TEXAS A&M PLANT BREEDING BULLETIN

March 2018

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

Texas A&M AgriLife Research continues its commitment to the development of improved genetics of agronomic and horticultural crops as we all seek to combat what Dr. Borlaug called the "population monster." We are all aware that yield potential of our crops must increase if the planet is going to support 9,000,000,000 plus people in a few short years with sufficient quantities of healthful food plus feed, fiber, shelter, biofuels, and green space.

To this end, we continue to develop improved cultivars and germplasm lines. Drs. Amir Ibrahim and Gary Peterson, along with several colleagues, recently released improved germplasm of oat and grain sorghum.

TAMO 412 oat

Amir Ibrahim and associates recently developed and released TAMO 412 oat for production in Texas and across the Gulf Atlantic region. TAMO 412 is a late maturing winter oat (104 days) and was later maturing than Horizon 201, LA 99016, Gerard 224, and TAMO 411 (a similar maturing oat released by Texas A&M AgriLife Research) when averaged over 19 locations. Plant height of TAMO 412 averaged 101.3 cm which was numerically shorter than Horizon 201 (113.5 cm) but taller than Gerard 224 (96.7 cm) and TAMO 411 oat (96.1 cm). Averaged over seven to ten locations each year from 2014 through 2106, the grain yield and grain volume of TAMO 412 were similar to all check cultivars. Forage production across the 7 to 10 locations in each year indicated significant GxE but TAMO 412 produced forage yields similar to one or more controls each year.
TAMO 412 was released on the basis of its competitive grain and forage yield potential, good winter survival, and exceptional

resistance to both crown rust and stem rust diseases under natural field conditions at multiple locations across the Gulf Atlantic region of the United States. In the 2016 Uniform Winter Oat Yield Nursery across 6 locations, TAMO 412 had better resistance to both crown and stem rust than Gerard 224, Horizon 201, or TAMO 411.

Authorized seed classes of TAMO 412 in the U.S. will be Breeder, Foundation, Registered, and Certified. Breeder and Foundation Seed of TAMO 412 will be maintained by Texas AgriLife Research Foundation Seed Unit. Upon complete registration, small quantities of seed for research purposes may be obtained from the corresponding author for at least 5 yr from the date of this publication.
Some data from the release documentation are presented below.

Summary of winter survival, heading date, plant height and straw strength of TAMO 412 in the 2014 - 2016 Uniform Winter Oat Yield Nursery (UWOYN); includes data from Texas Oklahoma, Louisiana, Arkansas, Alabama, Georgia, Florida, and North Carolina.

Cultivar	Winter Survival (%)	Heading Date d after 1 Jan.	Plant Height cm	Straw Strength (1-9)
Gerard 224	76.9	99.1	96.7	2.8
Horizon 201	79.8	98.7	113.5	4.1
LA99016	53.4	98.4	105.5	3.9
TAMO 411	85.3	99.4	96.1	3.6
TAMO 412	89.0	103.8	101.3	3.5
Mean	58.5	99.9	102.6	3.6
CV%	20.7	2.4	6.6	58.3
LSD (0.05)	17.5	1.5	4.51	1.9
Location-years	9	19	18	10

Straw strength: 1 = erect and 9 = flat.

Resistance to crown rust of TAMO 412 and other oat cultivars in the 2016 Uniform Winter Oat Yield Nursery (0 resistant – 9 susceptible).

Cultivar	‡CIF	QFL	PGA	BLA	WLA	CAS	Ave. 6 loc.
	(0-9)						
Gerard 224	6.5	8.0	6.0	3.5	4.0	9.0	6.2
Horizon 201	7.0	7.0	4.0	4.0	2.0	4.0	4.7
LA99016	4.5	6.0	2.0	1.5	2.0	4.0	3.3
TAMO 411	7.5	8.0	3.0	1.5	2.5	7.0	4.9
TAMO 412	4.0	5.0	2.0	1.0	0.5	1.0	2.3
Mean	5.9	6.8	3.4	2.3	2.2	5	4.3
Location-years	1	1	1	1	1	1	6

† Scale of 0 to 9, where 0 = immune and 9 = highly susceptible.
‡QFL = Quincy, FL; CIF = Citra, FL; PGA = Plains, GA; BLA = Baton Rouge, LA; WLA = Winnsboro, LA; CAS = Castroville, TX.

Resistance to stem rust of TAMO 412 and other oat cultivars in the 2016 Uniform Winter Oat Yield Nursery (0 resistant – 9 susceptible).

Cultivar	BLA	WLA	CAS	Ave. 3 loc.
	(0-9)			
Gerard 224	0.5	0.0	9.0	3.2
Horizon 201	0.0	2.5	9.0	3.8
LA99016	0.5	0.5	8.0	3.0
TAMO 411	0.5	0.5	5.0	2.0
TAMO 412	0.0	0.5	1.0	0.5
Mean	0.3	0.8	6.4	2.5
Location-years	1	1	1	3

† Scale of 0 to 9, where 0 = immune and 9 = highly susceptible.
‡ BLA = Baton Rouge, LA; WLA = Winnsboro, LA; CAS = Castroville, TX.

Grain yield and grain volume weight performance of TAMO 412 in the 2014 – 2016 Uniform Winter Oat Yield Nursery.

Cultivar	Grain Yield kg ha^{-1}				Grain Volume Weight kg m^{-3}			
	2014	2015	2016	Ave.	2014	2015	2016	Ave.
Gerard 224	7764	5880	4822	6239	420	413	415	417
Horizon 201	7896	6024	4232	6124	407	409	370	396
LA99016	5865	5353	5031	5438	431	409	388	412
TAMO 411	7711	5560	4790	6121	445	412	411	426
TAMO 412	7360	5664	4961	6073	441	422	407	426
Mean	7319	5696	4767	5999	429	413	398	415
CV (%)	21	20	18	20	6	6	7	6
LSD (0.05)	1365	1279	822	679	21	31	29	15
Location-years	10	7	9	26	10	7	9	26

Average of 10 locations in 2014, 7 locations in 2015 and 9 locations in 2016. Locations included Prattville AL, Quincy FL, Plains GA, Baton Rouge LA, Winnsboro LA, Brooksville MS, Waynesville NC, Salisbury NC, Stuttgart AR, College Station TX, Prosper TX, Farmersville TX and McGregor TX.

New, Sugarcane Aphid resistant grain sorghum

In 2013, the Sugarcane Aphid (SCA) was reported in south and east Texas, southern Oklahoma, eastern Mississippi, northeastern Mexico, and central, northeast and southwest Louisiana. In 2015, the aphid was reported in 417 counties of 17 states in the United States and in 2016, it was reported in Arizona and California. SCA has thus been reported in all sorghum-production regions of the United States.

RTx3410 through RTx3428

Gary Peterson and associates developed and recently released 19 sorghum [*Sorghum bicolor* (L.) Moench] germplasm lines. These lines, designated RTx3410 through RTx3428 were developed and released based on their resistance to damage caused by the SCA. All lines were developed from biparental crosses and selected using the pedigree method of plant breeding. Resistance in RTx3410 through RTx3426 was identified after the SCA became a consistent pest of sorghum in the United States in 2013. To develop RTx3427 and RTx3428, crosses and selections were made in the Texas A&M AgriLife Research program at various Texas locations and seed

provided to collaborating scientists at the Botswana College of Agriculture at Sebele and the South Africa Agriculture Research Council – Summer Grains Institute (ARC-SGI) at Potchefstroom. Resistance to the SCA in southern Africa was identified in Botswana and South Africa. Resistance in the United States was confirmed in evaluations following identification of virulent SCA in 2013. All lines at seedling and adult plant stages express moderate to high levels of resistance to SCA. Resistance in RTx3412 to RTx3426 is derived either from Tx2783 or an early generation sib. Resistance in RTx3410, RTx3411, RTx3427 and RTx3248 is from unknown sources of resistance. The genetic relationship between the resistance gene(s) from the different sources is not known. The lines with potentially diverse sources of resistance provide the sorghum industry with diversity of elite germplasm with resistance to SCA.

Seed of the lines will be maintained and distributed upon request by personnel at the Texas A&M AgriLife Research and Extension Center, 1102 E. FM1294, Lubbock, TX 79403-6603. Seed will be distributed via a Material Transfer Agreement.

Some data from the release documentation are presented below.

Evaluation of damage by sugarcane aphid to 19 sorghum germplasm lines in greenhouse and field experiments, 2014 – 2106.

Line	GH 1†	GH 2‡	W 2014	CS 2014	CC#1 (aphids) 2016	CC #2 (aphids) 2016	LB 2016
RTx3410	2.70	3.00	5	5	2.50 (279)	7.00 (3413)	5.0
RTx3411	3.00	3.00	6	5	3.00 (723)	8.50 (8265)	5.0
RTx3412	1.78	3.40	5	6	3.00 (199)	6.50 (6728)	5.5
RTx3413	1.14	3.30	5	4	0.50 (12)	8.00 (1398)	5.5
RTx3414	1.50	2.40	5	3	2.50 (284)	9.00 (8750)	5.5
RTx3415	2.30	4.30	4	3	3.00 (295)	6.50 (7090)	5.0
RTx3416	4.10	1.40	5	3	3.00 (95)	6.00 (1092)	4.5
RTx3417	3.90	2.20	4	3	2.00 (214)	8.50 (6772)	5.5
RTx3418	2.50	2.90	1	6	2.50 (287)	9.00 (3862)	7.0
RTx3419	3.60	2.00	1	5	4.00 (164)	8.50 (4025)	3.5
RTx3420	2.67	2.10	1	.	2.00 (49)	5.00 (1632)	3.0
RTx3421	3.25	2.00	4	.	5.00 (730)	6.00 (7860)	8.0

RTx3422	3.20	6.00	4	.	2.00 (588)	6.00 (3124)	3.5
RTx3423	3.29	1.60	3	3	0.05 (2)	6.00 (372)	5.5
RTx3424	3.56	1.80	3	4	2.00 (49)	5.50 (3815)	5.0
RTx3425	3.43	1.00	6	4	2.00 (174)	9.00 (6875)	5.5
RTx3426	3.67	3.10	1	3	3.00 (268)	9.00 (6962)	4.5
RTx3427	2.50	1.80	1	4	1.50 (32)	3.50 (1972)	4.0
RTx3428	2.50	2.00	1	3	2.00 (193)	4.50 (2915)	2.5
RTx2783 (R ck)	2.50	2.50	4	4	2.00 (72)	8.50 (6820)	5.0
RTx7000 (S ck)	8.60	7.40	7	7	6.50 (1929)	9.00 (10425)	7.5
LSD (.05)	1.28	0.79			2.75	2.90	1.3

†Evaluated at the USDA-ARS, Stillwater, OK.
‡Evaluated at West Texas A&M University, Canyon, TX.
W=Weslaco, CC=Corpus Christi, CS=College Station, LB=Lubbock.

Meetings of Interest

Meetings of Interest

National Association of Plant Breeders, NAPB will hold their annual meeting at the University of Guelph, Ontario, Canada August 7 – 10, 2018. More information will be available soon at https://www.plantbreeding.org.

American Society of Agronomy and

the Crop Science Society of America's annual meeting will be in Baltimore, MD, November 4 – 7. More 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 Summer & Fall 2018 (https://scsdistance.tamu.edu/available-courses)

Continuing Education

Available Courses

Summer Courses: May 21 – August 31, 2018

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**
- **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 2018

Plant Breeding Fundamentals – Full Course (3 Units) – Cost $679.65
May 21 – August 31, 2018

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 21 – August 31, 2018

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 21 – June 22, 2018

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 25 – July 27, 2018

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
July 30 – August 31, 2018
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.

Fall Courses: August 27 – December 14, 2018

Fall 2018

Plant Breeding Fundamentals – Full Course (3 Units) – Cost $679.65
August 27 - December 14, 2018
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 27 - December 14, 2018

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 27 – September 28, 2018

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 1 – November 2, 2018

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 5 – December 14, 2018

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 27 - December 14, 2018

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 27 – September 28, 2018
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 1 – November 2, 2018
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 5 – December 14, 2018
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 27 - December 14, 2018

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 27 – September 28, 2018
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 1 – November 2, 2018
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 5 – December 14, 2018
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.

Intellectual Properties in the Plant Sciences - Full Course (3 Units) - Cost - $679.65
August 27 - December 14, 2018
This course introduces the major foci of intellectual property (IP) impacting plant sciences, including: 1) traditional vs. emerging knowledge economies, 2) governing U.S. statutes and international treaties, 3) forms of IP protection, and 4) IP asset identification, valuation, capture, and deployment towards an understanding of best practices for the development of effective IP strategies and management of IP portfolios.

Unit I - Introduction to Intellectual Property, International Treaties and Patents ***Cost - $226.55***

August 27 – September 28, 2018

Unit I of the Intellectual Properties in the Plant Sciences Course. Topics covered include: IP Culture and the Knowledge Economy, Traditional Knowledge vs. Biopiracy, Sui generis Systems, International Treaties, Overview of Patentability, Utility Patents, and Plant Variety Patents.

Unit II - Intellectual Property Documentation ***Cost - $226.55***

October 1 – November 2, 2018

Unit II of the Intellectual Properties in the Plant Sciences Course. Topics covered include: Trademarks, Copyrights, & Trade Secrets; USPTO; Inventorship, Ownership, Compensation, IP Training; Confidential Information; IP Audit; IP Value; Competitive Intelligence; Cyberspace – IP and IT Cooperation.

Unit III - Intellectual Property Transfer and Enforcement ***Cost - $226.55***

November 5 – December 14, 2018

Unit III of the Intellectual Properties in the Plant Sciences Course. Topics covered include: Intellectual Property Transfer and Enforcement, IP Case Studies, IP Portfolio, IP Strategy and Leveraging IP Value.

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.