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Genetic Analysis of Quantitative Traits in Upland Cotton

(*Gossypium hirsutum* L.)

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ABSTRACT

The present study was carried out with fifty seven genotypes comprising of ten parents and forty five hybrids obtained from crossing of ten parents in diallel manner without reciprocals and two checks at Regional Agricultural Research Station, Lam Farm, Guntur, Andhra Pradesh during *kharif* 2013-14. The experiment was conducted in randomized block design with three replications. The data was recorded on plant height (cm), days to 50% flowering, number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), ginning outturn (%) and seed cotton yield per plant (g). The data was subjected to combining ability analysis. Both general combining ability and specific combining ability indicated significant mean sum of squares in analysis of variance. Most of the traits showed the predominance of non additive gene action.

Key words: *Cotton, diallel, combining ability, Gene action.*

Cotton is the most important cash crop of global importance with current estimates for world production of about 25 million tonnes accounting for 2.5 % of the world's arable land. In cotton, four cultivated species are present and India is the only country where all these four species are being cultivated. In India, *G. hirsutum* occupies the prime position in cultivation for its yield and fibre qualities. For breeding high quality varieties of cotton, the genetic information of yield attributing parameters is very essential. The main objective of the study is to know the gene action of the lines and their cross combinations using the diallel crossing techniques.

MATERIAL AND METHODS

Combining ability studies in upland cotton for seed yield and yield contributing traits was undertaken at Regional Agricultural Research Station, Lam Farm, Guntur, Andhra Pradesh during *kharif* 2013-14. The experimental material include 57 genotypes, comprising of 10 parents, 45 hybrids generated by crossing these parents in half diallel fashion and two checks (BUNNY Bt and KCH 707), were grown in randomized block design with three replications. Each plot consisted of two rows each of 6 m length with a spacing of 120 x 60 cm. All the necessary cultural and plant protection practices are carried out for a better crop stand. The data was recorded on ten randomly selected plants per entry per replication on plant height (cm), days to 50% flowering, number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), ginning outturn (%) and seed cotton yield per plant (g). The mean data was collected and subjected to combining ability analysis using diallel analysis (Method-2, Model-2) as given by Griffing (1956).

RESULTS AND DISCUSSION

Exploitation of heterosis is primarily dependant on the screening and selection of lines in available germplasm that could produce better combinations of important characters indicating the importance of selection of desirable parents for successful hybridization programme. The analysis of variance for combining ability was presented in Table 1 and the results revealed the existence of sufficient variability among the genotypes for all the eight characters studied. Parents showed non-significant values for sympodia per plant, ginning outturn % and seed cotton yield per plant. Similarly, parents *vs* hybrids component was significant for all the traits except for micronaire.

The parents, BBGH-1, BBGH-26, GHL-8 and BGH-94 were found to be good combiners for seed cotton yield per plant (Table 2). The parent, BBGH-77 is a good general combiner for days to 50% flowering and monopodia per plant. The parents, BBGH-33 and BL-7, are good general combiners for the trait, number of monopodia per plant. The parent, BBGH-26 is a good general combiner for ginning outturn. The parents BBGH-26, BBGH-1 and BGH-94 are good combiners for the traits *viz.,*, sympodia per plant, no. of bolls per plant, boll weight, plant height and seed cotton yield per plant. The parent GHL-8 is a good combiner for number of bolls per plant, boll

Table 1. Analysis of variance of combining ability for seed cotton yield and yield components in cotton (*Gossypium hirsutum* L.) during *kharif* 2013-14.

Source of variation	d.f.	Plant height (cm)	Days to 50% flowering	No. of monopodia per plant	No. of sympodia per plant	No. of bolls per plant	Boll weight (g)	Ginning out-turn (%)	Seed cotton yield per plant (g)
Replicates	2.00	40.22	0.13	0.10*	2.63	5.82	0.01	0.11	22.49
Treatments	54.00	356.47**	15.56**	0.27**	7.70**	63.54**	0.61**	4.22**	3073.26**
Parents	9.00	144.98**	20.36**	0.07**	4.59	40.35**	0.62**	2.80	402.64
Hybrids	44.00	188.26**	11.87**	0.26**	7.11**	36.76**	0.38**	4.20**	1873.40**
Parent *vs* Hybrids	1.00	9661.21**	134.57**	2.67**	61.40**	450.80**	10.89**	17.88**	79902.88**
Error	108.00	20.45	0.95	0.03	3.97	2.72	0.02	1.90	219.32
Total	164.00	131.33	5.75	0.11	5.18	22.79	0.22	2.64	1156.63
gca	9.00	153.26**	14.00**	0.14**	4.58**	25.34**	0.26**	2.04**	1268.70**
sca	45.00	111.94**	3.42**	0.08**	2.16	20.35**	0.19**	1.28**	975.57**
Error	108.00	6.82	0.32	0.01	1.32	0.91	0.01	0.63	73.11

** = Significance at 1% level *= Significance at 5% level

Table 2. General combining ability effects of parental lines for seed cotton yield and yield component characters in cotton (*Gossypium hirsutum* L.) during *kharif* 2013-14.

S.No	Parent	Plant height (cm)	Days to 50% flowering	No. of monopodia per plant	No. of sympodia per plant	No. of bolls per plant	Boll weight (g)	Ginning out-turn (%)	Seed cotton yield per plant (g)
1	BBGH-77	-7.30	-2.44**	-0.23**	-1.16**	-2.78**	-0.05*	-0.26	-15.78**
2	BBGH-3	1.51*	0.31	0.00	0.08	0.08	0.04	0.17	2.00
3	BBGH-26	2.64**	0.73	0.12**	0.78**	1.44**	0.11**	0.70**	10.40**
4	BBGH-33	-3.20**	-0.49	-0.09**	-0.24	-1.20**	0.00	-0.47*	-5.24*
5	BBGH-1	4.26**	0.76	0.06*	0.73**	1.37**	0.23**	0.41	14.06**
6	GHL-5	1.74*	0.37	0.07*	0.05	1.53**	-0.15**	-0.51*	1.52
7	BL-7	-1.13	0.39	-0.09**	-0.48	-0.44	-0.09**	-0.12	-4.74*
8	GHL-8	0.51	0.88	0.08**	0.08	0.56*	0.11**	0.19	6.12*
9	BGH-94	3.57**	0.72	0.08*	0.65**	0.92**	0.09**	0.28	7.41**
10	BGH-23	-2.61**	-1.23	0.00	-0.48	-1.48**	-0.29**	-0.40	-15.75**

** = Significance at 1% level *= Significance at 5% level

Table 3. Specific combining ability effects of hybrids for seed cotton yield and yield component characters in cotton (*Gossypium hirsutum* L.) during *kharif* 2013-14

S.No.	Hybrid	Plant height (cm)	Days to 50% flowering	No. of monopodia per plant	No. of sympodia per plant	No. of bolls per plant	Boll weight (g)	Ginning out turn (%)	Seed cotton yield per plant (g)
1	BBGH-77 x BBGH-3	-7.87**	-2.50**	-0.16	-1.78	0.92	0.09	0.38	8.27
2	BBGH-77 x BBGH-26	3.5	-2.14**	-0.23*	1.18	3.11**	-0.03	0.42	13.75
3	BBGH-77 x BBGH-33	2.56	1.74**	-0.03	0.98	7.50**	-0.01	1.2	30.52**
4	BBGH-77 x BBGH-1	16.36**	3.49**	0.21*	3.43**	6.96**	0.08	0.1	33.99**
5	BBGH-77 x GHL-5	12.04*	3.00**	-0.1	1.99	4.10**	0.04	0.87	19.75*
6	BBGH-77 x BL-7	-4.84	0.20	-0.15	-2.26*	-2.02*	-0.57**	-0.46	-29.32**
7	BBGH-77 x GHL-8	9.52**	1.82**	-0.09	1.42	2.03*	0.20*	0.46	15.15
8	BBGH-77 x BGH-94	-4.44	-2.05**	-0.08	-1.35	-3.46**	0.13	-1.01	-12.25
9	BBGH-77 x BGH-23	-7.70**	-1.41**	0.65**	-0.55	-3.53**	-0.27**	-0.76	-22.43**
10	BBGH-3 x BBGH-26	7.25**	1.00	0.07	1.18	6.69**	0.18*	-0.04	35.09**
11	BBGH-3 x BBGH-33	-7.03**	-2.78**	-0.30**	-1.03	-6.21**	-0.24**	-1.11	-36.27**
12	BBGH-3 x BBGH-1	4.52	1.17*	0.44**	0.33	2.91**	0.18*	0.89	18.77*
13	BBGH-3 x GHL-5	2.59	0.36	0.04	1.34	0.16	0.33**	0.73	12.33
14	BBGH-3 x BL-7	9.36**	0.55	-0.15	0.58	2.43**	0.19*	-1.90*	17.78*
15	BBGH-3 x GHL-8	3.26	0.86	0.12	0.82	0.72	0.14	-0.77	5.71
16	BBGH-3 x BGH-94	7.76**	2.01**	0.37**	0.62	3.44**	0.37**	2.05**	29.08**
17	BBGH-3 x BGH-23	0.53	0.73	-0.26**	0.2	0.65	-0.47**	-1.51*	-14.98
18	BBGH-26 x BBGH-33	3.84	1.66**	0.38**	1.31	3.87**	-0.19*	0.03	9.98
19	BBGH-26 x BBGH-1	-6.61**	-2.79**	-0.1	-0.87	-2.59**	-0.05	0.06	-13.42
20	BBGH-26 x GHL-5	8.93**	0.61	0.34**	0.2	-2.29*	0.32**	-0.12	1.8
21	BBGH-26 x BL-7	6.63**	1.52**	-0.01	1.73	2.65**	0.27**	1.24	19.05*
22	BBGH-26 x GHL-8	-1.41	-1.01	0.04	-1.41	0.19	0.15	0.28	7.27
23	BBGH-26 x BGH-94	-0.25	0.92	-0.03	0.79	0.44	0.26**	-0.71	13.1

Table 3 Cont..

S.No.	Hybrid	Plant height (cm)	Days to 50% flowering	No. of monopodia per plant	No. of sympodia per plant	No. of bolls per plant	Boll weight (g)	Ginning out turn (%)	Seed cotton yield per plant (g)
24	BBGH-26 x BGH-23	16.14**	3.31**	0.39**	1.39	3.48**	0.49**	2.48**	33.61**
25	BBGH-33 x BBGH-1	9.47**	0.64	-0.07	2.02	5.27**	0.26**	2.32**	34.01**
26	BBGH-33 x GHL-5	12.86*	0.38	0.33**	0.83	3.55**	0.35**	0.16	29.44**
27	BBGH-33 x BL-7	-5.50*	0.14	-0.20*	-2.15*	-3.27**	-0.52**	-2.35**	-34.64**
28	BBGH-33 x GHL-8	4.42	0.29	0.05	0.87	3.08**	0.21**	0.35	22.62**
29	BBGH-33 x BGH-94	3.36	0.92	0.11	1.04	3.75	0.31**	1.13	27.22**
30	BBGH-33 x BGH-23	5.53*	0.76	-0.04	-1.13	0.12	0.12	-0.05	3.26
31	BBGH-1 x GHL-5	-0.51	-1.21*	-0.06	-1.98	3.29**	-0.40**	-0.29	-2.57
32	BBGH-1 x BL-7	6.49**	0	0.14	-0.3	2.62**	0.16*	0.62	17.62**
33	BBGH-1 x GHL-8	4.46	1.41**	0.23*	0.12	1.61	-0.03	-0.54	6.76
34	BBGH-1 x BGH-94	5.26*	0.66	-0.16	0.66	-0.68	0.17*	-0.78	3.47
35	BBGH-1 x BGH-23	7.08**	1.62**	0.12	-0.1	1.89*	0.44**	-0.07	24.51**
36	GHL-5 x BL-7	1.12	1.28*	0	1.56	3.58**	0.37**	0.13	29.05**
37	GHL-5 x GHL-8	3.48	-0.2	0.30**	0.12	-2.84**	0.53**	0.16	6.89
38	GHL-5 x BGH-94	3.08	-0.05	0.43**	0.23	2.78**	0.25**	-0.27	22.79**
39	GHL-5 x BGH-23	-0.29	-0.1	-0.37**	-1.34	-0.8	-0.19*	0.02	-11.05
40	BL-7 x GHL-8	4.35	-0.23	0.26**	1.53	-0.67	0.46**	2.01**	13.34
41	BL-7 x BGH-94	7.96**	0.16	0.25**	0.86	2.31*	0.25**	0.63	18.37*
42	BL-7 x BGH-23	8.24**	1.88**	0.29**	0.76	2.32*	0.76**	1.63*	37.02**
43	GHL-8 x BGH-94	-1.35	-1.45****	-0.35**	-1.7	0.41	0.13	-1.08	6.71
44	GHL-8 x BGH-23	9.84**	1.94**	0.30**	1.18	2.62**	0.52**	-0.39	29.46**
45	BGH-94 x BGH-23	-1.67	0.08	-0.22*	-0.37	-0.2	-0.32**	0.83	-13.83

** = Significance at 1% level *= Significance at 5% level

weight and seed cotton yield per plant. The parents, BBGH-3 and GHL-5 showed good general combining ability for plant height. The results are in accordance with the findings reported by Patil *et al*. (2011), Nassar *et al.* (2013), Srinivas *et al*. (2014) and Rehana (2018).

Specific combining ability (*sca*) effects were estimated for eight characters and are presented in Table 3. Twenty hybrids recorded highest positive significant *sca* effects for seed cotton yield. The hybrids, BL-7 x BGH-23 (37.02**) and BBGH-3 x BBGH-26 (35.09**) recorded the highest *sca* effects for seed cotton yield due to H^{-}*gca* x H^{-}*gca* and L^{+}*gca* x H^{+}*gca* effects of parents, respectively. The superior cross combinations from two high general combiners revealed the contribution of additive and additive x additive gene action. While, the superior hybrids resulted from low x high general combiners revealed the contribution of complementary gene action arising due to both additive and non-additive gene actions. These research findings are in accordance with the results obtained by Alkuddsi *et al.* (2013), Nassar (2013), Kumar *et al.* (2013) and Rehana (2018).

Seventeen hybrids showed positive and significant *sca* effects in desirable direction for plant height. Eight hybrids showed significant negative *sca* effects for days to 50% flowering in desirable direction. Seven hybrids showed significant negative *sca* effects for monopodia per plant while only one hybrid, BBGH-77 x BBGH-1 (3.43**) showed significant and desirable positive *sca* effect for number of sympodia per plant. Twenty three cross combinations showed significant *sca* effects among 45 hybrids for no.of bolls per plant. Twenty three hybrids showed significant and positive *sca* effects for boll weight which is desirable. Five cross combinations recorded significant and positive *sca* effects for ginning outturn.

CONCLUSION

This study showed the predominance of non-additive gene action in the expression of most of the traits. The study also indicated the usefulness of the parents, BBGH-26, BBGH-1, and BGH-94 as good general combiners for many of the seed cotton yield traits and these parents can be exploited in the breeding programmes. The hybrids, BBGH-26 x BGH-23 and BL-7 x BGH-23 showed good specific combining ability, indicating their exploitation for commercial cultivation after thorough testing.

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