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Natural Crossing in Cotton (*Gossypium hirsutum* L.) in the Delta of Mississippi[1]

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ABSTRACT

The glandless trait was used to study the amount of natural crossing in cotton (*Gossypium hirsutum* L.) in the Delta of Mississippi. We sampled 102 hills of glandless cotton planted in fields of glanded cotton at 11 locations in 1972. Natural crossing varied from 0.0 to 5.9% and averaged 2.0%. There was only 0.2% natural crossing in the five Central Delta locations. These results indicate that in the Central Delta of Mississippi, cotton is essentially a self-pollinated crop.

Additional index words: **Cotton breeding, Genetic diversity, Isolation requirement, Variety maintenance.**

CROP-BREEDING procedures are determined largely by the amount of natural crossing. Cotton (*Gossypium hirsutum* L.) has been classified by most plant-breeding textbooks (1, 2, 6) as often being cross-pollinated. Allard (1) classified cotton as frequently having more than 10% cross-pollination, with ranges from 5 to 50%. Poehlman (6) reported that cross-pollination in cotton normally ranges from 5 to 25%. Loden and Richmond (3) reviewed the amount of natural crossing in cotton reported in 1950 and reported great variability in natural crossing, ranging from 1 to 81%. Most reports cited more than 10%. In 1952, Simpson (9) completed an extensive study of natural crossing in the cotton-growing areas of the United States. This study, which covered a 4-year period, reported ranges in regional averages of 10% in Central Texas to 39% in the southeastern United States. The average for this Mississippi Valley was 28%. In 1956, Simpson and Duncan (10) reported an average of 47% cross-pollination in Tennessee; in 1962, Richmond (7) reported a range of 24 to 40% crossing for four varieties of cotton grown at College Station, Texas. Sappenfield (8) reported a range of natural crossing from 1.0 to 32% in Southeast Missouri, with a 6-year average of 13.6%.

Since these reports were made, a great many changes in cotton culture have taken place, which might alter the amount of natural crossing. The objective of this study was to survey the amount of natural crossing in the Delta of Mississippi.

MATERIALS AND METHODS

The glandless trait was used to measure the percentage of natural crossing in cotton in the Delta of Mississippi. McMichael (4) suggested using the glandless trait for studying natural crossing. Later, he (5) reported that the glandless trait was conditioned by two recessive genes, gl_2 gl_2 gl_3 gl_3. Seeds produced by self-pollination on glandless plants are all glandless; seeds produced by cross-pollination of glandless females with glanded males will have glands.

Seeds of a glandless stock, BC_4F_4 of 'Stoneville 7A,' were planted in April and May 1972 at 11 locations. Individual hills of glandless seeds were hand-planted 26 m apart in a row of commercial cotton. At eight locations, the glandless seeds were planted at the same time as the normal cotton. At three locations, glandless seedlings grown in peat-moss pots were transplanted from the greenhouse to the field. In general, six hills were planted in each row. At seven locations, two rows were sampled. The two rows varied in distance from 35 m to 350 m apart. The exact numbers of rows and hills per location are indicated in Table 1.

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Table 1. Percentage natural crossing at 11 locations in the Delta of Mississippi.

Location	No. rows	No. hills	Mean $\bar{X}$ row	Mean $\bar{X}$ loc.
Delta Exp. Sta.	1	6	0.0	
	2	6	1.8	0.9
Stoneville	1	6	0.0	
	2	6	0.0	0.0
Indianola	1	6	0.0	
	2	5	0.0	0.0
Scott	1	5	0.1	0.1
Moorhead	1	4	0.0	0.0
Tunica	1	6	1.5	
	2	6	1.7	1.6
Sumner	1	6	0.2	
	2	6	2.2	1.2
Yazoo City	1	6	1.3	
	2	6	8.7	5.0
Batesville	1	6	10.7	
	2	6	1.2	5.9
Pritchard	1	5	3.4	3.4
Evansville	1	5	3.6	3.6
Total	18	102		
Average			2.0	2.0

Table 2. Analysis of variance for natural crossing.

Source	df	Mean square
Locations	10	89.65
Rows within location	7	64.86
Location + rows	17	79.44**
Hills within rows	84	34.92

** Significant at the 1% level of probability.

The glandless hills were harvested shortly before first harvest at 10 locations. At Moorhead, the cotton was mechanically harvested before the glandless samples could be taken. The observations for that location were taken from the second harvest.

A sample, usually consisting of 200 seeds, was taken from each hill and soaked in 25 C water for 24 hours. The seeds were then cut with a razor blade, and their glanded status was determined. A total of 18,542 seeds from 102 hills was sampled. Percentage of glanded seeds was computed for each hill.

RESULTS AND DISCUSSION

The average natural crossing at 11 locations was 2.0% (Table 1). The first five sites indicated in Table 1, which are located in the Central Delta, averaged 0.2% natural crossing. About 50% of the cotton planted in the United States is from cultivars produced from breeding programs in this area. The average natural crossing for the other six locations was 3.5%. These results are considerably lower than those previously reported (3, 7, 8, 9, 10). They indicate that, in the Delta of Mississippi, cotton is essentially a self-pollinated crop.

The analysis of variance (Table 2) indicates that natural pollination was quite variable. The coefficient of variability for hills within a row was 295%. The ranges were from 0 to 41.1%, 0 to 10.7%, and 0 to 5.9% for all hills, rows, and locations respectively. Simpson and Duncan (10) reported that bumble bees (*Bombus* spp.), the principal vectors of cotton pollen, are systematic in their visitation to cotton flowers. The bees move from one flower to another before flying out of the field. This would tend to make natural pollination high in the areas the bees visited, but it would be zero in those not visited and would account for the large variance detected among hills. The frequency distribution given in Fig. 1 indicates a very skewed distribution toward zero crossing. There were 70 hills that had no crossing, 18 with from 0.1 to 3.0%, and the remaining 14 with more than 3.0%.

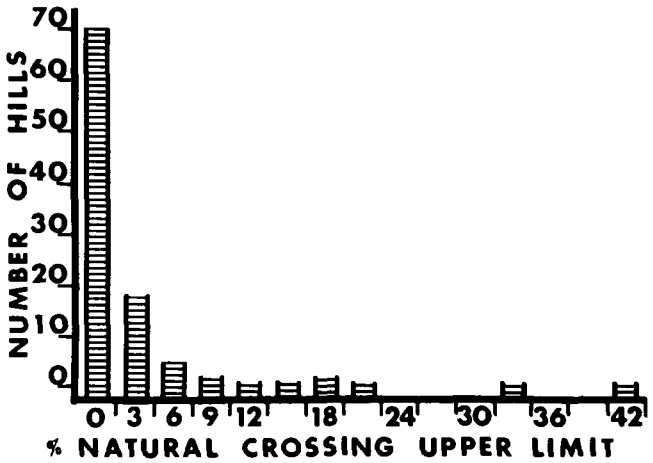

Fig. 1. Frequency distribution for percentage of natural crossing.

Considerable changes in cotton culture and its environment have taken place since earlier studies were reported. Two of these changes are probably most responsible for the low rate of natural crossing. First, considerable land clearing of wooded areas around cotton fields has taken place. Thus, the natural habitats of the principal insect pollinators, bumble bees, have in many places been destroyed. A second factor is that cotton in the Delta of Mississippi receives a large number of insecticide applications.

The low rate of natural crossing (2.0%) has several practical implications for breeders and seed-maintenance programs. Self-pollination would, in general, result in more homozygous varieties. Greater homozygosity would reduce the opportunity for heterosis to be expressed and also reduce the opportunities for recombinations. Under self-pollination, the genetic variability within a variety would also tend to be less than that where frequent crossing occurs. If past isolation requirements were established with regard to the higher rates of crossing, these results would imply that isolation requirements could be reduced.

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