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HETEROSIS IN SOME INTRASPECIFIC CROSSES OF GOSSYPIUM HIRSUTUM L.

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AC 307, a local strain of cotton, was crossed with six varieties of US origin, i.e., 1517 C, 1517 D, 1517 Br², Hopacala, Auburn 56 and Deltapine-smooth-leaf, to determine the extent of heterosis for plant height, seed cotton yield and its components in F_1 and subsequent inbreeding depression in F_2 generation. Heterosis was observed in all the characters, and as against mid-parent, it varied from 0.42 to 12.07% for plant height, 6.81 to 55.84% for number of bolls, from 13.21 to 65.92% for yield of seed cotton, 0.85 to 5.00% for seed index, from from 2.00% to 11.73% for lint index and zero to 11.48% for boll weight. F_2 generation showed general decline which averaged 3.65, 8.84, 13.27, 1.21, 1.81 and 3.11% as against mid-parental values in the respective characters.

INTRODUCTION

The Hirsutum varieties commercially grown in Pakistan are descendants of the cotton material imported in the first half of the 19th century. The continuous selection pressure in the material has so exhausted the genetic variability that further reselections carried out for many years in the varieties have not resulted in any substanial increase in lint yield. In order to get maximum benefit from new crosses involving local and foreign varieties, it is essential to obtain basic information on the adaptability of the exotic varieties and their combining ability for yield and its components. In this article results of heterosis studies in intraspecific crosses are reported.

The superiority of F_1 hybirds for increased yield has been reported by various workers. The increase in yield has been associated with increased boll number and boll size (Jones and Londen 1951, White and Richmond 1963) and heterosis for lint index was reported by Muramoto (1958). Heterosis for yield of seed cotton increase involving some local and exotic varieties of *G. hirsutum* L. has been reported by Khan (1964), who showed that some heterotic effect was retained in some F_2 crosses.

MATERIALS AND METHODS

The experimental material consisted of six commercial cotton varieties (*G. hirsutum L.*) of U.S.A. viz; 1517C, 1517D, 1517Br², Hopacala, Auburn 56,

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Deltapine-smooth-leaf and AC 307, a local strain. Crosses of AC 307, including its reciprocals, were made with all the other varieties in the beginning of September, 1968 to get F_1 seed. Selfed seed of all the varieties was also obtained for comparison. Half of the F_1 seed was sown in the green house in the beginning of December, 1968 to get the F_2 seed. The seed of F_1 (which was saved from the previous winter crop), the F_2 seed (got from the green house) alongwith the parents was sown on 5th June, 1969, in the field in a randomized block design with four replications in such a way that each block consisted of one row, each of F_1 and parents and two rows of F_2. The plant to plant and row to row distance was 1' and 2' respectively. Sowing was done by dibbling two seeds in each hole in order to ensure uniform stand. This was later thinned to one plant per hole. Ten plants of each family were sown in each row, out of which five middle plants were treated as experimental material.

The observations were recorded on height, boll number per plant, yield of seed cotton/plant, boll weight, seed and lint indices. Analysis of variance technique as described by Fisher (1958) was run on the data collected to determine significant differences amongst the various F_1 hybrids, F_2 progenies and parental populations included in the experiment. Percentage increased (+) or decrease (—) exhibited by the F_1 hybrids and the F_2 progenies as compared with the respective mid-parent and better parent values was also calculated for all the crosses for each character.

RESULTS AND DISCUSSION

An increase over the mean height of parents exhibited by F_1 in almost all the crosses (Table 1) ranged from 0.42% in AC 307 x Hopacala to 12.07% in AC 307 x 1517C. The F_1 hybrids of all the crosses differed significantly from the parental mean height except in the crosses AC 307 x 1517D, 1517Br2 x AC 307, AC 307 x Hopacala and Hopacala x AC 307. The mean height of F_2 plants, showed maximum reduction in the cross AC 307 x Hopacala followed by AC 307 x 1517 Br2, AC 307 x Auburn 56 and AC 307 X Deltapine-smooth leaf. Heterosis for height and vigour in F_1 generation of intraspecific crosses has been reported by White and Richmond (1963), Marani (1964) Young (1965). It was pointed out by Young (1965) that inbreeding depression in varietal crosses of cotton was more pronounced for height than for other characters.

TABLE 1. *Average parental performance for various economic characters.*

Parents	Plant Height (Inches)	Boll Number	Yield of seed Cotton (gms)	Boll Weight (gms)	Seed index (gms)	Lint index (gms)
AC 307	71.39	35 80	109.36	3.14	7.33	4.63
1517 C	59.37	13.80	43.35	3.27	7.15	4.17
1517 D	56 03	13.85	45.22	3.42	7.84	4.65
1517 Br2	57.13	18 98	58.26	3.23	7.26	4.55
Hopacala	65.61	19.80	68.88	3.45	7.30	4.23
Auburn 56	54.66	16.16	55.82	3.44	7.07	4.60
Delta Pine Smooth-leaf	50.66	20.25	109.83	2.89	6.79	4.41

TABLE 2. *Mean values of F_1 generation hybrids for various economic characters.*

Crosses F_1's	Plant Height (Inches)	Boll Number	Yield of seed cotton (gms)	Boll Weight (gms)	Seed index (gms)	Lint index (gms)
AC 307 x 1517D	67.62	32.10	101.25	3.32	7.72	4.85
1517D x AC307	69.59	33.30	115.35	3.52	7.71	4.54
AC307 x 1517C	72.32	27.30	96.12	3.69	7.29	4.57
1517C x AC307	67.62	30.00	108.67	3.26	7.36	4.57
AC307 x 1517Br²	66 49	27.15	92.31	3.42	7.27	4.65
1517Br²x AC307	65.42	33.25	109.18	3.29	7.53	4.59
AC307 x Hopacala	67.93	29.75	98.85	3.52	7.31	4.60
Hopacala x AC307	69.01	33.40	116.10	3.43	7.56	4.70
AC307 x Auburn 56	67.83	33.25	109.65	3.29	7.08	4.63
Auburn 56 x AC307	64.88	34.90	123.45	3.52	7.38	4.80
AC307 x Deltapine-smooth leaf	61.42	39.00	94.83	3.20	7.09	4.65
Deltapine smooth leaf x AC307	65.72	29.25	105.63	3.30	6.98	4.64

TABLE 3. *Mean F_2 values for various characters in 12 cotton crosses.*

Crosses F_2's	Plant Height	Boll Number	Yield of seed cotton (gms)	Boll Weight (gms)	Seed index (gme)	Lint index (gms)
AC307 x 1517D	65.74	22.05	71.92	3.29	7.39	4.58
1517D x AC307	63.37	28.20	81.69	2.97	7.19	4.46
AC307 x 1517C	65.30	16.25	55.84	3.23	7.11	4.05
1517C x AC307	61.35	17.65	57.52	3.33	7.12	4.23
AC307 x 1517Br²	59.23	21.20	70.29	3.31	7.01	4.28
1517Br² x AC307	61.11	19.65	61.12	3.21	7.26	4.55
AC307 x Hopacala	63.43	23 93	75.28	3.21	7.09	4.44
Hopacala x AC307	59.82	20.60	66.87	3.31	7.02	4.07
AC307 x Auburn	60.17	24.20	72.28	3.04	7.02	4.39
Auburn 56 x AC307	58.07	20.40	66.52	3.21	7.04	4.31
AC307 x Deltapine-smooth-leaf	57.27	26.85	79.72	3.05	6.85	4.50
Deltapine-smooth x AC307	63.12	21.29	64.85	3.03	6.83	4.19

TABLE 4. *Percent heterosis in F_1 of 12 cotton crosses.*

Crosses	Plant height	Boll Number	Seed cotton yield	Boll weight	Seed index	Lint index
AC307 x 1517D	+1.92	+36.77	+30 64	+0.30	+2.25	+6.59
1517 x AC307	+5.85	+18.59	+29.20	+7.31	+2.39	+4 53
AC307 x 1517C	+12.07	+42.55	+48.15	+11.48	+2.53	+11.75
1517C x AC307	+5.03	+55.84	+65.92	+3.79	+3.08	+5.29
AC307 x 1517 Br^2	+4.60	+27.04	+30.12	—	+1.25	+5.44
1517Br^2 x AC307	+2.49	+31.63	+30.73	+0.92	+3.17	+2.00
AC307 x Hopacala	+0.42	+21.67	+19.73	+4.14	+2.09	+5.02
Hopacala x AC307	+1.36	+30.87	+37.44	+3.00	+5.00	+7.79
AC307 x Auburn 56	+8.76	+ 36.43	+39.14	—	+0.85	+4.51
Auburn 56 x AC 307	+4.94	+54.42	+69.71	+6.66	+4.23	+7.14
AC307 x Deltapine-smooth-leaf	+4.01	+ 6.81	+13.21	+5.61	+2.76	+4.96
Deltapine-smooth-leaf x AC307	+9.42	+19.79	+27.28	+6.10	+1.15	5.93

TABLE 5. *Percent inbreeding depression in F_2 generation in various crosses.*

Crosses	Plant height	Boll Number	Seed cotton yield	Boll weight	Seed index	Lint index
AC307 x 1517D	+0.60	—6 05	—7.20	—0.60	—2.11	+0.65
1517D x AC307	—3.60	+0.46	—8.50	—9.45	—4.51	—3.61
AC307 x 1517C	+2.74	—15.14	—9.34	—2.41	—	—0.97
1517C x AC307	—4.70	—3.35	—12.71	—2.91	—0.28	—2 53
AC307 x 1517 Br^2	—6.81	—0.93	—0.91	—3.21	—2.35	—2.94
1517Br^2 x AC307	—4.26	—2.12	—26.81	—1.53	—6.00	—1.11
AC307 x Hopacala	—6.22	—2.12	—9.57	—5.02	—0.97	+0.68
Hopacala x AC307	—12.11	—19.27	—0.83	—0.60	—2.50	—6.65
AC307 x Auburn 56	—3.49	—0.69	—8.27	—7.59		—0.90
Auburn 56 x AC307	—6.06	—9.73	—8.55	—2.12	—0.56	—3.97
AC307 x Deltapine smooth leaf	—4.70	—1.15	—4.79	—0.66	—0.29	+1.58
Deltapine smooth leaf x AC307	+5.09	—20.91	—21.85	+.57	—1.01	—4.33

The F_1 hybrids of the cross Auburn 56 x AC 307 produced maximum boll number per plant (Table 2). Heterotic effect for boll number was observed in all the crosses while seven crosses produced more bolls per plant than their respective better parents. Only the cross, Auburn 56 x AC307, showed significant increase over mid and better parents by 20.13, and 18.46% respectively, In F_2 generation there was a decline for boll number per plant from the mid-parent values in almost all the crosses, However, the F_2 average was invariably higher than the lower parents. The minimum decrease in terms of inbreeding depression in F_2 generation for boll number was shown by a combination of AC307 x 1517D. These results agree with those of Kime and Tilley (1946), Muramoto (1958) and Young (1965),

F_1 hybrids gave increased seed cotton yield (Table 3) than the parental mean in all the 12 crosses. Four crosses, namely, 1517C X AC307, Hopacala x AC307, AC307 x Auburn 56 and Auburn 56 x AC307 gave significantly higher yield of seed cotton than the better parents. Comparing the average of both direct and reciprocal crosses, it was found that depression in seed cotton yield in F_2 was maximum in crosses involving parental varieties AC 307, 1517C and Auburn 56. The decrease in seed cotton yield was maximum in F_2 of the cross, AC307 x 1517 C. These observations are in agreement with those of Khan (1964) and Baluch and Memon (1966), who observed heterosis for lint yield in F_1 and inbreeding depression in F_2 and succeeding generation in intraspecific crosses of *G. hirsutum L.*

The F_1 hybrids of cross. AC307 x 1517C, gave the highest boll weight (Table 4). Increase in boll weight in F_1 over the mean of the parents was recorded for almost all the crosses while four of them exhibited an increase over the better parents. Out of 10 crosses, only the cross, AC307 x 1517C, gave significantly better values as compared to mid-parents. There was a general decline in boll weight in F_2 of all the crosses, and was maximum (-9.45) in 1517D x AC307.

Seed and lint indices (Table 5 and 6) are the indicator of ginning capacity of a variety of cotton and have bearing on lint yield. In the present studies, seed and lint indices showed increased values in F_1 generation over the mid-parents in all crosses. The increase over the mid-parents for seed index varied from 0.85 to 5.00 per cent while for lint index the increase ranged between 2.00 to 11.73 per cent. Lint index values in F_2 surpassed their respective better parents in all the crosses. In case of seed index only eight of the twelve crosses showed an increase over the better parents. Crosses involving cotton varieties, AC307 and 1517D, showed the maximum

values for seed index as well lint index. The results are in agreement with the findings of Kime and Tilley (1949), Muramoto (1958) and Marani (1963).

Heterosis menifested in the F_1 generation for various characters studied and inbreeding depression observed in varying degrees show that it seems possible to make effective selection for these characters.

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