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Genetic architecture for seed cotton yield and fibre quality traits in upland cotton (*Gossypium hirsutum* L)

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Abstract : The analysis of variance revealed that the presence of epistasis, additive and dominance genetic action for all the characters studied. Parents BBPSPS 25 and BBP 41 contributed maximum toward the epistasis for seed cotton yield and 2.5 per cent span length, respectively. Both additive and dominance gene action was observed for boll weight, days to boll bursting, fibre strength, and uniformity The traits like plant height, monopodia and bolls/plant, seed/boll, seed index, lint index, days to flowering, micronaire value and ginning percentage showed higher magnitude of additive genetic component, while rest had higher dominance genetic components. The appropriate breeding methods for the improvement have been discussed.

Keys words : Additive genetic component, dominance genetic component, epistasis, triple test cross

The scope for crop improvement is determined by the amount of genetic variability in relation to environmental modifications and the extent and nature of genetic environmental interactions. Various biometrical methods have been used in the past for estimating various types of gene actions. In most of the mating designs used so far, it is assumed that non allelic interactions are absent whereas the fact is often contrary to this assumption. In the presence of non allelic interactions, estimations of additive and dominance components are biased to a greater extent. The triple test cross analysis must be considered as significant advance from the view point of plant breeders. The appropriate analysis of triple cross yields information on epistasis as well as additive and dominance components.

The present investigating was carried out at the Cotton Research Unit, Dr. PDKV., Akola. The experimental materials consists of 2 lines *i.e.* AKH 081 and AKH 0601 and 11 testers BBP 1, BBP SPS 4, BBP 6, BBP 8, BBP SPS 10, BBP SPS 25, BBP SPS 41, BBP 109, BBP 126, BBP 187 and BBP 188. Two lines crossed with 11 testers resulting 22 F_1s were grown during *kharif,* 2006 at 90 x 60 cm spacing. The data were recorded for plant height, monopodia, sympodia and bolls/plant, boll weight, seeds/boll, seed index, lint index, seed cotton yield, days to flowering, days to boll bursting, 2.5 per cent span length, micronaire value, fibre strength, uniformity ratio (%) and ginning percentage. The information on genetic control of the traits under investigation was obtained using simplified triple test cross analysis which is specifically applicable to inbred line to two lines L_1 and L_2 to yield 2n progenies. The comparison (L_{1i}+L_{2i}-P_i) used for detecting the presence of epistasis. The additive and dominance components were estimated from the analysis of sums (L_{1i}+L_{2i}) and differences (L_{1i}-L_{2i}). The degree of dominance was estimated by using the formula as $(H/D)^{1/2}$.

The analysis of variance for the test of epistasis based on the comparison $L_{1i} + L_{2i} - P_i$ for P_i = 1 to 11families (Table 1). The mean squares due to epistasis were significant for all the traits indicated the presence of epistasis for all traits. Epistasis for seed cotton yield and other traits characters has been reported by Bhatti *et al.*, 2006.

The estimates of individual line contribution to the epistasis comparison have been presented in Table 2. The parents BBP 187 (119.5) and BBPSPS 4 (76.5) contributed maximum and minimum epistasis variation for plant height, respectively. The parents BBP 41 (3.9) and BBP 188 (1.1) contributed maximum and minimum epistasis variation for monopodia/ plant. For sympodia/plant BBP 1 (20.6) contributed more epistasis variation. Similarly, for bolls/plant, BBP 188 (34.0) contributed maximum variation while BBP 109 (18.7) contributed minimum. The parent BBP 41 (4.3)

Table 1. Analysis of variance for epistasis, sums and differences for seed cotton yield, its component characters and fibre quality traits

Source	Plant height	Mono-podia/plant	Sym-podia/plant	Bolls/plant	Boll weight	Seeds/boll	Seed index	Lint index	Seed cotton yield	Days to flowering	Days to boll bursting	2.5 per cent span length	Micro-naire value	Fibre strength	Uni-formity ratio (%)	Ginning per-centage
Analysis of variance for epistasis																
Epistasis ($L_{1i}+L_{2i}-P_i$)	45.24**	0.21*	1.45**	5.40**	0.052**	1.75**	0.485**	0.174**	116.1**	11.31**	3.12**	0.24*	0.17**	1.83**	1.59**	3.04**
Within family	28.96	0.3	1.81	12	0.012	0.43	0.066	0.02	54.12	3.83	0.72	0.21	0.015	0.034	0.34	0.14
Analysis of variance for sums and differences																
Sums ($L_{1i}+L_{2i}$)	43.93**	0.39*	1.73**	11.19*	0.03**	2.12**	0.315**	0.154**	109.3**	16.36**	2.02**	0.37*	0.18**	2.35**	1.54**	4.94**
Differences ($L_{1i}-L_{2i}$)	37.2*	0.21**	2.03*	20.34**	0.038**	1.61**	0.079*	0.112**	158.9**	6.57*	1.89**	0.45**	0.04*	2.08**	1.52**	2.26**
Within family	26.09	0.29	1.83	16.85	0.007	0.51	0.063	0.02	63.8	4.61	0.73	0.3	0.018	0.024	0.51	0.14

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

Table 2. Comparison of individual line (P_i) to the epistasis component ($L_{1i}+L_{2i}-P_i$) for different traits

Parents/ Families (P_i)	Plant height	Mono-podia/plant	Sym-podia/plant	Bolls/plant	Boll weight	Seeds/boll	Seed index	Lint index	Seed cotton yield	Days to flowering	Days to boll bursting	2.5 per cent span length	Micro-naire value	Fibre strength	Uni-formity ratio (%)	Ginning per-centage
BBP 1	111.0	3.3	20.6*	29.1	3.7	20.1	7.1	3.3	99.8	61.6	107.4	27.0	2.9	19.1	45.1	31.8
BBPSPS 4	76.5	3.0	16.4	22.3	3.6	19.1	4.9	2.3	73.8	66.1	106.1	27.2	4.7*	20.6	43.7	33.3
BBP 6	94.5	2.4	15.0	27.0	3.6	20.8	5	3.5	94.3	61.1	100.5	25.3	2.6	17.8	45.4	40.0*
BBP 8	97.5	2.8	14.7	23.4	3.5	23.1	5.7	2.9	75.3	58.1	100.7	25.2	2.9	22.7*	48.4	33.6
BBPSPS 10	102.0	2.8	19.7	24.8	3.8	25.4*	6.0	3.0	88.1	59.0	103.0	27.2	2.9	20.5	46.2	33.3
BBPSPS 25	115.5	2.7	16.8	29.3	4.1	21.7	7.3	3.9	108.8*	64.4	106.3	26.0	4.7*	19.4	48.6	34.7
BBP 41	97.0	3.9*	14.6	26.3	4.3*	26.1	8.8*	4.4	96.3	49.5	104.9	28.0*	3.8	20.6	46.3	33.1
BBP 109	100.5	1.8	16.5	18.7	2.8	22.3	7.4	4.1	47.4	67.5	107.6	26.4	3.2	16.3	48.0	35.7
BBP 126	99.0	1.6	16.0	26.1	3.2	24.1	7.8	4.8*	92.7	69.8*	108.9	26.8	3.5	15.7	42.1	38.8
BBP 187	119.5*	2.7	19.6	24.8	3.6	24.9	7.2	3.1	84.9	62.1	107.1	26.7	3.9	16.0	49.1*	29.9
BBP 188	107.0	1.1	17.1	34.0*	3.3	24.5	7.1	3.2	56.6	68.9	109.5*	26.5	3.4	16.4	46.3	31.5

*Epistasis parents

Table 3. Estimation of additive, dominance and degree of dominance for different traits in cotton

Source	Plant height	Mono-podia/plant	Sym-podia/plant	Bolls/plant	Boll weight	Seeds/boll	Seed index	Lint index	Seed cotton yield	Days to flowering	Days to boll bursting	2.5 per cent span length	Micro-naire value	Fibre strength	Uni-formity ratio (%)	Ginning per-centage
D	35.68	0.21	0.22	11.32	0.05	3.21	0.50	0.27	91.00	23.49	2.56	0.13	0.32	4.65	2.06	9.59
H	22.22	0.16	0.40	6.98	0.06	2.20	0.03	0.18	190.12	3.91	2.31	30.00	0.04	4.11	2.02	4.24
F	-22084.6**	-10.98**	-62.82**	-3421.22**	-25.14**	-478.22**	-138.05**	-7.79**	-368441.2**	-1688.09**	-3289.35**	-686.18**	-11.29**	-55.05**	21.60**	1627.51**
$(H/D)^{1/2}$	0.78	0.87	1.34	0.78	1.09	0.82	0.24	0.81	1.44	0.4	0.94	1.51	0.35	0.94	0.99	0.66

*Significant at 5 per cent level, **Significant at 1 per cent level and BBP 109 (2.8) contributed maximum and minimum epistasis variation for the boll weight, respectively. For seeds/boll parents BBPSPS 10 (25.4) contributed maximum epistasis variation, similarly for seed index in parent BBP 41(8.8). In lint index, parents BBP 126 (4.8) and BBPSPS 4 (2.3) contributed maximum and minimum epistasis variation. The parents BBPSPS 25 (108.8) and BBP 109 (47.4) contributed maximum and minimum epistasis variation for seed cotton yield, respectively. The parents BBP 126 (69.8) and BBP 41 (49.5) contributed maximum and minimum epistasis variation for days to flowering and for days to boll bursting BBP 188 (109.5) contributed more epistasis variation. For 2.5 per cent span length BBP 41 (28.0) contributed maximum epistasis variation while BBP 8 (25.2) contributed minimum. Parents BBPSPS 4 and 5 (4.7), BBP 8 (22.7), BBP 187 (49.1) and BBP 6 (40.0) contributed maximum epistasis variation for micronaire value, fibre strength, uniformity ratio and ginning percentage, respectively.

In the present study of additive genetic component (D) and dominance genetic component (H) were estimated irrespective of presence or absence of epistasis, in order to get over all picture of magnitude of additive and dominance components and their relative contribution towards genetic variation in the population. Significant mean squares for sums and differences were significant for all the traits indicating that the inheritance of these traits were controlled by both additive and dominance genetic components (Table 3). This result akin with Pole *et al.*, (2008). Plant height, monopodia and bolls/plant, seed/boll, seed index, lint index, days to flowering, micronaire value and ginning percentage showed higher magnitude of additive genetic component. Similar finding were also reported by Giri *et al.*, (2006) and Reddy *et al.*, (2006). Dominance genetic component contributing more towards sympodia/plant, seed cotton yield and 2.5 per cent span length confirm the findings of Giri *et al.*, (2006) and Reddy *et al.*, (2006). However, the degree of additive and dominance were close to unity for boll weight, days to boll bursting, fibre strength and uniformity ratio indicating both is importance for the expression of these traits. Nimbalkar *et al.*, (2004) reported that both additive and dominance gene action controlling these traits. The estimates of F is significant for all characters under study indicating that there is a additive contribution to variation but the additive is ambidirectional.

In the present study, both additive (D) and dominance (H) components of genetic variation played an important role in inheritance of characters under study. Therefore, simple recurrent selection should be utilized to capitalize the additive genetic variation. Also, selective intermating in F_2 generation should be followed and segregating material should be carried out by single seed descent method to obtain superior lines.

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