HETEROSIS FOR SEED COTTON YIELD AND QUALITY CHARACTERS IN UPLAND COTTON (*G.hirsutum L.*)

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ABSTRACT

A line x tester crossing programme was taken up with four lines and eight testers with a view to obtain best heterotic crosses for seed cotton yield and its attributing traits. Heterosis over better parent and two standard checks were estimated for seed cotton yield and its contributing characters in 32 cross combinations. The Crosses viz., GBHV 148 x H 1452 and GBHV 164 x NDIH 1938 showed highly significant positive standard heterosis as well as heterobeltiosis for seed cotton yield per plant and numbers of bolls per plant. Both the crosses also registered high per se performance with significant standard heterosis for numbers of bolls per plant, ginning percentage and lint index. The crosses exhibited the highest heterosis due to increase in numbers of sympodia per plant, boll number and boll weight which significantly associated with increase in yield and these crosses could be considered for exploitation of hybrid vigour.

KEY WORDS: G. hirsutum L., heterosis, seed cotton yield

INTRODUCTION

Cotton is a major fibre crop of global importance value. Cotton, the king of fibre, is one of the momentous and an important cash crop exercising profound influence on economics and social affairs of the world. Any other fibre crop cannot be compared with cotton for its fibre quality. So for this reason cotton is also known as “White Gold”.

The first reference pertaining to cotton, as per the far known at present, is found in Hindu Rig-Veda hymen, which was written during 15th century B.C. The use of cotton during 800 B.C can be noted from the records of Manu′s “*Dharmashastra*”. The Sanskrit word *karpasa*-i was used in these literatures that are connected to *kapas* of modern Hindustan. The technological and agricultural term in English, Cotton, which describes cultivated species of *Gossypium* comes from the Arabic word qutum or kutum.

India is pioneer in commercialization of heterosis in cotton. A noticeable heterosis is reported in cotton by many workers (Khadi *et al.*, 1992). Even though heterosis occurs in cotton, it has not been utilized widely as compared to maize and castor due to difficulties in producing cheap commercial F_1 hybrid seed production. For better exploitation of heterosis in cotton, development of simple and economically viable hybrid seed production technique is essential. Commercial exploitation of heterosis is possible only when it is high and consistent across the diversified environments for large scale hybrid seed production.

For a successful heterosis breeding programme in any crop, there are two important strategies involved (i) There must be presence of significant heterotic effect in the hybrids that can be exploited easily, and (ii) The feasibility of the hybrid seed production on commercial base. Cotton is an often cross-pollinated crop in which hand emasculation and hand pollination technique is feasible to produce hybrid seeds. Heterosis is useful to decide the direction of future breeding programme and to identify the cross combinations which are promising in conventional breeding programme. In this study, several cross combinations exhibited conspicuous heterobeltiosis and standard heterosis for different traits.

MATERIALS AND METHODS

Eight diverse females (NH-630, H-1452, BS-30, NH-635, NDIH-1938, BS-79, GJHV-358 and H-1353) and four good testers (GBHV-148, GBHV-164, GBHV-177 and G.Cot.16) were used to generate thirty two cross combinations by using line x tester mating design. The resultant thirty two inter specific hybrids were tested against two checks *viz*., G.Cot.Hy-8 and G.Cot.Hy-12 for the estimation of heterosis. Complete set of treatments were grown in RBD with three replications. One row of each hybrid and parents were sown at spacing of 120 x 45 cm during 2011-12 at Regional Cotton Research Station, Navsari Agricultural University, Bharuch. Five plants were chosen from each row to record observations on seed cotton yield and its seven contributing traits (Table 1). Heterosis was estimated over better parent as per the standard procedure of Meredith and Bridge (1972) and useful heterosis suggested by Rai (1978).

RESULTS AND DISCUSSION

The analysis of variance for parents and their hybrids (Table 1) revealed significant differences among genotypes, parents, crosses, parents vs. crosses for all the eight traits suggesting the presence of considerable genetic diversity with respect to various studied traits. Variance due to females vs. males which reflected hybrid genetic makeup was also highly significant for lint yield per plant, seed index and lint index.

Heterosis over better parent and two standard checks for eight characters was presented in Table 2. For number of sympodia per plant, 7, 9 and 8 crosses showed significant and positive heterobeltiosis, standard heterosis over G.Cot.Hy-8 and G.Cot.Hy-12 with range of -20.00 to 55.38 per cent, -15.79 to 41.75 per cent and -17.24 to 39.21 per cent, respectively. The cross combination GBHV 164 x NH 630 recorded the highest heterobeltiosis (55.38%), standard heterosis over G.Cot.Hy-8 (41.75%) and G.Cot.Hy-12 (39.21 %) Similar findings for this trait were reported by Bhatade and Rajeswar (1994), Singh *et al.* (1995), Patil *et al.* (2009), Jyotiba *et al.* (2010) and Sekhar babu et al. (2011).

In cotton, the numbers of bolls per plant is the most important yield component which is mostly positively associated with seed cotton yield. Three hybrids out of 32, exhibited significant positive heterotic effect over their respective better parent. The cross GBHV 148 x H 1452 was associated with maximum heterosis over their better parent (72.08 %). The numbers of hybrids exhibited significant and positive standard heterosis over both the checks were three and four for bolls per plant. The most promising cross combinations for number of bolls per plant according to standard check (G.Cot.Hy-8) were GBHV 148 x H 1452 (48.70 %) and GBHV 177 x H 1353

(33.27%), whereas in case of second check (G.Cot.Hy-12) were GBHV 148 x H 1452 (43.85 %) and G GBHV 177 x H 1353 (28.92%). The results assemble with the workers Naik and Patel (1982), Patel *et al.* (2000), Patil et al. (2009), Patil *et al.* (2010), Jyotiba *et al*. (2010), Sekhar Babu *et al.* (2011).

The extent of heterosis for boll weight ranged from -29.74 to 40.21 per cent, -8.86 to 38.70 and -16.26 to 35.51 per cent over BP, SC 1 and SC 2, respectively. The hybrid G.Cot.16 x GJHV 358 depicted the highest significant positive heterobeltiosis (40.21 %). Out of thirty two hybrids, 20 and 22 hybrids noticed with positive significant standard heterosis over SC 1 and SC 2, respectively. The highest value was observed for the cross GBHV 177 x BS 30 of 38.70 and 41.92 per cent, over SC 1 and SC 2, respectively for boll weight. Almost identical results have been reported by Patel *et al.* (2000), Jyotiba *et al.* (2010) and Sekhar Babu *et al.* (2011).

The extent of heterosis for seed cotton yield per plant ranged from -10.28 to 26.63 per cent, -6.99 to 31.27 per cent and -9.91 to 29.74 per cent over BP, SC 1 and SC 2, respectively. Among thirty two hybrids, four, seven and six hybrids showed significant and positive heterosis over BP, SC 1 and SC 2, respectively. Cross combinations, GBHV 148 x H 1452, G.Cot.16 x H 1353 and GBHV 164 x NDIH 1938 were the top ranking heterotic crosses showed positive significant economic heterosis for seed cotton yield per plant. The results reported in the present investigation are in agreement with the results of Naik and Patel (1982), Duhoon *et al.* (1983), Rajan *et al.* (2000), Patil *et al.* (2009), Jyotiba *et al.* (2010) and Patil *et al.* (2010) and Sekhar Babu *et al.* (2011) for seed cotton yield per plant.

While considering lint yield per plant, four, nine and nine crosses showed significant and positive heterobeltiosis, standard heterosis over SC 1 and SC 2 with range of -17.59 to 46.52 per cent, -11.82 to 57.86 per cent and -8.91 to 56.07 per cent, respectively. The highest, significant and positive heterobeltiosis (46.52 %), standard heterosis over SC 1 (57.86 %) and SC 2 (56.07 %) was reported by GBHV 148 x H 1452. The study of Tuteja *et al.* (2003) and Sekhar Babu *et al.* (2011) reported similar results for lint yield per plant.

The heterotic expression for ginning percentage ranged from -14.13 to 13.12 per cent over better parent, whereas ranged from -2.11 to 18.11 per cent and -4.12 to 15.67 per cent over SC 1 and SC 2, respectively. Among thirty two hybrids, GBHV 177 x BS 79 (13.12 %) and GBHV 177 x NH 635 (18.11 %) and (15.67%) showed the highest, significant and positive heterobeltiosis and standard heterosis over both the checks, respectively for ginning percentage. Patel *et al.* (2000), Patil *et al.* (2009), Jyotiba *et al.* (2010) and Sekhar Babu *et al.* (2011) also reported varying magnitude of heterosis for this character.

The cross combination G.Cot.16 x GJHV 358 (39.25%) exhibited the highest, significant and positive heterosis over better parent for seed index. The hybrid GBHV 177 x BS 30 depicted the highest significant positive standard heterosis of 46.77 and 45.99 per cent over SC 1 and SC 2, respectively. The extent of heterosis for seed index ranged from -26.51 to 39.25 per cent, -1.61 to 46.77 and -2.14 to 45.99 per cent over BP, SC 1 and SC 2, respectively. Among thirty two hybrids, 13, 27 and 27 hybrids showed significant and positive heterosis over better parent, standard heterosis over SC 1 and SC 2, respectively. For lint index, heterobeltiosis, standard heterosis over SC 1 and SC 2 ranged from -28.44 (GBHV 148 x NH 635) to 38.04 per cent (G.Cot.16 X NDIH 1938), -1.26 (GBHV 148 x H 1353) to 75.00 per cent

(GBHV 148 x H 1452) and -1.70 (GBHV 148 x H 1353) to 74.20 per cent (GBHV 148 x H 1452), respectively. Almost identical results have been reported by Bhatade and Rajeswar (1994), Patel *et al.* (2000), Jyotiba *et al.* (2010) and Sekhar Babu *et al.* (2011) for seed index and lint index.

CONCLUSION

GBHV 148 x H 1452 and GBHV 164 x NDIH 1938 appeared to be more promising heterotic cross combinations for seed cotton yield per plant and they might be due to increase in sympodia per plant, lint yield per plant, boll number and boll weight. These crosses could be checked for stability performance before exploitation of hybrid vigour for commercial cultivation.

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Table 1: Analysis of variance for different characters in upland cotton

Source of variation	d.f.	Number of Sympodia Per Plant	Number of Bolls Per Plant	Boll Weight (g)	Seed Cotton Yield Per Plant (g)	Lint Yield Per Plant (g)	Ginning Percentage (%)	Seed Index (g)	Lint Index (g)
Replications	2	0.22	0.31	0.02	0.46	0.29	0.07	0.01	0.29
Genotypes	38	19.94**	92.99**	0.55**	343.74**	65.80**	8.72	2.02**	65.80**
Parents (p)	10	7.22*	115.62**	0.76**	167.15	29.51*	6.13	2.07**	29.51*
Females	3	7.33	319.56	1.86**	155.07	17.65	1.35	0.98**	17.65
Males	6	7.76*	44.68**	0.40**	175.75	29.09*	7.02	2.45**	29.09*
Females *vs.* males	1	3.12	0.36	0.01	143.22	67.97*	14.22	2.73**	67.97*
Parents *vs.* Crosses	1	44.96**	15.55	2.82**	1852.20**	308.98**	12.21	8.00**	308.98**
Crosses (c)	27	23.65**	87.46**	0.41**	357.74**	70.83**	9.53	1.81**	70.83**
Females effect	3	7.95	66.70	0.06	389.80	34.19	10.76	0.40	34.19
Males effect	6	14.87	137.74	0.54	420.21	99.87	11.45	1.87	99.87
Females x Males effects	18	28.81**	73.67**	0.42**	332.33**	66.39**	8.72	1.99**	66.39**
Error	76	2.97	11.68	0.05	110.56	13.71	1.23	0.07	13.71

****, ** Significant at 5 % and 1 % levels, respectively.***

Table 2: Per cent heterosis over better parent and two standard checks (H_1 & H_2) for different characters in upland cotton

Charac-ters	*Per se*	Range			Best Cross						Number of Significant Crosses in Desirable Direction		
		H (%)	SH_1 (%)	SH_2 (%)		H (%)		SH_1 (%)		SH_2 (%)	H (%)	SH_1 (%)	SH_2 (%)
Number of Sympodia Per Plant	16.00 to 21.00	-20.00 to 55.38	-15.79 to 41.75	-17.24 to 39.31	GBHV 164 X NH 630	55.38	GBHV 164 X NH 630	41.75	GBHV 164 X NH 630	39.31	7	9	8
					G.Cot.16 X NDIH 1938	30.51	G.Cot.16 X NDIH 1938	35.09	G.Cot.16 X NDIH 1938	32.76			
					G.Cot.16 X NH 630	25.42	GBHV 164 X NH 635	0.10	GBHV 164 X NH 635	31.03			
Number of Bolls Per Plant	24.03 to 46.59	-30.65 to 72.08	-15.29 to 48.70	-21.17 to 43.85	GBHV 148 X H 1452	72.08	GBHV 148 X H 1452	48.70	GBHV 148 X H 1452	43.85	3	3	4
					GBHV 177 X H 1353	45.23	GBHV 177 X H 1353	33.27	GBHV 177 X H 1353	28.92			
					GBHV 177 X H 1452	16.89	G.Cot.16 X NH 630	19.43	GBHV 164 X H 1353	19.74			
Boll Weight (g)	2.39 to 4.15	-29.74 to 40.21	-8.86 to 38.70	-16.26 to 41.92	G.Cot.16 X GJHV 358	40.21	GBHV 177 X BS 30	38.70	GBHV 177 X BS 30	41.92	11	20	22
					GBHV 164 X GJHV 358	33.33	GBHV 164 X H 1452	12.86	GBHV 148 X H 1452	35.51			
					GBHV 177 X BS 30	27.66	GBHV 177 X NDIH 1938	25.30	GBHV 177 X NDIH 1938	28.21			
Seed Cotton Yield Per Plant (g)	99.67 to 125.03	-10.28 to 26.63	-6.99 to 31.27	-9.91 to 29.74	GBHV 148 X H 1452	26.33	GBHV 148 X H 1452	31.27	GBHV 148 X H 1452	29.74	4	7	6
					G.Cot.16 X H1353	26.05	GBHV 164 X NDIH 1938	24.54	GBHV 164 X NDIH 1938	23.09			
					GBHV 164 X NDIH 1938	20.63	G.Cot.16 X H1353	24.19	G.Cot.16 X H1353	22.74			

, ** Significant at 5 % and 1 % levels, respectively

Table 2: Contd….

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Chara-cters	*Per se*	Range			Best Cross						Number of Significant Crosses in Desirable Direction		
		H (%)	SH_1 (%)	SH_2 (%)		H (%)		SH_1 (%)		SH_2 (%)	H (%)	SH_1 (%)	SH_2 (%)
Lint Yield Per Plant (g)	32.59 to 44.26	-17.59 to 46.52	-11.82 to 57.86	-8.91 to 56.07	GBHV 148 X H 1452	46.52	GBHV 148 X H 1452	57.86	GBHV 148 X H 1452	56.07	4	9	9
					GBHV 164 X NDIH 1938	30.79	GBHV 164 X NDIH 1938	37.59	GBHV 164 X NDIH 1938	36.04			
					G.Cot.16 X NDIH 1938	23.98	GBHV 177 X NH 635	34.92	GBHV 177 X NH 635	33.39			
Ginning Percent age (%)	32.00 to 35.37	-14.13 to 13.12	-2.11 to 18.11	-4.12 to 15.67	GBHV 177 X BS 79	13.12	GBHV 177 X NH 635	18.11	GBHV 177 X NH 635	15.67	5	21	17
					GBHV 177 X H 1452	10.95	GBHV 177 X H 1452	16.21	G.Cot.16 X NH 630	13.20			
					GBHV 148 X H 1452	9.15	GBHV 148 X H 1452	14.32	G.Cot.16 X NDIH 1938	13.20			
Seed Index (g)	6.00 to 8.30	-26.51 to 39.25	-1.61 to 46.77	-2.14 to 45.99	G.Cot.16 X GJHV 358	39.25	GBHV 177 X BS 30	46.77	GBHV 177 X BS 30	45.99	13	27	27
					G.Cot.16 X BS 30	36.93	G.Cot.16 X GJHV 358	39.25	G.Cot.16 X GJHV 358	38.50			
					GBHV 164 X BS 30	32.73	G.Cot.16 X BS 30	36.56	GBHV 177 X NH 635	36.42			
Lint Index (g)	2.96 to 4.66	-28.44 to 38.04	-1.26 to 75.00	1.70 to 74.20	G.Cot.16 X NDIH 1938	38.04	GBHV 148 X H 1452	75.00	GBHV 148 X H 1452	74.20	16	26	25
					GBHV 164 X BS 30	34.85	G.Cot.16 X NDIH 1938	59.47	GBHV 177 X NH 635	74.18			
					GBHV 177 X BS 30	29.31	GBHV 177 X NH 630	56.62	G.Cot.16 X NDIH 1938	58.75			

****, ** Significant at 5 % and 1 % levels, respectively***

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