THE GENETICS OF FLOWERING RESPONSE IN COTTON. V. FRUITING BEHAVIOR OF *GOSSYPIUM HIRSUTUM* AND *GOSSYPIUM BARBADENSE* IN INTERSPECIFIC HYBRIDS[1]

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PREVIOUS reports on the genetics of flowering response in cotton have dealt with intraspecific hybrids. The purpose of this paper is to report the results of studies of flowering response in interspecific hybrids involving *Gossypium hirsutum* L. and *G. barbadense* L.

In all intraspecific *hirsutum* hybrids between short-day photoperiodic primitive stocks and day-neutral Upland stocks, flowering response has been found to be under multigenic control. In the study of the perennial race *marie-galante* crossed to day-neutral Upland (LEWIS and RICHMOND 1957), gene action was characteristically additive. However, genes for late maturity were present and may have caused some bias in the direction of the nonflowering type. The annual race *latifolium* was found free of the influence of genes for late maturity and consistently exhibited a high degree of partial dominance for the flowering type (WADDLE, LEWIS and RICHMOND 1961; KOHEL and RICHMOND 1962).

Results of the study of flowering response in intraspecific *barbadense* hybrids contrasted with those in *hirsutum* (LEWIS and RICHMOND 1960). Flowering response was under monogenic control and the nonflowering type was completely dominant.

MATERIALS AND METHODS

Two interspecific hybrids were studied. One involved short-day photoperiodic *G. hirsutum* race *marie-galante* (CB2133) and day-neutral *G. barbadense* cultivar 'Pima S-1.' The other involved short-day photoperiodic *G. barbadense* cultivar 'Lengupa' (CB2933) and day-neutral M-11, a doubled haploid originating from *G. hirsutum* cultivar 'Empire.'

Cross-fertilizations and self-fertilizations, to produce seeds for this study, were made under short-day conditions in the Winter Cotton Breeding Facility, Iguala, Mexico and in the winter greenhouses at Beltsville, Maryland and College Station, Texas. The populations under study were grown at College Station. Seeds of this material were planted individually in 6-ounce paper cups in the greenhouse. At about 2 weeks of age the resulting seedlings were transplanted to the field in 40-inch rows with 18-inch spacing between plants in the row. A long-day photoperiod was present during the flowering and fruiting season. Normal cultural practices of the cotton genetics nursery were followed.

Plants were scored daily for the occurrence of the first flower. TM-1, a long term inbred

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derived from a cultivated Upland cotton, was included in this study as the day-neutral standard. The date of flowering was recorded on a scale in order that the mean date of first flower in the TM-1 population would have a value of 10. The mean date of first flower of the other populations were expressed on this same scale (e.g., in 1963, the mean date of flowering for TM-1 was 70 and was rescaled so it would have a mean flowering score of 10; on this same scale, M-11 with a mean date of flowering of 68 had a mean flowering score of 8.) This made comparisons between years possible.

RESULTS AND DISCUSSION

In 1963, small test populations were grown in the field under a long photoperiod: (1) to determine whether or not "genetic breakdown" due to species incompatibility of the interspecific hybrids would influence the segregation of flowering response adversely; (2) to determine which populations would segregate for flowering response; and (3) to obtain preliminary information on type of segregation (i.e., whether monogenic or multigenic).

The genetic breakdown of the interspecific hybrids obviously was present, but there was no indication that it had an important influence on the segregation of flowering response. Morphologically aberrant types were in evidence, but they occurred in both flowering and nonflowering classes. The backcrosses to the nonflowering parents, both *hirsutum* and *barbadense*, failed to segregate for flowering response, so further retesting was not continued. The parents, F_1's and populations segregating for flowering response were continued for study in larger populations which were grown and scored for flowering response at College Station in the summer of 1964.

The monogenic control of flowering response found in *barbadense* was not expressed in the *hirsutum-barbadense* interspecific progenies (Table 1). Multi-

TABLE 1

Summary of data on flowering response involving G. hirsutum *and* G. barbadense *interspecific hybrid progenies*

	1963			1964			
Population	Number of plants	Percentage of plants flowering	Mean flower score*	Number of plants	Percentage of plants flowering	Mean flower score	Variance of flowering plants
TM-1	40	100	10(70)	80	100	10(72)	14
M-11	10	100	8	10	100	3	..
Lengupa	10	0	..	10	0	..	..
F_1	20	55	24	10	20	23	..
F_2	59	52	19	287	58	21	134
BC_1 (M-11)	60	93	13	197	95	14	72
BC_1 (Lengupa)	58	0	..	..	..	..	..
Pima S-1	8	100	12	..	..	..	..
Marie-galante	20	0	..	10	0	..	..
F_1	12	0	..	30	0	..	..
F_2	57	23	26	287	28	24	127
BC_1 (Pima)	57	51	19	357	54	17	62
BC_1 (M-G)	59	0	..	..	..	..	..

* The number in parenthesis is the actual mean number of days from date of planting to first flower.

TABLE 2

Summary of data on flowering response involving intraspecific hybrid progenies

Population	Percentage of plants flowering	Mean flower score*
Gossypium hirsutum		
Race *marie-galante* (LEWIS and RICHMOND)		
TM 1	100	10(78)
F_1	49	34
F_2	53	26
BC_1 (*marie-galante*)	0	. .
BC_1 (TM 1)	100	13
Race *latifolium* (a) (WADDLE, *et al.*)		
TM 1	100	10(76)
F_1	100	20
F_2	88	18
BC_1 (*latifolium*)	50	24
BC_1 (TM 1)	100	12
Race *latifolium* (b) (WADDLE, *et al.*)		
TM 1	100	10(78)
F_1	100	12
F_2	90	14
BC_1 (*latifolium*)	55	24
BC_1 (TM 1)	100	10
Gossypium barbadense (LEWIS and RICHMOND)		
Lengupa · Pima S-1		
Pima	100	10(73)
F_1	0	. .
F_2	28	13
BC_1 (Lengupa)	0	. .
BC_1 (Pima)	49	11

* The number in parenthesis is the actual mean number of days from date of planting to first flower.

genic control of flowering response similar to that of *hirsutum* was observed in the segregating interspecific progenies. However, the gene action in the interspecific hybrids was unlike that observed for these same parents in intraspecific hybrids. The results of previous studies of intraspecific hybrids are summarized and presented in Table 2 for comparison with the results of interspecific hybrids presented in this paper.

In the intraspecific study of *barbadense* flowering response (LEWIS and RICHMOND 1960), nonflowering was completely dominant and the F_1 (Lengupa · Pima) did not flower. However, in the present study, there was an absence of dominance in the interspecific F_1 (Lengupa · M-11) and a portion of the F_1 population flowered. The F_1 was apparently near the threshold level of response to day length. Segregation in the F_2 and BC_1 indicated additive gene action. The unique behavior of Lengupa in interspecific hybrids is further illustrated when the mean flower scores of the flowering plants in the segregating interspecific progenies are compared to the intraspecific progenies of the earlier study. The mean flower scores of the interspecific progenies varied from generation to generation as expected with additive multigenic control, but mean flower scores

showed little variation in the intraspecific progenies. This indicated that within those *barbadense* stocks there was almost a complete absence of segregation of minor genes controlling flowering response. In interspecific progenies, Lengupa contributed genes controlling flowering response which behaved similarly to those contributed by *marie-galante* in intraspecific populations.

The behavior of *marie-galante* in interspecific progenies was similar to intraspecific progenies in the complex control of flowering response, but differed in the expression of dominance (Table 1). In the intraspecific F_1 (*marie-galante* · TM-1) a portion of the F_1 population flowered, and the segregating generations indicated that flowering response was controlled by additive gene action (Table 2). The interspecific F_1 (*marie-galante* · Pima) did not flower and in the segregating generations there were fewer flowering plants, and the mean date of first flower was later, which indicated dominance of the short-day response. The percentage of flowering plants in the F_2 and BC_1 gave the appearance of simple inheritance, but the difference in mean flowering scores and variances of the two generations indicated that the segregation was multigenic.

The results of this study show the multigenic control of flowering response found in *hirsutum* to be the predominant control in interspecific *hirsutum-barbadense* hybrid progenies. Despite the lack of expression of the *barbadense* monogenic control of flowering response, there was an apparent contribution of *barbadense* genes when segregating with *hirsutum* genes.

Previous studies in this series have demonstrated the relative accessibility of hirsutum race germplasms isolated by the photosensitive mechanism. This study has shown that the germplasms of short-day photoperiodic *hirsutum* and *barbadense* are available for exploitation in the opposite species with no greater difficulty than that found in *hirsutum.*

SUMMARY

Short-day photoperiodic *hirsutum* and *barbadense* were crossed with day-neutral *barbadense* and *hirsutum,* respectively, to study the genetics of flowering response in interspecific hybrid progenies. The monogenic control of flowering response in *barbadense* progenies was not expressed; multigenic control similar to that found in *hirsutum* predominated in the *hirsutum-barbadense* interspecific progenies.

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