Published July, 1964

Inheritance of a Mutant With a Rudimentary Stigma and Style in Pima Cotton, *Gossypium barbadense* L.[1]

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IN 1960 two aberrant plants, identical in appearance, were observed in an experimental strain of Pima cotton, *Gossypium barbadense* L. The abnormal plants had small, shrivelled, and empty bolls with sunken tips, indicating sterility. These plants were pruned and transplanted to the greenhouse where subsequent observations revealed several floral abnormalities. The stigmas and styles were dwarfed and did not emerge from the androecium (Figure 1). The ovaries contained a normal compliment of ovules, but non-emergence of the stigma prevented pollination. The plants had, in addition to rudimentary stigmas and styles, corollas that did not fully open and petals that were corrugated rather than smooth. The pollen from the abnormal plants appeared normal. The inheritance of this association of characters found in the aberrant (mutant) *G. barbadense* plants is reported herein.

A complex of floral abnormalities and sterility similar to that described in this paper was reported in a strain of *Gossypium herbaceum* L. by Iyengar (1). Vijayaraghavan et al. (4) found that the abnormal development of the stigma and style, with resultant female sterility, and associated characters in *G. herbaceum* was conditioned by one

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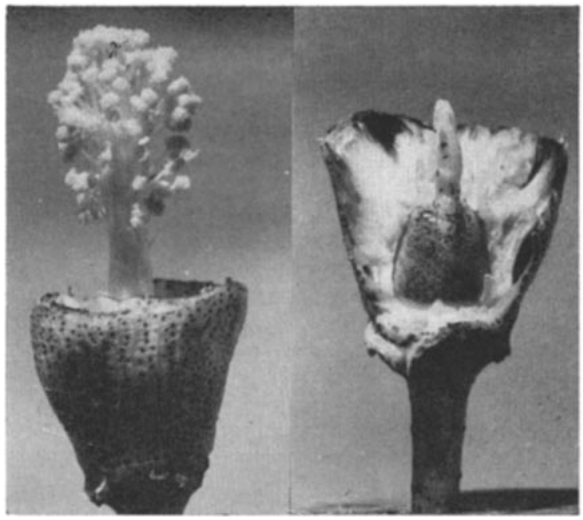

Figure 1. Left—Flower of the *G. barbadense* mutant, with corolla removed, on the day of anthesis showing non-emergence of the stigma and style from the androecium. Right—Flower of the same *G. barbadense* mutant with corolla, androecium, and part of the calyx removed showing the rudimentary stigma and style.

recessive factor pair. Vijayaraghavan et al. assigned the symbol *stg* to the gene conditioning the abnormal phenotype, the abnormal plants having the genotype *stg stg*.

MATERIALS AND METHODS

Stigmas on the two aberrant plants were exposed by dissection. Complete female sterility was shown by the failure of numerous attempts to produce seed on the aberrant plants by self-pollination and cross-pollination. Crosses were made between the aberrant plants and 'Pima S-2' by using pollen from the aberrant plants. 'Pima S-2' is the current commercial variety of *G. barbadense* and has a normal stigma and style. An F_1 population was grown at the tropical cotton breeding facility, Iguala, Gro., Mexico, and selfed to produce F_2 seed. Also a few F_1 plants were grown in the greenhouse and backcrossed to the abnormal phenotype and to 'Pima S-2'. All F_1 plants appeared normal.

An F_2 population composed of families from four F_1 plants was grown in the field in 1962 and scored for normal and mutant plants. Several normal F_2 plants were selfed to produce seed for F_3 progeny tests. Mutant F_2 plants were female sterile and could not be selfed. F_3 and backcross plants were grown in 6-inch pots in the greenhouse in the winter of 1962–63 and scored for normal and mutant plants. Classification of mutant plants was possible several days before the flowers opened because of the unique external appearance of the mutant's developing bud. This classification was verified by dissecting the flowers and observing the sunken ovary tip and rudimentary stigma and style.

EXPERIMENTAL RESULTS AND DISCUSSION

The numbers of normal and mutant plants in the F_1, F_2, and backcross populations are presented in Table 1 along with the appropriate Chi-Square analysis.

All F_1 plants had a normal phenotype. Each of the 4 F_2 families segregated in a ratio of 3 normal:1 mutant. A Chi-Square test for heterogeneity of the F_2 families was not significant.

The backcross of the F_1 to the mutant segregated 1 normal:1 mutant. The reciprocal backcrosses of the F_1 to normal 'Pima S-2' produced all normal plants.

Eighteen F_3 lines from normal F_2 plants were scored. Eleven F_3 lines segregated normal and mutant plants. The segregation ratios did not differ significantly from 3:1 for any of these F_3 lines. Seven F_3 lines did not segregate.

Table 1. Classification of *G. barbadense* plants from F_1, F_2, and backcross populations involving a rudimentary stigma and style mutant and Pima S-2.

Population	Number of plants			χ_2	P
	Normal	Mutant	Total		
F_1 (Pima S-2 × mutant)	27	0	27		
Expected 3:1					
F_2 (Pima S-2 × mutant) Family 1	131	40	171	0.24	.7-.5
F_2 (Pima S-2 × mutant) Family 2	107	42	149	0.81	.5-.3
F_2 (Pima S-2 × mutant) Family 3	137	35	172	1.98	.2-.1
F_2 (Pima S-2 × mutant) Family 4	122	40	162	0.01	.95-.9
Pooled F_2	497	157	654	0.34	.7-.5
Heterogeneity				2.69	.5-.3
Expected 1:1					
BC (Pima S-2 × mutant) × mutant	131	107	238	2.42	.2-.1
No segregation expected					
BC (Pima S-2 × mutant) × Prima S-2	55	0	55		
BC Pima S-2 × (Pima S-2 × mutant)	233	0	233		

The mutant plants expressed all the floral abnormalities to approximately the same degree in the F_2, F_3 and backcross generations. The normal plants showed no floral abnormalities in the F_1, F_2, F_3 and backcross generations. These observations indicate that the complex of characters described previously is inherited as a group and its expression is controlled by a single gene.

The possibility cannot be ruled out that this mutant in *G. barbadense* and the one previously described in *G. herbaceum* (1, 4) may be the same. This would be possible if the same locus mutated in the A genome of *G. herbaceum* and in the A genome of *G. barbadense* which is a tetraploid with an A and a D genome. Unfortunately, the *G. herbaceum* mutant is no longer available[3] so that allelism tests could not be made between the one reported herein and the one in *G. herbaceum*.

The symbol *stg* was assigned to the mutant gene conditioning the complex of characters in *G. herbaceum* (4). This symbol was also suggested by Knight (2) for a female sterile mutant reported in *G. hirsutum* by Stroman (3). We propose that the symbol *rs* be assigned to the gene in *G. barbadense* which conditions the mutant expression. Normal plants would have the genotype *Rs Rs* or *Rs rs* and mutant plants would have the genotype *rs rs*.

SUMMARY

A new mutant in *G. barbadense* is conditioned by one homozygous recessive factor pair. The mutant affects the development of the corolla, stigma, style, and boll. The mutant plants are completely female sterile. Pollen fertility is normal. The authors propose that the gene symbol *rs* be assigned to the allele conditioning the mutant expression.

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