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Aditi D Patel
Department of Genetics and Plant Breeding, Navsari Agricultural University, Gujarat, India

KV Vadodariya
Associate Research Scientist, Main Cotton Research Station, Navsari Agricultural University Gujarat, India

Kanak Bhati
Department of Genetics and Plant Breeding, Navsari Agricultural University, Gujarat, India

AG Singh
Department of Genetics and Plant Breeding, Navsari Agricultural University, Gujarat, India

Corresponding Author:
Aditi D Patel
Department of Genetics and Plant Breeding, Navsari Agricultural University, Gujarat, India

Heterosis and inbreeding studies for seed cotton yield and its component traits in *desi* cotton

Aditi D Patel, KV Vadodariya, Kanak Bhati and AG Singh

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Abstract
A study was conducted to assess the extent of the heterosis for sixteen yield and yield-attributing traits in four cotton hybrids (each having P_1, P_2, F_1, F_2, BC_1 and BC_2 generations) obtained by crossing four interspecific lines of *desi* cotton in a compact family block design with three replications during *kharif* 2017-18. Highly significant and positive relative heterosis, heterobeltiosis and inbreeding depression were recorded in most of the crosses. For seed cotton yield per plant, positive and highly significant relative heterosis, heterobeltiosis and inbreeding depression were recorded in all the four crosses indicated major role of non-additive gene actions in the inheritance of seed cotton yield per plant and its attributes, while cross III (GShv 362/12 x PA 812) recorded the highest heterotic effect among all crosses which also performed well for monopodia per plant, average boll weight, lint yield per plant, ginning percentage, lint index, fibre fineness and fibre strength.

Keywords: Heterosis, *desi* cotton, relative heterosis, heterobeltiosis, inbreeding depression

Introduction

Cotton the king of fibre reside one of the momentous and important cash crop exercising profound influence on economics and social affairs of the world. The word “cotton” derived from the Arabic word “al qutum” and popularly known as “White Gold”. India is going to be in surge in textile industry ahead of China which has been possible only due to cotton crop, which is the backbone of textile industry. Cotton plays vital role in Indian economy. The Gossypium species were domesticated in both the old and new world. It supplies products such as lint, oil, seed meal, hulls and linters. The genus Gossypium, a member of the Malvaceae family, consists of 50 species, four of which are generally cultivated species. Out of the four cultivated species, *Gossypium hirsutum* L. and *Gossypium barbadense* L. are tetraploids (2n=4x=52) and are commonly called as new world cottons. Whereas, *Gossypium arboreum* L. and *Gossypium herbaceum* L. are diploids (2n=2x=26) and known as old world cottons. India is the only country, where all four cultivated species of cotton *viz*., *G. herbaceum*, *G. arboreum*, *G. hirsutum* and *G. barbadense* are grown. These four species are referred as cotton. To know whether new cross combinations are suitable for exploitation of heterosis or whether these can be used to isolate useful and transgressive segregants from subsequent generations to develop a variety, evaluation of heterosis and inbreeding effects is essential. Identification of parents which show high magnitude of heterosis on crossing and production of hybrid seed with low cost is considered as a very important aspect for commercial exploitation of heterosis in cotton. India reside pioneer in commercialization of heterosis in cotton. A noticeable heterosis is reported in cotton by many workers. For better exploitation of heterosis in cotton, development of simple and economically variable hybrid seed production technique should be strengthen. Thereafter, number of intraspecific hybrids (*G. hirsutum* L. x *G. hirsutum* L.) and interspecific hybrids (*G. hirsutum* L. x *G. barbadense* L.) having high yield potentiality, big boll size, early in maturity coupled with extra-long staples (ELS) and desirable fibre traits have been released for commercial cultivation. Improvement in yield has been achieved through distant hybridization, particularly through interspecific hybridization.

Material and Methods

The present investigation was carried out to study the genetic parameters of four cotton crosses (GBhv 618/09 x ARBa 1502, GBhv 2399/09 x DWDa 1502, GShv 362/12 x PA 812 and GShv

385/12 x PA 812) obtained by crossing four interspecific lines of *desi* cotton in a Compact Family Block Design with three replications at Main Cotton Research Station, Navsari Agricultural University, Athwa farm, Surat were obtained by crossing four interspecific lines of *desi* cotton. The hybrids were generated during late *Kharif*-2017 from its respective parents. The observations recorded for sixteen different characters were subjected to generation mean analysis (each having P_1, P_2, F_1, F_2, BC_1 and BC_2 generations) to assess the gene effects controlling these traits to estimate the extent of heterosis and inbreeding depression.

Estimation of heterosis and inbreeding depression:

Heterosis expressed as per cent increase or decrease of F_1 hybrid over its mid-parent (relative heterosis) and over its better parent (heterobeltiosis) were computed as follow:

Relative heterosis (%) $= \frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$

Heterobeltiosis (%) $= \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$

Inbreeding depression(%) $= \frac{\overline{F_1} - \overline{F_2}}{\overline{F_2}} \times 100$

Where

$\overline{F_1}$ = Mean performance of the F_1 hybrid

$\overline{F_2}$ = Mean value of the F_2 generation

$\overline{MP}$ = Mean value of the parents (P_1 and P_2) of a hybrid

$\overline{BP}$ = Mean value of better parent

Result and Discussion

The manifestation of heterosis, heterobeltiosis and inbreeding depression are presented in Tables. The results revealed significant positive and negative mid parent and better parent heterosis in many crosses for different characters studied. The high values for heterotic effects also indicated that the parents used for the study were widely diverse. The results obtained on these aspects for different characters studied in four crosses of *desi* cotton *viz*., cross I (GBhv 618/09 x ARBa 1502), cross II (GBhv 2399/09 x DWDa 1502), cross III (GShv 362/12 x PA 812) and cross IV (GShv 385/12 x PA 812) here after referred to as cross I, cross II, cross III and cross IV respectively are presented and discussed in the following paragraphs.

For seed cotton yield per plant all crosses showed significant and positive relative heterosis as well as heterobeltiosis. Cross III recorded highest heterotic effect among all crosses which also performed well for monopodia per plant, average boll weight, lint yield per plant, ginning percentage, lint index, fibre fineness and fibre strength.

Further all crosses recorded significant and positive inbreeding depression for this trait. Similar results were reported by Soomro and Kalhoro (2000) [25], Soomro *et al.* (2000) [24], Ahmad *et al.* (2002) [3], Rauf *et al.* (2005) [22], Basamma *et al.* (2009) [6], Karademir and Gencer (2010) [13], Basal *et al.* (2011) [5], Karademir *et al.* (2011) [12], Patil *et al.* (2011) [19], Panni *et al.* (2012) [16], Patel *et al.* (2012) [18], El-Rafaey and El-Razek (2013) [7], Ranganatha *et al.* (2013) [20], Islam *et al.* (2014) [28], Patel *et al.* (2014) [17], Abid *et al.* (2015) [1], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Adsare *et al.* (2017) [2], Gohil *et al.* (2017) [9], Isong *et al.* (2017) [11], Khan *et al.* (2017) [14], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26], Rathava *et al.* (2018) [21], Yehia and Hashash (2019) [27] and AL-Hibbiny *et al.* (2020) [4].

Table 1: Estimates of relative heterosis (RH %), heterobeltiosis (HB %) and inbreeding depression (ID %) for days to first flower, plant height (cm), monopodia per plant, sympodia per plant, leaf area (cm^2) and bolls per plant in four crosses of *desi* cotton

Particulars	Days to first flower		Plant height (cm)		Monopodia per plant		Sympodia per plant		Leaf area (cm^2)		Bolls per plant	
	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE
Cross I (GBhv 618/09 x ARBa 1502)												
RH %	-12.68**	± 1.67	15.16**	± 3.30	16.05	± 0.32	25.48**	± 0.74	4.97*	± 0.65	0.91	± 1.28
HB %	-5.88**	± 1.63	5.69*	± 3.66	4.44	± 0.37	19.59**	± 0.75	3.89	± 0.85	-10.70**	± 1.38
ID %	-14.98**	± 2.04	9.62**	± 4.87	15.96	± 0.25	18.26**	± 0.83	13.49**	± 0.57	13.87**	± 1.36
Cross II (GBhv 2399/09 x DWDa 1502)												
RH %	-7.44**	± 1.38	11.17**	± 2.76	28.89	± 0.52	27.31**	± 0.49	13.94**	± 0.78	7.72	± 1.49
HB %	-0.16	± 1.37	5.29*	± 2.88	23.40	± 0.66	17.96**	± 0.55	4.11	± 0.99	6.58	± 2.26
ID %	-17.77**	± 1.76	15.07**	± 4.94	44.40**	± 0.45	23.70**	± 0.70	21.49**	± 0.73	13.79**	± 1.28
Cross III (GShv 362/12 x PA 812)												
RH %	-5.06	± 2.15	9.09*	± 4.71	68.89**	± 0.32	27.80**	± 1.29	9.67**	± 0.44	26.76**	± 1.55
HB %	5.86	± 2.33	4.53	± 4.99	52.00*	± 0.39	16.80	± 1.35	1.28	± 0.62	10.09	± 2.21
ID %	-4.73	± 2.63	10.68**	± 5.74	42.76**	± 0.31	12.11	± 1.30	4.26**	± 0.48	19.31**	± 1.85
Cross IV (GShv 385/12 x PA 812)												
RH %	1.87	± 1.73	7.30	± 6.28	26.58	± 0.78	22.65**	± 0.87	4.95*	± 0.69	13.78**	± 1.38
HB %	11.31**	± 1.99	4.54	± 6.65	0.00	± 0.89	4.69	± 0.99	1.08	± 0.74	5.92	± 1.46
ID %	-8.69**	± 2.42	19.03**	± 6.96	12.50	± 0.76	9.33*	± 0.82	6.99**	± 0.76	14.91**	± 1.53

* and **, significant at 5% and 1%, respectively and " - " represent zero

Table 2: Estimates of relative heterosis (RH %), heterobeltiosis (HB %) and inbreeding depression (ID %) for average boll weight (g), seed cotton yield per plant (g), lint yield per plant (g), ginning percentage (%) and seed index (g) in four crosses of *desi* cotton

Particulars	Average boll weight (g)		Seed cotton yield per plant (g)		Lint yield per plant (g)		Ginning percentage (%)		Seed index (g)	
	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE
Cross I (GBhv 618/09 x ARBa 1502)										
RH %	28.94**	± 0.12	18.02**	± 0.92	25.32**	± 0.49	6.36**	± 0.38	19.66**	± 0.07
HB %	12.64*	± 0.14	10.83**	± 1.06	15.32**	± 0.55	4.08**	± 0.41	9.03**	± 0.12
ID %	9.69**	± 0.11	15.84**	± 2.71	19.65**	± 1.04	4.38**	± 0.47	12.28**	± 0.12
Cross II (GBhv 2399/09 x DWDa 1502)										

RH %	44.90**	± 0.07	24.41**	± 2.31	31.69**	± 0.96	5.64**	± 0.32	23.00**	± 0.17
HB %	26.58**	± 0.06	10.79*	± 2.99	15.76**	± 1.20	4.08**	± 0.33	17.22**	± 0.16
ID %	13.36**	± 0.08	15.95**	± 2.83	20.85**	± 1.10	5.42**	± 0.38	12.80**	± 0.18
Cross III (GShv 362/12 x PA 812)										
RH %	36.40**	± 0.06	53.73**	± 1.76	67.27**	± 0.70	8.82**	± 0.43	9.44**	± 0.12
HB %	20.84**	± 0.07	40.48**	± 2.60	49.76**	± 0.96	6.31**	± 0.46	3.28	± 0.14
ID %	15.74**	± 0.08	25.78**	± 4.59	29.58**	± 1.71	4.81**	± 0.58	23.90**	± 0.18
Cross IV (GShv 385/12 x PA 812)										
RH %	35.36**	± 0.08	53.21**	± 2.76	61.71**	± 1.15	5.46**	± 0.46	11.93**	± 0.13
HB %	18.57**	± 0.11	46.30**	± 3.32	57.99**	± 1.34	2.98*	± 0.50	5.80**	± 0.14
ID %	12.42**	± 0.09	23.28**	± 3.38	29.15**	± 1.34	7.48**	± 0.59	25.92**	± 0.19

* and **, significant at 5% and 1%, respectively and " - " represent zero

Table 3: Estimates of relative heterosis (RH %), heterobeltiosis (HB %) and inbreeding depression (ID %) for lint index (g), 2.5 per cent span length (mm), fibre fineness (mv), fibre strength (g/tex) and oil percentage (%) in four crosses of *desi* cotton

Particulars	Lint index (g)		2.5 per cent span length (mm)		Fibre fineness (mv)		Fibre strength (g/tex)		Oil percentage (%)	
	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE
Cross I (GBhv 618/09 x ARBa 1502)										
RH %	31.34**	± 0.09	9.69**	± 0.13	8.68**	± 0.05	10.28**	± 0.21	6.56**	± 0.04
HB %	16.16**	± 0.11	5.64**	± 0.13	16.78**	± 0.04	5.52**	± 0.19	3.99**	± 0.04
ID %	18.23**	± 0.11	1.25*	± 0.13	6.53**	± 0.06	3.81**	± 0.20	3.26**	± 0.05
Cross II (GBhv 2399/09 x DWDa 1502)										
RH %	34.08**	± 0.12	-6.56**	± 0.35	-6.64	± 0.19	-6.02**	± 0.34	2.77**	± 0.03
HB %	30.74**	± 0.12	-7.95**	± 0.43	-3.92	± 0.19	-6.72**	± 0.28	1.22**	± 0.03
ID %	19.86**	± 0.13	-3.96**	± 0.34	-6.00	± 0.19	-2.40*	± 0.28	2.73**	± 0.03
Cross III (GShv 362/12 x PA 812)										
RH %	24.45**	± 0.09	-0.48	± 0.16	8.56**	± 0.06	6.56**	± 0.24	2.16**	± 0.04
HB %	13.68**	± 0.10	-1.90*	± 0.21	9.79**	± 0.08	2.96*	± 0.31	-0.38	± 0.04
ID %	28.87**	± 0.14	0.34	± 0.15	11.47**	± 0.05	5.26**	± 0.12	2.04**	± 0.05
Cross IV (GShv 385/12 x PA 812)										
RH %	22.20**	± 0.13	11.81**	± 0.12	-6.24**	± 0.07	10.50**	± 0.14	2.62**	± 0.05
HB %	19.76**	± 0.14	7.25**	± 0.14	2.40	± 0.04	9.31**	± 0.18	0.29	± 0.05
ID %	34.39**	± 0.16	7.35**	± 0.14	5.52**	± 0.06	7.81**	± 0.16	1.69**	± 0.07

* and **, significant at 5% and 1%, respectively and " - " represent zero

In case of days to flowering cross IV depicted significant and positive heterobeltiosis. In such characters negative heterosis is desirable. Cross I recorded negative and highly significant relative heterosis as well as heterobeltiosis which are desirable. While cross II recorded significant and negative relative heterosis which is also desirable for such character. Whereas all the crosses except cross III recorded significant but negative inbreeding depression. Similar results were also reported by Patel *et al.* (2014) [17], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Gohil *et al.* (2017) [9], Monicashree *et al.* (2017) [15] and Rathava *et al.* (2018) [21].

Out of four crosses cross I and cross II exhibited positive and significant heterosis as well as heterobeltiosis for plant height. The magnitude of relative heterosis was also significant and positive in cross III. The estimates of inbreeding depression were significant and positive in all crosses. Similar results were also quoted by Rauf *et al.* (2005) [22], Panni *et al.* (2012) [16], Ranganatha *et al.* (2013) [20], Patel *et al.* (2014) [17], Sawarkar *et al.* (2015) [23], Gohil *et al.* (2017) [9], Isong *et al.* (2017) [11], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26] and Rathava *et al.* (2018) [21].

The magnitudes of relative heterosis as well as heterobeltiosis were significant and positive only in cross III for monopodia per plant. While inbreeding depression was found significant and positive in cross I and cross III. Rauf *et al.* (2005) [22], Ranganatha *et al.* (2013) [20], Patel *et al.* (2014) [17], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Gohil *et al.* (2017) [9] and Monicashree *et al.* (2017) [15] also reported similar results.

All the four crosses exhibited positive and significant relative heterosis, while only cross I and cross II depicted positive and significant heterobeltiosis for sympodia per plant. The estimates of inbreeding depression were significant for all the cross except cross III. Similar results were also quoted by Rauf *et al.* (2005) [22], Ranganatha *et al.* (2013) [20], Patel *et al.* (2014) [17], Abid *et al.* (2015) [1], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Gohil *et al.* (2017) [9], Isong *et al.* (2017) [11], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26] and Rathava *et al.* (2018) [21].

For leaf area, all the four crosses exhibited positive and significant relative heterosis. None of the cross depicted positive and significant heterobeltiosis. All the four crosses showed significant and positive inbreeding depression.

In case of bolls per plant cross III and cross IV showed highly significant and positive relative heterosis while none of the cross recorded positive and significant heterobeltiosis. The estimates of inbreeding depression were significant and positive for all crosses. This results were in accordance with the findings made by Soomro and Kalhoro (2000) [25], Soomro *et al.* (2000) [24], Ahmad *et al.* (2002) [3], Rauf *et al.* (2005) [22], Basamma *et al.* (2009) [6], Basal *et al.* (2011) [5], Patil *et al.* (2011) [19], Panni *et al.* (2012) [16], Patel *et al.* (2012) [18], El-Rafaey and El-Razek (2013) [7], Ranganatha *et al.* (2013) [20], Patel *et al.* (2014) [17], Abid *et al.* (2015) [1], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Gohil *et al.* (2017) [9], Isong *et al.* (2017) [11], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26], Rathava *et al.* (2018) [21], Yehia and Hashash (2019) [27] and AL-Hibbiny *et al.* (2020) [4].

All crosses showed positive and highly significant relative heterosis, heterobeltiosis as well as inbreeding depression for average boll weight. Similar findings have been reported by Rauf *et al.* (2005) [22], Basamma *et al.* (2009) [6], Basal *et al.* (2011) [5], Panni *et al.* (2012) [16], Patel *et al.* (2012) [18], El-Rafaey and El-Razek (2013) [7], Ranganatha *et al.* (2013) [20], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Gohil *et al.*

(2017) [9], Isong *et al.* (2017) [11], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26], Rathava *et al.* (2018) [21], Yehia and Hashash (2019) [27] and AL-Hibbiny *et al.* (2020) [4].

Positive and highly significant relative heterosis, heterobeltiosis as well as inbreeding depression were recorded in all the four crosses for lint yield per plant. Similar results were also reported by Patel *et al.* (2012) [18], El-Rafaey and El-Razek (2013) [7], Gohil *et al.* (2017) [9], Rathava *et al.* (2018) [21], Yehia and Hashash (2019) [27] and AL-Hibbiny *et al.* (2020) [4].

Also for ginning percentage all crosses showed highly significant and positive relative heterosis, heterobeltiosis and inbreeding depression. Same findings has been also reported by Soomro and Kalhoro (2000) [25], Soomro *et al.* (2000) [24], Ahmad *et al.* (2002) [3], Rauf *et al.* (2005) [22], Basamma *et al.* (2009) [6], Karademir and Gencer (2010) [13], Patil *et al.* (2011) [19], Patel *et al.* (2012) [18], Ranganatha *et al.* (2013) [20], Patel *et al.* (2014) [17], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Gohil *et al.* (2017) [9], Isong *et al.* (2017) [11], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26] and Rathava *et al.* (2018) [21].

In case of seed index, all crosses showed highly significant and positive relative heterosis, heterobeltiosis and inbreeding depression except cross III for heterobeltiosis. Similar results has also been earlier reported by Patil *et al.* (2011) [19], El-Rafaey and El-Razek (2013) [7], Ranganatha *et al.* (2013) [20], Patel *et al.* (2014) [17], Sawarkar *et al.* (2015) [23], Gohil *et al.* (2017) [9], Isong *et al.* (2017) [11], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26], Rathava *et al.* (2018) [21], Yehia and Hashash (2019) [27] and AL-Hibbiny *et al.* (2020) [4].

Also for lint index relative heterosis, heterobeltiosis and inbreeding depression exhibited positive and significant results. Patil *et al.* (2011) [19], Ranganatha *et al.* (2013) [20], Patel *et al.* (2014) [17], Gohil *et al.* (2017) [9], Isong *et al.* (2017) [11], Monicashree *et al.* (2017) [15], Tigga *et al.* (2017) [26], Rathava *et al.* (2018) [21] and AL-Hibbiny *et al.* (2020) [4] have also reported similar findings for this trait in particular.

Cross I and cross IV exhibited positive and significant relative heterosis, heterobeltiosis and inbreeding depression for 2.5% span length. While cross II exhibited significant and negative relative heterosis, heterobeltiosis and inbreeding depression for this trait. These results generally correspond with the findings of Patil *et al.* (2011) [19], El-Rafaey and El-Razek (2013) [7], Sawarkar *et al.* (2015) [23], Eswari *et al.* (2016) [8], Monicashree *et al.* (2017) [15] and Yehia and Hashash (2019) [27].

For fibre fineness none of the cross showed negative and significant relative heterosis, heterobeltiosis as well as inbreeding depression except cross IV for relative heterosis. For fibre fineness heterosis in negative direction is desirable. These findings are in confirmation to the findings of Karademir and Gencer (2010) [13], Karademir *et al.* (2011) [12], El-Rafaey and El-Razek (2013) [7], Sawarkar *et al.* (2015) [23], Monicashree *et al.* (2017) [15], Yehia and Hashash (2019) [27] and AL-Hibbiny *et al.* (2020) [4].

In case of fibre strength only one cross II recorded significant but negative relative heterosis, heterobeltiosis as well as inbreeding depression, while other three crosses exhibited significant positive values of relative heterosis, heterobeltiosis and inbreeding depression. The result assemble with the workers Rauf *et al.* (2005) [22], Karademir and Gencer (2010) [13], Basal *et al.* (2011) [5], Karademir *et al.* (2011) [12], Patil *et al.* (2011) [19], Monicashree *et al.* (2012) [15], El-Rafaey and El-Razek (2013) [7], Sawarkar *et al.* (2015) [23], Yehia and Hashash (2019) [27] and AL-Hibbiny *et al.* (2020) [4].

For oil percentage, all the crosses recorded significant positive relative heterosis as well as inbreeding depression. While for heterobeltiosis significant and positive result was recorded by cross I and cross II only. These results are in accordance with the findings of Patel *et al.* (2014) [17], Sawarkar *et al.* (2015) [23] and Gohil *et al.* (2017) [9].

In the present investigation, heterosis for seed cotton yield was observed due to heterosis for component characters *viz.*, sympodia per plant, boll per plant, average boll weight, lint yield per plant, ginning percentage, seed index and lint index which resulted in increased seed cotton yield. So, these characters should be given due consideration while improving yield.

In general, heterosis followed by presence of inbreeding depression was observed in cross I (GBhv 618/09 x ARBa 1502) for days to flowering, plant height, sympodia per plant, average boll weight, seed cotton yield per plant, lint yield per plant, ginning percentage, seed index, lint index, 2.5% span length, fibre strength and oil percentage; in cross II (GBhv 2399/09 x DWDa 1502) for plant height, sympodia per plant, average boll weight, seed cotton yield per plant, lint yield per plant, ginning percentage, seed index, lint index and oil percentage; in cross III (GShv 362/12 x PA 812) for monopodia per plant, ave1rage boll weight, seed cotton yield per plant, lint yield per plant, ginning percentage, lint index, fibre fineness and fibre strength and in cross IV (GShv 385/12 x PA 812) for average boll weight, seed cotton yield per plant, lint yield per plant, ginning percentage, seed index, lint index, 2.5% span length and fibre strength indicated that positive and significant heterosis over mid-parent and better parent along with positive inbreeding depression may be attributed to major contribution from dominance (*h*) and additive x additive (i) gene effects and selection will be effective only in latter generations.

Significant positive heterosis for seed cotton yield per plant and its related traits followed by significant inbreeding depression indicates major role of non-additive gene actions in the inheritance of seed cotton yield per plant and its attributes.

Heterosis followed by absence of inbreeding depression were recorded in cross I for fibre fineness; in cross III for sympodia per plant indicated that absence of inbreeding depression and increase in performance of F_2 was accompanied by fixation of genes *i.e.*, additive gene action.

Conclusion

For seed cotton yield per plant, positive and highly significant relative heterosis, heterobeltiosis and inbreeding depression were recorded in all the four crosses, while cross III recorded highest heterotic effect among all crosses which also performed well for monopodia per plant, average boll weight, lint yield per plant, ginning percentage, lint index, fibre fineness and fibre strength. Highly significant and positive relative heterosis, heterobeltiosis and inbreeding depression were recorded in most of the crosses. Significant heterosis over mid-parent and better parent along with positive inbreeding depression may be attributed to major contribution from dominance (h) and additive x additive (i) gene effects, where selection will be effective only in later generations.

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