Indian J. Genet., **50**(2): 131–135 (1990)

EVALUTION OF HETEROSIS IN FIVE SETS OF DESI COTTON HYBRIDS

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(Received: March 8, 1988; accepted: March 15, 1989)

ABSTRACT

Sixty eight desi cotton hybrids were developed by crossing 30 genotypes selected from five groups of *Gossypium arboreum* races *bengalense* and *indicum* and *G. herbaceum*. In each group, 15 hybrids were created by diallel mating (without reciprocals). Interspecific crosses between two varieties each of *G. arboreum* races *bengalense* and *indicum* were also made with two *G. herbaceum* strains obtaining eight hybrids. Studies indicated that interspecific crosses exhibited higher magnitude of useful heterosis for seed cotton yield as compared to the intra racial hybrids tested in four groups. Negative heterosis for ginning out turn and halo length was shown by interspecific crosses. Intra racial hybrids of red x red (*G. arboreum* race *bengalense*) varieties also expressed higher magnitude of heterosis effect for seed cotton yield. Dwarf x dwarf hybrids expressed high heterosis for yield and halo length, but negative heterosis for ginning out turn. Crosses within the race *indicum* registered substantial heterosis for all characters under study.

Key words: Desi cotton hybrids, interspecific hybrids, intra bengalense hybrids, heterobeltiosis, useful heterosis.

Use of heterosis as a breeding method in upland cotton raised productivity to some extent. Efforts are now being made to explore heterosis in Asiatic Cotton for further increase in productivity. Recently, the hybrids GDH-22 and GDH-149 in the Gujarat State and DDH-2 in South Zone, have been released for general cultivation. However, productivity of these hybrids (GDH-22 and GDH-149), when tested under agroclimatic conditions of Marathwada region, was lower than the common checks, Eknath and Rohini. Ansingkar [1] reported higher productivity of desi cotton varieties over intra and interspecific American hybrids when both were evaluated under identical conditions. Higher heterosis for yield has been reported from crosses between *arboreum* races *bengalense* and *indicum* [2–4]. Holla [5] in interspecific crosses reported 62.4% heterosis for seed cotton yield over check, therefore, attempts were made to gather more information for exploitation of heterosis involving parents from different races of *G. arboreum* and compare them with interspecific crosses, *G. arboreum* x *G. herbaceum* for expression of heterosis [5–7] under Marathwada conditions.

MATERIALS AND METHODS

The present investigation is based on 68 hybrids from three diallel sets of crosses, involving 6 green with tall varieties (G x G); 6 green with dwarf and early maturing varieties (D x D); and 6 red plant varieties (R x R) of *G. arboreum* race *bengalense*. Similarly, 15 hybrids

were also created using 6 strains of *G. arboreum* race *indicum* (I x I). Interspecific crosses involving two genotypes each of the *bengalense* and *indicum* races of the *G. arboreum* with two *G. herbaceum* strains, received from Dharwad were made to obtain eight (A x H) hybrids. Thus, 68 hybrids along with all the parental strains (except the parents of pigmented hybrids), totalling 97 entries, were sown in a randomised block design with two replications at the Cotton Research Station, Nanded, with the recommended spacing, fertilizer dose and plant protection measures. Observations were recorded on seed cotton yield, boll wt, (bwt), seed index (SI), ginning out turn (g.o.t.%) and halo length on 10 plants/replication. Variance due to treatments was partitioned into five sources. The mean, range, heterosis over midparents (MP), better parent (BP) and commercial check (CH) were used as parameters for comparing the five groups of hybrids. The MP, BP and CH heterosis were determined in each group and SE was computed.

RESULTS AND DISCUSSION

Variance due to treatments was highly significant for all the characters. Partitioning of treatment variance revealed significant differences among hybrid within each group for all characters, except for SI in R x R and for bwt in D x D groups (Table 1).

Table 1. Mean sum of squares in five groups of desi cotton hybrids

Group	d.f.	Seed cotton yield		10-boll wt.		Seed index		Ginning out turn		Halo length	
		treatment	error	treatment	error	treatment	error	treatment	error	treatment	error
G x G	21	0.01	0.002	5.66	2.05	0.35	0.09	5.56	0.60	3.33	0.53
D x D	21	0.012	0.004	2.17	2.71	0.87	0.22	2.17	0.21	4.03	0.57
R x R	15	0.008	0.004	3.30	1.45	0.16	0.09	1.70	0.62	1.27	0.40
I x I	21	0.01	0.004	3.42	0.81	0.48	0.09	4.06	0.57	2.11	0.32
A x H	14	0.02	0.004	6.29	1.09	0.87	0.26	0.98	0.10	1.51	0.20

The intra-*bengalense* green hybrids (G x G) recorded the highest average seed cotton yield (364 g/plant), followed by interspecific (A x H) (359g) group. Amongst hybrids of A x H group, the highest seed cotton yield of 550 g/plant was produced by NA 274 x R 51 hybrid. The D x D hybrids gave relatively lower mean yield, which was 16.2% lower than G x G hybrids (Table 2). The highest heterosis of 70.9% was shown by A x H group, followed by R x R hybrids, (63.5%). Only 13.8% mean heterosis was observed in the D x D group. Useful heterosis of the 15 G x G hybrids was to the tune of 42.7%. Heterosis in four intraracial groups varied from 43.1% (line 104 x line 520 of the dwarf group) to 126.1% (NA 307 x line 299 of the red plant group) as compared to 7.1% (NA 130 x SM 150) to 161.9% (NA 274 x R 51) in the A x H interspecific hybrids.

Likewise, the magnitude of MP and BP heterosis was highest in the I x I (19.2%) and G x G (5.4%) hybrids, respectively. However, they were significantly less than the MP heterosis

(41.8%) and BP heterosis (32.9%) expressed by the A x H group. These results are in agreement with those reported earlier [3, 4, 7].

Table 2. Mean and range in desi cotton hybrids, parents and check variety for five characters

Character	Group	No. of	F_1		Parents		Check \
		hybrids	mean	range	mean	range	mean
Seed cotton yield (g)	G X G	15	364	240–525	325	195–495	255
	D X D	15	313	205–485	300	250–330	360
	R X R	15	327	220–405			200
	I X I	15	347	275–520	301	175–375	230
	A X H	8	359	225–550	255	215–290	210
10 boll wt. (g)	G X G	15	24.0	20.9–27.1	22.2	21.5–23.0	22.6
	D X D	15	23.3	20.6–25.5	24.5	23.0–25.9	22.5
	R X R	15	22.5	20.7–25.5			22.1
	I X I	15	23.3	20.8–25.0	21.5	22.0–25.0	22.8
	A X H	8	21.9	19.7–23.9	21.4	18.0–24.7	23.6
Seed index	G X G	15	5.7	5.1–6.5	5.6	4.7–6.5	5.9
	D X D	15	6.3	5.3–7.5	6.1	5.6–6.6	5.4
	R X R	15	5.5	5.1–6.3			5.5
	I X I	15	5.8	5.0–6.4	5.8	5.4–6.7	5.6
	A X H	8	6.8	5.7–7.5	6.3	5.8–7.6	6.1
Ginning outturn (%)	G X G	15	37.9	34.7–39.7	38.1	35.5–41.7	38.0
	D X D	15	35.5	35.0–36.5	34.7	33.7–35.5	37.7
	R X R	15	38.4	37.2–39.4			38.0
	I X I	15	38.4	36.2–40.7	36.8	34.7–38.0	37.7
	A X H	8	35.1	33.5–37.5	37.9	35.2–40.7	37.7
Halo length (mm)	G X G	15	24.6	22.8–26.2	23.7	21.9–25.8	24.0
	D X D	15	25.7	23.8–28.0	25.1	24.4–26.0	24.9
	R X R	15	24.4	23.7–25.7			24.5
	I X I	15	24.6	23.7–25.9	24.9	26.6–26.1	24.4
	A X H	8	24.5	24.3–27.8	24.2	23.4–25.6	24.0

* Hybrids of R X R could not be compare with respective parents due to stunted growth as a result of water logged conditions.

In respect of 10 bwt, the A x H group recorded low mean and narrow range while the G x G hybrids gave higher value. The mean bwt of the G x G hybrids was significantly higher (3.1%, 6.6% and 3.1%, respectively) over means of the remaining three intraracial crosses. Then mean heterosis (CH) and BP heterosis in the A x H were negative. Among the five groups, the G x G crosses recorded 8.6% and 6.2% MP, BP and CH heterosis, respectively.

All the intraracial hybrids, except those of D x D groups and the interspecific hybrids recorded mean SI at par with the check. The D x D hybrids produced seeds with 16.6% higher weight over check. However, the D x D hybrids did not appear to be suitable for rainfed cultivation as bold seeds require more moisture to germinate. From this view, the G x G and R x R hybrids are more suitable. The A x H hybrids recorded high positive

heterosis for yield, bwt and SI. Negative BP heterosis was obtained in the I x I (–6.5%), A x H (–4.9%) and G x G (–3.4%) while in positive direction by D x D (1.6%) crosses.

Amongst the four intra-racial groups, variability for g.o.t. (%) varied from 34.7 (line 330 x line 135) to 39.7 (PA 85/9 x line 819) in G x G and from 34.7 (line 80/153 x line 318) to 40.7 (line 299 x line 334) in I x I crosses. Hybrids of the A x H group recorded g.o.t. % from 33.5 (PA 156 x SM 150) to 37.5 (PA 156 x R 51). Range from this trial was relatively narrow (35.5%–36.5%) in the D x D hybrids. The A x H hybrids recorded negative heterosis for g.o.t. over midparent (–5.6%), check (–6.9%), and better parent (–10.6%). Among the four intra-racial groups, I x I hybrids recorded the highest mean MP (94.3%) as well as BP (2.1%) heterosis. The mean halo length of D x D hybrids (25.7 mm) was significantly higher than in the remaining groups. Amongst five groups, positive BP heterosis was observed only in the D x D group.

Table 3. Mean and range of heterosis (%) in five groups of cotton hybrids

Character	Group	MP heterosis			BP heterosis			Check		
		mean	range	CD	mean	range	CD	mean	range	CD
Seed cotton yield	G X G	12.3	–28.2–48.0	111	5.4	–38.3–37.1	129	42.7	–5.8–105.8	100
	D X D	4.3	–26.6–53.8	158	1.3	–37.6–49.2	185	13.1	–43.3–34.7	132
	R X R							63.5	10.0–102.5	118
	I X I	19.2	–7.5–64.8	158	3.0	–30.9–57.8	185	50.8	6.5–126.1	113
	A X H	41.8	–20.0–129.1	162	32.9	–22.4–107.5	189	70.9	7.1–161.9	144
10-boll wt.	G X G	8.6	–4.6–20.4	3.6	6.6	–4.3–19.4	4.2	6.2	–7.5–19.9	2.9
	D X D	4.5	–16.6–8.1	NS	7.2	–19.8–5.4	NS	3.5	–8.4–13.3	NS
	R X R							1.8	–6.3–15.4	2.6
	I X I	1.3	–5.5–11.7	2.2	2.1	–8.8–7.1	2.5	2.2	–8.8–12.7	1.8
	A X H	4.5	–7.3–20.2	2.7	2.2	–4.7–12.6	3.1	7.2	–16.5–1.3	2.2
Seed index	G X G	1.8	–7.9–20.8	0.7	6.5	–16.9–11.1	0.8	–3.4	–13.6–10.1	0.7
	D X D	5.0	–10.2–27.1	1.2	1.6	–10.6–27.1	1.3	16.6	–1.9–38.6	0.9
	R X R							–1.8	–7.9–14.5	NS
	I X I	1.7	–15.3–14.5	0.7	–4.9	–21.9–14.5	0.8	3.5	–10.7–12.5	0.6
	A X H	4.7	–4.5–17.5	0.8	–4.3	–15.8–15.6	1.5	9.8	4.9–21.3	1.1
Ginning outturn	G X G	0.2	–7.5–7.0	1.9	–3.4	–11.9–7.0	2.3	–0.1	–8.7–4.5	1.8
	D X D	1.1	0.6–6.1	1.1	1.1	–1.4–5.2	1.3	–5.8	–7.2–3.2	0.9
	R X R							–1.0	–3.4–3.2	1.6
	I X I	4.3	–0.3–10.6	1.8	2.1	–3.5–7.1	2.2	1.8	–3.9–8.0	1.5
	A X H	–5.6	–11.6–1.1	2.7	–0.6	–17.6–7.6	0.9	–6.9	–11.1–0.5	0.9
Halo length	G X G	3.4	–6.5–15.0	1.8	–0.8	–9.4–12.1	2.1	2.0	–5.0–9.2	1.5
	D X D	2.4	–7.4–12.2	1.8	0.8	–8.5–11.8	2.1	3.2	–4.4–12.4	1.5
	R X R							–0.4	–4.5–4.5	1.3
	I X I	1.2	–4.8–3.1	1.4	–3.4	–10.0–2.4	1.6	0.8	–4.1–6.1	1.1
	A X H	1.6	–2.5–10.6	1.1	–0.4	–5.1–10.2	1.3	–2.1	–4.6–7.9	1.1

The studies further revealed that out of 68 hybrids, hybrid of NA 274 x R 51 (A x H) for seed cotton yield (161%), hybrid of line 97 x line 520 (D x D) for halo length (12.4%) and hybrid of line 299 x line 334 (I x I) for g.o.t. (7.9%) occupied top position for the

respective characters.

At the same time, hybrids PA 85/9 x NA 330, line 2649 x line 1036 (G x G) and line 1194 x line 3054 (P x P) showed simultaneous positive CH heterosis for all the three important characters: (60%–102% for yield, 0.5%–3.2% for g.o.t., and 1.2%–9.2% for halo length). These hybrids need to be tested on large scale.

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