Interdepartmental Plant Biology Major
Fall Seminar Series (P Phy 696)

Perspectives in Plant Biology

Wednesdays 4:10 – 5:30 pm
Fall, 2008
210 Bessey

Date	Speaker	Topic
August 27	**Stephanie Moon** (IPB, BBMB, VP) **Jen Gray** (IPB, BBMB, VP) **Kan Wang** (Agron, IPB Chair)	• Issues regarding P Phy 696 • Fall Retreat
September 3	**Tracie Hennen-Bierwagen** (BBMB, IPB)	Biochemical and genetic analyses of physical associations among *Zea mays* starch biosynthetic enzymes
September 17	**Adam Bogdanove** (Plant Path)	Pathogen manipulation of host gene expression in bacterial diseases of rice
September 24	**Erik Vollbrecht** (GDCB)	Cell biological insights from Maize developmental mutants
October 1	**Jianbo Zhang / Tom Peterson** (GDCB)	Transposon-Induced Genome Rearrangements in Maize
October 22	**Olga Zabotina** (BBMB)	What do we know about plant cell walls and how important is it?
October 29	**Kirk Maloney** (EEOB)	Invasion biology using a geo-ecological approach
November 12	**Frederica Brandizzi** (Michigan State University)	Dynamics of the early plant secretory pathway
November 19	**Jack Horner** (GDCB)	The Role of Microscopy in Plant Cell Biology
December 3	**Stephanie Moon** (IPB, BBMB, VP) **Jen Gray** (IPB, BBMB, VP) **Kan Wang** (Agron, IPB Chair)	• Fall P Phy 696 conclusion • Arrange spring seminar series • Elect new officers for the IPPM Graduate Student Organization

Light refreshments will be available prior to seminar
Direct questions or comments to Stephanie Moon at 4-0347/ moonsm03@iastate.edu or Jen Gray at 4-0347 /jengray@iastate.edu

Plant Biology
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Perspective in Plant Biology

Wednesdays 4:10 – 5:30 pm
210 Bessey Hall

Invited Speaker: Dr. Tracie Hennen-Bierwagen (BBMB)

September 3, 2008

Biochemical and genetic analyses of multimeric complexes containing starch biosynthetic enzymes in maize endosperm

Abstract

Starch is assembled by the combined actions of multiple starch synthases (SS), starch branching enzymes (SBE), and starch debranching enzymes, however, the mechanisms responsible determining the molecular architecture of the polymer are unknown. Genetic evidence indicates that functional interactions occur between components of the starch metabolic pathway. Our current research has investigated the physical interactions between the SSs and BEs, which are likely to explain these genetic data. Numerous biochemical methods show that specific SSs and BEs exist in multisubunit complexes in maize endosperm extracts, including yeast two-hybrid tests, gel permeation chromatography, immunoprecipitation, and affinity purification. Assembly interdependence analyses revealed that SSIII, in addition to its enzymatic functions, serves as a scaffolding factor in assembly of a high molecular weight complex that contains at least one other SS and two SBEs. Additional proteins that associate with SSIII in the partially purified complex(es) were identified by mass spectrometry. Of particular interest is pyruvate orthophosphate dikinase (PPDK), which is known to function in leaves in C4 photosynthesis. We propose that in the amyloplast the generation of PPi by PPDK serves to inhibit the first committed step in starch biosynthesis catalyzed by ADP glucose pyrophosphorylase (ADPGPP), which also is associated with SSIII in a high molecular weight complex. Thus, the enzyme complexes identified here may function to regulate carbon flux between starch and other metabolic pathways during grain filling. Another function of the complexes may be to provide physical coordination among the biosynthetic enzyme active sites and thus impart architectural specificity to the product.

Edgington, N., Blacketer, M., Bierwagen, T.A. and Myers, A.M. (1998) Control of *Saccharomyces cerevisiae* filamentous growth by cyclin-dependent kinase CDC28. Mol Cell Biol **19,** 1369-1380.

Hennen-Bierwagen, T.A., Liu, F., Marsh, R.S., Kim, S., Gan, Q., Tetlow, I.J., Emes, M.J., James, M.G. and Myers, A.M. (2008). Starch biosynthetic enzymes from developing *Zea mays* endosperm associate in multisubunit complexes. Plant Physiol **146,** 1892-1908.

Hennen-Bierwagen, T.A., Lin, Q., James, M.G. and Myers, A.M. (2008). Maize starch synthase III is a scaffolding protein integrating multiple metabolic pathways. Submitted to Plant Physiol.

Brief biographical data of Dr. Tracie Hennen-Bierwagen

B.S., Biology, Iowa State University
Ph.D., Plant Physiology, Department of BBMB, Iowa State University
Assistant Scientist II, Department of BBMB, Iowa State University

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210 Bessey Hall

Invited Speaker: Dr. Adam Bogdanove (Plant Pathology)

September 17, 2008

Pathogen manipulation of host gene expression in bacterial diseases of rice

Abstract

Xanthomonas is a large genus of plant-associated bacteria that show a high degree of host specificity. Pathogenic members of the genus together cause diseases on over 390 plant species. Many exhibit tissue-specific pathogenicity. We have sequenced three Xanthomonas genomes that, with other, published Xanthomonas genomes, complete a representative set of vascular and non-vascular pathogens of the leading models for dicot and monocot biology, Arabidopsis thaliana and rice. We have also characterized transcript responses of rice to the two pathovars of the rice pathogenic species Xanthomonas oryzae, which differ in their tissue specificity. These new data have enabled a comparative and functional genomics approach to understanding fundamental aspects of Xanthomonas-plant interactions, including factors that determine the ability to colonize different types of plants and different plant tissues. Comparison of pathogenesis-associated gene clusters across strains has provided insight into the ancestral pathogen genome and narrowed the search for host-and tissue-specific adaptations. Intraspecific, and even interstrain variability in genes for lipopolysaccharide biosynthesis, coupled with functional and structural analysis, has revealed an important adaptive role for this extracellular cell component, but, curiously, without correlation to host or tissue that is colonized. Characterization of rice gene expression responses to the vascular and non-vascular pathovars of X. oryzae, and specific mutant strains, has elucidated the central role in pathogenesis of bacterial TAL (transcription activator–like) effector–mediated modulation of host gene expression. And, it has revealed largely distinct sets of host gene targets for the two pathogens that are consistent with their different modes of infection. Understanding of bacterial and plant determinants of host- and tissue-specific pathogenesis holds promise for the development of more durable and effective disease control and prevention strategies.

Brief biographical data of Dr. Adam Bogdanove

Adam Bogdanove received his B.S. degrees in biology from Yale University and his Ph.D. degree in Plant Pathology from Cornell University in 1997. He then held a Postdoctoral position at Purdue University in Agronomy followed by a second postdoctoral position in Molecular Plant Pathology at the Boyce Thompson Institute. Dr. Bogdanove began at Iowa State University as an Assistant Professor in the Department of Plant Pathology in 2000 and became an Associate Professor in 2006. His research focuses on molecular mechanisms of bacterial plant pathogenesis and plant defense: bacterial type III secretion, plant signal transduction, microbial and plant biotechnology for disease control.

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Plant Biology
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Perspective in Plant Biology

Wednesdays 4:10 – 5:30 pm
210 Bessey Hall

Invited Speaker: Dr. Erik Vollbrecht (GDCB)

September 24, 2008

Insights into cell biology from maize developmental mutants – the female gametophyte

Abstract

Alternating diploid and haploid generations characterize all sexually reproducing plants. In higher plants the diploid generation is the sporophyte or familiar, leafy plant, and the haploid generation consists of the gametophytes or pollen and embryo sac (ES). Angiosperm female gametophytes (the ESs) grow and develop within the nourishing maternal tissue of the ovule, but each is nevertheless a distinct, haploid organism that must undergo basic processes of plant development and specific processes of sexual reproduction. It is known that the female gametophyte expresses genes, and that some of these genes are essential for female gametophyte function. Thus, these common (e.g. metabolism, differentiation) and unique (e.g. fertilization) cellular and developmental processes can be studied by isolating mutations in single gametophytic genes. We have identified seven such recessive mutations, each of which essentially blocks sexual reproduction, and all of which map to a small chromosomal segment of the long arm of chromosome 3 (3L), the same segment defined by one of those chromosomal deficiencies. Based on genetic and phenotypic analysis, five of these mutations defined at least three different loci. We analyzed cellular phenotypes of female gametophytes just before, during and just after fertilization. Mutant mgl*-3L1 female gametophytes contained morphologically reduced chalazal poles. This phenotype suggested the 3L1 gene functions in antipodal differentiation. 3L1 mutants were fertilized normally but arrested almost immediately thereafter and eventually failed, implying that gametophytic antipodal function was required after fertilization. The mgl*-3L2 mutation resulted in pleiotropic defects in cellular structure specifically at the micropylar pole. Initial analysis suggested 3L2 mutants were unable to receive a pollen tube for fertilization. Similar genetic and phenotypic behaviors indicated 3L2 and 3L5 were probably allelic. The 3L4 mutation likely defined a third gene, which may supply a housekeeping type function. 3L4 female gametophytes were impaired in developmental progression, including antipodal growth and other aspects of morphogenesis. Each gene was also required in male gametophytes, for pollen to compete successfully in mixed pollinations. While pollen grains deficient for the 3L segment abort, 3L1, 3L2/5 and 3L4 pollen did not abort and could not be distinguished by differences in size or outward morphology . The additive combination of these distinct, single gene mutant phenotypes approximated most aspects of the 3L segmental deficiency phenotype, supporting the conclusion that the 3L segment contains relatively few genes essential to the female gametophyte.

Brief biographical data of Dr. Erik Vollbrecht

Erik Vollbrecht grew up in California and was an undergraduate at UC Berkeley where he majored in Biophysics. While working as a technician he discovered plant developmental genetics and returned to UC Berkeley for a Ph.D. in Plant Biology. At Berkeley he studied transposons, plant meristems and female gametophytes, three research areas in which he is currently active. In 1991 he cloned and analyzed the meristem gene knotted1, the first homeobox gene identified in plants. His thesis, earned in 1997, focused on gametophyte genetics. He then moved to Cold Spring Harbor Laboratory where as a postdoctoral researcher he was a DOE-Energy Biosciences Fellow of the Life Sciences Research Foundation in the laboratory of Rob Martienssen. At CSHL he continued to study meristems and to use transposons, in the study of maize inflorescence development. He moved to Iowa State University in 2004 where is currently an Assistant Professor in the Department of Genetics, Development and Cell Biology.

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Plant Biology
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Wednesdays 4:10 – 5:30 pm
210 Bessey Hall

Invited Speaker: Dr. Jianbo Zhang (GDCB)

October 1, 2008

Transposon-Induced Genome Rearrangements in Maize

Abstract

Since their discovery by McClintock, transposable elements have been associated with the generation of a variety of genome rearrangements, including deletions, direct and inverted duplications, and translocations. In addition to providing dispersed sequence homologies for ectopic recombination, transposons can induce genome rearrangements through alternative transposition reactions that utilize the termini of different elements. Transposition reactions involving transposon termini in direct orientation can generate deletions and inverted duplications. In addition, pairs of *Ac* termini in reversed orientation can undergo transposition reactions resulting in inversions, deletions, and translocations. In each of these cases, the rearrangement breakpoints are bounded by the characteristic footprint or target site duplications typical of *Ac* transposition reactions. These results show how alternative transposition reactions could contribute significantly to genome evolution by generating chromosome rearrangements, and by creating new genes through shuffling of coding and regulatory sequences (Zhang, Zhang and Peterson, 2006). To view an animation of the alternative transposition model, see http://jzhang.public.iastate.edu/Transposition.html.

This research is supported by NSF awards 0450243 to T. Peterson and J. Zhang, and 0450215 to D. Weber.

Brief biographical data of Dr. Jianbo Zhang

Dr. Jianbo Zhang received his B.S. in Agronomy from Hubei Agricultural College located in Wuhan, China. He then held the positions of a lecturer at Tianmen Adulet Education School in Tianmen, China before attending Fudan University in Shanghi where he received his M.S. in Genetics. Dr. Zhang held a second lecturer position in the Department of Biochemistry at Dalain Medical College in Dalian, China. In 1999 he received his Ph.D. from Iowa State University in Genetics under the direction of Dr. Tom Petersons lab working on genome rearrangements by non-linear transposons in maize. He then took a postdoctoral position with Dr. Peterson and has continued his work with maize transposable elements and in 2005 he became an Assistant Scientist in the Department of Genetics, Development and Cell Biology at ISU.

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Plant Biology
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Wednesdays 4:10 – 5:30 pm
210 Bessey Hall

Invited Speaker: Dr. Olga Zabotina (BBMB)

October 22, 2008

What do we know about plant cell walls and how important is it?

Abstract

The extracellular matrix of plant cells is of major importance for the structural integrity of these cells. The physical strength of the matrix provides these organisms their "skeleton" to maintain their spatial organization. The plant cell wall is the primary source of cellulose, the most abundant and useful biopolymer on Earth. Plant cell walls provide the raw materials for textiles, paper, lumber, films, thickeners and other products. Despite its critical importance, the detailed structure and the mechanisms by which the extracellular matrix is formed are not well known, primarily due to the fact that this matrix consists of a nanocomposite of highly heterogeneous polymers, whose chemical structures are difficult to assess. We are only beginning to collect the knowledge about how plants synthesize and assemble their cell walls, while understanding of which will open the door for the fundamental interpretation of plant growth, development and adaptation as well as for numerous biotechnological applications. Plants are remarkably flexible organisms, and their cell walls reflect this flexibility with a great adaptive capacity that allows the plants to sense and respond to any changes in environmental conditions. Conversely, plants are able to detect and respond to changes in their cell walls and therefore, the interaction between synthesis and modification mechanisms that occur during plant growth and adaptation is important, but it complicates the study of plant cell wall formation. Currently, biochemical characterizations as well as direct and reverse-genetics are the major approaches in the studies of synthetic pathways involved in plant cell wall construction. The successful characterization of mutants has provided significant information about the enzymatic machinery involved in this process.

Brief biographical data of Dr. Olga Zabotina

Olga Zabotina received her M.S. degree in chemistry from Kazan State University (Russia) and her Ph.D. degree in Plant Physiology and Biochemistry from Kazan Institute of Biology of Russian Academy of Sciences in 1987. She then held position of senior scientist leading the research group at the Institute of Biochemistry and Biophysics of Russian Academy of Sciences till 1999. From 1999 till 2002 she held a postdoctoral position at Rome University in Plant Physiology and Pathology department followed by a postdoctoral position at University of California in Riverside (department of Botany and Plant Sciences). Dr. Zabotina began at Iowa State University as an Assistant Professor in January 2008 in the Department of Biochemistry, Biophysics and Molecular Biology. Her research focuses on plant cell wall biosynthesis and modification: biosynthesis of polysaccharides, their metabolism during plant stress responses and biologically active oligosaccharides involved in these responses.

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210 Bessey Hall

Invited Speaker: Dr. Kirk A. Moloney (EEOB)

October 29, 2008

Exploring the native-invasive dialectic: a geo-demographic approach

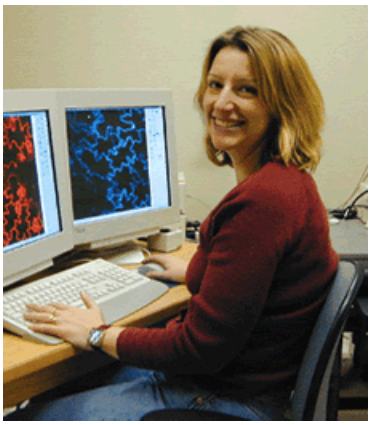
Abstract

There has been much discussion about the lack of a general theory of the factors that predispose a species to becoming a successful invader. I will argue that, for progress to be made, we need to take a systematically applied, comparative approach, examining in detail the relationship between exotic, invasive species and their native progenitors. This will be done using purple loosestrife (*Lythrum salicaria* L.) as a model species, comparing its behavior between plants originating from the native (Europe) and invasive (North America) range through a series of field and common garden studies.

Brief biographical data of Dr. Olga Zabotina

Kirk Moloney received his B.A. degree from Pomona College, his M.S. from the University of Vermont, and his Ph.D. from Duke University, all in the field of Botany with a concentration on ecology. After graduating from Duke, he was a postdoctoral and research scientist in the lab of Simon Levin at Cornell University from 1986 until 1992. Dr. Moloney then moved to Iowa State University in 1992 to take a position in the Department of Botany, which has since transmogrified. He now resides in the Department of Ecology, Evolution and Organismal Biology. His research currently focuses on the ecology and evolution of invasive species, with a particular emphasis on spatial dynamics of populations within a community context.

Direct questions or comments to Stephanie Moon at 4-0347/ moonsm03@iastate.edu or Jen Gray at 4-0347 /jengray@iastate.edu



Plant Biology Fall Invited Speaker

Dr. Federica Brandizzi

Associate Professor
Michigan State University
East Lansing, MI

PROTEIN TRAFFICKING IN THE PLANT EARLY SECRETORY PATHWAY

Plant secretory proteins are synthesized in the ER and then transported to the Golgi apparatus to be distributed to the plasma membrane or to the vacuoles/lysosomes. The Golgi is also involved in receiving materials from distal compartments for further recycling to other destinations within cells. The ER and Golgi apparatus are highly structured organelles made of domains that are morphologically and functionally distinct. How the ER and Golgi achieve and maintain their structure is subject of intense studies. Further, how these organelles maintain their identity despite the intense communication with other organelles is a fundamental question with a limited number of answers. Our most recent findings and approaches to solve these questions will be presented in this talk. As many fundamental processes at the molecular and cellular levels are common to all higher organisms, we expect that our findings will be directly relevant to other non-plant systems as well.

About Dr. Brandizzi

Dr. Brandizzi received her BS in Biology and PhD in Cell and Molecular Biology from the University of Rome, Italy. She spent the next 6 years at Oxford Brookes University, UK, as a postdoctoral fellow, research fellow, and lecturer. From 2003-2006, Dr. Brandizzi joined the Department of Biology at the University of Saskatchewan, Canada, as an Associate Professor and Canada Research Chair. Since 2006, Dr. Brandizzi moved to Michigan State University and became a faculty member at the MSU-DOE Plant Research Laboratory.

Wednesday, November 12, 2008
4:10 pm
210 Bessey

Sponsored by
the Graduate Organization of Plant Biology
and the Interdepartmental Plant Biology Major
at Iowa State University
http://www.agron.iastate.edu/ptf/ipb/home.asp

Plant Biology
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Wednesdays 4:10 – 5:30 pm
210 Bessey Hall

Dr. Harry T. (Jack) Horner

Department of Genetics, Development and Cell Biology &
Microscopy and NanoImaging Facility
Iowa State University

THE ROLE OF MICROSCOPY IN PLANT CELL BIOLOGY
and
The Enigmatic Plant Crystal Idioblast

Abstract

The seminar will be divided into two parts: the first will provide an overview of the types of microscopes available, and techniques carried out in the Microscopy and NanoImaging Facility (MNIF) located in the basement of Bessey Hall; and the second part will be an overview of a specific type of biological mineralization in higher plants. The history of microscopy spans about 500 years, beginning with simple hand-polished lenses of Anton von Leeuwenhoek and others, to the highly sophisticated and complex microscopic instruments of today. These latter instruments, along with a variety of modern techniques, are able to identify and decipher information down to the atomic level, and complement research in many different fields, such as biotechnology, molecular biology and material sciences. With the more recent approach of studying 'relevant' problems that garner grant money, there are many problems that fall into the category of 'difficult-to-fund' but very interesting and fundamental to basic science. One of these latter 'problem' areas is a plant's (and animal's) ability to produce inorganic compounds that seems to have no function. Calcium oxalate (CaOx) is one of these compounds that is naturally produced in a number of animals and humans, and is naturally excreted in the urine. However, this mineral, consisting of miniature crystals, sometimes aggregates and forms kidney and bladder stones. In the Plant Kingdom, CaOx, and its soluble forms, are present in certain algae, fungi, lichens, ferns, gymnosperms and about 75% of the angiosperms, with the crystals occurring as very specific shapes, such as: needles, prisms, crystal sand, styloids and druses. Most commonly, these crystals are formed within cell vacuoles in association with a 'complex' array of micro-machinery in the form of crystal chambers, organic paracrystalline bodies, tubules and vesicles, and arrays of membranes. The second part of the seminar, therefore, will present a variety of perspectives regarding the development, function, and systematic value of this enigmatic mineral compound formed by living systems.

About Dr. Horner

Dr. Horner received his BA, MS and PhD (1964) degrees from Northwestern University (Evanston, IL). He was awarded a two-year NIH postdoctoral fellowship and chose the lab of CC Bowen at Iowa State University (ISU). Afterwards, ISU offered him an assistant professorship (66-69), associate professorship (69-73) and professorship (73-present). In 1995, he was awarded title University Professor, in part, for his creation of the undergraduate major Biological/Premedical Illustration. Dr. Horner has directed the Microscopy and NanoImaging Facility (formerly Bessey Microscopy Facility) since 1970, and he teaches three graduate-level courses in microscopy. His field is plant cell biology and ultrastructure, and his research has included studies dealing with male and female sterility, micro- and mega-sporogenesis, bacterial leaf nodulation, calcium oxalate in fungi and higher plants, floral nectary development, and secretory trichomes. He has published over 136 research papers in 48 different referred journals.

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