TEXAS A&M AGRILIFE RESEARCH | EXTENSION

TEXAS A&M UNIVERSITY

TEXAS A&M PLANT BREEDING BULLETIN

August 2016

Our Mission: **Educate and develop Plant Breeders worldwide**

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

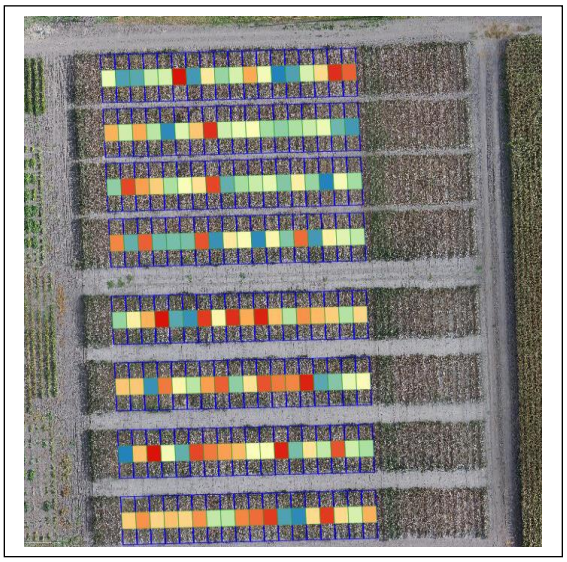
Cotton Breeders Visit A&M Breeding Nurseries

A cotton breeding field day was held at our Weslaco Research and Extension Center in the Lower Rio Grande Valley on 26 July. Several commercial cotton breeders attended the field day along with consultants and other Texas A&M AgriLife Research faculty. Activities consisted of presentations and discussions about the use of Unmanned Aerial Systems (UAS, also known as drones), high throughput phenotyping of cotton's growth and productivity, and advanced genetic material in Texas A&M AgriLife's cotton breeding programs for central and south Texas. Presentations and discussions were followed by a field tour of commercial varieties in the Official Variety Trial at the Weslaco Center and advanced upland cotton germplasm under consideration for release as parental germplasm or conventional cultivars from Texas A&M AgriLife.

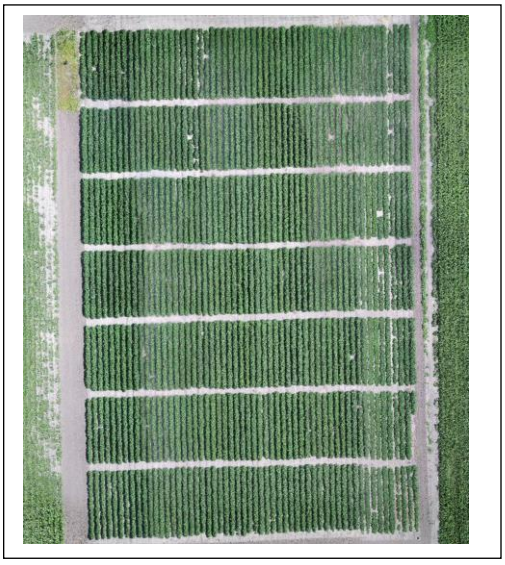
Juan Landivar, Resident Director of the Corpus Christi and Weslaco Research and Extension Centers, discussed his work with the use of UAS and remote sensing technology to assess the development of the cotton crop and identify yield potential of cultivars planted in conventional small plot performance trials. Juan noted that 2016 was the third year that he has been engaged in this area of research and that he was pleased with the progress of the project. His early efforts were with ground based platforms using sensors such as thermal infrared, NDVI, and ultrasonic mounted on a High-boy or chemical spray machine. From that meager beginning, Dr. Landivar has moved into UAS and developed a team consisting of Dr. Murilo Maeda and Andrea Maeda, Texas A&M AgriLife Research-Corpus Christi REC, Dr. Jinha Jung and Dr. Anjin Chang with Texas A&M University at Corpus Christi, Dr. Josh McGinty with Texas A&M AgriLife Extension at the Corpus Center, and Dr. Juan Encisco with Texas A&M AgriLife Research at the Weslaco REC. Juan's team currently is working with the cotton breeding and genetics group at College Station and Lubbock consisting of Jane Dever, Steve Hague, David Stelly, and Wayne Smith.

Dr. Landivar's team to date has been pleased with the use of plant height, canopy cover, NDVI, canopy temperature, and open boll counts from UAS platforms as predictors

of yield. In 2015, Juan's team divided standard small plots of upland cotton into one m^2 segments and assessed yield based on remote measurements from the UAS platform. The team also was able to accurately track canopy cover development and crop growth rates over the growing season. The technology used by the team in 2015 correctly identified the top yielding 9 entries (top 26%) in a 35 entry cotton variety trial. In 2016, Dr. Jung and others in the team have developed software that can count open cotton bolls from the aerial platform, a technology that hopefully will improve their yield prediction accuracy. A paired plot performance trial was established at Corpus using material from the AgriLife cotton breeding programs to test the accuracy of the new (and established) technology.



Low High
UAS estimated lint yield



Aerial photo of cotton variety trial

Dr. Steve Hague noted that his program centered around the development of high yielding varieties with drought tolerance and resistance to the cotton fleahopper and root-knot nematode. Steve shared data on three of his normal-leaf strains under consideration for release as conventional varieties and one okra-leaf strain that is early maturing and high yielding. These potential cultivars, his TAM 10X series strains, have high gin turnout and standard fiber packages with micronaire ranging from 4.3 to 4.6, fiber lengths from 1.11 to 1.16 inches, fiber bundle strengths in the low 30 grams per tex and excellent fiber length uniformity and elongation before break.

Steve noted that a former graduate student, Dr. Laura Ann McLoud, potentially identified the morphological mechanism of fleahopper resistance in upland cotton, i.e., a thickened carpel wall in susceptible-age flower buds that prevents the insect from penetrating the ovary with its proboscis. This discovery could make selection of more resistant plants easier, faster, and more accurate.

Smith noted strains in his program with variety potential that might be of interest to the commercial breeders and their programs as conventional varieties and also talked about elite quality parental material. Information was shared about our extra long staple upland (ELSU) and extra strength upland (ESU) lines that are near release as well as some information on lines that have been released. Some of the data presented by Hague and Smith are shown in the tables below.

One of the elite strains of Steve Hague (left) and a red leaf genetic marker genotype (right), Weslaco REC, August 2016.

Lint yield across seven locations as tested by the Cotton Improvement Lab of Texas A&M AgriLife Research in 2015.

Genotype	Weslaco	Corpus Christi	College Station (irr)	College Station (dry)	Thrall	Commerce	Chillicothe	Avg.
				lint lbs/a				
TAM X-63	1429	823	848	953	214	852	1277	914
TAM X-54	1493	1121	1050	825	215	898	1243	978
TAM X-78	1469	949	1087	976	229	947	1308	995
TAM 10 WG-11	1408	1067	791	1050	209	957	1387	981
TAM T-08	1169	788	705	678	183	557	1344	775
TAM Q-18	1709	1203	980	913	232	634	1130	972
PHY 499WRF	1406	1132	1126	1223	262	891	1114	1022

DP 1044 B2RF	1513	1046	1150	1010	248	620	1083	953
ST 4946 GLB2	1328	1265	911	901	300	781	1403	984
Mean of test	1429	983	1095	763	232	759	1251	
$LSD_{(0.05)}$	191	152	324	114	72	140	165	

Fiber and leaf traits from lines tested at Weslaco, TX, in 2015. The CCC loan rate was based on the 2015 schedule.

Genotype	CCC Loan rate	Micronaire	Length	Strength	UI	Elongation	Leaf Hair
	$	units	in.	g/tex	%	%	
TAM X-63	0.576	4.6	1.11	31.3	82.8	7.4	semi-smooth
TAM X-54	0.578	4.5	1.16	31.4	82.7	6.5	semi-hairy
TAM X-78	0.580	4.3	1.16	31.2	84.0	6.9	semi-smooth
TAM 10 WG-11	0.581	4.0	1.24	30.6	84.0	6.0	hairy
TAM T-08	0.583	4.1	1.32	32.4	84.5	6.7	hairy
TAM Q-18	0.578	4.4	1.18	30.5	83.9	6.7	semi-hairy
PHY 499WRF	0.580	4.7	1.14	31.4	84.7	8.1	semi-smooth
DP 1044 B2RF	0.563	4.7	1.10	29.5	83.3	7.7	semi-smooth
ST 4946 GLB2	0.576	4.9	1.14	30.7	83.8	8.1	semi-smooth
Mean of test		4.4	1.17	30.2	83.9	7.3	
$LSD_{(0.05)}$		0.3	0.05	1.9	1.3	1.0	

Performance of elite fiber quality upland cotton germplasm lines under irrigated or above average rainfall, 2013 – 2015

Genotype	Yield	Lint %	Micronaire	Length	Strength	UI	Elongation	# cmp
	lint #/ac	%	unit	in.	g/tex	index	%	
TAM 11 K-13	1172	35.7	4.2	1.36	34.9	85.1	5.5	6 loc-yr
TAM 11 L-24	1165	34.8	4.1	1.29	34.9	85.4	6.1	6 loc-yr
TAM 11 Q-56	1136	34.1	3.8	1.33	33.5	85.0	6.7	6 loc-yr
TAM 11 T-08	1060	35.3	4.0	1.32	36.0	84.8	6.6	6 loc-yr
TAM 11 U-96	1169	33.6	3.9	1.31	34.8	85.2	6.3	6 loc-yr
mean cks	1302	38.2	4.5	1.16	32.2	84.1	6.8	6 loc-yr

Performance of elite fiber quality upland cotton germplasm lines under severe drought, Corpus Christi, 2014

Genotype	Yield	Lint %	Micronaire	Length	Strength	UI	Elongation
	lint #/ac	%	unit	in.	g/tex	index	%
TAM 11 K-13	335	36.3	4.4	1.16	33.0	80.9	6.3
TAM 11 L-24	342	35.4	4.6	1.14	34.2	83.7	7.0
TAM 11 Q-56	321	35.1	4.1	1.15	33.7	83.3	6.7
TAM 11 T-08	312	34.3	4.4	1.15	36.2	83.4	7.3
TAM 11 U-96	363	34.2	4.4	1.10	33.8	81.5	7.0

mean cks	435	37.5	4.7	1.01	29.9	81.8	7.7

Meetings of Interest

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.

The annual meeting American Society of Agronomy-Crop Science Society of America-Soil Science Society of America will be held in Phoenix, AZ, 6-9 November. More information can be found at https://www.acsmeetings.org.

Distance Plant Breeding at Texas A&M

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

Continuing Education

Fall Courses: August 29 – December 16, 2016

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 2016

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 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.