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Gene Effects for Certain Quantitative Traits in American Cotton

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Six generations, viz., P_1, P_2, F_1, F_2, B_1 and B_2 of an inter-varietal cross RS 89 x American nectariless were used in estimation of gene effects for seven characters by a over all generation means. The gene action revealed that seed cotton yield was found mainly under dominance and complementary type of gene action while the characters boll number, boll weight, ginning percentage, seed index and lint index were controlled by duplicate epistasis. However, fibre length was under the control of additive gene action.

The first step in planning and evaluating a suitable breeding programme is to investigate the mode of inheritance of yield, its components and quality characters to describe genetic variation present in the cross and its descendent families. Relative magnitude of different gene effects is one of the criteria to judge the genetic potential of crosses. The present investigation was carried out to study the gene effect in an inter-varietal cross i.e RS 89 x *A.nectariless* and the results are presented herein.

MATERIALS AND METHODS

Two cotton varieties viz., RS 89 and *A nectariless*(designate them as P1 and P2) were grown for making the crosses. Part of the F1 was selfed to get F2 seeds and the remainder was used in making back crosses (B1 i. e. P1 x F1 and B2 i. e. P2 x F1). Seeds of all six generations was grown in Kharif 1974 at R.B S.College, Agra in a randomised block design with three replications. Each replication had one row of each parent and two rows of F1, F2 ,B1 and B2 progenies. The spacing adopted was 75 x 35 cm Observations were recorded for yield of seed cotton, boll number, boll weight, halo-length, ginning percentage, seed index and lint index.

The data for all generations were analysed by generation means method given by Jinks and Jones (1958) and Hayman (1958) and scaling tests as suggested by Mather, 1949 were used.

RESULTS AND DISCUSSION

The 'F' test indicated that variation due to replications was not significant for all the characters under study. The differences between the generations were found to be highly significant for all the characters. The data are presented in Table I. The mean performance of six generations for various characters is given in Table II.

The differences in yield per plant were significant. Parent 1 was significantly higher yielder than parent 2. The

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TABLE I. Analysis of variance of six generations for seven characters

Source	D. F.	MSS						
		Yield/plant	Boll number	Boll weight	Halo length	Ginning percentage	Seed index	Lint index
Replications	2	3.40	8.90	0.02	0.08	0.01	0.06	0.08
Generations	5	525.38**	171.06**	0.49**	1.30**	5.78**	5.13**	1.35**
Error	10	2.69	3.50	0.01	0.01	0.03	0.04	0.01

** Significant at 1% level.

TABLE II. Mean performance of six generations for different characters

Characters	Mean performance of generations					
	P_1	P_2	F_1	F_2	B_1	B_2
Yield/plant	37.25	27.80	61.87	30.27	34.30	36.13
Boll number	22.23	18.60	37.70	17.15	26.23	27.08
Boll weight	3.28	3.54	3.34	2.58	3.24	3.65
Halo-length	26.28	21.13	24.00	23.80	25.32	23.00
Ginning percentage	33.70	31.08	33.65	33.98	33.32	35.26
Seed index	8.93	5.84	8.40	7.52	8.50	7.30
Lint index	4.47	2.61	4.22	3.83	4.20	3.96

F1 yield was 66.1 per cent higher than P1. The yield level in B1 and B2 was almost similar but lower than their respective mid-parental values. The differences in boll number were also highly significant. The F1 value was much higer than the better boll bearing parent 1 (R.S. 89) while the F2 value (17.18) was even lower than the mid-parental value (21.9). The mean boll number in case of B1 (26.23) was lower than its mid-parental value (31.4), but the B2 value (27 08) was almost similar to its mid-parental value (28.15). Parents differed significantly for the character boll weight. The boll weight F1 (3.34) was not significantly different from the mid-parental value (3.41). Thus, the additive gene action was indicated for this character. However, the F2 mean was significantly lower than the mid-parental value as well as F1 value. The B1 value was significantly better than B1 value. The B1 and B2 values did not deviate significantly from the mid-parental values. Thus, the additivity in gene action for this character was further confirmed.

For halo-length, F1 and F2 values were almost equal to the mid-parental values (23.7), thus, the additive gene action was indicated. The B 1 value was nearly equal to its mid-parental value. Similarly, fibre length in B2 was almost equal to its mid-parental value.

Thus, on the basis of means of different generations additive nature of gene action is visualized. In case of ginning percentage, F1 was almost similar to the better parent P 1. The F 1 and F 2 values were significantly higher than the mid-parental value (32.29). The B1 value did not deviate significantly from its mid-parental value (33 67); while the B2 value was higher than all the generations and its mid-parental value. On the basis of mean of six generations dominance type of gene action is evident for this character.

The seed index of P1 was significantly higher than P2. The F 1 value was also significantly higher than its mid-perental value (7.38). The differences between F 2 and the mid-parental value were not significant. The B1 value did not deviate from its mid-parental value(8.66), but was lower than P1. The B2 value also did not deviate from its mid-parental value (7.12). Based on the mean values of F1 and F2 the presence of dominance type of gene action for this trait is indicated. In case of lint index P1 was much higher than P2. The F1 value was significantly higher than the mid-parental value (3.54), F2 and B2 but similar to B1. The lint index in B1 was significantly higher than B2. Partial dominance is indicated on the basis of means of different generations for this character.

SCALING TEST

The results of Mather's Scaling Test of A, B and C for various characters in six generations are tabulated in Table III. The value of 'A' was significant for all the characters, thus indicating the failure of additive model. The 'B' value was non-significant only for boll number and halo-length, whereas, 'C' significantly deviated from zero for all characters except halo-length.

GENE EFFECTS BASED ON SIX PARAMETERS MODEL

For yield of seed cotton the $\hat{d}$ value was non-significant indicating absence of additive gene effects. The dominance gene effects, as measured by $\hat{h}$ value was highly significant. As far as the epistatic interactions were concered, the add x add, add x dom. and dom x dom were signifi-

TABLE III. Mather's Scaling Test for different chatacters

Scales characters	Yield/ plant	Boll number	Boll weight	Halo-length	Ginning percentage	Seed index	Lint index
A	—30.52 ± 5.12	−10.47 ± 3.11	−0.14 ±0.08	+0.25 ±0.13	−0.71 ±0.20	−0.33 ±0.10	−0.29 ±0.05
B	—17.41 ± 4.16	− 2.14 ± 2.72	+0.42 ±0.12	+0.36 ±0.28	±5.79 ±0.20	+0.36 ±0.12	+1.09 ±0.30
C	—67.71 ±10.14	−50.63 ± 5.13	—3.18 ±1.05	+1.81 ±0.40	+3.84 ±0.40	—1.49 ±0.40	−0.20 ±0.05

cant for this character. The degree of heterosis was found to be more than one (1.64). Complementary type of gene interaction seems to be operating as indicated by the same sign of the components $\hat{h}$ and $\hat{l}$. The estimation of gene effects for number of bolls revealed that dominance and interaction components $\hat{i}$ and $\hat{j}$ values were highly significant. The $\hat{h}$ and $\hat{l}$ effects were in opposite direction, hence, the duplicate type of interaction was indicated. The degree of heterosis was found to be more than one (1.53). The results are in confirmity with those reported by Joshi, *et al*. (1961). For boll weight, all the estimates were highly significant. The $\hat{h}$ and $\hat{l}$ effects were on opposite directions, hence, the operation of duplicate type of gene interaction was indicated. The results were contradictory to those reported by Joshi, *et al*. (1961).

For halo-length the additive gene effects ($\hat{d}$) was highly significant. This was further evident by very low value of dominance ratio. Marani (1963) also reported appreciable amount of additive genetic varience for this character. The estimation of gene effects for ginning percentage revealed that additive, dominance and epistatic interaction effects were highly significant. The sign for dominance and dominance x dominance were in opposite directions. Thus, the duplicate type of epistatic interaction was in operation. However, the degree of dominance was very low

TABLE IV. Estimates of genetic parameters from the generation means on the basis of six parameter model

Genetic parameters/ characters	Yield per plant	Boll number	Boll weight	Halo-length	Ginning percentage	Seed index	Lint index
$\hat{m}$	+30.27 ± 2.15	+17.15 ± 1.03	+2.58 ±0.80	+25.36 ± 0.30	+33.98 + 0.10	+7.52 +0.10	+3.83 ±1.20
$\hat{d}$	— 1.83 ± 2.60	— 0.35 ± 1.70	—0.41** ±0.15	+ 2.52** ± 0.14	— 1.94** ± 0.14	+1.20** ±0.34	+0.24** ±0.05
$\hat{h}$	+49.12** ±10.43	+53.80** ± 5.57	+3.39 ±1.02	+ 1.20 ± 1.23	+ 2.50 ± 0.48	+2.53** ±0.40	+1.68** ±0.35**
$\hat{i}$	+19.78** + 7.08	+38.02 ± 5.36	+3.46 ±1.00	— 1.20 ± 1.23	+ 1.24** ± 0.48	+1.52** ±0.40	+1.00** ±0.25
$\hat{j}$	—13.12** ± 5.63	— 8.33** ∓ 3.65	—0.56** ±0.10	— 0.11 ± 0.28	— 6.50** ± 0.28	—0.69** ±0.15	—1.38** ±0.35
$\hat{l}$	+28.15* ±14.54	—25.41** ± 8.53	—3.74** ±1.00	+ 0.59 ± 1.32	— 6.32** ± 0.69	—1.55** ±0.40	— 1.88** ±0.35
Heterosis/ h-i/-/-d½jc	1.64	1.53	0.50	— 0.09	— 0.06	—0.93	0.53

*, ** Significant at 1% and 5% level respectively

and non-significant. It may be due to cancellation of dominance and dominance x dominance interaction as they are operating in opposite direction as they are operating in opposite directions. Marani (1968) observed significant $\hat{d}$, $\hat{h}$, $\hat{i}$ and $\hat{l}$ effects and duplicate type of epistasis was noticed in *intra-hirsutum* crosses. For seed index also the different types of gene effects were significant as in the case of ginning percentage. The duplicate type of epistatic was found to be present in this and lint index also. The dominant, as well as interaction gene effects were much higher in magnitude than, the additive gene effects. Marani (1968) also observed significant $\hat{d}$, $\hat{h}$, $\hat{i}$ and l effects for this character.

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