Relationships of Yield Component Variables to Yield and Fiber Quality Parameters

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RESEARCH PROBLEM

Increased yield and improved yield stability have been difficult traits to attain in a cultivar (Geng et al., 1987). Arkansas cotton production state averages have trended upward from 714 in 1999 to 1062 lb/acre in 2007 (Anonymous, 2008). During the same nine-year period, yields from the Arkansas Cotton Variety Testing Program fluctuated greatly among locations within and over years. Therefore, the upward trend in the state average yields may have masked a continued problem of yield stability among cultivars. These wide fluctuations suggest that strong genetic-by-environmental interactions are present that influence yield stability.

BACKGROUND INFORMATION

Lint percentage has long been used as selection criterion for improved lint yield. Lint percentage measures the relative proportions of lint and seed in seedcotton and is strongly influenced by seed size. Continued selection for increased lint percentage may have contributed to yield instability through the selection of smaller seeded lines. As early as 1908, Cook suggested lint index as a preferred selection tool over lint percentage (Cook, 1908). Lint index represents the grams of fiber per 100 seed. Selection for lint index will likely increase seed size since larger seed have greater surface area to produce fibers. Hodson (1920) recognized the importance of seed surface area and introduced lint frequency as a method of improving yield potential while reducing the influence of seed size. Lint frequency measures the grams of fiber of uniform length produced per square centimeter of seed surface area. Thurman (1953) expanded on previous findings with the introduction of lint density index. Lint density index measures the weight of fibers produced per 100 square centimeters of seed surface area. The search for appropriate selection criteria has continued to evolve, but has fallen short of the simultaneous improvement of lint yield and yield stability. A better understanding

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of the influence of fiber and yield components on lint yield could provide insight into yield stability.

**RESEARCH DESCRIPTION**

In an effort to improve selection methods, data from strain tests and irrigated and non-irrigated variety tests conducted in the University of Arkansas Cotton Breeding and Variety Testing programs were evaluated. Data were collected from 1999 through 2006 at four locations encompassing a range of 200 miles. Path coefficients from PathSAS were used to identify the direct effects and correlations of a model involving: lint yield; seed per acre; fiber density; seed yield; seed surface area; fibers per seed; seedcotton yield; seed percentage or lint index; lint weight per fiber; upper half mean length; and micronaire or uniformity index.

**RESULTS AND DISCUSSION**

Preliminary analysis indicated that seed per acre had the greatest influence on lint yield (0.86, 0.85, and 0.91) for the strain (Fig. 1), irrigated (Fig. 2) and non-irrigated (Fig. 3) variety tests, respectively. However, this trait exhibits low heritability and is highly dependent on environmental factors. Strain tests and non-irrigated variety trials proved to be poor representatives of true genetic relationships due to limited genetic diversity and moisture variability, respectively. The irrigated variety tests data indicated fiber density (0.17) had greater influence on lint yield than seed surface area (-0.02). Fibers per seed (0.68) had the greatest influence on fiber density, and lint index (0.69) had the greatest effect on fibers per seed. These preliminary data suggest that fiber density could serve as selection criteria for increased yield and stability.

**PRACTICAL APPLICATION**

The historical focus on lint yield improvement in breeding programs has encouraged decreased seed size and increased seed per acre. Although these traits have been shown to improve yield, they have been strongly influenced by environmental conditions and contributed to instability. The use of fiber density as a selection criterion could improve yield stability by improving the heritable traits that contribute to lint yield and minimizing the environmental influences. Ultimately, improved yield stability could lead to improved farm management by minimizing extreme fluctuations in net returns.

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Fig. 1. Direct effects and correlations on S5 and S6 strains from the University of Arkansas Cotton Breeding Program (1999-2006).
Fig. 2. Direct effects and correlations on V1 and V2 varieties from the University of Arkansas Cotton Breeding Program (1999-2006).

Fig. 3. Direct effects and correlations on V1 and V2 varieties under non-irrigated conditions from the University of Arkansas Cotton Breeding Program (1999-2006).