

## Population development, selection, and evaluation for heat stress.

P67 (Project 67 is located field d22).

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The primary objective of this research is to identify/develop broadly adapted Acala and Upland improved cotton germplasm with potential heat stress tolerance, better fiber quality, and lint yield, broadening the genetic base of cotton.

### Summary:

Cotton is routinely grown in the hot, irrigated areas of the far Western U.S., and these extended periods of high temperature can reduce cotton (*Gossypium hirsutum* L. and *G. barbadense*) lint yield, even with adequate irrigation conditions. Extended periods of extremely high temperatures are common in these areas during the critical stage of peak flowering. When temperatures in the San Joaquin Valley reach temperatures above normal during the critical stage of peak flowering, California growers suffer the consequences of reduced yield by these cotton varieties weaknesses to heat. The number of cotton commercial varieties for California with heat tolerance is not really known. However, it is known that Acala varieties Maxxa and PhytoGen 72 yield poorly in the heat stress environment of Maricopa, AZ.

A cooperative project was initiated in 2003 with the goals of developing adapted elite cotton germplasm for the improvement of fiber quality with heat tolerance, and providing parental materials for the improvement of heat tolerance of Acala/Upland cottons. In 2003, 2004, and 2005 potential lines were evaluated for heat tolerance in replicated nurseries across locations (Maricopa, AZ, Tifton, GA, and Shafter CA). From this research, four cotton germplasm lines SJ-U86 (Reg. no. GP-868; PI 642414 and NSSL 441398.01) (Ulloa et al., 2006), AGC85 (Reg. no. GP-860; PI 641928), AGC208 (Reg. no. GP-861; PI 641929), and AGC375 (Reg. no. GP-862; PI 641930) (Percy et al., 2005) were developed by USDA-ARS and Cotton Incorporated and released in 2005, and SJ-U86 jointly released with the University of California in 2006. Germplasm lines originated from the cross of commercial cultivars 'FiberMax 958' and 'SG 248'. The pedigree of FiberMax 958 is CS6S/Siokra S-324 Sicala V-1, and the pedigree of SG 248 is Mo 89-117/'DP 5415'. The new upland cotton germplasm lines possess superior lint, fiber length, and competitive fiber strength under heat stress environments found in the Western U.S. The lines were selected on the bases of agronomic and fiber quality performance under heat stress tolerance across three different environments (CA, AZ, and GA). All four lines performed better than elite cotton cultivars grown commercially in side by side comparisons.

The primary reason for the release of the SJ-U86 line as an alternative germplasm choice was its significantly higher lint yield and higher lint percent when compared with those of well-known Acala high-quality cottons, with no overall sacrifice of fiber quality. In addition to its

superior performance in the San Joaquin Valley of California (2219 and 2416 kg ha<sup>-1</sup>), SJ-U86 performs much better in the heat stress environment of Maricopa, AZ, where Acala cultivars Maxxa (1363 kg ha<sup>-1</sup>) and Phytogen 72 (1583 kg ha<sup>-1</sup>) yield poorly. In the hot environment of Maricopa, SJ-U86 yields slightly less than its heat-tolerant parent, SG 248 (2071 kg ha<sup>-1</sup>), but with significant improvement in almost all fiber quality traits. This combination of heat resistance similar to SG 248 with fiber quality that matches Maxxa and Phytogen 72 suggests that SJ-U86 could be a source of improved heat resistance for California cottons. It might also serve as a source of improved fiber quality for heat stressed environments such as the low deserts of Arizona.

This year, 2006, again, we are participating in a cooperative project with the goals to continue the developing of adapted elite cotton germplasm for the improvement of fiber quality with heat tolerance, and providing parental materials for the improvement of heat tolerance of Acala/Upland cottons. Four genetically diverse populations (fiber quality and heat tolerance) were created using double crosses; advanced generation progeny are being evaluated for yield and fiber performance at different locations (AK, AZ, CA, LSU, MSU, SC, UC, and UGA). Early generation individual plant selection was performed at Maricopa, AZ under extreme heat conditions, and this year 74 progeny are being evaluated here at Shafter. The lines selected for advancement had fiber lengths that were generally superior or comparable to two Acala check cultivars.

#### **Reference**

Percy, R., May L., Ulloa, M., and Cantrell, R. 2006. Registration of AGC85, AGC208, and AGC375 Upland Cotton Germplasm Lines. *Crop Sci.* 46: 1828-1829.

Ulloa, M., Percy, R., Hutmacher, R.G, and Cantrell, R. 2006. Registration of SJ-U86 Cotton Germplasm Line with High Yield and Excellent Fiber Quality *Crop Sci.* (in press).

#### **ACKNOWLEDGMENTS**

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