May to December in all four habitats, although not in all habitats in the same month.

"It's out there, but it's not out there as much as we thought it was," Selke said.

Environmental companies find it difficult to isolate *S. chartarum* from the indoor air even though they see contaminated surfaces because it grows slowly on media when other fungi are present. The key to better work in the laboratory, Kimbrough said, is identifying media that foster the growth of *S. chartarum*, but slow the growth of other common fungi, so that *S. chartarum* can be isolated and studied. In the meantime, trapping the organism in the wild, as in Selke's experiment, is a good alternative.

"With the proper medium, we could sample more widely," Kimbrough said.

The increase in hurricanes in Florida in recent years has fed public concern about black mold because storm-damaged homes are a prime target. The mold can proliferate in an environment with moisture and cellulose—drywall, for instance—and enjoys the same temperatures people enjoy, Kimbrough said. In severe cases, homes can become uninhabitable, and toxic black mold can cause scratchy throats, watery eyes, rashes, wheezing and other respiratory problems often associated with sick building syndrome.

But not every sample of this black mold is toxic, so Selke next wants to look at the DNA of samples to see if there are patterns in the distribution of toxic and non-toxic *S. chartarum*. Distinguishing between the two would require molecular testing.

While someone who finds black mold should limit their exposure and take care in cleaning it up, not all cases of mold are cause for alarm.

"We live in an ocean of spores," said Selke, and not all are harmful. "When you see black mold in the shower, that's not *Stachybotrys*."

Fear of black mold, however, can make consumers prey to scam artists, Kimbrough said.

"Probably one of the biggest scams is fly-by-night companies that find any kind of black mold," Kimbrough said. "People get alarmed and these companies charge exorbitant prices to clean it up."

Kimbrough points out that mold spores are in a home all the time, and only grow to unmanageable proportions when they are provided the right conditions, making prevention the best way to avoid a mold problem.

The kingdom of fungi is more than 460 million years old, so these organisms must be doing something right, Kimbrough said. Mycologists, he said, have their work cut out for them.

"There are 90,000 species of fungi described," Kimbrough said, "but we think there may be 1.5 million out there."

TEAM ANALYZES DATA
TO ANSWER IMPORTANT NATURAL RESOURCES QUESTIONS

University of Florida statisticians Linda Young and Mary Christman can tell you that sometimes the most important answer to a question is "I don't know."

The two researchers were asked in 2006 to analyze a huge database of information on red tide, a toxic algal bloom that frequently appears along Florida's Gulf Coast. At first glance, the database—64,053 records collected by 78 agencies dating back to 1953—looked like a treasure trove.

"The database looks huge and wonderful, but the data were not collected in a manner that allows us to answer the questions we were asked to answer," Christman said.

The Florida Fish and Wildlife Service asked Christman and Young to evaluate the data with three questions in mind: is red tide increasing in frequency, is it increasing in severity, and is it possible to detect any patterns in its behavior?

"In learning which questions we could not answer, we learned which questions needed to be asked."

— Mary Christman

Left to right: Drs. Linda Young and Mary Christman, Department of Statistics

"While the database can be used to answer other questions scientists might ask, it can't answer those three questions," Young said.

"The data are useful, but not to answer the questions being posed," Young said. "These data don't support whether red tide is increasing or decreasing."

Red tide is a natural phenomenon that has been observed in Florida since the 1840s. It is caused by higher than normal concentrations of *Karenia brevis*, a microscopic algae that can quickly grow into dense, reddish patches. *K. brevis* produces toxins that can harm or kill fish, birds and marine mammals. Near shore, it becomes airborne in sea spray and can cause respiratory problems in humans.

When red tide becomes concentrated enough, the state closes shellfish beds. And it hurts tourism by making a day at the beach unpleasant or even unhealthy. However, reports that red tide is worse than ever have caused unwarranted hysteria. Christman said coastal population growth may be one factor in the perception that red tide is worse because "more people see it, but more people are there to see it."

For the Fish and Wildlife Service to collect data from 78 agencies dating back to 1953 was a monumental undertaking, Young said. But once the data were collected, the issues in analyzing the records quickly became apparent.

Most samples were collected after a report of red tide, guaranteeing red tide would be found, rather than through a regular monitoring program, which might or might not find red tide in each sample. That left no way to determine whether red tide was more or less severe over time, or even always present.

Year to year, there were differences, too, with almost no records to analyze from 1960, but plenty to analyze from 2000. Agency to agency, sampling methods differed. Hillsborough County, for example, collected samples monthly at the same locations since 1987, providing a good database for Tampa Bay. But comparing that database to another, with samples collected more haphazardly, would be an apples-to-oranges comparison.

"Each agency kind of did its own thing, and most of the time they collected samples when they already knew it was there, and they went out to see how bad it was," Christman said. "So monitoring was prompted by the event rather than done regularly. Some of the monitoring was voluntary, such as when a research ship heading out would volunteer to bring back a sample. And the more you sample for it, the more you see.

"The real question—is it changing?—is something we can't answer now," Christman said.

"In learning which questions we could not answer, we learned which questions needed to be asked," Christman said. In the next phase of their research, Young and Christman will collaborate with scientists from the Fish and Wildlife Service to come up with a statistical model to allow for consistent sampling that will be suitable for analysis.

"Funding is a big issue. A program to answer these questions needs to be done over an extended area over a long time, and it can't be subject to funding vagaries," Young said. "Until we understand it, there's no hope of controlling it, but we have no foundation for answering the questions asked."

No Fishing, No Swimming

On vacation with her family last year in the Blue Ridge Mountains, Nancy Denslow was struck by a sign posted beside a beautiful, pristine-looking lake: NO FISHING, NO SWIMMING.

Denslow, a University of Florida biochemist, was all too familiar with the sign's warnings about rashes, autoimmune disorders, even cancer. She and colleague David Barber at UF's Center for Environmental and Human Toxicology in the College of Veterinary Medicine are researching how chemicals in the environment interact with the endocrine system. Many lakes in Florida also are off-limits to fishermen and swimmers, and studying the inhabitants of those lakes—the fish—provides insight into how contamination might affect other animals, including humans.

"We're all concerned about the chemicals in our environment and how they might be affecting us," Denslow said. "We wonder, 'Was I exposed to something?' There's reason to be concerned."

In studying fish, Barber and Denslow have found that some chemicals disrupt the hormones of fish, mimicking either estrogen or

"Fish are vertebrates, so if a fish is affected, humans could be affected as well ..."

— Nancy Denslow

Drs. Nancy Denslow and David Barber examine a largemouth bass in the aquatic toxicology facility at the University of Florida.

testosterone. These chemicals can masculinize a female fish or feminize a male fish, and that disrupts reproduction. Disrupting reproduction, in turn, can destabilize the populations of species of fish, causing economic and environmental damage.

"Reproduction is tightly regulated, requiring inputs of steroids and hormones at exactly the right time," said Barber, a toxicologist. "But chemicals in the environment can change the ability of hormones to do their jobs."

Normal concentrations of hormones are low, so it doesn't take much to disrupt them. Chemicals commonly found in detergents, pesticides, sewage and industrial wastewater can disrupt the sex hormones of animals that live in the water. In their research, Barber and Denslow have found that an egg yolk protein produced by female fish is showing up in male fish, indicating that the male fish have been feminized by exposure to a chemical.

"Fish are vertebrates, so if a fish is affected, humans could be affected as well," Denslow said. "It's important to understand the mechanism by which these compounds affect reproduction."

Barber and Denslow are careful to say that their research pertains only to fish, who spend their entire lives in the water and are therefore more susceptible to aquatic contamination. The "gender-bending" phenomenon, however, is not limited to fish and has been identified in other species like alligators, oysters, clams and conch.

The researchers have collected data at two Florida lakes, one relatively clean and one that has been contaminated by agricultural runoff. In the uncontaminated lake, the fish exhibit normal characteristics. But in the contaminated lake, feminized male fish and masculinized female fish have been found in alarming numbers.

"Normally plasma steroid levels of males and females would be different, but on these contamination sites, they're not," Barber said.

A contaminated male fish will mate with a clean female, previous research has shown. However, in competition with a clean male, the estrogenized male will not compete for the female fish. Super males also have turned up, and while they may compete to mate with the female, they may not produce as many offspring.

In the laboratory, Barber and Denslow have replicated the conditions in the lakes, using the same fish species (largemouth bass) and same contaminants (organochlorine pesticides), to scrutinize the effects of the chemicals. The laboratory work has shown that the chemicals ultimately cause reproduction to cease.

Florida also is wrestling with how to restore ecosystems that have been contaminated. Lakes with a long history of pesticide runoff could still contain DDT, a now-banned organochlorine that degrades so slowly that for all effective purposes it doesn't degrade. That pesticide already has been shown to interfere with hormones and reduce the number of eggs a female fish can lay, and some sites the state has tried to restore for wetlands have experienced bird die-offs. Barber and Denslow are working with state agencies in figuring out how to restore the contamination sites without harming fish and birds.

Their research is funded by the Superfund Basic Research Program and the Environmental Protection Agency, and as it progresses, Barber and Denslow hope to come up with information that can be used by those agencies for risk assessment. The presence of a contaminant, for example, may not represent a risk if the contaminant is not bioavailable. For contaminants that are bioavailable, the researchers hope to come up with guidelines for how much is safe and how much is hazardous. Using gene arrays, it also might be possible to develop a DNA fingerprint that would tell which pollutant is causing a problem and where it is coming from.

"For years, we only worried about a fish kill," Barber said. "Now we realize that a lot of things we do have unintended consequences. You don't see a lot of dead fish, but in some places the fish are still disappearing.

"Hormones control so much, from the physical to the behavioral," Barber said, "and if you change the balance of hormones, that changes a lot of things."

THE BEACH ECOSYSTEM PROTECTS BOTH BEACH MICE AND PEOPLE

What's good for the tiny beach mouse is good for human beach dwellers and the beach landscape as a whole, two University of Florida researchers are finding.

The pale mice, with big ears and dark eyes, live only in dune habitat, so they are good barometers of how healthy the beach landscape is, said Deborah Miller, a plant ecologist at UF's West Florida Research and Education Center in Milton.

But declines in populations of beach mice—one subspecies is extinct and only one is not listed as threatened or endangered—could be signaling a decline of the coastal ecosystem, said Lyn Branch, a wildlife ecologist in Gainesville.

"The issue is protecting the whole ecosystem, but we don't have an endangered ecosystem act, we have an endangered species act, and we can use it to protect the ecosystem," Branch said. "If we protect the habitat for the beach mice, we protect the infrastructure behind it for people. Large dunes are the best habitat for beach mice and large dunes provide the greatest protection from storm surge for human structures."

"THE ISSUE IS PROTECTING THE WHOLE ECOSYSTEM, BUT WE DON'T HAVE AN ENDANGERED ECOSYSTEM ACT ... "

– LYN BRANCH

Dr. Lyn Branch, Professor, Wildlife Ecology and Conservation

Research into restoration of dunes has advanced in the years since Hurricane Opal hit the Panhandle in 1995, flattening established dunes that stood 10 to 30 feet tall, Miller said. In Opal's aftermath, Miller and her colleagues began to study wood fences—in all shapes, sizes and configurations—as tools for sand accumulation. Researchers also studied sea oats and other vegetation to see which plants best stabilized the sand while providing beach mice with sources of food and cover.

Researchers had mapped the dunes and restoration work in the years since Opal's landfall, so they were ready to assess the effectiveness of various dune configurations as they surveyed the damage nearly 10 years later when Hurricane Ivan arrived in 2004.

Santa Rosa Island's foredunes, those closest to the ocean, had only rebuilt to a height of three to six feet in some areas—not at all in others—and Ivan wiped out most of these dunes, Miller said. During subsequent storms, researchers noted a significant increase in inland erosion, without the foredunes to provide protection.

"After Ivan, we looked at what survived," Miller said. "What we found was that taller and wider dunes—measuring from the Gulf inland—did better. Even if we compared dunes that were the same size in total area, the wider, taller ones did better."

Researchers also found that inland, or secondary, dunes that were not protected by foredunes sustained a lot of damage, pointing out the value of viewing the ecosystem as a whole.

"The foredunes and the secondary dunes behave together," Miller said. "The system develops better if the dunes develop together."

People, however, can be as much of a threat to the beach landscape and the beach mice as storms. More than three-quarters of the state's population lives in coastal counties, and coastal development plays a large role in disruption of the beach landscape by blocking sand movement that builds beaches and dunes and by fragmenting the dune systems.

For the nocturnal beach mice, learning to live in the new environment is difficult, Branch said.

"There are two problems with co-existence," Branch said. "People bring with them cats as introduced predators, and lighting, which exposes the beach mice to predators. The combination of lights and cats is not good."

Beach mice use the frontal dunes and scrub dunes and are dependent on linked habitats that often are no longer linked. Prime habitat for beach mice is the frontal dunes but they must be able to move to the scrub dunes when hurricanes remove the frontal dunes. Development can isolate mice in small pockets, making them more vulnerable to habitat loss from storms.

As long as Florida restores its beaches and dunes—state and federal agencies spent about $200 million on such projects in 2005 alone—the state has an opportunity to do so in a fashion that supports the remaining beach mice, which are unique to Florida. The mixed success of restoration thus far points to a need for more research, Miller said.

"We need better information to use in restoration, and then we'll see better results," Miller said.

Miller and her colleagues are looking at which plants to use, where and when to plant them and how tall the foredunes need to be before replanting woody plants in the scrub dunes. "We want to know how to replace this system," Miller said. "How to do that and meet with success."

Historically, beaches formed and reformed as sand shifted from place to place. However, the natural cycle of beach rebuilding has been disrupted, Branch and Miller point out, and now 38 percent of Florida's 825 miles of sandy beaches are in a state of critical erosion. The beach itself could be endangered.

"These habitats are very much threatened," Branch said, "both for the mice and as an ecosystem, which is of great economic and cultural importance to Florida."

Living with Citrus Canker

The era of citrus canker eradication in Florida drew to a close in 2006. After spending millions of dollars and destroying millions of trees, the state finally threw up its hands in defeat.

But the failed canker eradication program has given way to a canker control program that may be one of Florida agriculture's major successes, two University of Florida citrus researchers say.

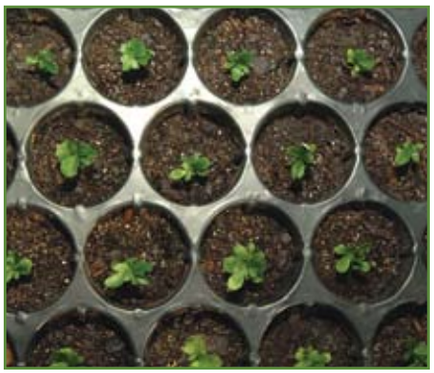
While it may not be possible to eradicate canker, the researchers say it is quite possible to adapt to canker and thrive.

Scientists at UF's Citrus Research and Education Center in Lake Alfred have been preparing for the possibility of having to live with canker for years. Soil microbiologist Jim Graham has been involved both in canker eradication efforts in Florida and in canker control research in South America for more than 20 years. As Argentina and Brazil have refined their methods for coping with canker, Graham and his colleagues have been taking note of the practices that have succeeded, and they are ready to pass that information on to Florida growers. This educational program has reached hundreds of growers and Graham is even taking

"After Hurricane Wilma, citrus canker had spread too far and wide to eradicate ... "

— Jim Graham

Dr. Jim Graham, Soil Microbiologist, counts bacterial colonies on an isolation plate from infected citrus seedlings.



groups to South America to see canker control in action.

"Because of our experience in South America, we were prepared for this," Graham said. "In Argentina, they have highly regimented production and packinghouse practices to produce clean, asymptomatic fruit."

Citrus canker is a bacterial disease that causes premature leaf and fruit drop and unsightly lesions on fruit. The disease reduces the quality and yield of fruit. People can readily spread the bacterial pathogen on hands, clothes or agricultural equipment. The bacterium also travels with wind-driven rain, which drives the pathogen into natural openings and wounds on fruit and leaves, causing infection.

Canker was first discovered in Florida around 1912, probably brought in on imported seedlings from Japan. It was eradicated in 1933. In 1986, it reappeared and again was eradicated. In 1997, the state entered its last phase of eradication, removing or cutting back 1.56 million commercial trees and 600,000 dooryard citrus trees.

Common thunderstorms spread canker, so the hurricanes of 2004 and 2005 made eradication a losing battle.

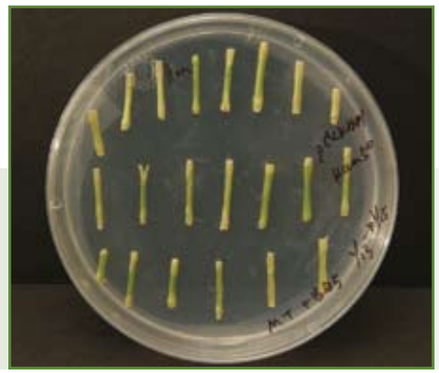
"After Hurricane Wilma, citrus canker had spread too far and wide to eradicate any longer," Graham said. "It no longer made sense. The cost of losing more trees to eradication was just too great."

Graham said eradication of mature trees depleted groves, but eradication of infected and exposed nursery trees left growers without the stock needed to replenish. Almost overnight, 62 percent of nursery trees were destroyed. Although one recommendation to growers is to replant with varieties that have more resistance to canker, these trees are not yet widely available in nurseries.

Management methods come with costs. Copper sprays control canker, but a grower needs to determine how many times he can spray and still make a profit. Overspraying also risks copper damage to the fruit and accelerates copper accumulation in the soil. Thanks to their experience in South America, Graham and his colleagues have been able to provide recommendations that tailor copper spray programs according to the variety's susceptibility to canker to minimize environmental and economic costs.

Windbreaks offer another solution, providing a barrier to wind-blown canker, although growers give up citrus-producing land and usually need to wait five years for the windbreaks to grow high enough. Other recommendations include decontaminating workers and equipment as they move from infected areas to non-infected areas, and growing nursery trees in greenhouses that shield them from exposure to canker inoculum.

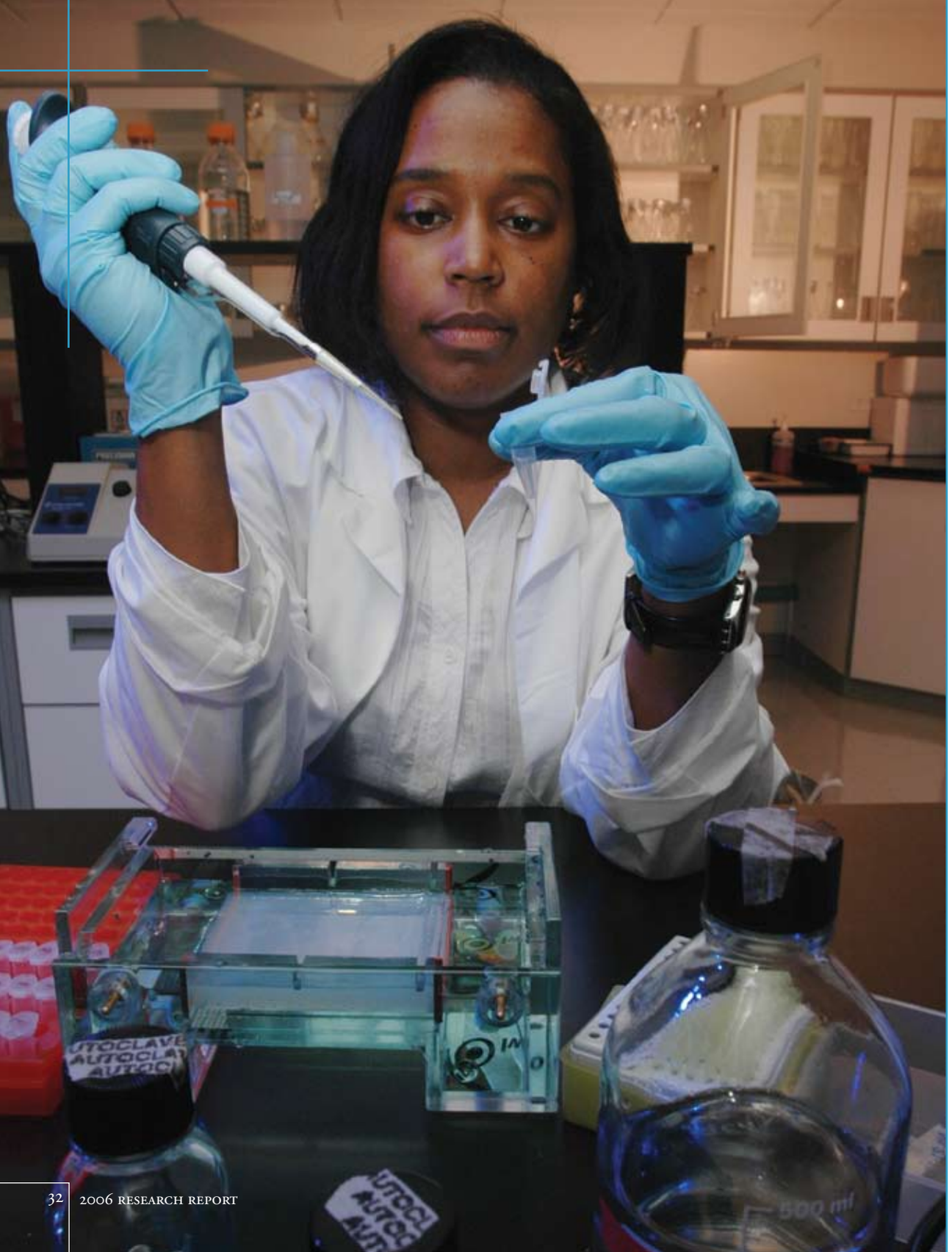
"Argentina manages so well using these methods that the presence of canker there is difficult to detect," Graham said. "What works in South America should work in Florida, too."



In the future, citrus canker management will require coming up with more resistant varieties, both through conventional breeding and genetic engineering, said Bill Dawson, the J. R. and Addie S. Graves Endowed Chair in Citrus Biotechnology.

"In the long term, we will need to develop plants that won't respond to the disease," Dawson said. "We will need to locate or breed better varieties."

The transition from canker eradication to canker control will greatly change the industry, the researchers said, but it shows the strength of UF's long-term commitment to citrus research.



Molecular Profiling

As a child in a military family, Chelsea Smartt spent four years in Africa. Toward the end of her father's tour of duty, Smartt's 14-year-old brother contracted malaria from a mosquito bite. The experience made a big impression on Smartt, then 9, and today the University of Florida molecular biologist's research program revolves around mosquitoes.

"I like mosquitoes, actually," said Smartt.

She came to the right place. Smartt arrived two years ago at UF's Florida Medical Entomology Laboratory in Vero Beach. The laboratory, which specializes in research on biting insects, is perched on the edge of mosquito paradise, 38 acres of hammock and marsh buzzing with mosquitoes.

"Most of the professors here have a mosquito biology background, and there's a concentration of knowledge on vectors of disease and transmission. We can ask questions and bounce ideas off each other," Smartt said. "It's also novel to have a lab combined with mosquito ecology. You can get a better understanding of what the mosquito is doing in the wild."

Because of their personal experience with malaria, Smartt's family appreciate the goal of her research: to prevent transmission of mosquito-borne pathogens by disrupting how mosquitoes use their blood meals.

In order to infect the mosquito host, a pathogen must pass through the mosquito's gut, Smartt said. So research into how the mosquito gut processes blood and pathogens is important in coming up with ways to control mosquito-borne diseases.

Dr. Chelsea Smartt adding genetic material to an agarose gel. This solid support can be used to see genetic differences between mosquitos infected with a pathogen and those that are not infected.

"It's like a person taking a food meal in the stomach. Different proteins are turned on to digest and break down the food to use it," Smartt said. "In mosquitoes, proteins are turned on after the blood comes in. So, if we can tease out the actual proteins, we can use them to inhibit parasite transmission in diseases like West Nile. We need to find one or more proteins we can use."

Smartt is working with the *Culex nigripalpus* mosquito, one of the main species that transmits the West Nile virus. By discovering which genes turn on and off after a blood meal, she hopes to isolate a gene that can be manipulated and use it to disrupt the digestion of the blood meal or interfere with development of the parasite in the gut. Disrupting digestion would keep the female from laying eggs, leading to control of the mosquito population, and interfering with the parasite would prevent its transmission to a person or animal.

Smartt also is looking into factors that allow some mosquito species to transmit disease while others cannot. The C*ulex nigripalpus* mosquito, for instance, is especially good at transmitting West Nile virus.

"There are a lot of mosquitoes in the world but not all are able to transmit a parasite," Smartt said. "What makes one able to do it and not another?"

If her research identifies a promising protein, Smartt could either leave it out or modify it to determine whether it in fact plays a role in disrupting transmission of disease.

"More than likely, it is not one protein, but a pathway, using two or three proteins," Smartt said.

While the release of mosquitoes genetically engineered without the proteins—and without the ability to transmit disease—would be in the distant future, a short-term possibility could be development of an insecticide that interferes with the blood meal.

Working with the C*ulex nigripalpus* means treading new ground, something Smartt especially likes about her research.

"Most researchers haven't worked with *Culex nigripalpus*, so it is uncharacterized at the molecular level," Smartt said. "Any information on its genes is novel. Anything furthers the field."

"IF WE CAN TEASE OUT THE ACTUAL PROTEINS, WE CAN USE THEM TO INHIBIT PARASITE TRANSMISSION IN DISEASES LIKE WEST NILE."

– CHELSEA SMARTT

INTERNATIONAL WORK FOSTERS PEACEFUL COLLABORATION

At first glance, the University of Florida might not appear to have much of a stake in science in Uzbekistan.

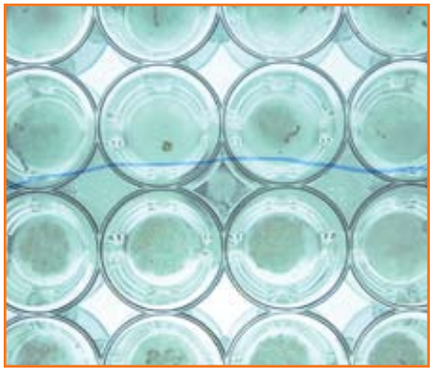
But as people travel around the world in greater numbers these days, so do pathogens, making global scientific collaboration ever more important, said UF researcher Christopher Mores.

Mores, a scientist at UF's Florida Medical Entomology Laboratory (FMEL) in Vero Beach, is part of the Cooperative Threat Reduction program, created by Congress following the fall of the Soviet Union to keep weapons of mass destruction out of the hands of rogue states and terrorists. In Uzbekistan, he is helping scientists modernize a Cold War-era biological research facility and shift its focus from weapons of mass destruction to peaceful science to protect people from pathogens. After his first visit in 2004, he knew he had his work cut out for him.

"The personnel were impressive but the state of the lab was quite bad," Mores said. "After the breakup of the Soviet Union, a lot of materials and equipment moved back to Russia, so there was a dearth of equipment, to put it mildly. Yet they were still doing good, classic work. Today, it's a fully functional facility, much safer, with a full molecular lab and western equipment. They have incredible capabilities now. The place is always buzzing, and they're producing a fantastic amount of data now."

The turnabout didn't happen overnight. Mores has visited Uzbekistan a half dozen times and navigated the regulations of two governments. He also has helped the scientists update their training and

Dr. Christopher Mores (top) examines tissue cultures for viral pathogenesis, while Dr. Stephanie Richards (bottom) dissects experimentally infected arthropods for further testing.



techniques, both in Uzbekistan and in visits by the Uzbek scientists to the FMEL. Today, the Institute of Virology functions as a national-level facility, much like the U.S. Centers for Disease Control and Prevention. The work of the lab focuses on arthropod-borne viruses, so scientists collect ticks and mosquitoes for virus testing, and test human and animal blood for the presence of antibodies. The work has led to joint research by UF and Uzbek scientists, along with journal publications and conference presentations.

The formerly Soviet scientists wholeheartedly embraced the shift in their work, Mores said.

"The thing to realize is that in the Soviet Union, biological weapons was THE place to work. They did the work because of the native science, the interest in what's out there, not from a nefarious desire. They're scientists, just like us. Now they can use their science to protect the health of the people of Uzbekistan."

Mores said his role in detecting any illicit use of pathogens first requires understanding how those pathogens occur naturally. That requires a knowledge of patterns of outbreaks, what strains of viruses look like around the world and when they occur. Uzbekistan has a number of arboviruses known to cause diseases in humans and animals, among them Crimean Congo Hemorrhagic Fever, which appears in small outbreaks throughout the year that need to be controlled before they become full-blown. The tick-borne disease has a 30 percent mortality rate and appears in a large swath from West Africa to Siberia.

The work benefits not only the people of Uzbekistan and nearby Central Asian countries, but the people of the United States as well.

"In Florida, we have so many invasive plants and animals, why shouldn't we be concerned about invasive pathogens as well? With major seaports and airports and a large immigrant population, the list is exhaustive of things that could find root in Florida," Mores said. "There is always something on the horizon we need to be on the lookout for."

Mores said international collaboration broadens the expertise that all scientists can draw on in identifying and controlling pathogens. Hundreds of arboviruses are known, but hundreds more likely have not been detected yet. The field is full of questions that need to be answered, but not enough researchers to give each virus full attention.

"Being involved in international research helps us prepare for the uninvited guests to Florida," Mores said. "It's not easy working half a world away, but the rewards are easy to see. It's good science."

"There is always something on the horizon we need to be on the lookout for."

— Christopher Mores

FINDING WHAT WORKS FOR FARMERS AND THE ENVIRONMENT

Since the early 1990s, farmers in the Everglades Agricultural Area (EAA) have been trying to balance the needs of their crops with the needs of the fragile Everglades ecosystem downstream.

Using best management practices, or BMPs, developed specifically for the area, their successes have been stunning, says University of Florida soil scientist Samira Daroub. By law, they were required to reduce phosphorus runoff by 25 percent, but they are averaging reductions more than twice that level. Some years, phosphorus reductions have reached 70 percent.

But varying results from farm to farm and year to year keep farmers and Daroub and her colleagues at the Everglades Research and Education Center asking questions.

"We have 100 percent of the farmers using BMPs," Daroub said. "So why do some farms do better than others, when all of them are implementing similar practices?"

"We now have a database of 10 years of field research we can look at to see what factors affect BMPs in the area."

"... OUR FOCUS IS ON HELPING THE FARMERS IMPLEMENT THE BMPS WIDELY AND CORRECTLY. WE WANT TO GIVE THE GROWERS BETTER ANSWERS ON WHAT WORKS ... "

— SAMIRA DAROUB

Right to Left: Dr. Samira Daroub sampling soils from the EAA with the help of exchange student Lucia Orantes-Cabrera and Dr. Orlando Diaz, Research Associate at Everglades Research and Education Center.

The Everglades Agricultural Area (EAA) borders the southern shore of Lake Okeechobee and is home to sugarcane, sod, rice and vegetable farms. Historically, agricultural runoff from the farms drained into the fragile Everglades ecosystem. One of the problems was phosphorus, which is beneficial as a nutrient for crops, but disruptive to native plants in pristine ecosystems.

From her post at the Belle Glade research center on the edge of the Everglades Agricultural Area, Daroub studies ways to manage agricultural phosphorus levels and educate growers.

Much of Daroub's research is conducted on-site at farms, giving her a real-world view of how to apply the science. After heavy rains, water is generally pumped off farms and into South Florida Water Management District canals. Managing the water flow in farm canals is one way she has identified for reducing phosphorus runoff. For example, if water in a canal is moving at a high speed, more of the sediment on the canal bottom will be suspended and transported with the water. The suspended sediment—and the phosphorus embedded in it—is then carried out of the area and will contribute to the EAA basin phosphorus load.

Reducing the speed at which the water is pumped helps reduce the erosion of the canal sediments. Daroub also has found that keeping a minimum water level in the agricultural canals helps because deeper water moves more slowly.

Routine cleaning of canals also reduces phosphorus transport out of the EAA, Daroub said. During the dry season, some farmers remove sediments from canal bottoms and spread the sediments on fields, allowing the phosphorus in the sediments to act as a fertilizer. The main drawback, she said, is the expense of such an operation.

Another beneficial, but expensive, method of managing phosphorus levels is controlling the growth of floating aquatic weeds in the canals, because the plants soak up phosphorus and move with the drainage water downstream into the natural ecosystem.

In addition to research, Daroub also is involved in outreach to growers, in workshops and in one-on-one BMP consultations on the farms. Although most farmers started using BMPs because of the legal requirement, many now come up with their own ideas to run by her.

"They've incorporated BMPs into everyday farming practices, and they like to be updated," Daroub said. "They know the science, they're very well-educated, so they come to us with questions, and we work together to answer them."

The growers also contribute to research via the Everglades Agricultural Area Environmental Protection District, in which they tax themselves to pay for environmental research in the area. The Florida Department of Environmental Protection and the South Florida Water Management District also have funded the research, which has attracted $3 million in grants in the last six years.

Fine-tuning the BMPs is a process, and Daroub said there is always room for improvement.

"Nowadays, our focus is on helping the farmers implement the BMPs widely and correctly," Daroub said. "A lot of things work, but maybe they could work better. We want to give the growers better answers on what works, what doesn't and how to implement this research on farms in the Everglades Agricultural Area."

DEVELOPING NEW VARIETIES OF POTHOS

Many gardeners know the popular golden pothos as the houseplant you just can't kill, no matter how brown your thumb.

But researchers know it as a stubborn laboratory subject that resists efforts to hybridize it, no matter how sophisticated your science.

University of Florida plant geneticist R.J. Henny and plant physiologist Jianjun Chen, however, are breaking down the pothos' resistance to change in a project that promises to produce the first new pothos variety in decades.

"The pothos is very popular worldwide because it is so easy to grow," said Chen, who works with Henny at UF's Mid-Florida Research and Education Center in Apopka. "It's one of the top 10 foliage plants worldwide, but it never flowers in nature so we can't hybridize it."

Homeowners who grow the plant simply by snipping off a stem and sticking it in water or potting media might wonder what the problem is. But it is precisely that means of cultivation, through cuttings, that makes pothos seemingly unchangeable.

"IT'S MORE THAN JUST APPEARANCE. IT HAS TO GROW WELL AND BE RELIABLE. THE ECONOMICS MATTERS."

— R.J. HENNY

Left to right: Drs. Jake Henny and Jianjun Chen examine a pothos plant regenerated from somatic embryogenesis.

Propagating a plant with cuttings means that the next generation shares the same genetic material as the last generation, producing little change over time. Plants that are more easily changed are propagated with flowers and seeds through sexual reproduction, which makes genetic variety more likely. Since the pothos does not naturally produce flowers or seeds, Henny and Chen needed to find a way to alter pothos asexually.

So resistant is the pothos to change, that while many other plants have 50 to 60 cultivars, or varieties, the pothos only has three, and they have been on the market for several decades.

That presented a challenge to Chen and Henny. In a project that started three years ago, they have developed a method to propagate pothos in tissue culture. To do this they take small leaf sections, about 1 square centimeter, put the pieces onto a growth medium and induce embryo-like structures. The embryonic structures are susceptible to manipulation and increase the possibility of mutations, called *somaclonal variation*. Several mutants have been identified, which can lead to potential new cultivars.

And in variety, there is money to be made.

Foliage plants, those grown for their leaves rather than their flowers or fruit, are one of the most rapidly growing sectors of U.S. agriculture, Henny and Chen said. The wholesale value of foliage plants in the United States increased from $13 million in 1949 to $721 million in 2005. Florida leads the nation, accounting for more than 55 percent of the national wholesale value of foliage plants since the 1960s. One reason is that Florida foliage growers keep consumers interested by continually bringing new varieties to market.

"With ornamentals, the question is, what's new?" Henny said. "But it has to be better also. It's more than just appearance. It has to grow well and be reliable. The economics matters."

Tissue culture also can provide nursery owners with a way to revitalize their stock with clean, disease-free plant material. Currently, pothos cuttings are imported from Central and South America, which opens up the potential for pathogens to move into the United States along with the plants, Chen said. Although nursery owners could use their own cuttings, doing so requires too much greenhouse space and labor.

Tissue culture is not the only tool the researchers have tried in their efforts to change pothos. Henny has used irradiation, which has resulted in two plants with shorter vines and smaller leaves. He also has tried getting the pothos to produce flowers and seeds, something it doesn't normally do.

"It's extremely difficult to induce flowering; there are all kinds of problems, and it will never be routine procedure," Henny said.

The researchers, however, have one unique hybrid that is currently being propagated for further testing prior to release.

The somatic embryogenesis techniques the researchers are using may have future applications, Chen said, perhaps in bioreactors that produce millions of plants quickly. Somatic embryogenesis also may be useful in transgenic plant production methods that allow for genetic material from one plant to be inserted into another plant.

For now, though, using it to change the stubborn pothos may be revolutionary enough.

LUCKY CALL LEADS TO UNPRECEDENTED INSECT ERADICATION EFFORT

University of Florida entomologist Rudolf Scheffrahn was going about his work at the Fort Lauderdale Research and Education Center when a call came in. A pest control operator treating a home had come across an insect that looked like an ant but ate wood, and he was puzzled.

"He had gone to a house in Dania Beach, and he said I needed to come out and take a look. When I got to the house, it was infested by a termite I'd seen many times on survey and collection trips to the Caribbean and South American," Scheffrahn said, recalling his 2001 visit to the home.

"But I was shocked to see it in Florida."

The pest was a tropical tree termite, and it had Scheffrahn worried. The termite was found far beyond the confines of the house and yard the pest control operator had inspected, in an area of about 40 acres, and Scheffrahn knew it could munch its way to Orlando and Tampa before colder temperatures in North Florida stopped it.

Convincing state authorities of the danger was another thing. If the pest had been gnawing on a major state crop, like citrus, there would have been millions of dollars and a league of people to help, Scheffrahn said. But it was an urban, structural pest, and those usually are left to homeowners to control.

Scheffrahn and UF entomologists Brain Cabrera and Bill Kern enlisted the help of Steve Dwinell, of the Division of Agricultural

Left to right: Drs. Bill Kern and Rudi Scheffrahn inspect a nest of the invasive arboreal termite, *Nasutitermes corniger*, collected in Dania Beach, FL.

Environmental Services at the state Department of Agriculture and Consumer Services. Dwinell understood the urgency of the problem, and was instrumental in forming an emergency task force.

The UF researchers discovered that two common pesticides would work on the tree termite, and Dwinell helped them get special use permits to use them on the new pest. One pesticide, for example, was approved only for use in structures, but the arboreal termite had infested tree canopies throughout the area. By 2003, the team was ready to start treatment.

"Originally, there were hundreds of colonies, and millions of insects can be in one colony, so we estimated there were hundreds of millions of termites," Scheffrahn said. "It was a fire that was spreading."

The team entered a cycle of surveying, locating infestations and treating them, then repeating the cycle again six months later. In December 2006, only three young colonies, not yet old enough to reproduce and multiply, remained. Those colonies were treated, and Scheffrahn anticipates that June's inspection will reveal no survivors.

"This is the first example of a social insect successfully eradicated in the United States and one of the first in the world," Scheffrahn said. "At least in the United States, this is unprecedented."

Scheffrahn said the insect likely hitched a ride to Florida on a boat that had traveled through the Caribbean. The termites have been found in the hulls of boats and in shipping containers. If a boat carrying the insects docked during flight season the insects—attracted to the city lights—would have flown toward land, Scheffrahn said.

Once established, the termites began to build nests on the ground, in trees and in structures. In late 2005, Hurricane Wilma assisted the eradication team by clearing out deadwood, making it easier to spot treetop nests. On structures, an infestation is easy to spot because the termites leave dark tubes as they tunnel up the sides of buildings.

Scheffrahn said he is particularly proud of what the scientists, regulators and pest control operators accomplished on a shoestring. With an investment of $50,000, they eradicated a pest that could have spread and ultimately caused more than $100 million in damage per year.

"When we get a report of a pest, we need to always take it seriously," Scheffrahn said.

The team approach to eradicating the tree termite has led to a better rapport with regulatory agencies, which now have a better understanding of the costs associated with non-agricultural pests, Scheffrahn said. The pest control industry will continue to play an important role, too, on the front lines.

"They are our eyes and ears out there. They see and treat thousands of homes," Scheffrahn said. "They need to identify a pest before they treat it."

When they see another puzzling pest, Scheffrahn said he hopes they will seek help, adding, "There was a lot of luck in that first phone call."

The tree termite likely won't be the last to land on Florida's shores.

"We certainly haven't seen the end of exotic termites. I've seen a number of pest species in offshore areas near Florida," Scheffrahn said. "We need to be ready to deal with whatever shows up."

"This is the first example of a social insect successfully eradicated in the United States and one of the first in the world."

– Rudy Scheffrahn

Helping Farmers Cope with Tomato Diseases

Since 1981, University of Florida horticulturist Steve Olson has watched farmers battle tomato diseases.

In severe cases of bacterial wilt, he has seen farmers abandon their tomato fields or turn to less-lucrative crops. He even knows of farmers who gave up and sold these farms.

Working at UF's North Florida Research and Education Center in Quincy, in the midst of a 5,000-acre tomato-growing region, Olson and plant pathologist Tim Momol don't have to go far to see the need for their research on bacterial wilt, bacterial spot and tomato spotted wilt virus.

"Gadsden County is bigger in tomatoes than many states," Olson said. "Tomatoes are important in Florida, important in the diet, and they're a cash crop for growers when they do well."

In fact, Florida tomatoes account for 65 percent of the $1 billion value of the U.S. tomato crop. Tomato diseases, however, can cut into profits.

Left to right: Horticulturists Drs. Steve Olson and Tim Momol discuss results of a bacterial spot experiment in a greenhouse.

Olson has seen crop losses as high as 100 percent from bacterial wilt, a soil-borne disease that historically is most severe in North Florida and South Georgia. The disease spreads easily on soil, on stakes and on the clothes and hands of field workers.

"Several thousand acres have gone out of tomato production due to bacterial wilt in the southeast," Olson said. "Once it gets in the soil, you have to abandon the farm or grow another crop."

Like bacterial wilt, bacterial spot thrives in Florida's warm, humid climate, Momol said. Bacterial spot, too, is moved by people and equipment and even by wind-driven rain, making it a widespread disease from Ohio to the Caribbean. While copper sprays help, resistance to copper is widespread in Florida, and the copper can build up in the soil, possibly causing problems in the future.

To manage tomato diseases, the researchers are turning to integrated crop management.

"We want to control plant diseases by focusing on the production system rather than on pesticides," Momol said. "In integrated crop management, you look at the whole cropping system. Sometimes when you change one thing, you have no idea the ripple effect it will have, so you have to look at the whole picture."

One example of using integrated crop management occurred recently when the researchers were trying to figure out why a field that had been free of disease suddenly became contaminated. They looked for a pattern of contamination and found the culprit.

"The farmer would plant, the field would be disease-free, then in a short period of time, the field would be contaminated," Olson said. "We found it was the water used for irrigation."

It was the first time bacterial wilt had been found in irrigation and surface water in the United States. Within 15 days of targeting the source of infection, the researchers had met with farmers and come up with a solution. A small amount of chlorine added to irrigation water can prevent this source of infection.

"That's the advantage of being here in the middle of the industry," Momol said. "We were able to talk to the growers at a breakfast meeting and change the production practices in a short turnaround time."

The researchers also have identified new compounds, such as thymol and yucca extract, that help in field management of bacterial wilt. These plant-derived compounds act as a bactericide. The researchers hold a U.S. patent on use of thymol against bacterial wilt. Momol said thymol can reduce a 90 percent rate of disease incidence on a field to 15 to 20 percent.

Momol and Olson have had some success with bacterial spot, too. Working with UF plant pathologist Jeff Jones in Gainesville, the researchers are using bacteriophages, viruses that infect bacteria, in treating plants for the disease. Combining bacteriophages with Actigard ®, which stimulates the tomato plant's natural resistance to bacterial spot, works better at controlling bacterial spot than using problematic copper sprays alone, Momol said.

For tomato spotted wilt, the researchers are using plant-derived essential oils as a repellent for thrips, a tiny insect that carries the virus. Using the natural compounds helps growers avoid using chemical insecticides, a big goal of integrated crop management practices.

Olson said breeding tomato plants with resistance to the virus will play an important role in helping farmers combat the disease. He and Momol work with tomato breeder Jay Scott, based at UF's Gulf Coast Research and Education Center in east Hillsborough County, on trials that evaluate plants with resistance as well as material from commercial breeders.

Olson said tomato farmers are receptive to research and open to new suggestions.

"If we can show them a better way," Olson said, "they will try it and see how it does."

"Tomatoes are important in Florida, important in the diet, and they're a cash crop for growers when they do well."

– Steve Olson

THE SCIENCE OF CLEAN WATER

The Biscayne Aquifer is the liquid heart of South Florida, supplying drinking water for more than 2 million people and fresh water for the fragile ecosystems of Biscayne and Florida bays.

So important is this resource that University of Florida water scientists Yuncong Li and Kati Migliaccio have made water the focus of their research and extension activities at UF's Tropical Research and Education Center in Homestead.

Li is collaborating with colleagues to plan an outreach program he calls the Water Academy, and he believes the Homestead research center would be the perfect site.

"We already provide water quality training for extension agents in four counties and we would like to expand that to other counties and local environmental groups and federal agencies," Li said. "This would make our research more accessible to the public."

Li already is working with the Miccosukee Indian tribe to monitor water quality on 189,000 acres the tribe owns. The tribe has long been concerned that water flowing onto the land is not clean enough. Under the Everglades Forever Act, water flowing into the natural area should contain no more than 10 parts per billion of phosphorus. In his water sampling program, however, Li has found that phosphorus levels are higher.

Li has established five monitoring stations from which he collects weekly samples and one site that is so remote that samples are collected every other week by helicopter. Li's data are being gathered into a database that can be used to analyze changes in the water quality over time as activities outside the Miccosukee land change and affect the water quality on the tribe's land.

Left to right: Drs. Yuncong Li and Kati Migliaccio use a rainfall simulator to research water and nutrient movement in a gravelly calcareous soil in South Florida.

Migliaccio's research focuses on those activities outside Miccosukee land and complements Li's studies. In work funded by the USDA, she is investigating how best management practices, or BMPs, for irrigation and nutrient management affect water quality.

In one of her projects, on papaya, she evaluated irrigation treatments that reduce water usage by 80 to 90 percent. In another study, on a palm tree farm, she found that water use could be cut by 95 percent and fertilizer use cut in half without changing the height, diameter or color of the trees.

Traditionally, water has not been a limited resource for South Florida farmers, Migliaccio said. But as the area has grown, so has pressure on the water supply, and that has prompted more research.

"It shows how much money can be saved on fertilizer and irrigation," Migliaccio said. "All the studies have resulted in even more water savings than I could have imagined."

"Our findings indicate it may be even better for the plant to have less water," Migliaccio said, "and it's nice to be able to give the growers better information."

For the experiments, Migliaccio measured water and nutrients both in the root zone and below the root zone. In the root zone, the plant has access to the water and nutrients. The amounts that seep below the root zone, however, are not available for the plant, which tells Migliaccio how to better manage water and fertilizers.

"Irrigation affects nutrients, and this helps us determine the combined effect of nutrient and irrigation practices," Migliaccio said.

Although Migliaccio began her research with an ecosystem focus, she discovered agronomic benefits as well. For the palm study, Migliaccio worked in real-world conditions at a grower's farm, an experience she found valuable.

"It's different in a field than in a research plot. Now I've seen both sides," Migliaccio said, "and this gives some sense of what's practical, so I can gear my research toward things growers can use.

"My research is interesting from a science point of view," Migliaccio said, "but it's practical, too."

"ALL THE STUDIES HAVE RESULTED IN EVEN MORE WATER SAVINGS THAN I COULD HAVE IMAGINED."

– KATI MIGLIACCIO

FEATURED SPOTLIGHT

PLANT SCIENCE UNIT IS A SMORGASBORD OF RESEARCH

As research director at the University of Florida's plant science unit in Citra, Danny Colvin oversees 450 experiments at any given time.

Blueberries here, potatoes there. Irrigation systems aboveground and below. Organic oranges and cold-tolerant oranges. Fertilizers on this plot, pesticides on another. Forage grasses on this pasture, the dreaded tropical soda apple on another. Nematodes underground, barn owl boxes on posts. Until recently, Colvin even loaned space to UF engineering students who needed room to test the robotic car they displayed at the National Championship game.

Colvin is surrounded by science—1,068 acres of it to be exact.

"We have wonderful laboratories, greenhouses and other facilities in Gainesville," Colvin said, "but until the development of the plant science unit, there was no comprehensive place to grow crops for Gainesville-based faculty."

Just 18 miles south of Gainesville, the Citra unit's gently rolling acreage has something for almost any agricultural researcher. About

"AGRICULTURAL RESEARCH IS STILL HANDS-ON, THERE'S STILL A LOT TO BE DONE."

— DANNY COLVIN

Danny L. Colvin, Director, Plant Science Research and Education Unit

115 researchers use it for experiments, teaching and demonstrations. Colvin, an agronomist by training, gave up his own weed science research when he saw the Citra site's potential for furthering the wide range of research in UF's Institute of Food and Agricultural Sciences. One of the main advantages was access to an actual farm.

"When I first joined IFAS, each faculty member maintained his own tractor, equipment, et cetera," said Colvin, recalling his arrival on campus in 1984. "Older faculty members had the tractors and equipment they needed for field work, but younger ones had to beg and borrow."

Or steal.

"One of the biggest arguments I ever saw was over irrigation pipes," Colvin said. "The pipes were painted on the end with a color designating which faculty member owned them. One guy painted over another guy's color."

Clearly, there had to be a better way. In 1995, when beef cattle research moved to other locations, the Citra site, donated to UF in 1972, was dedicated to plant science research. Colvin became its overseer.

"Now the faculty members don't have to spend half a day to get a machine to work for the 15 minutes of planting they need to do," Colvin said. "They tell us how they want it done, and we do it."

As a farmer—he was raised on a peanut and cotton farm in southern Alabama and has farmed peanuts himself—Colvin had the practical experience the job requires. And as a scientist, he understands what the researchers need.

"Here the researchers have a staff that understands statistics and research, who can see the big picture and understand what is important today," Colvin said. "Most researchers don't have hands-on experience with how to hook up a tractor to a breaking plow, and here they don't need to. They can focus on research."

The Citra site represents agriculture at its most precise. Using a global positioning system, or GPS, the farm is laid out on a grid, in blocks of 200 square feet. Each block has been drilled, so that the soil can be characterized at all depths. For each block, there is a historical record of the chemicals applied to it.

One section of the farm has eight miles of underground pipes for use in drip irrigation studies. Huge overhead irrigation systems also are available. In one experiment, satellites flying overhead transmit data back to the station.

The farm has three soil types and microclimates, providing a range of conditions for researchers. The main station for FAWN, the Florida Automated Weather Network, also is on the Citra site.

Researchers in Gainesville can access the grid by computer to find a certain soil for a certain crop, or to find a plot that might work for a study of how long a certain chemical stays in the soil.

Faculty members get an e-mail when their plots receive applications of fertilizers or pesticides.

On the eastern edge an arboretum designed to have 90 percent of Florida's common trees is springing up. Nearby, a 51-acre plot has been certified as organic. Another site is set up to study robotic harvesting. Wildlife studies are possible, too. Sandhill cranes migrate through the site, and it is populated by gopher tortoises.

Unlike a real farm, the Citra site is set up for quick change and unusual requests by researchers, like one crop grown with different row-spacing. Weeds are planted and nematodes released to study methods of controlling the crop pests.

"A real farmer would have a fit," Colvin said, "but we'll do it to accommodate our researchers, just to see what happens for the sake of science."

Colvin said the farm houses the finest turfgrass research facility in the United States. This section looks almost surreal, its miniature athletic field bracketed by a goalpost on one end and a soccer goal on the other, and sprouting a dozen different turfgrasses. Next to it is a baseball infield.

Nearby are three golf fairways, complete with greens and tees and even more varieties of grass being tested. Colvin said a machine with soles of golf shoes is rolled across some experiments to see how the grasses hold up under extreme foot traffic. A water hazard on one hole has sensors that measure how much fertilizer goes into the pond. A 9-hole putting course, again planted with different grasses, sometimes is used to introduce very young children to golf.

"If it's a grass that can be grown in Florida, it's here," Colvin said. "There's even a grass that can be watered with salt water, so we add salt when we irrigate it."

Disputes over tractors and pipes are a thing of the past.

"Agricultural research is still hands-on, there's still a lot to be done," Colvin said. "But there are no more arguments over who gets watered or who gets planted. We service all the researchers with any field experiment they wish to study, whether they have been at UF thirty years or just joined the faculty last month."

FEATURED SPOTLIGHT

KEEPING THE FOCUS ON RESEARCH

University of Florida fisheries and aquatic sciences Professor Dan Canfield teaches and conducts research. He is the founder of Florida LAKEWATCH, a citizen-volunteer water quality monitoring program now being emulated internationally.

He brings in more than $1 million a year in his research program. While he is an expert on water resource policy and aquatic ecosystem management, he is not an expert in legal terms and accounting. Nor does he want to be. And that's where Nancy Wilkinson comes in.

"When I go into Nancy's shop, they take care of the paperwork," Canfield said, "and I continue with my research."

Wilkinson's "shop" is the Institute of Food and Agricultural Sciences' Sponsored Programs office. The office handles both pre-award and post-award matters for the more than 900 faculty members in IFAS. It's a big job. In the 2005-2006 budget year, the office processed more than 1,000 grant applications, seeking almost $200 million in research funding.

Wilkinson, director of Sponsored Programs since December 2004, said she views her office as a service unit for researchers.

"We're trying to be sure we keep the faculty focused on what they do best, which is research," Wilkinson said.

IFAS Sponsored Programs Staff

Nancy Wilkinson, Director, IFAS Sponsored Programs and Director of Finance, Florida Agricultural Experiment Station

The office is unusual in that it services both ends of the grant process from one location. On the pre-award team, Wilkinson said, her staff reviews each grant application before it goes out to be sure that the legal terms and conditions can be met both by the granting agency and by UF. More and more, grant applications are being done electronically, and the pre-award staff is trained to buffer the researchers from the technological complications that sometimes are encountered with electronic processing.

For the post-award team, the job focus is more on finance and accounting. These team members follow the money, making sure the approved funding from the granting agency is released into the proper accounts. They then prepare an accounting of expenses and submit the invoice to the sponsor to obtain payment for UF/IFAS.

"It's not unusual to have a faculty member with three or more awards, all with different requirements, and we need to help them meet those requirements," Wilkinson said. "And when the money arrives, we provide the proper stewardship."

Wilkinson brings 25 years of experience to the job. She started her career at UF in the 1980s and "caught the bug for research administration." She went to Emory University to create a sponsored programs office there, eventually moving on to head sponsored programs at the University of Wisconsin-Madison, a perennial top-five university in attracting research funding.

She returned to UF in 2004 for the unique challenge of revamping a combined pre-award and post-award office—IFAS Sponsored Programs—on a more personal scale, where there is plenty of contact with the faculty.

"In the college environment we have here, the customer is the faculty, and we are close to the faculty," Wilkinson said. "If they need help, we're right here. It's terrific."

The office is working on improving response times and speeding up the movement of paperwork by revising processes and bringing on more personnel. As the level of funding has grown—$70 million moved through her office last year—the level of paperwork has grown, too. Still, she said, the process needs to "happen quicker, faster."

Canfield has no doubt she can make that happen. At Sponsored Programs, he said, he gets the personal attention that makes him feel like "a big fish."

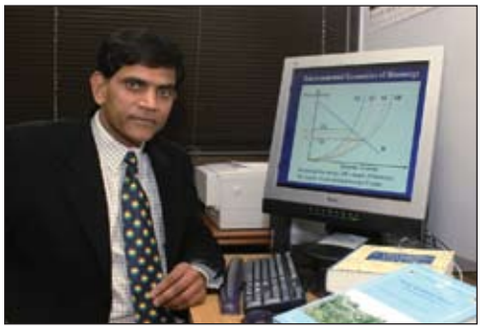
"It's like having a right hand. When you do grants, there are so many ins and outs, depending on the agency, and her staff knows them," Canfield said. "If I had to do all that, I wouldn't know how to or want to. This takes a burden off and keeps the faculty productive."

"WE'RE TRYING TO BE SURE WE KEEP THE FACULTY FOCUSED ON WHAT THEY DO BEST, WHICH IS RESEARCH."

— NANCY WILKINSON

JANAKI R.R. ALAVALAPATI, PH.D.

Associate Professor of Forest Resource Economics and Policy
Institute of Food and Agricultural Sciences



Janaki Alavalapati's research focuses on the economics and policy analysis of sustainable forestry, biodiversity and bioenergy.

"Rising demand for timber and non-timber products and increasing concern for the environment raises myriad issues relating to forest conservation and management," Alavalapati said.

Forest and resource conservation and management issues are expected to cause intense regional social, economic and environmental impacts.

"Knowledge about these impacts help forest land owners, corporate managers and policy makers make decisions relating to forest conservation and management," he said.

Alavalapati is currently analyzing policy issues associated with forests and other natural resources, including socio-economic and environmental impacts of forest and natural resource policy issues; distributional impacts of policies; and implications for resource management in Florida, the U.S. and the rest of the world.

Alavalapati has investigated climate change and forest carbon sequestration, wildland-urban interface, agroforestry, recreation, collective resource management and bioenergy.

His research findings have offered a scientific and economic basis to promote growing trees on ranchlands and conservation easements in Florida and to restore longleaf pine ecosystem.

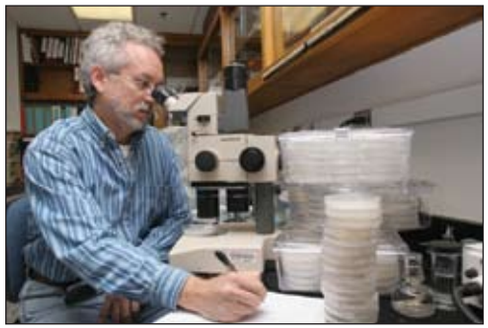
Due to Alavalapati's research findings, more progressive policies have been developed concerning the Nyungwe Forest management in Rwanda. In India, his research findings helped guide public participation in forest management. Alavalapati's research also helped protect areas of management in Nepal.

Alavalapati said that his own "ongoing research on designing optimum policies for forest biomass and bioenergy production is expected to produce results that encourage healthy forests, alleviate energy scarcity and revitalize rural communities in the U.S. South."

In the last five years, he has published two books, a conference proceeding, 20 book chapters, 50 refereed publications and a special issue of *Forest Policy and Economics.*

LAWRENCE E. DATNOFF, PH.D.

Professor of Plant Pathology
Institute of Food and Agricultural Sciences



Instead of using expensive pesticides to control crop diseases, Lawrence Datnoff says rice growers can save thousands of dollars in production costs and boost yields simply by adding some silicon to the soil.

"Silicon can be as effective as chemical fungicides alone," said Datnoff. "When it comes to controlling diseases, many registered fungicides do not have as broad a spectrum of activity." Research by Datnoff, his students and colleagues shows that increasing soil levels of silicon for rice controls several diseases, such as sheath blight, grain discoloration and rice blast, and increases yields at the same time.

"Rice growers could save themselves more than a half-million dollars annually in fungicide costs by increasing silicon levels in the soil," Datnoff said. "We've also measured yield increases ranging from 30 to 60 percent. Silicon also allows growers to produce rice in a more environmentally sound system, and the natural material provides consumers with a higher-quality product."

This research has major implications for other rice production areas with similar soils low in silicon.

Silicon also can help control certain insects and may help plants better utilize other nutrients such as phosphorous, allowing growers to better manage insecticides and fertilizers, Datnoff said.

"If growers worldwide use this material on the appropriate soils, they can reduce their use of fungicides and affect environmental quality. It's good environmental stewardship to look for alternatives, considering people's concerns with the use of fungicides and other pesticides and their perceived effects on land and water quality," Datnoff said.

Datnoff, along with his students and colleagues, have also shown that silicon suppresses many turfgrass diseases. And they are investigating similar effects against diseases of ornamentals, bedding plants and other agronomic crops.

RESEARCH FOUNDATION PROFESSORS (UFRF)

JUDE W. GROSSER, PH.D.

Professor of Cell Genetics
Institute of Food and Agricultural Sciences

Jude Grosser is helping Florida's citrus industry fight canker—by studying rice.

Rice offers disease resistance that Grosser and his colleagues are borrowing for use in citrus.

The grain has a gene that provides protection from rice bacterial blight, a disease closely related to citrus canker.

Grosser's research team transferred the resistance gene to Hamlin orange trees. The first of these trees is being tested in a quarantine facility to determine if it can resist the most common strain of citrus canker bacteria.

If the test proves successful, the trees will be field-tested to evaluate their ability to resist canker and produce fruit in a real-world environment, Grosser said. Eventually they could become the first canker-resistant citrus variety UF makes available to growers.

"Genetics research has great potential to help the citrus industry overcome this threat," Grosser said. "We're confident it will happen, and we've got a running start, thanks to all the work that's been done already."

Grosser is also looking to biotechnology to help develop citrus rootstocks that are needed to improve soil adaptation, tree survivability and tree size.

Another of Grosser's research projects focuses on developing seedless, high-quality, easy-to-eat cultivars.

L. CURTIS HANNAH, PH.D.

Professor of Plant Molecular and Cellular Biology
Institute of Food and Agricultural Sciences

Curt Hannah studies the molecular genetics of starch production in corn. He is particularly interested in genetic mutations that change the size, shape and texture of corn seed.

"The corn seed represents an ideal experimental playground," Hannah said. "Because corn seeds are large and easy to examine, subtle and not-so-subtle genetic differences are easily perused."

Hannah has been active in a long-term UF research project to understand how genes control development of corn and other cereal grains—the source of about 90 percent of the world's food supply.

By understanding the genetic basis for many traits of corn, including disease and insect susceptibility, biochemical composition and nutritive value, breeders will be able to use genetic tests and markers to more readily identify subtle but desirable traits in crops.

Corn plants contain more than 40,000 genes, and researchers want to learn more about the subset of those 40,000 genes that are important to agriculture, particularly from the standpoint of plant growth, metabolism, disease resistance and crop yield.

Hannah has received more than $12 million to support his research from the National Science Foundation and the U.S. Department of Agriculture.

Results from his research have been published in prestigious journals such as Proceedings of the National Academy of Sciences, Plant Cell, Plant Journal, and Plant Physiology.

Hannah has been awarded 14 patents and his work has been licensed to six of the leading plant biotechnology and breeding companies.

GEORGE O'CONNOR, PH.D.

Professor of Soil Chemistry
Institute of Food and Agricultural Sciences

George O'Connor is raising a cautionary note about restricting the use of biosolids on fields, forests and other areas.

Derived from sewage sludge, biosolids can be used to fertilize plants and enrich soil, said O'Connor.

The state recycles about 80 percent of its sludge this way, but critics say biosolids release too much phosphorus, a nutrient considered the state's top water-quality concern.

O'Connor recently completed a four-year study showing that there is actually wide variation in the amount of soluble phosphorus biosolids contain, depending on the processing methods involved. Also, some biosolids release more of their phosphorus than others.

"We've identified a method that can be used in the laboratory to predict how much phosphorus biosolids will release," O'Connor said. "This is a big step toward understanding the true environmental impact of biosolids and using them more efficiently."

Biosolids are produced by breaking down solids in sewage sludge using naturally occurring bacteria, then sanitizing and dewatering the material. The result is a black, soil-like material that contains important plant nutrients including phosphorus, nitrogen, calcium, magnesium and sulfur; biosolids also help soil retain water.

Florida produces 300,000 dry tons of biosolids each year and imports another 100,000 dry tons.

"The biggest challenge for Florida and the nation is to develop consistent, scientifically sound regulatory strategies for dealing with biosolids," O'Connor said. "We need to take advantage of the benefits biosolids offer, but use them in ways that help us manage the overall amount of phosphorus in the environment."

O'Connor's current research, funded by the Florida Water Environment Association, is investigating biosolids produced and used in Florida to determine their environmental impact.

"Right now, Florida is using multiple types of biosolids for land application," he said. "Building on our previous research, we want to identify any products that could constitute a problem and determine how we could better manage them."

K.T. SHANMUGAM, PH.D.

Professor of Microbiology and Cell Sciences
Institute of Food and Agricultural Sciences

K.T. Shanmugam's research focuses on ways to convert waste crops into ethanol, a renewable source of transportation fuel.

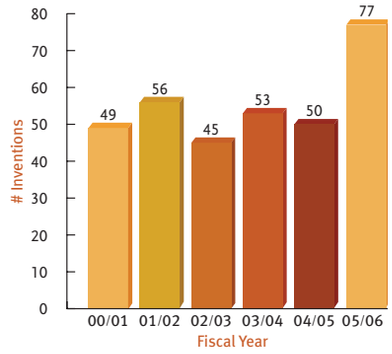
"Increasing the amount of ethanol produced to meet the transportation needs of the country would place a significant demand on corn, a food and feed source," said Shanmugam. "Lignocellulosic biomass, such as crop residues and energy crops, can serve as an alternate, inexpensive, feedstock for ethanol production without impacting the cost of corn."

Shanmugam plays a crucial role in the UF Florida Center for Renewable Chemicals and Fuels, where he has led the effort to genetically engineer bacteria for more efficient hydrogen production. He is also involved in making microbial fuel cells for electricity generation.

"Professor Shanmugam's knowledge of microbial physiology has been instrumental in the FCRCF's efforts to convert lignocellulose to ethanol," said Eric W. Triplett, professor and chair of the Department of Microbiology and Cell Science. "This work has led to significant grant support, important published works and intellectual property. This work will one day facilitate the conversion of large amounts of agricultural wastes in Florida to ethanol for transportation fuel."

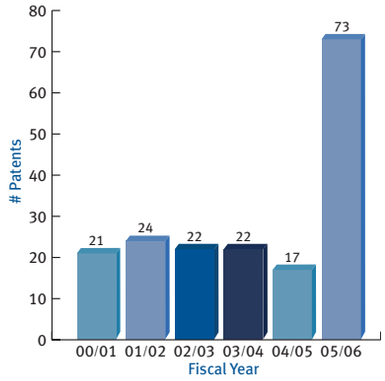
Shanmugan has been principal or co-principal investigator on more than $6 million in grant support from the U.S. Department of Energy and other agencies over the last five years.

IFAS INVENTIONS



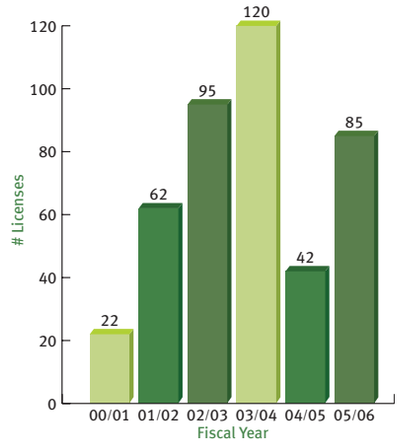
Fiscal Year	OTL Invention Disclosure	FFSP Cultivar Releases	TOTAL
00/01	37	12	49
01/02	22	34	56
02/03	28	17	45
03/04	32	21	53
04/05	29	21	50
05/06	33	44	77
TOTAL	**181**	**149**	**330**

U.S. PATENTS ISSUED



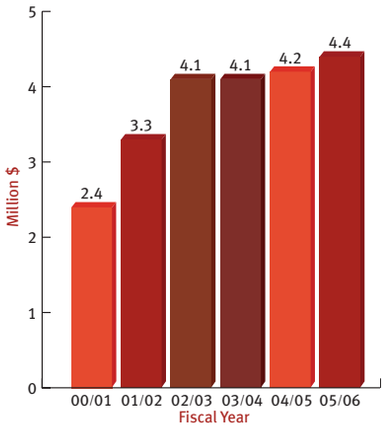
Fiscal Year	OTL Patents Patents Issued	OTL U.S. Patents Issued	FFSP US PVP/P Patents Issued	TOTAL
00/01	42	15	6	21
01/02	47	16	8	24
02/03	28	12	10	22
03/04	55	10	12	22
04/05	25	12	5	17
05/06	40	63	10	73
TOTAL	**237**	**128**	**51**	**179**

LICENSE AGREEMENTS



Fiscal Year	OTL License Agreements	FFSP License Agreements	TOTAL
00/01	3	19	22
01/02	21	41	62
02/03	22	73	95
03/04	15	105	120
04/05	14	28	42
05/06	18	67	85
TOTAL	**93**	**333**	**426**

IFAS LICENSE INCOME



Fiscal Year	OTL IFAS License Income	FFSP IFAS License Income	TOTAL
00/01	$1,772,585	$616,953	$2,389,538
01/02	$2,545,765	$705,805	$3,251,570
02/03	$2,716,928	$1,341,354	$4,058,282
03/04	$2,789,435	$1,269,660	$4,059,095
04/05	$2,635,258	$1,549,547	$4,184,805
05/06	$2,415,470	$1,982,585	$4,398,055
		TOTAL	**$22,341,345**

BERRY J. TREAT, M.S.

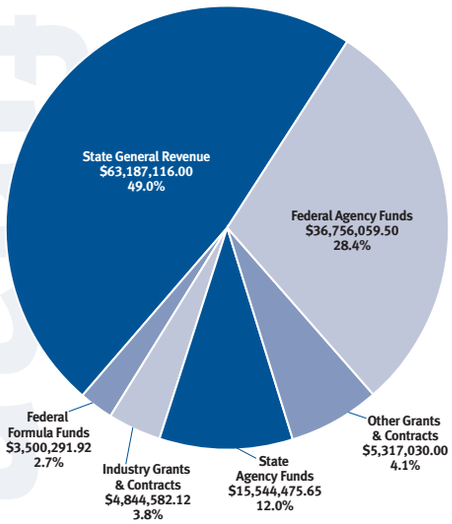
Assistant Director, Research Programs
Institute of Food and Agricultural Sciences

Berry J. Treat is the germplasm property manager for the Florida Agricultural Experiment Station (FAES) and Florida Foundation Seed Producers (FFSP). He is responsible for the marketing and licensing of all germplasm discovered and developed in the experiment station. Together with the Office of Technology and Licensing (OTL), they facilitate invention and technology transfer to the agriculture industry and manage all forms of intellectual property for IFAS using an invitation to negotiate (ITN) process. In the past year, FAES has released 44 cultivars, and OTL reported 33 invention disclosures. Total new cultivars and new inventions number 281 in the past five years. The majority of plant germplasm and inventions developed at UF/IFAS is protected through the federal US Office of Patents and Trademarks and/or the Plant Variety Protection Office. The licensing agents work closely with UF's faculty and plant breeders (currently working in over 40 crop areas) and assist in commercializing new and improved varieties and inventions around the world. IFAS revenue from licensed inventions was approximately $4.4 million in 2005-06 and a total $20 million in the past five years. IFAS research programs continue to benefit and grow because of technology transfer with private/commercial company partners.

DIRECTOR'S FINANCIAL REPORT

Research Expenditures by Source of Fund
State Fiscal Year 2005-2006

(NOTE: This is not an accounting document)



CATEGORY Source of Funds	Expenditures	Total
Formula Funds		
Hatch	2,395,289.13	
Multi-State	548,121.28	
McIntire-Stennis	556,881.51	
		3,500,291.92
State General Revenue		
General Revenue		**63,187,116.00**
Federal Agency Funds		
National Institute of Health	3,845,029.46	
USDA	18,644,506.26	
Department of Interior	2,490,159.03	
Department of Energy	1,618,076.95	
U.S. Department of State	35,000.00	
U.S. Veterans Affairs	66,307.18	
U.S. Army	501,432.83	
U.S. Air Force	143,544.66	
U.S. Navy	83,663.08	
Sea Grant	149,450.59	
Department of Commerce	554,139.12	
Department of Housing and Urban Develoment	894.77	
National Science Foundation	4,677,473.17	
National Aeronautics and Space Administration	699,704.80	
Environmental Protection Agency	477,184.84	
Agency for International Development	723,691.62	
Smith Lever	739,555.42	
Federal - Other	422,727.31	
Federal Flow Through - Other	883,518.41	
		36,756,059.50

CATEGORY Source of Funds	Expenditures	Total
State Agency Funds		
Department of Health	1,310,260.23	
Department of Education	22,072.04	
Department of Transportation	198,977.13	
Department of Agriculture and Consumer Services	6,737,190.91	
Department of Citrus	423,122.26	
Department of Environmental Regulations	2,568,227.64	
Department of Children & Families	249,708.92	
Department of State	26.25	
Department of Commerce	1,109.15	
Department of Business and Professional Regulation	19,964.86	
Department of Administration	103.03	
Department of Community Affairs	159,580.16	
Institute of Phosphate Research	143,016.69	
Department of Labor	1,252.56	
Game and Fresh Water Fish Commission	989,140.88	
Water Management District	2,692,464.91	
State Board of Regents	28,258.03	
		15,544,475.65
Other Sponsored Funds		
Foreign—Other	412,928.59	
Counties	1,538,440.98	
City	13,293.55	
Industry	4,844,582.12	
Non-Profit Organization	1,574,522.57	
Foundations	1,341,110.53	
Miscellaneous - Other	436,734.58	
		10,161,612.92
GRAND TOTAL		**129,149,555.99**

SUMMARY OF IFAS SPONSORED RESEARCH ACTIVITY

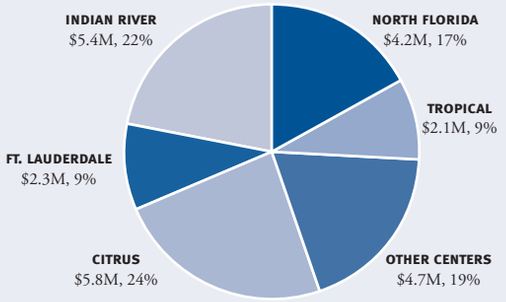
Proposals Submitted	1,004
Awards Received	819
New Awards Received	502
Renewals	34
Continuations/Supplementals	283
Total Research Awards FY 05-06	$68.5M

"The success of our faculty is based on discovery, innovation, and application of the best science."

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

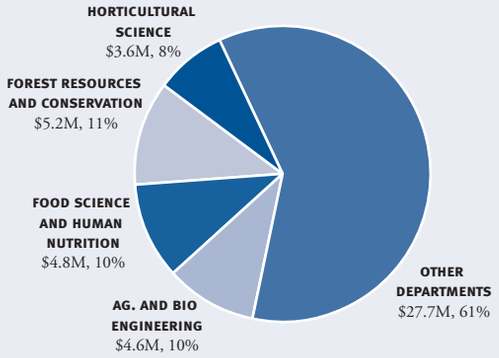
IFAS RESEARCH AWARDS BY UNIT

RESEARCH AND EDUCATION CENTERS
Total $16.9M, 25%



OTHER CENTERS $4.7M, 19%	
Everglades	$.70M
Florida Med. Entomology Lab	$.60M
Gulf Coast	$.50M
Mid Florida	$.60M
Range Cattle	$.02M
Southwest Florida	$.70M
West Florida	$.10M

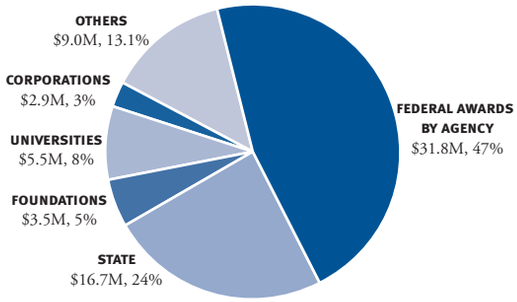
ACADEMIC DEPARTMENTS
Total $45.9M, 67%



OTHER ACADEMIC DEPARTMENTS $27.7M, 40.4%	
Agronomy	$1.5M
Animal Sciences	$2.0M
Entomology & Nematology	$3.0M
Environmental Horticulture	$1.9M
Family, Youth & Community Sci.	$2.5M
Fisheries & Aquatic Sciences	$2.7M
Microbiology & Cell Science	$3.2M
Plant Pathology	$2.8M
Soil and Water Science	$2.7M
Wildlife Ecology & Conservation	$3.2M
Other Academic Departments	$2.2M

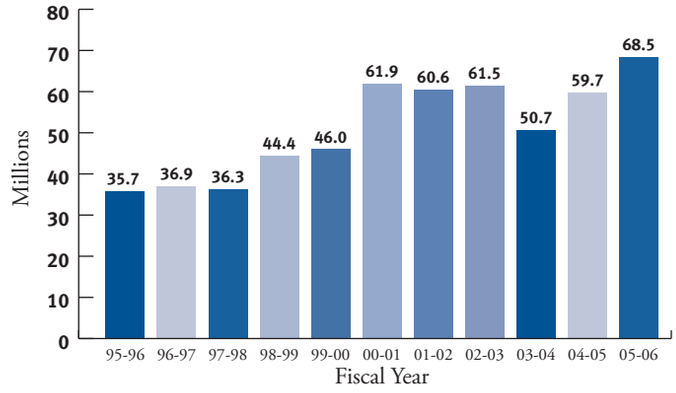
OTHER NON-ACADEMIC UNITS
$5.5M, 8.3%

IFAS RESEARCH AWARDS BY SPONSOR

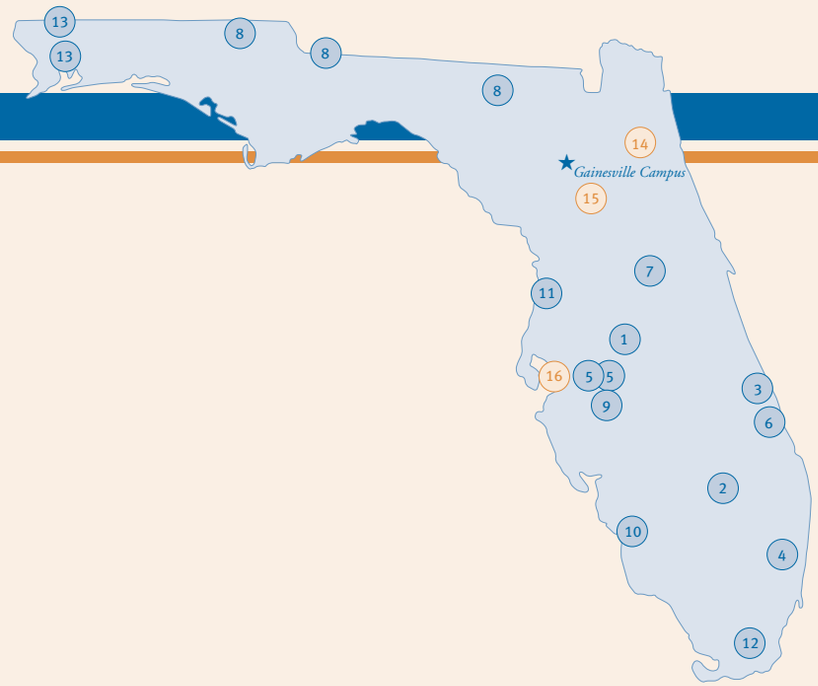


FEDERAL AWARDS BY AGENCY $31.8M, 47%	
USDA (CSREES)	$10.8M
USDA (ARS)	$1.20M
USDA (Others)	$5.20M
DOD (incl. Army)	$1.30M
NSF	$3.10M
NASA	$0.70M
NIH	$3.70M
Interior	$3.20M
Commerce	$0.90M
Energy	$1.30M
Others	$0.40M

SPONSORED IFAS RESEARCH AWARDS



UF/IFAS *Statewide Research and Education Network*



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 SUBTROPICAL AGRICULTURAL RESEARCH STATION (USDA–ARS) | *Brooksville*
12 TROPICAL REC | *Homestead*
13 WEST FLORIDA REC | *Jay, Milton*

Research and Demonstration Sites:

14 FLORIDA PARTNERSHIP FOR WATER, AGRICULTURAL AND COMMUNITY SUSTAINABILITY | *Hastings*
15 PLANT SCIENCE RESEARCH AND EDUCATION UNIT | *Citra*
16 TROPICAL AQUACULTURE LABORATORY | *Ruskin*

Academic Departments and Schools (GAINESVILLE, FL)

AGRICULTURAL AND BIOLOGICAL ENGINEERING
AGRICULTURAL EDUCATION AND COMMUNICATION
AGRONOMY
ANIMAL SCIENCES
ENTOMOLOGY AND NEMATOLOGY
ENVIRONMENTAL HORTICULTURE
FAMILY, YOUTH AND COMMUNITY SCIENCES
FISHERIES AND AQUATIC SCIENCES
FOOD AND RESOURCE ECONOMICS
FOOD SCIENCE AND HUMAN NUTRITION
SCHOOL OF FOREST RESOURCES AND CONSERVATION
HORTICULTURAL SCIENCES
MICROBIOLOGY AND CELL SCIENCE
SCHOOL OF NATURAL RESOURCES AND ENVIRONMENT
  ACADEMIC PROGRAMS
  RESEARCH AND OUTREACH/EXTENSION
PLANT PATHOLOGY
PLANT MOLECULAR AND CELLULAR BIOLOGY
SOIL AND WATER SCIENCE
STATISTICS
WILDLIFE ECOLOGY AND CONSERVATION

Multidisciplinary Programs (GAINESVILLE, FL)

AGRICULTURAL LAW CENTER
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
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

Supported Colleges (GAINESVILLE, FL)

COLLEGE OF AGRICULTURAL AND LIFE SCIENCES
COLLEGE OF VETERINARY MEDICINE

UF UNIVERSITY of FLORIDA IFAS

FLORIDA AGRICULTURAL EXPERIMENT STATION | INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES | UNIVERSITY OF FLORIDA

Produced by IFAS Communication Services | March 2007