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

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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. Fifty six hybrid combinations developed by crossing 7 lines and 8 testers were tested along with their parents including 4 checks in Line X Tester design for fibre quality characters during *kharif*, 2016 at three locations *viz.*, Cotton Research Station, Mahboob Baugh Farm, Parbhani (L_1), Cotton Research Station, Nanded (L_2), and Agricultural Research Station, Badnapur (L_3). The magnitude of heterosis was estimated in relation to better parent and Standard checks. Results revealed that the cross combination PA 785 x CNA 449 showed highest and desirable significant better parent heterosis for upper half mean length, PA 812 x Phule Dhanwantary for micronaire, whereas the cross PAIG 346 x Phule Dhanwantary for uniformity index and PAIG 346 x DWDa 1402 for fibre strength. With regards to quality traits significant standard heterosis was exhibited by the cross combination PA 809 x DWDa 1402 for upper half mean length and fibre fineness, PAIG 346 x HD 514 for ginning percentage, PAIG 346 x DWDa 1402 for fibre strength and PA 785 x CNA 449 for uniformity index.

Introduction

It has been estimated that cotton contributes to approximately 30% of the Indian agricultural gross domestic product and considerable export earnings. The organized sector of the Indian textile industry constitutes the largest single industrial segment in the country in terms of annual value of output and labour employed, both direct and indirect. There are more than 1,500 spinning mills, 250 composite mills in India having an installed capacity of approximately 35 million spindles and more than 1 lakh handlooms. The decentralized sector comprising power looms and handlooms, provide employment to over 2.5 million people. Thus, cotton is an immensely important crop for the sustainable economy of the country and livelihood of the Indian farming community.

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.

Since the time India attained independence, research efforts in cotton were intensified with the three major objectives of increasing the total production, raising productivity per hectare and to produce adequate long and extra-long staple cottons to meet the demands of the large Indian textile industry and ever growing population. Heterosis breeding was adopted as a major genetic approach for achieving these objectives through the development of high yield potential and high quality hybrid cottons.

Materials and Methods

The present study comprised of seven females (lines) and eight males (testers) with four standard checks thus making 56 F_1s using Line x Tester mating design. These lines, testers and hybrids along with four checks were sown during *kharif*, 2016 at three locations *viz.*, Cotton Research Station, MB Farm, Parbhani (L_1), Cotton Research Station, Nanded (L_2), and Agricultural Research Station, Badnapur (L_3). The observations recorded on ginning percentage, upper half mean length, micronaire value, uniformity index and fibre strength. Analysis was carried out as per the method suggested by Fonesca and Patterson (1968).

Results and Discussion

Environment wise analysis of variance revealed significant genotype effects for all the characters studied in all the three environments studied. This indicates that genotypes studied were different for the characters studied over the environments (Table 1). The pooled heterosis over better parent, check hybrid PKVDH 1,PKV Suvarna, NACH 12 and PA 255 is tabulated in Table 2.

Upper Half Mean Length (mm)

The highest significant heterosis over better parent was expressed in the cross PA 785 x CNA 449 (12.83 %) followed by PAIG 346 x DWDa 1402 (12.18 %) and PA 785 x DWDa 1402 (8.59 %).Only fourteen crosses followed significant positive heterobeltiosis. The range of heterobeltiosis was quite narrow *i.e.* 12.64 % to -14.39 % (PA 809 x Digvijay). The difference among the environments for heterobeltiosis for this trait was very close as compared to other traits. Fifty three, fifty, fifty three and sixteen crosses showed significant standard heterosis over the checks PKVDH 1, PKV Suvarna, NACH 12 and PA 255, respectively.

The cross PA 809 x DWDa 1402 exhibited highest significant standard heterosis over check PKVDH 1 (28.33 %),PKV Suvarna (25.93 %),NACH 12 (28.42 %) and PA 255 (14.75 %) followed by PAIG 346 x DWDa 1402 which recorded significant positive heterosis (27.96 %,25.56 %,28.05 % and 14.42 %) and high yielding cross PA 785 x

CNA 449 (25.99 %, 23.63 %, 26.08 % and 12.66 %). In all the environments the above mentioned crosses exhibited significant standard heterosis over checks. The difference among the environments was narrow. The range of standard heterosis over PKVDH 1, PKV Suvarna, NACH 12 and PA 255 was 28.33 % to -0.91 % , 25.9 3 % to -2.77 % , 28.42 % to -0.84 % and 14.75 % to -11.40 %, respectively.

Among interspecific crosses, the cross PA 785 x Digvijay exhibited highest positive significant standard heterosis over check PKVDH 1 (15.38 %),PKV Suvarna (13.21 %) and NACH 12 (15.46 %) followed by PA 812 x G.Cot 23 which recorded significant positive heterosis (14.71 %,12.56 % and 14.79 %, respectively).Whereas, none of the cross recorded positive significant heterosis over the check PA 255.

Micronaire (µg/ inch)

The lowest heterobeltiosis in desirable direction for fibre fineness was observed in PA 812 x Phule Dhanwantary (-32.23 %) followed by PA 785 x Phule Dhanwantary (-30.43 %). Total forty two crosses recorded significant negative heterobeltiosis. The heterobeltiosis pooled over the locations ranged from - 32.23 % to 13.18 % (PA 809 x G.Cot.23). The highest standard heterosis over PKVDH 1, PKV Suvarna, NACH 12 and PA 255 was observed in PA 809 x DWDa 1402 (-36.04 %, -27.56 %, -39.17 % and -21.75 %) followed by PA 809 x CNA 449 (-33.10 %, -24.23 %,-36.37 % and -18.16 %) and PA 740 x CNA 449 (-30.63 %, -21.44%, -34.02 % and -15.14 %).

All crosses showed significant standard heterosis in desirable direction over PKVDH 1 and NACH 12 respectively. Whereas thirty nine and fifteen crosses each showed negative significant standard heterosis over PKV Suvarna and PA 255, respectively. The heterosis ranged from - 36.04 % to -6.97 % over PKVDH 1,- 27.56 % to 5.36 % over PKV Suvarna, - 39.17 % to -11.52 % over NACH 12 and - 21.75 % to 13.81 % over PA 255. Among interspecific crosses, thirteen, ten, thirteen and three crosses recorded significant negative heterosis in desirable direction over standard checks PKVDH 1, PKV Suvarna, NACH 12 and PA 255, respectively.

Uniformity index (%)

The highest positively significant heterobeltiosis was observed in PAIG 346 x Phule Dhanwantary, (1.39 %) for fibre length uniformity followed by PAIG 346 x G.Cot.23 (1.31 %). None of the cross showed positively significant heterobeltiosis. The range of heterobeltiosis was 1.39 % to -4.77 % (PA 740 x Phule Dhanwantary). Forty six crosses each showed positively significant standard heterosis over PKVDH 1 and PKV Suvarna. The range of standard heterosis over PKVDH 1 was 6.27 % to -0.09 % while that of over PKV Suvarna, it ranged from 6.28 % to -0.08 % (PA 801 x Phule Dhanwantary). Whereas the only one cross PA 785 x CNA 449 showed positively significant heterosis over check NACH 12 (2.23%).

The highest standard heterosis was found in PA 785 x CNA 449 over PKVDH 1 (6.27 %), PKV Suvarna (6.28 %), NACH 12 (2.23 %) and PA 255 (1.08 %) followed by PA 785 x JLA 794 (5.16 %,5.17 %,1.17 % and 0.03 %) and PA 740 x DWDa 1402 (5.10 %,5.11 %,1.10 % and -0.03 %). Among interspecific crosses, ten crosses each recorded significant positive heterosis over checks PKVDH 1 and PKV Suvarna. Whereas, none of the cross exhibited significant positive heterosis over check NACH 12 and PA 255.

Table.1 ANOVA for fibre quality characters studied in three environments

Location	**Source of variation**	**d.f.**	**Mean sum of squares**				
			Ginning percentage (%)	**Upeer Half Mean Length (mm)**	**Micronaire (µg/ inch)**	**Uniformity index (%)**	**Fibre strength (g/tex)**
Parbhani (L_1)	Replication	1	0.12	0.88	0.010	0.91	0.04
	Treatment	74	3.99**	7.26**	0.49**	3.59**	6.38**
	Error	74	1.29	0.41	0.014	0.76	0.69
Nanded (L_2)	Replication	1	0.53	0.004	0.019	0.86	0.66
	Treatment	74	4.05**	7.55**	0.50**	3.75**	6.42**
	Error	74	1.25	0.56	0.012	1.02	0.51
Badnapur (L_3)	Replication	1	0.34	0.25	0.004	0.23	0.33
	Treatment	74	4.33**	7.40**	0.48**	3.49**	6.54**
	Error	74	1.51	0.50	0.010	1.51	0.68

*,** - Significant at 5 per cent and 1 per cent level, respectively

Table.2 Per cent heterosis pooled over environments over better parent (BPH), standard hybrid PKVDH 1 (SH 1),PKV Suvarna (SH 2), NACH 12 (SH 3) and standard variety PA 255 (SV 1)

Sr. No.	Crosses	Upper Half Mean Length (mm)					Micronaire (µg/ inch)				
		BPH	SH 1	SH2	SH3	SV1	BPH	SH 1	SH2	SH3	SV1
1	PA 801 x AKA 8	-2.83	9.72**	7.66**	9.79**	-1.89	-12.12**	-18.78 **	-8.02**	-22.76**	-0.65
2	PA 801 x Phule Dhanwantary	-7.72**	4.19*	2.24	4.27*	-6.83**	-25.51**	-9.11 **	2.93*	-13.56**	11.18**
3	PA 801 x CNA 449	2.26	15.46**	13.3**	15.54**	3.24	-14.08**	-27.16 **	-17.51**	-30.72**	-10.90**
4	PA 801 x HD 514	-7.82**	4.08*	2.13	4.16*	-6.93**	-9.04**	-10.11 **	1.80	-14.51**	9.96**
5	PA 801 x DWDa 1402	8.14**	22.10**	19.82**	22.19**	9.18**	-11.93**	-25.10 **	-15.18**	-28.77**	-8.38**
6	PA 801 x JLA 794	-0.02	12.89**	10.77**	12.96**	0.94	-4.30**	-18.87 **	-8.12**	-22.84**	-0.76
7	PA 801 x Digvijay	-4.99**	7.28**	5.27**	7.35**	-4.07*	-0.69	-15.81 **	-4.66**	-19.93**	2.98*
8	PA 801 x G.Cot 23	-4.05*	8.35**	6.32**	8.42**	-3.12	1.84	-13.67 **	-2.23	-17.89**	5.61**
9	PA 740 x AKA 8	-0.73	10.35**	8.28**	10.43**	-1.32	-7.00**	-14.05 **	-2.66*	-18.26**	5.14**
10	PA 740 x Phule Dhanwantary	-8.49**	1.73	-0.18	1.80	-9.03**	-26.96**	-10.88 **	0.93	-15.24**	9.03**
11	PA 740 x CNA 449	6.27**	18.15**	15.93**	18.23**	5.64**	-14.37**	-30.63 **	-21.44**	-34.02**	-15.14**
12	PA 740 x HD 514	3.81*	15.4**	13.24**	15.48**	3.19	-15.50**	-16.49 **	-5.43**	-20.58**	2.16
13	PA 740 x DWDa 1402	2.75	14.23**	12.09**	14.31**	2.14	-3.87**	-18.25 **	-7.42**	-22.25**	0.00
14	PA 740 x JLA 794	5.28**	17.04**	14.84**	17.12**	4.65**	-3.93**	-20.16 **	-9.59**	-24.07**	-2.34
15	PA 740 x Digvijay	-2.63	8.25**	6.22**	8.32**	-3.21	0.73	-15.11 **	-3.86**	-19.26**	3.85**
16	PA 740 x G.Cot 23	-1.88	9.08**	7.04**	9.16**	-2.46	12.12**	-9.17 **	2.86*	-13.61**	11.11**
17	PA 812 x AKA 8	-4.16**	14.61**	12.46**	14.69**	2.48	-19.18**	-25.31 **	-15.41**	-28.96**	-8.63**
18	PA 812 x Phule Dhanwantary	-4.34**	14.39**	12.25**	14.47**	2.29	-32.23**	-17.31 **	-6.36**	-21.36**	1.15
19	PA 812 x CNA 449	2.44	22.51**	20.21**	22.59**	9.54**	-6.08**	-28.28 **	-18.77**	-31.79**	-12.26**
20	PA 812 x HD 514	-1.48	17.81**	15.61**	17.89**	5.35**	-16.48**	-17.46 **	-6.52**	-21.50**	0.97
21	PA 812 x DWDa 1402	-0.77	18.66**	16.44**	18.75**	6.11**	-13.45**	-26.40 **	-16.64**	-30.00**	-9.96**
22	PA 812 x JLA 794	-2.11	17.06**	14.86**	17.14**	4.67**	-1.20	-17.90 **	-7.02**	-21.92**	0.43
23	PA 812 x Digvijay	-7.22**	10.96**	8.88**	11.03**	-0.79	-3.45*	-18.64 **	-7.86**	-22.62**	-0.47
24	PA 812 x G.Cot 23	-4.07*	14.71**	12.56**	14.79**	2.57	-2.56	-21.58 **	-11.19**	-25.41**	-4.06**
25	PA 809 x AKA 8	-9.36**	7.31**	5.30**	7.38**	-4.05*	-7.41**	-14.43 **	-3.10*	-18.62**	4.67**
26	PA 809 x Phule Dhanwantary	-2.57	15.35**	13.19**	15.43**	3.14	-25.08**	-8.58 **	3.53**	-13.06**	11.83**
27	PA 809 x CNA 449	0.66	19.18**	16.94**	19.26**	6.57**	-12.39**	-33.10 **	-24.23**	-36.37**	-18.16**
28	PA 809 x HD 514	-6.38**	10.84**	8.76**	10.91**	-0.89	-8.83**	-9.91 **	2.03	-14.31**	10.21**
29	PA 809 x DWDa 1402	8.39**	28.33**	25.93**	28.42**	14.75**	-24.78**	-36.04 **	-27.56**	-39.17**	-21.75**
30	PA 809 x JLA 794	5.13**	24.47**	22.14**	24.56**	11.3**	-8.81**	-24.22 **	-14.18**	-27.93**	-7.30**

Table.2 (Contd…)

Sr. No.	Crosses	Upper Half Mean Length (mm)					Micronaire (µg/ inch)				
		BPH	SH 1	SH2	SH3	SV1	BPH	SH 1	SH2	SH3	SV1
31	PA 809 x Digvijay	-14.37**	1.38	-0.52	1.45	-9.34**	0.63	-15.20 **	-3.96**	-19.35**	3.74**
32	PA 809 x G.Cot 23	-6.76**	10.39**	8.33**	10.47**	-1.29	13.18**	-8.91 **	3.16*	-13.36**	11.43**
33	PA 785 x AKA 8	-2.80	8.54**	6.51**	8.61**	-2.95	-9.38**	-16.26 **	-5.16**	-20.35**	2.45
34	PA 785 x Phule Dhanwantary	-2.95	8.37**	6.34**	8.45**	-3.09	-30.43**	-15.11 **	-3.86**	-19.26**	3.85**
35	PA 785 x CNA 449	12.83**	25.99**	23.63**	26.08**	12.66**	-0.55	-20.14 **	-9.55**	-24.04**	-2.30
36	PA 785 x HD 514	0.07	11.75**	9.66**	11.83**	-0.07	-12.43**	-13.46 **	-2.00	-17.70**	5.86**
37	PA 785 x DWDa 1402	8.59**	21.26**	18.99**	21.34**	8.43**	1.42	-13.76 **	-2.33	-17.98**	5.50**
38	PA 785 x JLA 794	4.48**	16.67**	14.48**	16.75**	4.33*	-3.15*	-19.52 **	-8.85**	-23.46**	-1.55
39	PA 785 x Digvijay	3.32	15.38**	13.21**	15.46**	3.17	0.80	-15.05 **	-3.79**	-19.21**	3.92**
40	PA 785 x G.Cot 23	2.05	13.95**	11.82**	14.03**	1.89	1.61	-18.22 **	-7.39**	-22.23**	0.04
41	PA 832 x AKA 8	-2.62	5.79**	3.80*	5.86**	-5.41**	-5.09**	-12.29 **	-0.67	-16.58**	7.30**
42	PA 832 x Phule Dhanwantary	0.19	8.84**	6.80**	8.92**	-2.67	-23.75**	-6.97 **	5.36**	-11.52**	13.81**
43	PA 832 x CNA 449	-0.18	8.44**	6.41**	8.52**	-3.03	-14.77**	-26.37 **	-16.61**	-29.97**	-9.92**
44	PA 832 x HD 514	-0.04	8.60**	6.56**	8.67**	-2.90	-10.89**	-11.93 **	-0.27	-16.24**	7.73**
45	PA 832 x DWDa 1402	5.30**	14.39**	12.25**	14.47**	2.29	-2.48	-15.76 **	-4.59**	-19.88**	3.06*
46	PA 832 x JLA 794	1.58	10.35**	8.28**	10.43**	-1.32	-6.84**	-19.52 **	-8.85**	-23.46**	-1.55
47	PA 832 x Digvijay	3.49*	12.43**	10.32**	12.51**	0.53	6.94**	-7.61 **	4.63**	-12.13**	13.02**
48	PA 832 x G.Cot 23	-1.21	7.32**	5.31**	7.40**	-4.03*	0.20	-13.43 **	-1.96	-17.67**	5.90**
49	PAIG 346 x AKA 8	0.10	14.17**	12.03**	14.25**	2.09	-3.24**	-10.58 **	1.26	-14.96**	9.39**
50	PAIG 346 x Phule Dhanwantary	-5.63**	7.64**	5.62**	7.71**	-3.75*	-24.74**	-8.17 **	3.99**	-12.66**	12.33**
51	PAIG 346 x CNA 449	7.14**	22.20**	19.91**	22.29**	9.27**	-4.72**	-25.75 **	-15.91**	-29.38**	-9.17**
52	PAIG 346 x HD 514	-5.89**	7.35**	5.34**	7.42**	-4.01*	-14.28**	-15.29 **	-4.06**	-19.43**	3.63**
53	PAIG 346 x DWDa 1402	12.18**	27.96**	25.56**	28.05**	14.42**	-4.84**	-19.08 **	-8.36**	-23.04**	-1.01
54	PAIG 346 x JLA 794	7.73**	22.88**	20.58**	22.96**	9.88**	-7.61**	-23.22 **	-13.05**	-26.98**	-6.08**
55	PAIG 346 x Digvijay	-9.03**	3.76*	1.82	3.84*	-7.22**	-6.73**	-21.40 **	-10.99**	-25.24**	-3.85**
56	PAIG 346 x G.Cot 23	-13.13**	-0.91	-2.77	-0.84	-11.4**	-5.22**	-23.72 **	-13.62**	-27.45**	-6.69**
	S.E.±	0.45	0.45	0.45	0.45	0.45	0.07	0.07	0.07	0.07	0.07
	C.D. @ 5%	0.90	0.90	0.90	0.90	0.90	0.13	0.13	0.13	0.13	0.13

Table.2 (Contd…)

Sr. No.	Crosses	Uniformity index (%)					Fibre strength (g/tex)				
		BPH	SH 1	SH2	SH3	SV1	BPH	SH 1	SH2	SH3	SV1
1	PA 801 x AKA 8	-0.08	3.67**	3.68**	-0.27	-1.39	0.20	13.61**	5.17*	9.54**	0.26
2	PA 801 x Phule Dhanwantary	-3.70 **	-0.09	-0.08	-3.89 **	-4.97 **	-12.97**	-1.31	-8.64**	-4.85*	-12.91**
3	PA 801 x CNA 449	-1.24	2.46**	2.47**	-1.43	-2.54 **	7.99**	22.44**	13.35**	18.05**	8.05**
4	PA 801 x HD 514	-2.28 **	1.39	1.39	-2.47 **	-3.56 **	-7.51**	4.88*	-2.91	1.12	-7.45**
5	PA 801 x DWDa 1402	-1.07	3.93**	3.94**	-0.01	-1.14	9.95**	24.66**	15.41**	20.2**	10.01**
6	PA 801 x JLA 794	-1.16	2.55**	2.56**	-1.35	-2.46 **	2.83	16.60**	7.94**	12.42**	2.90
7	PA 801 x Digvijay	-2.40 **	1.26	1.27	-2.59 **	-3.68 **	-1.20	12.03**	3.71	8.02**	-1.13
8	PA 801 x G.Cot 23	-2.39 **	1.27	1.28	-2.58 **	-3.67 **	-3.44	9.49**	1.36	5.56**	-3.38
9	PA 740 x AKA 8	-1.15	3.79**	3.8**	-0.15	-1.27	0.02	15.58**	7.00**	11.44**	2.00
10	PA 740 x Phule Dhanwantary	-4.77 **	-0.01	0.00	-3.81 **	-4.89 **	-5.65**	9.03**	0.93	5.12*	-3.79*
11	PA 740 x CNA 449	-2.25 **	2.64**	2.65**	-1.26	-2.37 **	1.35	17.12**	8.42**	12.92**	3.35
12	PA 740 x HD 514	-2.37 **	2.51**	2.52**	-1.38	-2.49 **	3.48	19.58**	10.7**	15.29**	5.52**
13	PA 740 x DWDa 1402	0.04	5.10**	5.11**	1.10	-0.03	-2.90	12.20**	3.87	8.18**	-0.99
14	PA 740 x JLA 794	-1.05	3.89**	3.90**	-0.05	-1.18	-2.30	12.90**	4.51*	8.85**	-0.37
15	PA 740 x Digvijay	-2.42 **	2.46**	2.47**	-1.43	-2.54 **	-5.54**	9.15**	1.05	5.24*	-3.67
16	PA 740 x G.Cot 23	-3.47 **	1.35	1.36	-2.50 **	-3.59 **	-6.65**	7.87**	-0.14	4.01	-4.80*
17	PA 812 x AKA 8	-2.48 **	2.40**	2.40**	-1.49	-2.60 **	6.03**	16.89**	8.21**	12.71**	3.16
18	PA 812 x Phule Dhanwantary	-4.12 **	0.67	0.68	-3.15 **	-4.24 **	0.51	10.80**	2.57	6.83**	-2.22
19	PA 812 x CNA 449	-1.02	3.93**	3.94**	-0.02	-1.14	14.86**	26.62**	17.22**	22.08**	11.74**
20	PA 812 x HD 514	0.02	5.02**	5.03**	1.03	-0.10	-0.22	10.01**	1.84	6.06**	-2.92
21	PA 812 x DWDa 1402	-0.19	4.85**	4.86**	0.87	-0.26	4.77*	15.50**	6.92**	11.36**	1.92
22	PA 812 x JLA 794	-1.22	3.72**	3.73**	-0.22	-1.34	2.36	15.16**	6.61**	11.03**	1.63
23	PA 812 x Digvijay	-1.11	3.83**	3.84**	-0.12	-1.24	-3.47	6.41**	-1.49	2.60	-6.09**
24	PA 812 x G.Cot 23	0.03	5.03**	5.04**	1.04	-0.09	-0.27	9.94**	1.78	6.00**	-2.98
25	PA 809 x AKA 8	-2.20 **	2.67**	2.67**	-1.23	-2.34 **	-2.21	15.28**	6.72**	11.15**	1.73
26	PA 809 x Phule Dhanwantary	-2.23 **	2.63**	2.64**	-1.27	-2.38 **	2.86	21.25**	12.25**	16.91**	7.00**
27	PA 809 x CNA 449	0.11	5.09**	5.10**	1.10	-0.04	-8.08**	8.36**	0.31	4.47*	-4.38*
28	PA 809 x HD 514	-3.47 **	1.34	1.34	-2.51 **	-3.61 **	-12.06**	3.68	-4.02*	-0.04	-8.51**
29	PA 809 x DWDa 1402	0.03	5.09**	5.1**	1.1	-0.04	3.73*	22.29**	13.21**	17.91**	7.92**
30	PA 809 x JLA 794	-0.91	4.02**	4.02**	0.06	-1.06	1.41	19.55**	10.67**	15.27**	5.50**

Table.2 (Contd…)

Sr. No.	Crosses	Uniformity index (%)					Fibre strength (g/tex)				
		BPH	SH 1	SH2	SH3	SV1	BPH	SH 1	SH2	SH3	SV1
31	PA 809 x Digvijay	-3.40 **	1.40	1.41	-2.45 **	-3.54 **	-15.58**	-0.48	-7.87**	-4.04	-12.17**
32	PA 809 x G.Cot 23	-2.32 **	2.54**	2.54**	-1.36	-2.47 **	-14.86**	0.36	-7.09**	-3.23	-11.43**
33	PA 785 x AKA 8	-1.21	3.86**	3.86**	-0.09	-1.21	-2.56	10.96**	2.72	6.98**	-2.08
34	PA 785 x Phule Dhanwantary	-2.54 **	2.46**	2.47**	-1.43	-2.54 **	-6.09**	6.95**	-1.00	3.11	-5.62**
35	PA 785 x CNA 449	1.09	6.27**	6.28**	2.23**	1.08	4.75*	19.28**	10.43**	15.01**	5.27**
36	PA 785 x HD 514	-1.24	3.82**	3.83**	-0.12	-1.24	-5.73**	7.35**	-0.62	3.50	-5.27**
37	PA 785 x DWDa 1402	-3.23 **	1.73*	1.74*	-2.13 **	-3.23 **	5.55**	20.19**	11.27**	15.89**	6.07**
38	PA 785 x JLA 794	0.04	5.16**	5.17**	1.17	0.03	-2.45	11.08**	2.83	7.10**	-1.97
39	PA 785 x Digvijay	-2.48 **	2.52**	2.53**	-1.38	-2.48 **	3.89*	18.31**	9.52**	14.07**	4.40*
40	PA 785 x G.Cot 23	-2.36 **	2.65**	2.66**	-1.25	-2.36 **	2.95	17.23**	8.53**	13.03**	3.45
41	PA 832 x AKA 8	-0.16	2.49**	2.50**	-1.40	-2.51 **	-4.03*	2.77	-4.86*	-0.91	-9.30**
42	PA 832 x Phule Dhanwantary	0.03	2.62**	2.62**	-1.28	-2.39 **	1.26	3.05	-4.6*	-0.64	-9.06**
43	PA 832 x CNA 449	1.11	3.72**	3.73**	-0.22	-1.34	6.04**	8.70**	0.63	4.80*	-4.08*
44	PA 832 x HD 514	-1.28	1.27	1.27	-2.58 **	-3.68 **	8.06**	9.98**	1.81	6.04**	-2.95
45	PA 832 x DWDa 1402	-2.31 **	2.63**	2.64**	-1.27	-2.38 **	8.91**	16.98**	8.29**	12.79**	3.23
46	PA 832 x JLA 794	-1.23	2.46**	2.46**	-1.44	-2.54 **	2.29	15.08**	6.53**	10.95**	1.55
47	PA 832 x Digvijay	-1.03	2.6**	2.61**	-1.30	-2.41 **	11.55**	13.53**	5.10*	9.47**	0.19
48	PA 832 x G.Cot 23	-0.14	2.44**	2.45**	-1.45	-2.56 **	7.71**	11.32**	3.05	7.33**	-1.76
49	PAIG 346 x AKA 8	-0.02	2.64**	2.65**	-1.26	-2.37 **	-5.79**	6.92**	-1.02	3.09	-5.64**
50	PAIG 346 x Phule Dhanwantary	1.39	3.93**	3.94**	-0.02	-1.14	-3.96*	9.00**	0.91	5.09*	-3.81*
51	PAIG 346 x CNA 449	1.17	3.71**	3.71**	-0.23	-1.35	1.27	14.94**	6.40**	10.82**	1.43
52	PAIG 346 x HD 514	-0.01	2.49**	2.50**	-1.40	-2.51 **	-8.99**	3.30	-4.37*	-0.40	-8.84**
53	PAIG 346 x DWDa 1402	-1.11	3.89**	3.89**	-0.06	-1.18	17.46**	33.31**	23.42**	28.54**	17.65**
54	PAIG 346 x JLA 794	-0.05	3.68**	3.69**	-0.26	-1.38	8.57**	23.23**	14.08**	18.81**	8.74**
55	PAIG 346 x Digvijay	-0.98	2.66**	2.67**	-1.24	-2.35 **	-9.63**	2.57	-5.05*	-1.10	-9.48**
56	PAIG 346 x G.Cot 23	1.31	3.85**	3.86**	-0.09	-1.22	1.59	15.31**	6.75**	11.18**	1.76
	S.E.±	0.63	0.63	0.63	0.63	0.63	0.52	0.52	0.52	0.52	0.52
	C.D. @ 5%	1.25	1.25	1.25	1.25	1.25	1.02	1.02	1.02	1.02	1.02

Table.2 (Contd…)

Sr. No.	Crosses	Ginning percentage (%)				
		BPH	SH 1	SH2	SH3	SV1
1	PA 801 x AKA 8	3.46	2.61	7.69**	2.57	7.30**
2	PA 801 x Phule Dhanwantary	2.47	-0.23	4.72*	-0.27	4.33*
3	PA 801 x CNA 449	1.95	-0.73	4.19*	-0.77	3.81*
4	PA 801 x HD 514	2.14	1.87	6.91**	1.83	6.52**
5	PA 801 x DWDa 1402	0.75	-1.90	2.96	-1.94	2.58
6	PA 801 x JLA 794	-2.96	-5.52**	-0.84	-5.55**	-1.20
7	PA 801 x Digvijay	0.07	-2.56	2.27	-2.60	1.89
8	PA 801 x G.Cot 23	2.55	0.11	5.07**	0.07	4.68*
9	PA 740 x AKA 8	7.07**	6.20**	11.46**	6.16**	11.05**
10	PA 740 x Phule Dhanwantary	3.46	0.96	5.96**	0.92	5.57**
11	PA 740 x CNA 449	2.36	-0.11	4.84*	-0.15	4.45*
12	PA 740 x HD 514	7.15**	6.86**	12.15**	6.81**	11.74**
13	PA 740 x DWDa 1402	0.20	-2.22	2.62	-2.26	2.25
14	PA 740 x JLA 794	-0.63	-3.03	1.77	-3.07	1.40
15	PA 740 x Digvijay	3.81*	1.30	6.31**	1.26	5.93**
16	PA 740 x G.Cot 23	1.94	-0.48	4.45*	-0.52	4.06*
17	PA 812 x AKA 8	3.37	2.52	7.60**	2.48	7.20**
18	PA 812 x Phule Dhanwantary	5.70**	0.28	5.25**	0.24	4.86*
19	PA 812 x CNA 449	1.37	-3.39	1.40	-3.43	1.03
20	PA 812 x HD 514	0.39	0.12	5.07	0.08	4.69*
21	PA 812 x DWDa 1402	0.76	-5.43**	-0.75	-5.47**	-1.11
22	PA 812 x JLA 794	3.78*	-0.04	4.91*	-0.08	4.52*
23	PA 812 x Digvijay	1.33	-1.33	3.56	-1.37	3.18
24	PA 812 x G.Cot 23	1.35	-1.06	3.84*	-1.10	3.46
25	PA 809 x AKA 8	3.89*	3.04	8.14**	3.00	7.75**
26	PA 809 x Phule Dhanwantary	3.71*	0.39	5.36**	0.35	4.98**
27	PA 809 x CNA 449	2.38	-0.90	4.01*	-0.94	3.63
28	PA 809 x HD 514	4.61*	4.33*	9.50**	4.29*	9.10**
29	PA 809 x DWDa 1402	3.80*	0.48	5.46**	0.44	5.07**
30	PA 809 x JLA 794	8.23**	4.77	9.96**	4.73**	9.55**

Table.2 (Contd…)

Sr. No.	Crosses	Ginning percentage (%)				
		BPH	**SH 1**	**SH2**	**SH3**	**SV1**
31	PA 809 x Digvijay	0.73	-1.91	2.95	-1.95	2.57
32	PA 809 x G.Cot 23	4.31*	1.83	6.88**	1.79	6.49**
33	PA 785 x AKA 8	6.78**	5.90**	11.15**	5.86**	10.74**
34	PA 785 x Phule Dhanwantary	3.95*	-0.75	4.16*	-0.79	3.78*
35	PA 785 x CNA 449	8.03**	3.15	8.26**	3.11	7.86**
36	PA 785 x HD 514	3.95*	3.67*	8.80**	3.63	8.41**
37	PA 785 x DWDa 1402	-4.66*	-8.97**	-4.46*	-9.01**	-4.81*
38	PA 785 x JLA 794	0.88	-2.84	1.97	-2.88	1.60
39	PA 785 x Digvijay	-0.95	-3.55	1.23	-3.58*	0.86
40	PA 785 x G.Cot 23	4.16*	1.68	6.72**	1.64	6.33**
41	PA 832 x AKA 8	0.20	-0.62	4.30*	-0.66	3.92*
42	PA 832 x Phule Dhanwantary	2.94	-2.33	2.50	-2.37	2.13
43	PA 832 x CNA 449	-1.18	-5.81**	-1.15	-5.85**	-1.51
44	PA 832 x HD 514	3.80*	3.52	8.65**	3.48	8.25**
45	PA 832 x DWDa 1402	2.35	-3.94*	0.82	-3.97*	0.45
46	PA 832 x JLA 794	-0.91	-4.57*	0.16	-4.61*	-0.21
47	PA 832 x Digvijay	2.10	-0.58	4.34*	-0.62	3.96*
48	PA 832 x G.Cot 23	4.35*	1.87	6.91**	1.83	6.52**
49	PAIG 346 x AKA 8	0.04	-0.77	4.14*	-0.81	3.76*
50	PAIG 346 x Phule Dhanwantary	7.07**	2.34	7.41**	2.30	7.01**
51	PAIG 346 x CNA 449	2.88	-1.67	3.20	-1.71	2.82
52	PAIG 346 x HD 514	11.21**	10.91**	16.41**	10.87**	15.98**
53	PAIG 346 x DWDa 1402	7.23**	2.49	7.56**	2.45	7.17**
54	PAIG 346 x JLA 794	7.91**	3.93*	9.08**	3.89*	8.68**
55	PAIG 346 x Digvijay	-3.67*	-6.20**	-1.55	-6.24**	-1.91
56	PAIG 346 x G.Cot 23	0.51	-1.88	2.98	-1.92	2.60
	S.E.±	0.67	0.67	0.67	0.67	0.67
	C.D. @ 5%	1.33	1.33	1.33	1.33	1.33

*,** - Significant at 5 per cent and 1 per cent level, respectively

Fibre strength (g/ tex)

The cross PAIG 346 x DWDa 1402 (17.46 %) possessed highest significant heterobeltiosis followed by PA 812 x CNA 449 (14.86 %). The observed range of heterobeltiosis was 17.46 % to -15.58 % (PA 809 x Digvijay). Over the environments, sixteen crosses showed and twelve crosses succeeded to show significantly positive standard heterosis over PKVDH 1, PKV Suvarna, NACH 12 and PA 255, respectively.

The highest standard heterosis over all the checks PKVDH 1, PKV Suvarna, NACH 12 and PA 255 was observed in cross PAIG 346 x DWDa 1402 (33.31 %,23.42 %,28.54 % and 17.65 % respectively) followed by cross PA 812 x CNA 449 (26.62 %, 17.22 %, 22.08 % and 11.74 % respectively) and cross PA 801 x DWDa 1402 (24.66 %, 15.41 %,20.20 % and 10.01 % respectively). The range of standard heterosis was 33.31 % to -1.31 % over PKVDH 1, 23.42 to -8.64 % over PKV Suvarna, 28.54 to -4.85 % over NACH 12 and 17.65 to -12.91 % over PA 255. Among interspecific crosses, eleven, four, nine and one cross had recorded significant positive heterosis in desirable direction over standard checks PKVDH 1, PKV Suvarna, NACH 12 and PA 255, respectively.

Ginning percentage (%)

High heterobeltiosis for ginning outturn was observed in cross PAIG 346 x HD 514 (11.21 %). Twenty two crosses exhibited positively significant heterobeltiosis. The range of heterobeltiosis was 11.21 % to -4.66 % (PA 785 x DWDa 1402). The highest standard heterosis was observed in cross PAIG 346 x HD 514 over PKVDH 1 (10.91 %), over PKV Suvarna (16.41 %), over NACH 12 (10.87 %) and over PA 255 (15.98 %) followed by PA 740 x HD 514 over PKV Suvarna (12.15 %) and over NACH 12 (6.81 %). Seven, thirty five, seven and thirty four crosses showed significant standard heterosis over checks PKVDH 1, PKV Suvarna, NACH 12 and PA 255, respectively.

Another high yielding cross PAIG 346 x JLA 794 also exhibited significant standard heterosis over PKVDH 1 (3.93%), PKV Suvarna (9.08 %), NACH 12 (3.89 %) and PA 255 (8.68 %). Across the environments, the standard heterosis over PKVDH 1 ranged from 10.91 % to - 8.97 % and over NACH 12 it ranged from 10.87 % to -9.01 %.Out of fourteen interspecific crosses, only four crosses recorded significant positive heterosis over better parent. None of the cross recorded significant and positive standard heterosis over the check PKVDH 1 and NACH 12, whereas eight and seven crosses each exhibited significant heterosis in desirable direction over the check PKV Suvarna and PA 255, respectively.

The high heterosis for fibre quality characters was also observed by Tuteja *et al.,* (2000), Naik and Patel (2004), Patil *et al.,* (2009), Jyotiba *et al.,* (2010), Patel *et al.,* (2011), Shinde *et al.,* (2012), Singh *et al.,* (2013), Sonawane *et al.,* (2013), Muhammad *et al.,* (2014) and Sharma *et al.,* (2016).

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