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Genetic improvement for seed cotton yield and its component traits through heterosis breeding in *Gossypium hirsutum* L

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Abstract : A study was made in *Gossypium hirsutum* cotton with 10x 10 diallel excluding reciprocals to estimate the magnitude of heterosis among different cross combinations for yield and its component traits. For this purpose 45 specific cross combinations were developed by using 10 diverse parents during 2008-2009. These hybrids along with 10 parents and standard check HHH 223 were planted during 2009-2010 at CCS Haryana Agricultural University, Cotton Research Station, Sirsa. The analysis of variance indicated the presence of variability among hybrids and their parents. Heterosis studies revealed that the maximum heterosis of 89.56 per cent for seed cotton yield was observed in cross combination HS 6 x H 1156 followed by H1156 x F 2013(81.7%). Heterosis for number of bolls/plant in H 1156 x RS 875 (74.59%), for boll weight in HS 6 x RS 875 (26.91%), for plant height in H 1117 x H1156 (21.82%), for monopodia in H 777 x 223M (178.05%), for in HS 6 x RS 875 (34.11%), for seed index in HS 88 x RS 875 (13.60%) and for ginning percentage in RS 875 x HS 274 (6.42%). The cross combination involving H1156 parent recorded significant positive heterosis for most of the characters. Thus, the parent H1156 can be used for exploitation of heterosis. The study also revealed good scope for commercial exploitation of heterosis as well as isolation of pure lines among the progenies of other heterotic F_1 hybrids.

Key words: *Gossypium hirsutum*, Cotton, heterosis, seed cotton yield

Cotton is one of the most important cash crops of India. On account of its agricultural as well as industrial importance, it is also called as 'White Gold'. In India, cotton is grown on about 12 million ha, which represents 27 per cent of the world cotton area. The average cotton productivity of cotton in India is about 482 kg/ha which is 64 per cent of world average of 754 kg/ha. Millions of people depend on cotton cultivation trade, transportation, ginning and processing for their livelihood. Therefore, there is a need to improve the productivity of cotton crop by developing a high yielding adaptable cotton variety or hybrid. Cotton is highly amenable for heterosis breeding and commercial exploitation of heterosis has achieved a spectacular success in India. Therefore, the present study was undertaken to find out the extent of useful heterosis over the check hybrid HHH 223 for seed cotton yield and its component traits in 45 hybrids obtained from 10 x 10 diallel involving genetically diverse parents.

The experimental material consisted of 10 parents of cotton *viz.*, H777, HS 6, HS 88, H1117, H 1156, RS 875, F 2013, F 2036, HS 274 and 223M were crossed in half diallel fashion during 2008-2009 to generate a total of 45 hybrids. These 45 hybrids alongwith 10 parents and one check hybrid HHH 223 were grown in a randomized block design (RBD) with three replications with a spacing of 100x 60 cm between row to row and plant to plant respectively

Table 1. Analysis of variance for yield and its component traits in upland cotton

S.V.	d.f.	Seed cotton yield/ plant	Boll number	Boll weight	Plant height	Monopods	Sympods	Seed index	GOT
Replication	2	380.0	83.0	0.02	159.4	0.6	1.1	0.5	0.2
Treatment	55	3242.8*	440.5*	0.30*	194.2*	5.7*	21.0*	1.0*	4.0*
Error	110	545.2	81.6	0.07	94.3	1.1	8.7	0.3	0.8

during 2009-2010. Five random plants were selected to record the data on seed cotton yield/ plant, bolls/plant, boll weight, monopods, sympods, seed index and ginning percentage. The data were statistically analyzed for estimation of useful heterosis (heterosis over best check HHH 223) as per standard method

The analysis of variance (Table1) indicated that the mean squares of genotypes for all the characters investigated were significantly different, indicating the presence of variability among hybrids and their parents.

Heterosis estimates over best check for different characters of 45 hybrid combinations is presented in Table 2. The results indicated that the phenomenon of heterosis was observed

Table 2 Heterotic effects for various characters

Sr No	Cross	Characters							
		Yield/ plant	Bolls	Boll weight	Height	Monopods	Sympods	Seed index	GOT
1	H 777 x HS6	-14.63*	-8.17	-9.04*	9.76*	4.88	-13.76*	-6.58*	-3.77*
2	H 777 x HS 88	-19.02*	-33.52*	5.02	-2.99	15.85	-20.20*	-2.19	-1.98
3	H 777 x H 1117	-19.51*	5.32	1.41	9.99*	41.46*	2.93	-3.51	-7.64*
4	H 777 x H 1156	-5.80	14.77*	-2.41	13.77*	-10.98	-2.64	-15.79*	-2.17*
5	H 777 x RS 875	32.36*	27.76*	0.00	8.53*	150.00*	-6.44	2.63	-2.55*
6	H 777 x F 2013	-15.42*	0.25	-7.23*	8.53*	-14.63	-0.59	-16.67*	-1.04
7	H 777 x F 2036	28.64*	21.55*	1.20	6.66	118.29*	-5.86	-3.51	-3.30*
8	H 777 x HS 274	18.45*	13.50	1.20	16.64*	86.59*	-16.11*	-8.33*	0.66
9	H 777 x 223M	14.83*	20.72*	-3.01	16.59*	178.05*	-9.81*	-6.58*	-4.72*
10	HS6 x HS 88	16.08*	29.02*	-2.81	10.95*	8.54	4.25	-6.14*	-6.04*
11	HS6 x H 1117	-12.38*	-24.40*	16.27*	0.97	106.10*	-20.50*	3.95	2.17*
12	HS6 x H 1156	89.59*	45.31*	25.30*	17.81*	159.76*	-12.45*	2.63	-2.36*
13	HS6 x RS 875	17.96*	30.61*	26.91*	20.40*	73.17*	34.11*	3.07	4.53*
14	HS6 x F 2013	-7.42	-10.52	11.04*	2.87	32.93*	-5.42	-7.46*	5.66*
15	HS6 x F 2036	-2.69	-6.40	18.47*	0.97	46.34*	-9.81*	10.96*	0.57
16	HS6 x HS 274	1.92	-27.57*	6.43	-5.12	60.98*	-19.47*	-8.33*	-1.89
17	HS6 x 223M	-7.52	-10.90	-3.61	-0.46	102.44*	-15.23*	-11.40*	2.83*
18	HS 88 x H 1117	-12.46*	-27.38*	19.68*	3.33	85.37*	-16.69*	-1.75	2.08
19	HS 88 x H 1156	9.15	-7.86	20.68*	8.56*	65.85*	-13.32*	3.07	-1.70
20	HS 88 x RS 875	-2.74	-29.47*	10.44*	3.81	58.54*	-11.71*	13.60*	-4.15*
21	HS 88 x F 2013	-20.35*	-21.36*	10.64*	15.65*	-12.20	4.69	-2.19	-0.09
22	HS 88 x F 2036	-4.81	-27.82*	24.10*	10.47*	17.07	2.49	4.82	-0.94
23	HS 88 x HS 274	11.72*	-7.03	14.66*	10.92*	60.98*	7.76	7.02*	-3.68*
24	HS 88 x 223M	51.68*	25.98*	21.69*	17.58*	29.27	13.03*	3.95	-1.60
25	H 1117 x H 1156	19.86*	3.23	17.87*	21.82*	73.17*	0.44	5.26	-3.49*
26	H 1117 x RS 875	1.38	-2.47	11.85*	20.88*	74.39*	0.29	10.09*	-2.83*
27	H 1117 x F 2013	10.98*	13.31	21.29*	12.83*	36.59*	3.37	3.07	-0.28
28	H 1117x F 2036	4.81	1.71	15.26*	10.47*	76.83*	29.14*	1.75	4.06*
29	H 1117x HS 274	29.80*	20.22*	8.63*	16.61*	24.39	1.90	2.63	4.72*
30	H 1117x223M	63.91*	51.71*	13.05*	14.96*	163.41*	-27.53*	-5.70*	3.58
31	H 1156x RS 875	54.32*	74.59*	8.63*	21.37*	53.66*	9.22	5.70*	-0.09
32	H 1156x F 2013	8 1.70*	64.45*	14.26*	13.31*	68.29*	-2.49	-5.70*	-1.32
33	H 1156x F 2036	62.80*	43.54*	11.04*	-1.14	143.90*	-4.83	-3.95	1.04
34	H 1156x HS 274	32.59*	13.37	11.65*	8.31*	68.29*	2.78	-7.46*	-2.26*
35	H 1156x223M	6.78	-6.53	-1.41	4.78	65.85*	28.70*	-10.09*	6.04*
36	RS 875x F 2013	26.34*	0.19	15.66*	16.13*	-12.20	-7.47	-16.67*	4.06*
37	RS 875x F 2036	14.92*	1.08	5.22	12.32*	52.44*	-4.10	-0.44	0.19
38	RS 875x HS 274	5.97	2.09	5.82	7.14*	34.15*	-2.49	-14.47*	6.42*
39	RS 875x223M	-13.27*	-19.46*	12.05*	5.26	40.24*	-5.42	-4.39	0.38
40	F 2013x F 2036	-7.52	-20.41*	3.41	-0.46	25.61	2.34	3.07	-3.11*
41	F 2013x HS 274	3.92	-2.79	10.44*	9.02*	12.20	-5.42	4.39	2.83*
42	F 2013x223M	22.72*	-4.50	14.06*	12.35*	13.41	-2.05	4.82	-0.47
43	F 2036x HS 274	2.44	10.84	-1.00	7.60*	12.20	3.95	-5.26	-0.94
44	F 2036x223M	6.12	-10.52	8.43*	3.36	36.59*	-4.54	-1.75	-1.89
45	HS 274x223M	-13.34*	-24.02*	4.82	8.53*	36.59*	-5.86	6.14*	-2.26

* Significant at 5 per cent level of significance

for all the characters, however, its magnitude varied with the characters. It is indicated that among 45 cross combinations, 20 cross combinations showed positive and significant heterosis over the check hybrid HHH 223 but the cross combinations HS 6 x H 1156, H 1156 x F 2013, H 1156 x F 2036 H, 1117 x 223M showed maximum and positive heterosis values for seed cotton yield. Heterosis for yield/plant was observed by Tuteja *et al.,* (2005), Patil *et al.*, 2009.

For bolls/plant, H 1117 x 223M, H 1156 x RS 875, H 1156 x F 2013 crosses showed highest heterosis value. With regards to boll weight, 27 cross combinations exhibited significant positive heterosis values but the crosses HS 6 x H 1156, HS 6 x RS 875, HS 88 x F 2036 had maximum and positive heterosis values while H 777 x HS 6, H 777 x F 2013 cross had negative and significant heterosis values. In case of plant height, 31 cross combinations exhibited positive and significant heterosis values but the maximum being in case of HS 6 x RS 875, H 1117 x H 1156, H 1117 x RS 875, H 1156 x RS 875 crosses. Not even single cross combinations showed negative and significant heterosis values for plant height (Jain *et al.*, 1998).

Thirty two cross combinations showed positive and significant heterosis values for number of monopods. Whereas, none of the cross combinations showed negative and significant heterotic values for this trait. Maximum heterosis effects were observed for H 777 x 223M, HS 6 x H 1156, H 1117 x 223M crosses. For number of sympods, only 4 cross combinations HS 6 x RS 875, HS 88 x 223M, H 1117 x F 2036, H 1156 x 223M exhibited positive and significant heterosis values. Majority of the cross combinations showed negative and significant heterosis effects for sympodial branches/plant.

Among 45 crosses, only 6 cross combinations HS 6 x F 2036, HS 88 x RS 875, HS 88 x HS 274, H 1117 x RS 875, HS 274 x 223M, H 1156 x RS 875 had positive and significant heterosis for seed index. Eleven cross combinations exhibited positive and significant heterosis effects for ginning percentage but the maximum heterotic effects were observed from HS 6 x F 2013, H 1156 x 223M, RS 875 x HS 274.

The scope of heterosis breeding is for exploitation of heterosis. The cross combinations HS 6 x H 1156, H 1117 x 223M, H 1156 x F 2013, H 1156 x F 2036 showed the standard heterosis values for seed cotton yield and the cross combination involving H 1156 parent recorded significant positive heterosis for most of the characters. Thus, these crosses and the parent H1156 can be used for development of hybrids. The study also reveals good scope for commercial exploitation of heterosis.

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