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Heterosis for seed cotton yield and attributing traits in American cotton (*Gossypium hirsutum* L.)

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ABSTRACT : The present study was undertaken to estimate economic heterosis with the objective of exploring possibilities of commercial utilization of newly developed hybrids. Material for this investigation comprised of forty American cotton hybrids developed on four female parents (testers) using ten male parents (lines) in line x testers mating design and one standard check (HHH 223).The experimental material was grown at CCS Haryana Agricultural University, Cotton Research Station Sirsa, during *kharif* 2014-2015 in a randomized block design with three replications. Observations were recorded for eight characters namely, plant height, monopods, bolls, boll weight, ginning outturn, seed index, lint index and seed cotton yield/plant. The economic heterosis was calculated over standard check HHH 223. Considerable amount of heterosis were recorded for seed cotton yield and other related characters under study. The hybrids H1117 × GS-10, H1117 × HS180, H1117 × PUSA1803, H1098 × HS180 , H1098 × RED 5-7, H1117 × Tamcot SP23 and H1098 × GS10 exhibited heterosis of more than 70 per cent and hence warrant their further testing over locations for commercial utilization.

Key words : American cotton, *Gossypium*, heterosis

Cotton (*Gossypium hirstum L.*) also known as **'White Gold'** is the crop of Indian history, civilization and industry. Cotton being a major cash and agri-crop in India has major impact on all over Indian agriculture. Among all the 80 cotton growing countries in the world, India occupies the fore most position in cotton acreage. Even after devoting so much land to cotton than any other country India lag behind in production due to its low productivity. This yield plateau in cotton productivity can be broken by identifying suitable high yielding hybrids exhibiting high economic heterosis and by increasing the area under hybrid cultivation. Hybrids are important not only for their high productivity but they are also generally good for stability of production. For commercial exploitation of heterosis, the magnitude of heterosis provides a guide to the choice of desirable parents for developing superior F1 hybrids, so as to exploit hybrid vigour or building the better gene pool after growing in subsequent generation. The main objective of conducting the present study was to identify the promising hybrids based on *per se* performance and heterosis.

The experiment consisted of forty American cotton hybrids developed during *kharif* 2014 on four female parents (testers) using ten male parents (lines) in line x tester mating design and one standard check (HHH 223). The experiment was conducted in a RBD with three replications at CCS Haryana Agricultural University, Cotton Research Station, Sirsa. A

spacing of 67.5 cm between rows and 60cm within the row was adopted. Hand emasculation was followed for crossing work. Data was collected on 5 randomly selected plants in each replication on 8 characters *viz.*, plant height, monopods and bolls/plant, boll weight (g), seed cotton yield/plant (g), ginning outturn, seed index (g) and lint index (g). The estimate of economic heterosis over standard check (HHH 223) was calculated as follows

$$\text{Per cent economic heterosis} = \frac{\overline{F}_1 - \overline{B}_1}{\overline{B}_1} x100$$

Where,

B_1 = mean performance of standard check

F_1 = mean performance of a cross.

The mean sum of squares for all the traits has been presented in Table 1. The perusal of data in table revealed that the mean sum of squares due to genotypes were highly significant for all the traits. This indicated that the material selected for the present investigation was quite appropriate for further genetical analysis as considerable amount of variability existed in the experimental material under investigation.

The heterosis for seed cotton yield and attributing traits over standard check hybrid HHH 223 of promising hybrids is presented in Tables 2 and 3. Persual of data in table reveled that for almost all the traits under study sustainable amount of economic heterosis were showed by several hybrids. For seed cotton yield, which is most important aspect of breeding, fifteen hybrids heterotic value of more than 70 per cent. Among which seven hybrids H1117 × GS10 (90.71 %), H1117 × HS180 (83.97 %), H1117 × PUSA1803 (83.57 %), H1098 × HS180 (80.27 %), H1098 × RED 5-7 (75.92 %), H1117 × Tamcot SP23 (75.37 %) and H1098 × GS10 (72.12 %) exhibited heterosis of more than 70 per cent. Both highest yielding hybrids H1117 × GS10, H1117 × HS180 also exhibited high heterotic values for number of monopods which were 88 and 138.99, respectively. Heterosis for seed cotton yield in American cotton has also been reported earlier by Solanki *et al.*, (2014), Sawarkar *et al.*, (2015), Sharma *et al.*, (2016) and Adsare *et al.*, (2017).

Out of forty crosses, eleven crosses showed desirable significant positive economic heterosis over standard check for boll/plant. Maximum heterosis (over 70%) was shown by crosses H1226 × HS 180 (100.12 %), H1117 × HS 180 (82.25 %) and H1098 × HS180 (71.97 %). These hybrids were also showing high heterotic values for seed cotton yield up to the extent of 58.26, 85.97 and 80.27 per cent, respectively

Table 1. Analysis of variance for different characters under study in upland cotton

Source of variation	d.f	Characters							
		Plant height (cm)	Mono-pods/ plant	Bolls/ plant	Boll weight (g)	Seed cotton yield/ plant (g)	Ginning outturn (%)	Seed index (g)	Lint index (g)
Replication	2	228.65	0.03	4.28	0.02	146.30	0.78	0.59	0.20
Treatment	40	252.18*	5.26*	211.85*	0.51*	2764.79*	5.64*	1.43*	0.58*
Error	80	62.37	0.10	17.29	0.08	79.16	1.47	0.45	0.19

Table 2. Extent of heterosis for different characters in upland cotton

Hybrids	Plant height (cm)	Mono-pods/ plant	Bolls/ plant	Boll weight (g)	Seed cotton yield/ plant (g)	Ginning outturn (%)	Seed index (g)	Lint index (g)
H1098 × GS10	-3.15	-21.85*	32.36	35.02*	72.12*	9.02*	12.15	28.34*
H1098 × Tamcot SP23	-1.59	-62.43*	52.22*	28.08*	50.28*	0.19	3.28	2.97
H1098 × FM 531B LINE 7	16.79*	-5.29*	6.89	-4.76	6.00	6.91	-1.40	9.39
H1098 × RED 5-7	-3.96	-11.48*	51.87*	7.80	75.92*	0.00	-13.54	-13.42
H1098 × HS180	1.78	-9.52*	71.97*	3.83	80.27*	1.73	-6.53	-3.87
H1300 × GS10	-1.97	66.51*	61.22*	28.84*	57.75*	0.58	11.22	12.11
H1300 × Tamcot SP23	4.70	-44.97*	-10.04*	24.88*	-26.66*	-0.58	-9.34	-10.53
H1300 × HS60	-1.97	-41.27*	9.81	28.41*	44.74*	3.07	18.23*	23.95*
H1300 × FM 531B LINE 7	-17.41*	99.84*	-22.20*	-16.09*	-31.90*	-4.61*	-11.68	-17.82*
H1300 × HS180	-0.78	173.70*	45.21	7.04	44.66*	6.33	-2.33	7.18
H1117 × GS10	-2.51	88.00*	68.58*	28.84*	90.71*	5.76	-2.33	6.39
H1117 × HS2	5.12	29.26	-4.21*	10.77	-13.48*	7.87*	6.55	20.71
H1117 × HS60	-3.56	-23.44*	28.16	33.04*	50.91*	1.73	19.63*	22.71*
H1117 × PUSA180	7.52*	190.63*	21.85	7.93	18.72	4.80	1.88	9.21
H1117 × HS180	9.39*	138.99*	82.25*	2.08	85.97*	8.06*	-21.49*	-11.66
H1226 ×PUSA1803	-5.08	29.26	10.98	2.74	6.04	-1.15	18.23*	16.66

indicating that bolls was mainly responsible for increase in seed cotton yield. Similar results were also reported by earlier workers Nakum *et al.*, (2014), Patel *et al.*, (2015) and Pundir *et al.*, (2017).

For boll weight, hybrids H1098 × GS10 (35.02 %), H1117 × H60 (33.04 %), H1117 × GS-10 (28.84 %), H1300 × GS10 (28.84 %), H1300 × HS60 (28.41 %), H1098 × Tamcot SP23 (28.08 %) and H1300 × Tamcot SP23 (24.88 %) showed high heterosis indicating the importance of this trait for the high heterotic value of seed cotton yield. Similar finding was also reported by Rajamani *et al.* (2014), Patel *et al.*, (2015) and Pushpam *et al.*, (2015).

As far as plant height is concerned, out of forty intra hirsutum crosses, three crosses showed positive significant heterosis for tallness while three crosses showed heterosis for dwarfness. Maximum heterosis for tallness was shown by H1098 × FM 531B LINE7 (16.79 %) followed by H1117 × HS180 (9.39 %) and H1117 × PUSA180 (7.52 %). Whereas maximum heterosis in negative direction was shown by the cross H1300 × FM 531B LINE7 (-17.41 %). Similar results were also confirmed by earlier workers Pushpam *et al.*, (2015) and Sharma *et al.*, (2016).

The crosses showing high heterosis for number of monopods were H1117 × PUSA180 (190.63 %), H1300 × HS180 (173.70 %), H1117 × FM 531B LINE7 (152.75 %) and H1226 × HS180 (151.85 %). Heterosis for this trait was reported by the earlier workers Kumar *et al.*, (2013) and Nirania *et al.*, (2013). Crosses showing heterosis for number of monopods were also showing hetrosis for seed cotton yield/plant, thus this character seems to play role in increased seed cotton yield/plant.

Table 3. Best crosses on the basis of heterosis for seed cotton yield and related characters

S. No.	Hybrids	Seed cotton yield/plant (g)	Mono-pods/ plant	Bolls/ plant	Boll weight (g)	Lint Index (g)	Ginning outturn (%)	Seed index (g)	Plant height (cm)
1	H1117 × GS 10	90.71*	88.00*	68.58*	28.84*	6.39	5.76	-2.33	-2.51
2	H1117 × HS 180	85.97*	138.99*	82.25*	2.08	-11.66	8.06*	-21.49*	9.39*
3	H1117 × PUSA 1803	83.57*	17.46	53.86*	18.27	13.24	6.72	2.34	-0.10
4	H1098 × HS 180	80.27*	-9.52*	71.97*	3.83	-3.87	1.73	-6.53	1.78
5	H1098 × RED 5-7	75.92*	-11.48*	51.87*	7.80	-13.42	0.00	-13.54	-3.96
6	H1117 × Tamcot SP 23	75.37*	-24.18*	59.11*	17.18	0.18	-0.77	1.40	4.74
7	H1098 × GS-10	72.12*	-21.85*	32.36	35.02*	28.34*	9.02*	12.15	-3.15
8	H1226 × HS 180	58.26*	151.85*	100.12*	-3.44	-2.97	4.03	-8.87	-3.75
9	H1300 × GS 10	57.75*	66.51*	61.22*	28.84*	12.11	0.58	11.22	-1.97
10	H1117 × HS 60	50.91*	-23.44*	28.16	33.04*	22.71*	1.73	19.63*	-3.56

Along with seed cotton yield quality traits are also the important criterion in the release of hybrid for general cultivation. Among all the characters studied, lowest heterotic values were found for ginning outturn. Out of 40 crosses, H1098 × GS10 (9.02 %), H1117 × HS180 (8.06 %) and H1117 × HS2 (7.87 %) showed desirable positive heterosis. For seed index and lint index only three crosses out of forty showed significant positive economic was shown by hybrids H1117 × H60 i.e. 19.63 and 22.71 per cent respectively, H1300 × HS60 *i.e.* 18.23 and 23.95 per cent, respectively. No particular pattern of heterosis was observed for seed index with respect to seed cotton yield and almost same pattern was shown by lint index. Dave *et al.*, (2014), Pushpam *et al.*, (2015) and. Lingaraja *et al.*, (2017) were also reported similar finding.

Present investigation revelved that seven hybrids exhibited heterosis of more than 70 per cent for seed cotton yield and significant heterotic values for other attributing traits. hence warrant their further testing over locations for commercial utilization.

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