IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
e ISSN-0976-593X Volume 13 | Issue 1 | January, 2018 | 60-66
DOI: 10.15740/HAS/IJPS/13.1/60-66
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RESEARCH ARTICLE

Study of heterosis for seed cotton yield, yield contributing traits in *Desi* cotton (*Gossypium arboreum* L.)

K.S. Thombre, V.N. Chinchane, D.B. Deosarkar and S.B. Borgaonkar

SUMMARY

Cotton crop is mainly cultivated for its fibre and hence yield is important in cotton. Cotton crop is highly amenable to both heterosis and recombination breeding as it is often cross pollinated. The present investigation on heterosis studies for yield and yield contributing traits in *desi* cotton (*Gossypium arboreum* L.) was undertaken with the objectives to study the extent of heterosis over mid parent (Average heterosis), better parent (Heterobeltiosis) and standard checks (Standard heterosis). In present investigation four lines were crossed with six testers to obtain 24 hybrids in line x tester design. Data were recorded on yield and yield contributing traits. Analysis of variance for means revealed significant differences for all the characters studied. The magnitude of heterosis, heterobeltiosis and standard/economic heterosis for all the characters in the present study were highly appreciable. Among all the characters, the magnitude of heterosis was highest for number of sympodia per plant measuring to the extent of 55.56 %, 47.37 % and 43.59 % over standard check PKVDH 1, PKV Suvarna and NACH 12 in the cross PA 734 x CNA 1016. It was followed by seed cotton yield per plant (48.77 %, 47.44 % and 33.49 %) in the cross PA 734 x ARBAS 1301 over standard check PKVDH 1, PKV Suvarna and NACH 12, respectively.

Key Words : Heterosis, Standard heterosis, Micronaire, Staple length, Heterobeltiosis

How to cite this article : Thombre, K.S., Chinchane, V.N., Deosarkar, D.B. and Borgaonkar, S.B. (2018). Study of heterosis for seed cotton yield, yield contributing traits in *Desi* cotton (*Gossypium arboreum* L.). *Internat. J. Plant Sci.*, **13** (1): 60-66, **DOI: 10.15740/HAS/IJPS/13.1/60-66**.

Article chronicle : Received : 28.08.2017; **Revised :** 17.11.2017; **Accepted :** 01.12.2017

Cotton also known as 'white gold' as it is preferred by farmers as cash crop beside other field crops. Cotton, occupies a pre-eminent position as a commercial crop in India. It is grown commercially in the temperate and tropical regions of more than 70 countries. India is perhaps the first country to make use of cotton. Cotton, the 'white gold' enjoys a pre-eminent status among all cash crops in the country. It is grown commercially in the temperate and tropical regions of more than 70 countries. Specific areas of production include countries such as China, USA, India, Pakistan, Uzbekistan, Turkey, Australia, Greece, Brazil, Egypt etc. where climatic conditions suit the natural growth requirements of cotton, which includes periods of hot

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and dry weather and adequate moisture obtained through irrigation. Genetic improvement in *Desi* cotton could be gained either through selection or exploitation of hybrid vigour. Therefore, more emphasis should be given to increase the seed cotton yield per unit area by developing hybrids with short stature and big boll size with sustained yield in multiple environments. To achieve such desirable characteristics in a new cultivar, proper breeding strategies should be followed. There is an urgent need to promote those cottons that could yield better as compared to existing cultivars.

For development of superior and heterotic hybrids in cotton, it is essential to utilize large number of available germplasm. In heterosis breeding programme, the selection of crosses on basis of heterosis is very important in producing superior hybrids.

MATERIAL AND METHODS

The present investigation was undertaken to study of heterosis for seed cotton yield and yield contributing traits in *Desi* Cotton (*Gossypium arboreum* L.). Twenty four cross combinations derived by crossing four lines with six testers in line x tester mating design. The experiment material consisted of 24 crosses ten parents along with three standard checks (PKVDH 1, NACH 12 and PKV Suvarna). The experiment was conducted at Cotton Research Station, Mahboob Baugh farm, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *Kharif* season of 2015-16. The mean values of all the treatments for the characters under study were worked out. Standard error and critical difference at 1 and 5 per cent level of significance were calculated by using the formula (Panse and Sukhatme, 1967). The magnitude of heterosis was estimated for all the characters under study over mid parent, better parent and standard check.

RESULTS AND DISCUSSION

The analysis of variance showed significant differences for all the characters studied. The mean sum of squares for the treatments were highly significant for various characters studied except boll weight. The analysis of variance for all the characters is presented in Table 1. The heterosis over mid parent, better parent and standard checks are presented in Table 2.

Earliness in flowering is desirable and hence the cross combinations having negative heterosis for days to 50 per cent flowering were desirable. Heterosis for days to 50 per cent flowering over mid parent ranged from -3.32% (PA 734 x AKA 2004-29) to 3.12% (PA 741 x JLA 0614). The crosses PA 734 x AKA 2004-29 (-3.32%), PA 734 x CNA 1016 (-2.59%) and PA 809 x NDLA 3020(-2.29%) were the most heterotic crosses over mid parent.

Heterosis over better parent ranged from -3.77% (PA 734 x AKA 2004-29) to 2.38% (PA 741 x JLA 0614).The cross PA 734 x AKA 2004-29 (-3.77%), exhibited highest significant negative heterosis followed by PA 741x NDLA 3020 (-3.64%) and PA 809 x NDLA 3020 (-3.18%). Heterosis over standard check PKVDH 1 ranged between -3.32% (PA 734 x AKA 2004-29) to 3.79 % (PAIG 77 x ARBAS 1301). The cross PA 734 x AKA 2004-29 (-3.32%) had higher significant heterosis over standard check PKVDH 1. Only one cross each was negative significantly superior over standard check PKVDH 1, PKV Suvarna and NACH 12. Significant negative heterosis for earliness was also reported by Deosarkar *et al.* (2009); Patel *et al.* (2005); Jaiwar *et al.* (2012) and Bayyapu *et al.* (2015).

Higher number of sympodia is an important attribute to yield hence positive heterosis for this trait is desirable. The mid parent heterosis for this trait was ranging from 20.00 per cent (PA 734x GAM 162) to 41.33 per cent (PA 809 × JLA 0614). Highest positive significant heterosis over mid parent was exhibited by PA 809 × JLA 0614 (41.33 %) followed by PA 809 × ARBAS 1301 (38.60 %) and PA 809 × AKA 2004-29 (38.67%). Significant positive heterosis over mid parent was exhibited by twenty four hybrids. Heterosis over better parent ranged from 9.30 per cent (PA 741 x AKA 2004-29 and PA 741 × GAM 162) to 39.47 per cent (PA 809 x JLA 0614). The cross PA 809 x JLA 0614 (39.47 %) exhibited highest positive significant heterosis over better parent followed by PA 809 x AKA 2004-29 and PA 809 × ARBAS 1301 (36.84%). Heterosis over standard check PKVDH 1 ranged from 30.56 per cent (PA 741 x GAM 162 and PAIG 77 × GAM 162) to 55.56 per cent (PA 734 x CNA 1016). The remaining crosses having higher positive significant heterosis over standard check were PA 741 x ARBAS 1301 (52.78%), PA 734 x NDLA 3020 and PAIG 77 × ARBAS 1301 (50.00%). All twenty four crosses were positive significantly superior over all the three checks *viz.*, PKVDH 1, PKV Suvarna and NACH 12. Heterosis for this trait was reported by the earlier workers (Guvercin, 2011; Tuteja *et al.*, 2011; Balu *et al.*, 2012; Ashokkumar *et al.*, 2013; Lalage *et al.*, 2011; Madhuri *et al.*, 2104 and Badhe *et al.*, 2015).

The cross PA 741x ARBAS 1301 (26.42%) exhibited highest significant positive mid-parent heterosis for number of bolls per plant followed by PA 741 x JLA 0614 (23.23%) and PAIG 77 x AKA 2004-29 (22.94%), where as, PA 809 x JLA 0614 (2.04 %) exhibited the lowest heterosis over mid parent. Thirteen crosses showed significant positive heterosis over mid-parent. In case of better parent heterosis, the cross PAIG 77 x AKA 2004-29 (21.82%) showed highest significant positive heterosis followed by the crosses PA 741 x JLA 0614 (19.61%), PAIG 77 x ARBAS 1301 (17.24%), PA 741 x ARBAS 1301 (15.52%), and the lowest heterosis over better parent was recorded by PA 809 x JLA 0614 (-1.96%). The cross PAIG 77 x ARBAS 1301 showed highest significant heterosis over all standard checks NACH 12 (36.00 %), PKV Suvarna (21.43%) and PKVDH 1 (25.93 %). The range of heterosis over the standard checks PKVDH 1, PKV Suvarna and NACH 12 was from -1.85 to 25.93, -10.71 to 21.43 and 0.00 to 36.00 per cent, respectively. Three, three and nine crosses each were positive significantly superior over check PKVDH 1, PKV Suvarna and NACH 12, respectively. The results are in agreement with the reports of Guvercin (2011); Basal *et al.* (2011); Tuteja *et al.* (2011); Balu *et al.* (2012); Muhammad *et al.* (2014) and Saifullah *et al.* (2014).

The cross PA 741 x AKA 2004-29 (14.64%) exhibited highest significant positive mid-parent heterosis for boll weight followed by PA 734 x NDLA 3020 (13.93%) and PA 734 x AKA 2004-29 (12.32%). Twenty three crosses showed significant positive heterosis over mid-parent.In case of better parent heterosis, the cross PA 741 x AKA 2004-29 (14.56%) showed highest significant positive heterosis followed by the crosses PA 734 x NDLA 3020 (12.14%). The range of heterosis over better parent recorded was from 0.78 to 14.56 per cent and PA 734 x ARBAS 1301 (0.78%) showed the lowest heterosis over better parent.

The cross PA 734 x CNA 1016 (11.72%) exhibited the highest positive heterosis over mid parent followed by PAIG 77 x ARBAS 1301 (10.00%), PA 734 x GAM 162 (9.86%) for number of seeds per boll. The range of heterosis over better parent was from -1.25 per cent (PA 741 x AKA 2004-29) to 10.96 per cent (PA 734 x CAN 1016). The cross PAIG 77 x ARBAS 1301 showed highest positive significant heterosis over all standard check PKVDH 1, PKV Suvarna and NACH 12. The heterosis over standard checks PKVDH 1, PKV Suvarna and NACH 12 ranged from 0.00 to 17.33, 7.14 to 25.71 and 1.32 to 15.79 per cent, respectively.

For plant height, the cross PAIG 77 x ARBAS 1301 (16.76%) has highest positive heterosis over mid parent followed by PA 809 × CNA 1016 (14.13 %), PA 734 x ARBAS 1301 (14.05%) and PA 741 x ARBAS 1301 (13.84%). Heterosis over better parent ranged from -1.09 per cent (PAIG 77 x CNA 1016) to 13.11 per cent (PA 734 x ARBAS 1301). The crosses PA 734 x ARBAS 1301 (13.11 %) PAIG 77 × ARBAS 1301 (12.22) and PA 741 x ARBAS 1301 (11.94%) recorded significant higher positive heterosis over better parent. Heterosis over standard check PKVDH 1 ranged from 3.12 per cent (PAIG 77 x CNA 1016) to 17.28 per cent (PA 734 x ARBAS 1301).These findings are in accordance with the results obtained by Dawod and Al-Guborry (2010); Guvercin (2011); Patel *et al.* (2015); Singh *et al.* (2013); Jaiwar *et al.* (2012); Kumar *et al.* (2013) and Baloch *et al.* (2015).

Early maturity is desirable and hence the cross combinations having negative heterosis for days to maturity were desirable. Heterosis over better parent ranged from -2.86 per cent (PA 734 x AKA 2004-29) to 1.75 per cent (PA 734 x JLA 0614). The cross PA 734 x AKA 2004-29 (-2.86%) exhibited highest significant negative heterosis followed by PA 741 x NDLA 3020 (-2.79%), PA 809 × NDLA 3020 (-2.58) and PA 741 ×

Table 1 : Analysis of variance for seed cotton yield, yield contributing and fibre quality traits in *Desi* cotton

Source of variations	d.f.	Days to 50% flowering	Days to 50% boll bursting	No. of sympodia/ plant	No. of boll/ plant	No. of seed / boll	Boll Weight (g)	Plant height (cm)	Days to maturity	Seed cotton yield/ plant (g)	Lint index	Seed index (g)	Harvest index
							Mean sum of squares						
Replications	2	1.810	1.765	0.441	2.819	2.441	0.002	37.846	1.576	35.226	0.119	0.320	0.955
Treatments	36	4.648**	5.608**	13.489**	10.730**	5.206**	0.050	126.509**	10.063**	108.037**	0.236**	1.068**	11.996**
Error	72	2.051	2.349	1.571	2.579	2.117	0.003	24.930	3.326	17.038	0.072	0.179	1.901

* and ** indicate significance of values at P=0.01 and 0.05, respectively

CNA 1016 (-2.40). Heterosis over standard check PKVDH 1 and PKV Suvarna ranged between -2.86 per cent (PA 734 x AKA 2004-29 and PA 741 x AKA 2004-29) to 1.98 per cent (PA 734 x JLA 0614). The crosses PA 741 x AKA 2004-29 and PA 734 x AKA 2004-29 exhibited highest significant negative heterosis over check PKVDH 1, PKV Suvarna and NACH 12.

In case of seed index the cross PA 809 x AKA 2004-29 (19.00%) showed maximum significant positive heterosis over mid-parent for seed index followed by PA 741 x ARBAS 1301 (16.40 %) and PA 809 x ARBAS 1301 (15.75 %). The range of mid-parent heterosis was from 1.87 to 19.00 per cent. The cross PA 741 x ARBAS 1301 (16.01 %) showed highest heterobeltiosis followed by PA 809 x ARBAS 1301 (15.39%) and PA 734 x ARBAS 1301 (13.25%). The better parent heterosis ranged from -7.34 to 16.01 per cent. Eleven and three crosses each showed positive significant heterosis over

Table 2 : Estimates of heterosis of 14 selected crosses in percentage over mid parent (M.P.), better parent (B.P.) and standard check (S.C.) for different characters

Sr. No.	Hybrids	Days to 50% flowering						Days to 50% boll bursting					
		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over			Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over		
					PKVDH 1	PKV Suvarna	NACH 12				PKVDH 1	PKV Suvarna	NACH 12
1.	PA 741x ARBAS 1301	70.00	-0.47	-2.33	-0.47	0.00	-0.47	109.67	-0.60	-1.79	-0.30	-1.20	-0.90
2.	PA 741x NDLA 3020	70.67	-0.70	-3.64*	0.47	0.95	0.47	110.67	-0.45	-2.35*	0.61	-0.30	0.00
3.	PA 741x CNA 1016	69.00	-1.43	-2.82	-1.90	-1.43	-1.90	109.00	-1.06	-2.10	-0.91	-1.80	-1.51
4.	PA 734 ×JLA 0614	70.67	0.47	0.00	0.47	0.95	0.47	111.67	1.06	0.30	1.52	0.60	0.90
5.	PA 734 x AKA 2004-29	68.00	-3.32*	-3.77*	-3.32*	-2.86	-3.32*	108.00	-2.26*	-2.99*	-1.82	-2.70*	-2.41**
6.	PA 734x ARBAS 1301	72.67	2.11	1.40	3.32*	3.81*	3.32*	112.00	0.45	0.30	1.82	0.90	1.20
7.	PA 734× CNA 1016	69.00	-2.59	-2.82	-1.90	-1.43	-1.90	106.67	-1.50	-1.50	-0.30	-1.20	-0.90
8.	PAIG 77x AKA 2004-29	69.67	-1.42	-2.82	-0.95	-0.48	-0.95	109.33	-1.20	-2.09	-0.61	-1.50	-1.20
9.	PAIG 77x ARBAS 1301	72.00	0.70	0.47	2.37	2.86	2.37	112.33	0.60	0.60	2.12	1.20	1.51
10.	PAIG 77x NDLA 3020	72.67	0.46	-0.91	3.32*	3.81*	3.32*	112.67	0.15	-0.59	2.42*	1.50	1.81
11.	PAIG 77x CNA 1016	71.00	-0.23	-0.47	0.95	1.43	0.95	111.00	-0.45	-0.60	0.91	0.00	0.30
12.	PA 809x JLA 0614	70.67	-0.47	-1.85	0.47	0.95	0.00	110.67	-0.30	-1.48	0.61	-0.30	0.00
13.	PA 809 x AKA 2004-29	70.33	-0.94	-2.31	0.00	0.48	3.79*	110.67	-0.30	-1.48	0.61	-0.30	0.00
14.	PA 809x ARBAS 1301	73.00	1.62	1.39	3.79*	4.29**	0.95	113.00	0.89	0.59	2.73*	1.80	2.11
	S.E.±	0.827	0.958	1.106	1.106	1.106	1.106	0.884	0.89	1.202	1.202	1.202	1.202

Contd… Table 2

Sr. No.	Hybrids	No. of sympodia/ plant						No.of bolls/ plant					
		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over			Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over		
					PKVDH 1	PKV Suvarna	NACH 12				PKVDH 1	PKV Suvarna	NACH 12
1.	PA 741x ARBAS 1301	18.33	35.80**	27.91**	52.78**	44.74**	41.03**	22.33	26.42**	15.52*	24.07**	19.64**	34.00
2.	PA 741x NDLA 3020	16.67	25.00**	16.28*	38.89**	31.58**	28.21**	18.00	11.34	10.20	0.00	-3.57	8.00
3.	PA 741x CNA 1016	16.00	17.07*	11.63	33.33**	26.32**	23.08**	19.33	16.00*	11.54	7.41	3.57	16.00
4.	PA 734 ×JLA 0614	16.33	20.99**	13.95	36.11**	28.95**	25.64**	18.00	12.50	5.88	0.00	-3.57	8.00
5.	PA 734 x AKA 2004-29	17.00	25.93**	18.60*	41.67**	34.21**	30.77**	20.33	22.00**	10.91	12.96	8.93	22.00**
6.	PA 734x ARBAS 1301	17.67	30.86**	23.26**	47.22**	39.47**	35.90**	20.00	16.50*	3.45	11.11	7.14	20.00**
7.	PA 734× CNA 1016	18.67	36.59**	30.23**	55.56**	47.37**	43.59**	19.67	21.65**	13.46	9.26	5.36	18.00
8.	PAIG 77xAKA 2004-29	17.00	30.77**	27.50**	41.67**	34.21**	30.77**	22.33	22.94**	21.82**	24.07**	19.64**	34.00**
9.	PAIG 77x ARBAS 1301	18.00	38.46**	35.00**	50.00**	42.11**	38.46**	22.67	21.43**	17.24*	25.93**	21.43**	36.00**
10.	PAIG 77x NDLA 3020	16.67	29.87**	25.00**	38.89**	31.58**	28.21**	20.67	20.39**	14.81	14.81	10.71	24.00**
11.	PAIG 77x CNA 1016	16.67	26.58**	25.00**	38.89**	31.58**	28.21**	19.00	7.55	5.56	5.56	1.79	14.00
12.	PA 809x JLA 0614	17.67	41.33**	39.47**	47.22**	39.47**	35.90**	16.67	2.04	-1.96	-7.41	-10.71	0.00
13.	PA 809 x AKA 2004-29	17.33	38.67**	36.84**	44.44**	36.84**	33.33**	19.67	15.69*	7.27	9.26	5.36	18.00
14.	PA 809x ARBAS 1301	17.33	38.67**	36.84**	44.44**	36.84**	33.33**	20.33	16.19*	5.17	12.96	8.93	22.00**
	S.E.±	0.723	0.888	1.025	1.025	1.025	1.025	0.927	1.149	1.326	1.326	1.326	1.326

Contd… Table 2

Contd.. Table 2

Sr. No.	Hybrids	No. of seeds / boll						Boll Weight (g)					
		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over PKVDH 1	PKV Suvarna	NACH 12	Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over PKVDH 1	PKV Suvarna	NACH 12
1.	PA 741x ARBAS 1301	28.67	6.83	6.17	14.67**	22.86**	13.16**	2.62	5.30**	1.95	4.67*	9.64**	5.94**
2.	PA 741x NDLA 3020	27.00	3.18	1.25	8.00	15.71**	6.58	2.57	7.90**	7.07**	2.93	7.82**	4.18*
3.	PA 741x CNA 1016	27.67	9.21*	3.75	10.67*	18.57**	9.21	2.66	8.29**	6.13**	6.27**	11.31**	7.56**
4.	PA 734 ×JLA 0614	25.33	3.40	2.70	1.33	8.57	0.00	2.64	7.55**	7.18**	5.47**	10.47**	6.75**
5.	PA 734 x AKA 2004-29	26.00	4.70	2.63	4.00	11.43*	2.63	2.72	12.32**	11.32**	8.80**	13.97**	10.12**
6.	PA 734x ARBAS 1301	25.67	0.00	-4.94	2.67	10.00	1.32	2.59	3.26	0.78	3.47	8.38**	4.72*
7.	PA 734× CNA 1016	27.00	11.72**	10.96*	8.00	15.71**	6.58	2.70	9.03**	7.72*	7.87**	12.99**	9.18**
8.	PAIG 77x AKA 2004-29	26.67	3.23	1.27	6.67	14.29**	5.26	2.65	6.72**	3.39	5.87**	10.89**	7.15**
9.	PAIG 77x ARBAS 1301	29.33	10.00*	8.64	17.33**	25.71**	15.79**	2.85	11.18**	11.04**	14.00**	19.41**	15.38**
10.	PAIG 77x NDLA 3020	28.33	8.97*	7.59	13.33**	21.43**	11.84*	2.69	9.07**	4.95*	7.47**	12.57**	8.77**
11.	PAIG 77x CNA 1016	26.67	5.96	1.27	6.67	14.29**	5.26	2.80	10.73**	9.57**	12.13**	17.46**	13.50**
12.	PA 809x JLA 0614	25.67	2.67	1.32	2.67	10.00	1.32	2.66	11.14**	8.13**	6.40**	11.45**	7.69**
13.	PA 809 x AKA 2004-29	25.00	-1.32	-1.32	0.00	7.14	-1.32	2.64	11.71**	10.00**	5.60**	10.61**	6.88**
14.	PA 809x ARBAS 1301	27.00	3.18	0.00	8.00	15.71**	6.58	2.72	11.17**	5.97**	8.80**	13.97**	10.12**
	S.E.±	0.840	1.027	1.186	1.186	1.186	1.186	0.036	0.043	0.050	0.050	0.050	0.050

Contd.. Table 2

Sr. No.	Hybrids	Plant height (cm)						Days to maturity					
		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over PKVDH 1	PKV Suvarna	NACH 12	Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over PKVDH 1	PKV Suvarna	NACH 12
1.	PA 741x ARBAS 1301	134.33	13.84**	11.94**	14.16**	9.81**	8.92**	150.00	-0.55	-1.75	-1.10	-1.96	-1.53
2.	PA 741x NDLA 3020	133.33	9.29**	4.17	13.31**	8.99**	8.11*	151.00	-0.77	-2.79**	-0.44	-1.31	-0.88
3.	PA 741x CNA 1016	129.67	8.66**	5.71	10.20**	5.99	5.14	149.00	-1.22	-2.40	-1.76	-2.61*	-2.19
4.	PA 734 ×JLA 0614	130.33	7.42*	6.83*	10.76**	6.54	5.68	154.67	1.87*	1.75	1.98	1.09	1.53
5.	PA 734 x AKA 2004-29	129.67	5.42	4.57	10.20**	5.99	5.14	147.33	-2.43**	-2.86**	-2.86**	-3.70**	-3.28**
6.	PA 734x ARBAS 1301	138.00	14.05**	13.11**	17.28**	12.81**	11.89**	154.00	1.20	0.87	1.54	0.65	1.09
7.	PA 734× CNA 1016	133.67	9.26**	8.97*	13.60**	9.26**	8.38*	149.33	-1.86*	-2.18*	-1.54	-2.40*	-1.97
8.	PAIG 77x AKA 2004-29	132.33	12.78**	6.72*	12.46**	8.17*	7.30*	149.00	-1.54	-2.19*	-1.76	-2.61*	-2.19*
9.	PAIG 77x ARBAS 1301	134.67	16.76**	12.22*	14.45**	10.08**	9.19**	153.00	0.33	0.22	0.88	0.00	0.44
10.	PAIG 77x NDLA 3020	133.00	11.45**	3.91	13.03**	8.72	7.84*	153.33	-0.33	-1.29	1.10	0.22	0.66
11.	PAIG 77x CNA 1016	121.33	4.00	-1.09	3.12	-0.82	-1.62	151.00	-0.98	-1.09	-0.44	-1.31	-0.88
12.	PA 809x JLA 0614	125.33	5.03	3.87	6.52	2.45	1.62	151.00	-1.09	-1.52	-0.44	-1.31	-0.88
13.	PA 809 x AKA 2004-29	134.67	11.29**	8.60*	14.45**	10.08**	9.19**	151.00	-0.55	-1.52	-0.44	-1.31	-0.88
14.	PA 809x ARBAS 1301	127.33	7.00*	6.11	8.22*	4.09	3.24	153.00	0.00	-0.22	0.88	0.00	0.44
	S.E.±	2.882	3.542	4.090	4.090	4.090	4.090	1.053	1.320	1.527	1.524	1.524	1.524

Contd.. Table 2

Sr. No.	Hybrids	Seed cotton yield/ plant (g)						Harvest index					
		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over PKVDH 1	PKV Suvarna	NACH 12	Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over PKVDH 1	PKV Suvarna	NACH 12
1.	PA 741x ARBAS 1301	53.60	25.07**	19.37*	34.24**	33.04**	20.45**	39.57	10.08**	9.52**	7.73*	11.17**	12.46**
2.	PA 741x NDLA 3020	50.76	25.17**	24.40**	27.14**	26.01**	14.08	41.04	11.86**	10.15**	11.75**	15.32**	16.66*
3.	PA 741x CNA 1016	52.81	26.92**	24.51**	32.28**	31.09**	18.69*	39.72	8.84**	7.76*	8.15*	11.60**	12.89**
4.	PA 734 ×JLA 0614	54.08	35.79**	30.67**	35.44**	34.23**	21.53**	39.17	8.65**	7.13*	6.64*	10.05**	11.32**
5.	PA 734 x AKA 2004-29	57.16	41.32**	34.07**	43.17**	41.89**	28.47**	39.89	10.13**	9.10**	8.60**	12.07**	13.37**
6.	PA 734x ARBAS 1301	59.40	42.85**	32.29**	48.77**	47.44**	33.49**	41.93	15.95**	14.69**	14.17**	17.81**	19.18**
7.	PA 734× CNA 1016	51.52	27.71**	21.46**	29.04**	27.88**	15.78*	40.91	11.43**	10.98**	11.38**	14.94**	16.27**
8.	PAIG 77x AKA 2004-29	54.92	29.46**	28.82**	37.56**	36.33**	23.43**	40.69	12.95**	11.45**	10.79**	14.33**	15.65**
9.	PAIG 77x ARBAS 1301	58.37	34.02**	30.01**	46.20**	44.89**	31.19**	39.31	8.63**	7.68*	7.04*	10.46**	11.74**
10.	PAIG 77x NDLA 3020	50.06	21.34**	18.60*	25.39**	24.27**	12.51	39.87	10.33**	9.20**	8.56*	12.03**	13.32**
11.	PAIG 77x CNA 1016	51.99	22.86**	22.57**	30.21**	29.05**	16.84*	39.53	8.32**	8.27*	7.63**	11.07**	12.35**
12.	PA 809x JLA 0614	49.60	28.07**	19.86*	24.23**	23.12**	11.47	40.00	9.04**	8.52**	8.91**	12.39**	13.69**
13.	PA 809 x AKA 2004-29	49.21	25.04**	15.42	23.25**	22.15*	10.59	40.85	12.87**	11.90**	11.22**	14.77**	16.10**
14.	PA 809x ARBAS 1301	54.01	33.41**	20.30**	35.28**	34.07**	21.39**	38.34	6.10*	5.02	4.38	7.72*	8.96**
	S.E.±	2.383	2.891	3.338	3.338	3.338	3.338	0.796	0.978	1.130	1.130	1.130	1.130

* and ** indicate significance of values at P=0.05 and 0.01, respectively

mid parent and better parent, respectively. Heterosis for this trait was reported by the earlier workers (Wankhade *et al.*, 2009; Tuteja *et al.*, 2011; Balu *et al.*, 2012 and Patil *et al.*, 2012).

Out of twenty four crosses twenty two crosses were found with significant positive heterosis effect over better parent for harvest index. The range of better parent heterosis was between 5.02 per cent (PA 809 x ARBAS 1301) to 15.87 per cent (PA 741 x AKA 2004-29). The most significant crosses obtained are PA 741 x AKA 2004-29 (15.87 %). PA 734 x ARBAS 1301 (14.69 %) and PA 809 x AKA 2004-29 (11.90 %). All crosses showed significant positive heterosis over check PKV Suvarna and NACH 12. The cross PA 734 x ARBAS 1301 showed the highest positive significant heterosis over all the checks. Heterosis for this trait was also reported by Gurerein (2011) and Patil *et al.* (2015).

Seed cotton yield is a complex trait, dependent on many other component traits, such as boll number and boll weight. The cross PA 734 x ARBAS 1301 (42.85%) showed the highest significant positive heterosis over mid-parent for seed cotton yield per plant followed by PA 734 x AKA 2004-29 (41.32%). All crosses showed significant positive heterosis over mid-parent for this trait except PAIG 77 × GAM 162. The range of heterosis was from 12.03 to 42.85 per cent. In case of heterobeltiosis, the cross PA 734 x AKA 2004-29 (34.07%) showed highest significant positive heterobeltiosis followed by the crosses PA 734 x ARBAS 1301 (32.29 %), PA 734 × JLA 0614 (30.67 %) and PAIG 77 × ARBAS 1301 (30.01 %). The cross PA 734 x ARBAS 1301 showed the highest significant positive heterosis over standard check PKVDH 1, PKV Suvarna and NACH 12. The range of heterosis over check PKVDH 1 was from 9.53 to 48.77 per cent. Twenty, twenty and ten crosses each showed significant positive heterosis over standard check PKVDH 1, PKV Suvarna NACH 12, respectively.

Seed cotton yield is a complex trait, dependent on many other component traits, such as boll number and boll weight. The cross PA 734 x ARBAS 1301 (42.85%) showed the highest significant positive heterosis over mid-parent for seed cotton yield per plant followed by PA 734 x AKA 2004-29 (41.32%). All crosses showed significant positive heterosis over mid-parent for this trait except PAIG 77 × GAM 162. The range of heterosis was from 12.03 to 42.85 per cent. In case of heterobeltiosis, the cross PA 734 x AKA 2004-29 (34.07%) showed highest significant positive heterobeltiosis followed by the crosses PA 734 x ARBAS 1301 (32.29 %), PA 734 × JLA 0614 (30.67 %) and PAIG 77 × ARBAS 1301 (30.01 %) The cross PA 734 x ARBAS 1301 showed the highest significant positive heterosis over standard check PKVDH 1, PKV Suvarna and NACH 12. The range of heterosis over check PKVDH 1 was from 9.53 to 48.77 per cent. Twenty, twenty and ten crosses each showed significant positive heterosis over standard check PKVDH 1, PKV Suvarna NACH 12, respectively. The results are in agreements with the results of Patil *et al.* (2009), Soomro *et al.* (2010) and Patil *et al.* (2013).

On the basis of this study it is concluded that the crosses having highly significant standard heterosis can be exploited for heterosis and heterosis breeding would be rewarding with further testing of these crosses for many seasons at multilocations.

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