INHERITANCE of Fineness of Lint in Upland Cotton

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FINENESS of cotton lint is a factor in the spinning of fine yarns. This relation may be noted in Baines' (1) and in Scherer's (5) descriptions of hand manufacture of cotton in ancient India. Fineness, or silkiness, of cotton lint, along with great length, as found in Sea Island, Egyptian, or extra-long-staple Upland has been the basis of the fine-cotton spinning industry since the advent of the factory system. Supply of these long and fine cottons and their factory utilization in fine spinning were discussed at some length in a paper given at a meeting of the New England Cotton Manufacturers' Association by Kittredge (4) about 60 years ago. In short cottons, particularly in short-staple and medium-staple Upland, fineness was not given much consideration as a factor in facilitating finer spinning until about 25 years ago.

In 1936 Webb (6) demonstrated that Sea Island lint cut to the length of ordinary Upland cotton produced yarn that still possessed strength to about the same degree as derived from the long fine cottons prior to being cut. Strength of yarn, therefore, appeared to be more a result of fineness of lint than of length of lint. Webb also tested naturally short and fine-lint cotton from a primitive Arizona or Hopi Indian cotton, and from its F₁ population derived from a cross with Acala, an Upland variety. He found that remarkably fine and strong yarns could be spun from such naturally short and fine cottons. Modern spinners, however, generally prefer fineness of lint in an intermediate range rather than extremely fine or extremely coarse. Yarns from extremely fine lint are apt to contain more neps and, therefore, be rougher; and yarns from extremely coarse lint are likely to have less strength.

The identification and separation of the function of fineness of lint from that of length of lint in machine spinning was delayed because of time required to characterize fineness. Prior to 1940 fineness of lint was determined by measuring the lint-hair diameter, by taking the weight of the lint hair, or by cutting and weighing a unit of length of the lint hair and expressing in micrometers per inch. Such methods have been relatively accurate, but extremely tedious and slow. The first fast and reasonably accurate method was provided by the arealometer, an air-flow device designed and described by Sullivan and Hertel (7) in 1940. Fine cotton, compressed in an air chamber such as provided by the arealometer, offered more resistance to a current of air flowing through the fibers than coarse cotton placed under the same condition. Several other air-flow instruments have been fashioned and built since 1940. The one of this group used most in commercial work is the micronaire (6). The arealometer was modified to measure immaturity of lint as well as fineness of lint by Hertel and Craven (3) in 1951. The basis of measuring fineness itself also was revised and the numerical expressions changed to be read in whole numbers.

After Webb's announcement of the importance of fineness in short cotton much emphasis was placed on breeding this characteristic into such cottons. More crossing of Hopi and Upland varieties was done and several combinations of interspecies hybrids were exploited. Breeding for finer lint was accelerated with the establishment of a national cotton fiber testing service by the U. S. Department of Agriculture in cooperation with the University of Tennessee at Knoxville. The newly developed arealometer was installed in that laboratory along with other instruments for rapid measurement of some of the other lint properties. The testing service was utilized by most of the federal and state cotton breeders of the Cotton Belt of the United States, especially for the fineness determination.

Among some segregates involving hybridization of 4 Upland varieties (Farm Relief, Coker Cleveland 5-7, Stoneville 5, and Dixie Triumph 12) sent to the Knoxville laboratory in 1943 by P. H. Kime of the North Carolina Agricultural Experiment Station considerable plant variation in fineness was noted. Although breeders were considering shifts in lint fineness as breeding objectives, there was little evidence especially in Upland cotton that this property was under gene control. In this respect the Kime variants attracted interest.

MATERIALS AND METHODS

Seeds of 6 of the plants (sixth generation from the four-way cross) showing maximum arealometer fineness were obtained from P. H. Kime and planted in plant-to-row isolation at the Pee Dee Experiment Station, Florence, S. C. (branch of the South Carolina Agricultural Experiment Station, Clemson) in 1944. In this growth, 4 of the six 1943 plants were found to be intermediate and 2 were coarse variants. Also further growth of subsequent generations at the Pee Dee Experiment Station demonstrated that the lint of the four fine stocks continued to be fine and the lines relatively stable. Those identified, these fine lines were collectively designated as "Kime's Fine." While the fine lines were being developed, contrasting coarse-lint lines also were isolated out of other Upland varieties. Half and Half and Florida Green Seed already having relatively coarse lint, it was not difficult to further raise their lint-coarseness levels by special plant selection. The coarse lines, however, were shorter in length of lint. The Kime's Fine lines had lint length of approximately 11/4 inches; the Half and Half lines, about 3/4 inch; and the Florida Green Seed lines, about 3/8 inch. Half and Half was an old commercial variety always having very short lint and very high lint percentage (2). Florida Green Seed had strong-lint and seed of a bright pea-green color (8).

During the flowering season of 1944, crossing was carried out at the Pee Dee Experiment Station between plants of the Kime's Fine lines and plants of the Half and Half lines, and between the same or similar plants of the Kime's Fine lines and plants of the Florida Green Seed lines. The plants used as parents of the crosses also were self-polliinated in order to grow pure parent lines parallel with the F₁ hybrids the following year.

In 1945, F₁ hybrids of plants having satisfactory contrast of fineness and coarseness and lines from the parent plants thus involved were grown. The respective F₁ hybrids also were backcrossed to both of their parent lines. All plants used in the F₁'s and parent lines for backcrossing were self-polliinated. Self-polliination was