# TEXAS A&M PLANT BREEDING BULLETIN

September 2017

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

**I'm pleased to distribute the first Texas A&M Plant Breeding Bulletin of the new academic year following a summer hiatus. I want to share with you the abstracts of three of our graduate students and one post doc that were presented at the annual meeting of the National Association of Plant Breeders (NAPB) that was held recently at the University of California-Davis. The meetings were outstanding and if you are not a member of this organization then I encourage to become a member. You can find information about NAPB at https://www.plantbreeding.org. NAPB is a scientific/educational non-profit organization. Annual membership is only $80 for professionals and $35 for students. This professional organization seeks to foster networking and cross-discipline collaborations among scientists and educators from across the globe, although primarily within the U.S., with interests in plant improvement and plant breeding. NAPB seeks to have 'one-voice' advocacy to influence decision makers on plant breeding policy and funding.**

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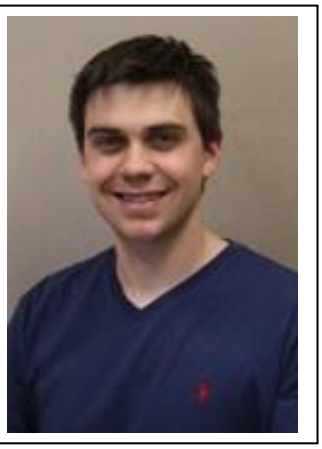
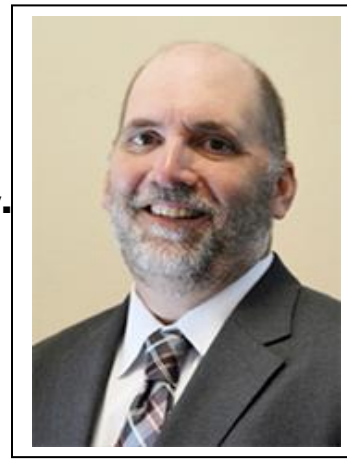


**Brian Pfeiffer is a PhD student with Dr. Bill Rooney, sorghum breeder at Texas A&M University. Brian has been active not only in his dissertation research and**



**Dr. Rooney's program but also in our graduate student organization and he helped lead the initial organizing committee for the Pioneer Plant Breeding Symposium Event held each February at Texas A&M.**

**Title: What's changing from 55 years of sorghum breeding? Brian Pfeiffer and William Rooney.**

**Abstract: Estimating genetic gains in sorghum [Sorghum bicolor (L.) Moench] is necessary to review past and present research and to determine whether the current rates of improvement will meet future production demands. Defining the rate of yield gains has a profound impact on growers, land owners, input suppliers, scientists, investors, policy makers and others. This study was conducted to determine the rate of genetic gain in yield and associated traits in grain sorghum over the past 50–60 years. A panel of sixty hybrids representing 50+ years of hybrid breeding and their respective parental lines from the Texas A&M AgriLife Research Sorghum Breeding Program and fourteen historical DuPont Pioneer hybrids were grown and evaluated across Texas in 2016. Based on data from these trials, grain sorghum yields have increased .008 t ha−1 annually in the both the Texas A&M and DuPont Pioneer sorghum breeding programs. Traits associated with yield including yield potential per plant, heterosis, test weight, panicle size, and grain number per panicle have also increased from long-term selection. Other traits such as leaf angle, days to maturity, plant height and yield stability had little to no change. The portion of yield gains in sorghum production attributed to plant breeding was 61%. Compared to other field crops, the rate of genetic gain in sorghum has been slower. Reasons to explain the slower gains include changes in production environments, shifts in trait priorities, reductions in**

**research and development, and less than optimized heterotic groups. Despite a plurality of reasons for why the rate of genetic yield gains is slower in sorghum, emerging technologies in sorghum breeding (i.e., doubled haploids, genomic selection) could lead to future increases.**

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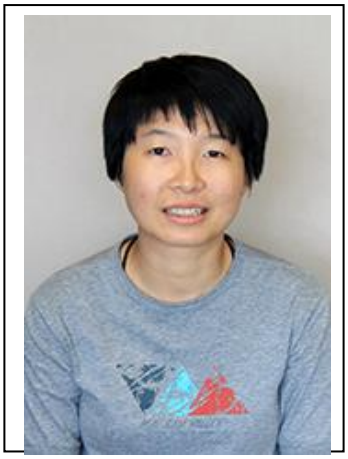

**Yuya Liang is a second year Ph.D. student in the Rice Genetics and Genomics program of Dr. Endang Septiningsih. Yuya joined Dr. Septiningsih's program after completing an M.S. in Crop Science at the National Taiwan University in 2016.**

**Title: Mapping QTLs for disease resistance and key agronomic traits in peanut using SNP-based next-generation sequencing markers. Yuya Liang, Michael Baring, Shichen Wang, and Endang Septiningsih**

**Abstract: High yielding peanut cultivars (Arachis hypogaea L.) with high grade ratings are prefered by the farmers. However, often this effort is hampered by major diseases in peanut. Leafspot is one of the important diseases of peanut that can cause more than 50% yield loss. The objective of this study is to identify and map quantitative trait loci (QTLs) for resistance to leafspot disease, yield, kernel weight, total sound mature kernels (TSMK) and other kernels (OK). A recombinant inbred line (RIL) population, derived from a released cultivar, Tamrun OL07, and a**

highly tolerant breeding line, Tx964117, was used as a mapping population. A total of 90 RILs were planted for phenotyping in Yoakum, Stephenville, and Brownfield, Texas. A genetic map spanning the 20 linkage groups was developed using 1,211 SNP markers based on double digest Restriction-site Associated DNA sequencing (ddRAD-seq). Some major and minor QTLs were detected for all traits. Several QTL clusters were also identified. Major QTLs identified in this study may be used as potential targets for peanut improvement through molecular breeding.

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Yun-Hua Liu is a post doc in the molecular genetics lab of Dr. Hong-Bin Zhang. She was a Ph.D. student with Drs. Zhang and Smith and conducted research that resulted in identifying over 400 genes important in fiber length and over 100 [illegible] to be important in fiber bundle strength in upland cotton. She has continued that work as a post doc for the last couple of years.

**Title: A gene-based breeding (GBB) system for enhanced and accelerated breeding in cotton. Yun-Hua Liu, Yang Xu, Meiping Zhang, Sing-Hoi Sze, Steve Hague, C. Wayne Smith, Shizhong Xu, Yanru Cui, and Hong-Bin Zhang**

**Abstract: Continued crop improvement will largely depend on application of new technologies. We previously constructed a genetic map consisting of 145,395 SNP markers, mapped 209 QTLs controlling cotton fiber length, strength, uniformity,**

**elongation, lint percentage, lint yield and seed yield, and cloned 10,954 genes controlling these traits. This study has demonstrated the utility of these genes and resulted in a gene-based breeding (GBB) system in cotton using the 474 cloned GFL (Gossypium Fiber Length) genes. GBB designs and breeds for superior cultivars based on (i) the number of favorable alleles, (ii) genotypes and (iii) expression profiles of the genes controlling the targeted trait(s). Importantly, it allows continuously pyramiding the favorable alleles or genotypes of the trait controlling genes into elite cultivars, thus realizing continued crop improvement. We found that when one of these three genic datasets was used for fiber length prediction, a prediction accuracy of r = 0.82 – 0.85 was obtained. When the prediction results of two or all of the three datasets were jointly used, the prediction of fiber length was completely ensured. Therefore, the cloned genes are capable of accurately predicting the targeted trait(s), thus improving the ability, accuracy and efficiency of plant breeding. Furthermore, we developed a GBB system for cotton, through which we have further confirmed the ability, utility and efficiency of GBB for enhanced and accelerated breeding in plants.**

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**Yu-Ming Lin is an M.S. student working with Dr. David Stelly Plant Breeding and Genetics**

**program. Yu-Ming received his B.S. degree in Agricultural Sciences at the National Taiwan University.**

**Title: High-density SNP-based Mapping and Multi-trait QTL Analysis of Isogenic Chromosome specific CS-B17 RILs in Upland Cotton (Gossypium hirsutum L.). Yu-Ming Lin, Luis De Santiago, Sukumar Saha, Robert Vaughn, Johnie N. Jenkins, Jack McCarty, Russell W. Hayes, Benjamin Todd Campbell, Amanda Hulse-Kemp, and David Stelly**

**Abstract: Quantitative genetic effects are often complicated by interactions among loci and/or environments, especially when interspecific hybridization is involved. We report here on QTL analysis of agronomic and fiber traits using a set of interspecific isogenic chromosome specific CS-B17 RILs, where each line is theoretically homozygous for a unique array of sub-chromosome-17 segments from two homozygous lines -- 'TM-1' G. hirsutum and '3–79' G. barbadense. Fifty CS-B17 RILs were phenotyped for 10 traits across 2 years at a total of 4 locations, and were genotyped via the Illumina CottonSNP63K Array. We applied 500 chromosome-17 SNPs for linkage mapping and QTL analysis using programs JoinMap, R/OneMap and R/qtl package. One or two QTLs were detected for each trait. Positions of the QTLs for lint percentage, fiber length, and micronaire were environmentally consistent, but for other traits varied. Epistatic interactions were evident, in that the low-quality recurrent parent contributed the desirable alleles for some of the traits but not others.**

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**I'm sure that you'll agree that the future is in good hands with young scientists such as these. Please congratulate them on a job well done.--Wayne**

# Meetings of Interest

**American Society of America, Crop Science Society of America, and Soil Science Society of America** will host more than 4,000 scientists, professionals, educators, and students at the 2017 International Annual Meeting, Managing Global Resources for Secure Future," October 22 – 25, 2017 in Tampa Florida. Additional 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

## Fall Courses: August 28 – December 15, 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
- Google Chrome or Mozilla 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.

**Fall 2017**

**Plant Breeding Fundamentals – Full Course (3 Units) – Cost $679.65**

**August 28 - December 15, 2017**

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**

**August 28 - December 15, 2017**

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*

*August 28 – September 29, 2017*

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*

*October 2 – November 3, 2017*

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*
*November 6 – December 15, 2017*
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.

**Advanced Plant Breeding - Full Course (3 Units) - Cost - $679.65**
**August 28 - December 15, 2017**
Expectations of genetic improvement for different plant breeding methods; relative efficiency for crops of different reproductive mechanisms; genetic variances, covariances and genotype-environment interaction components of variance used in planning selection procedures. Advanced 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 - Advanced Genetic Principles in Plant Breeding*
*August 28 – September 29, 2017*
Topics covered include: Hardy Weinberg, means and variances, covariances and heritability, mating designs, genetic diversity.
Cost - $226.55

*Unit 2 - Selection: Theory and Practice in Advanced Plant Breeding*
*October 2 – November 3, 2017*
Topics covered include: recurrent selection, inbred line selection and testcrossing, selection environments, indirect selection, multiple trait selection, QTL MAS, heterosis and hybrid prediction.
Cost - $226.55

*Unit 3 - Statistical Tools in Advanced Plant Breeding*
*November 6 – December 15, 2017*
Topics covered include: statistical concepts review, expected mean squares and combined analysis, GxE interactions and stability analysis, polyploidy.
Cost - $226.55

**Experimental Designs in Agronomic Research - Full Course (3 Units) - Cost - $679.65**
**August 28 - December 15, 2017**
Teaches fundamental principles and procedures of experimental designs in agricultural sciences. Emphasis includes factorial designs, predicting outputs, use of covariance, and balanced and unbalanced experimental designs as related to common agricultural research projects under field, greenhouse or growth chamber culture. Students will become familiarized with computer programming of common statistical software. Experimental Designs in Agronomic Research 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 - Factorial Experimental Designs in Agronomic Research*
*August 28 – September 29, 2017*
Topics covered include: Fundamentals of agricultural research methodology and methodology, basic statistical concepts for testing of hypothesis, introduction to simple computer statistical software programs and applications, complete randomized design, randomized complete block design, and Latin square design.
Cost - $226.55

*Unit 2 - Factorial and Unbalanced Designs in Agronomic Research*
*October 2 – November 3, 2017*
Topics covered include: Split-plot and split-split plot designs, nested designs, variance analyses, interactions with years and locations, comparisons of paired and grouped mean, estimation of missing values, the general linear model, and planned incomplete block design.
Cost - $226.55

*Unit 3 - Correlation, Regression, Covariance, and Biplot Analysis in Agronomic Research*
*November 6 – December 15, 2017*
Topics covered include: Correlation, regression, path coefficient analysis, covariance analysis, nearest neighbor analysis, augmented designs and moving means and analysis, database management, biplot analyses.

Cost - $226.55

This is a "self-paced" course and is available for viewing for a limited time. Time commitment is individual student driven. 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 voiced over PowerPoint video lectures.

# 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.**