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GENE EFFECTS FOR GINNING OUTTURN AND HALO LENGTH IN COTTON (*Gossypium arboreum* L.)

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Gene effects were estimated by the generation means analysis for ginning outturn and halo length in G27 x NR5 and G27 x LD124 crosses of *desi* cotton (*Gossypium arboreum* L.). Additive and additive x additive gene effects were significant for both the characters in the two crosses except for halo length in G27 x ID124 where those effects were not significant. The positive additive x additive gene effects can be exploited through selection. Significant non-allelic interactions indicated the importance of epistasis in inheritance of these characters.

The knowledge of genetic architecture of quantitative traits and the methods that could exploit such information are basic to any crop improvement programme. The present study was undertaken to obtain information on the nature and magnitude of gene effects for ginning outturn and halo length in *desi* cotton (*Gossypium arboreum* L.) based on partitioning of first-degree statistics.

MATERIALS AND METHODS

Parents, F_1, F_2, F_3, B_1 (F_1 x P_1) and B_2 (F_1 x P_2) generations derived from two varietal crosses, viz. G27 x NR5 and G27 x LD124 of *desi* cotton were studied at Punjab Agricultural University, Ludhiana. The two crosses were grown in separate experiments. The experimental design was randomized-block with three replications. Each replication comprised 36 rows i. e. 3 rows each of P_1 and P_2' one row each of B_1, B_2 and F_1, 12 rows of F_2 and one row each of 15 F_3 progenies. The row-to-row spacing was 60 cm and plant to-plant spacing was 45 cm. Five randomly tagged plants were taken in each row for recording the data on ginning outturn and halo length.

The generation means were worked out by taking the overall average of the replications for each generation. The adequacy of additive dominance model was tested by scaling tests following Mather and Jinks (1982). The generation means were analysed using weighted least squares method as suggested by Mather and Jinks (1982) to obtain information on the type of gene effects involved in determining the expression of a character. All gene effects were described by the F ∞ metric method discussed by Vanderveen (1959). The genetic parameters estimated were mean (m), additive (d), dominance (h), additive x additive (i), additive x dominance (j) and dominance x dominance (l). The three-and-six-parameter models were tested for goodness of fit by calculating the expected values for each of the generation means and comparing them with the observed values. The deviation of tha expected from the observed was tested by assuming that

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the squared deviations had a chi square distribution with the degrees of freedom equal to the number of generation means minus the number of parameters estimated.

RESULTS AND DISCUSSION

The analysis of variance indicated significant differences among the generations for ginning outturn and halo length in the two crosses. The mean values, scaling tests and estimates of genetic parameters are given in Tables 1, 2 and 3, respectively. The inferences for additive and dominance gene effects were drawn from the six--parameter model as non-allelic interaction effects were significant.

Table 1. Generation means for ginning outtern and halo length in *desi* cotton

Genetation	Cross 1 ((G 27 x NR 5)		Cross 2 (G 27 x LD 124)	
	Ginning outturn	Halo length	Ginning outturn	Halo length
P_1	35.74 ± 0.32	15.53±0.22	35.47±0.66	15.97±0.30
P_2	35.00±0.24	20.58±0.15	38.10±0.45	16.77±0.45
F_1	35.13±0.59	18.69±0.48	37.10±0.44	19.10±0.72
F_2	36.09 ± 0.32	17.02±5.22	37.00±0.35	17.27±0.15
F_3	35.71 ±0.08	17.39±0.17	37.52±0.31	17.08±0.23
B_1	37.83±0.15	17.00±0.46	37.17±0.43	19.17±0.33
B_2	33.55±0.43	20.40±0.46	35.37±0.57	20.10±0.61

Table 2: Scaling tests for allelic interactions in *desi* cotton

Scaling test	G 27 x NR 5		G 27 x LD 124	
	Ginning outturn	Halo length	Ginning outturn	Halo length
A	4.79±0.74**	1.56±1.05	−4.46 ±1.07**	4.33±1.32**
B	−3.01±1.08**	−0.19±1.06	1.77±1.39	3.27±0.77**
C	3.36±1.78	−2.95±1.32*	0.23±1.05	−1.86±1.04
D	−0.08±0.81	−1.79±0.87*	2.51±1.67	1.04±1.11

*, ** Significant at 5 and 1 per cent level

Ginning outturn

Non-allelic interactions predicted by the scaling tests were in agreement with the three-parameter model in in both the crosses. The significant epistatic gene effects were also estimated by the six parameter model.

Table 3 : Components of generation means in *desi* cotton

Character	Parameter model	Gene effects (m)	(d)	(h)	(i)	(j)	(l)	Chi-square
G27 x NR5								
Ginning outturn	3	35.43±0.14**	1.29±0.17**	1.83±0.42**				97.54**
	6	36.03±0.20**	0.42±0.20**	-1.24±1.33	-0.22±0.07**	8.30±0.78**	1.24±1.56	107.36**
Halo length	3	17.85±0.12**	2.62±0.13**	0.03±0.36				25.34**
	6	17.09±0.21**	2.59±0.13**	0.89±0.46	1.04±0.15**	1.80±1.33	0.83±1.48	6.31**
G27 x ID124								
Ginning outturn	3	37.19±0.28**	0.59±0.34	-0.29±0.55				18.29**
	6	34.75±0.37**	0.69±0.31*	1.45±1.46	0.54±0.27*	-1.24±1.25	-1.24±0.87	134.74**
Halo length	3	16.32±0.18**	0.15±0.25	2.79±0.33**				45.09**
	6	16.37±0.23**	0.55±0.27	1.84±1.20	0.28±0.17	-3.55±1.28**	1.03±0.98	42.56**

*, ** Significant at 5 and 1 per cent level.

in G27 x NR5 cross, additive, additive x additive and additive x dominance gene effects were significant and in G27 x ID124 cross additive and additive x additive effects were important. Sandhu and Koonar (1980) Singh *et. al.* (1982), Bhatade and Bhale (1983) and Singh and Sandhu (1986) also reported the importance of additive gene effects for this cheracter in different materials. The additive component in G27 x NR5 cross could be exploited through selection, but additive x additive interaction component being negative would inhibit the expression of character The importance of only fixable gene effects in G27 x ID124 cross indicated a good probability of success in selecting for high ginning outturn. The significant A and B scaling tests and corresponding (j) type interaction component on the six-parameter model in G27 x NR5 cross were in agreemnt with the conclusions of Mather and Jinks (1982). Inspite of the estimation of significant digenic interaction effects by the six-parameter model significant chi-square indicated the presence of higher order interactions and/or linkages.

Halo length

The scaling tests as well as the three-parameter model predicted non allelic interactions in the two crosses which were also identified by the six-parameter model. The additive x additive gene effects were significant in G27 x NR5 cross Bhatade and Bhale (1983), Khajjidoni *et al.* (1984) and Singh and Sandhu (1985) also indicated the importance of additive genetic component in inheritance through different studies. The importance of fixable component suggested that improvement through selection appeared feasible in this cross. In G26 x ID124 cross, additive x dominance gene effects only were important. The A, B and C scaling tests were significant and the corresponding (j) and (i) type interaction components also came out to be significant on the six-parameter model. These results coincide with the conclusions of Mather and Jinks (1982). The significant chi-square values on epistatic model in both the crosses indicated higher order interactions and/or linkages.

The greater contribution of additive gene effects, in general in the inheritance of ginning outturn and halo length suggested that selection in early segregating generations might be effective. The positive additive x additive component may cause high manifestation in some of the segregants even in advanced generation and can be exploited through selection. The significant interaction effects indicated the importance of episasis in inheritance of these characters. Therefore, the estimation of only additive-dominance gene effects and designing breeding methodology presuming absence of epistasis may be misleading.

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