

Plant Sciences Institute UPDATE

Lab probes protein properties

The Plant Sciences Institute has opened a new state-of-the-art facility to help Iowa State scientists analyze complex mixtures of proteins. The Proteomics Facility can detect changes that may enhance a plant's tolerance to drought, improve the nutritional quality of grain or diagnose a new plant disease.

Located on the ground floor of the new Roy J. Carver Co-Laboratory, the facility will provide services tailored to the investigator's needs, facility manager Bill Lewis said. "Wherever people need to go, that's where we'll go."

The facility, to be fully operational this summer, is a step beyond genomics in biotechnology research. It uses sophisticated robotics to sort through hundreds of proteins plants produce. Instruments break the proteins into peptides for analysis in a mass spectrometer, an

instrument that can measure their exact mass. Peptide mass information can then be used to identify proteins and the genes that encode them.

The research is complex. Although each gene encodes one protein, "Once a protein is made, there are enzymes that can modify it," Lewis said, "and each form has a different function."

A plant, for instance, may be genetically engineered to produce a protein that makes the plant herbicide-resistant. "As the plant grows, the protein may accumulate," Lewis said. Researchers will want to know

how quickly that protein is expressed and what conditions influence its expression.

The facility will serve Iowa State researchers and firms affiliated with the university. "Anybody looking at changes in plants or animals ... and looking for the cause of those changes are potential clients," Lewis said. wslewis@iastate.edu



The new Proteomics Facility managed by Bill Lewis has sophisticated robots and software that can help researchers sort through the multitudes of proteins plants produce.

Meeting charts pathway through new science of metabolomics

A meeting at Iowa State has helped set the course for an emerging science.

The Fifth Annual Plant Sciences Institute Symposium, June 3 through 6, hosted the Third International Congress on Plant Metabolomics. Metabolomics applies modern analytical chemistry to dissect metabolism, the chemical reactions that maintain life.

The meeting brought together the leading metabolomics practitioners for the first time in North America, said Basil Nikolau, director of the Center for Designer Crops. Nikolau led the team of genetics, development and cell biology professors Eve Wurtele and David Oliver to organize the Congress' scientific program. The Symposium Office, directed by biochemistry, biophysics and molecular biology professor Marit Nilsen-Hamilton, facilitated the meeting organization.

Metabolomics is growing rapidly, and the congress helped standardize protocols and database formats, Nikolau said. Metabolomics researchers have largely "done their own thing," he added. "There's recognition that coordination and collaboration are required."

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Growing young companies

If a greenhouse is a place to nurture young plants, think of the Innovations Development Facility (IDF) in the Roy J.



Carver Co-Laboratory as a place to grow young companies.

Faculty, staff and students at Iowa State are encouraged to commercialize their research and

to start new businesses in the Co-Laboratory Business Incubator. It is a facility much like a regular university laboratory to help Iowa State scientists make the transition from academic research to commercial development.

IDF was set up with financing from the Iowa Department of Economic Development and is operated by the Plant Sciences Institute. Its creation is timely, since a recent Battelle report identified biosciences as the greatest economic development opportunity for Iowa. Several fledgling businesses in IDF are pursuing research in the biosciences.

Interested faculty, staff and students can lease well-furnished laboratory modules for modest prices and have access to scientific instrumentation. Scientists can connect with on-campus business advisers, as well as a group of distinguished business leaders who have volunteered to serve as mentors.

In addition, a Public/Private Partnership Program is available to accommodate scientists from Iowa companies who want to collaborate with Iowa State scientists.

The mix of scientists from academic research labs, the business incubator and the partnership program will create a vibrant research environment in the Roy J. Carver Co-Laboratory. We hope the interaction will generate research ideas and spur on new businesses.

It's an excellent opportunity for Iowa State faculty, staff, students and Iowa companies. Please contact me if you're interested in learning more about the Innovations Development Facility.

Cheryl Kamman

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New center director fosters interaction

Thomas Baum needn't go far to check with researchers in the center he recently was appointed to direct. He shares the fourth floor of Bessey Hall with most of the 14 or so scientists affiliated with the Center for Plant Responses to Environmental Stresses.

"We always joke that if you have a question, you go once around the floor ... and you'll have your answer before you get back to your office," said Baum, an associate professor of plant pathology.

That proximity makes it easy for scientists to collaborate, Baum said. Their research concentrates on the fundamental ways plants react to weather, weeds, insects and disease.

The center's main facility also is in Bessey Hall, giving researchers access to growth chambers, centrifuges, incubators, gene expression imagers,

cold rooms and other equipment.

Baum is technically an interim center director with a three-year appointment.

He plans to advance Plant Sciences Institute initiatives, help scientists get what they need for research and encourage them to collaborate. He also wants to seek funds to further graduate education in plant stress.

Baum will keep up his research into cyst nematodes, tiny worms that can heavily damage soybean plants. The nematodes invade plant roots, altering normal cell function so they can feed. Baum's research has identified genes encoding proteins the nematode secretes to alter the cell.



Meeting charts pathway through new science.../CONTINUED



Lothar Willmitzer, a metabolomics leader in coordinating and synthesizing diverse data in the field, addressed the Plant Sciences Institute Symposium in Ames.

The keynote speakers advanced that process, Nikolau said. Lothar Willmitzer from the Max Planck Institute of Molecular Plant Physiology in Germany "set the stage on what needs to be done and what can be done" in the field. His colleague from the institute, Oliver Fiehn, drove home the lesson with an example: Applying metabolomics to heterosis, or hybrid vigor, in the model plant *Arabidopsis thaliana*.

Presentations by two Iowa State

researchers also were well received, Nikolau said. Wurtele discussed MET-NET, the software she and others are developing to illustrate interconnections between genes and metabolism. Chemistry professor Edward Yeung lectured on new analytic tools.

The recently completed W. M. Keck Metabolomics Research Laboratory is one reason Iowa State was chosen to host the gathering. The facility was dedicated during the symposium and already is drawing attention. Representatives from Plant Research International at Wageningen University, Netherlands, want to collaborate on a lab project, Nikolau said.

Around 160 of the 244 registrants were from outside Iowa, including Japan, Korea, Germany, Netherlands and the United Kingdom. The number of participants made this the largest of the three metabolomics gatherings.

The National Science Foundation and the U.S. Department of Energy Office of Basic Sciences helped finance the gathering.

News Briefs

Johnson leads oils unit

Lawrence Johnson, director of the Center for Crops Utilization Research, has been elected president of the American Oil Chemists Society, an international group of oilseed scientists.

"It's quite an honor," said Johnson, a professor of food science and human nutrition. During his one-year term, he'll chair governing board meetings and travel abroad.

"One benefit is I'm young enough in my career to take advantage of the international contacts ... I develop on society business," Johnson said. "It will be a big help to Iowa State and our center."

Borlaug interns go south

Two Iowa State juniors are this year's Borlaug Interns, working this summer at Mexico's International Maize and Wheat Improvement Center (CIMMYT).

The interns are Katie Petersen, a plant health and protection/international agriculture major with a minor in genetics; and Jason Haegele, a double major in agricultural and biosystems engineering and horticulture.

The internship introduces students to real-world research or field experiences in international development and food production. It's named for Iowa native and Nobel Laureate Norman Borlaug, a Plant Sciences Institute Board member.

Alliance aids database

Iowa State and a small college have collaborated to improve a worldwide database of corn genetic information.

Undergraduates at Kentucky Wesleyan College in Owensboro added journal references and data to the Maize Genetics and Genomics Database (MaizeGDB; www.maizegdb.org) at Iowa State. Carolyn Lawrence, an analyst in the lab of Iowa State professor Volker Brendel, said the students also tested database tools.

Lawrence established the program with Kentucky Wesleyan professor Evelyn Hiatt. They recently presented a poster on it at the 46th Annual Maize Genetics Conference in Mexico City.

Researcher reviews biotech crop risks

When he came to Iowa State this spring, Jeff Wolt planned to spend 75 percent of his



time on research and 25 percent communicating results to the public.

"From the get-go I've sort of flipped that around," said

Wolt, who joined the agronomy faculty and the Biosafety Institute for Genetically Modified Agricultural Products (BIGMAP). That's because the public wants information on what he does: studying the risks of deploying genetically modified crops.

"There's a very pressing need to communicate what the risk is and what the probability is from a scientific perspective," Wolt said. It's also critical to growing Iowa's biotech industry: "If we cannot produce sufficient scientific underpinning to the discussion of the risks and

benefits ... and communicate it (to the public), then these technologies will not go forward."

Risk assessment analyzes information to reach statistical conclusions about the probability of something going awry, Wolt said. "It describes what we know, but in the next breath you have to say 'This is what we don't know'—how uncertain we are," he said. More research or safeguards may be needed to deal with uncertainty.

Wolt focuses on biopharma corn—corn genetically modified to produce pharmaceuticals. One of his projects is a decision tree describing options for growing biopharma corn while keeping its genes from spreading to regular crops.

Previously, Wolt was a biotechnology risk analyst for Dow AgroSciences. One of his first tasks at Iowa State was helping organize a Risk Assessment Symposium on Corn-Produced Pharmaceuticals and Industrials in April. The gathering drew about 200 people. jdwolt@iastate.edu

Award energizes carbohydrate research

Nicola Pohl's sugar research has earned her a sweet reward.

Pohl, an assistant chemistry professor and affiliate of the Center for Crops Utilization Research, recently received the National Science Foundation Faculty Early Career Award. The \$510,000



grant will support her work on sugars—the simplest form of carbohydrates.

Pohl's research looks at the difference between sugars in various organisms. Sugars made by animals, plants and bacteria share most of the same building blocks, she said, but they're assembled in different ways.

"It's the way those building blocks are put together that gives us hope we can change that process and adapt plant

carbohydrates for new uses," Pohl said. Her research found that cells attach charged compounds to sugar molecules. The proteins to which sugars attach recognize the charged compound—not the sugar itself.

Learning how proteins and sugars correctly connect could be important

to developing new pharmaceuticals, Pohl said. Drugs could be made to bind selectively to proteins to treat disease or infection while reducing side effects.

Part of Pohl's grant also will finance her redesign of Iowa State's undergraduate organic chemistry courses. She's creating experiments that use sight and smell to demonstrate chemical reactions, helping students better understand the reaction taking place.

Recent research grants

The following 25 new grants totaling \$4.4 million were awarded recently to plant science researchers at Iowa State.

A Rice Oligo Chip and Identification of Genes Expressed During the Cereal Defense Response

National Science Foundation—\$490,480
(P. Schnable, agronomy)

Analysis of the CR4 Transduction Pathway Involved in Leaf Epidermis Differentiation

Department of Energy—\$100,000
(P. Beecraft, genetics, development and cell biology)

Functional Genomics of Endosperm Development in Maize

National Science Foundation—\$98,725
(P. Beecraft, genetics, development and cell biology)

Continued Technology Transfer and Commercialization of Soy Protein-Based Powder Adhesives Developed at ISU for Molded Products

Iowa Soybean Promotion Board—\$60,236
(D. Myers, food science and human nutrition)

Potential Benefits and Risks of the Production of Bulk Chemicals from Renewable Resources

Department of Commerce—\$52,257
(R. Anex, agricultural and biosystems engineering)

Cost-Effective Production of Baculovirus Insecticides

Environmental Protection Agency—\$47,524
(B. Bonning, entomology)

2003 Soybean Quality Report of the U.S. Soybean Crop

American Soybean Association—\$30,000
(T. Brumm, agricultural and biosystems engineering)

Development of Novel Plastics from Agricultural Oils

Archer Daniels Midland Company—\$28,000
(R. Larock, chemistry)

Increasing the Marketability and Consumption of Soybeans and Their Components Through the Development of Soy-Based Snack Foods

Iowa Soybean Promotion Board—\$27,351
(L. Wilson, food science and human nutrition)

Iowa Grain Quality Initiative

Iowa Corn Promotion Board—\$25,000
(C. Hurburgh, agricultural and biosystems engineering)

Global BYDV/CYDV Sequencing Project

USDA—\$876,000
(W. Miller, plant pathology)

Comparative Evolutionary Genomics of Cotton

National Science Foundation—\$953,892
(J. Wendel, ecology, evolution and organismal biology)

Strategies for Colon Cancer Prevention with Transgenic Alfalfa: Resveratrol Glucoside

American Institute for Cancer Research—\$165,000
(D. Birt, food science and human nutrition)

Functional Analysis of Plant MAPK Cascades in Stress and Hormonal Signaling

Massachusetts General Hospital—\$108,695
(K. Wang, agronomy)

Career: Meshing Synthesis and Biosynthesis in Research and Teaching

National Science Foundation—\$306,000
(N. Pohl, chemistry)

Genetic and Biochemical Basis for the Transformation of Energetic Materials (RDX, TNT, DNTs) in Plants

Department of Army, Corps of Engineers—\$266,735
(J. Shanks, chemical engineering)

Food Technology Commercial Space Center

National Aeronautics and Space Administration—\$200,000
(A. Pometto III, food science and human nutrition)

Regulation of Inflorescence Architecture in Maize

National Science Foundation—\$92,081
(V. Brendel, genetics, development and cell biology)

Global Soybean Meal Quality Update

American Soybean Association—\$86,337
(C. Hurburgh, agricultural and biosystems engineering)

Nanowire Based Functional Devices and Assemblies

Department of Energy—\$60,000
(K. Ho, physics and astronomy)

Development of the PCAP Program

Department of Health and Human Services—\$58,461
(X. Huang, computer science)

Understanding Biocomplexity: Developing Methods of Defining Sustainable Uses for Agricultural Products

National Science Foundation—\$41,973
(R. Anex, agricultural and biosystems engineering)

Foreign Material in Soybean Market Channels

American Soybean Association—\$33,070
(C. Hurburgh, agricultural and biosystems engineering)

Essential Nature of Fatty Acid Elongation in Plant Development

National Science Foundation—\$115,000
(P. Schnable, agronomy)

Evaluating and Improving Cropgro-Soybean and Ceres-Maize Models for Predicting Growth and Yield Response to Climate Change Factors

Department of Energy—\$72,177
(W. Batchelor, agricultural and biosystems engineering)

Plant Sciences Institute UPDATE

The Plant Sciences Institute Update is published four times each year by the Plant Sciences Institute at Iowa State University, 1060 Roy J. Carver Co-Laboratory, Ames, Iowa 50011-3650; phone 515 294-5255.

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.

On the Web at <http://www.plantsciences.iastate.edu/>



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