

# TEXAS A&M PLANT BREEDING BULLETIN

November 2018

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

**Several Plant Breeding students attended and presented posters at the annual meeting of the Agronomy Society of America and the Crop Science Society of America in Baltimore earlier this month. Anil Adhikari et al., Smit Dhakal, Ammani Kyanam et al., and Ranjita Thapa, et al. presented five poster presentations and their abstracts are presented below. I hope that you enjoy reading about the valuable research that these young folks are conducting during their graduate studies at TAMU in plant breeding.**

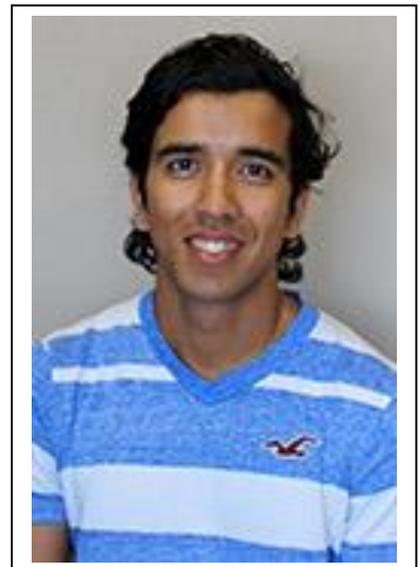


**A**nil Adhikari, Ph.D. student with Amir Ibrahim, wheat breeding, presented a poster entitled “Increasing Multi-Environment Testing Capacity in Hybrid Wheat Using F<sub>2</sub> Yield as a Proxy for F<sub>1</sub> Performance.”

**Abstract:** Commercial success of hybrid wheat (*Triticum aestivum* L.) depends on exploitation of yield heterosis by separation of heterotic pools, to facilitate the selection of the best single crosses. This requires accurate estimates of hybrid performance from multi-environment trials (METs). The current method of hybrid seed production, using chemical hybridizing agent, severely limits our ability to evaluate experimental hybrids in METs. A way to augment our F<sub>1</sub> trials is to use F<sub>2</sub> as proxy of F<sub>1</sub> performance. To test this hypothesis, a set of F<sub>2</sub> experimental hybrids were selected from F<sub>1</sub> trials of previous year and planted in Texas and Nebraska in 2017 and 2018 at six locations. Best linear unbiased predictions of yield were calculated, using mixed modelling after correcting for spatial variability. Pearson's and Spearman's rank correlation were calculated between F<sub>1</sub> yield of genotypes in McGregor, TX in 2016 and F<sub>2</sub> yield in single locations and locations combined across Nebraska, Texas and all six trials in 2017. Among individual locations, the highest correlations between F<sub>1</sub> and F<sub>2</sub> was obtained in McGregor ( $r = 0.94, P < 0.05$ ) whereas lowest was obtained in Grant, NE ( $r = -0.52, P < 0.05$ ). Rank correlation was also highest for McGregor ( $r = 0.88, P < 0.05$ ) and lowest for Grant, ( $r = -0.44, P < 0.05$ ). High correlations were observed for locations similar to the F<sub>1</sub> trial location in South Texas and six locations combined, as compared to locations in

**North Texas and Nebraska due to genotype-by-environment interactions. Comparison of heterosis in  $F_2$  and  $F_1$  revealed that,  $F_1$  heterosis and yield can be roughly estimated by doubling the heterosis estimates of  $F_2$ ; for most of the top ranked hybrids in METs. Using  $F_2$  hybrid performance as a proxy, offers a quick and efficient approximation of  $F_1$  hybrid performance for traditional wheat breeding programs.**

**S**mit Dhakah, Ph.D. student with Drs. Shuyu Liu and Amir Ibrahim, presented a poster entitled **“Association Analysis of End-use Quality in Synthetic Derived Winter Wheat.”**



**Abstract:** **Wheat (*Triticum aestivum* L.) is a major crop in terms of area planted and end-product consumed. The end-use quality is an important target trait for wheat, but its measurement in early generation breeding lines is limited because of the large number of lines at that stage. However, use of molecular markers as a proxy for end-use quality makes it feasible to test a large number of genotypes. A set of 298 synthetic derived lines (SDLs), developed from the backcross of 21 primary synthetic hexaploid wheat with**

**hard red winter wheat cultivars TAM 111 and/or TAM 112, were used for genome-wide association study (GWAS). These SDLs harvested from 16 environments over three years were evaluated for single kernel characterization system traits, milling yield, protein content and mixograph traits. Objectives of this study were to 1) find stable marker-trait associations for end-use quality traits in synthetic derived lines and 2) to develop KASP markers for early generation screening of wheat breeding lines. Analysis with 76K genotyping-by-sequencing (GBS) markers revealed 41 significant marker-trait associations after correcting for population structure and family relatedness. Results showed strong associations of hardness index (hard) and flour yield on the short arm of chromosome 5D. Association between midline peak time and midline tail width were found on chromosome 1B. Four GBS markers were stably associated with flour yield and hardness index in all the years and locations. Development of KASP markers are underway and will help accelerate MAS of end-use quality traits in wheat breeding programs. Authors Smit Dhakal, Chenggen Chu, Yan Yang, Shichen Wang, Jackie Rudd, Jason Baker, Ravindra Devkota, Shannon Baker, Joseph Awika, Amir Ibrahim, Geraldine Opena, Qingwu Xue, Shuyu Liu.**



**A**mmani Kyanam's poster was entitled "Evaluation of Effects of Trifluoromethanesulfonamide on Productivity and Seed Quality in Sorghum." Ammani is a Ph.D. student with Bill Rooney.

**Abstract:** *Sorghum* (*Sorghum bicolor* L. Moench) is a grain and forage crop grown in the semi-arid regions of the world. Discovery of cytoplasmic male sterility (CMS) systems made commercial hybrid seed production feasible and divided inbreds into B- (female) and R- (male) lines. Newly developed B-lines require sterilization, which involves several generations of backcrossing, to facilitate economical hybrid seed production and inbred line maintenance. In a breeding program, new B-lines must be sterilized and methods to reduce the number would be useful. Testcross evaluation does that, but methods of cross-pollination are not practical in generating sufficient quantities of seed required for testing of the hybrids. Trifluoromethanesulfonamide (TFMSA) was found to induce temporal male sterility in maize, and

**shown to be applicable in field sorghum (Boerman et. al. unpublished data). In this study, we will evaluate the effects of TFMSA on productivity and seed quality in 30 isocytoplasmic AB-line pairs. Foliar applications of TFMSA and deionized water were made to the male fertile B-lines and male sterile A-lines respectively at the rate of 15mg before boot leaf emergence. These bagged panicles are testcrossed to two R-lines (R.08306 and R.07178). The harvested panicles from the A and B-lines were compared to evaluate the effects of TFMSA on productivity and seed quality. Authors Ammani N. Kyanam, George L. Hodnett and William L. Rooney**

**Ranjita Thapa presented two posters at the ASA/CSSA meetings in Baltimore. Ranjita is a Ph.D. student with Dr. Endang Septiningsih.**



**R**anjita Thapa: “Genome-Wide Association Study for Traits Related to Tolerance to Flooding during Germination in Rice”

**Abstract:** Rice is one of the most important staple foods feeding more than half of the world's population. Direct seeded rice is becoming more popular in Asia and is the mainstay of rice cultivation in America. Tolerance to flooding during germination or anaerobic germination is one of the key traits to achieve uniform germination and seedling establishment in direct seeded rice which enable increasing rice production. Rapid coleoptile growth is an important trait that enables the germinating rice to access oxygen near the water surface. It is important to identify natural variations in coleoptile length of submerged germinating rice seedlings in rice breeding program to identify rice variety with high tolerance. The main objective of this study is to identify the chromosomal regions associated with coleoptile elongation and percent germination in submerged germinating rice plants using an enriched rice panel. Phenotypic evaluation of anaerobic germination was performed using 290 rice accessions in beaker glasses containing 8 cm deep water in a growth chamber maintained at 30°C. The rice panel was genotyped using the 7K rice SNP chip (Cornell University). Preliminary data analysis shows that there are many lines highly tolerant to anaerobic germination condition. We detected 18, 10, 10 and 10 significant SNPs under a mixed linear model for survival rate, coleoptile length under anaerobic germination, coleoptile length under control and flooding

**tolerance index, respectively. Authors: Ranjita Thapa, Rodante Tabien, Michael J. Thomson, Endang M. Septiningsih**

## **R**anjita Thapa: Transcriptomic Analysis of Diverse Rice Genotypes to Identify the Genes Controlling Cold Tolerance in Germinating Rice

**Abstract:** Rice germination and productivity is highly influenced by low temperature. The optimum temperature for rice germination is 30°C. Temperatures lower than 30°C is detrimental for germination and uniform plant stand. Germination of rice under cold temperature is slow and not uniform resulting in poor germination and irregular plant stand. The main objective of this study is to evaluate global expression of two contrasting rice phenotypes under cold stress and to identify key genes that play major roles and contribute to tolerance to cold germination using RNA-seq. Cold stress treatment was performed by germinating rice seeds in Petri dishes in a growth chamber maintained at 13°C. Results showed very highly significant differences in germination percentage and coleoptile length between the two genotypes under stress conditions. Samples for RNA-seq analysis were harvested from 7 days old germinating seeds under cold stress and normal temperature conditions. We identified 12,085 and 16,236 differentially expressed genes (DEGs) in tolerant and susceptible line, respectively.

**Among them, 7945 DEGs were common in both lines. Gene ontology analysis demonstrated that the differentially regulated genes mainly involved in cellular biosynthetic process, cellular metabolic process, cellular macromolecule biosynthetic process, cellular biosynthetic and translation process. Further analysis to identify the key genes that significantly contribute to cold tolerance in germinating rice seeds is underway. Authors: Ranjita Thapa, Rodante Tabien, Endang M. Septiningsih**

# Meetings of Interest Meetings of Interest

## **National Association of Plant**

**Breeders, NAPB** will hold their annual meeting at the University of Georgia, August 25-29, 2019. More information will be available soon at <https://www.plantbreeding.org>.

## **5<sup>th</sup> Annual Texas A&M Plant Breeding Symposium—21 February 2019**

Now accepting travel scholarships for graduate students to attend, speak, and present research posters. Symposium theme is “Plant Breeders, Assemble: how interdisciplinary teams are working together for crop improvement.”

Speakers will be **Dr. Jose Crossa**, statistician from CIMMYT; **Dr. Matt Rouse**, plant pathologist from UMN & USDA; **Dr. Robin Buell**, genomicist from MSU; and **Dr. William Rooney**, sorghum breeder from Texas A&M University.

More information at

<http://www.plantbreedingsymposium.com> or contact [pbsymposium@gmail.com](mailto:pbsymposium@gmail.com).

# Distance Plant Breeding at Texas A&M

## Distance Plant Breeding at Texas A&M

### **Available Courses**

**Spring Courses: January 14 – April 30, 2019**

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

- **High speed internet connection and updated browsers, including Internet Explorer and either Chrome or 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 2019**

**Plant Breeding Fundamentals – Full Course (3 Units) – Cost \$679.65**  
**January 14 – April 30, 2019**

**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 14—April 30, 2019**

**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 14 – February 18, 2019***

**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 29, 2019***

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 1 – April 30, 2019***

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](mailto: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 14 – April 30, 2019**

**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 14 – February 18, 2019***

***Unit 2 – Recombinant DNA and Cloning*      *Cost - \$226.55***  
***February 19 – March 29, 2019***

***Unit 3 – Sequencing Genomes and Other Genomic Tools*      *Cost - \$226.55***  
***April 1 – April 30, 2019***

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

**January 14 – April 30, 2019**

**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.**

**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](mailto:leann.hague@tamu.edu) or (979) 845-6148.**

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

*January 14 – February 18, 2019*

**Refresher course in host plant resistance breeding and selections.**

**Other Academic and Continuing Education courses in plant breeding and related disciplines that will be available during other semesters include Advanced Plant Breeding; Crop Production; Selection Theory.**

# 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](mailto:cwsmith@tamu.edu) or 979.845.3450.**