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ASPB Midwestern Section Newsletter

States included: IA, IL, IN, KS, KY, MI, MN, MO, ND, NE, OH, OK, SD, WV, WI Canada - MB, ON

Meet your 2015-2016 MW Section Officers!

Chair: Aaron Wyman, Assistant Professor of Biology at Spring Arbor University, in Spring Arbor, MI. Aaron's research areas include biomineralization in plants, biogenesis and function of plant peroxisomes, characterization of metabolic pathways in microbes, and science education, focusing on plant biology. Aaron joined the ASPB in 2001 and has previously served as Vice Chair for the ASPB MW Section in 2014-2015.

Vice Chair: Gustavo MacIntosh, Associate Professor of Biochemistry, Biophysics and Molecular Biology at Iowa State University. Gustavo's research focuses on how plants respond to insect attacks and the mechanisms used by insects to avoid plant defenses, as well as rRNA degradation through vacuolar mechanisms. Gustavo has been an ASPB member since 2000. He is also a member of the ASPB Minority Affairs Committee and previously served as Secretary/Treasurer for the ASPB MW Section in 2014-2015.

Secretary/Treasurer: Kathrin Schrick, Associate Professor of Biology at Kansas State University. Kathrin's lab is interested in plant sterols, specifically the roles sterols play in plant growth and development. Another focus of her lab's research is on homeodomain transcription factors that contain putative lipid/sterol-binding domains. Kathrin has been a member of the ASPB since 2004.

Executive Committee Representative: Edgar Cahoon, Professor of Biochemistry and Director of the Center for Plant Science Innovation at the University of Nebraska, Lincoln. Ed's research focuses on plant lipid metabolism with the goal of enhancing the nutritional and industrial value of crop plants and improving agronomic performance of crops. Ed has been a member of ASPB since 1988, served as the 2013-2014 MW section Chair, organized the 2012 meeting in Lincoln, NE and was a monitoring editor for Plant Physiology from 2002-2007.

Annual Meeting Organizer: Sen Subramanian, Associate Professor of Plant Science at South Dakota State University. Sen's lab work focuses primarily on root-microbe interactions with specific interest in understanding microRNAs in regulating hormone action during nodule development, and studying signaling mechanisms governing nodule and lateral rood development in soybean.

Past Chair, *ex officio*: Darron Luesse, Associate Professor of Biological Sciences at Southern Illinois University, Edwardsville. Darron is interested in how plants sense and respond to the environment, with a focus on gravitropism. This will be Darron's fifth year as a Midwestern Section officer, with previous terms as Chair, Vice Chair Secretary, and Treasurer.

Publications Manager: Valerie Haywood, Senior Instructor of Biology at Case Western Reserve University, Cleveland, OH. Valerie teaches introductory biology courses with a research focus on science education. She has been a member of the ASPB since 1998 and is currently serving on the ASPB Education Committee.

Inside This Issue

Save the Date! 2016 MW ASPB Section Meeting

The upcoming ASPB MW Section Meeting is scheduled for March 19th and 20th, 2016 at the University Center in Sioux Falls, South Dakota. Sen Subramanian, Associate Professor of Plant Science at South Dakota State University is this year's Annual Meeting Organizer.

Please check back on the ASPB MW Section website for meeting updates as they become available: http://my.aspb.org/group/midwestern

Five Questions with Midwest Section member…

Aaron Wyman. Aaron is an Assistant Professor of Biology in the Department of Biology and Chemistry at Spring Arbor University, in Spring Arbor, MI.

"…the Midwest meetings provided me great opportunities to present my research and teaching efforts."

1) What is your favorite thing about living and working in the Midwest? I am from the Middle of the Mitten and am the product of two farming families. My wife (Anne) is from the Thumb. While we don't like all seasons equally (yes, we are talking about you, Old Man Winter), our children (Evan and Tessa) love having four distinct seasons to frolic outside. Anne and I are very grateful to work, live, worship, and contribute in a community near so many of our friends and family. Michigan is home to us.

2) What has been the benefit to you of belonging to the Midwest section of ASPB? I readily made essential networking relationships as a Post-Doc at several Midwest meetings. Further, the MW meetings provided me great opportunities to present my research and teaching efforts. I have brought my undergraduates to MW meetings as well and am very grateful for the superb and effusive mentoring MW ASPB members provide undergraduates at these meetings.

3) Who or what has inspired your work the most? First, I'd like to thank the Academy…whoops, wait, wrong notecard. It truly is difficult to pinpoint one person who drove my passions for plant biology and teaching the most. My parents and grandparents provided daily examples of what hard work, determination, boldness, and Faith would do for your life's trajectory and path. I've been very lucky to have great mentors like Ken Belanger, Charlie Yocum, Laura Olsen, and Mary Alice Webb as a graduate student and post-doc. I continue to be amazed and inspired by the diversity of efforts Barbara McClintock and Norman Borlaug undertook for their extensive careers. Perhaps most important was Kay Grimnes, who set me on a path at 19 to become a professor at a liberal arts institution. I strive daily to emulate her love of teaching every student and patiently mentoring each one toward achieving their greatest potential.

4) What projects are you excited about working on in the future? Potty-training! No more diapers for Tessa! Woo hoo! Wait; you meant at SAU? Sorry; my bad. A major benefit of working with undergraduates, many of whom are first-generation college students, is they have very diverse interests and are curious about "everything". This means I can explore all things photosynthetic (other than spinach, which I spent five years working on and can no longer stomach the sight, smell, or flavor of). Our lab currently has projects involving peroxisome function, biomineralization, responses to magnetic fields, and crop biofortification.

5) What is one of your hidden talents? I'm not sure I have noticeable talents, frankly. I have been blessed with being quite red-green-brown-orange colorblind, thereby giving me the incredible ability to generate wildly clashing color schemes for clothing ensembles with complete naiveté; the students always seem to know when Anne has observed me prior to my leaving the house.

FPsc: A New Model System for Hands-on Education and Research in Plant Biology, Genetics, and Genomic Sciences

By Scott Woody
Associate Scientist, University of Wisconsin-Madison, ASPB Education Committee

FPsc is a self-compatible, highly inbred analog of the Wisconsin Fast Plants (WFP) variety of *Brassica rapa* (RC*Br*). FPsc flowers rapidly (~17 DAP), completing its life cycle in ~7-8 weeks to yield ~150 seeds/plant via self- or cross-pollinations. Since 2006, working in Rick Amasino's lab at UW-Madison, I have worked with successive cohorts of undergraduates, high school students, and area teachers to develop an integrated suite of Mendelian, molecular, and genomic resources useful throughout the K-16 curriculum. I have presented the FPsc resources at the ASPB educational outreach booth at several venues including the AAAS Family Science Days, the National Association of Biology Teachers (NABT) and National Science Teachers Association (NSTA) conventions, and the ASPB annual meeting. For additional information, visit: www.FPsc.wisc.edu

FPsc Mendelian genetic resources: UW-Madison students conducted EMS mutagenesis screens to identify mutant phenotypes unambiguously distinct from *wt* FPsc (Figure 1a), whose vertical transmission epitomize fundamental inheritance principles. The simple recessive FPsc *albino* (*alb*) and *ga-deficient dwarf* (*gad*) mutant alleles reliably yield 3:1 (*wt:mutant*) phenotypic F2 segregation patterns (Figures 1b and 1c). Conversely, segregation of the *abnormal leaf* (*ale*) dominant allele yields a 1:3 (*wt:ale*) phenotypic ratio (Figure 1d).

The FPsc mutants also provide "hooks" into other areas of the biology curriculum. For example, the *alb* mutant illustrates the role of photosynthesis in powering the plant life cycle; the *gad dwarf* mutant phenotype can be rescued of the *gad* phenotype by foliar GA3 application (see video at https://www.youtube.com/watch?v=lz26M1bN3g8), providing a starting point for discussion of physiology and the role of hormones in growth and development. Finally, the curled leaf phenotype of *ale* mutant segregants, tied with molecular characterization of the causative locus (see below) offers entre into stem cell biology and the notion of discrete developmental pathways.

FPsc molecular genetic resources: We have also developed a complimentary collection of molecular resources, primarily PCR-based molecular marker assays through which students can map mutant loci among the ~40,000 *B. rapa* genes. The marker collection currently includes ~75 polymorphic loci distributed across the ten chromosomes. Each marker assay supports robust PCR amplification. Perhaps most importantly, the marker assays permit unambiguous discrimination among the three possible genotypes (*FF, FR, RR*) that will be present in F2 (FPsc x R500) mapping populations (Figure 2). Information regarding molecular marker map positions, oligo primer sequences, gDNA extraction and PCR protocols is available at: http://fpsc.wisc.edu/markers/index.shtm.

Having witnessed the phenomenon several times, I contend that there is no laboratory exercise more capable of engaging student interest in genetic sciences and research than a gene mapping experiment. Such experiments provide a compelling biological context for students to apply PCR and electrophoresis technologies. Students use the phenomenon of genetic linkage

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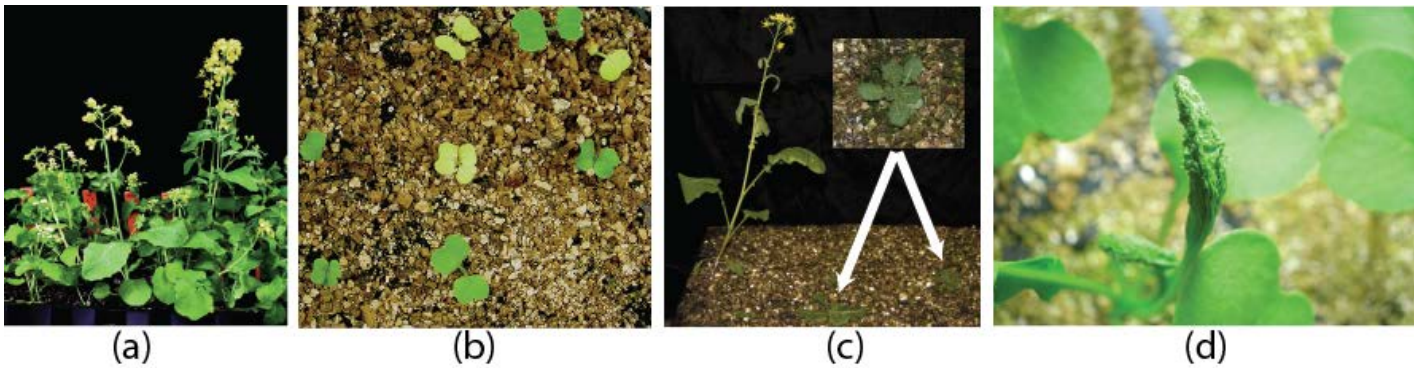


Figure 1. *B. rapa* FPsc and mutant derivatives. (a) Images of FPsc (left) and the canonical WFP variety (right). (b) 4 day-old F2 seedlings in which the *albino* mutant allele is segregating. (c) Owing to inactivation of an essential gene required for GA biosynthesis, FPsc *gad* mutant segregants display a classical *dwarf* phenotype. (d) The dominant FPsc *abnormal leaf* mutant allele induces profound leaf curling in F2 seedlings (note that the cotyledons are normal and, hence, not "true" leaves).

FPsc, continued…

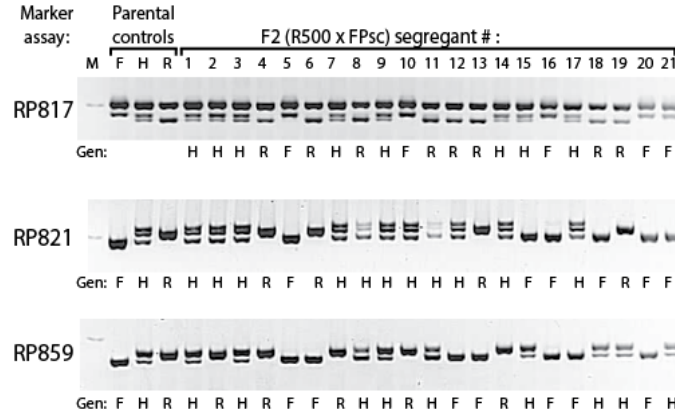


Figure 2. PCR-based FPsc molecular markers. Shown are PCR products of three marker assays used to determine F2 genotypes among segregants in an R500 x FPsc mapping population. Key: M: MW marker; F, H, R: FPsc, heterozygote, and R500 homozygous PCR products, respectively. Gen: F2 segregant genotype, inferred by comparison to parental controls.

as an experimental tool rather than learning it as an obscure historical anecdote and, in the end-game of a mapping experiment, students have a reason to care about the results of three-point cross analyses since those, alone, are sufficient to help students use the logic of genetics to define a genomic interval that *must* contain the causative mutant locus.

Importantly, mapping experiments offer the potential for educators to realize the Holy Grail of genetics education: helping students to make the connection between overt phenotype and underlying, DNA sequence-based genotype. For example, the dominant FPsc *ale* mutant phenotype results from disruption of a regulatory element upstream of the *B. rapa* orthologue of Arabidopsis *ASYMETRIC LEAVES 2* (*AS2*), a key determinant of abaxial/adaxial leaf patterning. In addition, mapping and sequence analysis of the locus responsible for the FPsc *gad dwarf* mutant phenotype indicates an EMS-induced lesion (a premature stop codon) in the *B. rapa* orthologue of the Arabidopsis *ga3* locus encoding *ent*-kaurene oxidase is responsible for the GA deficiency in *gad* mutants.

FPsc genomic resources: In 2008, the Joint Genome Initiative (JGI) approached us regarding a *de novo* whole genome sequence (WGS) assembly of the FPsc genome. JGI's principle interest at the time was to examine the capacity of "next-gen" sequencing platforms to decipher large and complex plant genomes. Our collaboration has yielded a WGS draft of *B. rapa* FPsc that is freely available: http://phytozome.jgi.doe.gov/pz/portal.html

The FPsc WGS has opened new opportunities to expand the range of genetic and genomic resources available to educators who want to expose their students to the world of genetics as practiced in the nascent Age of Genomics. For example, in a mapping experiment, BLAST searches using primer sequences of FPsc marker assays allow students to inspect candidate genes within the genomic interval that their mapping data says *must* contain the causative locus.

We have also generated RNA-Seq data sets of the FPsc mutants shown in Figure 1, useful for comparison to appropriate control populations. As our interest is firmly rooted in enhancing genetics education, the RNA-Seq data sets are freely available through the iPlants Data Store (http://www.iplantcollaborative.org/ci/data-store). Results of our own analyses are also freely available via the DNA Subway, Green Line track: http://dnasubway.iplantcollaborative.org/

Summary: We are very encouraged by the increasing adoption of FPsc resources by researchers and educators. The plant research community has a need to move beyond the established Arabidopsis paradigms, applying information learned to species of agronomic importance. *B. rapa*, having diverged from the Arabidopsis lineage only ~25-40 MYa, offers a platform for discovery of genetic novelties arising since that divergence and may inform our understanding of the genetic mechanisms that govern form, function, and environmental responses in plants.

Limited quantities of FPsc seed stocks are available via request to: swoody@wisc.edu. Those and additional materials will ultimately make their way into the peer-reviewed literature and/or to the FPsc web site: www.fpsc.wisc.edu

Bonus question! In Figure 2, what are the linkage relationships among marker loci included in the assays as revealed by inspection of F2 genotypes of the mapping population?
Send your answers to swoody@wisc.edu

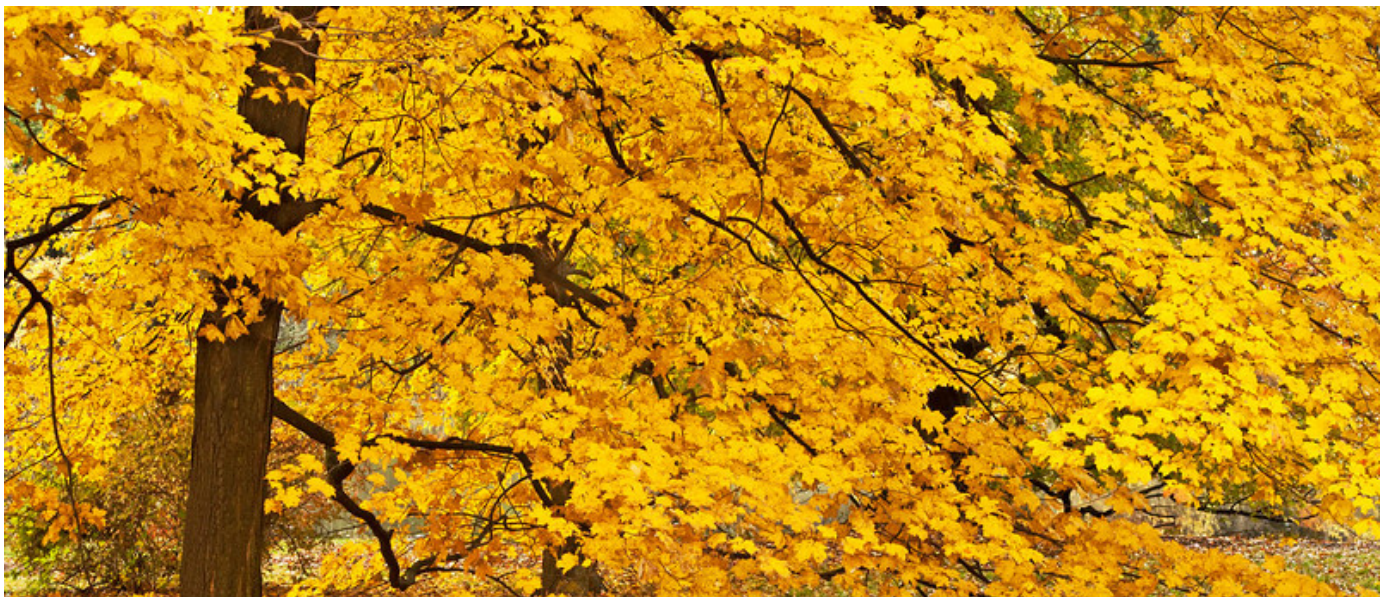
Accolades Section

Karen Chanchavac, a senior Biology major at Spring Arbor University in Spring Arbor, MI, and a research student working with Aaron Wyman, was awarded a Summer Undergraduate Research Fellowship (SURF) through the Michigan State University Plant Genomics program. Karen worked in David Lowry's lab characterizing various switchgrasses for biofuel production. Karen is also an ASPB member!

Sienna Lopez, a junior Biology major at Spring Arbor University (SAU)in Spring Arbor, MI, and a research student working with Aaron Wyman, was awarded a SURF award through the ASPB. Sienna worked in Dr. Wyman's lab, analyzing novel genes and their products for their roles at the molecular, cellular, and organismal levels in several different plant species. Sienna is also a member of ASPB.

Announcements

IPG Annual Meeting, University of Missouri: The Interdisciplinary Plant Group (IPG) at the University of Missouri will hold its 33rd annual symposium entitled "Heterosis: Working toward a genetic, molecular, developmental and physiological basis" from May 25-27, 2016. This symposium will bring together plant scientists working on hybrid vigor and related phenomena from many different angles using a variety of techniques including genetics, genomics, proteomics, metabolomics, physiology and breeding strategies. The species studied include Arabidopsis, maize, rice, tomato, wheat, sorghum, yeast and cassava among others. The goal of the meeting is to foster greater awareness and identification of gaps in the knowledge about heterosis that will need to be addressed by multi-disciplinary, collaborative research teams. The symposium will be held in the Christopher S. Bond Life Sciences Center on the University of Missouri campus in Columbia, Missouri. More information can be found at: www.ipg.missouri.edu/symposium. For registration information, please contact Vicki Bryan at bryanvj@missouri.edu.



Morton Arboretum, Illinois

Want to advertise a position, share some exciting news, or be featured in our next newsletter?
We would also love to hear about your best educational practices in plant biology!
Please send items to Valerie Haywood no later than December 1, 2015: vxh20@case.edu