

Plant Sciences Institute UPDATE

From the director

I am very excited to take on the role of the new director of the Plant Sciences Institute. Since my arrival at the beginning of the year, I've been warmly welcomed by many colleagues and friends of the institute. I'm pleased to see the groundswell of enthusiasm across the state from the governor, the legislature, stakeholders and Iowa citizens. The institute is, indeed, an enterprise of which we can all be proud.

I want to pay tribute to our interim director, Colin Scanes, who did a marvelous job in laying the foundation and setting the right course for the institute. Because of his excellent direction, I've been able to hit the ground running and maintain the momentum of the many exciting activities already under way. These include faculty searches, recruitment of institute-sponsored graduate students and supporting innovative research programs.

In my remarks to the many groups with whom I've met—both on and off campus—



in the past few weeks, I've emphasized that this is the right time and the right place for the Plant Sciences Institute. The national and international plant scientific community has scored some recent successes, for example, in completing the sequence of the genome of Arabidopsis, a model plant of little or no economic importance. With that accomplished, the direction of the plant scientific field has shifted to plants on which Iowa's economy depends—corn, soybean and alternative crops of the future.

In this new era, we will take on a strong leadership role in the plant sciences community and, with your help, build a world-class institute.

Stephen Howell
Director

IGERT enriches bioinformatics

Bioinformatics is an emerging field that unites computational and biological sciences. In 1999, Iowa State invested in this promising area by hiring new faculty and initiating new courses. An interdisciplinary research center was on the horizon and an interdepartmental graduate major was in the works. The defining moment in the development of bioinformatics at Iowa State, however, was the IGERT grant from the National Science Foundation. It propelled Iowa State's program straight to the top.

IGERT stands for Integrative Graduate Education and Research Training. Through the IGERT program, NSF provides funds for universities to establish new, innovative models for science and engineering graduate education that facilitates interdisciplinary research collaborations.

Dan Voytas, associate professor of zoology and genetics, secured the

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Plant Sciences Institute

Contribution advances research

There are various ways individuals and businesses can help the Plant Sciences Institute meet its research, teaching and financial goals. One of the most immediate ways is to make an “in-kind” contribution of equipment or other necessary services.

The Center for Plant Genomics recently received mass spectrometers, valued at \$1 million dollars, from an anonymous donor. These instruments will be put to use as soon as possible in the center’s proteomics laboratory.

The new mass spectrometers allow Iowa State researchers to identify specific proteins or genes by precisely weighing them or their constituent parts. Over the next several months, Patrick Schnable, center director and agronomy professor, and Parag Chitnis, biochemistry professor, will be among the faculty who will advance efforts to identify unique proteins and genes within corn, soybeans and other crops.

Although three of the institute’s nine centers have been at least partly endowed, all need additional space, staff and equipment. To learn more about ways to support the Plant Sciences Institute or the Roy J. Carver Co-Laboratory (the institute’s first new building), contact Keith Fortmann, director of development, 515 294-4280, or e-mail keith.fortmann@foundation.iastate.edu.

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Discovering oil

For 30 years, plant scientists have searched for the source of the compound that plants use to create oil. Over the years, a dozen or so laboratories worked on the complicated problem, suggesting various solutions without finding the definitive answer.

Last year, the mystery may have been solved — by three Iowa State University research groups. Their discovery could make it possible for plant breeders and genetic engineers to adjust the oil-producing capacity of corn, soybeans and other plants.

The three groups are led by Basil Nikolau, biochemistry professor and interim director of the Center for Designer Crops; David Oliver, botany professor and department chair; and Eve Syrkin Wurtele, botany professor. Their findings were published last year in the journal, *Plant Physiology*, Vol. 123.

The commercial oils produced by plants are made from fatty acids synthesized in an organelle called the plastid. These fatty acids are made from acetyl-coenzyme A (acetyl-CoA), which also is the “starting material” for the biosynthesis of waxes, flavonoids, certain amino acids and other compounds. “The fact that it’s a starting material for other things complicated the discovery,” said Nikolau.

About four years ago, Nikolau, Wurtele



and Oliver were able to deepen their inquiry by taking advantage of new sequencing data available from the *Arabidopsis* plant genome project. They worked independently, studying different parts of the same puzzle, in search of genes that could make acetyl-CoA.

What they found was unexpected. By the late 1980s, most scientists working on this problem hypothesized that acetyl-CoA was made by the enzyme acetyl-CoA synthetase (ACS). “We found that another enzyme—pyruvate dehydrogenase

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Bright future

Attracting topnotch graduate students is critical to achieving excellence in research. The Plant Sciences Institute fellows are among the best. They are, from left: Xu Li, biochemistry, biophysics and molecular biology; John Mayfield, associate dean of the graduate college; Joseph Robins, genetics; Heidi Kratch, horticulture; Fei Yu, interdepartmental plant physiol-

ogy; Shannon Schlueter, bioinformatics and computational biology; and Stephen Howell, institute director. Not pictured: Chang-Hui Yan, bioinformatics and computational biology.

News Briefs

New Faculty

Adam Bogdanove, assistant professor of plant pathology, will study bacterial plant pathogenesis and plant disease resistance mechanisms in soybeans, corn and rice in the Center for Plant Responses to Environmental Stress. His goal is to use novel gene discovery technologies alongside molecular biology, genetics, cell biology and biochemistry to generate knowledge and tools useful in interfering with disease and in improving natural plant defense. Bogdanove earned his bachelor's at Yale University and his Ph.D. at Cornell University. Most recently he has been a postdoctoral fellow with Purdue University and the Boyce Thompson Institute of Cornell University.

Going global

Two Plant Sciences Institute centers and two European universities recently signed agreements that will facilitate joint research and education. The Center for Plant Genomics established a partnership with the Biological Sciences Department of the University of Bristol, United Kingdom. The Laurence H. Baker Center for Bioinformatics and Biological Statistics and the Freie Universität Berlin also signed an agreement. The partnerships will enable exchanges of graduate students, postdoctoral fellows and faculty. The partners will work together on research, grant applications, development of intellectual property and technology transfer. Iowa State's bioinformatics and computational biology program has similar agreements with The Swiss Institute in Bioinformatics, Lausanne; University of Bielefeld, Berlin; and Fudan University, Shanghai.

New book on bioethics

The ethical dimensions of agricultural biotechnology are presented in a book of essays by Gary Comstock, professor of philosophy and religious studies and coordinator of Iowa State's bioethics program. *Vexing Nature? On the Ethical Case Against Agricultural Biotechnology* includes Comstock's narrative account of his personal 12-year philosophical journey

from vocal critic to cautious champion of genetic modification. Published by Kluwer Academic Publishers, Boston, it is available for \$99.95 from Kluwer@wkap.com or at bookstores. Discounts available.

Symposium details

The program is set for the Plant Sciences Institute symposium, "Post-transcriptional Control of Gene Expression in Plants," May 10-13 at Iowa State. The symposium will focus on exciting recent discoveries in the control of gene expression after transcription. Plenary speakers include: Hervé Vaucheret, INRA, France; Peter Waterhouse, CSIRO Division of Plant Industry, Australia; Witold Flipowicz and Thomas Hohn, Friedrich Miescher Institute, Switzerland; Stephen Mayfield, Scripps Research Institute; and Pamela Green, Michigan State University. For information, e-mail pbmb@iastate.edu, call 515 294-7978, or visit the Web at <http://molebio.iastate.edu/~gfst/phomepg.html>.

Out and about

Lawrence Johnson, director of the Center for Crops Utilization Research, attended the Royal Swedish Academy of Agriculture and Forestry's annual meeting where he presented a talk, "Responding to National Needs for Biorenewable Products and Bioenergy." Johnson is a Foreign Member of the Academy.

Patrick Schnable, director of the Center for Plant Genomics and the Center for Plant Transformation and Gene Expression, gave a talk on the use of anthocyanin pigments as markers for nonfood-grade GMO corn at the American Seed Trade Association in Chicago. He also presented, "A Challenge from the Post-post-genomic Era: Identification of the Physiologically Significant Substrate of a mtALDH Required for Male Fertility in Maize," at the Plant and Animal Genome meeting in San Diego.

Manjit Misra, Seed Science Center director, gave two talks in India: "Quality Seeds to Feed the World," at the M.S. Swaminathan Research Foundation, and "Digital Imaging for Management of Germplasm Resources," at the Central Rice Research Institute.

IGERT enriches/CONTINUED

\$2.4 million, five-year IGERT grant for computational molecular biology in 1999.

"The grant gave our program an important financial jump-start. It gave us the money to recruit the really talented students, bring in seminar speakers and improve our hardware and software."

Two-and-a-half years later, about 70 faculty from 15 disciplines and 16 graduate fellows are involved with the program. IGERT graduate fellows, who come from diverse backgrounds, work together to learn how to discern biological information from genome sequence and expression data.

Research is conducted in four interrelated areas: bioinformatics, genome evolution, genomics and macromolecular structure and function. Students collaborate on complex biological questions from a systems-wide perspective, Voytas said. "The strength of the training group is its multidisciplinary research environment. Scientists come at a problem from different backgrounds and perspectives. They gain unique insight into a problem that they wouldn't have if they were limited to the confines of their discipline."

This creates an exciting learning environment, he said. "Students are remarkably willing to conduct research outside the boundaries of their prior training."

Examples of interdisciplinary teamwork are already evident. A molecular biologist developed an algorithm to identify distinct functional domains of a protein. Her idea excited a computer scientist who was able to write graphics software to map the functional domains onto the protein's crystal structure. A statistics student then developed a way to assess the significance of the program's output. A joint publication will result from their combined efforts.

The IGERT grant has spurred development of 10 new interdisciplinary courses in two years for the new graduate program in bioinformatics and computational biology. For the Laurence H. Baker Center for Bioinformatics and Biological Statistics, IGERT is a resource for attracting and conducting research.

Discovering oil/CONTINUED

(PDH)—which was known to be involved, was actually responsible,” Nikolau said. “We looked at how the ACS and PDH coding genes are expressed during the development of the seeds when oil was being produced in the seeds,” Wurtele said. “It turned out that the PDH gene is coordinately expressed as other fatty acid biosynthetic genes consistent with its role in making oil, but the expression of the ACS gene was not coordinated with the other fatty acid biosynthetic genes or oil accumulation,” she said.

Scientists in Britain and at Michigan State University, who are studying the same problem from a very different approach, are coming to the same conclusion, Oliver said.

With a patent pending for the genes and for methods for altering acetyl-CoA generation, the Iowa State researchers are working on the absolute proof that PDH is the source. “By eliminating the ACS and PDH genes one at a time, we can see which one effects oil formation,” Nikolau said. “When we eliminated ACS, there was no effect on oil. We’re getting close and should have the absolute proof in about a year.”

Nikolau, Oliver and Wurtele are part of a consortium of Iowa State faculty who are addressing the question of how plants generate acetyl-CoA. The consortium also includes Patrick Schnable, agronomy professor and director of the Center for Plant Genomics and the Center for Plant Transformation and Gene Expression.

Recent research grants

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

Application of Biotechnology to Control the Soybean Cyst Nematode

United Soybean Board—\$1,000,000
(W. Fehr, agronomy)

Maize Gene Discovery, Sequencing and Phenotypic Analysis

National Science Foundation through Stanford University—\$303,192
(V. Brendel, zoology and genetics)

How Is Acetyl-CoA Generated in Plants?

Department of Agriculture—\$225,000
(B. Nikolau, biochemistry, biophysics and molecular biology)

Regulation of Barley Yellow Dwarf Virus Gene Expression

Department of Agriculture—\$200,000
(W. Miller, plant pathology)

Risk Assessment of a Recombinant Baculovirus Expressing a Protease

Department of Agriculture—\$190,000
(B. Bonning, entomology)

The English and Executive Business Management Training Program

China International Center for Economic and Technological Exchanges—\$154,443
(Y. Shyy, Seed Science Center)

Coordinate Regulation of the Acetyl-CoA Carboxylase Genes during Seed Development

Department of Agriculture—\$130,000
(B. Nikolau, biochemistry, biophysics and molecular biology)

Development of Novel Soy Plastics

Iowa Soybean Promotion Board—\$80,000
(R. Larock, chemistry)

Manipulation of Starch Debranching Enzyme Activities in Transgenic Plants

Department of Agriculture—\$75,000

(M. James, biochemistry, biophysics and molecular biology)

Discovery of Novel Developmentally and Environmentally Regulated Corn Promoters

Iowa Corn Promotion Board—\$70,000
(P. Schnable, agronomy)

Improvement of Soy Wax in Candle and Paper-Coating Applications

Iowa Soybean Promotion Board—\$60,000
(T. Wang, food science and human nutrition)

Blending Soy Protein with Synthetic Biodegradable Polymers to Expand Applications of Soy-Protein-Based Plastics

Iowa Soybean Promotion Board—\$51,500
(J. Jane, food science and human nutrition)

Testing Transgenic Plant Material with Heterodera Cyst Nematodes

Pioneer Hi-Bred International, Inc.—\$50,000
(T. Baum, plant pathology)

Plant Sciences Institute UPDATE

The Plant Sciences Institute Update is published four times each year by the Plant Sciences Institute at Iowa State University, 112 Office and Laboratory, Ames, Iowa 50011; phone 515 294-5255.

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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