

Plant Sciences Institute UPDATE

Plant Sciences Institute seed grant reaps state funds

A company rooted in the Plant Sciences Institute was at center stage when Iowa Gov. Tom Vilsack recently announced state financing for 28 economic development projects.

The technology developed by Phytodyne, Inc., will revolutionize the way plants can be genetically modified while limiting the accompanying risks, Vilsack said. The company was awarded \$5 million in forgivable debt and loans, including money from the Iowa Values Fund.

The financing will let the company add about 78 workers, most of them in lucrative technical jobs.

"It has been critical to Phytodyne to have a close relationship with Iowa State and the Plant Sciences Institute," said Dan Voytas, the company's co-founder

and an Iowa State professor of genetics, development and cell biology. One of the company's first patents was for technology based on research the institute financed, he said.



Iowa Gov. Tom Vilsack listens as Phytodyne, Inc., founder Dan Voytas discusses his company's plans at a Des Moines press conference. Vilsack announced the state will give the company \$5 million in forgivable debt and loans.

Phytodyne is also a tenant in the Innovations Development Facility at the Roy J. Carver Co-Laboratory, which opened last fall. The Co-Lab is the home of the institute's administrative offices and the focus of its efforts to develop plant-based technology and products.

Phytodyne's Genome Editor process is based on research supported by seed money from the institute, the Iowa Corn Promotion Board and the Consortium for Plant Biotechnology Research. Genome Editor makes inserting, modifying or deleting plant genes more efficient and precise, said Voytas,

New research initiatives to increase Iowa crop value

The Plant Sciences Institute has launched new initiatives to enhance the value of Iowa crops.

The initiatives will focus the efforts of institute scientists on improving grain quality and crop yield. The research thrusts are "a new effort to direct resources at specific research challenges and engage in projects that will give us tangible results," Plant Sciences Institute director Stephen Howell said.

The initiatives capitalize on the institute's core competencies: genomics, bioinformatics, plant metabolism and molecular breeding. The institute will work with partners at Iowa State—particularly the College of Agriculture—and with external partners to reach its goals.

Dr. John Greaves, Plant Sciences Institute board vice-chairman and president of Kemin Americas, Inc., said the initiatives arose from "a lively debate on what the PSI should be about and how it could refocus its efforts to really have a substantial and transformational effect on the farm economy."

The five initiatives are:

Plant genomes—Focuses on using genomics to enhance economically

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A new chapter

The Plant Sciences Institute opens a new chapter with the announcement of research initiatives on the front page of this issue of UPDATE.



The initiatives are aimed at enhancing the value of Iowa crops and will draw on the expertise

of institute scientists in cutting-edge areas of genomics, bioinformatics, plant metabolism and molecular breeding. The research initiatives are short-term, focused efforts to direct research toward obtainable goals that are important to our stakeholders.

The research initiatives are a new way of doing business for the institute. In its first few years, the institute focused on building its preeminence and serving as an instrument of change on campus. The research initiatives carry us another step forward by supporting focused research to solve major problems and enhance Iowa crop value.

Our initiatives are directed at improving grain quality and/or production, the major components of crop value. For example, in the initiative to unleash the power of plant genomes, we hope to identify genes in corn responsible for hybrid vigor and enhanced production. To enrich the nutritional value and health benefits of Iowa crops, we plan to examine how modifications in starch structure might aid diabetics by slowing the release of sugars from starch. In an initiative to utilize Iowa crop plants as protein biofactories, we plan to generate high-value proteins in plants for use as biopharmaceuticals and industrial products.

These are exciting challenges for the institute and an opportunity to significantly enrich agriculture and industry in our state.

Stephen Howell
Director

Scientist probes ears and tassels to improve corn

Erik Vollbrecht is all ears when it comes to talking about better, higher-yielding corn.

Vollbrecht joined Iowa State in November 2003 as an assistant professor of genetics, development and cell biology in the College of Agriculture, and is affiliated with the Center for Plant Transformation. His research focuses on the genes governing tassel and ear development.

Although ears—and heads in wheat, rice, and other cereal crops—produce grain, their genetics have been relatively unexplored for improving yield, Vollbrecht said.

Tassels also may affect yield. For instance, seed corn production relies on rows of male plants cross-pollinating rows



of female plants. “If you can increase the pollen production from a single plant, you can decrease the part of the field devoted to pollen production and increase yield,” Vollbrecht said.

Vollbrecht has used genomics and classical genetics to identify genes governing ear and tassel structure. He’s found that genes regulating tassel and ear development were important targets for selection by both domestication and evolution.

He never considered working with corn until he took his first job after college—in a University of California–Berkeley corn genetics lab. Vollbrecht went on to earn a doctoral degree in plant biology, and now says “I couldn’t picture myself working with anything else.”

Supplements may strengthen the elderly

An Iowa State researcher hopes to help older people stay stronger and more active.

Paul Flakoll, director of the Center for Designing Foods to Improve Nutrition and a professor of food science and human nutrition, animal science, and health and human performance, wants to see if dietary supplements help. He’s testing two amino acids and hydroxy methylbutyrate (HMB), a product of amino acid metabolism.

Amino acids are the building blocks for proteins that make muscle. Inadequate intake of essential amino acids may be one reason older people are weaker and less functional. HMB may slow protein and muscle breakdown.

Flakoll leads a Plants and Human Health thrust for the Plant Sciences Institute. His team has a two-year, National Institutes of Health \$850,000 grant to see if the supplements slow or

reverse muscle loss. Eighty central Iowa nursing home residents will participate, visiting Iowa State periodically for tests.

“What we’re really looking at are changes in strength, changes in muscle mass or size, and changes in functionality,



Subjects for a study of amino acid and HMB supplements volunteer for testing at Iowa State’s Human Metabolic Unit.

and then basic things like protein synthesis,” Flakoll said.

The subjects will learn about their health, but just as important, “They enjoy the time out,” Flakoll said. “They’re the best human study population you can work with.”

PSI seed grant/CONTINUED

who is affiliated with the Center for Plant Transformation and the Laurence H. Baker Center for Bioinformatics and Biological Statistics.

The technology harnesses homologous recombination, the natural process plants use to change their genetic blueprint. If DNA can be thought of as a text, Genome Editor is a word processor that lets scientists insert, change or delete sentences, Voytas said.

Voytas said recent research has made the technology even more efficient. With homologous recombination, only about one in a million cells acquires a desired genetic change. "We could enhance the efficiency of the reaction so one in 10 cells take up the modification," Voytas said.

Possible developments include allergy-free peanuts, high-starch corn for fuel production, plants producing materials to replace petroleum products, and soybeans that produce healthier oils, Phytodyne president Jon Leafstedt said. He believes the opportunity to work with Phytodyne will attract other plant biotech entrepreneurs to Iowa.

New research initiatives/CONTINUED



Dr. John Greaves makes a point at a recent Plant Sciences Institute Board meeting.

important traits such as hybrid vigor in corn. Scientists will scan plant genomes to identify genes that fueled past classical breeding successes and that can substantially improve future production.

Plant biofactories—Develops technologies to safely produce high levels of therapeutic and industrial plant proteins. The institute and colleges of Agriculture and Veterinary Medicine also will back the Biosafety Institute for Genetically Modified Agricultural Products to provide unbiased analysis of risks tied to generating plant-made pharmaceuticals and materials.

Plant nutritional value—Concentrates on delivering better nutrition in food and feed. Scientists in the colleges of Agriculture and Family and Consumer Sciences will collaborate on optimizing soybean protein and oil production. This initiative also will work to develop crops bearing food products that prevent diabetes.

Biorenewable products—Seeks to promote biobased product and bioenergy development. In partnership with Iowa State's Bioeconomy Initiative, institute scientists will focus on reducing inputs for biobased fuels, ethanol and soy biodiesel. Researchers will seek ways to tap bioenergy from underused materials, such as crop residues, and to promote alternative crops as biobased product sources.

Crop threat protection—Uses revolutionary technologies to identify genes and proteins that can help crops produce even when stressed by drought, disease and pests. Scientists will develop approaches to quickly detect disease and give plants ways to resist pathogens and predators. The institute will work with the College of Agriculture's Institute for Food Safety and Security to defend against bioterrorism.

News Briefs

Frost-fighting corn made

Iowa State researchers have developed corn that fights frost more effectively.

They inserted a gene that activates systems protecting cells from stress caused by heat, cold, or water loss, said Kan Wang, associate professor of agronomy and director of the Center for Plant Transformation. In tests described in a recent article in the Proceedings of the National Academy of Sciences, the transgenic corn withstood temperatures 2 degrees Celsius colder than unmodified corn.

The development could help corn survive frosts and allow production in areas previously considered too cold. The gene, from the tobacco plant, apparently doesn't affect growth under normal conditions.

The corn lines aren't yet appropriate for the marketplace, but are important for research, Wang said.

Gathering ponders risks

Assessing the risks posed by corn biotechnology is the focus of an upcoming symposium at Iowa State.

"Risk Assessment Symposium on Corn-Produced Pharmaceuticals and Industrials" will be hosted April 22 by the new Biosafety Institute for Genetically Modified Agricultural Products (BIGMAP).

"When you are dealing with a biological product and process, there are variables and other possibilities that contribute to uncertainty," said BIGMAP director Manjit Misra. The symposium will outline approaches for addressing risks and underlying uncertainties, he said.

A spectrum of stakeholders and interested Iowa State faculty are expected to attend, Misra added.

Metabolomics meeting

Metabolomics is on the table June 3 through 6 when 200 researchers visit Iowa State for the Plant Sciences Institute's fifth annual symposium.

The symposium this year hosts the Third International Congress on Metabolomics, a science that uses genomics to understand metabolism, the chemical reactions that maintain life.

It's a coup for Iowa State, said Basil Nikolau, professor of biochemistry, biophysics and molecular biology and director of the Center for Designer Crops.

"These meetings will set the tone for how the field will develop," Nikolau said. A major factor influencing the choice of Iowa State to host the congress was the new W. M. Keck Metabolomics Research Laboratory established here.

Recent research grants

The following 31 new grants totaling \$8 million were awarded recently to plant science researchers at Iowa State.

Biopolymers and Other Value-Added Products from

Distillers' Dried Grains

USDA—\$1,000,000

(R. Brown, mechanical engineering)

Application of Biotechnology to Control of the Soybean Cyst Nematode

United Soybean Board—\$747,800

(W. Fehr, agronomy)

Functional Analysis of Genes Involved in Leaf Initiation

National Science Foundation—\$622,652

(P. Schnable, agronomy)

Functional Genomics of Arabidopsis Starch Granule Metabolism

National Science Foundation—\$522,000

(A. Myers, biochemistry, biophysics and molecular biology)

PlantGDB-Plant Genome Database and Analysis Tools

National Science Foundation—\$499,419

(V. Brendel, genetics, development and cell biology)

Science-Based Risk Assessment for Approval of Genetically-Engineered Non-Food Crops

Iowa Department of Economic Development—\$246,125

(M. Misra, agricultural and biosystems engineering)

Technologies to Recover Recombinant Proteins from Plants for Use as Therapeutics and Industrial Enzymes

USDA—\$232,180

(L. Johnson, food science and human nutrition)

Regulation of Chloroplast Biogenesis: The Immutans Mutant of Arabidopsis

Department of Energy—\$220,000

(S. Rodermel, genetics, development and cell biology)

Computational Methods of Functional/Comparative Genomics

National Institutes of Health—\$144,500

(X. Gun, genetics, development and cell biology)

Development of Maturity P-IV Varieties for the Better Bean Initiative

United Soybean Board—\$114,710

(W. Fehr, agronomy)

Genetic Improvement of Soybean Disease Resistance

Iowa Soybean Promotion Board—\$65,042

(M. Bhattacharyya, agronomy)

Ionic Liquid Efficient and Recyclable Catalyst Systems for Making Biodiesel

United Soybean Board—\$51,660

(J. Verkade, chemistry)

Food Chain Economic Analysis

USDA—\$46,436

(C. Hurburgh, agricultural and biosystems engineering)

Center for Research on Dietary Botanical Supplements

National Institutes of Health—\$1,234,627

(D. Birt, food science and human nutrition)

Center for Designing foods to Improve Nutrition

USDA—\$679,822

(P. Flakoll, food science and human nutrition)

Biological and Physical Determinants of Outcrossing by Adventitious Corn Pollen

USDA—\$339,000

(M. Westgate, agronomy)

Increasing Soybean Profitability Through Soybean Disease Biotechnology

Iowa Soybean Promotion Board—\$219,799

(J. Hill, plant pathology)

Identification of Genes for Key Agronomic Traits in Maize

Iowa Corn Promotion Board—\$92,000

(P. Schnable, agronomy)

Regulation of Inflorescence Architecture in Maize

National Science Foundation—\$88,927

(V. Brendel, genetics, development and cell biology)

Switchgrass Production in Iowa: Soil Suitability and Varietal Performance

Chariton Valley Resource Conservation and Development, Inc.—\$86,400

(C. Brummer, agronomy)

Research Experience in Molecular Biotechnology and Genomics

National Science Foundation—\$70,000

(D. Oliver, genetics, development and cell biology)

Uniformity in Near-Infrared Measurements of Soybean Quality

American Oil Chemists Society—\$51,300

(C. Hurburgh, agricultural and biosystems engineering)

Enhancing the Microbial Safety of Fresh and Fresh-Cut Melon

USDA—\$36,834

(A. Mendonca, food science and human nutrition)

Development of Analytical Techniques for the Determination of BT Cry IF Endotoxin in Soil

Dow Agrosciences—\$11,340

(J. Coats, entomology)

Metabolic Engineering of E. coli Sugar-Utilization Regulatory Systems for the Consumption of Plant Biomass Sugars

USDA—\$150,000

(R. Gonzalez, chemical engineering)

Chemical Methodologies and Library Development

National Institutes of Health—\$104,176

(R. LaRock, chemistry)

Metabolic Engineering of E. coli Sugar-Utilization Regulatory Systems for the Consumption of Plant Biomass Sugars

National Science Foundation—\$101,057

(R. Gonzalez, chemical engineering)

Perturbation of Methyl Group Metabolism by Diabetes and Retinoid Compounds

American Diabetes Association—\$96,139

(K. Schalinske, food science and human nutrition)

Develop Starch Structure/Function Relationships

Iowa Corn Promotion Board—\$75,120

(J. Jane, food science and human nutrition)

Perturbation of Methyl Group Metabolism by Retinoid Compounds

Cancer Research and Prevention Foundation—\$70,000

(K. Schalinske, food science and human nutrition)

Microarray Analysis of Rice Deletion Lines

International Rice Research Institute—\$44,000

(P. Schnable, agronomy)

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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Plant Sciences Institute

1060 Roy J. Carver Co-Laboratory

Ames, Iowa 50011-3650