TEXAS A&M AGRILIFE RESEARCH | EXTENSION

TEXAS A&M UNIVERSITY

TEXAS A&M PLANT BREEDING BULLETIN

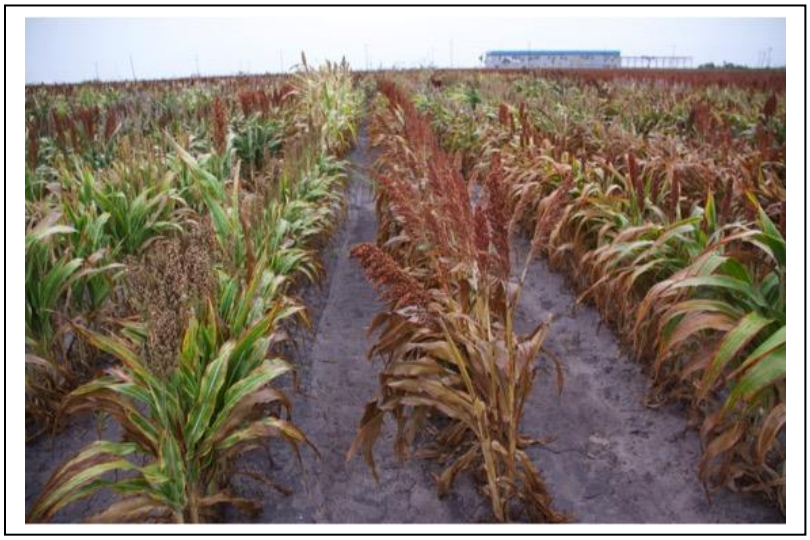
June 2016

Our Mission: Educate and develop Plant Breeders worldwide

Our Vision: Alleviate hunger and poverty through genetic improvement of plants

Congratulations to Dr. Chad Hayes

Dr. Chad Hayes, Sorghum Geneticist with USDA-ARS at Lubbock, is our first PhD graduate from our Distance Plant Breeding Degree Program. Chad graduated in May of this year. He worked with ARS in Lubbock while he was studying for his PhD degree through our distance program and was mentored by Dr. Bill Rooney, on-campus co-chair, and Dr. Gary Peterson (distance co-chair). Chad's research dealt with determining the value of two bioassays for the stay-green trait in sorghum. The following is extracted from his dissertation with only minor modifications.



Stay-green is an important agronomic trait in grain sorghum that contributes to higher and more stable grain yields under post-anthesis drought stress. It has also been credited with reduced lodging and increased disease tolerance due to improved general health of the plants through improved water use efficiency. Historically, breeders evaluate and select for the stay-green trait visually in the field with a rating system known as leaf and plant death rating (LPD). These LPD ratings are notoriously difficult to replicate, and require many environments for evaluation, primarily due to uncontrollable rainfall events, but also field variability for water holding capacity. Chad and his advisors recognized the need for a quick and reliable screening method to identify

the stay-green trait in breeding programs. Chad worked with 97 recombinant inbred lines derived from BTx642/TX7000. This population has been used in numerous studies dealing with the stay-green trait and thus is highly characterized. His study included four diverse locations: Weslaco, College Station, Lubbock, and Puerto Rico. The objectives of Dr. Hayes' research were to evaluate the efficacy of two lab-based bioassays for identification of the stay-green trait, those bioassays being quantum efficiency and leaf dhurrin content at anthesis.

Quantum efficiency relates to the conversion of incoming radiant energy to the photosynthetic capture of that energy. Quantum efficiency measurements made on leaf tissue were correlated with the standard evaluation technique of using leaf and plant death ratings. This bioassay did discriminate between the RIL parents, BTx642 and Tx7000, but the assay failed to identify differences in stay-green expression within the 97 RILs. Chad found this assay to be highly sensitive to minor variations in water stress and appears to only work effectively when plants are fully irrigated with no drought stress. Field conditions, especially in environments where periodic drought stress is common and field conditions are not managed extensively, produced erroneous results. Chad concluded that this assay could be useful for researchers that are interested in quickly identifying the phenotypic extremes of stay-green but only if the specific growing conditions mandated by the assay can be met.

The second bioassay was the quantification of leaf dhurrin content at anthesis. Dhurrin is a cyanogenic glucoside whose biological function is in doubt but is thought to be involved in prussic acid poisoning, etiolation, resistance to herbivores, and complex interactions with microorganisms. Leaf dhurrin at anthesis was quantified for each of the 97 RILs in this study and was found to be highly correlated with stay-green. Environment was the largest source of variation, much greater than genotype or replication.

Chad followed up the discovery of this association by QTL mapping of leaf dhurrin. A leaf dhurrin QTL (*Dhu1*) was discovered on SBI01. *Dhu1* was highly heritable and explained a large percentage of the variation of leaf dhurrin in this population. *Dhu1* is aligned with known genes involved in dhurrin biosynthesis and also aligned with a previously un-identified stay-green QTL (*Stg5*) in this linkage group, a finding consistent with previous studies identifying an association between leaf dhurrin and stay-green.

Dr. Hayes then used a diverse set of 10 breeding lines to verify the results obtained with the 97 RIL population. He evaluated these 10 breeding lines in four locations in 2014

for leaf dhurrin, leaf sugars and stay-green (LPD). Dhurrin was highly correlated with LPD rating from 2014 and all documented stay-green lines contained 2-3x higher dhurrin levels than senescent sorghums. Repeatability for dhurrin and LPD was high and GxE effects were relatively small, indicating that selection for high dhurrin is a good predictor for stay-green and that high dhurrin lines rank similarly when compared to low dhurrin lines, regardless of the environment.

Texas A&M University, AgriLife Research, and all of us involved in the Distance Plant Breeding Graduate Degree Program congratulate Dr. Chad Hayes as our first PhD graduate in the program and on his outstanding contribution to understanding stay-green in sorghum.

Congratulations

Dr. Steve Hague, cotton breeder at Texas A&M, on receiving the 2016 Crop Science Society of America Crop Science Teaching Award.

Dr. Sukumar Saha, USDA-ARS cotton geneticist and former TAMU graduate student, on receiving the 2016 Crop Science Society of America International Service in Crop Science Award.

The annual meeting of the National Association of Plant Breeders will be held in Raleigh, NC, 15 – 18 August. More information can be found at https://www.plantbreeding.org/annual-meeting-2016.

Distance Plant Breeding Program and Continuing Education courses available for Summer and Fall 2016 (https://scsdistance.tamu.edu/available-courses

Continuing Education Available Courses

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

Summer 2016: May 23 – September 2

Plant Breeding Fundamentals – Full Course (3 Units) – Cost $679.65
May 23 – August 26, 2016

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. Course topics: Botany and genetics; Evaluation of Populations; Manipulation of Populations; and Plant Breeding Systems.

Basic Plant Breeding - Full Course (3 Units) - Cost - $679.65
May 23 – September 2, 2016

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*
May 23 – June 24, 2016

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
June 27 - July 29, 2016
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
August 1 - September 2, 2016
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

Fall 2016: August 29 – December 16

Plant Breeding Fundamentals – Full Course (3 Units) – Cost $679.65
August 29 - December 16, 2016
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 29 - December 16, 2016
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 29 – September 30, 2016
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 3 – November 4, 2016
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 7 – December 16, 2016
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 29 - December 16, 2016

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 29 – September 30, 2016
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 3 – November 4, 2016
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 7 – December 16, 2016

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 29 - December 16, 2016

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 29 – September 30, 2016
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 3 – November 4, 2016
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 7 – December 16, 2016
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

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 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.