BREEDING METHODOLOGY IN A QUALITY COTTON DISTRICT

John C. Palmer, H. B. Cooper, Jr.
John W. Pellow, and David M. Anderson
J. G. Boswell Cottonseed Breeding
Corcoran, CA

Abstract

Cotton varieties developed for the San Joaquin Valley Quality Cotton District must be tested and approved by the San Joaquin Valley Cotton Board prior to commercial release. Cotton breeders have developed schemes incorporating *concurrent* selection for yield and high fiber quality in order to compete successfully under this scenario.

Introduction

The San Joaquin Valley Quality Cotton District (originally the One-Variety Cotton District) was established in 1925 by the California Legislature, at the request of cotton growers. The purpose of the District was to provide the most marketable, highest quality, and most uniform cotton possible, in order to bring the best possible monetary return to growers. To date, the concept has been successful as cotton farmers within the District have received premiums of 3 to 8 cents per pound of lint above prices received by farmers in the remainder of the U.S. cotton belt. The program is administered by the twenty member San Joaquin Valley Cotton Board (SJVCB) which is comprised of growers, industry representatives, and government officials. It is funded by an assessment on cottonseed delinted for planting. In the District, new cotton varieties cannot be commercially released unless they have first been tested and approved by the SJVCB.

Testing and Evaluation of New Cotton Varieties by the SJVCB

The law requires the SJVCB to establish Acala and Pima quality standards for all cottons grown within the District. Currently, Acala Maxxa and Pima S7 are the standard varieties used for comparison in all field trials. Following three years of testing, varieties can be approved for release only if they meet the existing Acala or Pima quality standard and are superior in some meaningful respect. In evaluating new varieties, the Board considers fiber length, uniformity, strength, elongation, micronaire, seed quality, productivity, spinning quality, and resistance to disease, including Verticillium wilt, (34 properties in all). The three year testing procedure employed by the SJVCB is outlined in Figure 1. During the first year of testing, prospective new cotton varieties are evaluated in the Screenings Test at three locations in the San Joaquin Valley. Lint samples from all entries are sent to Starlab, Inc. in Knoxville, Tennessee where miniature-spinning data is collected. The top performers based on yield, fiber, and spinning quality advance to the Variety Test for an additional two years of testing at eight locations. Large scale spinning data, determined by the International Textile Center in Lubbock, Texas is obtained each year. At the conclusion of testing, Board members review all data and vote whether or not to allow commercial release of the candidate varieties.

Breeding Methodology

In order to develop new cottons under this scenario, unique breeding and testing schemes have evolved. The method developed by H. B. Cooper, Jr. is shown in Figure 2.

In year 1, advanced strains, introductions, collections, old varieties, race stocks, transgenic cottons, etc. are crossed via conventional pollen transfer. Approximately 150 upland parental combinations are crossed each year. Twenty crosses of each of these combinations are made. Seed from each combination is bulked and the F1 generation is grown without selection at a winter nursery in Tecoman, Mexico.

In year 2, F2 seed from each combination is bulked and planted in the San Joaquin Valley in four rows, 200 feet long. From this population, visually productive plants are selected. Fifteen boll samples from each selection are hand picked and ginned on 8-saw micro-gin stands. Lint percent, seed index, and seed grade data is collected. Selections having low lint percentages, small seeds, and/or very few linters (a possible indication of seed coat fragment problems) are usually discarded without further testing. Fiber from the remaining selections is then tested on individual instruments for length, uniformity, short fiber, strength, elongation, and micronaire. Lines with adequate fiber are selected for advancement. (High Volume Instrument (HVI) classing has been found to lack the requisite precision necessary for accepting or rejecting cottons and is therefore no longer used).

In year 3, F3 seed from each individual plant selection is planted in single rows, 60 feet long. This is referred to as the "plant-to row" method. From each visually productive row, the most productive plants are individually selected, hand picked, and ginned (usually 5 to 7 plants). Again, selections are screened for lint percent, seed index, seed grade, and fiber properties. As before, lines having the desired traits are selected for advancement.

In year 4, the same process of selection and fiber testing is repeated in the F4 generation. Approximately 15,000 individual F2, F3, and F4 plant selections are made each year.

In year 5, rows of F5 cotton plants have usually achieved sufficient homogeneity to be considered for bulking. Visually productive progeny rows are bulk harvested with

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1628-1630 (1997)
National Cotton Council, Memphis TN

a cotton picker equipped with a bagging attachment. The seed cotton from each progeny row is then ginned on a miniature gin line complete with an incline cleaner, an impact cleaner, a feeder, a 40 saw gin stand, a super jet cleaner, and one or two lint cleaners. This line is identical to a commercial gin except in scale. Lint yield and gin turnout data is collected. Fiber is again tested on individual instruments.

At this point, field evaluation of the most promising progeny rows begins. Lines exhibiting good yield potential and acceptable fiber properties are evaluated in replicated field trials at multiple locations by the scheme outlined in Figure 3. Cottons are evaluated initially in the Lines Test. The top performers based on yield and fiber data continue to the Preliminary Strains Test. The best cottons then progress to the Advanced Strains Test. At this point, small bales of lint from the most promising lines are sent to the International Textile Center for assessment of spinning performance.

During each year of field testing, seed increases of all entries are grown at a separate location to allow for increasingly larger scale testing and to prepare for possible commercial release. When seed stocks are deemed sufficient, promising lines may be entered concurrently in the SJVCB field testing program, previously described. Data collected through private field testing can be submitted to the SJVCB in support of variety release.

Throughout the entire process, germplasm is discarded if found deficient in any way. Computer spreadsheet programs, such as Microsoft Excel, have been very useful in sorting data. By selecting *concurrently* for high yield and superior fiber characteristics, it has been possible to improve both without sacrificing either.

Evidence of the success of this approach has been documented in Figures 4 and 5 (Bassett, 1994). In the San Joaquin Valley, yield has improved at a faster pace than in the U.S. as a whole. Likewise, fiber strength has improved at a faster pace in the San Joaquin Valley than in the Mississippi Delta despite substantial fiber improvement there.

Summary

Concurrent selection for yield and high fiber quality has enabled cotton breeders in the San Joaquin Valley Quality Cotton District to successfully develop superior yielding varieties with added value fiber. Growers within the District continue to enjoy premiums paid by spinning mills for these high quality cottons. Keen observation and exhaustive testing of yield and fiber quality is necessary throughout the process to identify cottons that possess all of the characteristics required for successful commercial release.

References

Anonymous. 1993. San Joaquin Valley Quality Cotton District. Laws and Regulations, Seed and Quality Cotton Program. California Department of Food and Agriculture.

Bassett, D. 1994. Personal communication. Department of Agronomy and Range Science, University of California, Davis.

	No. of Locations	No. of Entries	Testing Performed
Screenings Tests	3	34	Yield Fiber Properties Miniature Spinning
Variety Tests (Year 1)	8	15	Yield Fiber Properties Large Scale Spinning
Variety Tests (Year 2)	8	15	Yield Fiber Properties Large Scale Spinning

Figure 1. San Joaquin Valley Cotton Board Acala cotton testing scheme.

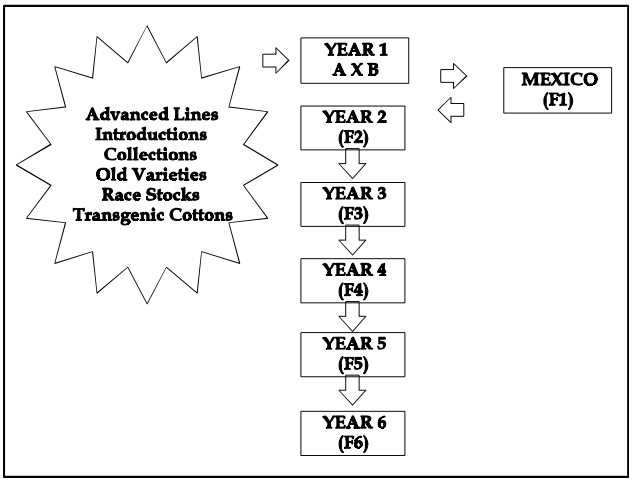

Figure 2. J. G. Boswell cotton breeding scheme.

	No. of Locations	No. of Entries	Testing Performed
Lines Tests	**2**	**40**	**Yield** **Fiber Properties**
Preliminary Strains Tests	**3**	**15**	**Yield** **Fiber Properties**
Advanced Strains Tests	**6**	**16**	**Yield** **Fiber Properties** **Spinning Properties**

Figure 3. J. G. Boswell Acala cotton testing scheme.

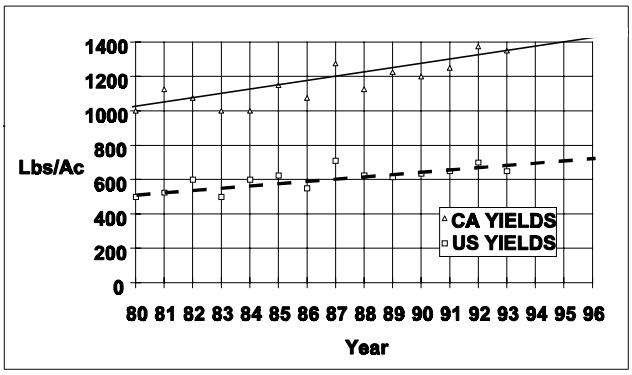

Figure 4. Cotton yield trends.

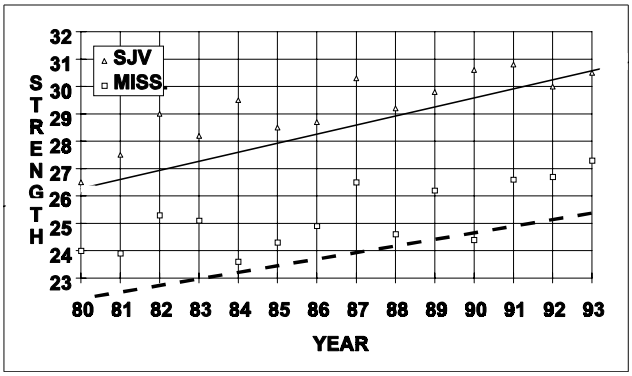

Figure 5. Changes in cotton fiber strength.