

# Plant Sciences Institute UPDATE

## \$6 million for study of Echinacea and St. John's wort

Two of the nation's top-selling herbal dietary supplement ingredients will undergo scientific scrutiny in a new National Institutes of Health (NIH) research program on dietary botanical supplements at Iowa State.

A \$6 million, five-year grant from NIH's National Institute for Environmental Health Sciences and Office of Dietary Supplements links Iowa State and University of Iowa scientists in multidisciplinary research on Echinacea and St. John's wort. The grant was announced in July by Sen. Tom Harkin, who chairs the Senate panel that funds NIH research.

Iowa State's Diane Birt will lead the program. Birt is professor and chair of food science and human nutrition and a researcher in the Center for Designing Foods to Improve Nutrition (CDFIN), which will administer the research.

Both herbs are grown in Iowa. In addition, Iowa State is home to USDA's North Central Regional Plant Introduction Station, which

maintains the nation's germplasm repository for Echinacea, conserving all known species in the genus.

Echinacea is used to treat infection and inflammation. St. John's wort has long been used for ailments ranging from headache to depression.

"Although there is substantial evidence of the herbs' potential health benefits, we know very little about the activity of these supplements — the nature of their active components and the plant factors that interact to optimize a health benefit or cause toxicity," Birt said.

Based on findings from the research, producers could be better able to grow appropriate varieties under conditions that promote bioactivity. The research could help manufacturers develop best procedures for processing, storage and delivery. The research also could make it possible to standardize and label supplements based on their actual chemical content. Researchers

CONTINUED ON PAGE 2

## New initiative aims to quantify risks and benefits

A new project initiated recently at Iowa State will launch research on an issue of great magnitude: the risks and benefits associated with genetically modified agricultural products (GMAPs). University enhancement funding of \$200,000 brings together expertise from the Plant Sciences Institute, the College of Agriculture and the College of Veterinary Medicine to do science-based analysis of biosafety issues for biotechnology and genetically modified products.

The goal of the joint initiative is to provide unbiased, science-based, credible education and guidance to private entities, regulatory and policy groups, and the public to safeguard both consumers and the environment.

"ISU is uniquely poised to lead the research and education activities on GMAPs in a transparent manner to build the public trust nationally and internationally," said Manjit Misra, who is one of the project leaders. Misra is director of the Seed Science Center.

"A key piece of the research that has been missing is a quantification of the risks associated with many of the developments in biotech. So long as this risk

CONTINUED ON PAGE 4



Diane Birt leads 21 key scientists in multidisciplinary research on two top-selling herbal supplements.



## Plants and human health

Two years ago, the Plant Sciences Institute took a major step into the human health arena. Diane Birt spear-



headed a move to bring the Center for Designing Foods to Improve Nutrition under the wing of the institute. The new relationship will encourage collaborations between plant scientists and human nutritionists and will promote testing the effects of plant products on the most prevalent human maladies.

Dr. Birt also succeeded in assembling a team that won a major award from the NIH to study medicinal plants (see page one). Interest in medicinal plants derives from folklore, but this study is based on good science. St. John's wort and Echinacea are reputed to have healing powers for a variety of ailments. This study seeks to identify the bioactive compounds and to determine their efficacy in treating human ailments.

This study is an important development for the institute because it examines ways that plants may directly benefit human health. We are all familiar with the ways that plants benefit us through diet and nutrition. We are less familiar with—and often skeptical about—the medicinal powers of plants. That may change as we identify and evaluate their bioactive compounds and find ways to improve bioavailability and control dosage.

Plants have extraordinary capacity to make compounds that are bioactive in humans. Many of these are difficult or expensive to synthesize in chemical or pharmaceutical laboratories. The more that we understand about the medicinal capacity of plants, the more that we can utilize them for real human health needs.

Stephen Howell  
Director

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 Equal Opportunity and Diversity, 515 294-7612.

## Iowa State wins three NSF Arabidopsis 2010 grants

Last year, the National Science Foundation initiated a new program to determine the functions of 25,000 Arabidopsis genes by 2010. Three teams of plant scientists at Iowa State secured funding under this program in August.

### Functional Genomics of Arabidopsis Starch Granule Metabolism (\$2 million)

A. Myers and M. James, *biophysics, biochemistry and molecular biology*, and E. Wurtele, *botany*

Starch is one of the most important products from plants—providing us with our major dietary source of energy. Key to the improvement of starch production is understanding the operation of the many genes that encode enzymes involved in starch assembly and disassembly. The researchers will determine the molecular and physiological functions of the Arabidopsis starch metabolism gene network. They will focus on 28 genes that are likely to be involved in starch polymerization and degradation.

### A Transposon-based System for Site-specific Recombination in Arabidopsis (\$911,106)

T. Peterson, *zoology and genetics and agronomy*; and D. Voytas, *zoology and genetics*

Site-specific genetic recombination (SSR) is a powerful tool for making specific genetic

modifications in organisms; however, methods for routine SSR are not available for higher plants. This research aims to develop a method for targeting modifications in specific genes using SSR in Arabidopsis. The approach used is based on the capability of transposable elements to induce recombination in plant cells. Successful completion will provide an important new means for making precise changes in plant genomes for fundamental research and practical applications.

### Visual Informatics Tools to Interactively Link Arabidopsis Metabolic and Regulatory Network Maps with Genome-wide Expression Data (\$300,000)

E. Wurtele, *botany*; D. Cook, *statistics*; and J. Dickerson, *electrical and computer engineering*

The goal of this research is to develop and implement powerful software tools for analysis of genome-wide expression data. The tools will consist of three modules that will integrate the visualization of the mRNA, protein and metabolite data sets with our understanding of the Arabidopsis metabolic and regulatory network. The software tools will provide a novel framework to formulate testable hypotheses regarding the function of specific genes and expand out holistic understanding of metabolism.

### \$6 million for study/CONTINUED

may also be able to identify related herbs with useful medicinal and nutritive bioactivities.

The research program includes 21 key scientists—plant scientists, epidemiologists, chemists, molecular biologists, nutritionists, immunologists and statisticians.

Botany professor Eve Wurtele will lead scientists who will pinpoint genetic, growth, environmental and harvest conditions that influence the quantity and quality of the plants' bioactive ingredients.

Researchers led by chemistry professor George Kraus will provide critical understanding of the plants' chemical constituents. They will isolate the constituents in pure form, determine the structure of the active constituents and synthesize quantities for bioassays and clinical trials.

Birt will lead scientists who will use state-of-the-art instrumentation at Iowa

State's Metabolomics Research Laboratory to identify and understand the bioactive constituents in the two plants. They will determine the bioavailability of the key constituents of the herbs in human subjects and develop the foundation for understanding the determinants of bioavailability.

Medical researchers at the University of Iowa will conduct epidemiological studies to determine the characteristics of human populations most likely to have either clinical improvements or adverse effects from using botanicals as dietary supplements.

NIH has invited the team to submit a proposal for a \$1 million grant to train graduate students, post docs and clinicians interested in studying botanicals and alternative medicine.

CDFIN is a center of the Plant Sciences Institute, College of Agriculture and College of Family and Consumer Sciences.

## First Borlaug Intern named

The Plant Sciences Institute and the World Food Prize awarded the first Borlaug Internship to David Schladt, who earned his B.S. in agricultural biochemistry in May. Schladt



David Schladt conducted research this summer at CIMMYT.

carried out food production research for eight weeks at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico.

The internship will be offered annually at Iowa State. It introduces interns to real-world research, community or field experiences that are involved in international development and food production. It is named for Nobel Laureate Norman Borlaug, who is an Iowa native.

At CIMMYT, Schladt conducted an experiment in the maize transformation lab

of Alessandro Pellegrinshi. "CIMMYT is a great place to work," Schladt said. "They have some of the best scientists on the planet. And the people really do want to help feed the world. It was an honor to work with them and make a small difference."

The World Food Prize recognizes the achievements of individuals who have advanced human development by improving the quality, quantity or availability of food in the world. Borlaug Interns will be honored at World Food Prize activities held each year in October. They will have the opportunity to meet and interact with past and present World Food Prize laureates.

## News Briefs

### New faculty

**Ramon Gonzalez** (Ph.D., University of Chile) has joined the chemical engineering faculty as assistant professor. He will conduct research in the Center for Crops Utilization Research in metabolic engineering, functional genomics and microbial fermentations. He completed his postdoctoral studies at the University of Florida and worked previously as a process engineer in a sugar cane factory in Cuba. **Reuben Peters** (Ph.D., University of California at San Francisco) is a new assistant professor of biochemistry and a researcher in the Center for Designer Crops. He will conduct research on the enzymatic mechanisms of plant natural-product biosynthesis, biochemical pathway identification and metabolic engineering, focusing on isoprenoid secondary metabolites of medicinal interest. He was a postdoctoral fellow at Washington State University.

### Research initiated

Four new plant science faculty, who came to Iowa State last year, have successfully secured funding to launch their research.

**Diane Bassham**, assistant professor of botany and a researcher in the Center for Plant Responses to Environmental Stresses (CPRES), received a three-year, \$210,000

grant from USDA. She will study the changes that take place in the structure of a plant cell when sufficient nutrients are not available. Bassham will identify the genes that control these responses and determine their role in the survival of plants under environmental stress.

**Adam Bogdanove**, assistant professor of plant pathology and a CPRES researcher, has received a Young Investigator Award of nearly \$1.1 million from NSF's Plant Genome Research Project. He will research the functional genomics of rice susceptibility to bacterial diseases. He will investigate the pathogen and host traits that create opportunities for microbes to exploit different plant tissues.

**Nicola Pohl**, assistant professor of chemistry and a researcher in the Center for Crops Utilization Research, received a \$200,000 five-year grant to discover new ways to produce biomedical materials and pharmaceutical products based on the chemical structure of starch. The grant is from the Herman Frasch Foundation, a fund administered by the American Chemical Society.

**Steve Whitham**, plant pathology assistant professor and a CPRES researcher, received a USDA grant of \$271,000 for three years. He will identify sets of plant genes that have altered patterns of expression when plants become infected with viruses.

This research will further the understanding of mechanisms that enhance infections and cause disease and lead to new strategies for controlling viral diseases in plants.

### Bravo!

**Thomas Baum**, an associate professor of plant pathology and a researcher in the Center for Plant Responses to Environmental Stresses, received the 2002 Julius-Kuehn Award from the German Phytopathological Society. The award honors a young scientist for exceptional research in phytopathology. Baum was recognized for his new discoveries of the identities and functions of nematode stylet secretions.

### Watch us grow!

We're closing in on the Roy J. Carver Co-Laboratory, the first building of the Plant Sciences Institute. It's scheduled for completion next summer, with a formal groundbreaking ceremony in the fall. You can see the building progress on the Web at <http://www.plantsciences.iastate.edu>. Click on "Watch us grow" in the right margin.



## Recent research grants

The following 23 grants totaling \$9.6 million were awarded recently to plant science researchers at Iowa State.

### Program for Research on Botanical Dietary Supplements

National Institutes of Health—\$7,156,941  
(D. Birt, food science and human nutrition)

### Green Chemistry Catalysis Laboratory

Department of Energy—\$485,000  
(G. Kraus, chemistry)

### Acquisition of Affymetrix GeneChip Microarray Instrumentation

National Science Foundation—\$250,000  
(R. Wise, plant pathology)

### Managing Interactive Stresses to Increase Soybean Yields

Soybean Research and Development Council—\$246,936  
(W. Batchelor, agricultural and biosystems engineering)

### Target Specificity of the Yeast Retrotransposon Ty5

National Institutes of Health—\$245,280  
(D. Voytas, zoology and genetics)

### Use of Enzymes to Enhance Soybean Ingredients in Food and Industrial Products

Department of Agriculture—\$173,977  
(L. Johnson, food science and human nutrition)

### Single-Molecule Immunoassay and DNA Screening

National Institutes of Health—\$167,802  
(E. Yeung, chemistry)

### Bone Response to Soy Isoflavones in Women

National Institutes of Health—\$133,638  
(L. Alekel, food science and human nutrition)

## New initiative/CONTINUED

remains unquantified, measures of economic costs and benefits will be meaningless,” Misra said.

The initial funds from Iowa State will create at least two new faculty positions to deal with risk assessment associated with GMAs and to conduct economic and statistical analysis associated with risk assessment.

“These faculty will provide quantitative, overall, systematic, bottom-line answers sought by policy makers, opinion leaders and state and federal

### Regulation and Metabolic Networking of Leucine Catabolism

National Science Foundation—\$115,000  
(E. Wurtele, botany)

### Functional Expression of a Starch Biosynthetic System in Maize

National Science Foundation—\$110,953  
(A. Myers, biochemistry, biophysics and molecular biology)

### Mutational Analysis of Photosystem I Function

National Science Foundation—\$91,963  
(A. Myers and P. Chitnis, biochemistry, biophysics and molecular biology)

### Evaluating and Improving CROPGRO-Soybean and CERES-Maize Models for Predicting Growth and Yield Response to Climate Change

National Institute for Global Environmental Change/University of Florida—\$70,068  
(W. Batchelor, agricultural and biosystems engineering)

### An Integrated Database for Barley Genomics

USDA/Oregon State University—\$50,000  
(D. Ashlock, mathematics)

### Optimizing Recovery and Fractionation of Lecithin from Extruded-Expelled Soybean Oil

Kerry Ingredient Company—\$45,889  
(T. Wang, food science and human nutrition)

### Engineering Carbohydrate Polymers for Value-Added Products from Agricultural Feedstocks

Petroleum Research Fund, American Chemical Society—\$40,000  
(N. Pohl, chemistry)

### Agroplastics: Feasibility of Blending Biomass with Plastic Resins

Chariton Valley Resource Conservation and Development, Inc.—\$37,087  
(D. Stokke, natural resource ecology and management)

regulatory agencies,” Misra said.

The university funding is just the start of a visionary program, Misra said. It will be leveraged to generate significant external funding from federal and other sources.

In addition to Misra, faculty leading this effort are Dermot Hayes, Pioneer Hi-Bred International Chair in Agribusiness; and James Roth, distinguished professor of veterinary microbiology and preventive medicine and assistant dean of veterinary medicine for international programs.

### Influence of Storage Conditions on Physico-Chemical Characteristics of Soybeans as Related to Tofu Making

USDA/North Dakota State University—\$36,263  
(L. Wilson, food science and human nutrition)

### Recovery of Brazzein from Corn

Prodigene—\$31,348  
(C. Glatz, chemical engineering)

### Production of Value-Added Corn Through Expression of Novel Proteins in the Grain

Iowa Corn Promotion Board—\$29,600  
(M. Lee, agronomy)

### High-Throughput Mapping Tools for Maize Genomics

National Science Foundation—\$27,440  
(P. Schnable, agronomy)

### Secretion of Proteins into the Nectar of Plants: A Novel Expression System for High-Level Production and Simple Purification of Plant Expressed Proteins

Iowa State University Research Foundation—\$26,480  
(R. Thornburg, biochemistry, biophysics and molecular biology)

### Maize Genetic Transformation Methods

Iowa Corn Promotion Board—\$20,000  
(K. Wang, agronomy)

### Assessment of the Potential for Gene Flow Between Transgenic Cotton and the Endemic Hawaiian Cotton *Gossypium*

Environmental Protection Agency—\$17,228  
(J. Wendel, botany)

## 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 is dedicated to becoming one of the world's leading institutes for plant science research, education and unbiased research-based information. Researchers in nine centers of the institute seek fundamental knowledge about the functioning of plants and 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 institute is supported through public and private funding. The work of the Plant Sciences Institute is expected to have economic benefits in Iowa and around the world.

To be added to our mail list, e-mail [psidir@iastate.edu](mailto:psidir@iastate.edu).

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

## IOWA STATE UNIVERSITY

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