



# Biennial Report

Illinois Agricultural Experiment Station

**Click on the headings below to view featured research projects from each of the departments in the College.**

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[2001-2003 Pie Chart](#)



UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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## Agricultural and Biological Engineering

**Loren Bode, Department Head**

The departmental research program focuses on issues related to environmental systems, mechanical/information systems for production agriculture and bioprocess systems. Emphasis is placed on engineering solutions related to global agriculture. Research is integrated within the following areas:

Environmental quality and protection pertaining to air, soil, water, plants and animals, and to production and housing systems involving humans, animals, plants and desirable microorganisms.

Technologies for precision production and effective energy utilization in agricultural and biological systems that are safe and environmentally friendly.  
Value-added technology for processing food and grain, nutraceuticals and biomaterials that include system optimization for recovery of co-products.



## Featured Research Projects

[Ethanol and Diesel Blends: E-Diesel Shows Promise in Tests](#)

[New Ethanol Process Reduces Costs, Recovers More Coproducts](#)

[Miniature Helicopter Maps Fields for Precision Agriculture](#)



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## Agricultural and Consumer Economics

**Andrew Isserman, Department Head**

The economy in the United States is greatly affected by what's happening in other countries. Our focus on global issues is evident in the three featured research projects from this department. How American farmers respond to the availability of cheap acreage available in Brazil is the topic of one project. Brazilian coffee farmer's ability to compete by growing specialty coffee is the focus of another featured project. And, when the mad cow incident struck Washington State, how consumers perceive risk was an important and timely discussion that had been already examined in a study that compared perceptions and attitudes toward risk.



## Featured Research Projects

[Brazilian Land Rush](#)

[Small Brazilian Coffee Farmers Face Big Problems](#)

[Risk Perceptions and Attitudes Drive Consumer Behavior](#)



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## Animal Sciences

### Neal Merchen, Department Head

The Department of Animal Sciences strives to be a global leader through research on significant problems in animal management and fundamental aspects of animal biology. Departmental faculty and students use creative approaches, state-of-the-art technology and genomic sequence information to gather and apply knowledge of the biological processes in livestock, poultry, laboratory, and companion animals. This approach has positioned the Department as one of the strongest of its kind and will provide a model to achieve global preeminence.



## Featured Research Projects

[No Significant Difference Found in Animals Fed GMO Corn and Soybeans](#)

[Research Dividends Doubled in Pet Research](#)

[Genome Mapping for Pig and Cow Funded](#)



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## Department of Crop Sciences

**Gary H. Heichel, Department Head**

Our mission is to develop and deliver educational and research programs that foster the creation and adoption of agricultural plant production systems that are profitable, environmentally sound, socially responsive, and sustainable.

Through research, we aim to:

- Improve crops and soil-crop management
- Develop disease, insect, and weed management strategies for crops
- Evaluate and preserve crop germplasm
- Discover useful genes from new or unique sources to improve crops
- Advance the frontiers of crop and pest management sciences
- and Protect the environment



## Featured Research Projects

[Red Light Treatment May Save Illinois Vegetable Crops](#)

[Soybean Lab Helps Test Soy-Fortified Foods in Tajikistan](#)

[Atmospheric Changes May Affect Crops in the Future](#)

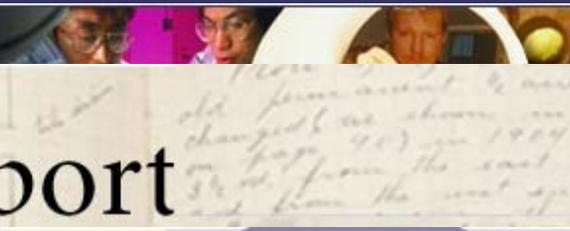


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## Food Science and Human Nutrition

### Faye Dong, Department Head

The Department of Food Science and Human Nutrition will implement education, research, and outreach programs designed to provide a safe, nutritious, and affordable food supply that enhances human health. The Department is responsible for and dedicated to excellence in and interactions among the three missions of learning (teaching), discovery (research), and engagement (outreach) in the fields of Food Science and Technology, Human Nutrition, and Hospitality Management. The Department will be a leader in:

(1) high quality instruction and preparation of students;  
(2) research areas of: bioactive components-identification, metabolism, effects of processing; food chemistry; food safety; human nutrition, metabolism, and relationship to disease; development of bio-based products; novel processing of foods; and the design of healthful food products.

Food Science and Human Nutrition



## Featured Research Projects

[Honey Has Potential as Dietary Antioxidant](#)

[Vegetable Benefits Depend on Genetics and Environment](#)

[Fast-Food Facts on Your Cell Phone](#)



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## Human and Community Development

**Robert Hughes, Department Head**

There was time with studies of community issues in rural Illinois would have seemed quaint and parochial and there was a time when studies of perceptions of biotechnology in Asia would have been viewed as inconsequential, but one of the results of globalization is that it is more apparent that community development research both near and far is vital to understanding social and economic development around the world. Faculty in the Department of Human and Community Development are actively studying families and communities in rural areas and how they are adapting to changing conditions and studying the impact of a globalized media on perceptions of scientific breakthroughs and new technologies.



## Featured Research Projects

[Southeast Asia Positive Toward Biotech Crops](#)

[Gay and Lesbian Families Opt for Rural Life Despite Obstacles](#)

[Life in Small Towns Becoming More Suburban](#)



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**Natural Resources and Environmental Sciences**

**Wes Jarrell, Department Head**

Natural Resources and Environmental Sciences



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[Controlling Insects Naturally](#)

[Berries Benefit Health](#)

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COLLEGE OF AGRICULTURAL,  
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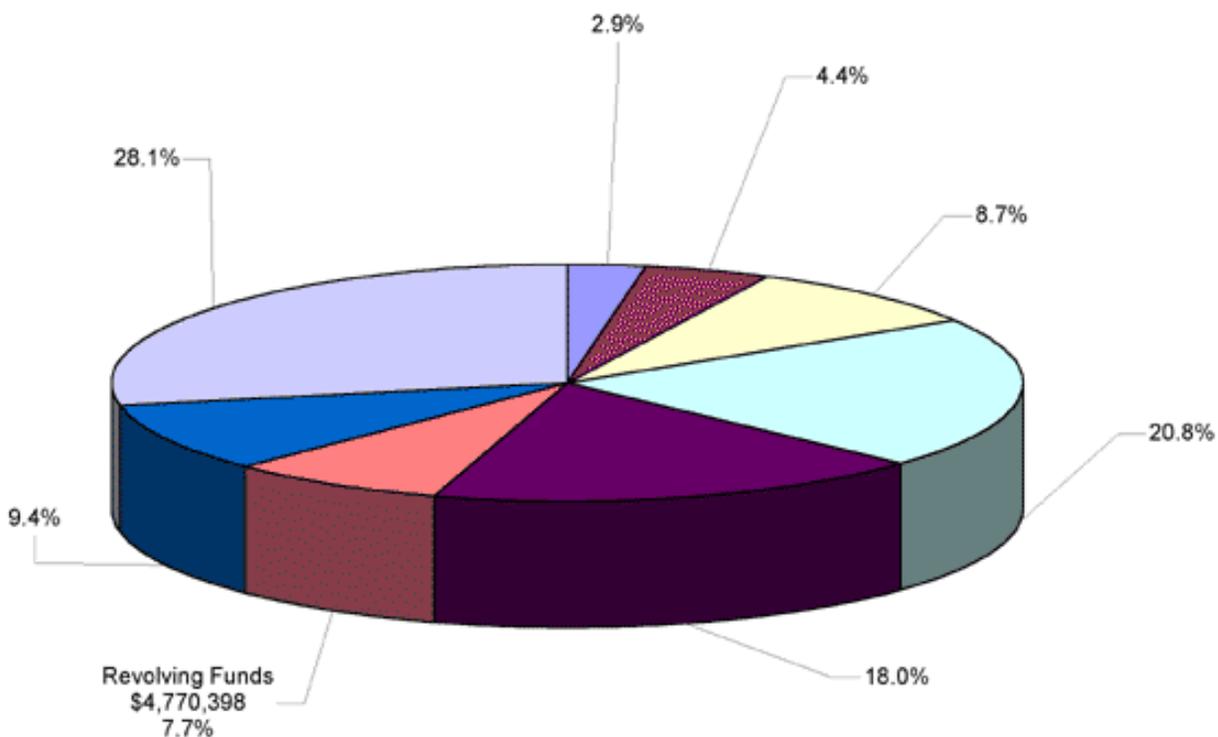
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## UIUC College of ACES FY02 Expenditures by Fund Source Agricultural Experiment Station



Source: Office of Administration and Finance, UIUC College of ACES  
FY02 Year-End UFAS Expenditure Data

**Total Expenditures = \$61,529,763**

fy02aes-expend-source.xls  
09/12/02:sa

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	<b>State Appropriations</b>	<b>28.1%</b>
	<b>State Contracts</b>	<b>20.8%</b>
	<b>Federal Contracts</b>	<b>18.0%</b>
	<b>Federal Appropriations</b>	<b>9.4%</b>
	<b>Private Contracts</b>	<b>4.4%</b>
	<b>Revolving Funds</b>	<b>7.7%</b>
	<b>Private Gifts</b>	<b>4.4%</b>
	<b>Institutional Funds</b>	<b>2.9%</b>

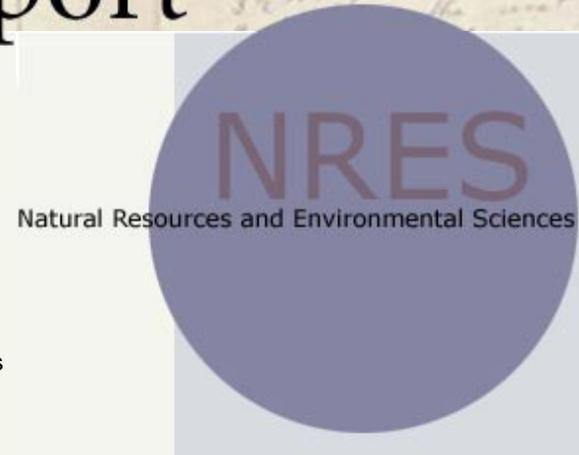


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## Natural Resources & Environmental Sciences

### New Web Tool Maps and Analyzes Illinois

Everyone, from farmers and natural resource experts to city planners and real estate agents, has an innovative new Web tool at his or her fingertips, thanks to the combined efforts of the University of Illinois, the Illinois Department of Natural Resources (IDNR), and other agencies.

The tool is the Resource Management Mapping Service (RMMS), a new Web site that allows people to create maps of any area within Illinois in a matter of minutes. The RMMS Web site is located at <http://space1.itcs.uiuc.edu/website/rmms/>.

"The uses for the RMMS Web site are as varied as the users," says Rick Farnsworth, a University of Illinois natural resources economist. "State staff use RMMS to track changes in natural resources and adapt management plans accordingly. And farmers visit the site to get a bird's-eye view of production or calculate acreage needed for state and federal conservation programs.

"A long-distance runner once used the Web site to measure and map a marathon route," Farnsworth adds. "In addition, real estate agents have used it to show prospective clients the area in which they hope to buy property.

"City planners also benefit," he says. "If a town wants to expand, they need information about the impact this growth will have. For instance, where will this growth occur in relation to the town's existing boundaries? Will growth encroach on the state's mandated buffer around public wells or protected habitat? They can start making decisions using the maps they create on this Web site.

"One of the key strengths of RMMS is that we have most of the data that are publicly available from state and federal agencies," Farnsworth notes. "Users can come to one site, locate the area of interest to them, and create the maps they need."

Users can search by county, watershed, town, or zip code, or they can draw rectangles on the map to zoom to an area they want to view, he says. Once there, they then can choose a base layer on which to lay all other data layers. There are more than a dozen base layers, including cropland maps from 1998, 1999, and 2000 or aerial photographs taken in 1998 and 1999 that allow you to see the land in question.

After a base layer has been chosen, any number of other layers can be added. These include:

1. Resource layers, which identify county land, lakes, rivers, watersheds, wetlands, and other natural resource features
2. Administrative layers, which include various IDNR districts, as well as townships and congressional and legislative districts
3. Economic layers, such as state highways, county roads, wells, and more

After choosing the layers you wish to see, simply hit the refresh button. One note of caution: Zoom in to the area you want to map before overlaying data. Most of the data sets are very large and take time to load. The smaller the area you choose, the less time you will spend waiting to view your map.

When users are finished, they can create their own log-in name and password, then load and save their map for future reference. Maps can also be printed or e-mailed to work associates, state agencies, family, or

friends.

According to Farnsworth, the next step for the RMMS site is to create decision tools based on the information available. "During the first two years, our job was to collect data and make it available over the Web," he says. "Now we're developing tools that will help agencies and the public assess the impacts of land-use change on the state's natural resources. Our partnership with IDNR and the other agencies is focusing university research on the state's resource problems and providing the means in which it can be used shortly after it becomes available."

The Wetland Impact Review Tool, or WIRT, is the first of several such tools that will come online in 2003. "When someone wants to change land use," says Farnsworth, "WIRT will alert the user to likely resource problems. Click on the WIRT tool, zoom in to the land in question, and draw a line around it. Everything else is automatic. WIRT will give you a heads up on the presence of nearby wetlands, nature preserves, streams, and flood zones, to name a few."

The RMMS Web site is funded by IDNR and the Illinois Council on Food and Agricultural Research (C-FAR). Farnsworth believes it is a noteworthy success story of cooperation that started with C-FAR members setting a high priority on better resource management of the state's natural resources.

"C-FAR provided funds to collect data and build new partnerships between the university and the state of Illinois," says Farnsworth. "The end result will be a state-of-the-art system that IDNR and the public can use to protect the state's soil, water, plant, and animal resources."

New Web Tool Maps and Analyzes Illinois—  
Source: Rick Farnsworth (765-496-3245; rlfarnsw@purdue.edu)



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## Natural Resources & Environmental Sciences

### Controlling Insects Naturally

Although mass plantings of red and yellow tulips in city parks are beautiful and a few well-placed trees surrounded by mulch in a parking lot provide shade for a car or two while breaking up the monotony of the asphalt, according to Lawrence Hanks, a University of Illinois entomologist, unless they are ruthlessly sprayed with insecticides they are sitting ducks for insect infestations.

“Controlling the insect population without the use of insecticides is a simple concept, really. It’s something that’s been looked at since the ’60s,” says Hanks. “The more plant diversity, the more stable the environment will be.”

Hanks began a study in 2000 with the hypothesis that planting a variety of flowering plants would attract natural enemies like insects to an area, keeping the insect population in check without the use of insecticides. The test plots have already demonstrated that the method works. His ultimate goal is to provide landscapers with a list of flowering trees, plants, and ground covers that will make a sustainable landscape for insecticide-free maintenance.

“What we’re recommending is that landscapers create a little plant community, a mini-wildlife refuge with plants that support insects, providing food for natural enemies like ground beetles and crickets,” says Hanks. He says that rather than islands of greenery in a parking lot, he would like to recommend that landscapers design more of a swath of green space—one that perhaps links with a larger nearby natural area or field. “They may have to give up a couple of parking spaces to make it happen, but they can also make an economic argument, because in the tiny areas they have to replace the trees more often due to infestation and they have to spray more.”

He explained that planting a tree with mulch around it is a popular landscape design for parking lots and along city sidewalks, but it is a pretty bleak ecosystem. If you plant a shrub next to the tree, you’re better off than having the tree by itself; but Hanks would like to see even more plant diversity to control the insect population. The alternative is spraying regularly with insecticides.

“People want greenways in their cities. They want flowers and birds but not the pests,” says Hanks. “They don’t want grasshoppers chewing up their greenery. But they also don’t want to use insecticides. If they use insecticides, they won’t attract birds, and their own domestic pets and children may suffer from contact.”

Hanks says that if people can accept having a variety of insects in their greenscapes, the population of one pest won’t get out of control. “Pine needle scales are terrible pests of ornamental plants,” says Hanks. “We noticed that in settings with diverse landscaping, you can hardly find one scale. But in a small parking lot green space—the kind you find next to a fast-food restaurant—there was a very high density of scale infestation.” The ecological balance sustains the populations of natural enemies.

“The next step in the study is to identify the mechanism—that is, what is it about the combination of plants that works? Is it the flower or the green part of the plant? Our study in the summer of 2003 will look at plots with the flowers intact and plots with the flowers snipped off to see which is more effective at controlling the insect population.”

NRES  
Natural Resources and Environmental Sciences

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The overall goal is to reduce the use of insecticides. Hanks says that it might mean that some people will have to change their mind to accept this strategy. But it would mean that, instead of an insect explosion that comes in and destroys the landscape, there would be much lower densities in an ecological balance that encourages other types of animal life.

“ So we’re saying that for the sake of an ecologically balanced environment, without the need for weekly spraying, accept the insects; and along with it you’ll get more of what you want, like birds and butterflies.”

This research is being conducted in collaboration with Clifford Sadof of Purdue University and is supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture. Hanks is also affiliated with the Department of Natural Resources and Environmental Sciences in the College of Agricultural, Consumer and Environmental Sciences at the University of Illinois.

Controlling Insects Naturally—  
Source: Lawrence Hanks (217-333-8862; hanks@life.uiuc.edu)



# Biennial Report

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## Natural Resources & Environmental Sciences

### Berries Benefit Health

For decades, mothers and grandmothers have said that drinking cranberry juice would help prevent urinary tract infections. Anecdotal evidence says that it works, but why it works and at what dosage, Grandma couldn't say. Researchers finally know the answer.

A team of researchers working in labs across the continent have been studying a variety of medicinal properties of cranberries and blueberries and have found some remarkable answers to age-old mysteries about the health benefits from eating berries. According to the "berry group" as they are often called, berries can protect against a wide variety of ailments, including urinary tract infections, cardiovascular disease, cancer, attention-deficit disorder, and diabetes. Berries are also the number one antidote for aging.

One member of the berry group at Rutgers, led by Amy Howell, has shown that the unique ability of cranberry and blueberry juices to combat urinary tract infections is not, as earlier suspected, an acidity effect but an anti-adherence. Mary Ann Lila, a plant scientist at the University of Illinois and a member of the berry group explains, "The berries actually interfere with the bacterial landing mechanism, preventing them from taking hold on the rough walls of the bladder and preventing colonization that can lead to infections. And, as a direct result of this conclusive research, for the first time, we are able to establish effective dosage recommendations for patients."

Interestingly, Lila's lab recently discovered that those same berry components (called proanthocyanidins) responsible for the anti-adherence also have potent anticarcinogenic properties. "Natural ingredients found in high concentrations in the berries are capable of inhibiting the initiation of carcinogenesis, as well as inhibiting tumor formation. It's remarkable that the berries have exhibited such far-ranging and diverse roles in human health protection," Lila says.

The team has also begun referring to blueberries as "brainberries," because of another berry research project that looks at brain functions. Researchers Jim Joseph and Barbara Shukitt-Hale at Tufts in Boston fed blueberry chow to lab rats and found a slowing and actual reversal of age-related loss in cognitive as well as motor and neurological functions. Rats' memory improved as measured by their ability to complete a maze. Diets rich in berries enhance dopamine release in the brain, as well, which improves the brain cells' ability to communicate. This brain function is reduced with age, but research has shown that eating blueberries can reverse the age-related decline in brain signals.

Lila cautions that the health benefits derived from eating berries may not be the same if taken as a dietary supplement from a bottle. "Dietary supplements are frequently produced and marketed based on one recognized bioactive component," says Lila. "They fail to look at the contribution of other components from the whole plant food." There appears to be a relationship among all the components that make up a plant food. When one component is separated out, the maximum effect is not seen. "So a dietary supplement containing only one isolated extract of a blueberry or cranberry," says Lila, "cannot be expected to provide full benefits and will not mimic the same results if someone were to eat the whole berry."

Lila says that when fresh blueberries are not available, canned blueberries are another option. Although the heating process for canning may take some of what she called "the good stuff" out of the berries, what's left in

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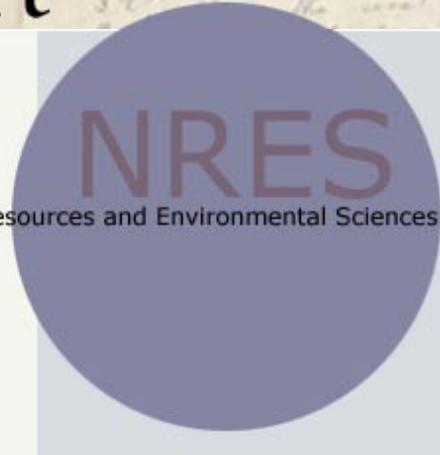
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the canned variety can be more easily absorbed into the body.

Funding for Lila's research is provided by the National Institutes for Health—National Center for Complementary and Alternative Medicine and the USDA Initiative for Future Agriculture and Food Systems.

Berries Benefit Health—

Source: Mary Ann Lila (217-333-5154; [imagemal@dogwood.itcs.uiuc.edu](mailto:imagemal@dogwood.itcs.uiuc.edu))



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## Human & Community Development

### Southeast Asia Positive Toward Biotech Crops

While well-fed countries engage in conversations about whether or not biotechnology should be used to prevent pests and boost the world's food production, developing countries in Southeast Asia express optimism toward the technology in hopes of saving their starving populations, according to a University of Illinois social scientist.

"In southeast Asia, key stakeholders believe that the benefits of biotechnology outweigh the risks," says Napoleon Juanillo, University of Illinois social scientist. "They have many more mouths to feed than we do in the United States, so they are focused more on feeding the hungry than engaging in discourse about the moral and ethical dimensions. Although moral and ethical concerns are expressed, for the most part, that is an elite discourse and one they do not have time to engage in."

Juanillo completed a collaborative survey in five Southeast Asian countries: Thailand, Vietnam, Philippines, Indonesia, and Malaysia. With help from approximately 250 university scientists in those countries, he surveyed urban consumers, businessmen, extension workers, farmer leaders, religious leaders, journalists, policy makers, and scientists about their opinions and perceptions on biotechnology.

"Those who participated in the survey are the key stakeholders of these countries," says Juanillo. "But they are also rational people who are looking realistically at their starving population and seeing the benefits of biotechnology as a way to feed the masses. Anything new and promising is welcome news to them. They seem to be saying, 'Our people are starving, and you're telling me to consider the risks?' It's an elite discourse."

By way of comparison, as of July 2002, the United States had a population of a little more than 280 million. Indonesia is about three times the size of Texas and has a population of more than 231 million. The total population of the five Southeast Asian countries Juanillo surveyed is estimated at 481 million people. "The message to Illinois farmers is that Southeast Asia is a big market for corn and soybean, and there is not much opposition to biotech products in those countries," says Juanillo.

Currently, Vietnam experiments heavily with biotech products. Indonesia grows biotech cotton. The Philippines recently approved field testing of biotech corn, while the Malaysian government is pushing for more experimentation and Thailand is just beginning experimentation.

"Although fear of the unknown typically drives up concern, the people of southeast Asia are hopeful of anything new that will help their country," says Juanillo. "They welcome any technology that will bring more prosperity to their country. Developing countries are always behind, and they look at biotechnology as a potential tool to help them catch up."

Juanillo says that there is a misconception that these Southeast Asian countries are just growing rice. "They're a tropical explosion. And, if biotechnology can help them to develop more varieties of mangoes or papayas, that's a good thing to them. Anything that can help them produce better crops, they're in favor of."

It all began with a talk at a conference in Thailand in 1999 about the role that culture and other social variables play in the public's perception of the risks of biotechnology. Napoleon Juanillo was asked by the Department of Agriculture in the Philippines to give a similar talk in the Philippines. This snowballed into more



speaking engagements.

With assistance from the International Service for the Acquisition of Agri-Biotech Applications (ISAAA) and the International Rice Research Institute (IRRI), Juanillo was able to coordinate studies in the five Southeast Asian countries. The logistics alone involved monumental orchestration. The survey first had to be translated into three other languages besides English—Thai, Bahasa Indonesia, and Vietnamese.

“ I made one trip to Bangkok, where the entire team gathered in order to describe the protocol for administering the surveys so that all of the data would be compatible. Later we met in Malaysia to look at the progress. The ISAAA served as coordinator of the project, and it was my job to analyze the data collected,” says Juanillo.

Juanillo says that the project was partially funded by Hewlett Foundation, the University of Illinois, the Illinois Council on Food and Agricultural Research (C-FAR), and the agricultural universities in the five Southeast Asian countries in which the studies took place. “These universities provided manpower consisting of geneticists, plant pathologists, and molecular biologists who are interested in what people think and whether the work they are doing with biotechnology is relevant,” says Juanillo. The survey was patterned after the Eurobarometer public perception surveys on biotechnology.

Southeast Asia Positive Toward Biotech Crops—  
Source: Napoleon Juanillo



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## Human & Community Development

### Gay and Lesbian Families Opt for Rural Life Despite Obstacles

Gays and lesbians live in rural areas for the same reasons straight people do—wide open spaces, family ties, and a less frenetic pace than life in a big city provides. But, if gays and lesbians have relationship problems, need to call the police, or encounter discrimination in their professional life, they may find themselves without resources that straight people, or gays and lesbians in a metropolitan area, take for granted.

“I own a farm and love the country. I would hate to be in a more populated area. I have many gay friends here whose company I truly enjoy,” says one respondent to a survey of 527 lesbian, gay, bisexual, and transgender (LGBT) people in central Illinois conducted by University of Illinois family studies expert Ramona Oswald.

Oswald knows her survey is biased toward people who belong to LGBT organizations or who have other LGBT people in their lives, and who are willing to fill out and return a survey, because she used organization mailing lists and volunteers who distributed surveys through their social network. The results of her study were published in Family Relations, the Journal of Family Psychology, and the Internet-based Journal of Rural Community Psychology.

The presence of a social network may make all the difference for LGBT people who choose to live in rural areas, says Oswald, who notes that the 2000 Census found same-sex couples living in virtually every U.S. county. Many respondents ranked strong relationships with their families, whether they included family of origin, a partner, children, or close friends who were considered family, as very important. But, if problems surface in these relationships, it can be difficult for people in the LGBT community to find help. Although counselors and services for heterosexual couples are readily available, very few are publicly identified as providing such services to the LGBT community, Oswald says. “When I sought services here, I encountered extreme homophobia,” wrote one respondent who required help because she had been abused.

In looking for help, LGBT people must be careful that they have found someone who will be helpful to them, not a counselor who will focus on what he or she feels is wrong with the new client’s family, Oswald says.

Oswald says it is important that counselors or social workers understand how isolated and invisible LGBT people may feel when relationships break up and that professionals should be able to connect gay people to sources of support.

“When you have fewer social ties, you have fewer alternatives if things don’t go well. You might stay in a relationship because you don’t feel you have very many social alternatives. In a more densely populated area, there might be more options not just for seeking help but also for finding other people to be in your life,” she says.

Oswald says the Internet has become an important source of support and information for gay people in rural areas and that the “open and affirming” movement in certain churches has created a welcoming climate in unexpected places for many LGBT people. One respondent wrote that she was recently hired as a minister in



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a small-town Protestant congregation and that everyone in the church knows she is a lesbian. Religious or spiritual beliefs were either very important or extremely important to 55 percent of survey respondents.

About a fourth of the respondents had children, but there are no LGBT parenting groups or groups that relate to schools or doctors or other organizations, says Oswald. "Individuals have to negotiate with teachers or doctors the best they can." Several respondents mentioned both the joys of having children and the struggles for support and acceptance that they face as parents. One respondent wrote, "We need more support for LGBT folks with children. There are plenty of us, and it's very difficult to become visible because of potential threats to children and also the threat of losing custody."

Oswald says that gay teens in central Illinois are very isolated. "I have spoken to high school kids who travel to the nearest gay community center on Friday nights when they can, but it's a 50-minute drive, and when they're at home, they pretend they're straight.

"Unfortunately, there is still a very strong antigay sentiment in the Midwest, and people have to deal with that hostility every day. It might be as benign, as well, you're fine, just don't ever talk about your life," she says.

But fear that the hostility may turn ugly is always present. One survey respondent wrote, "We're so vulnerable when we're alone. The cops here won't even file reports of the problems I've had with my neighbors. It's my love of the land, the family pride in the farm, the family . . . that keeps me here in the middle of nowhere."

Oswald has testified at hearings in Decatur, Bloomington, Springfield, and Peoria in favor of human rights ordinance protection on the basis of sexual orientation. "Unless you are included in the law, you can be discriminated against. One survey respondent wrote that the police just laughed at him when he tried to get help. Now that sexual orientation has been written into law in that city, the police would have to take him seriously," she says.

Over and over, respondents mentioned how important equal rights legislation for LGBT people was to them. "I am terrified that I will have a medical emergency and my partner will not be allowed to make decisions on my behalf. She alone understands my beliefs and respects them."

Another respondent said, "I was forced out of my job last year because I am gay. I sought legal advice from two attorneys who both declined my case, saying there is no state or federal law to protect me."

"I wish people would realize that we want basically the same things as heterosexual people—a house, a car, loving relationships, equal rights, and opportunities. Not special rights—just equal rights!" said another.

Oswald says that heterosexual people have an important role to play in creating an inclusive place for people of all sexual orientations. She encouraged counselors who are interested in expanding their practices to read gay newspapers, attend services in an "open and affirming" congregation, meet LGBT people, and find out what issues are important to them.

"It's really important that you see these issues as relevant to your life even if you're heterosexual. Because, whether you know it or not, chances are good that there are gay and lesbian people in your life," says Oswald.

Gay and Lesbian Families Opt for Rural Life Despite Obstacles—  
Source: Ramona Oswald (217-333-2547; roswald@express.cites.uiuc.edu)



# Biennial Report

Illinois Agricultural Experiment Station

## Human & Community Development

### Life in Small Towns Becoming More Suburban

Rural midwestern towns grew by leaps and bounds in the 1990s as urban professionals decided that small towns were great places to raise families. But, as many of these towns grew, they lost their small-town character, says Sonya Salamon, anthropologist and professor of community studies at the University of Illinois.

And those characteristics were valuable. "Small-town communities have a culture worth nurturing and protecting. The resources, connections, and commitment to young people found in midwestern small towns contribute a great deal to the successful development of youth," Salamon says.

In her new book, *Newcomers to Old Towns: The Suburbanization of the Heartland*, Salamon describes six small towns in Illinois, renamed for the sake of anonymity and located in the commuting zone of "Central City." She discusses the circumstances that made these towns resilient or led to their decline as they faced pressure to change.

In Salamon's study, one town grew dramatically in the past three decades because it had easy access to a midsized city via the interstate, interesting terrain with wooded areas, developers who created new subdivisions with grand houses, and good school systems. "Prairieview" began to look and feel more and more like a Chicago suburb.

But, says Salamon, its growth occurred at the expense of "Splitsville," another town in the commuting zone that was populated increasingly by rural families who couldn't afford the price of housing in newly fashionable Prairieview. Neglected housing in Splitsville was bought for back taxes and sold or rented to low-income people. Longtime residents didn't welcome the newcomers, who kept old cars in their yards and couldn't afford to have garbage collected weekly. When one member of the "old guard" turned off the water at a newcomer's home for nonpayment, the newcomer reacted by vandalizing the home of the water commissioner.

Other towns, called "Corntown" and "Arbordale," found different ways of handling the diversity created when Mexican American migrant workers decided to live in these communities permanently.

Such challenges are relatively recent in midwestern farm towns, long rumored to be dying. In fact, the population of rural America increased in the 1990s by more than 3 million people. Some small towns courted such growth with inducements, such as \$10,000 grants to families who bought land and built a new home.

"People have long denigrated small towns, calling them fished-out ponds, with the best and brightest kids leaving. But those farm towns didn't decline, because they're greater than the sum of their parts. These fished-out ponds do amazing childrearing. They just kept producing more of the best and the brightest, which says to me that the best and brightest are not those who have more ability than others but that having an entire village involved in the upbringing of its youth makes a dramatic difference," Salamon says.

In rural small towns, families often have a shared background over many generations, and community members share a social network that links families in functional and emotional ways. Homes have porches that face the street to promote neighborliness. These towns have public places, a central square, a café, or a



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bowling alley, where people gather. Families know and watch out for their neighbor's children, generations interact with each other, and if teenagers drag Main Street or hang out downtown, adults are tolerant because they know "they're good kids and there's not a lot to do here."

New subdivisions are usually not located near the town center, and they are not designed with communal spaces for recreation. "Newcomers have a consumption mentality. They buy a house in a new subdivision and consume the countryside for its natural setting, its good schools, and its low crime rate; but few of them put anything back into the places they call home," Salamon says.

"Kids in these suburban settings have a peer-structured youth culture. They don't interact as frequently with older adults in the community. The homes are built for privacy. People come home from work, drive into their attached garage, and they never see each other casually. There's very little 'neighboring,' and that's important in building a sense of community.

"Glen Elder, a prominent sociologist, says that these cultural dynamics produced Columbine. At about that time, the New York Times published the floor plan for the most commonly built suburban home, which has a children's wing with a private entrance. If the house is professionally cleaned and the kids have their own TV and computer, they don't even need to interact with their parents very much," Salamon says.

Salamon was struck by the number of small-town newcomers who didn't go to church in their home community, either driving into a small city for church or joining one of the huge new churches built along the interstates. "The older churches helped a lot with small-town festivals and put a lot back into the community. These mega-churches aren't nearly as concerned with building community in their towns. They're concerned about the church community. They're entrepreneurial about souls," she says.

"Families in places like Prairieview often plan to stay only until their children are out of school, and there is no expectation that children will come back to that town when they are grown," she says.

In contrast, Salamon quoted one man who had been raised in a place like "Smallville," which lies in a remote corner of a sparsely settled western Illinois county and has retained many of the strengths of the best agrarian towns. "When I got out of high school, the sight of that town in my rearview mirror was the best thing I'd ever seen," the man said wistfully, "and I've been trying to get back there ever since."

Life in Small Towns Becoming More Suburban—  
Source: Sonya Salamon (217-333-3829; ssalamon@uiuc.edu)



# Biennial Report

Illinois Agricultural Experiment Station

## Food Science and Human Nutrition

### Honey Has Potential as Dietary Antioxidant

Two University of Illinois studies are sweet news to honey lovers. One shows that honey's antioxidant qualities preserve meat without compromising taste. One published study says that honey—at least based on work done on human blood in the lab—slows the oxidation of low-density lipoproteins (LDLs), a process that leads to atherosclerotic plaque deposition.

Similar to a University of Illinois study in 1999, researchers found in both studies that dark-colored honey, especially buckwheat, provided more protective punch than lighter-colored honeys. "It still is too early to say definitively, but honey seems to have the potential to serve as a dietary antioxidant," says principal researcher Nicki Engeseth, a University of Illinois professor of food chemistry.

The newest study, published in the *Journal of Agricultural & Food Chemistry*, is the first to look at honey's effect on human blood. The study also found, using a much more precise method than the one used in 1999, that honey's antioxidants are equal to those in many fruits and vegetables in their ability to counter the degenerating activity of highly reactive molecules known as free radicals.

Engeseth and Jason McKibben, a researcher with Anheuser Busch in Santa Monica, California, reported that honey was more effective than traditional preservatives (butylated hydroxytoluene and tocopherol) in slowing oxidation in cooked, refrigerated ground turkey. While the meat browned during cooking more extensively than traditionally preserved products, taste was not negatively affected.

For the study, Engeseth and Nele Gheldof, a doctoral student in the Department of Food Science and Human Nutrition, measured the antioxidant and phenolic contents in honeys taken from seven floral sources. The study covered acacia, buckwheat, clover, fireweed, Hawaiian Christmas berry, soybean, and tupelo honeys. Researchers used the oxygen radical absorbance capacity (ORAC) assay, a tool that for the past decade has been widely used to analyze the same components in fruits, vegetables, and wines. Darker honeys had the highest values.

"We got ORAC values ranging from 3 to 17," Engeseth says. "Commonly consumed fruits and vegetables generally range from 0.5 to 16, based on a per gram basis. This finding is significant, because it clearly shows that there are antioxidants in the honey. If you ate as much honey as you did melon, for example, you would be getting a similar dose of antioxidants in your diet." Is such a scenario likely? No, but the idea that honey packs healthy quantities of antioxidants does strengthen the idea of using honey as a sugar substitute, Engeseth says.

Engeseth and Gheldof obtained blood samples from healthy human volunteers coming off a 12-hour fast. To the blood, they added the various honey varieties in an experiment to watch honey's impact on LDLs, the so-called bad cholesterol. In test samples, they also added copper to stimulate lipoprotein oxidation. Using a spectrometer, they found that honey (the darker the better) dramatically slowed the rate of formation of conjugated dienes, products of oxidation related to LDLs in blood. "The one thing about this study is that, even though it involved human blood in a test-tube assay, it does show that if honey is present it can act positively," Engeseth says.

Follow-up studies, either in progress or undergoing data analyses, will shed more light on the exact phenolic compounds in honey and on how effectively honey that is consumed prevents oxidation in the blood of human subjects.

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Phenolic compounds are phytochemicals, which are nonnutritious compounds in foods that may carry specific disease-fighting abilities. University of Illinois researchers also have found a significant correlation of phenolic content and antioxidant capacity of honey.

Both studies were partially funded by the National Honey Board.

Honey Has Potential as Dietary Antioxidant—

Source: Nicki Engeseth (217-244-6788; engeseth@uiuc.edu)



# Biennial Report

Illinois Agricultural Experiment Station

## Food Science and Human Nutrition

### Vegetable Benefits Depend on Genetics and Environment

We eat vegetables knowing they are good for us, and as University of Illinois research has revealed, can sometimes help in the fight against cancer. But just how beneficial a particular vegetable is may depend on what variety you are eating as well as environmental factors that affected the crop, according to Elizabeth Jeffery, University of Illinois nutritional scientist.

With USDA funding, Jeffery and fellow researchers analyzed 50 varieties of broccoli to measure their antioxidant and cancer-fighting compounds and found that broccoli varieties are not created equal. Some varieties had 10 times the vitamin E, twice the vitamin C, and 8 times the beta-carotene. These nutrients are antioxidants, thought to protect body cells from the damaging effects of oxidation.

The broccoli varieties also ranged in their amount of glucosinolates, compounds that promote the breakdown of carcinogens and suppress the growth of cancer tumors. But genetics isn't the whole story. "One type of glucosinolate called glucobrassicin, which has been shown to fight breast cancer tumors, varied dramatically as a result of its environment," says Jeffery. "This compound is produced when insects or animals bite the plant," she explains. "More than 50 percent of the amount of glucobrassicin in broccoli is determined by the environment in which the crop is grown."

Jeffery was inspired to do this research when she learned the results of a study done by John Juvik, University of Illinois plant geneticist. He evaluated beta-carotene, vitamin E, and vitamin C levels in a number of corn varieties. He, too, found great variation in these antioxidant nutrients. Some varieties had 100 times the beta-carotene and 25 times the vitamin E of others. Since that time, she and Juvik have worked together on enhancing the health benefits of broccoli. Other collaborators on this project include Mosbah Kushad, Matt Wallig, and Barbara Klein.

Farmers typically focus on yield and storage-life characteristics when they choose crop varieties but not nutrient levels. Jeffery doesn't expect farmers will have to choose between high yield and high nutrient content. "John Juvik and I both limited our research to varieties that had high yield," says Jeffery. "This means that high levels of nutrients and cancer-fighting compounds in a crop are value added," she says. The researchers hope to convince seed providers that nutritional benefits should be included in the marketing plan for many vegetable varieties.

Jeffery believes that understanding the mechanisms that trigger the release of important compounds such as glucobrassicin may open the door to genetically regulating the amounts of health-promoting compounds that crop plants produce. "More work is needed to get to that point, but one day we might breed broccoli plants that produce more of these compounds."

The next step for Jeffery is to evaluate the impact of processing on broccoli nutrients and cancer-fighting compounds postharvest. She has begun a study to assess how cooking and processing of broccoli impact its benefits.

Vegetable Benefits Depend on Genetics and Environment—  
Source: Elizabeth Jeffery (217-333-3820; ejeffery@uiuc.edu)

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## Food Science and Human Nutrition

### Fast-Food Facts on Your Cell Phone

The next time you visit a fast-food restaurant, bring your Internet-ready cell phone with you, because researchers at the University of Illinois have developed a wireless tool that calculates the number of calories and the amount of fat in the meal you're about to order.

"When people want nutritional information, 99 percent of the time they want to know the calories and fat content," says Jim Painter, University of Illinois professor of nutritional sciences. "So we started this wireless version of the nutrition tool by offering just the fat and calorie content for the top 10 nationwide fast-food chains."

The address for the site is <http://web.aces.uiuc.edu/aim/nat>. Once at the site, it's possible to choose a specific restaurant and create a meal by selecting items from a list of categories: entrée, side dish, salad, beverage, or dessert. "You choose items to make up a meal, and the total fat and calorie content will be calculated for you. If the totals are higher or lower than you expected, you can go back to a category, select a different item, then have your meal recalculated," Painter says.

"Once we get this accessible on handheld devices like Palm Pilots," says Painter, "I'd like to add an energy calculator, too, so that people can use it while they're out jogging. They can jog for 30 minutes, then check how many calories they've burned so far, then decide to jog farther or switch to a different activity." Painter says that he also plans to add family-style restaurant chains to the listing of fast-food chains.

Note: The wireless Web address <http://web.aces.uiuc.edu/aim/nat> will only work on a cell phone, not on a personal computer. "Any cell phone that is 'wireless Web ready' can access the site," says John Schmitz, one of the cocreators of the Web site. "These phones have what's called a 'microbrowser,' basically a very small version of Netscape or Explorer. Soon we will also develop the capability to reach wireless personal digital assistant devices like Palm Pilots and Pocket PCs."

The wireless calorie and fat calculator component is an extension of the Nutritional Analysis Tool. To access, visit <http://www.nat.uiuc.edu/> and choose NAT Tool Version 2.0. At this site, the information is not listed by restaurant. Visitors type in the kind of food they want information about, like "hamburger," and they will get a listing of items to choose from.

Fast-Food Facts on Your Cell Phone—  
Source: Jim Painter (217-581-6076; [cfjep@iu.edu](mailto:cfjep@iu.edu))



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## Crop Sciences

### Red Light Treatment May Save Illinois Vegetable Crops

Exposing seedlings to continuous red light in a greenhouse before transplanting them to the field is a method being explored to fight a deadly fungus in Illinois vegetable crops. The technique being tested by Mohammad Babadoost, plant pathologist at the University of Illinois in the College of Agricultural, Consumer and Environmental Sciences, along with his postdoctoral research associate, Sayed Zahirul Islam, has already shown promising test results.

“Four-week-old seedlings of pumpkin, pepper, and tomato, grown under continuous red light in a greenhouse for four weeks, were inoculated with *Phytophthora capsici*, a soilborne pathogen,” explains Babadoost. “The plants were then kept under natural light on the greenhouse bench. Control plants were either grown under natural light or continuous white light. Within 14 days of inoculation, 78 to 100 percent of the control plants died, but only 21 to 36 percent of the red light-treated seedlings became infected. Red light-treated pepper plants have been transplanted in a field, in soil highly infested with *P. capsici*, and the plants have survived well, while some of the control plants have already been killed by *Phytophthora* blight.”

The destructive fungus has caused up to 100 percent yield losses in fields in the past few years. It attacks pumpkins and other vegetables such as cucumbers, eggplants, melons, peppers, squashes, tomatoes, watermelons, and zucchinis and causes seedling death, foliar blight, and fruit rot. Babadoost says, “The losses caused by this pathogen have been so extensive that some growers have had to abandon raising the crops in their own areas and seek production of the crops in other areas.”

If successful, the red light therapy could become a new nonchemical method to control the disease caused by *Phytophthora capsici*. “So far, the results have been very promising,” Babadoost says. “But we still have a long way to go before we can say whether or not this will be a long-term solution.” The question is, how long will the treated plants maintain the red light-induced resistance against the fungus after transplanted in the field, where there is no longer a therapeutic red light?

Two other techniques being explored to battle the fungus on cucurbit crops like pumpkins are conventional chemical treatments and have already been shown in experiments to be effective. The first technique involves treating the seeds with chemicals before planting. In greenhouse tests, treated seeds were planted in fungus-infested soil and survived without developing seedling death. Babadoost says, “This method is effective, economically feasible, and environmentally safe. Seed treatment protects the plants in early growth stages.”

A second technique involves spraying the crop with fungicides. Fifteen different fungicides were tested in the laboratory and field for controlling *Phytophthora* blight and fruit rot of pumpkins. Soil-drenching fungicides were applied when the seeds were planted. Spray applications of the fungicides were made each week, starting from four weeks after planting.

Some of the 15 fungicides were able to suppress the growth and sporulation of the pathogen in the laboratory, and foliar blight and fruit rot in the field experiments. As a result, the United States Environmental Protection Agency granted special permission to use the fungicide Acrobat MZ to control *Phytophthora* blight and fruit rot in cucurbit vegetable crops in central Illinois.

Tom Laatsch, an agriculture manager for Nestlé, a company that sells processed pumpkin under the Libby label, walks Illinois pumpkin fields checking for signs of the blight. Although spraying Acrobat MZ appears to work, Laatsch does not believe it is the perfect solution. He noticed the blight appearing as much as a month earlier this year than last year. “Some fields have already been sprayed with chemicals twice, and that’s an expensive solution that the farmers would prefer not to use.”

Like human pathogenic fungi, plant pathogenic fungi grow best in warm, moist environments. So the amount of rainfall in a growing season can greatly affect the ability of the fungi to spread and damage a crop. In the pumpkin, *Phytophthora capsici* causes pre- and postemergence seedling death, leaf spot, vine blight, and fruit rot. The pathogen chokes the vine, which, like an umbilical cord, delivers water and nutrients from the soil to the leaves and fruit, causing them to die on the vine.

Illinois ranks first in pumpkin production among all states in the nation. “There are approximately 20,000 acres of pumpkins grown each year in Illinois—8,000 to 10,000 for processing and 10,000 to 12,000 for jack-o’-lanterns,” says Babadoost. More than 65 percent of processing pumpkins produced in the United States are grown in Illinois. “So these are important crops in Illinois.”

Red Light Treatment May Save Illinois Vegetable Crops—  
Source: Mohammad Babadoost (217-333-1523; babadoos@uiuc.edu)



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## Crop Sciences

### Atmospheric Changes May Affect Crops in the Future

To anticipate possible problems from global warming, researchers at the University of Illinois have launched a research project known as SoyFACE that can mimic the content of the atmosphere in the year 2050 and assess how those changes will affect crops. The main research facility for the project is located on 80 acres of farmland, just south of the main University of Illinois campus at Urbana.

To anticipate possible problems from global warming, researchers at the University of Illinois have launched a research project known as SoyFACE that can mimic the content of the atmosphere in the year 2050 and assess how those changes will affect crops. The main research facility for the project is located on 80 acres of farmland, just south of the main University of Illinois campus at Urbana.

Carbon dioxide has been increasing at a rate of 0.4 percent per year. Because plants take in carbon dioxide, this has been a positive change for plant production. In fact, rising carbon dioxide has the potential to increase yields by as much as 30 percent. But those yields are unlikely to be realized with today's soybean because varieties are adapted to the atmosphere of a century ago.

At the same time, ozone has a negative effect on crops. The gas has increased an average of 1 percent per year and is already estimated to have cost agriculture in the United States over \$2 billion in lost production. And soybeans are particularly sensitive to ozone. The problems of surface ozone changes are regional, depending in part on proximity to urban and industrial areas. "As the name SoyFACE suggests, the primary focus of the research is on soybeans, but the impact of atmospheric changes on corn is also under investigation," says Stephen Long, professor in the University of Illinois's crop sciences. "The project uses a new technology known as free air concentration enrichment (FACE). This consists of a network of tubing that delivers different concentrations of ozone and carbon dioxide into the air that surrounds the soybean and corn plants in the test field."

He notes that the system creates a kind of greenhouse without the walls and glass around it. The higher concentrations of gases dissipate as they rise out of the study area and into the general atmosphere without causing any change to the surrounding area. "The open-air field laboratory gives us an opportunity to look at a whole system in a 'real-world' way that isn't possible in greenhouses or controlled chambers," Long says. "In the FACE facility, we can look at all the biological processes, what's happening with the plants and soil as atmospheric gases change."

They have already observed some remarkable variations because of the changes in atmosphere inside the ring. Soybeans growing inside the ring of tubing stayed greener longer because of the elevated level of carbon dioxide than the soybeans growing just inches away, outside of the experimental arena. "The effects of atmospheric gases on a cropping system are very complex," Long says. "Once we understand the science behind the changes, we can begin to genetically modify the crop or select genotypes and management systems that take advantage of those changes to increase production under levels of atmospheric gases predicted for the future."

In mimicking the anticipated atmosphere of 2050, the researchers have found that soybean yields increased by 15 percent at the elevated carbon dioxide levels. Although the response was smaller, significant yield

increases were observed in some corn cultivars.

“Other results suggest that even greater yield increases could be possible,” Long says. “Decreased evaporation of water also might result in stress damage in hot years. By contrast, a 20 percent increase in ozone depressed soybean yields by 15 percent. Work during the coming growing season will aim to establish how rising ozone and carbon dioxide interact.”

Although there are several other facilities of this kind around the world studying different crops, this one is the largest. The only other FACE crops facility in the United States is in Arizona and is used for cotton and wheat research. The work is funded by the Illinois Council for Food and Agricultural Research (C-FAR).

Atmospheric Changes May Affect Crops in the Future—  
Source: Stephen Long (217-333-2487; stevel@life.uiuc.edu)



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## Animal Sciences

### No Significant Difference Found in Animals Fed GMO Corn and Soybeans

Currently in the United States, genetically modified corn, cottonseed, and soybeans that have reached the marketplace are approved for use in animal feed. But what does that genetically modified corn and soybeans do to the animals who eat it? According to recent research, nothing significant.

Jimmy Clark, a professor of ruminant nutrition in animal sciences at the University of Illinois at Urbana-Champaign, reviewed the results from at least 44 experiments conducted at universities in the United States, Germany, Argentina, and France. In each study, separate groups of chickens, dairy cows, beef cattle, and sheep were fed either genetically modified corn, cottonseed, or soybeans as a portion of their diet.

Each experiment independently confirmed that there is no significant difference in the animals' ability to digest the genetically modified crops and no significant difference in the weight gain, milk production, milk composition, and overall health of the animals when compared with animals fed the traditional crops.

Clark concludes, "Based on safety analyses required for each crop, human consumption of milk, meat, and eggs produced from animals fed genetically modified crops should be as safe as products derived from animals fed conventional crops."

Clark adds that about 70 percent of the genetically modified soybeans produced in the world and 80 percent of the genetically modified corn produced in the United States are used as animal feed. "Since these genetically modified crops were grown beginning in 1996, they have been fed to livestock, and no detrimental effects have been reported," Clark says.

In the experiments that Clark reviewed, the corn used was genetically modified with a gene from *Bacillus thuringiensis* (Bt), a soil bacterium that produces protein that kills the European corn borer, a common and very destructive pest in cornfields. Corn borers reduce the quality and yield of corn and damage the plant tissue, which results in an increased opportunity for fungal growth. The fungi can produce a dangerous toxin that can kill horses and pigs and cause esophageal cancer in humans. So eliminating the corn borer from corn, reduces the chance for growth of the fungi from the corn plant, improving the safety of corn for animals and humans.

The soybeans used in the studies were produced by inserting a gene that causes the plant to be tolerant to the environmentally friendly herbicide glyphosate. This tolerance to glyphosate allows farmers to spray and kill weeds without killing the soybeans.

In other studies the nutritional value of genetically modified corn and soybeans was compared with that of traditional crops. These studies showed no significant difference in the nutritional composition of the grains themselves.

Along with many other scientists working with biotechnology, Clark believes that biotech crops hold the answer to how the growing population of the world will continue to be fed. "It has been estimated that the supply of food required to adequately meet human nutritional needs over the next 40 years," Clark says, "is



quantitatively equal to the amount of food previously produced throughout the entire history of humankind.” With the current world population at about 6 billion and the estimated 10 billion people expected by the year 2040, Clark believes that modern methods of biotechnology must be used to produce enough feed for livestock and food for humans.

No Significant Difference Found in Animals Fed GMO Corn and Soybeans—  
Source: Jimmy Clark (217-333-0123; jhclark@ansc.uiuc.edu)



UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Research

# Biennial Report

Illinois Agricultural Experiment Station

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## Animal Sciences

### Research Dividends Doubled in Pet Research

A family of research projects in the University of Illinois Department of Animal Sciences is producing information useful in combating diabetes and obesity in dogs and humans, according to the project's leader, George Fahey, professor of animal sciences. "We get a double impact from this research—what works in a dog tends to work in a human," he explains.

The projects focus on a number of areas related to diabetes, gastrointestinal health, and obesity and have identified novel carbohydrates that, when ingested by both dogs and humans, improve tolerance for carbohydrates while increasing dietary fiber content. "There are a number of these 'novel' carbohydrates that most people know nothing about," says Fahey. "One in particular—pullulan cyclodextrin—can modify the glycemic index, an indicator of tolerance for carbohydrates. When both humans and dogs eat too many carbohydrates, obesity may result, and this often can be a precursor for diabetes."

However, tests indicate that pullulan cyclodextrin actually blunts the body's glycemic response, decreasing the spikes in blood sugar levels that can be an extenuating circumstance in diabetes. "When this carbohydrate is included in the diet in any form, the result is better control of the glycemic response," says Fahey. "And you don't have to eat a lot of it to get the job done. Additionally, this novel carbohydrate has a fiberlike quality that allows its substitution for traditional dietary fiber sources. Less of these novel carbohydrates is needed, thus lowering the amounts of traditional dietary fibers that must be ingested for optimal health."

The research has important implications for both dogs and humans afflicted with diabetes or at risk for the disease. "The American population is overweight, and type II diabetes is occurring at almost epidemic levels," Fahey says. "The same thing is occurring in the pet population. Thirty percent of dogs in the United States are overweight and, like humans, have diabetes and large bowel problems as a result. One way to combat this is to modify the diet."

Fahey says clinical trials are continuing, but the early indications are positive. "These are pure carbohydrates and very palatable," he says. "And it also appears they have the added benefit of doing the same thing as a large amount of fiber content in the diet without negative side effects."

Research Dividends Doubled in Pet Research—  
George Fahey (217-333-2361; [gafahey@uiuc.edu](mailto:gafahey@uiuc.edu))





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## Animal Sciences

### Genome Mapping for Pig and Cow Funded

Three University of Illinois researchers were recently awarded \$3 million to use over a five-year period to create comprehensive genome maps of the pig and the cow. "It took a billion dollars to sequence the human genome. The National Institutes of Health had this huge investment in technology, people, and equipment and they finished early," says Lawrence Schook, animal science geneticist, "so they decided to use the remainder of the resources to sequence the genomes of other species." The research funded by USDA will be the first step toward sequencing the cow and pig genomes.

Schook, along with Jonathan Beever and Harris Lewin, who are also animal science geneticists at the University of Illinois in the College of Agricultural, Consumer and Environmental Sciences, was selected to develop detailed maps of the cow and the pig using the facilities at the University of Illinois Keck Center. For about 10 years, the three researchers have been studying genes that have an economic impact such as disease resistance, lactation, and growth. Schook and Beever study cows and Lewin studies pigs.

Schook explained that in the evolutionary sense cows, pigs, and humans have something in common—a placenta. But they have enough differences to make contrasting easy. "Having the gene maps and sequences of other species, particularly other mammals, will help us better understand the human genome."

"There are hidden secrets in the coding," says Lewin. "Only a small part of the genes encode protein. About 5 percent of gene coding of the cow, the pig, and the human is very similar. Another 5 percent is similar but noncoding. The other 90 percent is what we call 'DNA glue.' It either doesn't do anything or codes unknown functions."

Geneticists think that minor differences in the 5 percent of the coding that is similar and the 5 percent that is the same but noncoding DNA are what make a cow a cow and a pig a pig. By looking at gene sequences for different species side by side, comparing and contrasting, scientists can better understand how cows, pigs, and humans evolved.

"The honeybee genome, for example, was relatively simple to map because of its smaller size," says Lewin, "and although very different from humans, it is hardwired genetically for certain behaviors, so we can learn something about human social behavior and aggression from the honeybee." That work is being performed by University of Illinois entomologist Gene Robinson.

"We were very fortunate," says Schook. "I was at the University of Illinois for a number of years and then left. I came back because I wanted to do genetic work that would help agriculture. This project was presented many years ago when I was here the first time but didn't get funded. This was the right time, because of the extra years of funding available and the great technological advances made in genomics."

Genome Mapping for Pig and Cow Funded—



Sources: Jonathan Beever (217-333-4194; jbeever@uiuc.edu)  
Harris Lewin (217-333-5998; h-lewin@uiuc.edu)  
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## Agricultural & Consumer Economics

### Brazilian Land Rush

As a member of a farm family who hopes one day to farm on his own, Jason Moss has a natural interest in soybean production in Brazil and its challenge to U.S. producers. But a summerlong stay in that South American nation left the University of Illinois student convinced that Brazil is indeed the new frontier of soybean farming.

“Soybeans have now become a Third World product,” says Moss, a junior in the College of Agricultural, Consumer and Environmental Science’s Department of Agricultural and Consumer Economics. “One challenge for U.S. farmers is how one can earn a First World income producing a Third World crop. The cost of production difference is nearly \$2.50 per bushel in favor of the Brazilians.

“If Chicago Board of Trade prices go to \$4.00, there is no conceivable way an Illinois farmer could afford to continue growing soybeans—a crop many now heavily rely on for rotations and income.”

Moss prepared a research report on his June 1 to August 10, 2002, stay in Brazil as part of an internship course offered by Peter Goldsmith, an assistant professor of agribusiness and farm management.

“One of the things I find particularly interesting about Moss’s report is the opportunities it identifies for young people interested in farming,” says Goldsmith. “He’s looking 20 or 30 years down the horizon and identifying opportunities.

“Young people interested in becoming agricultural producers face a stiff challenge, especially in the barriers to obtaining the capital needed to control land. Some might not look forward to competing for ground and slugging it out here when cheaper land is available in Brazil.”

Goldsmith notes that ADM has a corporate presence in Brazil as well as in the United States, as does one of the largest cooperatives Cenex Harvest-States. So it makes sense that some U.S. farmers may decide to maintain farms in the United States and Brazil to take advantage of economic opportunities.

In addition to establishing a cooperating relationship with a Brazilian university, Goldsmith is part of a long-range University of Illinois research project examining the future of the soybean/meat production complex worldwide.

Because of the large amount of land coming under cultivation and the low costs, Brazil is becoming a new frontier of agricultural development. The family Moss stayed with migrated from Holland in 1989, and immigrant farmers are common. Much of the growth is centered in the state of Mato Grosso.

“It has become a magnet for several reasons,” says Moss. “It is viewed as an area with cheap land, infinitely large fields, and large amounts of cleared land. It has attracted considerable American investment. What makes Mato Grosso the center for direct foreign investment is the price of land and the potential for expansion. The land rush in Brazil is a mirror image of the United States in the 19th century.”

Crunching numbers can reveal the Brazilian economic edge in soybean production. For the 2000 crop year, variable costs to produce soybeans in central Illinois were \$97.00 per acre, or \$2.16 per bushel. Fixed costs for the same period were \$226.00 per acre, or \$5.02 per bushel. For the same period in Mato Grosso, the variable costs were \$108.20 per acre, or \$2.21 per bushel. “But fixed costs were only \$48.10 per acre, or 98 cents per bushel,” Moss says.



Many areas in Mato Grosso average 60 to 65 bushels per acre, and the average farm size is considerably larger. Although the cost of land is the largest cost for the central Illinois farmer, the cost of fertility is the highest cost for a Mato Grosso producer. "Land costs in 2000 for the central Illinois farmer were 35.9 percent of his total costs, while the Mato Grosso producer's land costs were only 9.6 percent of his total costs," says Moss. "Fertility costs constituted 31.7 percent of the Mato Grosso producer's total costs, while accounting for only 5.3 percent of his Illinois counterpart's total costs.

"Labor provides another significant cost difference. U.S. labor costs \$33.00 per acre, 10 times higher than the Brazilian labor cost of \$3.92 per acre."

The Moss family operates a 3,500-acre operation near Quincy. Moss contemplates taking the family business international and is exploring opportunities in Brazil.

Brazilian Land Rush—

Source: Peter Goldsmith (217-333-5131; pgoldsmi@uiuc.edu)



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## Agricultural & Consumer Economics

### Small Brazilian Coffee Farmers Face Big Problems

Illinois farmers forced to sell their corn and soybeans on the commodity market are growing more corn and selling it for less money, while those farmers who grow specialty corn and soybeans are selling less for more. A similar phenomenon is happening to Brazilian coffee bean growers, according to a recent study by a University of Illinois agricultural economist.

"If you want to compare it to the corn market here in Illinois, the naturally processed Arabica coffee bean would be like white corn—a high-demand specialty crop—and the low-grade commodity Arabica coffee bean is like the #2 yellow corn," says Hamish Gow, economist in the College of Agricultural, Consumer and Environmental Sciences at the University of Illinois. He and his graduate student, Mariana Gonzalez, recently completed a study of the coffee market in Brazil.

By way of background, Gow explains that, when the coffee market was deregulated in the 1990s, small coffee bean growers suffered. The smaller farmers have traditionally been growing low-quality commodity-grade Arabica coffee beans. These beans are used in the instant and filtered coffee markets, where quality is less of a concern: Consumers normally attribute the burned, bitter flavor of poor-quality coffee to the hours it may have spent sitting in pots in restaurants and on kitchen countertops.

Small farmers didn't have the technology or incentives to produce high-quality, naturally processed Arabica beans—the preferred bean for making higher-priced gourmet espresso coffees. (Under the previous system, the Brazilian government operated a fixed pricing scheme, with no quality differentiation.)

The naturally processed Arabica beans are sweeter than beans processed under alternative methods but also become bitter if continually heated, so they are best for the increasingly popular coffee shops that can charge high prices for specialty coffees brewed one cup at a time. The problem is that they are also substantially more difficult to produce.

"Unless organizations can develop to assist small farmers to produce high-quality, naturally processed Arabica coffee beans for this specialty market, they will be forever relegated to ever-decreasing returns in a low-quality commodity market," says Gow. "First, we tried to understand the driving forces behind the dynamics of the coffee market following deregulation in the '90s. Then we looked more closely at what has been working or not working, particularly for small farmers."

Gow explains that some farmers formed open co-ops, which were not successful because there was no commitment to the group; if some of the farmers in the co-op brought in poor-quality beans, the entire group suffered. The larger farmers are able to contract with a company. "And they can afford to purchase the equipment needed for the 100-plus steps to deliver high-quality, naturally processed Arabica beans. They can produce a high-quality bean and sell it for a higher price," he says.

"We tried to take a step back to see the big picture of what was happening to these small coffee farmers in Brazil. What we learn in developing countries like Brazil can help us understand and help small farmers in Illinois who are facing some of the same instability."

The project was funded by the Federation of Industry for the State Minas Gerais in Brazil.



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Small Brazilian Coffee Farmers Face Big Problems—  
Source: Hamish Gow (217-265-0320; hgow@uiuc.edu)



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## Agricultural & Consumer Economics

### Risk Perceptions and Attitudes Drive Consumer Behavior

Recalls in children's car seats and toys, reports of product tampering, and food contamination have created financial losses for individual companies; but other crises, such as the threat of mad cow disease, can cripple an entire industry. Understanding what drives the behavior of consumers when faced with product-related crises like these was the topic of a recent study at the University of Illinois.

A team of researchers in the College of Agricultural, Consumer and Environmental Sciences at the University of Illinois, led by Joost M.E. Pennings, looked at how people respond to a risky situation. They evaluated German, Dutch, and American consumer reactions to the threat of mad cow disease.

The researchers broke down risk behavior into two components: risk perceptions and risk attitudes. Risk perceptions are based on whether people think it is likely that they might, for instance, contract a disease from eating beef—their perception of the likelihood that something bad will happen to them. Risk attitude (or risk aversion) reflects consumers' general predisposition to the risk of contracting the disease—and how willing they are to take a risk in the first place.

"If beef consumption is primarily driven by risk perceptions—that is, the likelihood of contracting a disease," says Pennings, "the solution to the mad cow crisis would be to educate consumers about the level of risk they are taking." Pennings explained the flip side of the risk coin: If consumers' response to the mad cow crisis is driven by their risk attitudes, then the beef industry has fewer and costlier options, namely to test each cow for the disease and to slaughter those that test positive, hence ensuring that the risk is eliminated.

The three-country study showed significant differences in consumers' risk attitudes and perceptions. Not surprising, Americans included in the survey showed little apprehension about eating beef, since mad cow disease was not a problem in the United States at the time the survey was taken. But, even though the severity of the disease has been about the same in Germany and the Netherlands, the Dutch responses to questions in the survey paralleled the Americans' answers.

What consumers understand about mad cow disease also played a role in the findings. "One of the biggest concerns with mad cow disease," says Pennings, "is that contaminated beef can cause Creutzfeldt-Jacob disease in humans. Yet, since the chance of getting the disease by eating beef is extremely small, it is puzzling that consumers react the way they do."

Pennings suggested that the perception of risk on the part of consumers can be lessened with more education. The more people understand about the risks, the more informed they are to make decisions on their behavior.

Currently, the probability of contracting Creutzfeldt-Jacob disease is not accurately known. The researchers suggest that in such a situation different policy measures must be taken in different countries. In countries such as the United States, tough measures are required to prevent a mad cow crisis because risk attitudes drive consumption and little can be done to change consumers' risk attitudes. This means testing and slaughtering all suspected cows.



In countries such as Germany, both risk perceptions and risk attitudes drive consumer behavior, suggesting not only the need for tough measures but also for extensive and responsible dissemination of accurate information by government, industry, and media. In contrast to the United States and Germany, Dutch consumer behavior is driven mainly by risk perceptions. In this case, honest and consistent communication by both the government and the beef industry is more effective than a mass slaughtering of cows.

“If the probability of contracting Creutzfeldt-Jacob is accurately known,” says Pennings, “risk perception becomes a more important driver of beef consumption in low and mildly risky situations.” He says that in low-risk situations, messages from the government, the beef industry, and the media will have a bigger impact on helping consumers decide whether or not to eat beef, particularly in the United States and the Netherlands. However, in the case of high risk, recall of products or, in the case of mad cow, elimination of entire herds may be necessary.

The findings from this study can help managers and public officials understand these cross-cultural differences and help them to predict how and why consumers in different countries will respond to a crisis.

Risk Perceptions and Attitudes Drive Consumer Behavior—

Source: Joost M.E. Pennings (217-244-1284; jmpennin@uiuc.edu)



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## Agricultural & Biological Engineering

### Ethanol and Diesel Blends: E-Diesel Shows Promise in Tests

Two John Deere 9650 combines, moving side by side through the same Illinois cornfield in the fall of 2001, looked identical in all respects from the outside. But deep inside the engines, there was a major difference between the twin machines. One combine ran on pure diesel fuel, the other on a blend of 10 percent ethanol, 89 percent diesel, and 1 percent additive.

“The operators reported that they could not tell the difference between the two machines day to day,” says Alan Hansen, a University of Illinois agricultural engineer, who has been conducting side-by-side studies each spring and fall since 2000. “Producers found that the combine running on the ethanol-diesel blend could keep up pretty well with the combine running on diesel only.”

Although performance was not noticeably different to the operators, Hansen says there were still some differences. For example, because ethanol has less energy content than diesel, machinery using the blend had slightly greater fuel consumption—an increase of 3 to 5 percent. The same increase in fuel consumption showed itself in other side-by-side tests conducted with John Deere 9400 tractors and 9650 Caterpillar Challenger tractors.

The ethanol-diesel blend, better known as E-diesel, may not have as much energy content as pure diesel, but politically it packs a lot of punch. Backers see E-diesel as a major new market for ethanol and midwestern corn, not to mention an effective way to help engine manufacturers meet tough new emission standards from the U.S. Environmental Protection Agency. According to Hansen, emissions tests performed at national laboratories have shown consistent results: “With a 10 percent blend, you can expect as much as a 25 to 30 percent reduction in particulate emissions—soot and smoke.”

The prognosis for E-diesel is good, Hansen notes, but there are still many hurdles to surpass before engine manufacturers will feel confident backing warranties for engines that run on the blend. In particular, concerns revolve around durability, safety, and performance. University of Illinois researchers, led by Hansen, fellow agricultural engineer Qin Zhang and agricultural economist Rob Hornbaker, have been conducting in-lab durability tests since 1999 on engines running on E-diesel. Funding and support have been provided by the Illinois Department of Commerce and Community Affairs, the Great Lakes Regional Biomass Energy Program, and the Illinois Corn Marketing Board.

In their first series of laboratory tests, University of Illinois researchers used a 15 percent ethanol-diesel blend in a Cummins 5.9-liter engine, which has an injector system that relies entirely on fuel for lubrication. Ethanol lowers a fuel's ability to lubricate the engine, Hansen notes, although the additive in the blend does contain a small amount of a lubricity agent.

After running for 500 hours in the laboratory, the Cummins engine came through in good condition, but there was some abnormal deterioration of the resin that encapsulates a sensor in the injection system. “There are some nonmetal components in the fuel injection system that you have to be careful about,” Hansen says.

A second 500-hour test was performed on a different engine using a 10 percent ethanol-diesel blend this time. The engine, currently being taken apart and studied, is expected to be in pretty good condition, Hansen

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says. However, there appears to be some swelling of nonmetal seals in the injection pump as a result of the ethanol.

These laboratory tests have proved to be somewhat more severe than in-field tests, he adds. The studies of E-diesel used on tractors and combines under actual field conditions have not shown any such wear problems on the engine.

Performance may also be an issue with ethanol, Hansen says, because the rule of thumb is that, for every 5 percent of ethanol that you add to a blend, energy content goes down by 2 percent. That is why fuel consumption is slightly higher with E-diesel; it takes more fuel to supply the same power.

When it comes to safety issues, the concern is flammability. Ethanol is not as flammable as gasoline, but it is more flammable than diesel. So to use E-diesel, diesel fuel tanks will need safety features similar to those found in gasoline fuel tanks. According to Hansen, some of the national laboratories are "looking deeply into the safety issue, developing guidelines on how the blend can be used."

While researchers search for ways to make E-diesel an effective and economical alternative for off-road vehicles, such as farm machinery, engine manufacturers will be watching closely. As Hansen points out, it can take 5 to 10 years for manufacturers to phase in new engine designs that reduce emissions and meet tough new EPA standards. But, if you switch to E-diesel, the environmental benefits are immediate.

Ethanol and Diesel Blends: E-Diesel Shows Promise in Tests—  
Source: Alan Hansen (217-333-2969; achansen@uiuc.edu)



# Biennial Report

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## Agricultural & Biological Engineering

### New Ethanol Process Reduces Costs, Recovers More Coproducts

In the ongoing effort to squeeze every penny possible out of a bushel of corn, researchers at the University of Illinois are working to modify and combine the two processes that govern ethanol production—wet milling and dry grind. The resulting process is called a biorefinery.

In the past, agricultural engineers Vijay Singh and Kent Rausch have worked on modifications to both the wet milling and dry grind processes. "Now we want to combine those modifications," says Singh, "to reduce the cost of the process and recover more valuable coproducts."

"The key is in the coproducts," says Rausch. "Low-cost ethanol production depends on the value of coproducts resulting from the process."

Wet milling accounts for 40 to 45 percent of the total ethanol produced in the United States. The wet milling process soaks the corn in water with sulfur dioxide for 24 to 36 hours so that the kernel can be separated into its four component parts—germ, protein, fiber, and starch—in a process called fractionation.

After fractionation, the starch is fermented into ethanol, and the three remaining parts are sold as coproducts, such as germ, corn gluten meal, and corn gluten feed. In the corn milling industry, the value of these coproducts is relatively high.

Dry grind, on the other hand, starts with raw corn that is finely milled and cooked. The starch is fermented and converted into ethanol, and the three nonfermentables (protein, fiber, and fat) are carried through the process and recovered at the back end as a feed product called distillers dried grains with solubles (DDGS).

Because the initial hydration process in wet milling takes up to about 21 percent of a plant's total capital, wet milling is almost three times as expensive as dry grind. The added expense is partially recovered in the higher-valued coproducts and the overall large scale of wet milling. The average wet milling plant processes 200,000 to 300,000 bushels of corn per day.

Dry grind costs less, but production runs at 50,000 bushels per day and produces only one low-value coproduct, DDGS. DDGS can be used for feed for livestock, but because of its high-fiber content, it can be fed in only limited quantities to nonruminant animals, such as swine and poultry.

Rausch and Singh hope to take advantage of the high-value coproducts produced in wet milling and the relatively low capital cost of dry grind by combining the latest advances in both technologies.

Essentially, the biorefinery process adds wet milling technology to the front end of the dry grind process. It also incorporates the most recent advance in wet milling technology—enzymatic milling. Instead of soaking corn in water with sulfur dioxide for a day and a half, researchers have developed a process that uses enzymes rather than sulfites to fractionate the corn. The enzymatic technology takes only six hours and eliminates health or environmental concerns caused by the use of sulfites.

 The image shows a large, light blue circular logo with the letters "ABE" in a bold, serif font. Below the logo, the text "Agricultural & Biological Engineering" is written in a smaller, sans-serif font.
 

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After this shortened fractionation step, the pericarp fiber (outer coating of a kernel) and germ can be removed prior to fermentation. This is a departure from the conventional dry grind process, which is designed to ferment as much of the corn kernel as possible.

Germ recovered from the modified dry grind process is of a quality that can be used for oil extraction. In addition, pericarp fiber recovery at this stage allows a producer to pack more fermentable material in the fermentor, thereby producing more ethanol per batch and further improving cost savings.

The removal of germ and pericarp fiber also reduces and refines the DDGS that is recovered at the back end of the modified dry grind process. According to Singh, this solves two problems. "The U.S. market for DDGS is saturated. By pulling the germ and pericarp fiber out, you reduce the volume of DDGS by 45 percent. You also diversify the market for DDGS because the DDGS that you're getting now is a potentially higher-protein feed that can be fed to poultry and swine."

Coproduct value is a major factor in the sustainability of the ethanol industry. And value is the bottom line, Rausch says. Biorefinery, which focuses on coproduct recovery, has the potential to reduce ethanol production costs and improve the profitability of the corn processing industry. With ethanol production using more than 980 million bushels of corn per year, that adds up to a lot of pennies.

New Ethanol Process Reduces Costs, Recovers More Coproducts—

Sources: Vijay Singh (217-333-9510; vsingh@express.cites.uiuc.edu)

Kent Rausch (217-265-0697; krausch@uiuc.edu)



# Biennial Report

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## Agricultural & Biological Engineering

### Miniature Helicopter Maps Fields for Precision Agriculture

In the war in Iraq, the U.S. military used unmanned vehicles for reconnaissance and scouting. In the war against weeds and insects, University of Illinois researchers are using an unmanned vehicle, as well—a miniature helicopter.

The Illinois Laboratory for Agricultural Remote Sensing is using a 4-foot-by-3-foot, remote-controlled helicopter to generate maps for precision agriculture. A camera, mounted on the front of the helicopter, takes color and infrared field map images, says Lei Tian, University of Illinois agricultural engineer.

Farmers can use these maps to determine nitrogen stress or weed pressure on crops so that application equipment can automatically vary chemicals according to field needs. As a result, farmers save money by using the chemicals more accurately.

“Precision farming was really hot in the '90s, but lately it has cooled down,” says Tian. “One of the reasons is that the sensing systems weren’t advanced enough yet to create good maps of the fields.”

Before Tian and his colleagues used the miniature helicopter, they relied on satellite images and aerial images taken from planes to create maps. But the drawback was that the image delivery depended on weather conditions and other uncontrollable factors.

In addition, he says, because timing is critical when studying nitrogen stress or weed infestations, researchers could not rely on satellite or airplane images that might have been generated days, even weeks, before or after the data must be collected.

It was also difficult to find planes and pilots that could be available at the right time to fly over the fields. So that’s when they turned to the remote-controlled helicopter. The advantage of using a remote-controlled helicopter is flexibility, says Tian. The researchers can take pictures anytime they want. The helicopter takes aerial images throughout the growing season, and the accuracy of these images is verified with ground equipment.

Presently, Tian is working on an autopilot system for the helicopter, which will be a one-button system. Simply press the button and the autopilot does the rest. But for now two people pilot the unmanned vehicle. One person controls the helicopter, and the other person controls the camera.

Once the system is refined, Tian envisions companies someday using such equipment to scout fields and create aerial maps for farmers.

The Illinois Laboratory for Agricultural Remote Sensing (ILARS) was established, in part, to engage U.S. agribusinesses in applied remote-sensing research and to develop practical tools in the areas of sensing, image processing, and data processing. ILARS is supported by the Illinois Council on Food and Agricultural Research (C-FAR).

Miniature Helicopter Maps Fields for Precision Agriculture—  
Source: Lei Tian (217-333-7534; lft@age.uiuc.edu)

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