Welcome to the first issue of the PBS Medium, the PBS program’s newsletter. The PBS Medium will be produced periodically to highlight current events in the PBS program, student achievements, and notes from program Alumni. In this issue, you can read about students who have recently been awarded degrees, and learn about all the awards students have received and papers they have published. Very impressive! With the 1st-year students now settled in to their labs, we are preparing to welcome the next class at Itasca in August.

Regents Professor and McKnight Presidential Chair Ronald L. Phillips retired at the end of May, 2010, after 42 years on the faculty of the Department of Agronomy and Plant Genetics. As stated at his induction into the National Academy of Sciences, "Dr. Phillips has coupled the techniques of plant genetics and molecular biology to enhance our understanding of basic biology of cereal crops and to improve these species by innovative methods.” A celebration of Ron's exemplary career was held on Monday, May 24, 2010, with an all-day symposium. The symposium featured several of Ron's previous 55 graduate students and some postdoctoral scientists talking about their recent research. The evening dinner was a gala affair with music, fun and reminiscences.
New Additions to PBS

R. Ford Denison, Adjunct Professor, Department of Ecology, Evolution, and Behavior
Research: Evolution of legume-rhizobium mutualism; agricultural implications of past and ongoing natural selection; life-history tradeoffs as a possible explanation for stress-induced longevity.
http://www.cbs.umn.edu/eeb/faculty/DenisonRFord/

Adrian Hegeman – Assistant Professor, Department of Horticultural Science
Research: The Hegeman laboratory uses high throughput mass spectrometric analysis to measure hundreds to thousands of compounds simultaneously in plant extracts. These data sets can be used to provide comprehensive descriptions of the molecular status of a biological system or to define diagnostic metabolic differences between groups of plants and varied environmental or genotypic backgrounds. A major research focus concerns the creation of new isotope-assisted metabolomics tools and resources that can take advantage of our capacity to metabolically label plant materials with stable isotopes.
http://horticulture.cfans.umn.edu/Adrian_Hegeman.html

Igor Libourel - Assistant Professor, Department of Plant Biology
Research: Systems analysis of metabolism, metabolic adaptation and environmental relationships.
http://www.cbs.umn.edu/plantbio/faculty/LibourelIgor/index.shtml

David Moeller - Assistant Professor, Department of Plant Biology
Research: Evolution of species’ geographic ranges, Ecology and genetics of speciation, Mating system and floral evolution, Evolution of plant-herbivore and plant-pollinator interactions, Molecular population genetics and phylogeography.
http://www.cbs.umn.edu/plantbio/faculty/MoellerDavid/index.shtml

Jennifer Powers – Assistant Professor, Departments of Ecology, Evolution & Behavior; Plant Biology; and Soil, Water and Climate
Research: Terrestrial biogeochemistry, ecosystem processes, microbial ecology, tropical ecology and landscape ecology.

Imke Schmitt - Assistant Professor, Department of Plant Biology, Curator of Lichenized Fungi, Bell Museum of Natural History
Research: Evolution of lichenized fungi, molecular phylogenetics, symbiosis, fungal systematics, evolution of biosynthetic genes.

Robert Stupar - Assistant Professor, Department of Agronomy and Plant Genetics
Research: My research focuses on soybean molecular genetics. Specifically, my lab is interested in defining the transcriptional variation present in soybean and assessing the relationship between this transcriptional variation and phenotypic variation. We are also interested in identifying the genetic and epigenetic causes of this variation.
http://agronomy.cfans.umn.edu/STUPAR_ROBERT_M.html

In Memory
Peter Graham, Professor in the Department of Soil, Water and Climate died suddenly on May 9, 2009. Peter had been with the University of Minnesota since 1982. Peter’s research centered on the symbiotic relationship of legumes and rhizobia. Peter is survived by loving wife of 47 years, Rosemary; children, Michael (Joanne), Geoff (Dale), Michelle Graham; grandchildren, Kealan, Sydney, Samantha, Eric and Matthew.
**Student Achievements**

**Great Accomplishments -- PBS students received an array of awards!**

The PBS Financial Aid Committee awards PBS students for travel to conferences and meetings each spring, summer, and fall. This past year students have gone to events such as the Annual Meeting of the American Society of Plant Biologists, the Ecological Society of America’s 95th Annual Meeting, and the Metabolomics 2010 conference, to name a few. They will be traveling as far away as Quebec, Amsterdam, and Indonesia. The students that received travel awards this past year are Jessica Biever, Moumita Chakravarty, Amy Dykstra, Carrie Eberle, Steve Eichten, Roseanne Healy, Jo Heuschele, Xing Liu, Cece Martin, Ryoko Oono, Suma Sreekanta, Mike Wilson, Tim Whitfeld, Heather Whittington and Peng Yu.

Carolyn Crosby awardees - Amy Dykstra, Jo Heuschele, Moana McClellan and Tim Whitfeld.

MPGI Travel awardees: Xiaoqing Sun and Tim Whitfeld.

Amy Dykstra received a Minnesota Center for Community Genetics research grant.

Roseanne Healy received financial awards from A Survey of truffles and false truffles in Minnesota oak woodlands and savannas from Minnesota Department of Natural Resources; Graduate Student Award from the Society of Systematic Biologists, and Friends of Farlow Fellowship, Harvard University, Cambridge, MA.

Jo Heuschele received the Midwest Aquatic Plant Management Society Research Scholarship.

Mike Nelson received a two-year IGERT Fellowship.

Timothy Whitfeld received a Deland Award for Student Research, Arnold Arboretum, Harvard University for thesis field work in Papua New Guinea; a Graduate seminar, EEB8990 (Functional Traits) award for analysis of leaf nutrient content, for thesis project; and the Dayton Fellowship Award from EEB.

Xing Liu attended the Cold Spring Harbor Course.

**PBS Summer Fellowship Recipients – Summer 2009**

Jessica Biever, Moumita Chakravarty, Jing Chen, John Compton, Amy Dykstra, Carrie Eberle, Brendan Epstein, Kai-Ting Fan, Sajeet Haridas, Roseanne Healy, Jo Heuschele, He Huang, Lingtian Kong, Xing Liu, Moana McClellan, Toko Mori, Sumitha Nallu, Ryoko Oono, Chris Pinahs, Yiping Qi, Jessica Savage, Kerrie Sendall, Suma Sreekanta, Xiaodong Sun, Xiaoqing Sun, Ye Sun, Heather Whittington, and Mike Wilson.

**Publications:**


Smith, M. E. and **R. A. Healy.** “Otidea subterranea sp. nov.: Otidea goes below ground.” Mycological Research 113: 858-866.


Recent Graduates

CONGRATULATIONS!!!

Edward Gilding (adv. David Marks) earned his Ph.D. in June 2009. Ed is doing a post doc at the University of Queensland in Australia.

Lingtian Kong (adv. David Marks) earned his Masters degree in June 2009. Lingtian is currently working on a degree in the Mathematics Department here at the U of M.

Yiping Qi (adv. Fumiaki Katagiri) earned his Ph.D. degree in October 2009. He is currently working as a post doc at the University of Minnesota in the Department of Genetics, Cell Biology and Development with Dan Voytas.

Songqing Ye (adv. Jerry Cohen) earned his Ph.D. degree in September 2009. He is currently working as a research associate on a joint grant with Jerry Cohen and Janet Slovin at the USDA-ARS in Beltsville, MD. Songqing is working with Janet, at the USDA lab and at the University of Maryland, College Park.

Yun Zhou (adv. Min Ni) earned his Ph.D. degree in January 2010. Yun currently holds a post doc position at the California Institute of Technology.

Updates

The Plant Biological Sciences Program would like to extend a thank you to all the faculty and students serving on committees during this past year. We truly appreciate all of your dedication and hard work!

Thanks to five months of diligent preparation and work after the Open House, the Admissions committee finished the process of reviewing applications for incoming students. We are happy to announce that there will be seven new faces joining us this fall.

Peng Yu and You Lu have been awarded a three-year Monsanto Fellowship. This fellowship was created in 2009, as Monsanto created a grant of $10 million to help young scientists in research of wheat and rice.

More good news! Moana Mcclellan has been awarded a one-year Fulbright Fellowship. She will be spending most of next year in Costa Rica working on her research.

Tim Whitfield has received the Graduate School Doctoral Dissertation Fellowship.

Cece Martin has received the Minnesota Agricultural Experiment Station/CFANS Graduate Research Fellowship.

Kelsey Morovic, a student worker, was awarded the Outstanding Student Employee Award for her phenomenal work in the Plant Biology Main Office!!

Moana Mcclellan received the Interdisciplinary Doctoral Fellowship for 2010-2011.
This was a great year for the Phytograds. The new student orientation at Itasca Biological Research Station was an informative and fun week for new students, Peng, Zhou, Alyson, Alicia, Yu, Cece, and Steve, and to get acquainted with current students and faculty in a beautiful setting. The orientation retreat was full of adventure and learning as we went on two bog walks, canoed, hiked to the Mississippi headwaters, completed labs, went fungi/lichen hunting, relaxed at the end of the week cookout, and so much more. Back on campus we started out with a meeting in the fall to plan out our fun year. Fall semester included the annual Greenhouse party, which was a bit rained out but still a good time. Later in the semester we got together to catch-up and enjoy a relaxing lunch at Mim’s café.

In the winter the Phytograds welcomed prospective students in an eventful open house weekend. In addition to the PBS on-campus activities, several students including: Jessica, Ye, Kai-Ting, Mike, and Cece showed the potential students a fun night of french fries, malts, and dancing at the Kitty Kat Club. The winter continued to be a season packed full of amusing get-togethers for the Phytograds. Several students cheered on the Minnesota Rollergirls at a Rollerderby bout at the Famous Roy Wilkins Auditorium in downtown St. Paul. Rumors abound that a few grad students may consider joining the Rollerderby themselves. What could their derby name be? Perhaps, Helianthus Paci-FLOOR US! Once the excitement from the derby calmed down several students including: Heather, John, Ye, Peng, Kai-Ting, Jessica, and Cece, headed up for a relaxing weekend of skiing, movies, and brownies at winter Itasca. The weather was ripe for skiing on Saturday and we skied to the visitor’s center, on the lake, and to the Headwaters. After all of that activity a spaghetti dinner, card games, sleep, and just a little science talk were on the main agenda.

Back on campus later in the semester, the soup lunch was a huge success. Several different delicious soups were served in addition to sides, salads, bread, and desserts. Many people from the department attended and $311.40 was raised, half of that was donated to TeachSMART Volunteer program. In April, the students were able to relax and socialize before finals at a game night pizza party. The semester ended with the plant sale and a bake sale, both of which were a great success and a nice way to head into summer. This was a great year for the Phytograds and we are all excited to concentrate on our research over the summer so we are ready for more fun events next year.

Research Highlights – Current Students
Amy Dykstra recently presented a talk at the Midwest Ecology and Evolution Conference in Ames, Iowa. The talk was entitled, “No evidence of local adaptation in seedling recruitment or seedling survival of Echinacea angustifolia.” Amy is gearing up for her third field season, studying purple coneflower in western Minnesota and South Dakota. She sowed seeds into four experimental plots in fall 2008; she will visit each site at least twice during the 2010 season to census for survivors, and assess herbivory and growth of the plants.
He Haung - Advisor: Bill Gray

Genetic analyses of novel COP9 signalosome (CSN) mutants suggest multiple roles for the CSN in auxin signaling.

The COP9 signalosome (CSN) is an evolutionarily conserved multisubunit protein complex that regulates a variety of signaling and developmental processes. The only known biochemical activity of the CSN is an isopeptidase activity that cleaves the ubiquitin-like protein RUB/NEDD8 off of the cullin subunits of cullin-based ubiquitin-ligases (deneddylation). In the Arabidopsis auxin response pathway, CSN deneddylation activity is required for optimal activity of the SCF<sup>TIR1</sup> complex: the ubiquitin-ligase responsible for targeting Aux/IAA proteins for proteolysis in response to auxin. In a genetic screen for enhancers of the <i>tir1</i>-<i>1</i> auxin response defect, we identified two recessive mutant alleles of <i>CSN1</i> and <i>CSN3</i>, designated as <i>csn1-10</i> and <i>csn3-3</i>, respectively. Although they both display similar auxin response defects, RUB-modified CUL1 accumulates only in the <i>csn1-10</i> mutant, suggesting that the deneddylation activity of the CSN complex is unaffected by the <i>csn3-3</i> mutation. Genetic interactions between these CSN mutants and other auxin response mutants also suggest that <i>csn1-10</i> and <i>csn3-3</i> affect distinct aspects of CSN function. Additionally, the Aux/IAA reporter protein AXR3NT-GUS is stabilized in <i>csn1-10</i> but not <i>csn3-3</i> seedlings, indicating the SCF<sup>TIR1</sup> activity is unaffected by the <i>csn3-3</i> mutation. The contradiction between the quantitatively similar auxin response defects of <i>csn1-10</i> and <i>csn3-3</i> but opposing effects of these two mutations on SCF<sup>TIR1</sup> suggest that the CSN plays a second role in addition to CUL1 deneddylation in the auxin response pathway.

Carrie Eberle - Advisors: Alan G. Smith and Neil O. Anderson

I am a fourth-year Ph.D. candidate in the PBS graduate program, studying reproductive plant biology. My thesis focuses on understanding reproductive barriers between closely related species that regulate gene flow, fitness and seed set. These prezygotic interspecific incompatibility interactions occur between the pollen of one species and the pistil of another closely related species. Interspecific incompatibility (II) effectively prevents hybridization and maintains species. Our lab developed a transgenic <i>Nicotiana tabacum</i> line that has ablated transmitting tract cells, resulting in hollow styles. We have found that normally II pollinations are compatible with the ablated <i>N. tabacum</i> style, implicating the transmitting tract in the II interaction. I am using a biochemical approach to elucidate the transmitting tract factors that are involved in II. A unique pollen tube growth assay using the hollow style of the ablated line was developed to facilitate the identification of the pistil factors involved in II. Transmitting tract extracts are injected into the ablated style prior to pollination and the pollen tube growth response to the injection is measured. Using this approach I have identified the II factor as a protein, retained in a 50 Kda molecular weight filter. I am currently using FPLC to identify the protein(s) involved in II.

Xiaoqing Sun - Advisor: Carolyn Silflow

In green algae such as Chlamydomonas, hydrogenase enzymes in the photosynthetic pathway produce hydrogen under anaerobic conditions. Due to the high efficiency of these [Fe-Fe] hydrogenases, algal systems could provide a source for biohydrogen production. Studies show that transcripts of the two hydrogenase genes (<i>HYDA1</i> and <i>HYDA2</i>) are present at low levels in aerobically grown cells but are induced under anaerobic conditions. To examine the regulation of hydrogenase gene expression, I’m using reporter gene constructs to assay the activity of the promoter and 5’UTR regions of <i>HYDA1</i> and <i>HYDA2</i>. The promoter and 5’UTR sequences of <i>HYDA1</i> and <i>HYDA2</i> were fused to the coding sequence of the <i>PF14</i> gene, required for cell motility. When transformed into mutant (immotile) <i>pf14</i> cells, the
pHYDA1::PF14 and pHYDA2::PF14 constructs produced a conditional swimming phenotype inducible by hypoxia. The results suggest that the HYDA gene expression is regulated at the level of transcription and the promoter and 5'UTR sequences contain elements required for hydrogenase gene to respond to anoxia. To identify genes affecting HYDA expression, conditionally motile transformants were mutagenized and constitutively motile strains were selected. One mutant strain C5-4 was shown to contain a transposon insertion in HYDA2 5'UTR in the reporter gene construct, causing the constitutive swimming phenotype probably by disrupting repressive elements in the promoter and 5'UTR region. In aerobic conditions, a few constitutive swimmer strains have increased expression of HYDA as compared to the original transformants. This result shows that the mutations identify genes in the pathway for regulating the expression of hydrogenase genes. Cloning the genes identified by these mutants will reveal components of the signaling pathway.

**POLAR AUXIN TRANSPORT IS INCREASED BY LIGHT IN TOMATO AND ARABIDOPSIS HYPOCOTYLs**

Xing Liu - Advisors: Jerry Cohen and Gary Gardner

As a fourth-year graduate student in the PBS program, I am currently focusing on the light effects on the polar auxin transport (PAT) in hypocotyls. I have established a PAT assay system with agar blocks and [3H]IAA, which provides very low background and high specific basipetal auxin transport, and has been successfully applied in both etiolated Arabidopsis and tomato hypocotyls. I found that PAT increased in etiolated tomato hypocotyls to similar levels after treating the plants with a 1-d cool white fluorescent light, or 1-h white light followed by 1-d darkness, or 1-h blue or red light followed by 1-d darkness. This promotion in PAT was very sensitive to low levels of blue light, and 20s of 5 μmol m-2 blue light followed by 1-d darkness leads to a significant increase of PAT. I also found that this promotion of PAT was due to a higher transport velocity, and was not altered in the blue light photoreceptor cryptochrome 1 tomato mutant. On the other hand, the content of free IAA in different tissue sections was not changed in plants with increased PAT compared with the dark-grown control, indicating that some other IAA metabolic pathways were activated to keep the IAA content constant. This light-induced PAT has also been found in Arabidopsis seedlings, and 2-d continuous white light, red light or blue light doubled the PAT in dark-grown Arabidopsis hypocotyls. I am now using available photoreceptor mutants in both tomato and Arabidopsis to identify the mechanism of the light induced basipetal PAT. I will also perform finer free auxin content mapping and auxin biosynthesis analysis in dark-grown plants followed by light treatments, to reveal the network among light signaling, auxin biosynthesis, and auxin re-distribution.

**PBS Faculty Research**

*George's Jungle:*

In an effort to save some of the planet's most critical habitat, Bell Museum Curator George Weiblen oversees an international research station deep in Papua New Guinea's tropical forest.

On May 23, Bell Museum Curator of Plants George Weiblen will be surrounded by heads of state from Papua New Guinea, top executives of a transnational shipping company worth billions — and 22,000 acres of the densest tropical rainforest in the world.

As a leading scientist at the newly opened Swire Papua New Guinea Research Station, a facility devoted to tropical forest research, botanist Weiblen will be on hand to celebrate the center's grand opening, as well as a wonderland-like journey eight years in the making.

Swire station is located in Papua New Guinea's Madang Province, a low-lying region known for its punishing humidity and lush, tropical rainforests. Third in size only to the Amazon and Congo's, Papua New Guinea rainforests make up less than one half of one percent of the Earth's land mass, but are home to more than five percent of the world's plant and animal diversity.
The research station, located in a 22,000-acre forest, is a four-hour hike from the nearest road. It's only a brief walk from the research station to Weiblen's research plot where he and his research students began to map, measure and identify some 250,000 trees in a 125-acre plot of jungle just last year.

Weiblen's research is part of a global network of rainforest studies coordinated by Harvard University's Center for Tropical Forest Science (CTFS). The center provides a long-term scientific framework for monitoring the effects of climate change through a series of forest plots across the globe. "Trees are perfect climate-monitoring stations," says Weiblen. "They don't move and their growth and health are affected by carbon dioxide in the atmosphere, as well as other variables like rain, sun and temperature."

Like many forests in undeveloped countries, New Guinea's tropical forests are in the crosshairs of international logging companies. The majority of the country's trees are mature hardwoods of a uniform size—highly prized on the international market and quick work for experts in tree removal.

One of the most diverse countries in the world in terms of people and languages, Papua New Guinea is a tribal society with indigenous clans claiming ownership of the land. Members of the Wanang clans watched their neighbors sell logging rights to the forests in exchange for a devastated landscape, small royalties and temporary roads. Wanang leaders approached Weiblen and colleagues, who were doing ecological research in the area, with an idea of renting the forest to researchers—instead of instead of exporting raw logs for cash why not import jobs to the community through field research?

With financial support from CTFS, the National Science Foundation and John Swire & Sons Ltd., a British-based international shipping company, Weiblen presented tribal leaders with a plan—long-term access to the forest in exchange for on-site education, health care, and local employment opportunities. Despite cultural challenges, land disputes, language barriers (Weiblen speaks Melanesian pidgin), and financial pressures, the new research station is officially open for business.

"Forest conservation on indigenous lands is a tricky proposition— one that hasn't been perfected by anyone," says Weiblen. As the project's go-to guy with a 25 person staff, Weiblen often receives urgent satellite phone calls from Wanang in the middle of the night at his home in Saint Paul. And Weiblen is still in a race against time as development threatens to extinguish New Guinea biodiversity before it can be recorded or protected.

Weiblen has led an effort to designate forest reserves in lowland logging areas by founding the station, the forest plot, and a surrounding protected area. "I suppose it's Lutheran guilt that compels me to give something back to Wanang after all we've discovered there," said Weiblen. He's confident that the Papua New Guinea experiment has enriched the lives of students, researchers and local people. He's less sure about whether what he's done to help protect the biodiversity will stick; "the biologist in me is content, but the environmentalist in me isn't at peace yet."

Alumni: Please let us know if you change positions, so we can keep the alumni database current. If you would like to be included in the next PBS Medium, email a short description of your current position (including pics) to desha001@umn.edu
**A Word from our Alumni**

**Yadong "Adam" Huang**  
Ph.D. degree, October 2008  
Sue Gibson, Advisor

“I graduated from the PBS program in 2008. Currently I am working as a postdoctoral fellow at the University of Missouri-Columbia. My project aims to understand the metabolic regulation of storage compound accumulation in oilseeds at the posttranslational level. A mass spectrometry-based method has been developed to indentify putative kinase substrates (Huang et al., A quantitative mass spectrometry-based approach for identifying protein kinase clients and quantifying kinase activity, Analytical Biochemistry in press) and applied to oilseeds phosphoproteomics studies. Besides science, I enjoy fun time with my little girl!”

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**Nelson Garcia**  
Masters Plan A, October 2008  
Ron Phillips, Advisor  
Senior Researcher  
Research involvement:  
1) Use of japonica and wild rice to widen genetic diversity of hybrid rice parental lines  
2) Breeding hybrid rice parental lines with resistance to bacterial blight using marker-assisted selection  
3) Development of beta-carotene rich rice varieties through marker-assisted breeding using Golden Rice 2  
4) Induced mutagenesis for developing herbicide-tolerant rice.”

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**PBS 6th Annual Retreat**

The PBS annual retreat was held on Monday, May 17, at the Como Park Visitor Center. Guest speakers were Dr. Andrew Baumgarten, a Research Scientist at Pioneer Hi-bred Int’l and Dr. Nathan Springer, Associate Professor, in the Plant Biology Department at the University of Minnesota, both of whom are PBS alumni. PBS students gave research talks and also participated in a poster session.