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Original Research Article

Heterosis Studies for Fibre Quality Traits in Desi Cotton (*Gossypium arboreum* L.)

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A B S T R A C T

Cotton crop is mainly cultivated for its fibre and hence quality of lint is important in cotton. Cotton crop is highly amenable to both heterosis and recombination breeding as it is often cross pollinated. The present investigation entitled "Heterosis studies for fibre quality traits *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 18 characters. Analysis of variance for means revealed significant differences for all the characters studied. The magnitude of heterosis, heterobeltosis and standard/economic heterosis for all the characters in the present study were highly appreciable. Among all the fibre quality characters, the magnitude of standard heterosis for 2.5 % span length over PKV Suvarna was high in the cross combinations PA 809 X ARBAS 1301 (23.75**) and PA 809 X JLA 0614 (21.07**). In case of micronaire the magnitude of standard heterosis over PKV Suvarna was found significant in the cross combinations was PA 809 X ARBAS 1301 (-21.82**) and PA 809 X JLA 0614 (-16.36**). The high magnitude of standard heterosis for fibre strength over NACH 12 was recorded in the cross combinations PA 809 X ARBAS 1301 (21.54**) and PA 809 X AKA 2004-29 (16.67**). With regards to lint index magnitude of standard heterosis over PKV Suvarna was exhibited by PAIG 77 X ARBAS 1301 (18.50**) and PAIG 77 X AKA 2004-29 (16.49**). The cross combinations PA 734 X AKA 2004-29 (9.56**) and PAIG 77 X AKA 2004-29 (8.80**) displayed highly significant standard heterosis over PKVDH 1 for ginning out turn respectively.

Introduction

Cotton, the king of fibres, occupies a pre-eminent position as a commercial crop in India. Cotton also known as 'white gold' as it is preferred by farmers as cash crop beside other field crops. 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 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. The desi cotton is mainly grown for surgical cotton in our country. Therefore, there is urgent need to develop varieties and hybrids which will have better quality fibre characteristics. 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 come closer in quality to the most sought by modern textile mills.

For development of superior and heterotic hybrids in cotton, it is essential to utilize large number of available germplasm. In the context of quality assessment, high volume instrument testing is universally accepted by the industry and is becoming a requirement, enabling cotton to be marketed more directly on textile mill needs rather than the traditional grade, staple and micronaire. This has contributed to the development and acceptance of high quality hybrids and varieties.

In heterosis breeding programme, the selection of crosses on basis of heterosis is very important in producing superior hybrids.

Materials and Methods

The present investigation was undertaken to Study of heterosis for fibre quality 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, 1961). 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 was highly significant for all the characters studied. 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.

The range for mid parent heterosis for 2.5 per cent span length was from -15.30 per cent (PA 741 x CNA 1016) to 13.26 per cent (PA 809 x JLA 0614). The crosses, PA 809 x JLA 0614 (13.26 %), PA 741x JLA 0614 (10.87 %), PA 809 x GAM 162 (10.44 %) and PAIG 77 x JLA 0614 (10.34 %) showed higher positive significant heterosis over mid parent.

Eleven hybrids showed significant positive heterosis over mid parent for span length. For better parent only one hybrid i.e. PAIG 77 × JLA 0614 (3.97 %) showed significant positive heterosis for span length. The range of heterosis over better parent was from -18.30 (PA 741 x CNA 1016) to 3.97 (PAIG 77 x JLA 0614). Twenty one, sixteen and nineteen hybrids each out of twenty four showed significant positive heterosis over check PKVDH 1, PKV Suvarna and NACH 12, respectively.Similar results were obtained by Deosarkar *et al.,* (2009), Patel *et al.,* (2009), Tuteja *et al.,* (2011), Jaiwar *et al.,* (2012), Ashokkumar *et al.,* (2013), Kumar *et al.,* (2013), Singh *et al.,* (2013) and Abro *et al.,* (2014).

With regards to fibre fineness eleven crosses out of twenty four showed significant negative heterosis over mid parent. The cross PAIG 77 x NDLA 3020 (-15.00%) showed the highest significant negative heterosis over mid parent followed by PA 809 × ARBAS 1301 (-14.85 %). Ten crosses showed significant negative heterosis over better parent. The cross PAIG 77 x NDLA 3020 and PA 809 × NDLA 3020 (-26.09%) showed the highest significant negative heterosis over better parent followed by PA 809 × ARBAS 1301 (-23.21%).

Twenty two, ten and twenty four crosses each showed significant negative heterosis over check PKVDH 1, PKV Suvarna and NACH 12, respectively. The cross PA 809 × ARBAS 1301 showed highest negative significant heterosis over standard check PKVDH 1, PKV Suvarna and NACH 12. The results are in agreement with the reports of Basal *et al.,* (2011), Tuteja *et al.,* (2011), Balu *et al.,* (2012), Patil *et al.,* (2013), Singh *et al.,* (2013), Ranganatha *et al.,* (2013) and Bayyepu Reddy *et al.,* (2015).

In case of uniformity out of twenty four crosses, the crosses *viz.,* PA 809 x ARBAS 1301 (4.88 %), PA 809 x NDLA 3020 (3.75 %), PAIG 77 x NDLA 3020 (3.14 %) and PA 741 × GAM 162 (2.47 %) exhibited significant positive heterosis over mid-parent. The range of mid parent heterosis was from -4.19 per cent (PA 809 x CNA 1016) to 4.88 per cent (PA 809 x ARBAS 1301).

The range of better parent heterosis was from -4.46 per cent (PA 809 x CNA 1016) to 3.61 per cent (PA 809 x ARBAS 1301). Only one cross PA 809 x ARBAS 1301 (3.61 %) out of twenty four crosses recorded significant positive heterosis over better parent. Three, one and seventeen crosses each showed significant positive heterosis over the standard checks PKVDH 1, PKV Suvarna and NACH 12, respectively. Heterosis for this trait was reported by Deosarkar *et al.,* (2009), Basal *et al.,* (2011), Lalge *et al.,* (2011), Patil *et al.,* (2015), Muhammad *et al.,* (2015) and Baloch *et al.,* (2015).

The mid parent heterosis for fibre strength was ranged from -4.97 per cent (PA 809 x NDLA 3020) to 10.34 per cent (PA 741 x AKA 2004-29). Twelve crosses showed significant positive heterosis over mid parent for fibre strength. The cross PA 741 x AKA 2004-29 (9.51 %) was highest in significant positive heterosis followed by PAIG 77 x JLA 0614 (5.91 %).

Seven crosses recorded significantly positive heterosis over better parent for fibre strength. The better parent heterosis ranged between -9.47 per cent (PA 809 x NDLA 3020) and 9.51 per cent (PA 741 x AKA 2004-29). Twenty two crosses each showed significant positive heterosis over check PKVDH 1 and NACH 12 while, five crosses showed significant positive heterosis over check PKV Suvarna. The cross PA 809 × ARBAS 1301 showed highest significant positive heterosis over all standard checks PKVDH 1,PKV Suvarna and NACH 12.Similar results were found by Tuteja *et al.,* (2011), and Ranganatha *et al.,* (2013).

The mid parent heterosis for short fibre index was ranged from -20.39 per cent (PA 809 x GAM 162) to 18.18 per cent (PA 741 x CNA 1016). Nine crosses exhibited significant negative heterosis over mid-parent for short fibre index. The range of heterosis over better parent was between -31.67 per cent (PA 809 x GAM 162) to 13.04 per cent (PA 741 x CNA 1016). Seventeen crosses exhibited significant negative heterosis over better parent for short fibre index.

Table.1 Analysis of variance for seed cotton yield, yield contributing and fibre quality traits in desi cotton

Source of variations	d.f.	Ginning outturn (%)	2.5% Span length (mm)	Fibre fineness (Micronaire) (µg/inch)	Fibre strength (g/tex)	Uniformity ratio (%)	Short fibre index
		Mean sum of squares					
Replications	2	0.105	0.887	0.033	0.265	2.783	0.056
Treatments	36	3.820**	15.019**	0.825**	5.102**	7.729**	5.024**
Error	72	1.607	0.391	0.023	0.259	1.644	0.191

*, **significantat5%and1%levels, respectively

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	2.5% Span length (mm)						Fibre fineness/ Micronaire (µg/inch)					
		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	27.70	-4.48**	-7.05**	9.92**	6.13**	7.78**	5.30	-5.36**	-5.36*	-13.11**	-3.64	-20.90**
2	PA 741x NDLA 3020	25.60	-2.48	-14.09**	1.59	-1.92	-0.39	6.00	-4.00*	-13.04**	-1.64	9.09**	-10.45**
3	PA 741x CNA 1016	26.20	-15.30**	-18.30**	3.97	0.38	1.95	5.60	9.80**	0.00	-8.20**	1.82	-16.42**
4	PA 734 ×JLA 0614	26.90	2.87	-3.24	6.75**	3.07	4.67*	5.90	4.42*	3.51	-3.28	7.27**	-11.94**
5	PA 734 x AKA 2004-29	27.30	3.02	-1.80	8.33**	4.60*	6.23*	5.70	3.64	1.79	-6.56**	3.64*	17.91**
6	PA 734x ARBAS 1301	27.50	-1.79	-2.48	9.13**	5.36**	7.00**	5.50	-1.79	-1.79	-9.84**	0.00	-13.43**
7	PA 734× CNA 1016	28.90	-3.75	-9.88**	14.68**	10.73**	12.45**	5.50	7.84**	-1.79	-9.84**	0.00	-17.91**
8	PAIG 77x AKA 2004-29	27.50	3.97*	-0.72	9.13**	5.34**	7.00**	5.70	8.57**	5.56*	-6.56**	3.64	-14.93**
9	PAIG 77x ARBAS 1301	28.20	0.89	0.00	11.90**	8.05**	9.73**	5.40	0.93	-3.57	-11.48**	-1.82	-19.40**
10	PAIG 77x NDLA 3020	26.30	4.37*	-5.05**	4.37*	0.77	2.33	5.10	-15.00**	-26.09**	-16.39**	-7.27**	-23.88**
11	PAIG 77x CNA 1016	27.20	-8.98**	-15.18**	7.94**	4.21*	5.84**	5.60	15.46**	9.80**	-8.20**	1.82	-16.42**
12	PA 809x JLA 0614	31.60	13.26**	0.96	25.40**	21.07**	22.96**	4.60	-9.80**	-19.30**	-24.59**	-16.36**	-31.34**
13	PA 809 x AKA 2004-29	30.70	8.67**	-1.92	21.83**	17.62**	19.46**	5.00	1.01	-7.41**	-18.03**	-9.06**	-25.37**
14	PA 809x ARBAS 1301	32.30	8.57**	3.19	28.17**	23.75**	25.68**	4.30	-14.85**	-23.21**	-29.51**	-21.82**	-35.82**
	S.E.±	0.361	0.446	0.515	0.515	0.515	0.515	0.088	0.107	0.123	0.123	0.123	0.123

Continued

Sr. no.	Hybrids	Fibre strength (g/tex)						Uniformity ratio (%)					
		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over			Mean	M.P. Heteros is (%)	B.P. Heterosis (%)	% Standard heterosis over		
					PKVDH 1	PKV Suvarna	NACH 12				PKVDH 1	PKV Suvarna	NACH 12
1	PA 741x ARBAS 1301	27.40	3.59**	3.01	10.04**	1.48	11.38**	82.00	0.61	0.00	1.23	0.00	3.80**
2	PA 741x NDLA 3020	25.90	-0.58	-1.52	4.02*	-4.07*	5.28**	81.00	1.89	-1.22	0.00	-1.22	2.53
3	PA 741x CNA 1016	25.90	-4.25**	-6.83**	4.02*	-4.07*	5.28**	81.00	-2.41*	-3.57**	0.00	-1.22	5.07**
4	PA 734 ×JLA 0614	26.20	1.95	-3.68**	5.22**	-2.96	6.50**	80.00	-2.44*	-2.44	-1.23	-2.44	2.53
5	PA 734 x AKA 2004-29	26.80	0.94	-1.47	7.63**	-0.74	8.94**	83.00	1.22	1.22	2.47	1.22	1.27
6	PA 734x ARBAS 1301	27.30	1.49	0.37	9.64**	1.11	10.98**	82.00	0.61	0.00	1.23	0.00	5.06**
7	PA 734× CNA 1016	29.40	6.91**	5.76**	18.07**	8.89**	19.51**	84.00	1.20	0.00	3.70**	2.44	3.80**
8	PAIG 77x AKA 2004-29	24.90	-2.92*	-3.86**	0.00	-7.78**	1.22	81.00	-1.22	-1.22	0.00	-1.22	5.06**
9	PAIG 77x ARBAS 1301	26.80	3.08*	0.75	7.63**	-0.74	8.94**	82.00	0.61	0.00	1.23	0.00	2.53
10	PAIG 77x NDLA 3020	26.70	4.30**	3.49*	7.23**	-1.11	8.54**	82.00	3.14**	0.00	-1.23	0.00	3.80**
11	PAIG 77x CNA 1016	25.30	-4.89**	-8.99**	1.61	-6.30	2.85	82.00	-1.20	-2.38	3.70**	0.00	1.27
12	PA 809x JLA 0614	27.50	4.36**	-3.51**	10.44**	1.85	11.79**	84.00	1.82	1.20	2.47	2.44	3.80**
13	PA 809 x AKA 2004-29	28.70	5.51**	0.70	15.26**	6.30**	16.67**	83.00	0.61	0.00	6.17**	1.22	6.33**
14	PA 809x ARBAS 1301	29.90	8.53**	4.91**	20.08**	10.74**	21.54**	86.00	4.88**	3.61**	2.47	4.88**	5.06**
	S.E.±	0.294	0.357	0.412	0.412	0.412	0.412	0.740	0.917	1.059	1.059	1.059	1.059

Continued

Sr. No.	Hybrids	Short fibre index (%)						Ginning outturn (%)					
		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% Standard heterosis over			Mean	M.P. Heter osis (%)	B.P. Heterosis (%)	% Standard heterosis over		
					PKVDH 1	PKV Suvarna	NACH 12				PKVDH 1	PKV Suvarna	NACH 12
1	PA 741x ARBAS 1301	10.20	13.33**	6.25	-21.54**	-16.39**	-5.56	34.49	-0.50	-1.31	-0.81	-2.63	-0.79
2	PA 741x NDLA 3020	11.00	1.85	-16.67**	-15.38**	-9.84**	1.85	36.03	1.96	0.82	3.63	1.74	3.66
3	PA 741x CNA 1016	10.40	18.18**	13.04**	-20.00**	-14.75**	-3.70	34.81	0.36	-0.37	0.12	-1.70	0.15
4	PA 734 ×JLA 0614	10.50	-0.94	-11.02**	-19.23**	-13.93**	-2.78	37.11	3.41	2.22	6.72*	4.77	6.75
5	PA 734 x AKA 2004-29	10.00	-2.91	-10.71**	-23.08**	-18.03**	-7.41*	38.09	3.38	-0.36	9.56**	7.56*	9.59**
6	PA 734x ARBAS 1301	9.90	4.21	3.13	-23.85**	-18.85**	-8.33*	35.92	2.87	1.29	3.32	1.43	3.35
7	PA 734× CNA 1016	9.00	-3.23	-4.26	-30.77**	-26.23**	-16.67**	35.31	1.04	-0.43	1.56	-0.29	1.59
8	PAIG 77x AKA 2004-29	10.10	-3.81	-9.82**	-22.31**	-17.21**	-6.48	37.83	3.01	-1.05	8.80**	6.81*	2.69
9	PAIG 77x ARBAS 1301	9.80	1.03	0.00	-24.62*	-19.67**	-9.26**	35.42	1.78	0.56	1.86	0.00	0.26
10	PAIG 77x NDLA 3020	11.20	-2.61	-15.15**	-13.85**	-8.20**	3.70	35.66	0.51	-0.22	2.56	0.69	0.19
11	PAIG 77x CNA 1016	10.40	9.47**	6.12	-20.00**	-14.75**	-3.70	34.74	-0.24	-1.35	-0.08	-1.90	1.50
12	PA 809x JLA 0614	8.80	-13.73**	-25.42**	-32.31**	-27.87**	-18.52**	35.88	0.94	-1.15	3.20	1.32	4.85
13	PA 809 x AKA 2004-29	9.10	-8.08*	-18.75**	-30.00**	-25.41**	-15.74**	35.69	-2.25	-6.64*	2.66	0.78	8.83**
14	PA 809x ARBAS 1301	8.00	-12.09**	-16.67**	-38.46**	-34.43**	-25.93**	34.85	0.76	0.14	0.23	-1.80	1.89
	S.E.±	0.056	0.301	0.348	0.348	0.348	0.348	0.732	0.906	1.046	1.046	1.046	1.046

Out of twenty four crosses, twenty four, twenty four and fifteen crosses each showed significant negative heterosis over checks PKVDH 1, PKV Suvarna and NACH 12, respectively. The most significant negative heterotic crosses were PA 809 x ARBAS 1301, PA 741 x JLA 0614 and PA 809 x GAM 162. Heterosis in negative direction for this character was reported by Bloek *et al.,* (2010), Gauverin (2011) Patil *et al.,* (2012), Singh *et al.,* (2014) and Madhuri *et al.,* (2015).

For ginning out turn the range of mid-parent heterosis was from -2.25% (PA 809 x AKA 2004-29) to 3.95% (PA 741 x GAM 162) for ginning outturn. Out of twenty four crosses none of the cross showed significant positive heterosis over mid-parent and none of the cross showed significant positive heterosis over better parent for ginning outturn. Seven and four crosses each exhibited significant positive heterosis effect over the check PKVDH 1 and PKV Suvarna. The most significant positive heterotic crosses were PA 734 × AKA 2004-29 and PAIG 77 × AKA 2004-29. Similar results were reported by Dawod *et al.,* (2010), Tuteja *et al.,* (2011) and Balu *et al.,* (2012), Badhe *et al.,* (2015) and *et al.,* (2015). 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 at least three to four seasons at multilocations.

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