TEXAS A&M PLANT BREEDING BULLETIN

October 2017

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

Cotton resistant to thrips--

Dr. Jane Dever, Cotton Breeder, Texas A&M AgriLife Research and Extension Center at Lubbock, TX recently released CA 4005 and CA 4006, upland cotton, *Gossypium hirsutum* L., germplasm lines having partial resistance to thrips, *Thysanoptera: Thripidae*. Co-developers were Dylan Wann, Mark Arnold, Megha Parajulee, and Heather Elkins, all with the Lubbock Research and Extension Center. Jane noted that Thrips are common pests of cotton worldwide, typically causing economic damage within the first few weeks after planting. While thrips can cause plant death, their primary impact on cotton is loss of the apical meristem and delayed maturity, both serious issues on the High Plains of Texas. With the recent loss of granular aldicarb from the U.S. market and resistance development to neonicotinoid insecticides, host plant resistance could play an important role in the integrated management of thrips pests. Both CA 4005 and CA 4006 were originally selected for early-season cold tolerance. However, these lines were both indirectly selected during the time period each year when thrips populations, and their subsequent effects on seedling cotton, are greatest on the Texas High Plains. Additionally, these lines appear to have to have thicker leaf cuticles, which could be associated with thrips tolerance, similar to a thicker outer epidermal layer in *G. barbadense* leaves.

CA 4005 originated as a single-plant selection of CA 1012 in 1997. CA 1012 is a breeding line that was developed for early-maturity and improved fiber quality by Levon Ray in 1964. CA 1012 was early-planted at Lubbock in 1997 with subsequent selections through 2005. The progeny row designated as CA 4005 was selected in 2006. CA 4006 was developed through standard pedigree breeding with 12 cycles of repeated selection in the cold tolerance nursery at Lubbock. It originated from a cross between Acala B1810 and Acala 1517-88 (Reg. No. 93, PI 511354).

Table 1. Agronomic performance and HVI fiber quality data of CA 4005, CA 4006, and three check cultivars across four site-year-locations in Texas from 2012 through 2014 are shown below.

Genotype	Thrips index 1=resistant	Lint yd Kg ha^{-1}	Mic units	UHML mm	UI index	Strength kN m kg^{-1}	Elong %
CA 4005	3.5 d	1311 a	3.6 b	28.7 bc	80.7 ba	304 c	7.9 b
CA 4006	3.6 cd	1194 a	3.6 b	29.8 a	81.8 ab	338 a	7.6 b
Atlas	6.3 a	1277 a	4.0 a	28.1 c	81.7 ab	315 bc	9.3 a
FM 958	4.3 bc	1295 a	3.6 b	29.0 b	81.9 a	321 a-c	8.1 b
FM 989	4.6 b	1309 a	3.5 b	29.3 ab	81.8 ab	328 ab	8.0 b

Mic=micronaire; UHML=upper half mean length of fibers; UI=length uniformity index; Elong=elongation of fibers before break

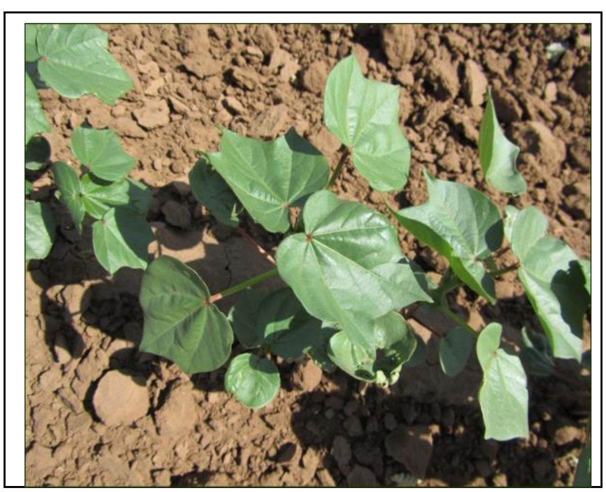

Figure 1. Thrips tolerant germplasm line (left) and thrips susceptible plants (right).

Cotton with improved fiber length and strength-- Wayne Smith and associates (Eric Hequet, Steve Hague, and Don Jones) released three germplasm lines of upland cotton (*Gossypium hirsutum* L.) possessing exception fiber quality. These germplasm lines were developed to assist commercial cotton breeders in improving the fiber quality of cultivars available to producers. These lines are designated as extra long staple upland (ELSU), extra strength upland (ESU), and/or long staple upland (LSU) phenotypes. One line, TAM 11K-13 ELSU will produce fibers with average length equal to those produced by pima (*G. barbadense* L.) when grown under irrigated conditions. TAM 11T-08 ELSU-ESU often produces average fiber length equal to the average length of pima and also expresses exceptional fiber bundle strength that exceeds that of upland cultivars available to U.S. producers, with the exception of some acala type cultivars. TAM 11L-24 LSU produces fibers with average length greater than most upland cultivars available to U.S. producers but shorter than that produced by pima cultivars. All three germplasm lines are valuable sources of fiber length that will allow dryland upland cotton producers in the U.S. to produce raw cotton that will not be discounted for short fibers.

Table 2. Performance of TAM 11K-13 ELSU, TAM 11L-24 LSU, and TAM 11T-08 ESU in the cotton cultivar trials at four locations with irrigation or ample rainfall in 2015.

Genotype	Lint yield	Lint percent	Mic	UHML	Str	UI	Elong
	kg ha^{-1}	%	unit	mm	kN m kg^{-1}	index	%
TAM 11K-13 ELSU	1111 a	34.9 c	4.1 ab	34.3 a	338 bc	85.2 a	6.1 d
TAM 11T-08 ELSU-ESU	1048 a	34.5 c	4.1 b	33.0 b	360 a	84.9 ab	6.9 c
TAM 11L-24 LSU	1109 a	35.1 c	4.3 ab	31.8 c	339 bc	85.2 a	6.4 cd
PHY 499 WRF	1344 a	42.3 a	4.7 a	28.2 e	327 cd	84.5 ab	8.5 a
DP 1044 B2F	1299 a	39.2 b	4.5 ab	27.9 e	294 e	83.2 c	8.8 a
FM 2484 B2F	1210 a	39.8 ab	4.2 ab	30.0 d	318 d	84.2 b	6.2 d

Mic=micronaire; UHML=upper half mean length of fibers; UI=length uniformity index; Elong=elongation of fibers before break

Table 3. Agronomic performance and fiber quality of TAM 11K-13 ELSU, TAM 11T-08 ESU, and four comparison cultivars when grown under severe drought at Corpus Christi, TX in 2014.

Genotype	Lint yield	Lint percent	Mic	UHML	Str	UI	Elong
	kg ha^{-1}	%	units	mm	kN m kg^{-1}	ratio	%
TAM 11 K-13 ELSU	375 c	36.3 b	4.4 b	29.5 a	324 bc	80.9 b	6.3 d
TAM 11 T-08 ELSU-ESU	349 c	34.3 c	4.4 b	29.2 a	355 a	83.4 a	7.3 bc
TAM 11 L-24 LSU	383 c	35.4 bc	4.6 ab	29.0 a	335 b	83.7 a	7.0 cd
DP 491	552 a	38.4 a	4.5 ab	26.2 bc	292 d	82.2 ab	6.7 d
PSC 355	487 a	37.8 a	5.0 a	24.6 c	279 d	80.4 b	8.2 ab
Tamcot 73	482 a	35.9 b	4.5 ab	25.9 bc	310 c	82.5 a	7.1 bcd

Mic=micronaire; UHML=upper half mean length of fibers; UI=length uniformity index; Elong=elongation of fibers before break

Figure 2. Left picture shows advanced breeding line (left) and standard check (right). Right picture depicts elite quality line (center) with other advanced stains.

Corn inbred lines for southern adapted hybrids—

Six inbred maize lines were released recently by Dr. Seth Murray with co-developers Kerry Mayfield, Jecob Pekar, Patrick Brown, Aaron Lorenz, Tom Isakeit, Gary Odvody, Wenwei Xu, and Javier Betran. Seth noted that Texas corn producers need maize (*Zea*

***mays* L.) hybrids with higher yield and better adaptation to the long growing season and multiple stresses found in the growing regions of Texas. Modern commercial inbreds and hybrids have been selected from temperate germplasm insufficiently adapted to Texas and other Southern U.S. environments. Maize inbred lines Tx741, Tx775, Tx777, Tx779, Tx780 and Tx782 were approved for release by Texas A&M AgriLife Research in early 2017. These lines were crossed with a variety of commercial testers and the resulting hybrids were grown at multiple locations over several years. Several hybrids from each line produced yields that met or exceeded those of current commercial hybrids. Furthermore, these lines and their hybrids had additional beneficial traits including high test weight, and reduced susceptibility to diseases (including southern rust (*Puccinia polysora*)) and aflatoxin buildup. Derived from unique tropical germplasm or tropical by temperate crosses, these inbred lines were selected under the high day and night temperatures that often cause heat and water stress in Texas. Compared to temperate genetics, some of these lines and their hybrids had reduced incidence of southern corn leaf blight (*Bipolaris maydis*) and lower susceptibility to lepidopteran insects. Both lines per se and their hybrids flowered a few days later than commercially available material and had some indications of photoperiod sensitivity. These lines broaden the genetic diversity of U.S. maize, are of immediate use in commercial hybrids and useful in breeding new corn lines and hybrids adapted to Southern US environments. Data from 2014 are shown below to illustrate these new inbred lines.**

Table 4. Hybrid performance of Tx inbred maize lines when crossed with various tester inbred lines in 2013.

Tx line	Hybrid yield	Time to anthesis	Time to silk	Plant height	Ear height	Percent moisture	Test weight
	T ha^{-1}	days	days	cm	cm	%	kg hl^{-1}
Tx741	10.12***	86*	88	213	75	12.6	75.3
Tx741	8.51**	88	89	221**	87**	12.8	76*
Tx741	8.48**	88	90	214	75	12.8	76.2*
Tx741	7.73	86***	88**	211	74	12.5	75.8
Tx775	9.03*	90*	92***	182*	65	12.5	72.3
Tx775	8.32***	88	89	211	79	11.7*	73.2**
Tx775	8.13***	87	88**	206	70	11.7*	71.6***
Tx775	7.46*	85***	87***	204	73	11.1***	72.2***
Tx775	7.63	88	89	201	73	11.9	72.4***
Tx777	9.41***	88	89	221**	80	12.3	73.7
Tx777	8.73***	87	88	211	71	12	73.6
Tx777	8.49	88	90	219	68	12.4	70.3***
Tx777	8.47***	89**	90*	215*	83*	12	73.2*
Tx777	7.55*	91***	91***	214*	73	12.1	72.6***
Tx778	10.75***	89	90	211	75	12.5	74.3
Tx779	8.58	87	87*	203	74	12.4	76.3**
Tx779	8.53**	88	89	203	76	12	75.2
Tx779	8.46***	89*	90	217**	83*	12.5	76.9***
Tx779	8.35*	94***	95***	203	92**	13.2	77.9***
Tx779	8.16**	89**	90	204	75	12.7	75.2
Tx779	8.14**	90***	91***	208	78	12	75.1
Tx779	7.93*	85***	86***	198	72	11.9	76.3**
Tx780	9.08***	88	90	211	83	11.8	71.8***
Tx780	8.87***	91***	92***	223**	92***	12.8	74.7
Tx780	7.8*	90***	91**	217**	76	12.8	73.9
Tx780	6.77	92***	92***	212	74	12.9	73.1
Tx782	7.72*	86*	89	203	68	12.1	72.9***
Tx782	7.38	88	89	215*	82*	12.9	76.6***
Tx782	7.28	89*	90	211	76	12.7	76.2***
Tx782	7.24	90***	92***	204	78	11.9	71.1***
Tx782	7.16	87	88	202	75	11.6*	75.4
Tx782	7.12	86***	86***	201	68	12.9	75.7**
Check	8.04	87	88	209	71	12.1	74.4

* ** *** significantly different from the overall mean at the 0.05, 0.01, and 0.001 level

Figure 3: Demonstration grow out of Tx777 (left side in both pictures), LH195 (right side in both pictures) and their hybrid (center in both pictures) in College Station in 2013. Plant heights were fairly typical for inbreds and hybrids in a late planting at College Station, TX (Left photo). The ears generated from this plot were open-pollinated (right photo); Tx777 had incomplete seed set and some ear rot on some plants, LH195 had poor seed set and ear rot on most plants, the hybrid had full seed set and remained clean. This poor seed set and ear rot is typical in Texas, especially when late planted where it is more susceptible to heat and water stress.

Meetings of Interest

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 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.