IOWA STATE UNIVERSITY

Plant Sciences Institute UPDATE

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Workshop brainstorms biorenewables priorities

An interdisciplinary workshop has set a course for making vegetable oils better suited for biorenewable energy.

The August 18 gathering at Iowa State is part of the Plant Sciences Institute's Biorenewables Research Initiative. "We're trying to step back and say, 'How can we change feedstocks (crops used for biorenewables) to cut processing costs and enhance performance?'" said Larry Johnson, director of the Center for Crops Utilization Research.

Joe Bozell, National Renewable Energy Laboratory (head of table), discusses oils with Iowa State faculty and commodity and cooperative representatives at biorenewables workshop.

The workshop "educated people on the goals, identified some opportunities and even identified some expertise that could participate in addressing key issues," said Basil Nikolau, director of the Center for Designer Crops and a presenter at the gathering.

Participants set research priorities. Seed money will be allocated to the four most urgent:

- **Increase oil content and reduce oligosaccharides while maintaining protein content.** "Elevating oil levels in plants is going to be key to competing with petroleum," Johnson said.
- **Induce production of wax esters.** Biodiesel is made by converting fatty acids in soy oil to wax esters. "If we can make these esters in seeds, then that process and the byproduct glycerol would be eliminated," Nikolau said.
- **Induce production of branched fatty acids.** "This would keep soy-based fuels and lubricants liquid at colder temperatures and make them more stable," Nikolau said.
- **Conduct a market analysis of vegetable oil options.** "What's the economics of this?" Johnson asked.

Johnson is planning a second workshop, on lignocellulose—plant residues or woody plant material—as a biorenewable source. "The advantage of a workshop is you engage the creativity of a lot of faculty and focus them on issues that can make a difference for Iowans," he added.

Corn could carry cure for pig problems

Iowa State scientists want to make protecting pigs from disease as easy as feeding them ground corn.

Animal science professor Joan Cunnick is collaborating with Kan Wang, associate professor of agronomy and director of the Center for Plant Transformation, to ensure the safety of corn that could inoculate pigs against porcine reproductive respiratory syndrome (PRRS) virus. The project is part of the Plant Sciences Institute's Biopharmaceuticals Research Initiative.

"Edible vaccines have a lot of promise for animal and human health. We want to make sure it's a safe promise," Cunnick said.

Cunnick will address the vaccine corn's safety. Wang has put a gene in the corn encoding a protein, which stimulates an immune response. The researchers hope it will produce an enhanced antivirus response when given with PRRS virus proteins.

Joan Cunnick studies corn vaccine safety.

Cunnick's experiments will see if the antigen causes an unintended allergy to other plant materials. She also will

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CSI at PSI

Crime Scene Investigation is, so I am told, one of the most popular shows on TV. Investigators in white lab coats swarm to the crime scene, take DNA samples, and—after some high-powered lab tests—get their suspect.

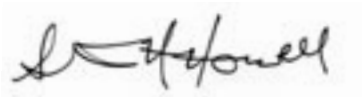
The crime scene for institute scientists is somewhat different: a field in South America, where our crime-stoppers are chasing down a different outlaw—soybean rust. And like CSI, institute scientists are using the latest high-powered molecular tools.

Soybean rust is a great peril to Iowa farmers. The disease moved from Asia into South America in 2001 and is predicted to invade the United States in the next year or two. Soybean rust is a fungal disease, but pesticide industry representatives claim they won't be able to make enough fungicide to hold the disease at bay when it comes.

Iowa State, along with many partners including the Iowa Soybean Association, is mounting a major offensive against soybean rust. Information sessions have already been held, and farmers have been alerted to watch for symptoms.

For its part, the Plant Sciences Institute has devoted its "Crop Protection Initiative" to soybean rust and is contributing what it knows best: the latest technology in gene expression analysis. PSI scientists, led by Thomas Baum and Steven Whitham, will use DNA chips to scan the soybean genome and learn what genes react in susceptible plants when rust infects them and what allows resistant plants to defend themselves.

Hopefully, these tools will be crime stoppers; if not, they will give us a better profile of the criminal, so that others can better protect us from soybean rust.



Stephen Howell
Director

First Fellows graduating, moving up

Members of the first class of Plant Sciences Institute Fellows are graduating—and taking top-notch posts.

PSI fellowships offer a 12-month stipend, paid tuition and guaranteed support for four years. The first six fellows were named in 2000.

Joe Robins genetically analyzed complex traits in alfalfa. The interdepartmental genetics student expects to earn his doctorate in December, then will move to Logan, Utah, to work as a U.S. Department of Agriculture research geneticist.

Robins said the fellowship's prestige was as important as the money. "PSI is developing quite a reputation, nationally and internationally, so wherever I go I will have a connection to it," he said.

Another fellow, Heidi Kratsch, already is in Utah as an assistant horticulture professor at Utah State University.

The future is less certain for Shannon Schlueter, who expects to receive his doctoral degree in bioinformatics and computational biology in May. In his research, he searched plant genomes for elements that affect gene transcription. Schlueter, a former Texan, hopes to find a position in Iowa.

"That would be fine with me as long as the winters hold off," he added.

Fellow Joe Robins, right, with his mentor, agronomy professor Charles Brummer.

Fellow Shannon Schlueter, foreground, was mentored by Bergdahl Professor of Bioinformatics Volker Brendel.

Corn could carry cure for pig problems/CONTINUED

run tests to find the minimum amount of antigen needed to spark an immune response, so she can calculate a dose that won't stimulate a response.

The antigen stimulates antibodies at mucous surfaces in the digestive tract, Cunnick said. "What's interesting is that if it stimulates an immune response at one mucosal surface, it stimulates it at all mucosal surfaces," she added. "If you can induce an immune response in the gut, then you should have cross-immunity in the lungs, where PRRS infections start."

Corn is a perfect plant to carry an edible vaccine, Cunnick said, because it can be changed to produce the antigen and has a long storage life.

PRRS virus infects pigs' respiratory systems, but also can cause low birth-weight litters or spontaneous abortions in sows. The National Pork Board estimates the disease costs farmers $570 million per year.

Inquiry could make fitter people, plants

Reuben Peters' research could affect both what people eat and how they live.

"What we're doing applies to plants and potentially to human health," said Peters, an assistant professor of biochemistry, biophysics and molecular biology.

Peters, an affiliate of the Center for Designer Crops, recently received a three-year, $461,973 grant from the National Science Foundation. The grant could be renewed for another two years for a total of $797,000.

The money will support research on cytochromes P450, a group of enzymes, in terpenoid production. Terpenoids—largely plant natural products—often are useful as drugs and industrial products. But terpenoids are complex, making them difficult to make in the lab, and the plants that produce them often are rare or make small quantities.

In the end, Peters wants to engineer microbes to produce plant-derived terpenoids, especially labdane-related diterpenoids, a group of chemicals plants use to defend themselves from disease.

Reuben Peters chose to study plant terpenoids after his aunt was treated with a plant-derived breast cancer drug.

"This class of terpenoids is broad-spectrum and has been shown to be effective antibiotics, anticancer drugs, and anti-inflammatory agents," Peters said. Plants that make more of these terpenoids also may be better at resisting infections.

Peters is studying the role of cytochromes P450 in producing gibberellins, a group of plant growth hormones, as well as other labdane-related diterpenoids that rice plants use to ward off microbial infections.

Biotech venture right at home in Co-Lab

Katie Thompson believes she's found the right place for her biotechnology venture.

The company, EnzEye, Inc., is in the Innovations Development Facility at the Roy J. Carver Co-Laboratory. The Co-Lab's business incubator "removes one of the major barriers for a start-up—and fosters collaboration with Iowa State faculty," Thompson said.

EnzEye is developing a nondestructive, high-capacity process to identify and sort genetically modified grain and plant materials. "Currently available tests destroy the material and don't allow sorting," Thompson said.

Thompson earned degrees in biology and molecular pathology at the University of California-San Diego, then founded a company based on a way to combine chemicals into potential new drugs. The company was sold in the 1990s and Thompson started a software firm for pharmaceutical research. The company started fast, fueled by money from her first business, but eventually folded.

Katie Thompson in an incubator module at the Roy J. Carver Co-Laboratory.

Thompson moved to northwest Iowa, near her brother-in-law and sister, Denny and Becky Winterboer. She hadn't planned to start another company until she and Denny discussed how to avoid contamination from genetically modified organisms (GMOs). The Winterboers helped found EnzEye.

The technology "is a tool that we believe will help the public accept GMOs," Thompson said.

News Briefs

Greenhouse going up

Construction started in August on a specialized greenhouse for the Roy J. Carver Co-Laboratory.

The greenhouse is designed to keep transgenic plant material, such as pollen, from being released to the outside environment. Windows will be sealed, unlike standard greenhouse ones that can be cranked open, building manager Peter Lelonek said. Air leaving the facility will be filtered and backup systems will maintain ventilation and temperature if power or equipment fails.

The main level will have two 800-square-foot greenhouse areas, Lelonek said. The building is expected to open in August 2005.

Pathogens pursued

An Iowa State researcher along with colleagues from Kansas State and the Institute for Genomic Research will lead a multi-institutional project to sequence the genomes of bacterial pathogens that are recognized as U.S. biosecurity threats.

Adam Bogdanove, assistant professor of plant pathology and member of the Center for Plant Responses to Environmental Stresses, has received an 18-month, $684,500 grant from the USDA to lead scientists from over twenty laboratories in eight countries to annotate the genomes of bacterial pathogens belonging to the genus *Xanthomonas*. The research aims to uncover the differences between bacterial pathogens that attack the vascular system of plants and those that do not.

Interns return

Iowa State's Borlaug interns have returned from a summer at Mexico's International Maize and Wheat Improvement Center (CIMMYT).

Katie Petersen, a junior in plant health and protection/international agriculture with a minor in genetics, did two-week rotations at CIMMYT's Applied Biotechnology Center. Petersen said the experience made her determined to learn more about the social and political aspects of biotechnology.

Jason Haegele, a senior double major in agricultural and biosystems engineering and horticulture, studied genetic markers in wheat. The internship reinforced his interest in plant breeding, Haegele said.

Recent research grants

The following 29 new grants totaling $9.4 million were awarded recently to plant science researchers at Iowa State.

Magnetic Capture Hybridization and Real-Time Multiplex PCR for the Detection of Seed Borne Pathogens
USDA—$900,000
(M. Misra, agriculture and biosystems engineering)

New Technologies for Production of Methyl Esters
West Central Cooperative—$623,238
(G. Kraus, chemistry)

Identification of Genes for Key Agronomic Traits in Maize
Iowa Corn Promotion Board—$125,000
(P. Schnable, agronomy)

New Technologies for the Production of High Value Chemicals from Glycerin
West Central Cooperative—$90,000
(G. Kraus, chemistry)

Multi-Disciplinary Education and Training in Biobased Products: Graduate Major in Bioresource Engineering
Department of Energy—$89,681
(R. Brown, mechanical engineering)

Collaborative Research: Metabolic Engineering of Hairy Roots for Alkaloid Production
National Science Foundation—$81,879
(J. Shanks, chemical engineering)

ITR: Algorithms and Software for Knowledge Acquisition from Heterogeneous Distributed Autonomous Data Sources
National Science Foundation—$49,999
(V. Honavar, computer science)

Center for Research on Dietary Botanical Supplements
National Institutes of Health—$1,358,671
(D. Birt, food science and human nutrition)

A Transposon-Based System for Site-Specific Recombination in Arabidopsis
National Science Foundation—$313,681
(T. Peterson, genetics, development and cell biology)

Food Technology Commercial Space Center
National Aeronautics and Space Administration—$300,000
(A. Pometto, food science and human nutrition)

Database of Maize Genome Information
USDA—$250,000
(V. Brendel, genetics, development and cell biology)

Target Specificity of the Yeast Retrotransposon Ty5
National Institutes of Health—$245,280
(D. Voytas, genetics, development and cell biology)

Genomics of Rice Susceptibility to Bacterial Diseases
National Science Foundation—$224,578
(A. Bogdanove, plant pathology)

Control of Cap-Independent Translation by a Viral 3' UTR
National Institutes of General Medical Services—$214,729
(W. Miller, plant pathology)

Protein Structure Function Relationships
National Institute of General Medical Sciences—$146,000
(V. Honavar, computer science)

Synthesis and Application of Alumina with Hierarchical Nanoporous Structure
Petroleum Research Fund, American Chemical Society—$80,000
(B. Shanks, chemical engineering)

LPS-Specific Aptimers for Microbial Detection
National Institutes of Health—$71,660
(M. Nilsen-Hamilton, biochemistry, biophysics and molecular biology)

Seed Quality Evaluation of Corn Germ Plasm Selected for Adaption to Sustainable Agriculture Production Practices
USDA—$43,640
(S. Goggi, agronomy)

Metabolic Engineering of E. coli Sugar Utilization Regulatory Systems for the Consumption of Plant Biomass Sugars
National Science Foundation—$39,884
(R. Gonzalez, chemical engineering)

Identification of Sequences Required for P1 Paramutation
USDA—$33,900
(T. Peterson, genetics, development and cell biology)

Effect of Corn Stover Storage on Fiber Quality
Cargill Dow L.L.C.—$32,069
(M. Kuo, natural resource ecology and management)

VCA – A High-Density Genetic Map of Maize Transcripts
National Science Foundation—$1,173,468
(P. Schnable, agronomy)

Enzyme-Assisted Aqueous Processing of Soybeans
USDA—$626,827
(L. Johnson, food science and human nutrition)

ISGA-PGR: Plant GDB—Genome Database and Analysis Tools
National Science Foundation—$479,264
(V. Brendel, genetics, development and cell biology)

Cyp701a: A Family of Multifunctional Cytochromes P450 in Terpenoid Biosynthesis
National Science Foundation—$461,973
(R. Peters, biochemistry, biophysics and molecular biology)

The Function of Subtilase Genes in Plant Development
National Science Foundation—$396,833
(S. Howell, genetics, development and cell biology)

Mobile RNAs Mediate Long-Distance Signaling Responses
National Science Foundation—$386,000
(D. Hannapel, horticulture)

Genetic and Genomic Dissection of Male Fertility and Fertility Restoration in Maize
USDA—$325,000
(P. Schnable, agronomy)

Coarse-Grained Models of Proteins
National Institutes of Health—$263,238
(R. Jernigan, biochemistry, biophysics and molecular biology)

Plant Sciences Institute UPDATE

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The Plant Sciences Institute at Iowa State University is dedicated to becoming one of the world's leading plant science research institutes. More than 200 faculty from the College of Agriculture, the College of Liberal Arts and Sciences, the College of Family and Consumer Sciences, and the College of Engineering conduct research in nine centers of the institute. They seek fundamental knowledge about plant systems to help feed the growing world population, strengthen human health and nutrition, improve crop quality and yield, foster environmental sustainability and expand the uses of plants for biobased products and bioenergy. The Plant Sciences Institute supports the training of students for exciting career opportunities and promotes new technologies to aid in the economic development of agriculture and industry throughout the state. The institute is supported through public and private funding.

To be added to our mail list, e-mail psidir@iastate.edu.

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