Inheritance of Fiber Strength in a Cross between the Upland Cotton Varieties AHA 50 and Half and Half

F. W. Self and M. T. Henderson

HIGH tensile strength of fiber is important in cotton because of its association with spinning quality and strength of the fabric produced from the fiber. Practically all cotton varieties now being grown in the humid eastern half of the American cotton belt have comparatively weak fiber, and increased strength is one of the major objectives of cotton breeders in the United States. Strains of Upland cotton with high fiber strength have been developed recently in the western part of the cotton belt and are commonly designated AHA or Acala—Hopi strains. These strains were developed from hybridization between the well known Acala variety of Upland and a stock known as Hopi, because it has been grown by the Hopi Indians in the southwestern part of the United States. Hopi is now considered to be a form of *Gossypium hirsutum*, the species which also includes Upland cotton varieties. In the breeding of the AHA strains the Acala × Hopi hybrid was backcrossed once to the Acala parent.

The most promising of the AHA strains has been given the designation AHA 50. The exceptionally high strength of AHA 50 is apparently due to genes for strength contributed by both parents. AHA 50 is very unproductive in the eastern half of the cotton belt but has been used extensively as a parent in attempts to combine its high strength with high yielding ability for this region. Considerable difficulty has been encountered in accomplishing this combination, and a study of the inheritance of the fiber strength involved should be of value in overcoming these difficulties.

**REVIEW OF LITERATURE**

Despite the importance of fiber strength and the attention it has received in breeding programs, there have been few reports of actual experiments designed to provide information concerning the inheritance of this character. It has been the experience of cotton breeders that strength behaves as a quantitative characteristic, being governed by several pairs of genes and subject to a considerable amount of environmental influence.

Ware and Harrell studied inheritance of strength in *F₁*, *F₂*, *F₃*, first and second generation backcrosses of a cross between two Upland varieties. Strength was measured with the Pressley strength tester. The parents differed by approximately 1.0 Pressley index unit. It was concluded that the difference in strength was quantitative in inheritance, that there was essentially absence of dominance and that the means of *F₂* lines tended to resemble the phenotypes of the *F₁* plants from which they were derived.

Hancock showed that appreciable variation in strength occurs among individual plants and among bolls on a single plant through environmental influences alone.

**MATERIALS AND METHODS**

The study was made in *F₁*, *F₂*, and *F₃* populations between the high strength AHA 50 strain and the Half and Half variety, which was known to be low in fiber strength. Populations of the parents, *F₁* and *F₂*, were grown and tested for strength in 1951. *F₃* lines were grown in 1952. Seed used in planting both populations was obtained by controlled selfing of the parents. The populations of the parents were selfed progeny plants used in making the original cross. The *F₁* lines were used in a randomized block design with three replications per line.

All populations were harvested and tested for individual plants. The strength determinations were made with Pressley strength tester and results are presented as Pressley strength units—breaking strength in pounds per milligram of strength measurements were made in an air conditioned laboratory. Two lint samples of known strength index were used as a check on accuracy of the operator and the equipment. Strength determinations two breaks were made of each plant. If the indices from these two breaks did not differ by more than 0.3 unit, they were averaged in arriving at the Pressley plant. If the first two breaks differed by more than 0.3 unit, a third break was made for the plant and the two within the tolerance of 0.3 unit were averaged.

**RESULTS**

The results with the parents, *F₁* and *F₂*, are presented as frequency distributions in table 1. Plants of the Half and Half parent ranged from 6.5 to 7.8 Pressley strength units with a mean of 7.1. Plants of the AHA parent plants varied from 9.0 to 10.5 units and had a mean of 9.8. Since the parents had been selfed for several generations, the plant-to-plant variation within each population was presumably to environment. Thus, a considerable amount of variation, ranging from 1.0 to 1.5 units may be caused by environmental influences alone. The mean difference in the parents was 2.7 units.

The *F₁* was essentially intermediate between the parents although the mean, 8.2, was somewhat below the average of the parents.

A relatively large *F₂* population consisting of 480 plants was planted in 1952 and tested (table 1). The *F₂* population had a continuous range from 6.6 to 9.9 units, typical of quantitative inheritance. Probably all genotypes that can be gained by selfing of the *F₁* generation and tested for fiber strength are included in the *F₂* population. The first two breaks differed by more than 0.3 unit.

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