Kolbyn Joy, right, won first place in the Cotton Improvement Conference speech contest, Trey Cutts, center, won second, and Rosa Jauregui, left, won third place. Each received a plaque and a cash award.

This month’s Texas A&M Plant Breeding Bulletin is a little longer than most because I’m focusing on eight graduate students from Texas A&M, plus one former graduate student in our program, who recently presented results of their research at the 2012 Beltwide Cotton Improvement Conference in Orlando, FL. Seven of these young men and women are Ph.D. candidates and two are M.S. candidates. Our future is in good hands.

Kolbyn Joy is a Ph.D. candidate and is on track to graduate in May, 2012. His presentation was entitled “Generation Means Analysis of Fiber Length and Fiber Bundle Strength Using Extra Long Staple Upland, Mutated Upland, and Interspecific Hybrid Germplasm.” Kolbyn’s coauthors were Wayne Smith, Steve Hague, and Don Jones. Kolbyn’s study concentrates on the breeding behavior and inheritance of fiber length and strength found in three distinct genetic sources, i.e., populations derived through [1] interspecific hybridization of *Gossypium hirsutum* and *G. barbadense*, [2] chemical mutation techniques, and [3] intraspecific hybridization within *G. hirsutum*. Kolbyn noted that “longer and stronger fibers are capable of producing stronger, finer, and thus more valuable and versatile yarns... which can withstand ever-increasing speeds during yarn and fabric manufacturing. A greater understanding of the genetic control of length and strength within each of these various genetic backgrounds in our program will aid breeders in determining the most efficient and effective breeding methodologies for improving U.S. cotton cultivars.” Additive and dominant gene action for both fiber length and fiber bundle
strength was significant in most populations. Populations derived with the interspecific hybrid parent exhibited more epistatic gene effects than populations derived using intraspecific parents or mutation-derived parents. As many as 30% of some F₂ populations in his diallel analysis of his five parental genotypes were positive transgressive segregates, i.e., exhibited fiber length and/or fiber strength greater than either parent. Kolbyn won first place in the student presentation competition based on his presentation, clarity and appropriateness of visual aids, and quality of research.

George (Trey) Cutts is a Ph.D. candidate directed by Jane Dever. His presentation in Orlando was entitled “Segregation Analysis and Improvement of Mutation-based Herbicide Resistance in Cotton (Gossypium hirsutum L.).” Trey’s coauthors were Jane Dever and Dick Auld. Trey is completing the second year of his Ph.D. studies directed at determining the number of genes and their gene action for resistance to imidazolinone herbicides in cotton. Dick Auld selected for such resistance following seed treatment with ethyl methanesulfonate (EMS). Trey noted in his presentation that “previous studies have indicated that tolerance is controlled by a partially dominant gene, but little is known about the gene action…segregation analysis studies have been initiated by selection of tolerant parental stocks and crossing these with an established cultivar.” Trey and Dr. Dever will have inheritance studies in the field in 2012 and 2013 that will include parents, F₂, and F₃ generations, parental efficacy trials, and parental equivalency trials that will determine if any other mutation events are evident in the imidazolinone resistant material. In a somewhat different twist for most plant breeding students, Trey will conduct a market analysis to determine feasibility, applicability, relative benefits, and pricing strategies of this potential new variety/herbicide system. “Plant protection and herbicide tolerance are vital components of modern plant breeding and it is necessary to understand the many associated problems that need to be addressed in cotton improvement. This project will help increase weed control options for producers.” Trey won second place in the student presentation competition based on his presentation, clarity and appropriateness of visual aids, and quality of research.

Rosa Jauregui, a Ph.D. candidate under the direction of Steve Hague and Keerti Rathore, won third place in the student presentation competition. Her research presentation was entitled “Introgression of the Ultra-low Gossypol Seed Trait into Elite
Cotton Germplasm.” Rosa noted in her presentation abstract that Keerti Rathore, at Texas A&M University, had developed cotton plants with normal gossypol glands in vegetative tissue but ultra-low gossypol (ULG) levels in the seeds, making those seeds suitable for human consumption. The objectives of her dissertation study are to [1] integrate this trait into elite germplasm, [2] develop techniques to improve breeding efficiency, and [3] measure performance of newly converted germplasm. Rosa and her colleagues used the backcross method to introduce the ULG trait from transgenic Coker 312 plants into four elite lines from the U.S. and two lines developed in East Africa. Rosa noted that “annual cottonseed production in the U.S. averages 6 million MT per year and approximately 1.5 kg of seeds are harvested for every kilogram of lint produced. For this reason, ultra-low gossypol cottonseed will be of substantial value for growers…we are faced with the challenge to feed nine billion people by 2050, while arable land areas decrease and crop yields are affected by severe weather conditions around the world. The availability of a crop that can be grown not only for its fiber but also as a food and feed source is of remarkable importance.” Rosa had converted lines in field trials at College Station, TX, in 2011. Preliminary results suggest the integration of ULG does not affect the production potential of the various genotypic backgrounds tested.

Ben Beyer, a Ph.D. candidate with Wayne Smith, presented research results entitled “Diallel Analysis of Three Confirmed Extra Long Staple Upland (ELSU) Cotton (Gossypium hirsutum) Lines.” Ben is in the later stages of his collegiate career and currently is completing his data analyses and dissertation writing for a May 2012 graduation. Ben reported, “In order for the U.S. to maintain its presence in the global economy, there must be improvement in fiber quality. Expanding the genetic base of upland cotton can be accomplished by utilizing primary germplasm resources from the national germplasm collection and upland cotton varieties from foreign countries…The basis of my research is identifying varieties from China and Africa that may contain alleles for further fiber length improvement in upland cotton beyond the extra long staple lengths currently found in our program at Texas A&M.” His research also includes three upland cotton lines from the USDA national germplasm collection that possess the extra long staple trait and determining if the genes for their fiber length are allelic to those responsible for the extra
long fiber length of TAM B182-33 ELS. Ben reported that among his set of parents that TAM B182-33 ELS and Ewings Long StapleXTidewater exhibited good combining ability for fiber length in both 2010 and 2011, while TAM B182-33 ELS was the better parent for enhancing fiber strength. Ben also has completed a line x tester analysis designed to determine combining ability of 37 cultivars from around the world, primarily China and Africa, with TAM B182-33 ELS to provide additional variation for fiber parameters.

Kendra Gregory is an M.S. candidate directed by Wayne Smith and Eric Hequet. She presented data entitled “Degree of Fiber Whiteness in World Upland Cultivars” with Wayne Smith, Eric Hequet, Ben Beyer, and Richard Percy as co-authors. In her abstract, she noted that cotton cultivars having whiter fibers are desirable due to decreased processing costs and because of environmental concerns. TAM B182-33 ELS germplasm line of upland cotton, and Tamcot CAMD-E, a short staple obsolete cultivar, were crossed with 36 cultivars representing unique germplasm pools from China (12 cultivars), west and central Africa (7 cultivars), south Africa (10 cultivars), and seven cultivars representing distinct germplasm pools within the United States. Kendra grew parents and F1s at College Station, TX in a line x tester design during the summers of 2010 and 2011. She harvested individual bolls by hand (to avoid the presence of trash particles in the lint that could bias the color measurements) within one day of boll cracking, followed by hand deburring and drying in limited light. Kendra commented, “It is preferable for textile manufacturers that whiter cottons are produced, since yarn and fabrics are the end products of cotton. The textile manufacturers should be able to save on bleaching agents and other finishing chemicals prior to dyeing, resulting in lower production costs and a more environmentally friendly product. It is possible that the marketing of “greener” textile products could be particularly favorable for textile manufacturers.” Kendra reported differences among the parents in her study for the degree of whiteness of fibers with an old cultivar from south Africa having the whitest fibers. She also reported that differences in general combining ability suggest that genetic improvement in the degree of whiteness is possible.
Ben Meritt also is an M.S. candidate who presented a talk entitled “Boll Maturation Time in Extra Long Staple Upland Cotton.” Ben’s coauthors were Camilo Morello, Kendra Gregory, Wayne Smith, and Steve Hague. When asked to describe this work, Ben wrote, “boll maturation (early maturity) has been a closely monitored characteristic of upland cotton (Gossypium hirsutum L.) in the U.S. throughout the twentieth century because it provides an escape mechanism from pests as well as allows adaptability to seasonal conditions. Long cotton fibers could, in the future, allow the U.S. (and Texas) to keep a competitive edge in an industry that is shifting toward international markets which more readily accept these longer fibers. The genotype used in this study, TAM B139-17 ELS, is an extra long staple line that has been observed to require a longer time to mature.” This work was conducted in 2010 by Camillo Morello, a visiting scientist from EMBRAPA in Brazil, and Ben completed the second year of data collection and analysis. His and Camilo’s results suggest that the longer season requirement of TAM B139-17 ELS is a result of a longer boll maturation period, i.e., the length of time from open flower to open boll. All other morphological measurements of maturation time such as node of first fruiting limb, days to first flower, and speed of floral initiation in this indeterminate plant were not different for the ELS genotype relative to the other upland genotypes in the study. Ben suggested that “reducing boll maturation period in the Texas A&M ELS material will be a challenge if the extra time is needed to achieve the extra fiber length.”

Eng Hwa Ng’s presentation was entitled “Crossing Elite Cotton Cultivars to Improve Fiber Elongation.” Eng is a Ph.D. candidate in Wayne Smith’s cotton breeding program and his paper was coauthored by Wayne Smith, Steve Hague, and Eric Hequet. Eng noted that “Over the years, there has not been significant efforts in improving fiber elongation of upland cotton, G. hirsutum in the U.S. due to a lack of high speed measurement technology. High Volume Instrument technology is the industry standard for measuring fiber properties worldwide but lacks consistency relative to fiber elongation. However, elongation is an important trait in fibers and yarns that results in more work to break.” Eng selected seven distinct upland
cotton genotypes with diverse genetic backgrounds that differed in elongation for his study. His analyses will include diallel analysis and generation means analysis (GMA) with this selected set of parents. While the High Volume Instrument machines typically are not calibrated for elongation, Eric Hequet has developed standards and the machine can be used to obtain repeatable measurements. However, the Stelometer is older and more reliable technology for elongation measurements but it can not be used to test as many samples per unit time. Thus, both machines are included in Eng’s study, the Stelometer in his diallel study and the High Volume Instrument in his GMA study. Eng reported that a strain from Jane Dever cotton breeding program in AgriLife Research at Lubbock and PSC 355 cultivar were the best parents among his parental set when breeding for elongation and that a high strength USDA-ARS strain developed by Bill Meredith at Stoneville, MS and one of Wayne Smith’s ELS lines were the poorest parents for this purpose.

Juliana Osorio-Marin is a Ph.D. student with Jane Dever. Her presentation was “Improvement of Cotton (Gossypium hirsutum) Fiber Spinning Quality through Selection and Inheritance of Fiber Elongation.” Juliana also is in the data analysis and dissertation writing phase of her collegiate career. Juliana commented that “Results from this project will lay the foundations for future efforts to breed new varieties with improved work-to-break. Improved work-to-break will result in lower fiber breakage when the fibers are submitted to mechanical stresses such as ginning, carding, spinning, and weaving. Thus development of new varieties with higher elongation will improve the quality and reputation of U. S.-grown cotton through reduced short fiber content and strength of yarn and fabric.” Juliana reported that the F₂ and F₃ generations in her study showed a wide range of variation for elongation (6.9% - 12.8% for the F₂ and 4% - 9.20% for the F₃), which allowed for divergent selection for populations exhibiting either low or high fiber elongation. She reported low correlation values between elongation and fiber strength in her populations, suggesting that breeding for lines with good strength and elongation might be possible. She added, “high correlations between F₂ and F₃ (r=0.7183) and between F₃ and F₄ (r=0.8762) for fiber elongation demonstrate that divergent selection is suitable, and should allow for the development of comparable lines with low and high
elongation to be tested in spinning processes. The ultimate result of my work will be better yarn quality and improved weaving efficiency, that will improve U.S. competitiveness.”

And finally, an Aggie who is now working on his Ph.D. with Peng Chee at the University of Georgia, Nino Brown, presented a paper entitled “Variable Effect of a Fiber Length QTL Deployed within Several Regionally Adapted Cultivars” I’m including Nino because he received his M.S. degree in Plant Breeding with me in 2010, and as he said, there’s no such thing as a former Aggie. Nino noted that “We are interested in quantifying and characterizing several individual QTLs previously identified that are highly correlated with fiber length and strength. Analyzing them within several genetic backgrounds lends robustness to the experiment, and could potentially provide us with excellent germplasm lines or even cultivars from Peng’s program.” Peng and his lab have determined that a QTL found in Sealand 883, G. barbadense, is commonly found within pedigrees of Pee Dee cultivars and germplasm and thus should be found in other current or obsolete American cultivars because Pee Dee germplasm has been used widely by cotton breeders. For his Ph.D. project, Nino is determining if this QTL results in the same expression or impact on fiber length when deployed in four distinct genetic backgrounds, Acala SJ-4, Paymaster HS-26, DP50, and GA-2004089 representing the arid Southwest, Texas High Plains, Mississippi Delta, and Southeastern growing region ecotypes, respectively. Nino reported on the background leading to his work and noted, “along with adding to our understanding of the diversity of our breeding materials, my work also might provide us with a diagnostic tool in deciding cross combinations in order to pyramid fiber quality traits. Fingers crossed.”

Other News

Reminder: The 2012 NAPB annual meeting will be held in Indianapolis, IN August 6-8. Reminders and additional information on the 2011 meeting will be noted in future Plant Breeding Bulletins.
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