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Brief Articles

AN ASSOCIATION BETWEEN MALE STERILITY AND FIBER STRENGTH IN HYBRIDS OF UPLAND COTTON, *Gossypium hirsutum* L.[1]

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ABSTRACT

Backcrosses of cytoplasmic-genetic male sterility to Stoneville D_2 247, an experimental strain of Upland cotton *(Gossypium hirsutum)* showed a highly significant correlation between fiber strength (T_1) and male sterility. No such association between T_1 and sterility appeared in similar backcrosses to several widely-grown commercial varieties of Upland cotton.

VARIOUS combination of genes and cytoplasm which affect male-sterility have been transferred into Upland cotton (*Gossypium hirsutum* L.). An earlier paper presents a detailed discussion of gene-cytoplasm-environment interactions which determine the level of sterility in one typical group of hybrids[3]. A high degree of male sterility results from combining cytoplasm from *Gossypium anomalum* Tod., a gene or genes for sterility from a diploid species, and daily maximum temperatures above 90°F. Reciprocal hybrids with *G. hirsutum* cytoplasm remain highly fertile until temperatures approach or exceed 100°F; even under extreme stress conditions they rarely produce any completely male-sterile flowers. The heterozygous partially sterile segregates with *G. anomalum* cytoplasm were the female parents in each backcross generation of a program to transfer male sterility into several different commercial varieties and experimental strains of Upland cotton. In 1962 a small number of fiber samples was collected from fertile and partially sterile plants in segregating backcross progenies. The samples were tested at the U. S. Cotton Field Station, Knoxville, Tennessee. Although the number of samples was small, the tests indicated that the fiber properties were similar in the recurrent parent variety, the fertile segregates, and the partially-sterile segregates. The single exception was in backcrosses to the experimental strain Stoneville D_2 247[4]. The samples from partially-sterile plants in this case had T_1 values (fiber strength) strikingly higher than either the recurrent parent strain or the fertile segregates in the same progeny row.

In 1963 an experiment was designed to determine (a) if the high T_1 values recorded in 1962 would recur in 1963; (b) if high T_1 values in the D_2 247 backcrosses were associated with partial sterility and lower values with fertility; (c) if an association between sterility and fiber strength occurred in similar progenies with another recurrent parent.

In 1965 another experiment was caried out to determine (d) if extremely high T_1 values would occur in the highly fertile reciprocal backcrosses with cytoplasm from *G. hirsutum* L. Stoneville D_2 247.

Materials And Methods

The partially sterile plants tested in 1962 had *G. anomalum* cytoplasm; they were from the fifth backcross of Upland cotton (*G. hirsutum* L.) to a trispecies hybrid (*G. anomalum* Tod. × *G. thurberi* Wawra & Peyr.) × *G. hirsutum* L. M8. The M8 doubled haploid was the Upland parent for the first three backcrosses; subsequent backcrosses to Upland cotton were with 'Stoneville D_2 247,' an experimental strain with the D_2 Smoothness gene transferred into the Upland genome from *Gossypium armourianum* Kearney. The plants grown in 1963 were the third backcrosses to Stoneville D_2 247. The 1965 progeny rows were fifth backcrosses to this strain. They consisted of two sets of reciprocal backcrosses between Stoneville D_2 247 and single partially sterile plants with *G. anomalum* cytoplasm. The Stoneville D_2 247 and a selfed progeny row from a partially sterile third backcross plant were grown as controls in 1965.

Mean plant sterility scores were determined in 1963 by the methods described by Meyer and Meyer (1965). Mean plant sterility scores were not determined for the Stoneville D_2 247 material in 1965. The plants were classified as "fertile" or "partially sterile" on the basis of anther sterility approximately two weeks after maximum daily temperatures began to reach 95°F. Previous experience with plants with *G. anomalum* cytoplasm has shown (Meyer and Meyer, 1965) that plants heterozygous for male sterility become almost completely male-sterile at such times, but homozygous "fertile" plants remain highly fertile until field temperatures have become much higher.

Results

Both in 1963 and in 1965 fiber strength was higher for Stoneville D_2 247 plants classified "partially-sterile" than for those classified "fertile". Figure 1 presents the data for the 1963 backcrosses to Stoneville D^2 247 and Fig. 2 for backcrosses to M8. For the Stoneville D_2 247 progeny rows the correlation of − 0.17 between T_1 and Mean Plant Sterility Score is significant at the 0.01 level. The correlation of − 0.57 for the M8 progeny rows is not significant. Table 1 shows that the mean T_1 values for partially sterile plants in all of the progeny rows with D_2 247 as recurrent parent are significantly higher than those of the recurrent parent, the "fertile" plants in the same progeny rows, or any of the M8 selfed or backcrossed plant classes.

In 1965 plants were classified "fertile" or "partially-sterile" as described above. As in 1963, differences

Table 1. Ranked mean T_1 (fiber strength) values for plants classified "partially sterile" (S) and "fertile" (F) in backcross progeny rows with G. anomalum cytoplasm compared with the recurrent parents* Stoneville D_2 247 and M8.

Parent variety	Generation	Mean T_1 of plants classified† S	F		Parent variety	Generation	Mean T_1 of plants classified S	F	
D_2 247	BC_5	2.676		A	M8	BC_5	1.935		C
D_2 247	BC_5	2.531		A	D_2 247	BC_5		1.933	C
D_2 247	BC_5	2.526		A	D 247*	self		1.928	C
D_2 247	BC_5	2.490		A	M8	BC_5		1.913	C
D_2 247	BC_5		2.200	B	M8	BC_6		1.901	C
D_2 247	BC_5		2.027	B C	M8*	self		1.894	C
M8	BC_6	2.010		B C	M8	BC_5	1.852		C
D_2 247	BC_5		1.989	B C	M8	BC_5		1.841	C
M8	BC_5		1.980	B C	M8	BC_5	1.804		C
M8	BC_5	1.945		C	M8	BC_5		1.800	C

† Means followed by the same letter do not differ significantly at the 0.01 level of probability.

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[3] Meyer, V. G., and J. R. Meyer. 1965. Cytoplasmically controlled male sterility in cotton. Crop Sci. 5:444-448.

[4] I wish to thank Dr. C. W. Manning of the Stoneville Pedigreed Seed Company for supplying the seed of Stoneville D_2 247 used in this study. VGM

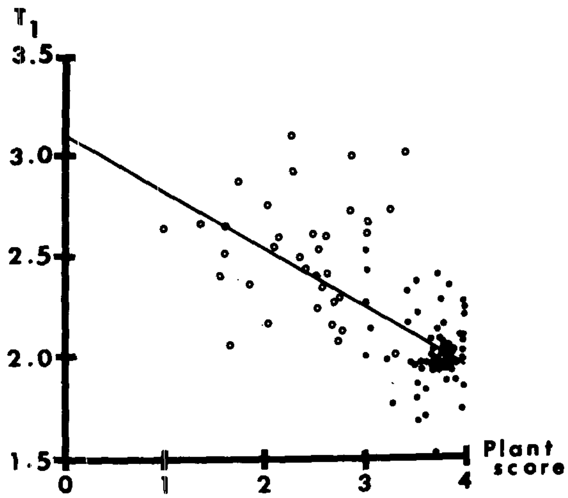

Fig. 1. Correlation of r = — .57** between fiber strength (T_1) and mean flower sterility score of plants in backcross progenies with the recurrent parent Stoneville D_2 247. Open circles = plants classified "partially sterile". Solid dots = plants classified "fertile".

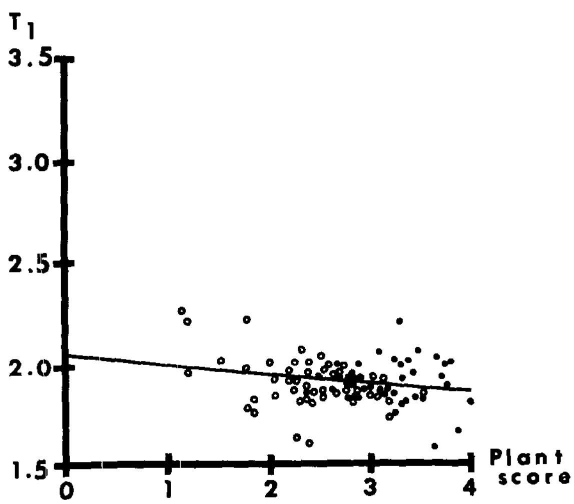

Fig. 2. Correlation of r = — .17 n.s. between fiber strength (T_1) and mean flower sterility score of plants in backcross progenies with the recurrent parent M8. Symbols same as in Fig. 1.

in fiber strength of these two classes of plants were significant at the 0.01 level of probability. At the time that bolls began to open, plants in the rows with *G. anomalum* cytoplasm appeared shorter than those with *G. hirsutum* cytoplasm. The F values obtained from analysis of variance of individual plant heights indicated that there were differences significant at the 0.01 level of probability between cytoplasms, and between "fertile" and "partially-sterile" plants in the same row, but no significant between-row differences not attributable to cytoplasm. There were no significant correlations within any of the plant classes of the reciprocal crosses or the controls, but the total backcross population, consisting of two sets of reciprocal hybrids, showed a significant correlation of — 0.4061** between T_1 and plant height. The backcrosses with *G. anomalum* cytoplasm had a correlation of — 0.4247**, while the correlatioin for the reciprocal crosses with *G. hirsutum* cytoplasm was non-significant (r = — 0.2882).

Discussion And Conclusions

The 1963 results for the D_2 247 material suggest that its male-sterility was associated with high fiber strength. These data raised the question: "Is the increased strength determined by genes linked with sterility, or does it result from a pleiotropic effect which produces sterility in anthers and strength in fibers?" The reciprocal hybrids with *G. hirsutum* cytoplasm were grown in 1965 to see if such generally fertile populations would produce any plants with unusually high fiber strength. These progeny rows produced five partially sterile plants. Even though such plants were far more fertile than the "partially-sterile" plants with *G. anomalum* cytoplasm, they produced enough sterile anthers and nearly-sterile flowers to prevent their classification as "fertile" plants. Four of these five plants had high T_1 values. Occurrence of abnormally high fiber strength only in the partially sterile plants favors interpretation of the data by assuming that the same physiological mechanism produces both sterility and high fiber strength.

Since this experiment was begun, a similar association between cytoplasmically controlled male sterility and fiber strength has been observed in two other experimental strains of cotton. 'Bobshaw Hi-Linter' and 'Del Cerro 169' differ strikingly from each other and from Stoneville D_2 247 in plant and fiber properties. However, the introgressive genes and cytoplasm from *G. anomalum* which produce male sterility also increase T_1 values in these varieties. No apparent association between fiber strength and male sterility has appeared in progenies from the other varieties used in test crosses: several strains of Acala; D_2 723; M11 doubled haploid; 'Deltapine 15,' 'Deltapine Fox 4,' and 'Deltapine Smooth Leaf;' 'Stoneville 5A,' 'Stoneville 7,' and 'Stoneville 3202.'

These data suggest that cytoplasmically controlled male sterility has little effect on plant and fiber properties of most varieties of Upland cotton. However, strikingly high fiber strength in segregating populations from interspecific gene transfer programs should be checked for association between fiber strength and male sterility.

CYTOLOGICAL EXAMINATION OF PANGOLAGRASS (*Digitaria decumbens* Stent) INFECTED WITH STUNT VIRUS[1]

S. C. Schank and J. R. Edwardson[2]

RESEARCH workers in several countries have reported a virus disease of pangolagrass (*Digitaria decumbens*) called stunt. This virus causes severe reduction in yield and has been reported in Fiji (1), British Guiana (2), Surinam (3), Taiwan (5) and Peru (6). The stunt disease is also believed to occur in other countries experiencing declines in productivity of pangolagrass pastures. The distribution of plant-

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