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Study on heterosis for Fibre quality traits in intra (*G. arboreum* x *G. arboreum*) and interspecific (*G. herbaceum* x *G. arboreum)* crosses of desi cotton

AV Shinde, DB Deosarkar, VN Chinchane, AS Deshmukh and NR Thakur

Abstract
The Line x Tester method of analysis was followed involving seven female lines *viz*., PA 810, PA 828, PA 837, PA 811, PAIG 380, G. Cot. 25 and G. Cot. 17 for study of heterosis for various fibre quality characters at three environments *viz*., Parbhani, Nanded & Badnapur. The F_1 and their parents were evaluated in randomized block design with three replications, observations were recorded on Fibre length (mm), Micronaire (µg/inch), Uniformity ratio (%) and Fibre strength (g/tex). The magnitude of heterosis was estimated in relation to better parent and standard checks. Results revealed that the cross combination PA 828 x Phule dhanwantary showed the highest and desirable significant standard heterosis for UHML, PAIG 380 x JLA 505 for micronaire value, whereas, the cross PA 837 x PA 08 and PAIG 380 x PA 08 for uniformity ratio and PA 811 x JLA 794 for fibre strength and also exhibited high percentage of heterobeltiosis and high *per se* performance.

Keywords: Heterosis, interspecific, heterobeltiosis & Line x Tester

Introduction
Cotton belongs to the genus *Gossypium* under tribe *Gossypiene* of family *Malvaceae*. It comprises 50 species, four of which are cultivated, 44 are wild diploids and two are wild teraploids. Out of the four cultivated species; *G. hirsutum* and *G. barbadense* commonly called as new world cotton are tetrapoids (2n=4x=52), whereas, *G. arboreum* and *G. herbaceum* are diploids (2n=2x=26) are commonly called as old world cottons.
To overcome biotic and abiotic stresses, intra arboreum and inter specific breeding between *G. herbaceum* and *G. arboreum* were carried out and varieties were released for commercial cultivation in the part of India. Further improvement is in progress by evaluating large number of *herbaceum* race germplasm to develop draught tolerant and early matured cultures with adaptation to water stress so as to reap profitable yield in central zone of India, and local cotton growing rainfed area of Maharashtra (Patil *et al*., (2016).
Since India's independence, cotton research has been stepped up with the three main goals of increasing total production, increasing productivity per hectare, and producing enough long and extra-long staple cottons to meet the demands of the country's large textile industry and ever-growing population. Heterosis breeding was used as a significant genetic approach to achieve these goals by developing hybrid cottons with great yield potential and high quality. In India, heterosis has been extensively used to increase yield. Geographical and genetic diversity, agronomic performance, adaptability, and parental genetic base are all factors to considered, which play an important role in the manifestation of heterosis in cotton.

Material and Methods
The present investigation on "Study on heterosis for fibre quality traits in intra (*G. arboreum* x *G. arboreum*) and interspecific (*G. herbaceum* x *G. arboreum)* crosses of desi cotton" was conducted at the Department of Agricultural Botany, VNMKV, Parbhani. The experimental material for present investigation consisted of fifteen diverse genotypes. These selected fifteen genotypes possess good amount of variation for fibre length, micronaire value, uniformity ratio & fibre strength. The fifteen genotypes used in the present study were PA 810, PA 828, PA 837, PA 811, PAIG 380, G. Cot. 25 & G. Cot. 17 (Lines) and AKA 7, phile dhanwantary, JLA 794, PA 08, PA 402, DLSA 17, AKA 8 and JLA 505(Testers). Complete set of entries comprising of 56 F_1's, 7 lines, 8 testers and 3 checks (PKV Suvarna, PKVDH 1 & PA 255)

were grown in Randomized Block Design with two replications. The experiment was conducted under rainfed condition at three locations *viz.,* Cotton Research Station, Mahboob Baugh Farm, Parbhani (L_1), Cotton Research Station, Nanded (L_2), and KVK, Badnapur (L_3) during *kharif*, 2020. The sowing of trials was done on 1st July, 3rd July and 6th July, 2020 at L_1, L_2 and L_3 locations, respectively.

Result and Discussion

The experimental material for mating design proposed by Kempthorne (1957) [10] comprises of the mf (male x female) progeny families only. However many research workers are tempted to raise parental lines along with mf progeny families in a bid to get a single degree of freedom for the contrast 'parents vs. hybrids'. Significance of mean squares for parents vs. hybrids is taken to indicate presence of heterosis.

Environment wise analysis of variance revealed significant genotype effects (p< 0.01) for all the characters studied in all the three environments. This indicates that genotypes studied were different for the characters studied over the environments (Table 1).

Moreover, when there is significance, it is quite likely that many hybrids do not show heterosis but significance is caused by only a few highly heterotic hybrids; further the tests using F-ratio with one degree of freedom are known to be less efficient than those with large degrees of freedom (Dabholkar 1999) [6]. Hence, in this research the heterosis is mentioned in following pages irrespective of significance of parents vs. crosses for the particular trait. The pooled heterosis over better parent, check hybrid PKV Suvarna, PKVDH 1 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 G. Cot. 17 x PA 402 (9.90%) followed by G. Cot. 17 x JLA 505 (8.79%) and G. Cot. 17 x DLSA 17 (5.39%) Only six crosses followed significant positive heterobeltiosis. The range of heterobeltiosis was quite narrow *i.e.* 9.90% to -17.41% (PA 811 x PA 08). The cross PA 828 x Phule Dhanwantary exhibited highest positive significant standard heterosis over check PKV Suvarna (24.49%), PKVDH 1 (21.54%) and PA 255 (13.05%) followed by PA 810 x Phule Dhanwantary (22.87%, 19.96% and 11.58%), respectively. Among interspecific crosses, the cross G. Cot. 25 x PA 08 and G. Cot. 17 x DLSA 17 exhibited highest positive significant standard heterosis over check PKV Suvarna (14.78%), PKVDH 1 (12.06%), and PA 255 (4.23%).

Fiber quality parameters of cotton, fiber length and fineness have a vital influence on the yarn strength. The increasing fiber length results in improved yarn strength because a long fiber generates a greater frictional resistance to an external force. High fiber length and the tensile strength of the fibers becomes the controlling factor of yarn strength. The identification of cultivars or hybrids with high fiber length and strength is essential to current modernized spinning mills. Gutierrez *et al.* (1998) indicated that the most interesting crosses were those which exhibit heterosis or heterobeltiosis for seed cotton yield and for some fiber characters. In the present investigation some of the crosses exhibited significant heterosis for yield as well as for one or more fiber quality traits. The heterosis for fibre properties was less influenced by environment for this crosses and parents. Similar findings were also reported by Soomro *et al.,* (2006), Ashokkumar *et al.,* (2013), Srinivas and bhadru (2015), Munir *et al.,* (2016) [14], Eswari *et al.,* (2016) [8], Sirisha *et al.,* (2019) [16] and Udaya *et al.,* (2020).

The fibre is the main economic plant product of cotton hence apart from seed cotton yield, the lint quality is also an important trait. The high values of fibre length are desirable with the values of fibre strength. Heterosis values for fibre quality traits were generally lower than that for yield components, which is in agreement with finding of Basal *et al.,* (2011).

Interspecific hybrids showed higher heterobeltiosis values than observed for staple length (Munir *et al.,* 2016) [14].

Micronaire (µg/ inch)

The lowest heterobeltiosis in desirable direction for fibre fineness was observed in PAIG 380 x PA 08 (-17.31%) followed by PA 828 x JLA 794 (-17.17%) Total forty two crosses recorded significant negative heterobeltiosis. The heterobeltiosis pooled over the locations ranged from -17.31% to 3.52% (G. Cot. 17 x DLSA 17).

The highest standard heterosis over PKV Suvarna, PKVDH 1 and PA 255 was observed in PAIG 380 x JLA 505 (-13.04%, -16.71% and -4.32%) followed by PAIG 380 x PA 08 (-12.08%, -15.79%, and -3.27%), and PAIG 380 x AKA 7 (-10.83%, -14.60% and -1.90), respectively. Whereas twenty nine, fifty and only one cross each showed negative significant standard heterosis over PKV Suvarna, PKVDH 1 and PA 255, respectively. The heterosis ranged from -13.04% to 7.19% over PKV Suvarna, - 16.56% to 2.66% over PKVDH 1 and – 4.32% to 17.93% over PA 255. Among interspecific crosses, six and thirteen crosses recorded significant negative heterosis in desirable direction over standard checks by PKV Suvarna and PKVDH 1.

The fibre fineness value in particular range is desirable as it is one of the most important quality parameters. In hybrid group, mostly the negative heterosis is desirable. The lower micronaire may be due to inherent reduction in fibre diameter, inadequate cellulose deposition of the fibre wall or a combination of the diameter and wall thickness factors. Above results are in close agreements with Rajamani *et al.,* (2009) [15]. Deshmukh *et al.,* (2014) [7], Sharma *et al.,* (2016), Lodam *et al.,* (2017) [11], Monicashree *et al.,* (2017) [12] and Chinchane *et al.,* (2019) [5].

Uniformity ratio (%)

The highest positively significant heterobeltiosis was observed in G. Cot. 17 x JLA 794, (3.78%) for uniformity ratio followed by PAIG 380 x PA 08 (3.42%). The range of heterobeltiosis was 3.78 to -3.48% (PA 828 x JLA 505).

Twenty seven, four and eighteen crosses each showed positively significant standard heterosis over PKV Suvarna, PKVDH 1 and PA 255. The range of standard heterosis over PKV Suvarna was 5.81% to -1.19%, over PKVDH 1 was 3.61% to -3.36% (PA 828 x JLA 505), while that of over PA 255, it ranged from 5.09% to -1.99% (PA 828 x JLA 505).

The highest standard heterosis was found in PA 837 x PA 08 and PAIG 380 x PA 08 over PKV Suvarna (5.81%), PKVDH 1 (3.61%) and PA 255 (5.09%) followed by PA 810 x Phule Dhanwantary (5.37%, 3.18% and 4.65%) and PA 811 x PA 402 (4.50%, 2.32% and 3.78%).

Among interspecific crosses, five and two crosses recorded significant positive heterosis over checks PKV Suvarna and PA 255. Whereas, none of the cross exhibited significant positive heterosis over check PKVDH 1. These results confirmed the findings of Baloch *et al.,* (2015), Muhammad *et* *al.*, (2015), Monicashree *et al.*, (2017) [12] and Chinchane *et al.*, (2018) [4].

Fibre strength (g/ tex)

The cross G. Cot. 25 x AKA 7 (18.75%) possessed highest significant heterobeltiosis followed by PA 811 x JLA 794 (18.62%). The observed range of heterobeltiosis was 18.75% to -15.90% (PA 810 x DLSA 17). Over the environments, twenty three crosses showed significantly positive heterobeltiosis.

Thirty four, thirty eight and twenty three crosses succeeded to show significantly positive standard heterosis over PKV Suvarna, PKVDH 1 and PA 255, respectively.

The highest standard heterosis over all the checks PKV Suvarna PKVDH 1 and PA 255 was observed in cross PA 811 x JLA 794 (21.18%, 24.35% and 14.66%, respectively) followed by cross PA 810 x AKA 8 (20.39%, 23.54% and 13.91%, respectively) and cross PAIG 380 x AKA 8 (18.82%, 21.93% and 12.43,% respectively).

In this case for above mentioned crosses and some other crosses the standard heterosis over the checks was higher in low yielding environments, moderate in moderate yielding environment while lower in high yielding environment. Same trend was found for heterobeltiosis in this trait. Among interspecific crosses, six, seven and four crosses had recorded significant positive heterosis in desirable direction over standard checks PKV Suvarna, PKVDH 1 and PA 255, respectively.

Cotton textile sector demands better yield and high quality cotton, for this reason improvement of yield and fiber quality is one of the important targets of all cotton breeders. The present study aimed to facilitate the selection in cotton breeding program and development of cotton with high yielding and better fiber quality. In respect of fibre strength, high fibre strength is most desirable trait of fibre quality character. In the present investigation some of the crosses exhibited significant heterosis for yield as well as for one or more fiber strength trait. The heterosis for fibre properties was less influenced by environment for this crosses and parents, similar finding were reported by Karademir *et al.*, (2009), Deshmukh *et al.*, (2014) [7], Munir *et al.*, (2016) [14], Eswari *et al.*, (2016) [8], Sirisha *et al.*, (2019) [16] and Udaya *et al.*, (2020) [17].

Interspecific hybrids showed higher heterobeltiosis values than were observed for intraspecific hybrids for fibre strength (Munir *et al.*, 2016) [14].

Table 1: ANOVA for various characters studied in three environment

Location	Source of variation	D. f.	Mean sum of Squares			
			Upper half mean length (mm)	Micronaire (µg/inch)	Uniformity ratio (%)	Fibre strength (g/tex)
Parbhani (L1)	Replication	1	0.217	0.032	0.013	0.227
	Treatment	73	6.141**	0.169**	4.028**	10.549**
	Error	73	1.911	0.036	0.918	0.548
Nanded (L2)	Replication	1	0.010	0.000	3.366	0.230
	Treatment	73	5.494**	0.161**	3.940**	10.126**
	Error	73	0.541	0.039	2.585	0.336
Badnapur (L3)	Replication	1	0.666	0.000	0.252	0.236
	Treatment	73	5.235**	0.173**	4.238**	10.260**
	Error	73	0.715	0.011	1.101	0.249

*,**- 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 PKV Suvarna (SH 1), PKVDH1 (SH 2) and standard variety PA 255 (SV 1)

Sr. No.	Crosses	Upper half mean length (mm)				Micronaire (µg/in)			
		BPH	SH 1	SH 2	SV 1	BPH	SH 1	SH 2	SV 1
1	PA 810 X AKA 7	-5.96 **	14.98 **	12.25 **	4.41 *	-10.29 **	-8.92 **	-12.76 **	0.21
2	PA 810 X JLA 794	-1.49	20.45 **	17.59 **	9.37 **	-10.68 **	-3.74 *	-7.81 **	5.91 **
3	PA 810 X PA 08	-5.46 **	15.59 **	12.85 **	4.96 *	-11.81 **	-6.23 **	-10.19 **	3.16
4	PA 810 X PA 402	-0.33	21.86 **	18.97 **	10.66 **	-10.71 **	-9.68 **	-13.50 **	-0.63
5	PA 810 X AKA 8	-8.28 **	12.15 **	9.49 **	1.84	-6.87 **	-5.08 **	-9.09 **	4.43 *
6	PA 810 X Phule Dhanwantary	0.50	22.87 **	19.96 **	11.58 **	-9.30 **	-12.08 **	-15.79 **	-3.27
7	PA 810 X JLA 505	-1.32	20.65 **	17.79 **	9.56 **	-8.41 **	-4.99 **	-9.00 **	4.54 *
8	PA 810 X DLSA 17	-2.81	18.83 **	16.01 **	7.90 **	-6.11 **	-2.78	-6.89 **	6.96 **
9	PA 828 X AKA 7	-3.52	16.60 **	13.83 **	5.88 **	-6.89 **	-5.47 **	-9.46 **	4.01 *
10	PA 828 X JLA 794	-14.91 **	2.83	0.40	-6.62 **	-17.17 **	-10.74 **	-14.51 **	-1.79
11	PA 828 X PA 08	-16.92 **	0.40	-1.98	-8.82 **	-5.50 **	0.48	-3.76 *	10.55 **
12	PA 828 X PA 402	-12.23 **	6.07 **	3.56	-3.68	-8.63 **	-7.57 **	-11.48 **	1.69
13	PA 828 X AKA 8	-7.54 **	11.74 **	9.09 **	1.47	-1.51	0.38	-3.86 *	10.44 **
14	PA 828 X Phule Dhanwantary	3.02	24.49 **	21.54 **	13.05 **	-9.96 **	-9.88 **	-13.68 **	-0.84
15	PA 828 X JLA 505	-4.86 *	14.98 **	12.25 **	4.41 *	-1.39	2.30	-2.02	12.55 **
16	PA 828 X DLSA 17	-9.21 **	9.72 **	7.11 **	-0.37	-2.78	0.67	-3.58 *	10.76 **
17	PA 837 X AKA 7	-1.54	16.19 **	13.44 **	5.51 **	0.76	2.30	-2.02	12.55 **
18	PA 837 X JLA 794	-0.69	17.21 **	14.43 **	6.43 **	-11.48 **	-4.60 *	-8.63 **	4.96 *
19	PA 837 X PA 08	-1.20	16.60 **	13.83 **	5.88 **	-5.95 **	-0.00	-4.22 *	10.02 **
20	PA 837 X PA 402	-10.63 **	5.47 *	2.96	-4.23 *	-0.28	0.86	-3.40 *	10.97 **
21	PA 837 X AKA 8	-4.80 *	12.35 **	9.68 **	2.02	-9.78 **	-8.05 **	-11.94 **	1.16
22	PA 837 X Phule Dhanwantary	1.72	20.04 **	17.19 **	9.01 **	2.67	-0.48	-4.68 **	9.49 **
23	PA 837 X JLA 505	-0.34	17.61 **	14.82 **	6.80 **	-7.86 **	-4.41 *	-8.45 **	5.17 *
24	PA 837 X DLSA 17	0.17	18.22 **	15.42 **	7.35 **	-6.48 **	-3.16	-7.25 **	6.54 **

25	PA 811 X AKA 7	-11.34 **	12.35 **	9.68 **	2.02	-5.38 **	-3.93 *	-7.99 **	5.70 **
26	PA 811 X JLA 794	-9.27 **	14.98 **	12.25 **	4.41 *	-10.41 **	-3.45	-7.53 **	6.22 **
27	PA 811 X PA 08	-17.41 **	4.66 *	2.17	-4.96 *	-11.72 **	-6.14 **	-10.10 **	3.27
28	PA 811 X PA 402	-10.22 **	13.77 **	11.07 **	3.31	-1.99	-0.86	-5.05 **	9.07 **
29	PA 811 X AKA 8	-8.47 **	15.99 **	13.24 **	5.33 *	-6.02 **	-4.22 *	-8.26 **	5.38 **
30	PA 811 X Phule Dhanwantary	-13.58 **	9.51 **	6.92 **	-0.55	-0.20	-3.26	-7.35 **	6.43 **
31	PA 811 X JLA 505	-7.03 **	17.81 **	15.02 **	6.99 **	-10.17 **	-6.81 **	-10.74 **	2.53
32	PA 811 X DLSA 17	-8.31 **	16.19 **	13.44 **	5.51 **	-2.96	0.48	-3.76 *	10.55 **
33	PAIG 380 X AKA 7	-3.49	11.94 **	9.29 **	1.65	-14.99 **	-10.83 **	-14.60 **	-1.90
34	PAIG 380 X JLA 794	0.17	16.19 **	13.44 **	5.51 **	-8.01 **	-0.86	-5.05 **	9.07 **
35	PAIG 380 X PA 08	4.89 *	21.66 **	18.77 **	10.48 **	-17.31 **	-12.08 **	-15.79 **	-3.27
36	PAIG 380 X PA 402	-4.71 *	10.53 **	7.91 **	0.37	-12.61 **	-8.34 **	-12.21 **	0.84
37	PAIG 380 X AKA 8	-8.03 **	6.68 **	4.15	-3.13	-6.67 **	-2.11	-6.24 **	7.70 **
38	PAIG 380 X Phule Dhanwantary	1.22	17.41 **	14.62 **	6.62 **	-3.66 *	1.05	-3.21	11.18 **
39	PAIG 380 X JLA 505	0.87	17.00 **	14.23 **	6.25 **	-17.09 **	-13.04 **	-16.71 **	-4.32 *
40	PAIG 380 X DLSA 17	2.79	19.23 **	16.40 **	8.27 **	-12.80 **	-8.53 **	-12.40 **	0.63
41	G. Cot. 25 X AKA 7	-3.04	3.44	0.99	-6.07 **	-3.96 *	0.00	-4.22 *	10.02 **
42	G. Cot. 25 X JLA 794	-4.28 *	8.70 **	6.13 **	-1.29	-4.63 **	2.78	-1.56	13.08 **
43	G. Cot. 25 X PA 08	0.00	14.78 **	12.06 **	4.23 *	-10.28 **	-4.60 *	-8.63 **	4.96 *
44	G. Cot. 25 X PA 402	5.24 *	9.72 **	7.11 **	-0.37	-8.84 **	-5.08 **	-9.09 **	4.43 *
45	G. Cot. 25 X AKA 8	5.14 *	7.69 **	5.14 *	-2.21	-9.02 **	-5.27 **	-9.27 **	4.22 *
46	G. Cot. 25 X Phule Dhanwantary	-3.67	11.54 **	8.89 **	1.29	-4.05 *	-0.10	-4.32 *	9.92 **
47	G. Cot. 25 X JLA 505	2.93	6.68 **	4.15	-3.13	-6.35 **	-2.49	-6.61 **	7.28 **
48	G. Cot. 25 X DLSA 17	1.30	10.32 **	7.71 **	0.18	0.37	4.51 *	0.09	14.98 **
49	G. Cot. 17 X AKA 7	1.14	7.89 **	5.34 *	-2.02	-7.46 **	-6.04 **	-10.01 **	3.38
50	G. Cot. 17 X JLA 794	-7.84 **	4.66 *	2.17	-4.96 *	-6.94 **	0.29	-3.95 *	10.34 **
51	G. Cot. 17 X PA 08	-3.35	10.93 **	8.30 **	0.74	-13.53 **	-8.05 **	-11.94 **	1.16
52	G. Cot. 17 X PA 402	9.90 **	14.57 **	11.86 **	4.04	-1.14	-0.00	-4.22 *	10.02 **
53	G. Cot. 17 X AKA 8	0.20	2.63	0.20	-6.80 **	-2.45	-0.58	-4.78 **	9.39 **
54	G. Cot. 17 X Phule Dhanwantary	-1.40	14.17 **	11.46 **	3.68	-4.88 **	-4.60 *	-8.63 **	4.96 *
55	G. Cot. 17 X JLA 505	8.79 **	12.75 **	10.08 **	2.39	-3.05	0.58	-3.67 *	10.65 **
56	G. Cot. 17 X DLSA 17	5.39 *	14.78 **	12.06 **	4.23 *	3.52 *	7.19 **	2.66	17.93 **
	S. E.+	0.56	0.56	0.56	0.56	0.09	0.09	0.09	0.09
	C.D. @ 5%	1.12	1.12	1.12	1.12	0.18	0.18	0.18	0.18

Table 2: Contd…

Sr. No.	Crosses	Uniformity ratio (%)				Fibre strength (g/tex)			
		BPH	SH 1	SH 2	SV 1	BPH	SH 1	SH 2	SV 1
1	PA 810 X AKA 7	0.86	2.87 *	0.73	2.17	1.54	16.47 **	19.52 **	10.20 **
2	PA 810 X JLA 794	1.71	3.75 **	1.59	3.04 **	-4.27 *	9.80 **	12.68 **	3.90 *
3	PA 810 X PA 08	-0.31	1.69	-0.43	0.99	-4.27 *	9.80 **	12.68 **	3.90 *
4	PA 810 X PA 402	0.80	2.81 *	0.67	2.11	-1.54	12.94 **	15.90 **	6.86 **
5	PA 810 X AKA 8	2.08	4.12 **	1.96	3.41 **	4.96 **	20.39 **	23.54 **	13.91 **
6	PA 810 X Phule Dhanwantary	3.31 **	5.37 **	3.18 **	4.65 **	-3.08	11.18 **	14.08 **	5.19 **
7	PA 810 X JLA 505	0.61	2.62 *	0.49	1.92	-10.94 **	2.16	4.83 *	-3.34
8	PA 810 X DLSA 17	-1.47	0.50	-1.59	-0.19	-15.90 **	-3.53	-1.01	-8.72 **
9	PA 828 X AKA 7	0.12	2.37 *	0.24	1.67	14.05 **	9.80 **	12.68 **	3.90 *
10	PA 828 X JLA 794	-2.20 *	0.00	-2.08	-0.68	1.04	-4.71 *	-2.21	-9.83 **
11	PA 828 X PA 08	-1.71	0.50	-1.59	-0.19	16.84 **	10.20 **	13.08 **	4.27 *
12	PA 828 X PA 402	-0.55	1.69	-0.43	0.99	-0.56	4.31 *	7.04 **	-1.30
13	PA 828 X AKA 8	-0.98	1.25	-0.86	0.56	12.16 **	6.67 **	9.46 **	0.93
14	PA 828 X Phule Dhanwantary	-1.04	1.19	-0.92	0.50	16.67 **	15.29 **	18.31 **	9.09 **
15	PA 828 X JLA 505	-3.48 **	-1.31	-3.36 **	-1.99	5.66 **	2.55	5.23 *	-2.97
16	PA 828 X DLSA 17	-1.53	0.69	-1.41	-0.00	12.06 **	5.69 **	8.45 **	-0.00
17	PA 837 X AKA 7	-0.24	2.12	0.00	1.43	-14.29 **	-12.94 **	-10.66 **	-17.63 **
18	PA 837 X JLA 794	1.59	4.00 **	1.83	3.29 **	14.29 **	16.08 **	19.11 **	9.83 **
19	PA 837 X PA 08	3.36 **	5.81 **	3.61 **	5.09 **	11.20 **	12.94 **	15.90 **	6.86 **
20	PA 837 X PA 402	0.79	3.19 **	1.04	2.48 *	8.97 **	14.31 **	17.30 **	8.16 **
21	PA 837 X AKA 8	-0.18	2.19	0.06	1.49	3.09	4.71 *	7.44 **	-0.93
22	PA 837 X Phule Dhanwantary	-2.26 *	0.06	-2.02	-0.62	0.00	1.57	4.23 *	-3.90 *
23	PA 837 X JLA 505	-1.04	1.31	-0.80	0.62	-8.88 **	-7.45 **	-5.03 *	-12.43 **
24	PA 837 X DLSA 17	-2.14	0.19	-1.90	-0.50	-1.74	-0.20	2.41	-5.57 **
25	PA 811 X AKA 7	-2.59 *	1.12	-0.98	0.43	10.17 **	12.55 **	15.49 **	6.49 **
26	PA 811 X JLA 794	-0.66	3.12 **	0.98	2.42 *	18.62 **	21.18 **	24.35 **	14.66 **
27	PA 811 X PA 08	-0.30	3.50 **	1.35	2.79 *	3.45	5.69 **	8.45 **	-0.00
28	PA 811 X PA 402	0.66	4.50 **	2.32 *	3.78 **	11.96 **	17.45 **	20.52 **	11.13 **
29	PA 811 X AKA 8	-0.66	3.12 **	0.98	2.42 *	3.26	5.49 **	8.25 **	-0.19
30	PA 811 X Phule Dhanwantary	-0.42	3.37 **	1.22	2.67 *	-1.15	0.98	3.62	-4.45 *

31	PA 811 X JLA 505	-2.05	1.69	-0.43	0.99	2.30	4.51 *	7.24 **	-1.11
32	PA 811 X DLSA 17	0.24	4.06 **	1.90	3.35 **	-2.69	-0.59	2.01	-5.94 **
33	PAIG 380 X AKA 7	1.04	3.37 **	1.22	2.67 *	7.39 **	16.86 **	19.92 **	10.58 **
34	PAIG 380 X JLA 794	1.65	4.00 **	1.83	3.29 **	2.70	11.76 **	14.69 **	5.75 **
35	PAIG 380 X PA 08	3.42 **	5.81 **	3.61 **	5.09 **	8.47 **	18.04 **	21.13 **	11.69 **
36	PAIG 380 X PA 402	0.37	2.69 *	0.55	1.99	6.31 **	15.69 **	18.71 **	9.46 **
37	PAIG 380 X AKA 8	-0.98	1.31	-0.80	0.62	9.19 **	18.82 **	21.93 **	12.43 **
38	PAIG 380 X Phule Dhanwantary	1.65	4.00 **	1.83	3.29 **	-8.29 **	-0.20	2.41	-5.57 **
39	PAIG 380 X JLA 505	-1.59	0.69	-1.41	-0.00	-10.63 **	-2.75	-0.20	-7.98 **
40	PAIG 380 X DLSA 17	0.00	2.31 *	0.18	1.61	-6.85 **	1.37	4.02 *	-4.08 *
41	G. Cot. 25 X AKA 7	2.58 *	4.25 **	2.08	3.54 **	18.75 **	15.49 **	18.51 **	9.28 **
42	G. Cot. 25 X JLA 794	-1.04	0.56	-1.53	-0.12	11.90 **	8.82 **	11.67 **	2.97
43	G. Cot. 25 X PA 08	-0.43	1.19	-0.92	0.50	0.81	-1.96	0.60	-7.24 **
44	G. Cot. 25 X PA 402	-2.77 *	-1.19	-3.24 **	-1.86	6.73 **	11.96 **	14.89 **	5.94 **
45	G. Cot. 25 X AKA 8	-0.25	1.37	-0.73	0.68	7.46 **	4.51 *	7.24 **	-1.11
46	G. Cot. 25 X Phule Dhanwantary	-2.52 *	-0.94	-3.00 **	-1.61	-11.71 **	-12.75 **	-10.46 **	-17.44 **
47	G. Cot. 25 X JLA 505	-0.68	0.94	-1.16	0.25	0.20	-2.55	0.00	-7.79 **
48	G. Cot. 25 X DLSA 17	-1.91	-0.31	-2.39 *	-0.99	-4.84 *	-7.45 **	-5.03 *	-12.43 **
49	G. Cot. 17 X AKA 7	0.50	1.31	-0.80	0.62	13.06 **	13.73 **	16.70 **	7.61 **
50	G. Cot. 17 X JLA 794	3.78 **	3.00 **	0.86	2.30 *	-0.97	-0.39	2.21	-5.75 **
51	G. Cot. 17 X PA 08	-0.37	0.56	-1.53	-0.12	3.31	3.92 *	6.64 **	-1.67
52	G. Cot. 17 X PA 402	2.81 *	2.81 *	0.67	2.11	12.90 **	18.43 **	21.53 **	12.06 **
53	G. Cot. 17 X AKA 8	1.55	2.62 *	0.49	1.92	-0.39	0.20	2.82	-5.19 **
54	G. Cot. 17 X Phule Dhanwantary	-1.00	-0.94	-3.00 **	-1.61	-4.09 *	-3.53	-1.01	-8.72 **
55	G. Cot. 17 X JLA 505	-0.62	0.81	-1.28	0.12	-9.16 **	-8.63 **	-6.24 **	-13.54 **
56	G. Cot. 17 X DLSA 17	1.93	2.25 *	0.12	1.55	-13.26 **	-12.75 **	-10.46 **	-17.44 **
	S. E.+	0.90	0.90	0.90	0.90	0.49	0.49	0.49	0.49
	C.D. @ 5%	1.79	1.79	1.79	1.79	0.98	0.98	0.98	0.98

Conclusion
Cross combinations *viz*, PA 810 x Phule Dhanwantary, PAIG 380 x PA 08 should be exploited for fibre quality improvement,

References

1. Arunachalam V. The fallacy behind the use of modified Lx T design. Indian J. Genet 1974;24(2):280-287.
2. Baloch AW, Baloch MJ, Jatoi WA, Veesar NF. Production of superior f1 hybrids: genetic analysis for estimating combining ability in upland cotton (*Gossypium hirsutum* L.). Journal of agricultural research 2010;48(4):419-421.
3. Basal H, Canavar O, Khan NU, Cerit CS. Combining ability and heterotic studies through Line × Tester in local and exotic upland cotton genotypes. Pakistan journal of Botany 2011;43(3):1699-1706.
4. Chinchane VN, Thombare KR, Jayewar NE. Heterosis studies for fibre quality traits in desi cotton (*Gossypium arboreum* L.). International journal of current microbiogy and applied sciences 2018;6:983-989.
5. Chinchane VN, Duomai K, Deosarkar DB. Heterosis studies for qualitative and quantitative characters in cotton (*Gossypium arboreum* L.). Journal of cotton research and development. 2019;33(1):36-43.
6. Dabholkar AR. Elements of biometrical genetics. Concept publication company. New Delhi 1999, 217.
7. Deshmukh JD, Deosarkar DB, Deshmukh VD. Heterosis for fibre quality traits in cotton (*Gossypium hirsutum* L). Journal of cotton research and development. 2014;28(2):217-219.
8. Eswari KB, Kumar S, Gopinath, Rao MVB. Heterosis and combining ability studies for improvement of seed cotton yield and fibre quality traits in inter and intraspecific hybrids of allotetraploid cottons. International journal of current research 2016;8(7):34546-34553.
9. Karademir E, Gencer O. Combining ability and heterosis for yield and fiber quality properties in cotton (*G. hirsutum* L.) obtained by half diallel mating design. *Notulae botnicae horti agrobotanici.* 2010;38(1):222-227
10. Kempthorne O. "An Introduction to Genetic Statistics" John Wiley and Sons Inc., New York, 1957, 453-471
11. Lodam VA, Pathak VD, Patil SS, Faldu GO. Improvement in lint yield and fibre quality traits in inter and intra specific hybrids in American cotton. Journal of cotton research and development. 2017;31(2):171-179.
12. Monicashree C, Balu PA, Gunasekaran M. Combining ability and heterosis studies on yield and fibre quality traits in upland cotton (*Gossypium hirsutum L.*). International journal of current microbiology and applied sciences 2017;6(8):1-17.
13. Muhammad MY, Mari TS, Laghari S, Soomro ZA, Abro S. Estimation of heterosis and heterobeltiosis in F_1 hybrids of upland cotton. Journal of Biology, Agriculture and Healthcare 2014;4(11): 68-71.
14. Munir S, Hussain SB, Manzoor H, Quereshi MK, Zubair M, Nouman W *et al*. Heterosis and correlation in interspecific and intraspecific hybrids of cotton. Genetics and molecular research 2016;15(2):1-14
15. Rajamani S, Mallikarjuna CH, Naik RK. Heterosis for yield and fibre properties in upland cotton, *Gossypium hirsutum* L. Journal of cotton research and development. 2009;23(1):43-45.
16. Sirisha ABM, Ahamed ML, Kumar PVR, Kumari SR, Rao VS. Heterosis Studies for Fibre Quality Traits in Upland Cotton (*Gossypium hirsutum* L.). The andhra agricultural journal 2019;66(2):293-295
17. Udaya V, Saritha HS, Patil RS. Heterosis studies for seed cotton yield and fibre quality traits in upland cotton (*Gossypium hirsutum* L.). Indian journal of agricultural research 2020;1:1-5.