TEXAS A&M PLANT BREEDING BULLETIN

May 2015

Our Mission: **Educate and develop Plant Breeders worldwide**
Our Vision: **Alleviate hunger and poverty through genetic improvement of plants**

Meghyn Meeks recently completed her dissertation study under the direction of Dr. Ambika Chandra, Associate Professor-Turfgrass Breeding, Texas A&M AgriLife Research-Dallas, Department of Soil and Crop Sciences. Meghyn's dissertation study centered around the development of interspecific hybrids of Kentucky bluegrass and Texas bluegrass for the southern United States. Kentucky bluegrass is grown as a cool-season grass in U.S. home lawns and various sports turf venues. "However, environmental conditions such as prolonged periods of drought and heat as well as heavy shade often result in a loss of visual appeal, and early dormancy or death of the turf stand," according to Meghyn. Texas bluegrass, on the other hand, is a species of *Poa* that is native to and therefore well adapted to the southern climate. It possesses "important heat and drought tolerant characteristics but traditionally has served only as an uncultivated forage grass, with approximately 40,000 acres grown in Texas." This bluegrass does not have desirable turfgrass quality or seed trait characteristics, and, unlike other forage grasses, its dioecious nature requires close proximity of male and female plants for seed production. However, Texas bluegrass is interfertile with Kentucky bluegrass, providing the opportunity for the development of a hybrid *Poa* turfgrass with the desirable traits of both Kentucky and Texas bluegrasses.

Dr. Meeks had four objectives in her dissertation study on bluegrass. Her goals were to [1] develop new interspecific hybrid bluegrasses, [2] optimize a seed germination technique to maximize hybridization efforts, [3] use flow cytometry and molecular markers to identify hybrid progeny, and [4] evaluate the growth response and performance of hybrid bluegrasses maintained in shade. In 2012 and 2013, Meghyn made controlled pollinations among a number of *Poa* species,

including Kentucky and Texas bluegrass. Seeds from these crosses were germinated through two techniques that resulted in the successful establishment of 61 new interspecific hybrids. A higher percentage of individuals (89%) were recovered through germination on nutrient agar medium than soil. In addition to these hybrids, Meghyn lead the 2014 release of 'DALBG 1201' hybrid bluegrass (see Texas A&M Plant Breeding Bulletin October 2014), which was the superior genotype of 52 Texas x Kentucky hybrids developed by Dr. James Read in 2001.

Meghyn's use of flow cytometry verified that first generation hybrids between Kentucky and Texas bluegrass have an intermediate genome size to their parents. Her data showed variation in the nuclear DNA content in four hybrids of TAES 6012 x CS#4, ranging from 9.21 to 11.14 pg/2C, and she suggested that this variation could possibly be originating from some sort of chromosomal re-arrangements (duplications/deletions), loss of non-homeologous chromosomes, or simply due to random variation in the DNA content of the apomictic pollen parent. Her study revealed a wide variation in the nuclear 2C DNA content in 19 different genotypes of Texas bluegrass, possibly suggesting variation in ploidy levels within this species. Previous cytological research suggested that Texas bluegrass has ploidy levels of 6x (2n=42), 8x, and higher, but had not been demonstrated on a large set of germplasm.

Other work included the investigation of molecular markers to identify hybrids for early selection. It was determined that a thioredoxin-like gene (*trx*) could be used as a sequenced-based selection system. An additional *trx* allele was discovered to be specific for Texas bluegrass, and contained a large insertion characteristic of a miniature inverted-repeat transposable element (MITE), that may help elucidate the origin of this species. Meghan presented these results, along with the flow cytometry findings, in an oral competition at the 2014 ASA-CSSA-SSSA meeting in November where she received first place in the Turfgrass Science division by the Turfgrass Breeders Association.

One of the most sought after traits in the turf industry, probably second behind drought tolerance, is shade tolerance. Few plant species can be grown without some level of direct sunlight but homeowners, parks and recreation area developers, and the golf and sports field industry seek a turf type grass that can grow and maintain cover in partial to full shade. It has been estimated that 20 to 25% of established turfgrass stands are impacted by some type of light restriction. Both trees and grass cover provide erosion control and

reduced temperatures on sports fields, recreation areas, and residential and commercial buildings.

To evaluate shade tolerance, Meghyn used five interspecific Texas x Kentucky hybrids (three experimental lines plus cultivars ‘Reveille’ and ‘Thermal Blue’). These were compared with a shade tolerant standard tall fescue cultivar, a shade sensitive Kentucky bluegrass cultivar, and experimental CS#4 which is a shade tolerant ecotype of Kentucky bluegrass persisting for multiple years in a shaded environment in College Station, TX. Meghyn compared these genotypes under light environments of full sun, moderate shade, and heavy shade. Only the hybrid bluegrass cultivar DALBG 1201 released by Meeks et al. (Texas A&M Plant Breeding Bulletin October 2014) and an experimental line 5654 displayed acceptable performance under both moderate and heavy shade conditions and were comparable to tall fescue in turfgrass quality.

Congratulations to Dr. Meghyn Meeks for a terrific dissertation study and on receiving her degree in May 2015. Meghyn is currently employed as a Turfgrass Research Associate with Dr. Chandra at the Dallas Center. Her contact information is Meghyn.meeks@agnet.tamu.edu, (972) 952-9228.

Continuing and Distance Education in Plant Breeding at Texas A&M

Continuing education course modules in plant breeding and genetics, and related disciplines are available from Texas A&M University to clientele interested in gaining new information in plant breeding or simply seeking refresher courses. This program is

designed for individuals employed in private industry, CGIAR centers, government agencies, non-government organizations, and other agriculture professionals who need and desire additional knowledge and training in plant breeding but who are not interested in an additional academic degree. A professional certificate can be a part of this program. No campus visit is required. Course modules available for January through May 2015 are (https://scsdistance.tamu.edu/purchase/**):**

SUMMER 2015

Introduction to Plant Breeding Fundamentals – Full Course) – Cost $679.65
May 18 – August 28, 2015
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
May 18 – August 28, 2015

Unit 1 - Introduction to Basic Plant Breeding Cost - $226.55
January 20 – February 20, 2015
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 23 – April 3, 2015
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 6 – May 13, 2015
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.

FALL 2015

Introduction to Plant Breeding Fundamentals – Cost $679.65

August 31- December 18, 2015

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 31- December 18, 2015

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 31 – October 2, 2015
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 5 – November 5, 2015
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 9 – December 18, 2015
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 31- December 18, 2015

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 31 – October 2, 2015
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 5 – November 5, 2015
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 9 – December 18, 2015
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 31- December 18, 2015

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 31 – October 2, 2015
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 5 – November 5, 2015

Topics covered include: Split-plot and split-split plot designs, nested designs, variance analyses, interactions with years and locations, comparisions 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 9 – December 18, 2015
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.

Soil Fertility - Full Course (3 Units) - Cost - $679.65

August 31- December 18, 2015

Chemical and biological reactions in soils that influence nutrient availability to plants; environmental aspects associated with nutrient availability and fertilization, especially for nitrogen (N) and phosphorus (P). Topic covered include: introduction and historical background; plant essential nutrients, soil plant relations, calculations in soil fertility, soil acidity, soil nitrogen, soil phosphorus, potassium, calcium, magnesium, sulfur and the micronutrient elements.

Topic 1 – Introduction and Historical Background
Major contributions to soil chemistry and fertility. Introduction to soils and climate of Texas.

Topic 2 – Plant Essential Nutrients, Soil-Plant Relations
Plant available forms of nutrients, functions of nutrients in plants, types of soils where deficiencies might be anticipated, relative quantities required by plants.

Topic 3 – Calculations in Soil Fertility
Chemical notations, mole on a weight basis, mole on a charge basis, equivalents, ppm, concentrations of solutions, lbs/acre, kg/ha, lbs/1000 ft2, etc.

Topic 4 – Soil Acidity
Measurement and causes, active and reserve acidity, effects on nutrient availability and chemical properties, influence on plant grown, correction of, exchangeable Al, Al hydroxyl polymers, effective CEC

Topic 5 – Soil Nitrogen
Reactions of N in soils, N cycle, N gains and losses, biological N2 fixations, factors influencing availability, mineralization-immobilization, nitrification, NO-3 movement and groundwater contamination, eutrophication, NH4+ fixation, NH3 volatilization, denitrification, nitrification inhibitors, production of N fertilizers, acidification from NH4+ fertilizers, selection of N source potential environmental effects

Topic 6 – Soil Phosphorus
Phosphorus cycle, low uptake efficiencies – reversion in acid and alkaline soils, solubility product constants of reversion precipitates, solubility diagrams, influence of soil pH on P availability, method of application, production of P fertilizers, potential environmental consequences, eutrophication

Topic 7 – Potassium, Calcium, Magnesium
Potassium cycle, available forms, soil reactions, K+ fixation, mineral sources, factors influencing plant availability, fertilizer sources

Topic 8 – Sulfur and the Micronutrient Elements

Reactions of S in soils, S cycle, sources of S fertilizers, anticipated crop responses, reactions influencing availability of micronutrients in soils, pH effect chelates, extent of micronutrient deficiencies, correction of deficiencies.

Other Continuing Education courses in plant breeding and related disciplines that will be available during other semesters include Host Plant Resistance; 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.