



## DEPARTMENT OF AGRICULTURAL AND BIOLOGICAL ENGINEERING

UF UNIVERSITY of  
FLORIDA  
IFAS

*Engineering...Managing...Packaging*



### New Energy in ABE

Spotless equipment gleams brightly under florescent lights and there's an excitement stirring in the new lab addition to the Agricultural and Biological Engineering building. But these fermenters aren't cooking just any old brew...they're creating the fuel of tomorrow.

Few are immune to the pain at the pump, but thanks to researchers at the University of Florida some relief could be in sight.

A new breakthrough technology developed by Dr. Lonnie Ingram, a distinguished professor of microbiology in the Institute of Food and Agricultural Sciences, uses genetically engineered *E. coli* bacteria to produce fuel ethanol from inedible plant biomass, such as sugarcane residues, rice hulls, municipal green waste, forestry and wood wastes and other organic materials.



The technology utilizes the bacteria to target sugars in cellulosic materials. Since the process uses only the waste products from crops or forestry operations, there is no effect on the food chain, and less

petroleum is used to make cellulosic ethanol than corn ethanol.

While a large demonstration facility is being built in South Florida in partnership with Florida Crystals, a smaller biofuels research pilot plant is operating in the brand new laboratory constructed on the west end of Rogers Hall. It will be used to train ABE engineers and graduate students in various process engineering aspects of biofuel production and purification, and procedures for conducting biofuel tests.

"Initially the laboratory will focus on fuel ethanol conversion technologies, and its activities will be expanded to include process development for production of other biofuels such as hydrogen, biogas and biodiesel," noted Pratap Pullammanappallil, an assistant professor in the Agricultural and Biological Engineering Department. "Funding for its operation will be provided by the biofuel industry to investigate and develop technologies."



Pullammanappillil will operate the facility in cooperation with Ingram and John Owens, a research scientist in UF's microbiology and cell science department.

"The laboratory will provide facilities to develop and engineer bioprocesses for the conversion of various biomass feedstocks

to biofuels such as ethanol, butanol, biogas, biodiesel and hydrogen," he explained.

"The production of ethanol from cellulosic biomass has proven to be technically feasible via a multitude of different processing schemes," added Owens. "However, developing a viable commercial process involves optimizing unit operations toward developing a more economical process that considers the environmental impacts and sustainability. I expect that this new facility will help explore commercial viability of cellulosic ethanol technologies."



According to Ingram, half of the automotive fuel in the United States could be replaced with ethanol from renewable agricultural crops and forest wastes, and seven percent of all biomass for fuel could be grown in Florida.

"Florida could be the top state in the country for producing cellulosic ethanol," said Ingram.

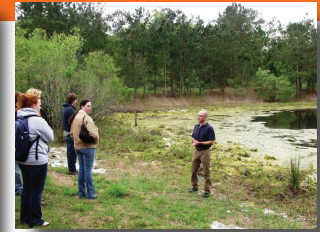
As the technology develops, the opportunities for Agricultural and Biological Engineering faculty and graduate students will continue to expand and their efforts may help that pain at the pump subside to a dull ache.

So bag up those leaves and save your orange peels. One day soon they may be brewing the fuel of the future.

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# Chris Martinez



There is endless adventure to be found among the trees and paths of the forest environment, so it isn't unusual that Chris Martinez spent many afternoons after school in the nearby woods. In addition to providing hours of exploration, it also sparked an interest in wetlands, wildlife and nature photography that persists today. Ultimately, those adventures turned into a career in agricultural and biological engineering (ABE).

Now ABE assistant professor Chris Martinez is training this interest on research and extension. The focus of his current projects involves water resources and water quality.



"One issue we hear in the news often lately is related to climate, such as the extreme drought currently affecting much of the southeast," says Martinez. "I'm working on a project that will use climate forecasts to improve water resource management in the Tampa Bay area as well as investigating the relationships between different land uses, nutrient pollution, and incidences of Red Tide."

Martinez earned his bachelors degree in Environmental Studies from The Richard Stockton College of New Jersey and received his Masters and Doctoral degrees in Environmental Engineering right here at the University of Florida.

Although his focus is primarily research and extension, he finds that he also truly enjoys teaching.

"Seeing the proverbial light bulb turn on over a student's head is truly a sight to see," explains Martinez. "The gratification I find in teaching can come in many forms, whether working one on one with a graduate student, within a research team, or with extension clientele."

He will soon take on the role of faculty advisor of the student chapter of the American Water Resources Association (AWRA) here at UF. The student chapter includes both undergraduate and graduate students from a host of engineering and non-engineering departments on campus.

Martinez plans to continue his focus on issues concerning urban water use and water quality. His work will investigate new ways to reduce home outdoor water use and to reduce nutrient pollution from urban/suburban landscapes.

"In the near future I also plan to investigate the potential impacts of climate change on water resources and water quality in the state of Florida," he notes.

According to Martinez the future for ABE engineers lies in several directions.

"I see more and more ABE engineers moving into either high-tech fields such as bioprocessing and biomedical engineering, or into fields that deal directly with natural resources such as biofuel production and land and water resource engineering and protection," he says. "In my opinion students should consider ABE due to the breadth of topics they will be exposed to and the many different directions they can go with their career."

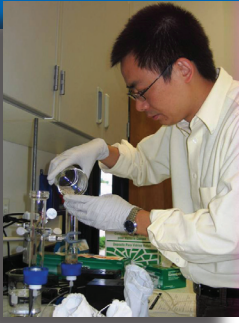
## Goodbye Betty!

ABE wishes a very fond farewell to **Betty Pearson** who had been a mainstay in the department (off and on!) since 1970. In addition to serving as the receptionist, Betty helped keep the department running smoothly by making sure supplies were stocked, notices were posted and questions were answered!



Among the many things we will miss about Betty are her amazing baked goods and friendly smile!

Enjoy retirement Betty. You earned it!



## Bin Gao

**B**ig solutions sometimes come in small packages. Just ask ABE assistant professor Bin Gao, whose research in nanotechnology could lead to cleaning large areas of water with tiny particles.

“Nanotechnology is the control of matter on the atomic and molecular scale, and promises exciting new solutions to environmental problems, especially in respect to water quality problems,” explains Gao.

Gao’s interest in water research began at Nanjing University in China, where he earned his bachelor’s and master’s degrees. He completed his education with a Ph.D. from Cornell University.



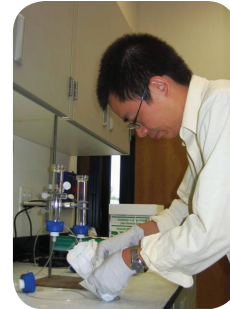
“I have a long-time interest in water-related research because water is a very important component to people and the society, maybe the most important, in my opinion,” says Gao. “As an undergraduate, I participated in a project of water treatment and groundwater remediation and it provided me the opportunities to learn more about the importance of water and water research.”

Gao’s current research focuses on the environmental impact of nanotechnology, which carries both benefits and risks. Recent investigations suggest that engineered nano-materials can be designed and synthesized to act as separation and reaction media for contaminants in water and can be used to enhance retention and biodegradation of water pollutants.

“I am particularly interested in studying how nanotechnology influences water quality. Nanotechnology is a double-edged sword to the environment. It holds great promise for pollution control, environment remediation, and resource conservation; however, like all emerging technologies with great promise, it presents health and environment risks,” explains Gao. “My research program will be mainly focused on improving current application and understanding of the benefits as well as risks

of nanotechnology on water and water resources. This research is critical to improve current capacity to protect the ecosystem and public health.”

In an ever-changing world Gao thinks that ABE provides the diversity that makes it a good choice for students.



“The program is interdisciplinary and covers various subjects from machinery design to molecular engineering. A well-trained ABE graduate will find many career opportunities not only in traditional agricultural management and engineering, but also in food processing, biological engineering, water resources engineering and many other areas,” says Gao.

## Hello Max



**Max Williams** has joined the ABE department as the Coordinator of Administrative Services. He has been at UF since 2003, most recently in the Astronomy Department.

“I came to ABE because of the opportunity for interactions with a panoply of different departments, colleges, and organizations. I like the approachability of the ABE faculty and staff as well as the wonderful facilities,” he explains. “I hope to continue to provide the same great level of customer service the administrative staff has been giving, as well as bringing innovative approaches for improving departmental and organizational efficiency.”

Max’s responsibilities include scheduling, supervising, and coordinating day-to-day activities of office personnel, supervising all payroll activities, analyzing departmental data and developing information and reports, and managing department financial operations.



## 'Sense'ible Irrigation

Over the past several years researchers in the Agricultural and Biological Engineering Department have been conducting research on automatic irrigation control systems using soil moisture sensors (SMS) on landscape and drip irrigated vegetables as well as controllers using climate data to estimate plant evapotranspiration (ET) for landscape irrigation scheduling.

"We have found that homeowners in Central Florida over-irrigate by as much as 2-3 times the amount needed in the landscape and that simply adjusting time clock run times can result in a 30% applied water reduction," explains ABE associate professor Michael Dukes. "Inefficient irrigation practices on landscapes are exacerbating water supply problems throughout the state."

In 2004 the researchers began to study soil moisture control systems for residential irrigation. The first phase of the study has been completed and using SMS controllers resulted in average irrigation savings of 72% or 1,094 mm (43 inches) over a 10 month study period.

"In 2006, we began a new phase where we installed SMS controllers on existing homes in Pinellas County, Florida," said Dukes. "When compared to homes without irrigation control modification, the SMS homes resulted in 53% irrigation savings in 8 months."

Studies also are underway on another "Smart" irrigation technology. Climate-based controllers or "ET controllers" use three general approaches: 1) signal-based, 2) on-site measurement, and 3) historical ET based. Signal based

controllers, receive a signal that typically consists of reference ET (ET<sub>o</sub>) for the previous day or receive information to calculate the ET<sub>o</sub> for the previous day. On-site measurement controllers on the other hand use sensors connected to the controller to gather weather parameters used to estimate ET<sub>o</sub>. Finally, historical based ET controllers are pre-programmed with a database of historical mean ET values. Most of the controllers maintain a theoretical balance of moisture content in the soil and then schedule irrigation when allowable depletion levels have occurred. On the other hand, some of the controllers simply replace the accumulated crop ET on the next allowed watering window. Preliminary results have shown irrigation savings of 9 to 59% under dry conditions.

In another area of research Dukes notes that Florida vegetable production area ranks second in the U.S. and has a \$1.3 billion cash value. Drip irrigation has become an important technique in vegetable production over the past 20 years but must be managed efficiently.

"We have developed an inexpensive soil moisture controller that can be paired with off-the-shelf soil moisture sensors," explains Dukes.

In addition, SMS irrigation controllers intended for residential application have been used for irrigation control of the vegetable irrigation research.

"We have found that homeowners in Central Florida over-irrigate by as much as 2-3 times the amount needed in the landscape."

Dr. Michael Dukes

"In bypass configuration, SMS controllers allow pre-determined irrigation windows programmed in a time clock only if the soil moisture content at the start of the event is less than a preset threshold. This research has shown that small and frequent irrigation events as controlled by the soil moisture sensor systems reduce irrigation application 74-79% compared to fixed time irrigation on tomato, 37-66% on green bell pepper, and

33-80% on zucchini squash. In all cases, marketable yield was unaffected or increased due to better water management," says Dukes.

Looking ahead, Dukes says that the next step with the vegetable irrigation research is to implement and demonstrate SMS automatic irrigation control on commercial farms.

## Polar Packaging



Anyone who's mailed a package recently knows that shipping costs can often exceed the value of the products in the box. So imagine living in a community so isolated that the only way to obtain perishable foods and produce is by airmail!

That was the dilemma faced by 90,000 people in approximately 140 isolated communities in Northern Canada.

The solution...the Food Mail Program established by the Government of Canada. It has existed since 1983, but was not known as Food Mail until 10 years later. The program, also known as Northern Air Stage Program, is administered by Indian and Northern Affairs Canada (INAC). INAC provides funding to Canada Post for transporting nutritious, perishable foods to isolated communities by air. This funding helps keep the cost of food down and requires that transportation of these products be done in optimum conditions to improve the quality of the food reaching remote communities.

Dr. Jean-Pierre Emond, a professor in the ABE Packaging Science program, has volunteered with the program as a scientific advisor since 1996, and travels annually to assist with the delivery of the packages. The Canadian government covers the cost of traveling and data collections for packaging performance under extreme conditions.



"The program provides a lower postage rate for nutritious perishable foods. These foods, such as vegetables, fruit, bread, meat and milk, can be shipped as food mail for \$0.80 per kilogram plus \$0.75 per parcel. There has been no increase in this rate since July 1993. Non-perishable food and some essential non-food items can also be

shipped under this program at higher postage rates. Foods of little nutritional value, such as pop and chips, are not funded," explains Emond.

The program also has specific requirements for packaging to ensure that the products reach their destination in good condition.

"There are guidelines for size, temperature, box liners, cushioning material and insulation to keep the boxes and products from crushing or other damage," explains Emond.

In 2006-2007, approximately 15,900,000 kilograms of food and other goods were shipped under this program. The Canadian government spends \$42 million per year to cover the freight cost of the food.

In addition to bringing nutritional food to Inuit communities, especially to the children, the results of the program have been significant.

"Wasted food has dropped by 96% and there has been a significant decrease of the cost of food for the communities due to the reduction of spoiled food," notes Emond. "The program helps insure better quality and nutritional value of fresh produce and provides safer food to isolated communities."

The success of the program has resulted in continued funding, as the Canadian government will continue to sponsor the Food Mail Program for another five years.

Dr. Emond says he'll hang on to his winter gear for a while longer.

"I have agreed to volunteer for another three years!"



## Goin' Green in AOM

These days there is a lot of talk about sustainable buildings but students in the Agricultural Operations Management (AOM) Construction and Process Management program had the opportunity to hammer out an actual solution.

The local energy provider, Gainesville Regional Utilities (GRU), proposed to AOM professor Wendell Porter that his students build the GRU cutaway house display for the upcoming Home Show. Indigo Green, the new, local sustainable building products store, was brought in to supply an array of building products such as no Volatile Organic Compound (VOC) and low VOC paints, sustainable countertops and cabinets, two kinds of flooring products, etc.

Nineteen students spent many hours constructing the 'home' in the AOM shop under the supervision of Dr. Porter and engineering technician Jimmy Rummel. According to Porter the experience provided lessons that went beyond construction techniques.

"They learned real-time decision making skills, management issues and technical skills. In addition, they provided a real world review of brand new sustainable building products. Many which made a good impression and one or two that did not," explained Porter.



The project wasn't without obstacles, including uncooperative weather the day of the move to the O'Connell Center. Porter notes that the biggest challenge was "getting everything through a double wide door in one piece in a torrential downpour."

With thousands of visitors attending the event, the students got to interact with many visitors who stopped at the exhibit.

"People were very interested in the whole house concept. Materials, insulation, lighting. The air handler

in conditioned space and not in the attic or garage," said Porter. Building on this experience, Porter notes that other projects could be in the works.

"We MIGHT do a blitz build where we prebuild a floor and the trusses. Much like a regular house has the slab done ahead of time and a subcontractor delivers the trusses already made. Then we deliver all the material to the Ag Shop and try to build a lab shed in one day. This building would include a completely finished interior with insulation, drywall, AC and lights," he explained.

Porter is eager to provide hands-on opportunities to AOM students so they can gain valuable real-world experience before graduation.

"Students rarely get a chance to actually incorporate everything we are supposed to teach them in a living, breathing real life example," he explained. "Deadlines, budgets, unexpected problems (weather extremes), the public, new products, last minute insurmountable problems that have to be overcome... somehow, and group management issues."

## Donors make a difference!

Whether it's a piece of valuable equipment for our laboratories or funding for a student conference, the ABE department is fortunate to be the beneficiary of generous donations by alumni, friends, and corporations. In 2007 we received pledges totaling over \$216,000 and we truly thank everyone who donated.

We would especially like to acknowledge significant donations from Cenicana, Elizabeth Ordway Dunn Foundation, Ingersoll Rand and International Corrugated Packaging and thank them for their generous support of our programs.

The ASABE Student Club thanks Mr. & Mrs. Dale Zimmerman for their funding of the team's trip to the 2007 ASABE National Convention to compete in the Fountain Wars competition.



**We need your support more than ever in 2008-2009!** To contribute contact SHARE at 352-392-5427.

# Accomplishments

## 2007 ASABE Award Winners

Dr. Tom Burks, Dr. Michael Dukes and Dr. John Schueller are recipients of ASABE Outstanding Reviewer Awards. This is a special recognition for help in ensuring high quality ASABE peer-reviewed journals. Only 10 reviewers are recognized annually.



Dr. William Miller was awarded the 2008 Citrus Engineering Award, sponsored by Progress Energy. He was also named an ASABE Fellow, which recognizes a member of unusual professional distinction, with outstanding and extraordinary qualifications and experience in, or related to, the field of agricultural, food, or biological systems engineering.

Dr. Melanie Correll received the Young Researcher Award from the Florida Section of ASABE. The award honors dedicated use of scientific methodology to seek out facts or principles significant to agricultural engineering.



Dr. Michael Dukes received the Outstanding Service Award from the Florida Section of ASABE. This award is given to a member of the society who has served the section with distinction. The recipient is also seen as a representative of the Agricultural Engineering community in his place of work.

## Other Notable Awards:

Dr. Jonathan Earle is the first UF faculty member to receive the prestigious Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. He was honored as one of only 10 recipients nationwide in a ceremony at the White House. Dr. Earle was recognized for his work to create several mentoring and outreach programs including the STEPUP program.



Dr. Melanie Correll was awarded the NASA and European Space Agency Award which honors outstanding accomplishments in spaceflight research. She was recognized for her work on project TROPI which was a series of experiments that were performed on the International Space Station

Dr. Bruce Welt was named a North American Colleges and Teachers of America (NACTA) 2007 Teacher Fellow.



Cecilia Amador was selected as a recipient of an Outstanding Student Award, from the UF International Center. Cecilia is a Student Government Senator, Vice-President Elect of the Graduate Student Council, and President of the Hispanic Graduate Student Association.

Stuart Muller was selected as a recipient of an Alec Courtelis Award from the University of Florida International Center. He has volunteered his services to NSF integrated Graduate Education and Research Training, is a member of three organizations and holds an officer's position with the UF chapter of the American Water Resources Association.



ABE Graduate Student Alex Stimpson and ABE Undergraduate Rhea Savia Pereira were winners in the Student Poster Competition at the American Society of Gravitational and Space Biology (ASGSB) conference.

Recent graduate Elana Rich was selected as the winner of the 2007 Marvin Byer Award for her submission to the annual graduate student competition sponsored by Research and Development Associates (R&DA) for Military and Food and Packaging Systems.



Mary Shedd was Second Place in the Graduate Student Paper Competition at the 2007 Soil and Crop Science Society of Florida

Fernando Vargas' poster titled, "Degradation of Polylactic Acid (PLA) Exposed to Steam" was selected as the winner of the student poster competition at the Society of Plastics Engineers GPEC 2008 Conference.



# ABE/UF

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## Comprehensive Review 2008

The ABE department underwent a 10-year Comprehensive review in March 2008, requested by the College of Agricultural and Life Sciences. Six reviewers nationally recognized in the ABE community were selected to oversee the process. Dr. Art Teixeira coordinated the Review Committee that wrote a self-study document provided to the review team prior to their visit.

Over 5 days, the reviewers spent time learning about the teaching, research and extension programs and assessing ABE strengths and challenges. The reviewers participated in faculty presentations but also engaged faculty, students and staff in open informal discussions. Since the ABE department is also included in the College of Engineering, the team visited with the Dean of Engineering and the Chairs of several engineering departments that closely collaborate with the ABE programs. They also spent some time with the departmental advisory board, and various administrators of IFAS, CoE and UF. The program included a trip to the Citrus Research and Education Center, one of 12 RECs that are located throughout the state and the PSREU Plant Science Research and Education Unit in Citra where some of the faculty members conduct their field research studies.

“Perhaps the most interesting outcome from the review was recognizing that the ABE Department should focus on depth in areas of strength, and reduce the breadth of its programs,” said Teixeira.

The team tried to focus on the areas that will help ABE continue as one of the best departments in the country and to become even better, offering valuable insights that might be incorporated into ABE’s strategic planning. They helped identify a number of key issues that need to be addressed, including having a holistic approach to the entire department, defining a vision for “biological engineering”, building on existing strengths and making a hiring plan based on long-term goals.

“Preparation of the self-study document that captured department growth and all the changes in the last 10 years has been a very interesting and informative exercise. The faculty and staff dedicated a lot of time to prepare these materials and did a wonderful job. I believe that this process made them feel proud of our accomplishments in the last 10 years and will help us to move forward even further. I am looking forward to working with faculty on our strategic plan using suggestions included in the review report,” said Dorota Haman, department Chair.



Reviewers meet with ABE faculty at the Tropical Research and Education Center.