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Study of High Heterotic Crosses in Relation to Combining Ability and Genetic Divergent Parents in *Herbaceum* Cotton

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ABSTRACT

Study was conducted on genetic divergence among sixty genotypes of G. herbaceum along with their combining ability and heterosis using 10 diverse parents in diallel analysis. Observations on five representative randomly chosen plants were recorded for days to squaring, average boll weight, number of bolls per plant, number of seeds per boll, seed cotton yield per plant, lint yield per plant, ginning percentage, mean fibre length, fibre finness, fibre bundle strength, seed fibre index and mean values were used to compute D^2 *statistics, heterosis and combining ability following Model I method 2 of Griffings (1956). The comprehensive analysis of breeding value of different genotypes was done based upon heterosis, combining ability effects of parents and crosses among them, and genetic divergence between parents involved in the cross. Highest heterosis for seed cotton yield per plant was observed in cross Gvhv 235 x Gvhv 473 followed by Gvhv 133 x Gvhv 235 and Gvhv 235 x Gvhv 404. These crosses involved parents with good general combining ability and maximum divergence among parents. Gvhv 404 and Gvhv 235 formed separate cluster with high cluster distance from rest of the clusters with high heterosis for seed cotton yield and many yield contributing characters. Gvhv 404 and Gvhv 235 figured potential parents worth exploiting for genetic gains for seed cotton yield and its contributing traits. Crosses Gvhv 235 x Gvhv 473 and Gvhv 235 x Gvhv 404 were identified to be exploited for genetic enhancement for yield improvement in G. herbaceum.*

Key words: *Heterosis, Cotton, Genetic, Genotypes*

INTRODUCTION

Cotton is a cash crop of textile significance and is considered to be the backbone of the wide spread network of agro-based industries in the country. It occupies vital position in the overall development of our agrarian developing country for it's largest employment generating potential as compared to any other crop. Beside textile, cotton has a wide range of by-products having variety of end uses. There are four cultivated species of cotton namely; *Gossypium hirsutum*, *G. barbadense*, *G. arboreum* and *G. herbaceum* and all of these are cultivated in India.

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The qualitative and quantitative advantages of hybrids available especially in *G. hirsutum* have resulted in diverse change in cotton cultivation with shifting of area under *G. herbaceum* and *G. arboreum* to *G. hirsutum*.

However, Gujarat and Karnataka still grow *G. herbaceum* on very large acerage without much spectacular yield enhancement. Large scale adoption of hybrids has revolutionized the yield of *G. hirsutum* cotton in many states including Gujarat. The germplasm enhancement and heterotic breeding for commercial exploitation needs to be taken up urgently and meticulously in *G. herbaceum* for improving the productivity especially in unfavourable cultural conditions.

MATERIAL AND METHODS

Sixty genotypes of *G. herbaceum* selected from large collections of germplasm maintained at Cotton Research Station, Viramgam were subjected to D^2 analysis to study the genetic divergence. All the sixty genotypes were grown in randomized complete block design with three replications keeping the distance between rows and plants as 120 cm and 30 cm respectively to study the genetic divergence. Observations on five randomly chosen plants per replication per treatment were recorded for eleven characters i.e. days to squaring, average boll weight(g), number of bolls per plant, number of seeds per boll, seed cotton yield per plant, lint yield per plant (g), ginning percentage, mean fibre length (mm), fibre fineness (mg), fibre bundle strength (g/tex) and Seed fibre index (g) and their mean values used to compute the D^2 values as per Mahalanobis[1].

Ten parents with divergent D^2 values were selected to investigate the heterosis and combining ability using diallel analysis. Ten parents and their forty five hybrids were evaluated for heterosis and combining ability at two locations (Regional Cotton Research Station, Viramgam and Agriculture Research Station, Dhandhuka) during *Kharif* 2003-04. The parents and hybrids were grown in randomized block design in three replications and all recommended production technology was followed to raise the normal crop. Observations on five randomly chosen plants per replication per treatment per location were recorded on eleven characters and plot means were used for analysis of variance and calculating the heterosis and combining ability following Model I method 2 of Griffings[2]. Results of study on genetic divergence and combining ability have been reported separately[4,5]. The present study includes comprehensive analysis of breeding values of different genotypes based upon different parameters like heterosis, combining ability effects of parents and crosses among them and genetic divergence between two parents involved in the cross.

RESULTS AND DISCUSSION

The choice of parents for heterosis breeding from superior germplasm is made based upon their *per se* performance, combining ability and genetic divergence. The specific set of parents for high yielding hybrids are chosen on the basis of their specific combining ability and nicking potential of parental lines for yield and yield contributing characters including fibre quality. Divergent parents with distinctive attributes are generally used in breeding programme. The present study conducted on genetic divergence in sixty genotypes and combining ability of ten selected parents (based on D^2 value) and their forty five hybrids has brought out very useful information which can be used in crop improvement programme of *herbaceum* cotton. The highest heterotic crosses for different characters along with combining ability effects and genetic divergence are presented in Table1. The highest heterosis for seed cotton yield per plant was recorded by Gvhv 235 x Gvhv 473. This cross combination had significant specific combining ability effect and involved good x good general combiner. The two parents involved in the cross were grouped into different clusters (16 and 9) with cluster distance of 8.89. The high heterosis for seed cotton yield per plant in Gvhv 235 x Gvhv 473 was accompanied by high heterosis for number of bolls per plant and lint yield per plant. Cross combination Gvhv 235 x Gvhv 404 with high cluster distance between parents also exhibited high positive heterosis over better parent and significant specific combining ability effect for seed cotton yield per plant.

The crosses between parents from the same clusters do not exhibit high heterosis for either seed cotton yield or any of the direct yield contributing characters. However, B.Ged x Gvhv 133 (both parents from cluster-I) for early squaring and number of seed per boll and V797 x Gvhv 352 (parents from cluster-II) for fibre bundle strength showed high heterosis. Gvhv 404 (cluster-XVII) and Gvhv 235 (cluster-XVI) forming separate cluster with high cluster distance from rest of the clusters figured potential parents exhibiting heterosis for seed cotton yield and many of its contributing characters. There are different reports in the literature regarding relationship between genetic divergence among the parents and the extent of heterosis in their cross combinations. In the present study, in majority of the cases high heterotic crosses were the combinations of the divergent parents. These parents should be exploited for genetic enhancement and heterosis breeding in *G. herbaceum* for improvement in seed cotton yield.

Table 1: High heterotic crosses for different characters alongwith combining ability effects and genetic divergence of parents

Sr. No	Characters	Cross Combinations	Hete-rosis over B.P. / M.P.	SCA effect	GCA effect of parents		Cluster number		Clusters distance between parents
					P1	P2	P1	P2	
1.	Days to squaring	W8 X Gvhv 473	-29.87	-17.33**	4.67**	4.50**	13	9	8.24
		B.Ghed X Gvhv 133	-29.35	-10.19**	15.67**	3.28**	1	1	
		B.Ghed X Gvhv 235	-27.61	-11.14**	15.67**	-1.44**	1	16	8.59
2.	Average boll weight	V797 X Gvhv 133	22.07	4.30**	-0.86**	4.30**	2	1	6.99
		V797 X Gvhv 404	22.43	4.98**	-0.86**	-2.80**	2	17	8.39
3	No. of bolls per plant	Gvhv 249 X Gvhv 473	113.32	29.00**	10.26**	1.44**	18	9	15.7
		Gvhv 235 X Gvhv 473	93.17	13.01**	8.18**	1.44**	16	9	8.89
		Gvhv 133 X Gvhv 235	30.88	8.18**	-5.04**	8.18**	1	16	8.59
4.	No. of seeds per boll	B.Ghed X Gvhv 133	27.78	2.70**	-0.31	0.86**	1	1	
		W8 X Gvhv 404	15.77	2.45**	-1.41**	-0.15	13	17	9.8
		W8 X Gvhv 473	15.00	3.54**	-1.41**	-0.65**	13	9	8.34
5.	Seed cotton yield per plant	Gvhv 235 X Gvhv 473	85.92	21.97**	14.61**	5.82**	16	9	8.89
		Gvhv 133 X Gvhv 235	59.40	14.61**	-0.58	14.61**	1	16	8.59
		Gvhv 235 X Gvhv 404	56.36	16.57**	14.61**	-2.27**	16	17	14.46
6.	Lint yield per plant	Gvhv 235 X Gvhv 473	60.56	7.22**	6.64**	0.38	16	9	8.89
		Gvhv 133 X Gvhv 235	54.06	6.64**	-0.04	6.64**	1	16	8.59
		Gvhv 235 X Gvhv 404	33.48	6.54**	6.64**	0.41	16	17	14.46
7.	Ginning percentage	Gvhv 352 X Gvhv 404	15.20	3.67**	-0.21	3.67**	2	17	8.39
		Gvhv 133 X Gvhv 404	13.72	2.45**	1.01**	3.67**	1	17	10.2
		W8 X Gvhv 404	11.62	3.79**	-0.68*	3.67**	13	17	9.8
8.	Mean Fibre length	W8 x Gvhv 473	8.55 @	1.87**	-1.13**	0.11	13	9	8.24
		W8 x Gvhv 235	8.06 @	1.33**	-1.13**	0.22	13	16	11.9
9.	Fibre fineness	Gvhv 346 x Gvhv 404	14.60 @	5.60**	2.42**	-6.96	1	17	10.2
		V797 x Gvhv 473	12.16 @	8.65**	0.78	1.13*	2	9	6.92
10.	Fibre bundle strength	Gvhv 235 X Gvhv 249	24.20	2.91**	1.55**	2.91**	16	18	17.12
		V797 X Gvhv 352	12.04 @	1.03*	0.08	-0.57**	2	2	
		Gvhv 352 X Gvhv 404	11.95 @	1.50**	-0.57**	1.50**	2	17	8.39
11.	Seed fibre index	Gvhv 352 X Gvhv 473	20.71 @	1.37**	-0.23	1.73**	2	9	6.92
		Gvhv 235 X Gvhv 346	17.22 @	1.70**	0.19	-0.07	16	1	8.59
		Gvhv 133 X Gvhv 352	18.41 @	1.11*	-0.55**	-0.23	1	2	6.99

Note: @ = Heterosis exhibited over mid parental value
** = Significant at 1% level of significance.

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