TEXAS A&M PLANT BREEDING BULLETIN

February 2018

TEXAS A&M UNIVERSITY--EDUCATING AND DEVELOPING PLANT BREEDERS WORLDWIDE TO ALLEVIATE HUNGER AND POVERTY THROUGH GENETIC IMPROVEMENT OF PLANTS

The Texas A&M Plant Breeding Symposium will be held at the TAMU Memorial Student Center on 22 February. This is a one-day research conference for students, faculty, and non-university guests interested in plant breeding, genetics, and related sciences. The theme for the fourth annual symposium is *The Omics Era: A New Page in Plant Breeding.* World-class scientists will be on campus to share their research on phenomics, genomics, transcriptomics, and other advances in plant breeding as we tackle the issue of how to feed the world with modern plant breeding.

The event is completely free to attend, but registration is required. Can't attend in person? The event will be live streamed via web conferencing (registration required for webinar access.)
For more information, visit plantbreedingsymposium.com.

Plant breeding has become a data driven field. The increase in large-scale data collection in traditional fields such as genetics have evolved with the emergence of computational and high-throughput methods. Genomics, proteomics, metabolomics, transcriptomics, ionomics, and phenomics, known collectively as "-omics," are tools being applied by plant breeders to improve crop varieties. The Texas A&M Plant Breeding Symposium "Omics Era- A New Page in Plant Breeding" brings together plant scientists and breeders using these novel methods and applying them across plant breeding programs.

Schedule:
7:30 Student Poster Competition - Participants and Judges only
8:00 CHECK-IN / ON-SITE REGISTRATION
8:30 Welcome – Graduate Student Organizing Committee
8:40 Dr. Jason Rauscher, DuPont Pioneer

8:55 Dr. Duke Pauli, University of Arizona
9:45 Dr. Sindhuja Sankaran, Washington State University
10:35 COFFEE BREAK
10:50 Katie Rogers, University of Florida
10:58 Student Speaker - TBA
11:06 Kyle Parmley
11:14 Student Speaker - TBA
11:22 Suraj Sapkota, University of Georgia
11:30 Student Speaker - TBA
11:40 POSTER SESSION
12:30 LUNCH
1:40 Dr. Keerthi Rathore, Texas A&M University
2:30 Dr. John Van Hemert, DuPont Pioneer
3:20 COFFEE BREAK
3:40 Dr. Aaron Lorenz, University of Minnesota
4:30 Closing Remarks – Graduate Student Organizing Committee
4:45 ADJOURNED
6:00 Evening Social and Awards Ceremony @ Cafe Eccell

The Texas A&M Plant Breeding Sympoisium is an affiliate event of the DuPont Plant Sciences Symposia Series.

The organizing committee has developed an outstanding program that features the following speakers.

Aaron Lorenz

Aaron Lorenz is an Associate Professor of Soybean Breeding and Genetics in the Department of Agronomy and Plant Genetics at the University of Minnesota. Dr. Lorenz's research focuses on the application of new technologies to

plant breeding, the mining of genetic diversity for cultivar development, and the genetic architecture underlying complex traits. Many of his publications have explored the application and optimization of genomic selection for plant breeding. Dr. Lorenz teaches introductory plant genetics and breeding to undergraduates and advanced plant breeding to graduate students.

Presentation Title: Exploring genomic prediction for crop Improvement: Broadening the reach of evaluation

Abstract: There are countless combinations of factors that could be tested in a breeding program in an effort to identify superior and well-adapted varieties. A variety development pipeline, however, is limited by the resources available for testing performance for complex traits across multiple environments. To circumvent this dilemma, forms of prediction have long been used in plant breeding to help ensure that valuable testing resources are only used on breeding line candidates of high genetic value. Genomic prediction is one of the latest forms of prediction used in plant breeding programs, and holds great potential for widening the reach of testing and evaluation in breeding programs. This seminar will briefly highlight a few examples, followed by an in-depth analysis of genomic prediction for single-cross performance in maize. Opportunity and techniques for model optimization will also be discussed.

Duke Pauli

Duke Pauli recently joined the University of Arizona as Assistant Professor where his lab focuses on elucidating the genetics of abiotic stress tolerance, including heat and drought. He received his PhD in

Plant Genetics with an emphasis on the application of genomic-assisted breeding for the development of superior malting barley varieties for agricultural production. Upon completion of his PhD, he joined the lab of Dr. Michael Gore at Cornell University where his work centered on the use of field-based, high-throughput phenotyping technologies to investigate stress adaptive traits in cotton as well as the temporal dynamics of QTL expression. His future research is aimed at continued development and application of field-deployable technologies to better understand the physiological response of plants to adverse environmental conditions.

Presentation Title: Phenomics: Illuminating the genetic basis of cotton resiliency.

Abstract: Heat and drought stress represent two of the most common abiotic stresses that plants encounter in modern agricultural production systems, resulting in significant economic losses. As climate change continues to increase the frequency and severity of these conditions, the development of stress-resilient cultivars becomes pivotal to sustaining crop yields. Central to meeting this challenge is the ability to elucidate the genetic and physiological basis of key stress adaptive and agronomic traits. To investigate these traits, multidimensional phenotypic data are needed that capture the dynamic response of plants to continuously changing conditions over the growing season. In light of this, we implemented high-throughput phenotyping of the plant canopy to map quantitative trait loci (QTL) controlling stress-responsive traits in a cotton population evaluated under contrasting irrigation treatments in a hot, arid environment. The ability of the field-based, mobile phenotyping system to collect data throughout the growing season revealed the temporal patterns of QTL expression in response to environmental conditions. A subset of these identified canopy trait QTL co-localized with those found to control variation for several physiological and agronomic traits, suggesting pleiotropic QTL. To further enhance these results, we investigated how seed ionomic profiles varied by preferential uptake of soil elements in response to drought conditions under high temperature, such as calcium which is critical for regulating stomatal aperture. This was done in combination with analyzing the ion profile of the soil itself

to assess the effects of spatial variability on the observed phenotypic data. These combined results demonstrate the value of multidimensional data sets generated from novel phenotyping technologies to help provide insight into the varied physiological responses of plants to abiotic stress.

Sindhuja Sankaran

Sindhuja Sankaran is an Assistant Professor in the Department of Biological Systems Engineering, Washington State University. She is working in the Agricultural Automation Engineering research emphasis area of the department since 2013. Her research interests are advanced sensing techniques for high-throughput crop phenotyping, with special focus on the development of optical and chemical sensor-based tools for non-invasive, rapid and continuous crop monitoring applications. In 2015, she led a team to organize a conference on 'Advances in field-based high-throughput phenotyping and data management.' She currently is leading the phenomics aspects of ongoing NIFA-AFRI grants, where her focus is on developing high-throughput phenotyping tools for field and postharvest crop trait evaluation in cereal, legume, and specialty crops. Sankaran holds a BS in Zoology, a MS in Environment Science, a MS in Environmental Engineering, and a PhD in Agricultural and Biosystems Engineering.

Presentation Title: Sensors for phenomics: Role of automated image processing and machine learning in high-throughput sensing.

Abstract: Sensor advancements to evaluate crop phenotypes have drastically increased in recent years. Multiple sensors at variable scales have been utilized to assess different traits from plant performance field traits to post-harvest crop quality traits. Some of the

sensor developments in phenomic research will be discussed, focusing on the importance of data analytics associated with high-throughput sensing, especially image processing steps to achieve automated image analysis and machine learning approaches to accomplish robust phenotypic predictions. These aspects will be explained using examples from row/field and tree fruit crops.

Keerti Rathore

Keerti Rathore is a Professor in the Department of Soil and Crop Sciences at Texas A&M University. His research focuses on the genetic improvement of crops through the development of protocols for efficient delivery of genes, optimal expression of transgenes, and rapid recovery of transgenic cotton, rice, and sorghum. Projects include regeneration from cell & tissue cultures, use of new reporter and selectable marker genes to understand and improve the transformation process, promoter analysis, enhancement of disease resistance in plants, conferring drought tolerance to crop plants, conferring insect resistance to crop plants, improving nutritional quality of seeds, and production of recombinant antibodies and vaccines in plants. He has recently applied for deregulation of transgenic localized suppression of Gossypol with cotton seed, making his lab one of a handful of public programs that have released a deregulated transgenic crop. Additionally, his group is working on root knot nematode resistance and development of CRISPR/CAS protocols for cotton.

Presentation Title: From conception to(wards) deregulation of ultra-low gossypol cottonseed - A 21-year-long odyssey

Abstract: The amount of cottonseed (a highly undervalued byproduct of lint production), produced worldwide contains enough protein to

meet the basic requirements of 500 - 600 million people per year at a rate of 50 g protein/day. However, gossypol, a noxious compound present in the seed glands, renders cottonseed unfit as food for human consumption or even as feed for non-ruminant animals. We have used seed-specific RNAi to silence δ-cadinene synthase gene(s), thus blocking the first committed step in the biosynthesis of gossypol. The gossypol levels in the seed have been reduced from ~10,000 ppm to well below 450 ppm, a level considered safe for human consumption. The rest of the plant maintains normal levels of this defensive terpenoid for protection against insects and diseases. This Ultra-low Gossypol Cottonseed (ULGCS) trait, when commercialized has the potential to make cottonseed as valuable as the lint, thus providing additional benefits to the cotton producers. The project began in 1996 and the proof-of-concept was established in 2005/2006. The breakthrough was achieved with the availability and use of the right tools and technologies, persistence, and teamwork. Most other labs would have moved on after publishing one or two papers based on this achievement. However, considering the potential impact of developing this technology into a viable product, it would have been unconscionable not to pursue it further. So, in the second phase of the work, several hundred new ULGCS lines were generated, screened and characterized at the biochemical/molecular level. We conducted eight, multi-location, multi-year, regulatory field trials to confirm the stability and heritability of the ULGCS trait. Based on the performance and proof of substantial equivalence (with the exception of the desired, ultra-low gossypol levels in the seed) to the parental variety, a petition to deregulate a ULGCS event has been submitted to USDA-APHIS and a dossier to US-FDA. This ULGCS event is one of only five genetically engineered new plant varieties created by a public institution to seek pre-market approvals in the 25-year history of agricultural biotechnology.

John Van Hemert

Formally trained in Computational Biology, Multivariate Statistics, and Machine Learning, John has worked in Discovery R&D at DuPont Pioneer since 2011. Projects are balanced between developing computational methods that enrich the discovery pipeline, and characterize its products-- some of which appear in scientific and IP literature. He leads statisticians, computational biologists, and data scientists around the world, working on everything from experiment design, to drone imagery analysis, to molecular biotechnology development. Before that, Dr. Van Hemert was a Staff Scientist at Iowa State University in the Crop Genome Informatics Laboratory where he led modernization of the Plant Expression DataBase (PlExDB). His PhD (2010) is from the Electrical and Computer Engineering Department at Iowa State University in Bioinformatics and Computational Biology, where he worked on Systems Biology of the Grapevine for an international consortium of researchers.

For more information, please visit http://plantbreedingsymposium.com/2018home where you will find registration information, additional information about this year's symposium, video and audio from previous symposia, and contact information. We cordially invite you to attend this outstanding event developed independently by our graduate students. I believe that you will be enlightened and entertained.

Meetings of Interest

National Association of Plant Breeders, NAPB will hold their annual meeting at the University of Guelph, Ontario, Canada August 7 – 10, 2018. More information will be available soon at https://www.plantbreeding.org.

American Society of Agronomy and the Crop Science Society of America's annual meeting will be in Baltimore, MD, November 4 – 7. More information at https://www.acsmeetings.org/.

Distance Plant Breeding at Texas A&M

Distance Plant Breeding Program and Continuing Education courses available for Fall 2017 (https://scsdistance.tamu.edu/available-courses)

Continuing Education

Available Courses

Spring Courses: January 16 – May 8, 2017

To fully participate in our continuing education courses, students should have:

- **High speed internet connection and updated browsers, including Internet Explorer and either Chrome of Firefox**
- **Common plug-ins (e.g. Adobe Reader, Flash Player, Virus Protection, Java, etc.)**
- **Speakers and Webcam with microphone**
- **Skype**
- **Ability to either scan or fax course documents to the instructor**

Spring 2018

Plant Breeding Fundamentals – Full Course (3 Units) – Cost $679.65
January 16 -May 8, 2018

Introduction to the field of plant breeding for students without a plant breeding background. Includes common plant breeding terminology and introduction of concepts. Genetic improvement of crops by hybridization and selection; special breeding methods and techniques applicable to naturally self-pollinated, cross-pollinated and asexually reproduced plants.

Basic Plant Breeding - Full Course (3 Units) - Cost - $679.65
January 16-May 8, 2018

Basic Plant Breeding can be taken as an entire course (all three units) or each unit can be taken individually. For participants in our Professional Certificate in Plant Breeding and Genetics, completion of all three units is required.

Unit 1 - Introduction to Basic Plant Breeding Cost - $226.55
January 16 – February 16, 2018
Introduction to Basic Plant Breeding provides a review of plant reproduction, genetic variation, gene banks, germplasm preservation, gene segregation, the power of selection and its role in plant breeding, and an introduction to intellectual property and its role in the life of a plant breeder. This unit is designed to prepare the participant to explore the genetics and methodologies employed by plant breeders of self and cross pollinated crop species in units two and three of Basic Plant Breeding.

Unit 2 - Breeding Self Pollinated Crops Cost - $226.55
February 19 – March 30, 2018
The frequency of any specific heterozygous locus will be reduced by 50% for every generation of selfing, resulting in a mixture of homozygous lines within any natural population. Phenotypic selection within heterozygous generations will lead to homozygous or near homozygous germplasm lines or cultivars under self-pollination. This unit is designed to communicate plant breeding methodologies that take advantage of the genetic consequences of natural or forced self-pollination in agronomic crops. Topics will include: [1] the basics of segregation, [2] breeding methodologies, [3] the grain sorghum conversion program-an example of backcrossing in a different direction, [4] review of a commercial soybean cultivar development program, and [5] a review of the types of genetic releases from Texas A&M AgriLife Research.

Unit 3 - Breeding Cross Pollinated Crops Cost - $226.55
April 2 – May 8, 2018
Topics covered include: quantitative genetics and plant breeding, effects of selection on Hardy Weinberg Equilibrium, mating designs with cross pollinated crops, breeding methods for cross pollinated crops, deviations from Mendelian ratios, genetic male sterility and hybrid seed production, seed certification and types of release.

Recommended textbooks are “Breeding Field Crops” by J.M. Poehlman and D.A. Sleper, and “Principles of Cultivar Development” by W.F. Fehr. A final exam will allow the participant to assess their grasp of topics covered. Participants in the Plant Breeding and Genetic Certificate Program must score 70% on the final exam for each unit.

This is a "self-paced" course and is available for viewing for a limited time. Time commitment is individual student driven. Few outside assignments are made. Students should view each lecture, review all previous lectures and be prepared to

discuss any issues that are unclear. Each unit has a printable note set and most units have a set of review questions that can be used as a tool to check your comprehension and grasp of unit concepts. Feel free to contact the instructor, Dr. Wayne Smith, by e-mail (cwsmith@tamu.edu) or phone (979-845-3450) with any questions you have or if you need additional information.

Analysis of Complex Genomes – Full Course (3 Units) – Cost - $679.65

January 16-May 8, 2018

Genome structure, organization and function of model organisms and higher eukaryotes; theory and methodology of genetic and physical mapping, comparative genomics, sequencing, sequence analysis and annotation; emphasis on understanding the function of complex genomes, genome-wide expression analysis, genetic and epigenetic mechanisms; X-inactivation, imprinting, gene silencing, transposons, genome duplication and evaluation. Requires an in-depth and working knowledge of basic and advanced plant breeding concepts.

Unit 1 – DNA Marker Technology and Genetic Mapping Cost - $226.55
January 16 – February 16, 2018

Unit 2 – Recombinant DNA and Cloning Cost - $226.55
February 19 – March 30, 2018

Unit 3 – Sequencing Genomes and Other Genomic Tools Cost - $226.55
April 2 – May 8, 2018

Quantitative Genetics and Plant Breeding - Full Course (3 Units) - Cost - $679.65

January 16-May 8, 2018

Applied aspects of quantitative genetics in plant breeding; examination of methodologies to analyze quantitative variation in crop species; genetic phenomena (inbreeding, heterosis and epistasis); quantitative trait loci (QTL) mapping and marker-assisted selection (MAS); genotype by environment interaction, heritability multiple traits and selection theory with implications in plant breeding. Requires an in-depth and working knowledge of basic and advanced plant breeding concepts.

Introduction to Host Plant Resistance (1 Unit) - Cost - $226.55

January 19 – February 19, 2016

Host plant resistance programs from the standpoint of the plant breeder.

Other Academic and Continuing Education courses in plant breeding and related disciplines that will be available during other semesters include Host Plant Resistance; Crop Production; Selection Theory; Marker Assisted Selection; Genomic Analysis; Field Crop Diseases; Field Insects; Essential Nutrients in Crop Growth; and others. For more information visit https://scsdistance.tamu.edu/ or contact LeAnn Hague, Distance Education Coordinator in Soil and Crop Sciences at leann.hague@tamu.edu or (979) 845-6148.

Distance Degrees in Plant Breeding

M.S. and Ph.D. degree programs at Texas A&M.

Visit https://scsdistance.tamu.edu/plant-breeding-distance-education/ for details.

Please direct comments concerning this bulletin to Wayne Smith, cwsmith@tamu.edu or 979.845.3450.