

Plant Sciences Institute UPDATE

From the director

Groundbreaking for the Roy J. Carver Co-Laboratory on October 20 is a long-awaited event for the Plant Sciences Institute. The co-laboratory will be the institute's administrative home and an attractive and interactive environment where university and private sector scientists can work side by side. The co-laboratory concept and public/private partnerships are relatively new in the plant sciences. Public and private sector groups need to join together and work cooperatively, because the scale of plant research is often greater than what any single entity can do. Furthermore, much research in modern academic laboratories has potential commercial applications.

The institute is committed to generating ideas and products useful to agriculture and industry. An Iowa Business Council report shows that Iowa agriculture badly needs help. Production agriculture has dwindled to only five percent of the state's gross product (1998). Clearly, the state is not being adequately compensated for the bounty from its vast land resource.

Research conducted in the co-laboratory can add value to Iowa agriculture. New

crops are being designed with added nutritional quality, increased yield and vigor, better sources of biorenewable energy and novel compounds. Scientists will develop and work with the latest technologies, particularly in genomics and proteomics, to analyze and improve plant qualities.



Developing new products and launching new enterprises will require substantial investment from the state and others. Iowa start-up companies, for which the co-laboratory will provide incubator space, need capital. The university and investment communities must work together to generate resources. The institute also seeks strong industrial partners, particularly from established Iowa-located firms, to work with co-laboratory scientists. Together these groups should make the co-laboratory an exciting and productive scientific enterprise.

We hope you can join us on October 20 for the Roy J. Carver Co-Laboratory ceremony!

Stephen Howell
Director

Institute funds promising research

Seven innovative research projects with promising futures have received start-up funds from the Plant Sciences Institute. Two-year grants were awarded to Iowa State faculty in a competitive program intended to stimulate excellence in plant science research through multidisciplinary collaboration. Funding for each project is between \$10,000 and \$25,000 per year. The projects are described below.

High-Throughput Structural Biology: A New Strategy in the Assignment of Function to Plant Genes

A. Aleshin and R. Honzatko, biochemistry, biophysics and molecular biology; and P. Schnable, agronomy.

A typical plant produces thousands of proteins, many of which bear no clear relationship to those found in animals and bacteria. The researchers will develop a high-throughput process to determine the function of plant proteins. They will determine the

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Plant Sciences Institute

Carver Co-Lab expands

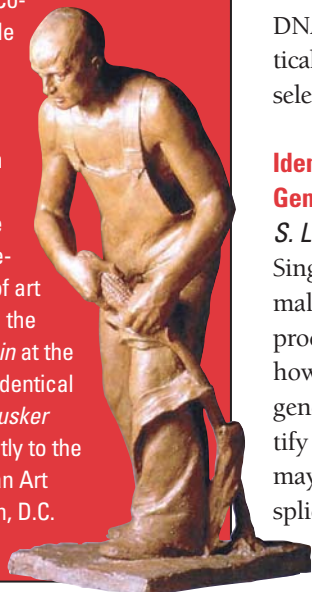
The Roy J. Carver Charitable Trust and the Iowa Board of Regents, state of Iowa, approved plans to enlarge the Plant Sciences Institute's Roy J. Carver Co-Laboratory from a two- to a three-story building. A ground-floor level will be incorporated to provide more space for research labs, incubator labs and plant growth chambers. The new level will enlarge the building from 30,000 to 45,000 gross square feet.

Located northwest of the Molecular Biology Building, the co-laboratory will include research and industry incubator laboratories and faculty and administrative offices.

A groundbreaking ceremony will be October 20, although the 18-month construction is expected to begin sooner.

The Cornhusker

A percentage of the construction cost of new state buildings is dedicated to artwork. The Carver Co-Laboratory will include a bronze casting of Christian Petersen's 1941 sculpture, *The Cornhusker*. Petersen was Iowa State's sculptor-in-residence from 1934 to 1955, creating several works of art on campus, including the *Four Seasons Fountain* at the Memorial Union. An identical casting of *The Cornhusker* was presented recently to the Smithsonian American Art Museum, Washington, D.C.



Institute funds research/CONTINUED

three-dimensional structure of the proteins and infer their biochemical function from structural similarities to other proteins whose functions are known.

Interaction Specificity of Related Bacterial Avirulence Proteins and Their Cognate Receptors in Soybean and Tomato

A. Bogdanove, plant pathology

This project will examine the specificity of plant receptors that detect disease-causing microbes. Bogdanove will identify receptors of specific bacterial signals that trigger defense responses in soybeans and compare the soybean receptors to similar proteins in tomato to identify important structural features. Modification of the receptors to increase their ability to recognize diverse pathogenic microbes could prove an effective strategy to help control plant diseases.

Pedigree-based QTL Detection to Identify Valuable Crop Genes and Understand Long-term Selection Response

J. Jannink, agronomy; R. Fernando, animal science; and M. Lee, agronomy

In plant breeding programs, the capacity for continued response over many generations of selection is not well understood. Understanding the mechanisms that influence performance response is the first step toward harnessing them to improve crops. The researchers will study an oat population that responded to selection over nine generations by increasing its oil content more than 60 percent. They will use new DNA information technologies and statistical analysis methods to determine why selection was so successful.

Identification of Alternatively Spliced Genes in Arabidopsis

S. Lal and V. Brendel, zoology and genetics

Single genes in plants and animals normally encode only one gene product. In a process known as alternative splicing, however, some genes produce multiple gene products. The researchers will identify and analyze genes in Arabidopsis that may have the property of alternative splicing. Their results could determine the extent of alternative splicing in agronomically important plants.

Development of NMR Tools for Metabolic Flux Maps of Soybean Seeds

J. Shanks, chemical engineering; M. Spalding, botany; and M. Westgate, agronomy

Molecular approaches to manipulate seed composition could help meet growing demand for modified oils and proteins and other plant-based products. However, scientists don't fully understand how seed metabolism is regulated. In this project, researchers will apply a novel metabolic flux mapping technique to learn how the carbon moves through key steps in intermediary metabolism. This knowledge will help scientists identify consequential regulatory steps in seed metabolism.

A Transposable Element-based System for Site-specific Recombination in Arabidopsis

D. Voytas and T. Peterson, zoology and genetics

Much of agricultural biotechnology has focused on introducing genes into plants to increase commercial value. However, introduced genes cannot be targeted to predicted sites in the genome. The researchers propose to develop a technology to specifically target sites of gene introduction and make predicted changes in plant genes.

Global Analysis of mRNA Translation State in Response to Plant Stress

S. Whitham and W. A. Miller, plant pathology; and D. Oliver, botany

To understand how plants protect themselves from environmental stress, scientists need to identify the genes whose expression patterns change in response to stresses and determine how these changes are regulated. The researchers will develop a method to simultaneously study the expression patterns of thousands of plant genes during different stress conditions and determine how the expression of many of these genes is regulated. The work will provide a powerful new tool that will improve the accuracy of genomics-scale gene expression analysis.

Center explores phytochemicals and health

Examining the ways that plant constituents prevent chronic diseases and promote good health is an emphasis in the institute's Center for Designing Foods to Improve Nutrition.

Center director Diane Birt, professor and chair of food science and human nutrition, is a leading researcher in this area. Birt was recently recognized for her novel research with a national award from the American Association for Cancer Research. She was cited for her work using animal cancer models, which have provided concrete mechanistic information on the effects of dietary energy restriction. Ultimately, Birt's research could have a major impact on the design of cancer prevention measures for many human cancers.

Birt has studied various mechanisms by which phytochemicals in the diet can prevent cancer, including the effect of flavonoids on skin cancer. She's currently researching colon cancer prevention.

"We're looking at the actual chemicals in plants and trying to understand the cellular mechanism involved in preventing cancer. We're examining how the cancer preventative agents can normalize cell cycle in cancer cells. We want

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Researching phytochemicals and cancer, from left: Chilly Chung, Diane Birt, Angela Au and Michelle Yan.

Iowa State research on plants and human health

- The importance of plant constituents, including isoflavones in soy products, on lowering blood cholesterol and the identification of ways to improve the cholesterol-lowering potential of soy. (S. Hendrich, P. Murphy, L. Johnson, *food science and human nutrition*)

- The role of isoflavones in enhancing bone density in perimenopausal women. (L. Alekel, *food science and human nutrition*)
- Improving the vitamin A activity in plants used as food in developing countries. (W. White, *food science and human nutrition*, and S. Rodermeil, *botany*)
- Identifying plant stanins and sterol esters that are most effective in lowering circulating cholesterol in humans. (D. Lewis, T. Wang and P. White, *food science and human nutrition*)

News Briefs

Award winner

A faculty member in the Laurence H. Baker Center for Bioinformatics and Biological Statistics received a prestigious award. Xun Gu, assistant professor of zoology and genetics and agronomy, was one of 10 selected from 200 nominees for a DuPont Young Professor Grant. The \$75,000 three-year grant helps untenured faculty develop their research programs. Faculty must be nominated by members of the DuPont technical community; Gu was nominated by Guoping Shu of Pioneer Hi-Bred International. Gu will use the award to continue developing models of functional divergence in gene families.

Bioinformatics workshop

The Laurence H. Baker Center for Bioinformatics and Biological Statistics will host the second Iowa State University/University of Iowa Joint Bioinformatics Workshop, September

21-22 in Ames. This year's workshop will feature speakers from the bioinformatics group at Bielefeld University in Germany. Information about the conference is available on the Web at www.bioinformatics.iastate.edu.

Biobased for students

The emerging biobased products industry is of great interest to Iowa State faculty, including many in the institute's Center for Crops Utilization Research. To help advance the industry, three new academic programs are under way. Separate grants totaling more than \$1 million were awarded by the National Science Foundation and the U.S. Department of Energy to fund the start-up of these intersecting programs.

To create an area of specialization in biobased products for M.S. and Ph.D. students, George Kraus, professor of chemistry, and colleagues developed three team-taught, multidisciplinary courses for students in agriculture,

science and engineering. These core courses will form the foundation for a new master's level graduate major in bioresource engineering. Under the leadership of Robert Brown, professor of chemical engineering and mechanical engineering, several faculty are establishing a program of advanced study on the use of plant and crop-based resources to produce products. The 30-credit program will include coursework, research and industrial interaction. The first course will be available in the fall. Integrated into these graduate programs will be four new laboratory modules on chemicals from biorenewables. Charles Glatz, chemical engineering professor and chair, and other faculty are developing the modules (bioinformatics, plant metabolic engineering, plant protein recovery and development of materials for skin tissue propagation), which will be added to chemical engineering undergraduate courses.

to see if they selectively inhibit the mutated cell and leave the normal cell alone," Birt explained. "The idea is to take cells when they're in the very early stages of damage or abnormality, get them out of the process and stop them from dividing."

Birt is working with an alfalfa genetically modified by Nancy Pavia, Samuel Roberts Noble Foundation, to accumulate resveratrol glucoside. The resveratrol has an antibacterial, antimicrobial activity that prevents field rot during wet periods.

"Although the alfalfa was developed for agronomic reasons, data in the literature suggested that resveratrol in the aglycone form (when it has no glucose) can prevent skin cancer. We decided to look at how it works in the diet to prevent colon cancer," Birt said.

"We've found the resveratrol aglycone prevents colon cancer at a really early stage. It prevented an early lesion in the colon of mice," she said.

The next steps might be to determine the best way to process the alfalfa that contains resveratrol glucoside, understand how it interacts with other agents and see what happens during digestion, she said. "We're writing a grant application for funding now."

Future studies could potentially genetically modify other edible plants to contain the compound and determine if it actually prevents cancer in animals and humans.

Recent research grants

Following are recent grants for plant science research at Iowa State.

Energy Restriction, Cell Signaling, and Cancer Prevention

National Institutes of Health—\$246,982
(D. Birt, food science and human nutrition)

Structure and Function of VAR2, a Plastid Chaperonin with Homology to E. coli FtsH

Department of Agriculture—\$225,000
(S. Rodermeil, botany)

CRCD—Chemicals from Biorenewables

National Science Foundation—\$144,355
(C. Glatz, chemical engineering)

A DNA Sequence Assembly Program

National Institutes of Health—\$132,850
(X. Huang, computer science)

Processing of Plant Seed for Protein Recovery

Dow Chemical Company—\$131,290
(C. Glatz, chemical engineering)

Functional Expression of a Starch Biosynthetic System in Maize

National Science Foundation—\$108,491
(A. Myers, biochemistry, biophysics and molecular biology)

Functional Genomics of Endosperm Development in Maize

National Science Foundation/University of Florida—\$102,644
(P. Becraft, zoology and genetics)

Support to a Business Partnership between the Seed Trade Association of Kenya and the American Seed Trade Association

U.S. Agency for International Development—\$102,050
(M. Misra, agricultural and biosystems engineering)

Bioethics Institute

South Dakota State University—\$32,000
(G. Comstock, philosophy and religious studies)

Oat Improvement and Oat Cultivar Development

Quaker Oats Company—\$31,650
(J. Jannink, agronomy)

Oat Crown Rust Research

Quaker Oats Company—\$31,650
(J. Jannink, agronomy)

Computational Analysis of Cellulases

Genencor International, Inc.—\$28,476
(P. Reilly, chemical engineering)

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Plant Sciences Institute UPDATE

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Prepared by University Relations, Teddi Barron, editor.

The Plant Sciences Institute at Iowa State University, which consists of nine research centers, is supported through public and private funding. It is dedicated to becoming one of the world's leading institutes for plant science research, education and unbiased research-based information. Researchers are seeking fundamental knowledge about the functioning of plants. They are developing ways 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 work of the Plant Sciences Institute is expected to have economic benefits in Iowa and around the world.

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

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