Stability of Cotton Varieties

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THERE is a popular concept that cotton varieties "run out" if seed from preceding crops is used for planting from year-to-year without roguing or selection. Organized communities for cotton improvement are set up with the basic idea that seed for general planting shall not be more than 2 or 3 generations removed from breeder's seed. Such rapid renewal of seed supplies may be justified if the organized community fails to comply fully with the production standards set up for isolation in the field and for prevention of seed mixture at the gin. However, with seed of well-bred varieties produced under conditions minimizing crossing or gin mixing with other sorts, there has been serious doubt whether measurable changes in varietal integrity occur in so few generations.

Moore (2) measured the influence of genetic change in a strain of upland cotton and found no difference in the length of fiber or its variability after 1, 2, or 3 years of either mass-selfing or open-pollinating when cross pollination or mixing with other varieties was prevented. O'Kelly (4) in a 10-year study of change within cotton varieties found a progressive increase in the proportion of naked seed in the later generations. There was also a progressive decrease in lint percent and boll weight, probably associated with naked seed. Changes in seed cotton yields and staple length were too small and variable to be evaluated in O'Kelly's experiments.

There is evidence that varietal integrity (1) (3) is not maintained under production systems now used in some organized one-variety communities but more information is needed as to the causes contributing to the so-called "running-out". When that becomes available, efforts can be directed more intelligently to the correction of practices now at fault. Information on the genetic phase of this problem has been obtained in experiments at Knoxville, Tenn. In these experiments, the extent of genetic changes in specific properties in advanced generations of cotton varieties have been measured.

MATERIALS AND METHODS

Four varieties were used in the Knoxville experiments, namely:

Coker 100-W'll— a commercial variety developed under open pollination and representative of seed sold by reputable breeders in the main Cotton Belt.

Acda 5675 and Empire 9—two varietal strains that had been maintained for five or more years by selection within self-pollinated lines. These strains should be fairly homozygous for all characters.

Cobalt—a cotton increased and maintained by selections in an F1 hybrid population. Such a variety would be heterozygous for many characters.

The above varieties were increased in 1946 in plots widely separated from other cotton. The seed cotton was harvested and ginned carefully to prevent any mixture with seed of other varieties. A portion of the seed of each variety was placed in reserve storage and the remainder was used to plant similar isolated increase blocks in 1947. This procedure was followed in each subsequent year until seed of five successive generations was obtained. No selecting or roguing was done in any of these multiplication stages. Thus, the reserve stocks represented seed 1 to 5 generations removed from breeder's seed, maintained free from outcrossing with other sorts in the field and free from mixture with other sorts at the gin.

The reserve seed stocks from each increase generation were used to plant a comparative experiment in 1951. A split-plot design with 36 replications was used. Varieties were grown on whole plots and "generations" were grown on sub-plots. Whole plots were randomized within each main plot. Sub-plots were single rows 22 feet long and 40 inches apart. The sub-plots (generations within varieties) were at randomized positions within the whole plots and the varieties were randomized within replications. Yields were obtained on the individual row units and seed cotton samples were taken on each unit for determining seed and fiber properties.

RESULTS

The principal genetic factors that determine the value of a cotton variety from the standpoint of the farmer are those that influence yield, boll weight, lint percentage, and fiber length. Data on these and other properties for the 1946 and 1950 generations of each variety are given in table 1. Data from the intermediate generations were included in the statistical analysis but were omitted from the table since they reveal no important trends.

Yield level was approximately 1,400 pounds of seed cotton per acre. The coefficient of variability for yield was 10.8%. The experiment was sufficiently precise to show highly significant difference in yield between varieties, but there was no significant difference in yield between generations either in the combined averages or within any individual variety.

The yields of the intermediate generations were above or below those obtained for 1946 and 1950 seed, but in no case was there a definite trend toward change in yield level in the different generations. The yield for all generations of the four varieties are shown graphically in figure 1. The horizontal trend in yield is typical of the results with the other properties measured in this experiment.

The experiment provided very precise tests for boll weight, lint percent, and fiber length, the coefficient of variation for these factors were 6.0%, 1.7%, and 2.4%, respectively. As with yield, however, significant differences were obtained only between varieties. In no case was there a significant change in any of these properties in the combined data or within varieties attributable to generation or "years-from-breeder".

Other genetic factors not of primary importance to the farmer but of interest to plant breeders were measured in this experiment. These included length uniformity, strength, fineness, immaturity ratio, lint index, and seed weight. There was no significant change in length uniformity, strength, fineness, or immaturity in any of the varieties during the 5-year period. There were significant differences in lint index and seed weight among genera-