IOWA STATE UNIVERSITY

Plant Sciences Institute UPDATE

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ISU to play vital role in solving corn genome

If genomes were jigsaw puzzles, the corn genome would have twice the pieces as the human puzzle.

Scientists in Iowa State's Center for Plant Genomics have been chosen to participate in a $29.5 million, three-year project to sequence the entire corn genome—to decode the entire genetic blueprint for the plant researchers call maize.

Patrick Schnable, director of the Center for Plant Genomics, said it's the most ambitious genome sequencing project yet—even more complicated than the human genome. Although both are about the same size, corn has an estimated 50,000 to 60,000 genes. Humans have about 26,000 genes. Decoding the maize genome will let researchers discover the role each gene plays in corn's development and function. "That will allow more precise changes to make maize more useful," said Schnable, professor of agronomy and genetics, development and cell biology.

"It's a wonderful source of food and livestock feed," he added. "But we see a much greater future as a source of fuel and industrial substrates." Having the entire genetic code will help scientists genetically modify corn so it converts to ethanol more efficiently. Corn also could be more easily modified to produce pharmaceuticals or industrial materials.

Credit: Nicolle Rager Fuller, National Science Foundation

Sequencing the genome also would make it easier to modify maize so it uses nitrogen more efficiently and resists drought, Schnable said. "Water is becoming a very important commodity for world peace," he said. "If we can develop crops—and we will be able to—that can tolerate drought and lack of

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Borlaug honored with medal

Norman Borlaug, a founding member of the Plant Sciences Institute Board and Nobel Peace Prize winner, will receive the 2004 National Medal of Science, the nation's highest scientific honor.

Borlaug, 91, and seven other honorees will receive the awards at a White House ceremony.

Often called "Father of the Green Revolution," Borlaug first went to Mexico in 1944 to help poor farmers. The native Iowan took high-yielding, disease-resistant wheat strains to Asia and Africa, where they doubled yields in places such as Pakistan and India. He also worked with governments and institutions on farm credit and pricing policies. Borlaug conceived the World Food Prize, designed to honor those who have improved the quantity, quality and availability of food throughout the world.

Borlaug is a distinguished professor of international agriculture at Texas A&M University and a senior consultant to Mexico's International Maize and Wheat Improvement Center (CIMMYT).

A tribute to Paul Flakoll (1957-2005)

Paul Flakoll, Director of the Center for Designing Foods to Improve Nutrition (CDFIN) and professor of food science and human nutrition and of animal science, lost a long battle against cancer and passed away on Saturday, December 17, 2005. Paul was an inspiration to us all, and he never let his struggle dim the twinkle in his eye or his determination to advance his work at the Plant Sciences Institute.

Paul Flakoll

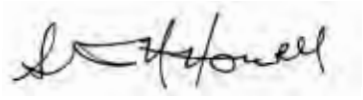
As CDFIN director, Paul championed human health and nutrition. His passion was to apply his nutrition research for the betterment of aging Iowans, particularly in their fight against obesity and type 2 diabetes.

Paul headed the Nutrition Research Initiative in the Plant Sciences Institute. Under his leadership, the Nutrition Initiative was working to develop anti-diabetic foods focusing on healthy carbohydrates and plant-derived nutrients.

Paul's most recent success was in spearheading a proposal to the Biosciences Alliance of Iowa, which recently awarded $700,000 to Iowa State to establish the Human Nutrition Wellness Research Center. The center will evaluate the safety and efficacy of new foods, food ingredients or dietary supplements developed by Iowa-based companies. Funding will be used to purchase equipment and complete minor renovations to a building in the ISU Research Park.

At the time, Paul said that "The funding and creation of this center will give ISU researchers and Iowa-based companies focused on food and nutraceutical production an expanded capability to conduct human nutritional research studies and test new foods and supplements."

The Human Nutrition Wellness Research Center should be a lasting tribute to his memory.



Stephen Howell
Director

Computer biology program gets $3M

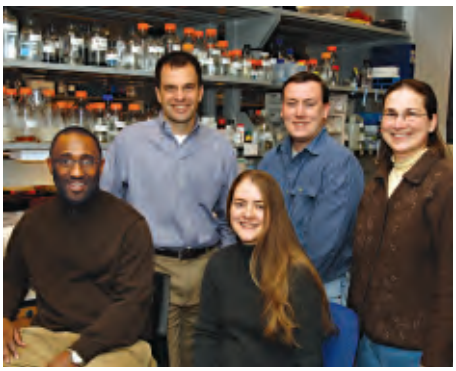
A $3 million, five-year grant for Iowa State's graduate program in computational molecular biology shows that nothing succeeds like success.

The Integrative Graduate Education and Research Training (IGERT) grant continues a $2.6 million National Science Foundation grant awarded in 1999. With that grant, Iowa State built a graduate program in bioinformatics and computational biology, with more than a dozen departments participating, said genetics, development and cell biology professor Daniel Voytas, the project's leader. Computational biology uses computer science, mathematics and statistics to decipher biological problems.

"In addition to the life sciences, there's mathematics, statistics, engineering, physics and other departments involved," said Voytas, an affiliate of the Center for Plant Transformation and the Laurence H. Baker Center for Bioinformatics and Biological Statistics. "The program is really about bringing together these disparate disciplines."

More than 80 faculty conduct bioinformatics, computational biology and biological statistics research at Iowa State, working with 30 graduate students supported by fellowships provided through the earlier grant. "We're one of the biggest graduate programs in the country in computational biology," Voytas added.

"Research fostered by the program has contributed to Iowa State's preeminence in organizing and interpreting corn and swine genetic data," Voytas said. Iowa State researchers also have developed computational tools that have spread to other institutions, including programs to assemble DNA sequence data into whole genomes.



Genetics, development and cell biology professor Dan Voytas joins with IGERT fellowship recipients (front left) Mgavi Brathwaite and Julie Hoy, (back left) Voytas, Scott Emrich and Joset Etzel.

Voytas said project leaders would use the new grant to extend the program beyond Iowa State. To enhance minority education in the program, Iowa State will team with New Mexico State University, Las Cruces.

The grant will help Iowa State "develop a network of institutions that are either currently training graduate students or developing training programs in computational biology," Voytas said. "This will give our students exposure to other perspectives and other types of research."

Interns return

The Plant Sciences Institute sponsored three Borlaug Interns during summer 2005: animal science senior Meghan Wymore, left, and biology junior Suzanne Kehret, who interned at the International Maize and Wheat Improvement Center (CIMMYT) near Mexico City; and agronomy senior Japheth Weems, who interned at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Andhra Pradesh, India.

ISU to play vital role in solving corn genome/CONTINUED

nitrogen, they will help to promote world stability."

For the project, researchers will focus on B73, a corn cultivar developed at Iowa State that is the basis for many of the world's commercial lines of corn. It's used widely in corn genetics research.

To sequence the genome, scientists first break corn's DNA into segments. The segments are analyzed to determine the precise arrangement of four chemical bases—C, G, T and A—that make up the genome. Then the billions of base pairs are reassembled into a complete genome.

Iowa State scientists will play a major role in the last step: assembling the DNA sequence data. The job plays on one of Iowa State's strengths: gene mapping, in which the locations of genes are plotted on corn chromosomes, the cellular structures in which DNA is bundled. Mapping provides "landmarks" as the genome is assembled.

The Genome Sequencing Center at Washington University School of Medicine in St. Louis will generate the sequence data. The University of Arizona at Tucson and Cold Spring Harbor Laboratory in New York also are participating. The National Science Foundation and the federal departments of agriculture and energy are financing the project.

Schnable and Srinivas Aluru, professor of computer and electrical engineering, head Iowa State's team. The science foundation awarded Iowa State a separate $600,000 grant, with an additional $300,000 match from the Laurence H. Baker Center for Bioinformatics and Biological Statistics, for a high-performance computer. The machine, expected to be one of the most powerful in the world, will be used for corn genome sequencing and other projects. Baker center director Robert Jernigan and Arun Somani, professor and chair of electrical and computer engineering, will lead that grant.

Metabolomics targets gene function

Iowa State researchers will lead a project designed to understand the functions of plant genes by studying their effect on the plant's chemical makeup.

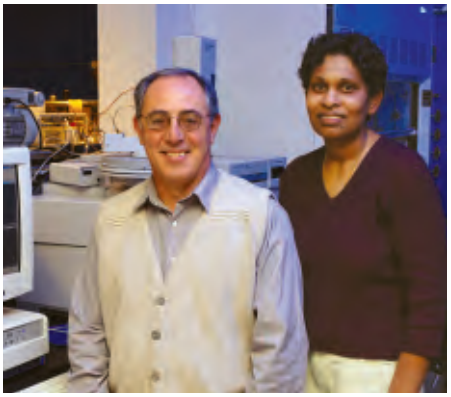
To determine each gene's function, researchers will ascertain how the absence of that gene function (caused by a mutation) affects the plant's metabolites. Metabolites are biochemical constituents that are intermediates in the biosynthesis of plant products, such as oils, sugars and proteins.

"We're looking at metabolites and working up to the genes from the bottom," said project leader Basil Nikolau, professor of biochemistry, biophysics and molecular biology and director of the Center for Designer Crops and the W. M. Keck Metabolomics Research Laboratory. "We'll use metabolomics to decipher the function of genes whose functions are unknown. It's a new way of doing that."

"Ultimately, understanding gene function will lead to improvements in oils, starches and proteins from plants, including corn and soybeans," Nikolau said.

The National Science Foundation is financing the $1 million, two-year project, which focuses on genes in Arabidopsis, a plant used as a model organism in research. Arabidopsis is the first plant to have its entire genetic code deciphered, but the functions of about a third of its 25,000 genes are still unknown.

The pilot project will focus on 100 Arabidopsis genes. Researchers will use



Basil Nikolau, director of the Center for Designer Crops, and Ann Perera, lab manager of the W. M. Keck Metabolomics Research Laboratory.

instruments that detect about 2,000 metabolites in plant material. First they'll find how environmental and developmental stimuli affect metabolite production. Then they'll establish conditions that minimize those effects and analyze plants in which targeted genes are "knocked out." They'll integrate the results with data from protein function, gene transcription and other studies to create new tools for determining gene function.

Other Iowa State researchers involved are Julie Dickerson, associate professor of electrical and computer engineering; Philip Dixon, professor of statistics; George Kraus, University Professor of chemistry; Nicola Pohl, assistant professor of chemistry; and Eve Wurtele, professor of genetics, development and cell biology.

Institute gets organizational change

Provost Ben Allen announced that the Plant Sciences Institute and the Institute for Physical Research and Technology would report to the vice provost for research, beginning September 1, 2005. The move is intended to strengthen the functions of the two institutes by placing them within the university's research umbrella.

The announcement coincided with the arrival of Dr. John Brighton as vice provost for research. Brighton was most recently an assistant director of the National Science Foundation and head of its Engineering Directorate.

Vice provost for research John Brighton.

Recent research grants

The following 28 new grants totaling $7.66 million were awarded recently to plant science researchers at Iowa State.

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

USDA National Needs Fellowship in Food Safety and Quality
USDA—$138,000
(A. Mendoca, food science and human nutrition)

Seed Commercialization Project
International Crops Research Institute for the Semi-Arid Tropics—$114,574
(J. Cortes, Seed Science Center)

Value Added University Research Grant
USDA—$95,000
(B. Babcock, economics)

Relational Legume Genome Database: The Breeder's Toolbox
USDA—$68,000
(V. Brendel, genetics, development and cell biology)

Risk Considerations in Bio-Fuels Investment Decisions: Real Options Analysis
USDA—$37,916
(J. Miranowski, economics)

Mapping the sgRNA2 and sgRNA3 Promoters of BYDV
National Institutes of Health—$29,751
(W. A. Miller, plant pathology)

Technology Transfer and Commercialization of Soy Protein Hydrolysate for the Purpose of Facilitating Technology Transfer of Soy-Protein-Based Adhesives
Iowa Soybean Promotion Board—$29,200
(D. Myers, food science and human nutrition)

MRI: Acquisition of a 512-Node Bluegene/L Supercomputer for Large-Scale Applications in Genomics and Systems Biology
National Science Foundation—$600,000
(S. Aluru, electrical and computer engineering)

Recombination Mechanisms in Maize
USDA—$300,000
(P. Schnable, agronomy)

Discovery of Protein Sequence Structural Function Relationships
National Institutes of Health—$273,942
(V.G. Honavar, computer science)

Coarse Grained Models of Proteins
National Institutes of Health—$263,184
(R. Jernigan, biochemistry, biophysics and molecular biology)

Structure and Function of Human Hexacoordinate Hemoglobins
National Institutes of Health—$217,005
(M. Hargrove, biochemistry, biophysics and molecular biology)

SoyMap: An Integrated Map of Soybean for Resolution and Dissection of Multiple Genome Duplication Events
Purdue University—$194,078
(R. Shoemaker, agronomy)

Center for Research on Botanical Dietary Supplements
National Institutes of Health—$171,905
(D. Birt, food science and human nutrition)

Genomics of Rice Susceptibility to Bacterial Pathogens
National Science Foundation—$31,304
(A. Bogdanove, plant pathology)

Granular Development and Value-Added Utilization of Gem Line Starch
USDA—$22,439
(J-L. Jane, food science and human nutrition)

A Rice Oligo Chip and Identification of Genes Expressed During the Cereal Defense Response
National Science Foundation—$949,076
(P. Schnable, agronomy)

Comparative Evolutionary Genomics of Cotton
National Science Foundation—$898,781
(J. Wendel, ecology, evolution and organismal biology)

Center for Designing Foods to Improve Nutrition
USDA—$606,523
(P. Flakoll, food science and human nutrition)

Functional Genomics of Arabidopsis Starch Granule Metabolism
National Science Foundation—$513,085
(A. Myers, biochemistry, biophysics and molecular biology)

Biotechnology Test Production, IA: Technologies to Purify and Recover Recombinant Proteins from Plants for Use as Therapeutics and Industrial Enzymes (Year 3)
USDA—$434,288
(C. Glatz, chemical engineering)

Coupling Lagrangian Stochastics and Large Eddy Simulation to Predict Long Distance Dispersal of Pollen
USDA—$390,360
(M. Westgate, agronomy)

High Hydrostatic Pressure Process Parameters Impact on Soy Components Extractability and Characteristics
USDA—$290,000
(S. Jung, food science and human nutrition)

VCA: A Two Component AC/DS Platform for Reverse and Forward Genetic Analysis in Maize
Boyce Thompson Institute for Plant Research, Inc.—$245,306
(E. Vollbrecht, genetics, development and cell biology)

Genomics of Rice Susceptibility to Bacterial Diseases
National Science Foundation—$225,075
(A. Bogdanove, plant pathology)

NIH-NSF Bioengineering and Bioinformatics Summer Institute in Bioinformatics and Computational Biology
National Science Foundation—$146,476
(V. Brendel, genetics, development and cell biology)

Osmoprotection of Pseudomonas Syringae During Its Association with Plants: Role of the BetT OpuC Transporters
National Science Foundation—$130,000
(G. Beattie, plant pathology)

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 largely from the College of Agriculture, the College of Liberal Arts and Sciences, the College of Human 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.

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