J. Cotton Res. Dev. **29** (1) 19-22 (January, 2015)

Combining ability study for yield and its component traits through line x tester mating design in Asiatic (*Gossypium herbaceum* L.) cotton

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ABSTRACT : The objectives of this research were to estimate general and specific combining abilities of F_1 hybrids, to identify suitable parents and hybrids for yield and its contributing traits. Line x tester analysis involving 4 lines and 10 testers was carriedout to study 8 traits in Asiatic cotton. Analysis revealed significant GCA and SCA mean squares for all the traits; however additive as well as non additive gene effects were important for most of the traits. Among the four female lines, G.Cot 23 showed significant GCA effect for seed cotton yield, boll weight, ginning percentage, 50 per cent boll bursting and plant height, while female lines G.Cot 17 and Jaydhar were good general combiner for ginning percentage and 50 per cent boll bursting, respectively. Among the tester parents, GBhv 178 and GBhv 215 were desirable as it manifested higher estimates of GCA effects for majority of the traits, while tester parent GBhv 198 was good general combiner for seed cotton yield and boll weight. The hybrids G.Cot 23 x GBhv 191, Jayadhar x GShv 820/91, Jayadhar x GBhv 198, Digvijay x GShv 695/93 and G.Cot 17 x GShv 384/92 exhibited significantly higher SCA effect for majority of the character under study. For ginning percentage the hybrids G.Cot 17 x GShv 820/91, Jayadhar x GShv 820/91 and Digvijay x GShv 820/91 exhibited highly significant SCA effect. The crosses involving diverse type of parents and showing high SCA effects for seed cotton yield/plant could be successfully utilized for exploitation of hybrid vigour.

Key words : Cotton, gene effects, general combining ability, specific combining ability, L x T crosses

Asiatic (*desi*) cottons are still cultivated on large scale in India because of their good agronomic base strong resistance to disease and pest, drought tolerance and suitability under rainfed conditions. After the introduction of *Bt* cotton, significantly deceased the area of *desi* cotton because of their smaller boll size and low potentiality of yield but now there is a big demand of short staple cotton for denim and surgical cotton and hence price is now increase of short staple cotton due to shortage of *desi* cotton. Genetic diversity is the first step to create unique gene combinations for superior new cultivars. Thus, breeders tend to select genetically diverse parent having different genes. Knowledge on combining ability is useful for selection of desirable parents for exploitation of hybridity and transgressive expressions. Combining ability studies also elucidate the nature and magnitude of gene action involved in the inheritance of seed cotton yield and its related characters which will be useful to follow segregating material. Line x tester analysis would reveal general combining ability (GCA) effects of parents and specific combining ability (SCA) effects of hybrids.

The genetic population was developed through line x tester (4 x10) mating design. Four well adapted commercial cotton cultivars (Digvijay, G.Cot 17, G.Cot 23 and Jaydhar) were used as lines and were hand crossed with 10 cotton genotypes treated as testers (GShv 384/92, GShv 695/93, GShv 820/91, GShv 613/97, GShv 531/92, GBhv 178, GBhv 191, GBhv 198, GBhv 201 and GBhv 215) and their 40 crosses and one commercial hybrid as a check (G. Cot. DH 9) were grown in randomized block design with 3 replications at Regional Cotton Research Station, Maktampur, Bharuch during *kharif* 2011-2012. One row of each treatment having 5.4 m length with 12 dibbles was sown. Observations were recorded on 5 randomly

Table 1. Analysis of variance for combining ability for different characters in cotton.

Source of variation	d.f.	Seed cotton yield/ plant (g)	GOT (%)	Boll weight (g)	Bolls/ plant	Mono-podia/ plant	Sym-podia/ plant	Plant height (cm)	Days to 50 per cent boll bursting
Replication	2	111.87	0.16	0.01	6.41	0.13	2.25	29.30	36.43
Females	3	12503.42**	144.36**	3.42**	392.27*	11.96^{NS}	9.66^{NS}	8890.31**	3061.53**
Males	9	2209.48**	6.89^{NS}	0.09*	307.66*	9.86^{NS}	9.82^{NS}	1390.11^{NS}	508.68**
Males x Females	27	660.06**	9.13**	0.04**	108.48**	5.67**	7.43**	732.33**	42.67**
Error	78	56.05	1.32	0.002	11.85	0.18	0.99	31.49	16.89
Estimates									
ó^{2}f		394.78**	4.51**	0.11**	9.46*	-	-	271.93**	100.63**
ó^{2}m		129.12**	-	0.00	16.60*	-	-	-	38.83**
ó^{2}fm		200.84**	2.63**	0.01	31.55**	1.83**	2.14**	234.40**	8.98**
ó^{2}GCA		318.87	3.17	0.08	11.50	-	-	209.89	82.97
ó^{2}SCA		200.84	2.63	0.01	31.55	1.83	2.14	234.40	8.98
ó^{2}GCA / ó^{2}SCA		1.59	1.21	6.28	0.36	-	-	0.89	9.24

* Significant at 5 per cent ** Significant 1 per cent NS – Non significant

selected plants in each plot on seed cotton yield, plant height, boll number, boll weight, ginning percentage, monopodia, sympodia and 50 per cent boll bursting. After recording the observations for each character, the analysis of variance was carried out. The mean square from line x tester design and the general combining ability (GCA) and specific combining ability (SCA) variance and effects were calculated.

The combining ability variance was computed for 8 characters. The estimates of general combining ability (GCA) variances for female and male were significant for days to 50 per cent flowering, bolls/plant, boll weight and seed cotton yield/plant, it indicated the variability present in the population. Where as, specific combining ability (SCA) variances for F x M interaction were highly significant for all

Table 2. Estimation of general combining ability effects of parents for different characters in cotton.

Parents	Seed cotton yield/ plant(g)	G.P (%)	Boll weight (g)	Bolls/ plant	Mono-podia/ plant	Sym-podia/ plant	Plant height (cm)	Days to 50 per cent boll bursting
Digvijay	-14.29**	0.24	-0.11**	-4.65**	0.64**	0.81**	23.45**	12.50**
G.Cot. 17	7.36**	2.19**	0.04**	2.04**	0.24**	-0.50**	-12.12**	2.33**
G.Cot. 23	25.47**	0.60**	0.44**	-0.94	-0.03	-0.21	2.34*	-3.27**
Jaydhar	-18.53**	-3.04**	-0.37*	3.54**	-0.85**	-0.10	-13.66**	-11.57**
S.E.(g_i)	1.39	0.20	0.01	0.68	0.07	0.18	0.98	0.72
S.E.(g_i- g_j)	1.96	0.29	0.01	0.96	0.11	0.26	1.39	1.02
GShv 384/92	-0.45	0.62*	-0.19**	4.21**	-0.11	-0.78	0.03	4.50**
GShv 695/93	-31.87**	0.57	-0.05**	-11.09**	0.41**	-1.65**	13.58**	15.67**
GShv 820/91	9.85**	0.69*	-0.04**	5.03**	2.31**	-0.48	-12.77**	-0.58
GShv 613/97	-13.10**	0.98**	-0.05**	-5.07**	0.09	0.37	-11.23**	2.00
GShv 531/92	-2.67	0.02	0.14**	-2.82**	-0.52**	1.05**	-15.68**	-0.58
GBhv 178	8.30**	-0.78*	0.02*	4.43**	-0.36**	1.18**	12.20**	-4.50**
GBhv 191	0.42	0.02	0.03*	-0.12	-0.34**	0.03	9.93*	-7.33**
GBhv 198	10.17**	-1.03**	0.06**	0.93	-1.16**	-0.68*	2.22	-1.58
GBhv 201	8.00**	-0.67*	0.04**	1.83	-0.02	0.82**	6.73**	-2.08
GBhv 215	11.37**	0.95*	0.05**	2.69*	-0.12	0.15	-5.02**	-5.50**
S.E. (g_j)	2.19	0.32	0.01	1.07	0.12	0.29	1.55	1.14
S.E. (g_i-g_j)	3.10	0.45	0.02	1.52	0.18	0.41	2.20	1.61

* Significant at 5 per cent ** Significant 1 per cent

the characters. The combining ability variance and genetic components are incorporated in Table 1. Non additive type of genetic variance was observed to play a central role in case of days to 50 per cent boll bursting, bolls/plant, boll weight and seed cotton yield/plant (Preetha and Raveendran (2008). Estimate of general and specific combining ability effects for all the characters are presented in Table 2 and 3, respectively. Among female parents G.Cot.23 and G.Cot. 17 were found to be the best general combiner for days to 50 per cent boll bursting, ginning percentage, boll weight and seed cotton yield per plant.. Amongst male parents, GBhv 215

Table 3. Estimation of specific combining ability effects of hybrids for different characters in cotton

Hybrids	Seed cotton yield/ plant(g)	G.P (%)	Boll weight (g)	Bolls/ plant	Mono-podia/ plant	Sym-podia/ plant	Plant height (cm)	Days to 50 per cent boll bursting
Digvijay x GShv 384/92	6.27	0.02	0.06*	3.52	-2.74**	2.20**	-11.23**	-8.33**
Digvijay x GShv 695/93	19.42**	0.36	0.09**	5.22*	0.68**	-0.46	12.62**	-4.50*
Digvijay x GShv 820/91	-12.76**	-2.67**	-0.14**	-2.30	0.44	-0.43	-18.10**	-2.58
Digvijay x GShv 613/97	3.92	-0.61	-0.08**	4.07	1.44**	1.45*	1.10	2.17
Digvijay x GShv 531/92	-8.85*	-0.75	-0.07*	3.22	-0.39	-1.16*	-10.18**	4.75*
Digvijay x GBhv 178	14.32**	-1.52*	-0.02	9.37**	1.98**	0.90	3.53	1.33
Digvijay x GBhv 191	-3.40	2.35**	0.06*	-2.55	-1.17**	-1.41*	-0.13	3.17
Digvijay x GBhv 198	4.59	1.70**	0.05**	-3.40	-0.62*	-0.76	14.85**	2.88
Digvijay x GBhv 201	-1.31	-1.43*	0.10**	-8.17**	-0.69**	0.40	-7.40*	0.25
Digvijay x GBhv 215	-22.21*	2.55**	-0.04	-8.97**	1.08**	-0.73	14.95**	1.67
G.Cot 17 x GShv 384/92	16.22**	-1.10	0.18**	0.76	0.73**	2.25**	27.67**	2.50
G.Cot 17x GShv 695/93	-5.16	-1.26	0.01	0.79	-0.72**	-0.28	-16.81**	0.00
G.Cot 17 x GShv 820/91	3.52	2.61**	0.06*	-2.13	-0.09	0.68	-4.59	0.25
G.Cot 17 x GShv 613/97	-0.86	1.20	0.04	-0.16	-0.36	-0.03	-2.99	0.33
G.Cot 17 x GShv 531/92	1.51	0.63	0.02	1.32	1.08**	-1.12	14.72**	-2.08
G.Cot 17 x GBhv 178	-4.39	1.16	0.06*	-0.86	-1.22**	-1.98*	-12.29**	-2.17
G.Cot 17 x GBhv 191	-12.64**	-1.20	0.02	-6.11**	-0.51*	-0.90	-15.16**	-4.00
G.Cot 17 x GBhv 198	-3.13	-1.02	0.03	-0.56	0.44	1.62**	-6.11*	-0.42
G.Cot 17 x GBhv 201	5.31	0.48	0.04	4.27*	0.31	1.18*	24.04**	4.42
G.Cot 17 x GBhv 215	-0.39	-2.50	-0.21*	2.67	0.34	-1.42*	-8.48**	1.17
G.Cot 23 x GShv 384/92	-7.82	-0.11	-0.25**	0.80	1.06**	-0.84	-2.99	-0.90
G.Cot 23x GShv 695/93	-5.20	3.10**	-0.09**	-0.16	-0.06	0.43	2.80	-0.40
G.Cot 23 x GShv 820/91	-15.45**	-1.64*	0.16**	-6.21**	-2.02**	0.40	19.15**	-1.48
G.Cot 23 x GShv 613/97	7.23	-0.78	-0.17**	4.42*	-0.22	-0.99	-3.25	-2.73
G.Cot 23 x GShv 531/92	7.13	-1.32*	0.07*	-0.63	-0.32	-0.14	-5.14	1.85
G.Cot 23 x GBhv 178	10.97*	0.68	0.05	-0.21	-0.56*	1.06	3.65	-1.23
G.Cot 23 x GBhv 191	25.58**	-0.21	0.10**	7.34**	3.49**	1.81**	28.25**	1.60
G.Cot 23 x GBhv 198	-21.90**	-1.43*	-0.07*	-2.51	-0.89**	-1.47*	-15.90**	2.52
G.Cot 23 x GBhv 201	-5.47	2.04**	0.02	-1.61	0.11	-1.10	-2.95	0.68
G.Cot 23 x GBhv 215	4.90	-0.31	0.08**	-1.21	0.59*	-1.17*	-28.60**	0.10
Jaydhar x GShv 384/92	-14.58**	0.19	0.01	-5.08*	0.95**	-3.62**	-13.45**	6.73**
Jaydhar x GShv 695/93	-9.07*	-2.20**	-0.01	-5.84**	0.10	0.32	1.40	4.90*
Jaydhar x GShv 820/91	24.68**	1.70**	0.05	10.64**	1.67**	-0.65	3.55	3.82
Jaydhar x GShv 613/97	-10.30*	0.19	0.11**	-8.33**	-0.86**	-0.43	5.15	0.23
Jaydhar x GShv 531/92	0.20	1.45*	-0.01	-3.91	-0.36	2.42**	0.60	-4.52*
Jaydhar x GBhv 178	-20.90**	-0.31	-0.10**	-8.29**	-0.20	0.02	5.11	2.07
Jaydhar x GBhv 191	-9.55*	-0.94	-0.19**	1.32	-1.81**	0.50	-12.95**	-0.77
Jaydhar x GBhv 198	20.43**	0.74	0.05	6.47**	1.07**	0.62	7.16*	-4.18
Jaydhar x GBhv 201	1.47	-1.09	0.07**	5.51*	0.27	-1.48*	-13.69**	-5.35*
Jaydhar x GBhv 215	17.70**	0.26	0.17**	7.51**	-0.83**	2.32**	17.13**	-2.93
S.E. (S_{ij})	4.38	0.65	0.03	2.15	0.25	0.58	3.12	2.29
S.E. (S_{ij}-S_{kl})	6.19	0.91	0.04	3.04	0.35	0.83	4.41	3.24

* Significant at 5 per cent ** Significant 1 per cent

and GBhv 178 were observed to be the top combiner for days to 50 per cent boll bursting, bolls/plant, boll weight and seed cotton yield/ plant. The parent GBhv 198 was good combiner for seed cotton yield and boll weight.

The hybrid G.Cot 23 x GBhv 191 exhibited maximum SCA effect 25.58 for seed cotton yield and it was closely followed by Jaydhar x GShv 820/ 91(24.68). For bolls/plant Jaydhar x GShv 820/ 91 recorded maximum SCA effect 10.64, closely followed by Digvijay x GBhv 178 (9.37). Regarding boll weight G.Cot 17 x GShv 384/92 and Jaydhar x GBhv 215 were the best specific combinations with the highest SCA effect 0.18 and 0.17, respectively. G.Cot 23 x GShv 695/93 (3.10) was the highest ranking hybrid for ginning percentage. For earliness point of view Digvijay x GShv 384/92 and Jaydhar x GBhv 201 possessed significant desirable negative SCA effects 8.33 and 5.35, respectively. The hybrid G.Cot 23 x GBhv 191 depicted highest SCA effect 3.49 for monopodia/plant whereas Jaydhar x GShv 531/92 possessed maximum value of SCA 2.42 for sympodia/plant and it was closely followed by Jaydhar x Gbhv 215 (2.32). However, plant height was concerned again the hybrid G.Cot 23 x GBhv 191 ranked first with 28.25. The hybrid G.Cot 23 x GBhv 191 expressed highly significant SCA effect for all the characters except ginning percentage and 50 per cent boll bursting.(Table 3).

The best cross combination for different characters usually did not combine the respective best male and female parents. Seven cross combinations for seed cotton yield showed conspicuous SCA effects. The best specific combination, G.Cot 23 x GBhv 191 involved good x average combining parent. The cross combinations Jaydhar x GShv 820/91, Jaydhar x GBhv 198, Digvijay x GShv 695/93, Jaydhar x GBhv 215 and G.Cot 17 x GShv 384/92 which had also high SCA effect for seed cotton yield also register significant SCA effects for bolls/plant, boll weight and plant height. The results regarding significant GCA and SCA effects are in conformity with those of (Ahuja and Dhayal (2007).

The significance of GCA and SCA mean squares suggests the importance of both additive and non additive variances for all the characters. A comparison was made of the crosses selected on the basis of their SCA effects with their mean performance in various traits. There was no consistent association between *per se* performance of the crosses and their SCA effects. These estimates may also be biased because of non fulfillment of any of the assumption involved in the models. Hence, the choice of best cross combinations should be based on GCA ,SCA or in combination could be more realistic and useful. Almost identical results have been reported by Ahuja and Tuteja (2000) and Rao and Reddy (2002).

The study of combining ability has revealed that selection of bolls and boll weight might result in the improvement of yield. Further, more the potential breeding material for yield and its components may be handled through recurrent selection.

REFERENCES

Ahuja,S. L. and Dhayal, L. S. 2007. Combining ability estimates for yield and fibre quality traits in 4 x 13 line x tester crosses of *Gossypium hirsutum. Euphytica* **153** : 87-98

Ahuja, S.L. and Tuteja, O.P. 2000. Heterosis and combining ability for yield and its component traits in upland cotton. *J. Cotton Res. Dev.*,**14** : 138-42.

Preetha, S. and Raveendran, T. S. 2008. Combining ability and heterosis for yield and fibre quality traits in line x tester crosses of upland cotton. *International J. Plant Breed. Gene.* **2** : 64-74.

Rao, G., Nageshwara and Reddy, M. Shivasantha 2002. Combining ability studies of yield and yield contributing traits using diversified plant types in cotton. *J. Cotton Res. Dev.*, **16** : 19-23.

Recieved for publication : March 30, 2013
Accepted for publication : July 25, 2013