

INTERDISCIPLINARY PLANT GROUP  
UNIVERSITY OF MISSOURI

ANNUAL REPORT  
2010





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# Letter from the Director

Dear Friends and Colleagues,

The IPG has always been committed to graduate education and training. In 2008, we came together as a group to establish a core curriculum for first and second year graduate students. The goals we set out to meet were to provide graduate students, no matter their home department, with a basic and interdisciplinary understanding of plant biology and to provide them with a collegial and interdisciplinary support network.

In 2010, the IPG underwent an external evaluation to assess if and how well we have met these goals. Preliminary findings from the assessment, which was conducted by MU's Office of Science Outreach, suggest that students find IPG courses useful for developing an understanding of plant science topics in general. Students with less plant biology background find IPG courses more useful than students with stronger plant biology backgrounds. Awareness of the IPG and in-



volvement with its activities are directly related to how much the student is linked to the IPG through, among other things, their advisor's own relationship to and enthusiasm for the IPG, distance to the Life Sciences Center, and personal interests. More advanced students highlighted the importance of local and external networking and pointed specifically to the symposium and seminar series. A full report of findings from this assessment will be available in 2011.

Dr. Walter Gassmann spearheaded the effort to develop the curriculum, to get courses cross-listed, and to promote the curriculum. He also participated in the assessment. For these contributions, as well as for many others to the IPG, Dr. Gassmann was awarded the first-ever IPG Excellence Award in 2010.

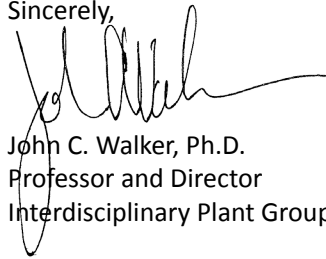
Many of our students were also honored in 2010. Some of their awards are highlighted in this report. Julian Lenis, a doctoral student in Dr. Kristin Bilyeu's lab, was awarded first place in the 2010 ASA-CSA-SSSA Graduate Student Poster Competition. Priya Voothuluru, a doctoral candidate in Dr. Bob Sharp's lab, received this year's Best Student Paper Award at the 37th Annual Meeting of the Plant Growth and Regulation Society of America. IPG undergraduates also shine. Three of Dr. Chris Pires' undergraduates — April Diebold, James Pflug, and Michelle Tang — received scholarships in 2010, including prestigious Goldwater and McNair scholarships.

In 2010, three of our long-standing IPG members retired: Drs. Dale Blevins, Arun Chatterjee, and David Sleper. Dave and Dale were among the original core of plant biologists and agronomists that composed the IPG when it was established in 1981. Arun was one of the first seven plant faculty hired in 1986 as part of the Food for the Twenty First Century (F21C) to boost MU's strengths in plant biology. Together, they helped to establish the strong research foundation in the plant sciences that we are now known for worldwide.

This year, the IPG was instrumental in recruitment of Drs. Paula McSteen and David Braun to MU. Both faculty joined the Division of Biological Sciences as associate professors. This "dynamic duo" bring with them tremendous research and training strengths in studies of plant physiology, developmental mechanisms, and maize genetics. In addition to exciting research projects, which are briefly described in this report, both are enthusiastic and generous individuals. We look forward to a long and productive partnership.

As director of the IPG, I am grateful for the opportunity to facilitate, support, and promote the efforts of such an outstanding cadre of scholars. I look forward to a prosperous 2011.

Sincerely,

A handwritten signature in black ink, appearing to read "John C. Walker", with a long horizontal flourish extending to the right.

John C. Walker, Ph.D.  
Professor and Director  
Interdisciplinary Plant Group

# 2010 Executive Committee



**John Walker, Ph.D.**

Director, IPG  
Professor  
Divisions of Biological Sciences  
and Plant Sciences



**Walter Gassmann, Ph.D.**

Associate Professor  
Division of Plant Sciences



**Scott Peck, Ph.D.**

Associate Professor  
Division of Biochemistry



**Amy Replogle**

Graduate Student  
Division of Plant Sciences



**Kathy Newton, Ph.D.**

Professor  
Division of Biological Sciences



**Jeff Anderson, Ph.D.**

Postdoctoral Fellow  
Division of Biochemistry

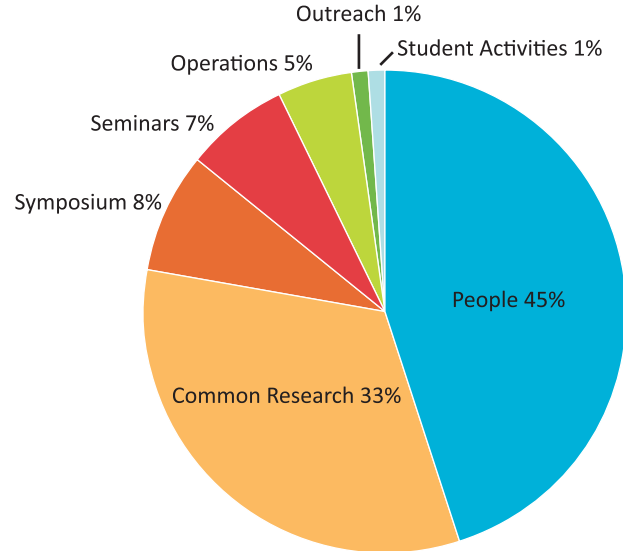
# Income/Expenditures 2010

## Grants/Contracts Received

Title: Symposium on Plant Protein Phosphorylation  
PI: John Walker  
Source: National Science Foundation  
Amounts: \$10,000

Title: Symposium on Plant Protein Phosphorylation  
PI: John Walker  
Source: Department of Energy  
Amounts: \$7,500

## Budget Expenditures





# Faculty



**Heidi Appel, Ph.D.**  
Senior Research Associate  
Division of Plant Sciences



**Kristin Bilyeu, Ph.D.**  
Research Molecular Biologist  
USDA-ARS  
Adjunct Assistant Professor  
Division of Plant Sciences



**James Birchler, Ph.D.**  
Curators' Professor  
Division of Biological Sciences



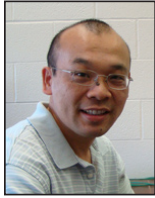
**David Braun, Ph.D.**  
Professor  
Division of Plant Sciences



**Dale Blevins, Ph.D.**  
Professor  
Division of Plant Sciences



**Arun Chatterjee, Ph.D.**  
Professor  
Division of Plant Sciences



**Jianlin Cheng, Ph.D.**  
Assistant Professor  
Department of Computer Science



**Ye Duan, Ph.D.**  
Assistant Professor  
Department of Computer Science



**Edward Coe, Ph.D.**  
Professor Emeritus  
Division of Plant Sciences



**David Emerich, Ph.D.**  
Professor & Associate Chair  
Director of Undergraduate Studies  
Division of Biochemistry



**Georgia Davis, Ph.D.**  
Associate Professor  
Division of Plant Sciences



**James English, Ph.D.**  
Professor  
Division of Plant Sciences





**Deborah Finke, Ph.D.**  
Assistant Professor  
Division of Plant Sciences



**Felix Fritschi, Ph.D.**  
Assistant Professor  
Division of Plant Sciences



**Sherry Flint-Garcia, Ph.D.**  
Research Geneticist, USDA-ARS  
Adjunct Assistant Professor  
Division of Plant Sciences



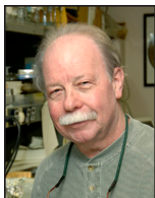
**Candace Galen, Ph.D.**  
Professor  
Division of Biological Sciences



**William Folk, Ph.D.**  
Professor  
Division of Biochemistry



**Walter Gassmann, Ph.D.**  
Associate Professor  
Division of Plant Sciences



**Thomas Guilfoyle, Ph.D.**  
Professor  
Division of Biochemistry



**Antje Heese, Ph.D.**  
Assistant Professor  
Division of Biochemistry



**Perry Gustafson, Ph.D.**  
Research Geneticist, USDA-ARS  
Adjunct Professor  
Division of Plant Sciences



**Bruce Hibbard, Ph.D.**  
Research Entomologist, USDA-ARS  
Adjunct Associate Professor  
Division of Plant Sciences



**Gretchen Hagen, Ph.D.**  
Research Professor  
Division of Biochemistry



**Timothy Holtsford, Ph.D.**  
Associate Professor  
Division of Biological Sciences



**Toni Kazic, Ph.D.**

Associate Professor  
Department of Computer Science



**Emmanuel Liscum, Ph.D.**

Professor and  
Co-Director of Graduate Studies  
Division of Biological Sciences



**Dmitry Korkin, Ph.D.**

Assistant Professor  
Department of Computer Science



**Bruce McClure, Ph.D.**

Professor  
Division of Biochemistry



**Hari Krishnan, Ph.D.**

Research Molecular Biologist  
USDA-ARS  
Adjunct Professor  
Division of Plant Sciences



**Michael McMullen, Ph.D.**

Research Geneticist, USDA-ARS  
Adjunct Professor  
Division of Plant Sciences



**Paula McSteen, Ph.D.**

Associate Professor  
Division of Biological Sciences



**Melissa Mitchum, Ph.D.**

Associate Professor  
Division of Plant Sciences



**Jan Miernyk, Ph.D.**

Research Molecular Biologist  
USDA-ARS  
Adjunct Professor  
Division of Biochemistry



**Brian Mooney, Ph.D.**

Associate Director, Proteomics Center  
Assistant Professor, Division of  
Biochemistry



**Jeanne Mihail, Ph.D.**

Professor  
Division of Plant Sciences



**Kathy Newton, Ph.D.**

Professor  
Division of Biological Sciences



**Henry Nguyen, Ph.D.**  
Endowed Professor  
Division of Plant Sciences  
Director, National Center for Soybean  
Biotechnology



**Scott Peck, Ph.D.**  
Associate Professor  
Division of Biochemistry



**Melvin Oliver, Ph.D.**  
Supervisory Research Geneticist,  
USDA-ARS  
Adjunct Professor  
Division of Plant Sciences



**J. Chris Pires, Ph.D.**  
Assistant Professor  
Division of Biological Sciences



**Stephen Pallardy, Ph.D.**  
Professor  
Department of Forestry



**Joseph Polacco, Ph.D.**  
Professor Emeritus  
Division of Biochemistry



**Douglas Randall, Ph.D.**  
Professor Emeritus  
Division of Biochemistry



**Robert Sharp, Ph.D.**  
Professor  
Division of Plant Sciences



**James Schoelz, Ph.D.**  
Professor &  
Director of Graduate Studies  
Division of Plant Sciences



**Chi-Ren Shyu, Ph.D.**  
Director, MU Informatics Institute  
Associate Professor  
Department of Computer Science



**Jack Schultz, Ph.D.**  
Professor, Division of Plant Sciences  
Director, Bond Life Sciences Center

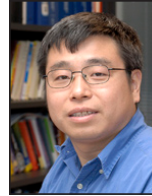


**David Sleper, Ph.D.**  
Professor  
Division of Plant Sciences



**Gary Stacey, Ph.D.**

Professor, Divisions of Plant Sciences  
and Biochemistry  
Assoc. Director, National Center for  
Soybean Biotechnology



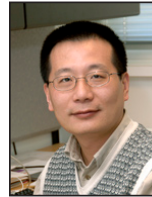
**Dong Xu, Ph.D.**

Director, Digital Biology Laboratory  
Professor, Department of Computer  
Science



**Jay Thelen, Ph.D.**

Associate Professor  
Division of Biochemistry



**Shuqun Zhang, Ph.D.**

Professor  
Division of Biochemistry



**John Walker, Ph.D.**

Director, IPG  
Professor  
Divisions of Biological Sciences  
and Plant Sciences



**Zhanyuan Zhang, Ph.D.**

Director, Plant Transformation Facility  
Associate Professor  
Division of Plant Sciences



# Graduate Students

Name	Advisor
Dierking, Emily	Bilyeu
Lenis, Julian Mario	Bilyeu
Pham, Tung Anh	Bilyeu
Masonbrink, Rick	Birchler
Sun, Lin	Birchler
Ahmad, Mursaleen	Cheng
Deng, Xin	Cheng
Tegge, Allison	Cheng
Wang, Zheng	Cheng
Gerau, Mike	Davis
Leach, Kristen	Davis
He, Qing	Duan
Kanawong, Ratchadaporn	Duan
Xi, Yonjian	Duan
Strodtman, Kent	Emerich
Holou, Roland	Folk
Liang, Bo	Folk
Boardman, Dara	Fritschi/Wiebold
Maw, Michael	Fritschi

Name	Advisor
Nguyen, Hien	Fritschi
Donahue, Janelle	Fritschi
Hoyos Villegas, Valerio	Fritschi
Liu, Shengjun	Fritschi
Young, Brad	Fritschi
Becklin, Katie	Galen
Geib, Jennifer	Galen
Tipton, Alice	Galen
Coleman, Courtney	Gassmann
Gao, Fei	Gassmann
Nam, Daniel	Gassmann
Nguyen, Phuong Dung (Ellie)	Gassmann
Ping, Huang	Gustafson
Meihls, Lisa*	Hibbard
Mahoud, Mervat	Hibbard
Zukoff, Sarah	Hibbard
Joshi, Sneha	Korkin
Patil, Santosh	Korkin
Thieu, Thanh	Korkin
Holland, Jennifer J.	Liscum
Roberts, Diana	Liscum
Kim, Jun Pyo	McMullen



<b>Name</b>	<b>Advisor</b>	<b>Name</b>	<b>Advisor</b>
Replogle, Amy	Mitchum	Riggs, Kara	Sharp
Yeckel, Greg	Mitchum	Smith, Dante	Sharp
Langewisch, Tiffany	Newton	Voothuluru, Priyamvada	Sharp
Lough, Ashley	Newton	Chang, Jia-Fu	Shyu
Gutierrez, Juan	Nguyen/Sleper	Green, Jason	Shyu
Quach, Truyen N	Nguyen	Han, Jing	Shyu
Espinoza, Catherine	Oliver/Sharp	Harnsomburana, Jaturon	Shyu
Sennett, Aurelian	Oliver/Sharp	Pang, Bin	Shyu
Wan, Ying	Peck	Reneker, Jeffrey	Shyu
Ziobro, Holly	Peck	Zhao, Nan	Shyu
Arias-Garzón, Tatiana	Pires	Sexton, Sarah	Sleper
Edger, Patrick	Pires	Choi, Jeongmin	Stacey
Hertweck, Kate	Pires	Le, Mi Ha	Stacey
Mayfield, Dustin	Pires	Nguyen, Tran	Stacey/Nguyen
Wheeler, Erica	Pires	Son, Geon	Stacey
Mônica Medeiros-Silva	Polacco	Song, Lihui (visiting)	Stacey
Angel, Carlos	Schoelz	Thibivilliers, Sandra	Stacey
Rodriguez, Andres	Schoelz	Wang, Jun (visiting)	Stacey
Tah, Tapashree	Schoelz	Yan, Zhe	Stacey
Coffman, Clayton	Schultz/Appel	Stevenson, Severin	Thelen
Ferrieri, Abigail	Schultz/Appel	Swatek, Kirby	Thelen
Rehrig, Erin	Schultz/Appel	Niederhuth, Chad	Walker

<b>Name</b>	<b>Advisor</b>	<b>Name</b>	<b>Advisor</b>
Alazmi, Mehsari S.	Xu	Patil, Abhijit K.	Xu
Buell, Joseph	Xu	Patil, Kapil S.	Xu
Bollinger, Curtis	Xu	Xu, Yang	Xu
Gao, Jianjiong	Xu	Yao, Qiuming	Xu
He, Zhiquan	Xu	Zhang, Chao	Xu
Kushwaha, Garima	Xu	Han, Ling	S. Zhang
Lin, Guan Ning	Xu	Lu, Sha	Z. Zhang

### **M.Sc. and Ph.D. degrees awarded, 2010**

**Carlos Angel, Ph.D.** (Schoelz). Characterization of resistance to tombusvirus in nicotiana species

**Roland A. Y. Holou, Ph.D.** (Folk). Nitrogen management for biofuel production from sweet sorghum

**Katie Becklin, Ph.D.** (Galen). Friends in high places: ecology of mycorrhizal associations in alpine plant communities

**John Fortman, M.Sc.** (Duan). Confocal microscopy imaging analysis of plant morphodynamics

**Juan Jose Gutierrez-Gonzalez, Ph.D.** (Nguyen). Genetic basis of isoflavone accumulation during soybean seed development: special focus on water-deficit conditions

**Lisa N. Meihls, Ph.D.** (Hibbard/Davis). Development and characterization of resistance to transgenic corn in western corn rootworm.

**Guan Nin Lin, Ph.D.** (Xu). Genome-wide microbial phylogeny reconstruction with polytomy identification

**Erin Rehrig, Ph.D.** (Schultz/Appel). The role of Arabidopsis ERF transcription factors in defense against generalist and specialist insects

**Yongjian Xi, Ph.D.** (Duan). Data-driven 3D shape modeling



# Postdocs, Research Staff

## Postdoc/Research Staff

	<u>Lab</u>
Gillman, Jason	Bilyeu
Little, Paul	Bilyeu
Albert, Patrice	Birchler
Gaeta, Robert	Birchler
Gao, Zhi	Birchler
Krishnaswamy, Lakshmi	Birchler
Xie, Weiwu	Birchler
Lukaszewska, Krystyna	Blevins
Cui, Yaya	Chatterjee
Ratnaparkhe, Milind	English
Melia-Hancock, Susan	Flint-Garcia
Cook, Jason	Flint-Garcia
Kenzior, Alexander	Folk
Kenzior, Olga	Folk
Lu, Lu	Folk
Houx III, James H.	Fritschi
Singh, Shardendu	Fritschi
Woods, Terry L.	Fritschi
Bhattacharjee, Saikat	Gassmann

## Postdoc/Research Staff

	<u>Lab</u>
Kim, Sang Hee	Gassmann
Pike, Sharon	Gassmann
Li, Hanbing	Guilfoyle/Hagen
Guo, Yiming	Guilfoyle/Hagen
Korasick, David	Heese
Barry, Julie	Hibbard
Frank, Daniel	Hibbard
Higdon, Matt	Hibbard
Zukoff, Anthony	Hibbard
Oehrle, Nathan	Krishnan
Wonseok, Kim	Krishnan
Morrow, Johanna	Liscum
Kumar, Aruna	McClure
Browne, Christopher	McMullen
Guill, Katherine	McMullen
Yao, Hong	McSteen
Durbak, Amanda	McSteen
Johnston, Mark	Miernyk
Taylor, Susan	Mihail
Kandoth, Pramod	Mitchum
Heinz, Robert	Mitchum
Kankanala, Santhosh	Mitchum

**Postdoc/Research Staff**

Lee, Christopher B  
 Wang, Jianying  
 Yang, Xuejing  
 Dahal, Diwakar  
 Faries, Kaitlyn  
 Coombs, Jill  
 Kumar, Rajesh  
 Liu, Cuilan  
 Manavalan, Lakshmi Praba  
 Musket, Theresa  
 Nguyen, Vinh  
 Shi, Haiying  
 Valliyodan, Babu  
 Wu, Xiaolei  
 Vaughn, Laura  
 Vuong, Tri  
 Xu, Xiangyang  
 Cho, In-Jeong  
 Elder, Jim  
 Hosman, Kevin  
 Anderson, Jeffrey  
 Shahollari, Bationa

**Lab**

Mitchum  
 Mitchum  
 Mitchum  
 Newton/Mooney  
 Newton  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Nguyen  
 Oliver  
 Oliver  
 Pallardy  
 Peck  
 Peck



*In a study published in 20 January 2010 issue of The Plant Cell, Dr. Mingjie Chen, a postdoctoral fellow in the Thelen lab and senior author on the paper, shed light on the metabolic changes that occur during a plant's transition from heterotrophy to autotrophy.*

**Postdoc/Research Staff**

Zhang, Zhe (Jenny)  
 P. Roxanne Steele  
 Xiong, Zhiyong  
 Hoyos, Elizabeth  
 Angel, Carlos  
 Gilbert, Emily

**Lab**

Peck  
 Pires  
 Pires  
 Randall  
 Schoelz  
 Schoelz

<b>Postdoc/Research Staff</b>	<b>Lab</b>	<b>Postdoc/Research Staff</b>	<b>Lab</b>
Valdez, Sandra	Schoelz	Demartini, Diogo	Thelen
Aouhal, Ouassim	Schultz/Appel	Houston, Norma	Thelen
Rubino, Lucy	Schultz/Appel	Ahsan, Nagib	Thelen
Bondra, Mary LeNoble	Sharp	Balbuena, Tiago	Thelen
Garnett, Justin	Sharp	Huang, Yadong	Thelen
Patharkar, O. Rahul	Sharp	Lee, Dong-gi	Thelen
Yamaguchi, Mineo	Sharp	Meyer, Louis	Thelen
Brown, Sabrina	Sleper	Peters, Carlotta	Thelen
Clark, Kerry	Sleper	Bennewitz, Stefan	Walker
Cole-Shannon, Christine	Sleper	Taylor, Isaiah	Walker
Pathan, M.S.	Sleper	Wang, Ying	Walker
Wilcox, John A.	Sleper	Trupti, Joshi	Xu
Brechenmacher, Laurent	Stacey	Zhang, Jingfen	Xu
Dahmen, Jeremy	Stacey	Mao, Guohong	S. Zhang
Gomez-Hernandez, Nicolas	Stacey	Liu, Yidong	S. Zhang
Libault, Marc	Stacey	Chen, Xinlu	Z. Zhang
Stacey, Minviluz	Stacey	Yin, Xiaoyan	Z. Zhang
Tanaka, Kiwamu	Stacey	Zhou, Liwen	Z. Zhang
Wan, Jinrong	Stacey	Karpova, Olga	Z. Zhang
Findley, Seth	Stacey	Kennon, Angela	Z. Zhang
Agrawal, Ganesh Kumar	Thelen	Wang, Neng	Z. Zhang
Chen, Mingjie	Thelen		

# Plant Talks

**Plant Talks** is a lunchtime discussion series organized by and featuring IPG graduate students and postdoctoral fellows. The program gives young investigators an informal venue to share their research ideas and results with their peers. Equally important, it builds collegial support and networks of graduate students and postdocs across disciplines, labs, and buildings. Presentations range from complete and/or partial stories to exciting preliminary observations with proposed future directions to useful methods and approaches.



*Dr. O. Rahul Patharkar (postdoc, Sharp) and Catherine Espinoza (Ph.D., Oliver), 2010 Plant Talks organizers*

## Spring

Mineo Yamaguchi (Sharp), Saikat Bhattacharjee (Gassmann), Courtney Coleman (Gassmann), Nathan Gross (English), Valerio Hoyos (Fritschi), Janelle Donahue (Fritschi), Kiwamu Tanaka (Stacey), Sivanandan Chudalayandi (Birchler), In-jeong Cho (Oliver), Severin Stevenson (Thelen), Mike Gerau (Davis), Jason Cook (Flint-Garcia), Tatiana Arias (Pires), Jennifer Holland (Liscum)

## Summer

Trupi Joshi (Xu), Jenny Zhang (Peck), Shyakumar Barampuram (S. Zhang), Yadong Huang (Thelen), Bradley Young (Fritschi), Deanna Boardman (Fritschi), Roland Holou (Folk)

## Winter

Jingfen Zhang (Xu), Zhe Yan (Stacey), Robert Gaeta (Birchler), Susana Lizcano (Brune), Amy Replogle (Mitchum), Andres Rodriguez (Schoelz), Fei Gao (Gassmann), Julian Lenis (Bilyeu), Ying Wang (Walker) Seth Findley (Stacey)

## Spring 2010

**Kristin Bilyeu, Ph.D.**, University of Missouri  
Candidates as suspects: Delivering more nutritious soybeans after molecular genetic detective work

**Jeff Bennetzen, Ph.D.**, University of Georgia  
Transposon driven and derived genome evolution in the grasses

**Sherry Flint-Garcia, Ph.D.**, University of Missouri  
Diverse maize and teosinte for genetic dissection of agronomic traits

**Wendy Peer, Ph.D.**, Purdue University  
I have an AP for that! The role of aminopeptidase M1 in root meristem maintenance

**Federica Brandizzi, Ph.D.**, Michigan State University,  
Integrity of the plant Golgi

**June Medford, Ph.D.**, Colorado State University  
Designing plant traits with synthetic signal transduction and computer re-designed proteins

**Ben Matthews, Ph.D.**, USDA-ARS, Beltsville, MD  
Broadening resistance of plants to nematodes using biotechnology

**Xin Li, Ph.D.**, University of British Columbia  
The autoimmune model snc1: a sneaky tool for finding signaling components in R protein-mediated resistance

**Matt Lingard, Ph.D.**, Monsanto  
Using cell biology to uncover roles for peroxisomal proteases in Arabidopsis and to understand gene function in transgenic crops

**Robert Sharp, Ph.D.**, University of Missouri  
Root growth at low water potentials: complexity and coordination of cellular responses

## 2010 student organizers

(L-R): Diana Roberts, Lakshmi Manavalan, Jeongmin Choi



## Fall 2010

**Shibu Jose, Ph.D.**, University of Missouri  
The Center for Agroforestry: from genes to landscape and beyond

**Brian Mooney, Ph.D.**, University of Missouri  
Quantitative proteomics of maize hybrids exhibiting different levels of heterosis

**Michael Clegg, Ph.D.**, University of California  
What can genetics tell us about the history of plant domestication?

**Alison DeLong, Ph.D.**, Brown University  
The importance of being dephosphorylated: analysis of protein phosphatase 2A functions

**Shubhra Gangopadhyay, Ph.D.**, University of Missouri  
Applications of bio/nano technology

**Ismail Dweikat, Ph.D.**, University of Nebraska-Lincoln  
Development of biofuels crops: where politics meet plant biology

**Sarah Liljgren, Ph.D.**, University of North Carolina  
Traffic and signaling control organ abscission in Arabidopsis

**John Christie, Ph.D.**, University of Glasgow  
Structure, function, and application of phototropin receptor kinases

**Sally Assmann, Ph.D.**, Pennsylvania State University  
Network biology approaches toward understanding guard cell function

**David Nes, Ph.D.**, Texas Tech  
Unearthing the molecular libraries of the sterol metabolome

**Gassmann Lab**, University of Missouri  
Adventures in genetics: the plant innate immune system

**Andy Pereira, Ph.D.**, Virginia Bioinformatic Institute  
Drought stress response and resistance in plants



# Symposium on Plant Protein Phosphorylation

The 27th Annual Interdisciplinary Plant Group Symposium took place on May 26-28, 2010, on the Columbia campus of the University of Missouri in the Christopher S. Bond Life Sciences Center.

Protein phosphorylation and dephosphorylation play key roles in many aspects of plant biology, including control of cell division, pathways of carbon and nitrogen metabolism, pattern formation, hormonal responses, and abiotic and biotic responses to environmental signals. Twenty-eight speakers were invited to give presentations on their research. The IPG Symposium is the only U.S. meeting organized around plant protein phosphorylation as a unifying theme. This year's symposium marked the tenth international Symposium on Plant Protein Phosphorylation and the seventh IPG Symposium focused on the topic.



**Speakers and Organizers:** Front row (L-R): Claudia Jonak, Alison DeLong, Paula McSteen, Douglas Randall; Second Row (L-R): June Kwak, Yasunori Machida, Jung-Youn Lee, Elizabeth P. B. Fontes, Sorina Popescu, Heribert Hirt, Jay Thelen, Michelle Leslie, Yan Guo; Third Row (L-R): Dominique Bergmann, Antje Heese, Taishi Umezawa, Scott Peck, Jianmin Zhou, Shuqun Zhang, Gloria Muday; Fourth Row (L-R): Paul Grimsrud, Elena Shpak, Jeff Anderson, Morten Petersen, Gary Stacey, Brian Mooney; Top Row (L-R): Brian Ellis, Jan Miernyk, Joseph Kieber, Michael Muzynski, Steven Huber

## Registration

Industry .....	4
University, Government, Non-Profit .....	47
Postdoc/Student .....	22
MU Faculty .....	26
MU Staff .....	21
MU Postdoc/Students .....	45
<b>Total .....</b>	<b>165</b>
Countries Represented .....	13
U.S. States Represented .....	21

## Poster Submissions

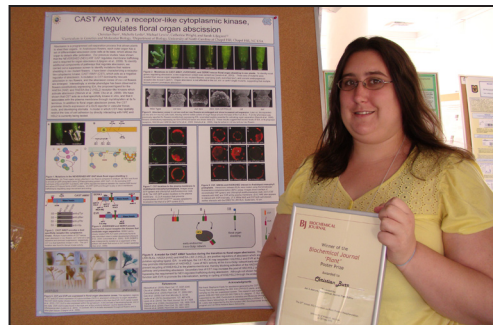
Students .....	24
Postdocs .....	14
Faculty/Other .....	11

## 2010 Organizing Committee

John Walker, Ph.D.	Jan Miernyk, Ph.D.
Jay Thelen, Ph.D.	Shuqun Zhang, Ph.D.
Scott Peck, Ph.D.	Brian Mooney, Ph.D.
Paula McSteen, Ph.D.	Jianlin Cheng, Ph.D.
Antje Heese, Ph.D.	Gary Stacey, Ph.D.

## Sponsors

U.S. National Science Foundation, U.S. Department of Energy, Stadler Genetics Symposium, Monsanto, *Journal of Integrative Plant Biology*, *Journal of Experimental Biology*, National Center for Soybean Biotechnology, *Biochemical Journal*, Missouri Wines, BlueStem



*Christian Burr, University of North Carolina-Chapel Hill, winner of the 2010 Biochemical Journal's Best Poster Award*

The 2010 IPG Symposium included a banquet in honor of **Professor Douglas D. Randall** for his leadership and scientific contributions to the field of protein phosphorylation in plants.





## Awards & Honors



### **Gassmann receives first-ever IPG Excellence Award**


The award acknowledges distinguished contributions to the study of interdisciplinary research in plant biology at MU.

Gassmann, associate professor of plant sciences, was chosen to receive the award for his exceptional efforts in the development, implementation, and success of the IPG graduate curriculum and in recognition of his support of the interdisciplinary study of plant biology.

“Dr. Gassmann is a natural choice to be the first recipient of the IPG Excellence Award,” said John Walker, director of the Interdisciplinary Plant Group and professor of biological sciences. “He is an excellent colleague, and for ten

years he has been an invaluable member of the IPG who has generously shared his time, resources, and tremendous expertise with other faculty, students, and postdocs on campus.”

Gassmann was presented with the award on November 29, 2010, at the IPG seminar.

Gassmann uses complementary biochemical, cell biological, and genetic approaches to investigate molecular-level mechanisms that plants use to recognize and respond to pathogens. One such mechanism is effector-triggered immunity. This involves detection of specific pathogen-derived effector proteins that enter the plant cell, interact with host proteins, and trigger a vigorous resistance response. Gassmann’s lab is focused on an *Arabidopsis* gene (RPS4) that specifies resistance to bacterial pathogens expressing the avirulence gene (*avrRps4*). He has shown that alternative RPS4 transcripts are essential for resistance and that generation of alternative transcripts is under tight regulation. Recently, his lab identified a negative regulator of effector-triggered immunity that may function as a scaffold protein in a transcriptional repressor complex. 



## **Stacey named Fellow of American Academy of Microbiology and American Society of Plant Biologists**

He was awarded the distinction of Fellow from the American Academy of Microbiology for his accomplishments in the area of plant-microbe interactions, especially as they relate to the nitrogen fixing symbiosis between legumes and bacteria.

The American Society of Plant Biologists awarded Fellow status to Stacey in recognition of distinguished and long-term contributions to both research in plant biology and service to the Society.

Stacey is a professor in the Divisions of Plant Sciences and Biochemistry. His research concerns interactions between plants and microbes. Since the 1980s, his lab has focused on the symbiotic relationship between the soil bacterium, *Bradyrhizobium japonicum*, and its symbiotic host, soybean. His lab chemically characterized

signal molecules released by both plant and bacteria that allow the intimate interaction between these two organisms. His pioneering research into the genetics of the bacterium also resulted in the identification of the biochemical signal that results in the formation of nodules on the soybean.

Recently, the Stacey lab was instrumental in sequencing the soybean genome, the first major crop legume species with a published complete draft genome sequence. The lab is currently testing out a number of tools to help determine the specific function of genes in soybean, which could lead to more targeted plant improvement.

Stacey's research accomplishments have garnered him numerous awards and honors, including his election to the American Association for the Advancement of Science in 2009. He also is recipient of the Distinguished Researcher Award from MU's College of Agriculture, Food, and Natural Resources. In 2009, he was appointed to chair the U.S. Department of Energy's Biological and Environmental Research Advisory Committee. 🌱



## Nguyen elected Fellow of American Association for the Advancement of Science

Nguyen was recognized for his distinguished research contributions to plant genetics and genomics, and for national and international recognition of his research leadership in abiotic stress research especially drought tolerance.

Nguyen, an endowed professor of plant sciences, is using both forward- and reverse-genetics to understand the regulatory networks and mechanisms of drought tolerance. Current efforts in his lab include characterizing gene expression products at the transcriptome, proteome, and metabolome levels and conducting a comparative genomics study of soybean and *Arabidopsis* under drought stress. Other projects include studies of soybean resistance to soybean cyst nematodes, soybean rust, and *Phytophthora sojae* as well as construction of proteome and metabolome maps of soybean. Nguyen directs the National Center for Soybean Biotechnology. 🌱

## Blevins Receives Crop Science Teaching Award

The award, given by the Crop Science Society of America, recognizes individuals who exemplify “traits that characterize excellence in resident classroom teaching of crop science at the undergraduate and graduate level.”



Blevins, professor of plant sciences, has taught graduate courses in crop physiology and plant nutrition, and undergraduate courses in plant physiology and plant structure and function. He was awarded the distinguished William T. Kemper Award for Excellence in Teaching in 1993 from the University of Missouri.

His research program focuses mainly on crop physiology and plant nutrition. 🌱

## Graduate Student Award Recipients

**Amy Replogle** (Ph.D., Mitchum) and **Abigail Ferreiri** (Ph.D., Schultz/Appel), *Chancellor's Award for Public Outreach*

**Tatiana Arias** (Ph.D., Pires), travel grants from MU, the International Association for Plant Taxonomy, and BSA/ASPT.

**Jeongmin Choi** (Ph.D., Stacey), IPG 2010 *Certificate of Recognition* for commitment to the interdisciplinary study of plant biology.

**Cathy Espinoza** (PhD, Oliver/Sharp), Division of Plant Sciences Travel Grant.

**Valerio Hoyos** (M.S., Fritschi), travel award from *Douglas D. Randall Young Scientists Development Fund*.

**Julian Lenis** (Ph.D., Bilyeu), travel award from *Douglas D. Randall Young Scientists Development Fund*; 1st place in the 2010 ASA-CSA-SSSA C01 Graduate Student Poster competition.

**Roland Holou** (Ph.D., Folk), 3rd place in the 2010 ASA-CSA-SSSA Graduate Student Minority Poster Contest.

**Kara Riggs** (Ph.D., Sharp), Life Sciences Fellowship

**Dante Smith** (M.S., Sharp), Gus T. Ridgel Fellowship

**Severin Stevenson** (Ph.D., Thelen), 1st Place, MU Technology and Innovations Expo

**Kirby Swatek** (Ph.D., Thelen), Charles W. Gehrke Analytical Training Award; MU Life Sciences Center Graduate Student Association Travel Award; Life Science Fellowship Travel Grant Award; Biochemistry Travel Grant Award; Interdisciplinary Plant Group Travel Grant Award

**Erica Wheeler** (Ph.D., Pires), runner-up, Molecular Cytology Core's imaging contest for her stereoscope image of developing inflorescences

**Priya Voothuluru** (Ph.D., Sharp), Best Student Paper Award at the 37th Annual Meeting of the Plant Growth Regulation Society of America; travel award from CIAT; travel award from the Plant Growth Regulation Society of America



## Undergraduate Student Award Recipients

**April Diebold** (B.S., Pires), Goldwater scholarship

**Jarrold Dye** (B.S., Peck, top right), 1st place poster award, 2010 Undergraduate Research and Creative Achievements Forum

**Fiona Odu** (B.S., Mitchum) McNair Scholar

**James Pflug** (B.S., Pires), MU LSUROP fellowship

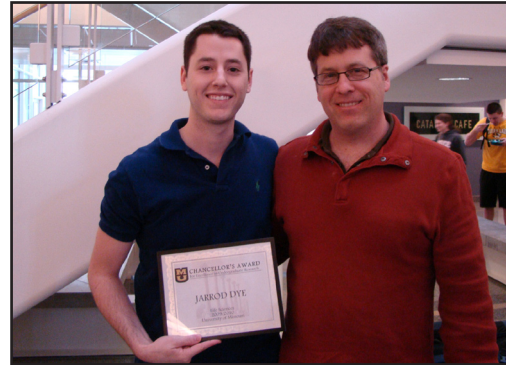
**John Smeda** (B.S., Mitchum) CAFNR Undergraduate Research Fellowship

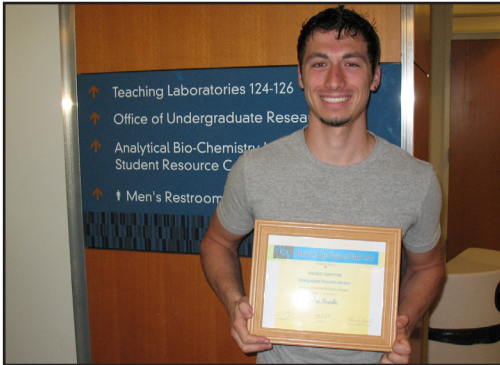
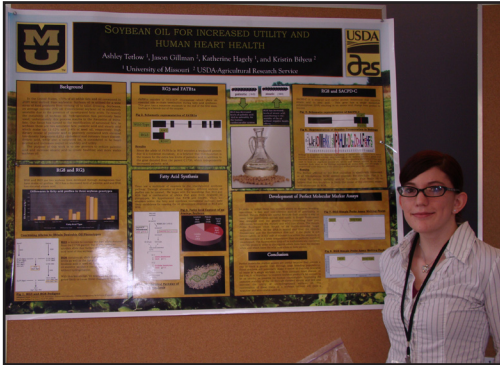
**Michelle Tang** (B.S., Pires), LSUROP fellowship; McNair Scholar

## Postdoc & Research Staff Accomplishments

**Justin Garnett** (Research Lab Technician, Sharp) received the “Above and Beyond” Award from the College of Food, Agriculture, and Natural Resources

**Melissa A. Remley, Ph.D.**, (bottom, right) accepted the position of Instructor in the Division of Plant Sciences





## Awardees for Life Sciences Week 2010 Poster Competition

**Courtney Coleman** (Ph.D., Kovacs/Gassmann) was awarded 2nd place in the Genetics, Environment, and Evolution category

**Chris Lee, Ph.D.** (Postdoctoral Fellow, Mitchum), was awarded 3rd place (tie) in the Physiology and Human Disease category

**Truyen Quach** (Ph.D., Nguyen) was awarded Honorable Mention in the Genetics, Environment, and Evolution category

**John Smeda** (B.S, Mitchum, lower left), was awarded Honorable Mention in the Genetics, Environment, and Evolution category

**Ashley Tetlow** (B.S. Bilyeu, upper left), was awarded Honorable Mention in the Molecular and Cellular Biology category

## New Faculty

### Two New Maize Geneticists Come to Campus

In July 2010, **Paula McSteen, Ph.D.** and **David Braun, Ph.D.** joined the Division of Biological Sciences as associate professors. The two bring with them tremendous research and training strengths in studies of plant physiology, developmental mechanisms, and maize genetics.

McSteen hails from Dublin, Ireland, where she received the B.Sc. degree from Trinity College in genetics in 1991. She received the Ph.D. degree in plant developmental genetics at the University of East Anglia, John Innes Center, in the UK in 1996. She spent the next seven years at the Plant Gene Expression Center in Berkeley, CA. In 2003, she accepted the position of assistant professor in the Department of Biology at Pennsylvania State University, where she received tenure and was promoted to associate professor in 2009.

McSteen's lab, which is located in the Bond Life Sciences Center, studies genetic and hormonal regulation of maize



*Paula McSteen, 2010*

inflorescence (flowering branches) development. The long-term goal of her research is to understand how shoot growth is regulated through pathways of auxin biosynthesis, transport, and signal transduction and the extent to which these mechanisms and interactions are conserved among flowering plants. Her lab has identified two genes that act in parallel pathways regulating the production of



*David Braun, 2011*

auxin from tryptophan. Using a combination of genetics, molecular biology, and cell biology, McSteen is currently investigating each pathway's contribution to the localization and amount of auxin present in the cell and the plant and using a combination of reverse- and forward-genetics to compare the role of auxin in maize and Arabidopsis development.

Braun received the B.A. degree in biology from the University of California-San Diego, Revelle College, in 1991 and the Ph.D. degree in biology at the University of Missouri in 1997. As a postdoctoral associate in Michael Freeling's lab at UC-Berkeley from 1997-2002, he worked on identifying genes involved in the development of ligule and auricle of the maize leaf. He accepted the position of assistant professor in the Department of Biology at Pennsylvania State University in 2003, where he received tenure and was promoted to associate professor in 2009.

Braun's lab, which is located in Tucker Hall, studies carbon partitioning, the process whereby photoassimilates are distributed from photosynthetic tissues throughout the plant. His long-term goal is to identify the genes that regulate how and where carbon is allocated in plants. Recently, his lab identified the first genetic regulators of carbon partitioning in maize, the Tie-dyed (TDY) loci. Using a combination of molecular genetics, physiology, and cell biology techniques, Braun is testing whether TDY1 acts as a sugar flux or an osmotic stress sensor to upregulate sugar export into the veins by controlling sucrose transporters. 🌱

## Retirements

### **Dale Blevins, Ph.D., 1978-2011**

On January 1, 2011, Dale Blevins officially retired from his position as professor in the Division of Plant Sciences.

Blevins received the B.S. degree in chemistry from Southwest Missouri State University in 1965, the M.S. degree in soils from University of Missouri in 1967, and the Ph.D. degree in plant physiology from the University of Kentucky in 1972. He did his doctoral work on the influence of nitrate metabolism on ion uptake and ionic balance in barley seedlings with Dr. A. J. Hiatt. As a postdoctoral associate (1972-74), he worked with Dr. Harold J. Evans in the Department of Botany and Plant Pathology at Oregon State University. His first job as an assistant professor was in the Botany Department at the University of Maryland (1974-77). Blevins joined the faculty of the Agronomy Department (now, Division of Plant Sciences) at MU as an assistant professor in 1978. He received tenure and was promoted to associate professor in 1980 and full professor in 1985. He chaired the Agronomy Department from 1999-2000.



*Dale Blevins, sometime in the 1980s*

Blevins' research interests lay in the topic of plant mineral nutrition. The initial focus of his research was on nitrogen metabolism in soybean root nodules and leaves. His major contributions included the biochemistry of ureide synthesis in legume nodules, ureide catabolism in soybean leaves, effects of boron on branching and yield in soybean, and growth hormone production in legume nodules. His contri-



Dale Blevins, circa 2008

butions to ureide metabolism are the subject of many review articles and book chapters. In the mid-1990s, Blevins discovered that magnesium and phosphorus play a role in grass tetany and switched his research program from soybean physiology to forage physiology. His research contributions in this area include effects of phosphate levels on magnesium availability in forage grasses and micronutrient

concentrations in stockpiled tall fescue treated with phosphorus. Most recently, Blevins and his PhD student determined that NAD-malic enzyme sub-type C4 plants, like switchgrass, need more manganese for optimum growth and development than other C4 or C3 plants. His research contributions were often directly applicable to agriculture in Missouri and elsewhere.

Blevins has authored/co-authored 90 refereed publications (with many still in the works), 16 invited book chapters, and 17 popular press articles. He received in excess of \$3.9 million in competitive research funding as PI or co-PI. He served his profession in many capacities, including in an editorial role for *Crop Science*, *Plant Physiology*, and *Plant & Soil*.

Blevins is widely regarded as an exceptional teacher. His awards include the MU's W.T. Kemper Teaching Excellence Award (1993), Alumni Distinguished Faculty Award (1992), CAFNR's Outstanding Graduate Advisor Award (2006), and the Crop Science Society of America Teaching Award (2010). He mentored 10 M.S. and 11 Ph.D. students and 7 postdoctoral associates.

Blevins is a Fellow of the American Society of Agronomy (1992) and the Crop Science of America (1992). 🌱

## **Arun K. Chatterjee, 1987-2010**

On November 1, 2010, the IPG said good-bye to one of its long-standing members, Dr. Arun Chatterjee, professor of plant sciences.

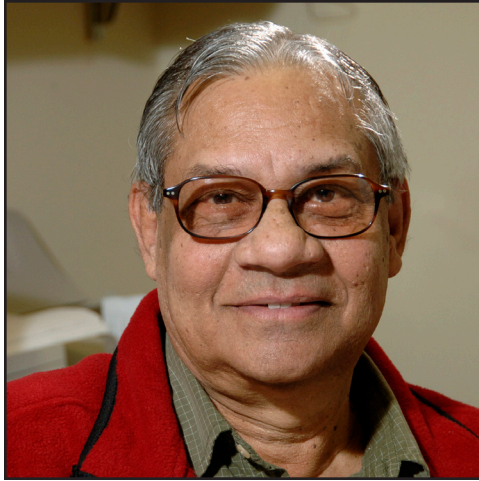
Chatterjee received the B.S. in agriculture and the M.S. degree in plant pathology from Bihar Agricultural College, Bhagalpur, India, in 1959 and 1962, respectively, and a second M.S. degree and the Ph.D. degree in microbiology from the University of Guelph, Ontario, Canada, in 1968 and 1971, respectively.

His postdoctoral experiences included research associate at the University of California, Davis (1971-1973), research associate at the University of Calgary, Alberta, Canada, (1973-1975), and assistant research bacteriologist at UC-Davis (1975-1977). He held the position of assistant professor at Boston University, Boston, MA, before taking a faculty position at Kansas State University, Manhattan, KS, where he obtained the rank of full professor (1979-1987). Chatterjee joined the faculty of the University of Missouri on June 15, 1987, where he has held the rank of professor for 23 years.



*Arun Chatterjee, 1986*

Chatterjee was hired as part of the Food for the Twenty-First Century (F21C) Program. F21C was established in 1986, with funds appropriated from the Missouri Legislature, to support a long-range research program in food and agriculture at MU. Chatterjee was recruited as a member of the F21C's Plant Cluster (now, IPG) to strengthen the University's research in plant pathology.



Arun Chatterjee, 2007

Over the intervening years, Chatterjee became internationally recognized for his research on *Erwinia carotovora*, a bacterium that can cause disease in a wide range of plants, including carrots, tomatoes, potatoes, and onions. His studies have shed light on molecules in this bacterium that lead to disease in some plants and resistance in others.

Many of his findings are novel, including the discovery of the regulatory roles of a small RNA, called rsmB, and an RNA-binding protein called RsmA, in controlling the production of proteins that destroy leaf tissues. His work led to new genetic and molecular tools and concepts that facilitated the exploration of *Erwinia* and other bacterial systems, including human and animal pathogens.

Chatterjee published over 100 refereed publications and mentored 9 graduate students, 18 postdoctoral associates, 6 visiting scientists, and countless undergraduates. He received in excess of \$6.8 million in competitive federal research funding as PI or co-PI. He served his profession in an editorial capacity for *Current Microbiology*, *Applied & Environmental Microbiology*, the *European Journal of Plant Pathology*, and *Molecular Microbiology*; as a panel member for competitive federal grant programs; and as program director for the National Science Foundation from 2000-2001.

Chatterjee is a Fellow to the American Phytopathological Society (1986), the American Academy of Microbiology (2002), and the American Association for the Advancement of Science (2011). 🌱



## Dave Sleper, 1974-2010

Dr. David A. Sleper, professor of agronomy in the Division of Plant Sciences, retired from the University of Missouri on October 1, 2010. With his retirement, MU and the IPG say good-bye to a world-class plant breeder.

Sleper received the B.S. and M.S. degrees in plant breeding from Iowa State University, Ames, in 1967 and 1969, respectively. Upon completion of the Ph.D. degree in plant breeding and genetics from the University of Wisconsin in 1973, he accepted the appointment of assistant professor at the University of Florida, where he worked on the breeding and genetics of tropical forage grasses and taught the beginning genetics course for the whole campus. On October 1, 1974, he joined the agronomy faculty at MU as an assistant professor. He received tenure and promotion to associate professor in 1978 and was promoted to full professor in 1984.

Sleper's initial research at MU focused on forage and turf grass breeding, specifically *Festuca arundinacea* (tall fescue) and *Dactylis glomerata* (orchardgrass), with the bulk of the effort on tall fescue. His research placed emphasis



Dave Sleper, sometime in the 1980s

on breeding for improved forage quality, with the ultimate goal of developing a forage grass that would reduce the hazard of grass tetany, a metabolic disease of grazing dairy cows. He released four forage grass cultivars, including three tall fescues with resistance to the toxic endophytic fungus *Acremonium coenophialum*, and one orchardgrass with tolerance to *Puccinia graminis*.



Dave Sleper, circa 2007

In 1994, Sleper refocused his breeding and research efforts to soybean. His primary objectives included breeding for resistance to the soybean cyst nematode, *Phytophthora* rot, and other biotic and abiotic stresses. His program emphasized identifying new sources of resistance and mapping QTLs for resistance to the soybean cyst nematode. It also emphasized the breeding and genetics of modifying

oil and protein in soybean. In the 16 year period, he developed and released fifteen varieties and two germplasm of soybean.

Sleper's refereed publications numbered nearly 200 in his career. He co-authored, with J. M. Poehlman, the fifth edition of *Breeding Field Crops* (2006; Ames, IA: Blackwell Press), which is recognized as the most successful undergraduate textbook in the world on plant breeding.

Sleper served as president to the Crop Science Society of America (CSSA) in 2000 and the American Association of Agronomy (ASA) in 2006 and was appointed Fellow in these organizations. He served two terms as Non-Resident Fellow of the Samuel Roberts Noble Foundation. He was regularly sought out for advice on issues associated with breeding, including by the Noble foundation and Forage Genetics International, Inc. and other organizations.

Sleper was well regarded as a passionate teacher, both in the classroom and in the lab or field. He was the primary advisor for nearly 30 graduate students and several post-doctoral associates. 🌱

## *New Grants/Contracts*

### **University of Missouri plant genome research receives \$3 million boost from National Science Foundation**

In 2010, MU received a \$3 million boost to its plant genetics research with the receipt of three new Plant Genome Research Program awards. The awards, which range from \$600,000 to \$1.5 million over five years, will support projects that further knowledge of how plant genes function and govern plants' interactions with their environment in three economically important crops -- corn, soybean, and canola.

Gary Stacey, a professor of plant sciences, is principal investigator on a four-year, \$1.5 million project to use soybean root hairs as a model system for studying cellular function in plants. Co-investigators on the project include Dong Xu and Jianlin Cheng, MU professors of computer science with expertise in bioinformatics and systems biology.



Scott Peck, associate professor of biochemistry in the Bond Life Sciences Center, is co-investigator on a four-year, multi-institutional research project that will aid in developing canola with greater tolerance to drought conditions.

James Birchler, curators' professor of biological sciences, is co-principal investigator on a multi-institutional project to study the functional genomics of chromosome centromeres in maize.

Peck and Birchler received approximately \$600,000 and \$900,000, respectively, to support the portion of the work to be conducted at MU.

<b>IPG Investigator(s), Title, Sponsor</b>	<b>Award</b>
<b>Birchler</b> , Functional genomics of maize centromeres, NSF .....	\$894,701
<b>Duan</b> , CMMI: Division of Civil, Mechanical, and Manufacturing Innovation, NSF.....	\$360,000
<b>English</b> , Defense peptides to protect soybean from rust, Missouri Soybean Merchandising Council .....	\$79,900
<b>English</b> , Selection of defense peptides to protect wheat from Fusarian head blight, USDA-ARS .....	\$15,074
<b>Finke</b> , Natural-enemy biodiversity and vector-borne disease dynamics, NIFA .....	\$251,119
<b>Fritschi/Sharp</b> , Drought simulators critical for translational research from the lab to the field, MU .....	\$317,000
<b>Fritschi</b> , Carbon isotope discrimination analysis as a tool for research, MARDF .....	\$13,520
<b>Fritschi</b> , Carbohydrate dynamics in cotton: impacts of early vigor, Cotton Inc. ....	\$49,301
<b>Fristchi</b> , Evaluation of genotypic variation in early vigor of cotton, Cotton, Inc.....	\$8,500
<b>Gassmann</b> , Vitis Gene Discovery, USDA-NIFA.....	\$394,992
<b>Hibbard</b> , The potential for western corn rootworm larval movement with a SmartStax refuge in the bag product, Monsanto .....	\$16,667
<b>Hibbard</b> , MIR604- and 5307-western corn rootworm resistant colonies: follow up studies, Syngenta.....	\$77,778
<b>Hibbard</b> , Syngenta corn rootworm RIB , trials A and B, Syngenta, .....	\$77,750
<b>Hibbard</b> , Evaluation of Cry34/35Ab1 resistance to western corn rootworm larval feeding under high rootworm pressure in the field and greenhouse, Pioneer .....	\$15,000
<b>Hibbard</b> , Larval feeding behavior: a role in resistance of the Western Corn Rootworm to transgenic corn, USDA .....	\$20,000
<b>Hibbard</b> , Rootworm IRM studies for 2010, Monsanto .....	\$37,000

<b>McClure</b> , Saturday Morning Science, Monsanto (Gift).....	\$11,600
<b>McMullen/Flint-Garcia</b> , Genetic architecture of maize and teosinte, NSF .....	\$811,114
<b>McSteen</b> , Genetic and genomic approaches to understanding the role of auxin in shoot development, NSF .....	\$4,753,764
<b>Mitchum/Nguyen</b> , Soybean cyst nematode biology and management, NIFA .....	\$517,452
<b>Newton</b> , 52nd Annual Maize Genetics Conference, March 18-21, 2010 in Riva del Garda, Italy, NSF .....	\$50,000
<b>Nguyen</b> , Engineering soybean byproducts into isoflavones, Danforth .....	\$25,000
<b>Nguyen</b> , Genetic improvement of flooding tolerance in soybean, USB .....	\$103,388
<b>Nguyen/Stacey</b> , Development and deployment of biotechnology for soybean improvement, MSMC.....	\$174,412
<b>Nguyen</b> , National Center for Soybean Biotechnology, USDA .....	\$642,161
Oliver, Ecophysiological, Biochemical, and Molecular Mechanisms of Desiccation Tolerance in Ferns, Picker Interdisciplinary Science Institute, Colgate University .....	\$188,467
<b>Pallardy</b> , Mizzouri Ozark Ameriflux Project Phase Three, Oak Ridge National Lab .....	\$186,616
<b>Peck</b> , Cell-type specific networks in Brassica guard cell responses to drought, NSF.....	\$600,000
<b>Schoelz</b> , Exploring gene transient expression systems and gene sil, Cenicafe .....	\$85,000
<b>Schoelz</b> , Understanding virus intra- and intercellular movement, Noble Foundation .....	\$238,151
<b>Sharp</b> , Improvement of drought tolerance in soybean: plasticity of root system development, MSMC.....	\$65,057
<b>Sharp</b> , Effect of VBC-30083 on maize seedling root growth at low water potentials, Valent BioSciences Co.....	\$10,500
<b>Sharp</b> , Workshop: Improving tolerance of common bean to abiotic stresses, Worldwide Universities Network .....	\$15,500

<b>Sharp/Blevins</b> , Abscisic acid/ethylene interactions in abiotic stress tolerance of tall fescue, MU .....	\$48,453
<b>Shyu</b> , Collaborative research: Biological shape spaces, transforming shape into knowledge, NSF.....	\$266,241
<b>Sleper</b> , Development of a mutant soybean rust RIL population util, USDA-ARS .....	\$4,000
<b>Stacey/Cheng/Xu</b> , Soybean root hairs: a model for single-cell plant biology, NSF .....	\$1,500,000
<b>Stacey</b> , Systems view of root hair responses to abiotic stress, DOE .....	\$901,202
<b>Thelen</b> , Allergen profiling of maize germplasm, Dupont.....	\$270,000
<b>Thelen</b> , Standardizing a proteomics approach for soy allergen profiling, Syngenta .....	\$79,486
<b>Thelen</b> , Quantitation of soybean allergens in GM and conventional varieties using mass spectrometry, Syngenta .....	\$157,045
<b>Thelen</b> , Quantitation of seed allergens from three varieties of soy from eight geographical locations, HESI .....	\$77,673
<b>Thelen</b> , Relative and absolute quantitation of seed protein allergens from 20 varieties of soy, HESI .....	\$47,660
<b>Walker</b> , Symposium on Plant Protein Phosphorylation, May 26-28, 2010, NSF .....	\$10,000
<b>Walker</b> , Symposium on Plant Protein Phosphorylation May 26-28, 2010, DOE.....	\$7,000
<b>Zhang S</b> , A MAP kinase cascade downstream of ERECTA and ERECTA-like receptors in regulating plant development, NSF .....	\$546,729
<b>Zhang Z</b> , DOW Graduate Student Agreement, Dow AgroSciences.....	\$153,000
<b>Zhang Z</b> , Genetically transform plant species, Los Alamos National Laboratory .....	\$79,180
<b>Zhang Z</b> , Development of a high throughput Agrobacterium-mediated, MARDF.....	\$64,900
<b>Zhang Z</b> , Production of transgenic corn events to test new promoters, Dow AgroSciences.....	\$71,750

## Mapping the Soybean Genome

A team of researchers, including several IPG members, recently completed a study identifying 1.1 billion base pairs of DNA in the soybean genome, including more than 90 distinct traits that affect plant development, productive characteristics, disease resistance, seed quality and nutrition.

“The completion of this large, demanding project was only possible through the concerted efforts of the entire soybean community,” said Gary Stacey. “Important contributions were made through state and national soybean checkoff organizations, such as the Missouri Soybean Merchandising Council and United Soybean Board, who funded some of the initial work. This foundation and the involvement of scientists at other universities, such as Stanford, Purdue and Iowa State, convinced the Department of Energy to fund the project.”



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## U.S. Patents Issued to IPG Faculty, 2010

- 7,700,831 B2 Plants resistant to infection by Phytophthora and Pythium. **James T. English**, Roy O. Morris, Francis Schmidt, George P. Smith, Sharon Bishop-Hurley
- 7,881,994 Plants resistant to infection by Phytophthora and Pythium. **James T. English**, Roy O. Morris, Francis Schmidt, George P. Smith, Sharon Bishop-Hurley
- 7,732,667 Nucleic acid molecules from rice controlling abiotic stress tolerance. **Henry Nguyen**
- 7,700,831 B2 Phage-display plant defense peptides directed against *Phakopsora pachyrhizi* and *Uromyces appendiculatus*. **James T. English**, Francis Schmidt, **Gary Stacey**, Zhiwei Fang

## IPG Members Listed as Inventors or Co-Inventors on U.S. Patent Applications, 2010

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