

# Plant Sciences Institute UPDATE

## From the interim director

Welcome to the first newsletter of Iowa State University's Plant Sciences Institute! We're delighted to bring you updates on many of the exciting plant science activities that have occurred at Iowa State since the institute was established in September 1999.

We're making considerable progress toward achieving our long-term goal of bringing international recognition to Iowa State for its premier research, teaching and outreach programs in plant sciences. We're also committed to being relevant to the crops (particularly corn and soybeans), people (producers, processors, etc.) and communities of Iowa.

The institute has made such tremendous progress during its first year of existence because of the outstanding efforts of the faculty and the strong support from the university administration, the State of Iowa and private donors.

As you'll read in this newsletter, the programs of the institute focus on:

- the fundamental plant sciences,
- the applied science and technology supporting the profitable and environmentally

- sound production of crops, and
- the utilization of crops for food, livestock feed and biobased products and bioenergy.

The Plant Sciences Institute is built on the strong foundation of Iowa State's considerable strengths in the plant sciences and the university's long tradition of service to agriculture in Iowa and throughout the world. By further enhancing the already

excellent faculty and facilities at Iowa State, we can play a major role in resolving many of the world's greatest agricultural challenges.

It has been an honor to serve as interim director during this exciting time. I appreciate having the opportunity to collaborate

with many of you to lay the foundation for one of Iowa State's most remarkable initiatives and to help introduce it in Iowa and beyond. During the coming months, I will work closely with Stephen Howell to ensure a smooth transition.



Colin G. Scanes, Interim director

## Institute director named

At press time, Iowa State University appointed Stephen Howell to the position of director of the Plant Sciences Institute. Howell is an internationally known researcher in the genetics of plant pathology and physiology. He is vice president for research at the Boyce Thompson Institute for Plant Research Inc., a private, independent nonprofit corporation affiliated with Cornell University in Ithaca, New York. His five-year appointment begins January 1.

Howell joined Cornell and the Boyce Thompson Institute in 1998 as Boyce Schulze Downey scientist and BTI's director of plant molecular biology. From 1969 to 1998, he was on the faculty at the University of California, San Diego.

Howell holds a doctoral degree from Johns Hopkins University (1967) and a bachelor's degree from Grinnell College (1963). He was a Guggenheim Fellow in 1976 and has served as visiting scientist in Japan, Australia and England.



# Plant Sciences Institute

## Off to a strong financial start

**T**he sources and amount of gifts to the Plant Sciences Institute clearly indicate strong, early support. After providing initial funding in 1998, the State of Iowa appropriated \$2.2 million in 1999 and increased that support to a total of \$4.67 million in 2000. Companies and federal agencies contributed \$4.8 million in external grants during the Institute's first year. This amount is expected to grow.

Donations from individuals and foundations have been the largest source of support. Within the institute's first nine months, three of eight centers were fully endowed. Examples include:

- A \$10 million gift for the Laurence H. Baker Center for Bioinformatics and Biological Statistics and the Laurence H. Baker Endowed Chair in Biological Statistics
- A \$5 million anonymous gift to endow the Seed Science Center (including a partially endowed chair)
- A \$3 million gift from the Roy J. Carver Charitable Trust for a new building. Presently in the design phase, the new Roy J. Carver Collaboratory is scheduled for completion in 2002. It will provide laboratory space for Iowa State faculty to collaborate with each other and with industry scientists. There will also be incubator space for start-up biotechnology companies.

*Iowa State University does not discriminate on the basis of race, color, age, religion, national origin, sexual orientation, sex, marital status, disability, or status as a U.S. Vietnam Era Veteran. Any persons having inquiries concerning this may contact the Director of Affirmative Action, 318 Beardshear Hall, 515 294-7612.*

## Center for Designing Foods joins institute

**T**he Center for Designing Foods to Improve Nutrition (CDFIN) has become the ninth research center in the Plant Sciences Institute.

CDFIN has been a research center at Iowa State since 1990, administered through the College of Family and Consumer Sciences. Diane Birt, professor and chairman of the department, is director of CDFIN.

CDFIN faculty and scientists conduct interdisciplinary research to improve nutrition and promote good health through new and traditional foods. Research emphasizes improving human diets by enhancing the plant-based constituents and by improving feeding strategies of animals used for animal-based foods.

Among the CDFIN research projects under way are studies to assess the impact of dietary soybeans on human health. These include identifying

the components that reduce serum cholesterol and improve bone density and assessing factors that influence bioavailability of these agents. CDFIN researchers also are developing strategies for improving human foods through the genetic modification of plants.



**CDFIN researchers seek ways to enhance plant-based foods.**

## Two new partnerships established

**T**he Plant Sciences Institute has entered into two strategic agreements that will expand and strengthen our education, research and outreach.

In August, the institute signed a three-year agreement with The International Maize and Wheat Improvement Center (CIMMYT), Mexico, which has one of the world's leading programs in corn and wheat breeding. The collaboration will focus on cooperative activities in biotechnology, corn and wheat breeding and education and communication. Activities will include joint research; exchanges of faculty, scientists and graduate students; and exchanges of scientific materials, including germplasm.

CIMMYT is an internationally funded, nonprofit center focused on improving maize and wheat systems in developing countries. Two CIMMYT scientists won this year's World Food Prize for development of a high-protein corn.

In June, a partnership of six institutions created a consortium that will conduct multidisciplinary research and technology transfer on biobased products and energy. The Midwest Consortium



**The Midwest Consortium will research biobased products like Iowa State's biocomposite boards.**

for Sustainable Biobased Products and Bioenergy brings together scientists from Iowa State's Plant Sciences Institute and Agricultural Experiment Station, the Department of Energy's Ames Laboratory at Iowa State, Argonne National Laboratory, University of Illinois, Michigan State University and Purdue University.

"The goal is to develop a new chemical industry in the Midwest based on agricultural feedstocks and biotechnology," said Colin Scanes, institute interim director. "The consortium will have the necessary resources to integrate technologies, build technical infrastructures and link the private and public partners who will bring biobased chemicals to commercial reality."

## News Briefs

### Interim director of bioinformatics center named

Hal Stern, Iowa State professor of statistics, has been named interim director of the Laurence H. Baker Center for Bioinformatics and Biological Statistics. Stern, who is a Fellow of the American Statistical Association, was on the faculty at Harvard University for seven years before joining Iowa State's faculty in 1994. He earned his Ph.D. from Stanford University in 1987. He succeeds James Cornette who retired in May. A national search for a permanent director will begin soon.

### Three new faculty hired

Xiaoqi Huang (Ph.D., Pennsylvania State), associate professor of computer science, will analyze DNA sequences and develop computer programs for plant genome research in the Laurence H. Baker Center for Bioinformatics and Biological Statistics. He was on Michigan Technological

University's faculty for nine years. Most recently, he was associate professor at the Keck Graduate Institute of Life Sciences and a principal scientist at Paracel Inc. in California.

Nicola Pohl (Ph.D., University of Wisconsin), assistant professor of chemistry, researches in the area of reductive chemistry of carbohydrates. She will work on using crops for biobased industrial products in the Center for Crops Utilization Research. Pohl was National Institutes of Health (NIH) Postdoctoral Fellow at Stanford University for three years.

Steve Whitham (Ph.D., University of California), assistant professor of plant pathology, will research host genes involved in supporting or restricting virus infections at the Center for Plant Responses to Environmental Stresses. From 1996 to 1999, he was NIH Postdoctoral Fellow at the Institute of Biological Chemistry. For the past year, he was a staff scientist at Novartis Agricultural Discovery Institute.

### Scanes speaks on GMOs in England

In August, institute interim director Colin Scanes gave an invited talk on genetically

modified organisms to the Royal Agricultural Society of England. The society is an independent charity devoted to the advancement of British agriculture. The audience included farmers, legislators, environmentalists and scientists. Scanes also was featured speaker at a luncheon of journalists at the U.S. Embassy in London.

### Six graduate fellows named

The institute awarded excellence fellowships to six new graduate students this fall. The fellowship provides a one-year \$20,000 stipend plus tuition, and a supplement for three additional years. The students, their previous school and their area of study are: Heidi Kratch (University of Wisconsin), horticulture; Xu Li (Peking University), biochemistry, biophysics and molecular biology; Joseph Robins (Utah State University), genetics; Shannon Schlueter (Texas A&M University), bioinformatics computational biology; Chang-Hui Yan (Peking University), bioinformatics computational biology; and Fei Yu (Chinese Academy of Science), interdepartmental plant physiology.

## Laboratory enables cutting-edge proteomics research at Iowa State

Iowa State's proteomics instrumentation facility is one of only a handful of university labs nationwide dedicated to proteomics, the analysis of the protein complement of the genome. About 10 research groups are using the one-year-old laboratory.

"Genomics gives us the cookbook and proteomics allows us to use the recipes," said Parag Chitnis, biochemistry professor. "Proteomics is the next step, we're using genome sequences to understand its function. Proteins perform the function—they're ultimately responsible for traits."

In the ISU facility, a Voyager DE Pro MALDI-TOF mass spectrometer is used for high-throughput peptide mass fin-

gerprinting to identify proteins. It provides proteome analysis opportunity for accurate mass determination and for fragmentation with post-source decay.

The proteomics facility makes possible research that otherwise could not be undertaken at Iowa State, including:

- an examination of changes of protein in the corn proteome during low temperatures, which pose serious problems for young corn seedlings;
- analysis of the differences that occur in the genome expression in developing soybean seeds stressed by high temperatures; and
- identifying the proteins expressed in response to diseases like soybean cyst nematode.

## Recent research grants

**Functional analysis of plant MAPK cascades in stress and hormonal signaling**  
National Science Foundation—\$536,713  
(K. Wang, agronomy)

**The genetic basis of winter hardiness in alfalfa**  
U.S. Department of Agriculture—\$365,000  
(C. Brummer, agronomy)

**Mutational analysis of photosystem I function**  
National Science Foundation—\$262,450  
(P. Chitnis, biochemistry, biophysics and molecular biology)

**Function of the maize starch synthase zSSIII/DU1 in amylopectin biosynthesis**  
Department of Energy—\$171,000  
(A. Myers, biochemistry, biophysics and molecular biology)

**Collaborative project for identifying and characterizing corn lines for commercial applications**  
Iowa Corn Promotion Board—\$167,620  
(J. Jane, food science and human nutrition)

## Institute funds five Iowa State research projects

The Plant Sciences Institute has awarded five research grants to Iowa State faculty. Each project receives funding of \$25,000 per year for two years. The projects are described below.

### Computational methods for gene expression data to understand the actions and interactions of genes

*D. Ashlock, mathematics; P. Becraft, zoology and genetics; J. Dickerson, electrical and computer engineering; and E. Syrkin Wurtele, botany*

The researchers will develop powerful, user-friendly software packages to analyze vast amounts of data harvested at Iowa State through molecular technologies such as RNA and protein profiling. The approaches developed will be integrated visualization tools to create a Gene Expression Toolkit, a complete analysis system capable of adding other larger biological data sets as technologies evolve.

### Development of an RNA virus vector for high-throughput gene function analysis in cereals

*W. A. Miller, plant pathology*

A limiting factor in functional genomics research is the ability to analyze gene function at the whole-plant level in a high-throughput way. To solve that problem in barley, maize and other cereals, Miller will develop a method in which just a fragment of a gene can be inserted in a viral genome, which is then rubbed on a plant. The ensuing viral RNA replication induces the host plant to shut off expression of its own copy of the gene. The result will be a valuable research tool that enables rapid knockout of cloned genes with unknown functions.

### Innovative tools for proteome analysis

*P. Chitnis, biochemistry; R. S. Houk, chemistry; and S. Kothari, electrical and computer engineering*

Researchers will develop high-throughput methods to characterize post-translational modifications or ion-binding abilities of separated proteins, thereby enhancing the power of proteomics. They will develop experimental and computational tools for global analysis of changes in the corn proteome.

### Gene expression in polyploids

*J. F. Wendel and R. C. Cron, botany*

Nearly all higher eukaryotes contain redundancy in their genomes, due primarily to a process of genome doubling called polyploidy. Although many of the world's most important crops—including maize, wheat, soybean and cotton—are polyploids, virtually nothing is known about expression of genes doubled by polyploidy. Researchers in this project will use species of the cotton plant to provide the first substantive examination of duplicate gene expression in polyploids. They will study the expression of approximately 20 pairs of genes duplicated by a polyploid speciation event one to two million years ago.

### A high-throughput, integrated, continuous-flow, nano-liter-scale PCR system for the analysis of plant genomes

*S. Chen, industrial and manufacturing systems engineering, and P. Schnable, agronomy*

Cost and throughput limitations associated with current genotyping technologies limit the scope of research. This collaboration between a biologist and a microfabrication expert will lay the groundwork for developing a revolutionary nano-technology device that will utilize micro-electro-mechanical systems (MEMS) technology to conduct high-speed, low-cost, high-throughput, accurate and sensitive polymerase chain reaction (PCR)-based genotyping.

### Recent research grants/CONTINUED

#### Structure and function of the cotton genome: An integrated analysis of the genetics, development and evolution of the cotton fiber

University of California-Davis—\$160,053  
*(J. Wendel, botany)*

#### Computational methods for functional and comparative genomics

National Institutes of Health—\$144,500  
*(X. Gu, zoology and genetics)*

#### Bioinformatic tools for extraction and modeling of signal transduction networks

The Procter & Gamble Fund—\$128,871  
*(D. Ashlock, mathematics)*

## Plant Sciences Institute UPDATE

Plant Sciences Institute Update is published 4 times each year by the Plant Sciences Institute at Iowa State University, 112 Office and Lab, Ames, Iowa 50011; phone (515) 294-5255. Prepared by University Relations.

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.

Visit us on the Web at <http://www.plantsciences.iastate.edu/>

## IOWA STATE UNIVERSITY

Plant Sciences Institute  
112 Office and Laboratory  
Ames, Iowa 50011-3020

NONPROFIT ORG.  
U.S. POSTAGE  
PAID  
AMES, IA  
PERMIT NO. 200