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Heterosis studies for fibre quality of upland cotton in line x tester design

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Cotton fibre length, strength and fineness properties have vital influence textile industry. The developing high fibre length and strength cultivars or hybrids are essential to current modernized spinning mills. Therefore, the present study was carried out to assess the expression of *per se* performance and heterotic effect for fibre quality traits from 28 hybrids involving four adapted varieties as lines and the seven accessions as testers in Line x Tester analysis. Significant range of variability was observed all the traits in parents and their 28 hybrids. Fibre length in parents and their hybrids ranged from 23 to 32.9 mm and 25.40 to 33.3 mm, respectively. The hybrid MCU 12 x SOCC 17 and SVPR 2 x TCH 1641 for fibre elongation exhibited significant positive heterotic effects. Eleven hybrids showed significant negative heterotic effects for fibre fineness and hybrid MCU 5 × SOCC 17 displayed greater negative heterosis. Mean performance of bundle strength in parents and hybrids was 20.6 and 21.9 (g/tex), respectively. The hybrids MCU 12 x TCH 1644 and SVPR 2 x TCH 1646 for 2.5% span length, MCU 5 x SOCC 17 and Surabhi x F 776 for bundle strength exhibited significant positive heterotic effect, *per se* performance and high *sca* effects and can be utilized for direct selection.

Key words: Cotton, heterosis, fibre length and strength, micronaire, Line x Tester (L x T) analysis.

INTRODUCTION

Cotton is the leading natural fibre crop of the world. It is an important cash crop of India being used throughout the textile industry and plays a key role in the national economy. Fibre quality of a specific cotton genotype is a composite of various characteristics, including fibre length, fibre strength, fineness, and fibre elongation. These traits have their individual importance in spinning, weaving and dying units (Munro, 1987). Fibre length and strength properties mainly influence textile processing (Kohel, 1999). In addition, fibre uniformity is also of tremendous value to the textile industry. It is greatly correlated with the efficient spinning and weaving processes, which convert the fibre into fabrics. However, these traits are highly influenced by the environment with special reference to the fineness (Yuan et al., 2005; Percy et al., 2006). Ahuja. (2003) suggested that developing high fibre length and strength cultivars or hybrids is required to current modernized spinning mills. Hereafter, it is the need of the day to improve fibre quality in the dominating *hirsutum* genotypes, to fulfill the requirements of growing processing and textile industry. Current commercial cultivars of upland cotton have limited variability for these fibre quality traits. Industrial demand of cotton with the superior fibre traits is also a source of the guideline for cotton breeders. The success of these traits depends on the identification of genotypes

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with the ability to transmit high production potential into specific genotypic combinations (Basal and Turgut, 2005; Iqbal et al., 2003). Heterosis is a performance of F_1/F_2 genotypic combinations and is useful in determining the most appropriate parents for specific traits (Khan et al., 2010). Development of hybrids as a commercial variety is getting importance. Cotton is highly amenable for both heterosis and recombination breeding. Heterosis has substantially remained as one of the significant developments in cotton breeding programs, (Singh, 1982; Chaudhari et al., 1992; Baloch et al., 2003; Baloch, 2004; Memon et al., 2005; Ganapathy and Nadarajan, 2008; Khan et al., 2010).

Several studies have been reported on yield and yield attributing traits, but little work has been reported on the genetics and heterosis of fibre quality traits in cotton breeding. A few reports in the literature (Rahman et al., 1993; Zhang et al., 2002; Basal and Turgut 2003; Preetha and Raveendran, 2008; Karademir et al., 2009; Karademir and Gencer, 2010; Karademir et al., 2011; Bolek et al., 2011) have determined that cotton genotypes differ in fibre quality traits. The estimates of *per se* performance and heterosis provided useful information with regard to the possibilities and extent of improvement in the fibre characters of breeding material through selection. Therefore, present study objective was to estimate genetic variation for mean performance of parents and their hybrids and to estimate the effects of heterosis in F_1 cross combinations, to obtain information heterotic potential as to develop hybrid with improved fibre quality traits through Line x Tester (L x T) analysis.

MATERIALS AND METHODS

Genetic material

A field experiment was conducted to evaluate the fibre quality traits performance of four commercially cultivated varieties of upland cotton as *viz.,* MCU 12, MCU 5, SVPR 2, Surabhi and and seven *Gossypium hirsutum* genetic accessions as *viz.,* F 776, F 1861, SOCC 11, SOCC 17, TCH 1641, TCH 1644 and TCH 1646. These cultivars were cultivated in southern states of India, and collected from department of cotton, Tamil Nadu Agricultural University (TNAU), Coimbatore, Tamil Nadu, India. Genetic accessions were collected from Central Institute of Cotton Research (CICR), Coimbatore, Tamil Nadu, India.

Experimental design and field procedures

The cotton cultivars and accessions were evaluated in randomized block design (RBD) with three replications at Cotton Breeding Station, Tamil Nadu Agricultural University, Coimbatore, and Tamil Nadu in India. Each genotype was grown in a 4.5 m length row adopting a spacing of 75 cm between rows and 30 cm between the plants, to have 15 plants per row.

Sampling, traits measurements and methods

Data were recorded on five randomly selected plants per replication for all the five characters *viz.,* 2.5% span length (mm), fibre strength (g/tex), micronaire (µg/inch), uniformity ratio and fibre elongation percentage (%). Fibre quality traits were analyzed by high-volume instrument (HVI). The L x T analysis of heterosis was performed as suggested by Kempthrone (1957). Heterosis was calculated in terms of percent increase (+) or decrease (-) of the F_1 hybrids against its mid parent, better parent and standard parent value as suggested by Fehr (1987).

RESULTS AND DISCUSSION

Analysis of variance

The analysis of variance showed that line was significant for the characters viz., 2.5% span length, bundle strength and fibre elongation percentage. The testers varied significantly for the 2.5% span length, micronaire value and bundle strength. In case of the line x tester component, significant variation was observed for all the characters (Table 1). Between the parents and hybrids were observed substantial variation for all the characters. In addition, the parents versus hybrids showed significant variation for all the characters.

Mean performance

Significant variation was observed for each trait in all the genotypes. Mean expression of the fibre quality characters was recorded on the eleven genotypes and their 28 crosses. The comparison of treatment means indicated that cultivars had a significant effect on 2.5% span length (Table 2). Mean performance of parents, 2.5% span length had a minimum expression of 23 (TCH 1641) to 32.9 mm (MCU 5). Previous studies reported that fiber length could vary widely with plant variety and growing conditions. Ehsan et al. (2008), Copur (2006) and Khan et al. (1989) reported similar results for fiber length. The hybrids SVPR 2 x TCH 1641 and MCU 5 x TCH 1646 registered minimum (25.40 mm) and maximum (33.3 mm) length. The mean fibre length of hybrids was 29.83 mm. Niagun and Khadi (2001) observed that mean fibre length for *Gossypium barbadense* crosses was 35. 9 mm and this is the greater value compare to our results, and is in conformation with *G. barbadanse* which is higher in fibre length than *G. hirsutum.*

Fibre fineness or micronaire and fibre strength are very important characteristic of the fiber quality of cotton and are extremely useful for textile industry. In parents, bundle strength was ranged from 18.9 to 22.9 (g/tex). Maximum and minimum values recorded in hybrids were 23.80 g/tex in MCU 5 x SOCC 17 and 19.60 g/tex in SVPR 2 x TCH 1644. These results were supported by earlier studies (Khan, 2002; Karademir et al., 2011). The average bundle strength of parents and hybrids was 20.6 and 21.9 g/tex, respectively. Niagun and Khadi (2001) observed mean fibre strength for *G. hirsutum* crosses

Table 1. Analysis of variance showing mean square for fibre quality traits.

Source of variation	df	2.5 % Span length (mm)	Uniformity Ratio (%)	Micronaire (µg/inch)	Bundle strength (g/tex)	Elongation Percentage
Replication	2	117.64	23.05	41.97	13.20	18.49
Parents	10	108.48**	29.30**	5.42**	22.74**	25.06**
Hybrids	27	77.15**	9.59**	4.19**	23.27**	11.73**
Parents Vs Hybrids	1	322.09**	6.36*	16.70**	105.71**	4.35*
Error	76	0.18	0.55	0.08	0.19	0.14
Replication	2	78.11	19.00	43.17	8.41	10.28
Lines	3	6.59**	1.45	0.71	8.74**	6.76**
Tester	6	3.80*	1.58	3.81*	3.14*	1.02
line x tester	18	32.45**	8.74*	5.02**	12.90**	6.38**
Error	54	0.21	0.63	0.07	0.18	0.15

Table 2. Ranges for mean expression of parents in fibre quality characters.

S/N	Character	Minimum value	Maximum value	Mean	Parents recording	
					Lowest	Highest
1	2.5% Span length (mm)	23.00	32.90	28.15	SOCC 11	Surabhi
2	Bundle strength(g/tex)	18.93	22.90	20.66	TCH 1641	Surabhi
3	Micronaire (µg/inch)	3.40	4.60	4.03	Surabhi and F 1861	SOCC17
4	Uniformity ratio (%)	44.00	51.00	48.36	Surabhi & TCH 1641	MCU 5
5	Fibre elongation (%)	5.80	9.60	7.53	TCH 1641	SOCC11

was 26.6 g/tex, and this is greater than the value of present results.

The tester SOCC 17 recorded the greatest micronaire value of 4.6 µg/inch and lowest of 3.4 µg/inch in F 1861. Differences between the cultivars with respect to fiber fineness were also found significant by Copur (2006) and Ehsan et al. (2008). Of the 28 hybrids, MCU 12 x F 776 recorded the lowest value of 3.40 µg/inch. The highest value (4.80 µg/inch) was recorded by MCU 12 x TCH 1646. The average value of micronaire value in hybrids was 3.79 µg/inch (Table 3). Niagun and Khadi (2001) observed mean micronaire for *G. hirsutum and G. barbadense* crosses was 2.95 µg/inch, and this showed that the present study significantly exploited the hybrids than earlier studies.

The range for uniformity ratio was from 44 to 51(%), the genotypes exhibiting the values being Surabhi and MCU 5 respectively. The mean value of uniformity ratio for tester was 48.42. Among the hybrids, Surabhi x TCH 1641 recorded the lowest value of 45% and highest value (50%) recorded the SVPR 2 x TCH 1644 and SVPR 2 x SOCC 17 (Table 3). The hybrids had a mean uniformity ratio of 47.98 (%) which was intermediate between their parental group values. Niagun and Khadi (2001) observed mean uniformity ratio for *G. barbadense* crosses was 44.3, and this is lower than the present results. Fibre elongation percentage in testers had a range of 5.8 in TCH 1641 to 9.6 in SOCC 11. MCU 12 and SVPR 2 among the lines recorded the lowest and highest elongation of 6.8 and 8.5, respectively. The mean values of fibre elongation percentage for lines and testers were 7.27 and 7.67, correspondingly. The hybrids varied from 6.3 (Surabhi x TCH 1641) to 9.50 (SVPR 2 x TCH 1641) in respect of elongation percentage and displayed a mean of 7.37.

Expression of Heterosis for fibre quality traits

Estimation of heterotic effects is necessary to identify the new cross combinations that are suitable for direct exploitation. Therefore, heterosis over mid parent, better parent and standard parent was estimated in the entire cross combinations under study. For fibre length or 2.5% span length, eighteen hybrids displayed significant positive relative heterosis over mid parental value, with a range of 2.44% in MCU 12 x TCH 1646 to 17.35% in MCU 5 x SOCC 11 (Table 4). The results of heterosis are in conformity with the reports of Tuteja et al. (2005), Iraddi and Kajjidoni (2009), Karademir and Gencer (2010) and Karademir et al. (2011). Significant positive heterobeltiotic effect was discernible in thirteen hybrids, and ranged from 2.36 to 14.43%. Standard heterosis ranged from 2.75% in MCU 12 x F 1861 to 14.43% in

Table 3. Mean performance of F_1 crosses for fibre quality traits.

Hybrids	2.5% span length (mm)	Bundle strength (g/tex)	Micronaire (µg/inch)	Uniformity ratio (%)	Fibre elongation (%)
MCU 5 x F 776	32.0	22.4	3.6	46	7.1
MCU 5 x F 1861	29.2	23.6	4.1	49	7.5
MCU 5 x SOCC 11	30.1	23.0	3.7	49	7.0
MCU 5 x SOCC 17	30.5	23.8	3.6	48	6.8
MCU 5 x TCH 1641	30.5	21.1	3.5	48	7.4
MCU 5 x TCH 1644	31.1	21.1	3.7	46	7.1
MCU 5 X TCH 1646	33.3	22.1	3.5	48	6.6
MCU 12 x F 776	33.1	22.6	3.4	48	7.7
MCU 12 x F 1861	29.9	22.1	3.5	48	7.4
MCU 12 x SOCC 11	30.3	23.0	3.9	46	6.5
MCU 12 x SOCC 17	27.0	20.3	4.4	48	8.5
MCU 12 x TCH 1641	30.4	22.4	3.6	47	7.1
MCU 12 x TCH 1644	31.8	22.3	4.0	47	6.8
MCU 12 x TCH 1646	30.1	21.9	4.8	49	6.8
SURABHI x F 776	32.5	23.6	3.5	47	7.1
SURABHI x F 1861	31.0	20.9	4.5	49	6.5
SURABHI x SOCC 11	30.2	21.8	3.5	47	6.9
SURABHI x SOCC 17	29.2	20.5	3.5	49	7.2
SURABHI x TCH 1641	32.1	21.6	4.1	45	6.3
SURABHI x TCH 1644	26.7	20.9	3.6	50	8.0
SURABHI x TCH 1646	30.8	22.1	3.6	47	6.5
SVPR 2 x F 776	30.0	19.8	3.6	49	8.3
SVPR 2 x F 1861	27.1	20.7	3.8	48	8.3
SVPR 2 x SOCC 11	25.8	20.9	3.6	48	8.2
SVPR 2 x SOCC 17	26.6	20.0	3.9	50	8.0
SVPR 2 x TCH 1641	25.4	19.8	3.9	49	9.5
SVPR 2 x TCH 1644	27.4	19.6	3.7	50	7.8
SVPR 2 x TCH 1646	31.1	20.5	3.9	47	7.3
Mean of parent	28.1	20.6	4.0	48.3	7.5
Mean of cross	30.0	21.9	3.7	49.9	7.6
SE	0.24	0.25	0.16	0.43	0.21

MCU 5 x TCH 1646 exhibited by 22 hybrids for this character. The present findings was substantiate with Tuteja et al. (2005), Iraddi and Kajjidoni (2009) and Tuteja and Banga (2011).

The heterotic expression of relative heterosis for uniformity was significant and positive for four hybrids and negative for ten hybrids (Table 4). Niagun and Khadi (2001) and Karademir et al. (2009) noticed significant negative and positive heterosis for uniformity ratio, and this is in conformity to our results. All the hybrids showed heterobeltiosis in the negative direction. Twenty seven hybrids recorded significant heterosis ranging from 4.55 to 13.64% over standard parental value in positive direction.

The hybrid MCU 12 x TCH 1646 and Surabhi x F 1861 displayed significant positive relative heterosis over the mid parent and better parent value for micronaire. Eleven hybrids expressed significant negative heterosis over mid parent for micronaire. Which indicates that the greater the micronaire value, the lower the fineness. These results are in the agreement with earlier research findings of Carvalho et al. (1994), Soomro (2000), Rauf et al. (2005), Karademir and Gencer (2010) and Karademir et al. (2011) who reported varying degree of heterosis and heterobeltiosis for micronaire. Significant positive standard heterosis of 14.29% was evident in the hybrid MCU 12 x TCH 1646 for microanire value.

For bundle or fibre strength, fourteen hybrids displayed significant positive relative heterosis over mid parental value, with a range of 3.27% in Surabhi x TCH 1641 to 18.70% in MCU 5 x SOCC 17. Hybrid vigour was also observed by Hassan et al. (1999), Soomro (2000), Rauf et al. (2005) and Karademir et al. (2011). Significant positive heterobeltiosis over the better parents was discernible in seven hybrids, and it ranged from 3.60 to

Table 4. Expression of heterosis in hybrids (%) for 2.5% span length, uniformity ratio, and micronaire.

Hybrids	2.5 % Span length			Uniformity Ratio			Micronaire		
	di	dii	diii	di	dii	diii	di	dii	Diii
MCU 5 x F 776	14.70 **	13.07 **	9.97 **	-8.91 **	-9.80 **	4.55 **	-10.00	-16.28 **	-14.29 *
MCU 5 x F 1861	3.00 **	2.82 *	0.34	-1.01	-3.92 **	11.36 **	6.49	-4.65	-2.38
MCU 5 x SOCC 11	17.35 **	6.36 **	3.44 **	-2.97 **	-3.92 **	11.36 **	-13.95 **	-13.95 *	-11.90 *
MCU 5 x SOCC 17	15.46 **	7.77 **	4.81 **	-4.95 **	-5.88 **	9.09 **	-19.10 **	-21.74 **	-14.29 *
MCU 5 x TCH 1641	6.27 **	4.81 **	4.81 **	1.05	-5.88 **	9.09 **	-17.65 **	-18.60 **	-16.67 **
MCU 5 x TCH 1644	9.89 **	9.89 **	6.87 **	-8.00 **	-9.80 **	4.55 **	-10.84 *	-13.95 *	-11.90 *
MCU 5 x TCH 1646	16.03 **	14.43 **	14.43 **	-3.03 **	-5.88 **	9.09 **	-14.86 **	-17.83 **	-15.87 **
MCU 12 x F 776	15.94 **	11.82 **	13.75 **	-3.03 **	-4.00 **	9.09 **	-12.82 *	-17.07 **	-19.05 **
MCU 12 x F 1861	3.10 **	1.01	2.75 *	-1.03	-2.04	9.09 **	-6.67	-14.63 *	-16.67 **
MCU 12 x SOCC 11	15.21 **	2.36 *	4.12 **	-7.07 **	-8.00 **	4.55 **	-7.14	-9.30	-7.14
MCU 12 x SOCC 17	-0.25	-8.78 **	-7.22 **	-3.03 **	-4.00 **	9.09 **	1.15	-4.35	4.76
MCU 12 x TCH 1641	3.58 **	2.70 *	4.47 **	1.08	-4.08 **	6.82 **	-13.25 **	-14.29 *	-14.29 *
MCU 12 x TCH 1644	9.84 **	7.43 **	9.28 **	-4.08 **	-4.08 **	6.82 **	-1.23	-2.44	-4.76
MCU 12 x TCH 1646	2.44 *	1.58	3.32 **	1.03	0.00	11.36 **	18.52 **	17.07 **	14.29 *
SURABHI x F 776	7.62 **	-1.22	11.68 **	0.00	-6.00 **	6.82 **	-1.41	-5.41	-16.67 **
SURABHI x F 1861	1.14	-5.78 **	6.53 **	6.52 **	2.08	11.36 **	32.35 **	32.35 **	7.14
SURABHI x SOCC 11	8.29 **	-8.00 **	4.01 **	0.00	-6.00 **	6.82 **	-9.09	-18.60 **	-16.67 **
SURABHI x SOCC 17	1.68	-11.25 **	0.34	4.26 **	-2.00	11.36 **	-12.50 *	-23.91 **	-16.67 **
SURABHI x TCH 1641	3.55 **	-2.43 *	10.31 **	2.27	2.27	2.27	7.89	-2.38	-2.38
SURABHI x TCH 1644	-12.75 **	-18.84 **	-8.25 **	7.53 **	2.04	13.64 **	-2.70	-10.00	-14.29 *
SURABHI x TCH 1646	-0.54	-6.28 **	5.96 **	2.17	-2.08	6.82 **	-2.70	-10.00	-14.29 *
SVPR 2 x F 776	6.32 **	3.69 **	3.09 *	-1.01	-2.00	11.36 **	-10.00	-16.28 **	-14.29 *
SVPR 2 x F 1861	-5.35 **	-6.22 **	-6.76 **	-1.03	-2.04	9.09 **	-1.30	-11.63 *	-9.52
SVPR 2 x SOCC 11	-0.64	-10.83 **	-11.34 **	-1.68	-2.67 *	10.61 **	-16.28 **	-16.28 **	-14.29 *
SVPR 2 x SOCC 17	-0.50	-8.06 **	-8.59 **	1.01	0.00	13.64 **	-12.36 **	-15.22 **	-7.14
SVPR 2 x TCH 1641	-12.46 **	-12.71 **	-12.71 **	6.81 **	1.36	12.88 **	-8.24	-9.30	-7.14
SVPR 2 x TCH 1644	-4.25 **	-5.30 **	-5.84 **	2.04	2.04	13.64 **	-10.84 *	-13.95 *	-11.90 *
SVPR 2 x TCH 1646	7.18 **	6.87 **	6.87 **	-3.09 **	-4.08 **	6.82 **	-6.02	-9.30	-7.14

*, **, Significant at 5% and 1% level respectively; di, Relative heterosis; dii, heterobeltiosis; diii, standard heterosis.

18.41%. Carvalho et al. (1994) while studying heterosis in cotton also reported similar results for fibre strength. Standard heterosis was positive in twenty-seven hybrids, and the range was from 4.58% in SVPR 2 x TCH 1641, SVPR 2 x F 776 to 25.70% in MCU 5 x SOCC 17 for fibre strength. Tuteja and Banga (2011) observed positive standard heterosis in all the conventional hybrids, and few of male sterility based hybrids for fibre strength, and these are conformed in the present study results.

Five hybrids exhibited significant positive relative heterosis over mid parental value for fibre elongation percentage (Table 5). The estimates ranged from 10.34% in Surabhi x TCH 1644 to 32.87% in SVPR 2 x TCH 1641, and none of the hybrids were found to be significant over the better parent. Karademir et al. (2009) and Karademir et al. (2011) observed significant both positive and negative heterosis for fibre elongation percentage in cotton. Standard heterosis was positive in eighteen hybrids, and the range was exhibited from 12.07% in Surabhi x TCH 1646, Surabhi x F 1861, MCU 12 x SOCC 11 to 63.79% in SVPR 2 x TCH 1641 for elongation percentage.

Conclusion

Fibre quality parameters of cotton, fibre length and fineness have a vital influence on the yarn strength. The increasing fibre length results in improved yarn strength because a long fibre generates a greater frictional resistance to an external force. High fibre length and the tensile strength of the fibres becomes the controlling factor of yarn strength. The developing high fibre length and strength cultivars or hybrids are essential to current modernized spinning mills. Therefore, the present study was carried out for improving fibre quality traits from upland cotton by line x tester design. The results showed that hybrids are superior to the parents for all the fibre

Table 5. Expression of heterosis in hybrids (%) for bundle strength and elongation percentage.

Hybrids	Bundle strength			Elongation percentage		
	di	dii	diii	di	dii	diii
MCU 5 x F 776	6.92 **	2.75	18.31 **	-5.33	-12.35 **	22.41 **
MCU 5 x F 1861	14.66 **	12.03 **	24.65 **	4.90	1.35	29.31 **
MCU 5 x SOCC 11	12.75 **	11.11 **	21.48 **	-15.15 **	-27.08 **	20.69 **
MCU 5 x SOCC 17	18.70 **	18.41 **	25.70 **	-12.26 **	-20.93 **	17.24 **
MCU 5 x TCH 1641	8.11 **	4.98 **	11.44 **	16.54 **	7.25	27.59 **
MCU 5 x TCH 1644	6.37 **	5.31 **	11.80 **	-2.07	-6.58	22.41 **
MCU 5 x TCH 1646	9.95 **	9.95 **	16.73 **	-2.22	-4.35	13.79 *
MCU 12 x F 776	2.73	1.80	19.37 **	3.36	-4.94	32.76 **
MCU 12 x F 1861	2.16	-0.45	16.73 **	4.23	0.00	27.59 **
MCU 12 x SOCC 11	7.23 **	3.60 *	21.48 **	-20.73 **	-32.29 **	12.07 *
MCU 12 x SOCC 17	-3.79 *	-8.56 **	7.22 **	10.39 **	-1.16	46.55 **
MCU 12 x TCH 1641	8.91 **	0.90	18.31 **	12.70 **	4.41	22.41 **
MCU 12 x TCH 1644	6.44 **	0.45	17.78 **	-5.56	-10.53 *	17.24 **
MCU 12 x TCH 1646	3.55 *	-1.35	15.67 **	1.49	-0.00	17.24 **
Surabhi x F 776	5.59 **	3.06	24.65 **	-4.44	-11.52 **	23.56 **
Surabhi x F 1861	-4.93 **	-8.73 **	10.39 **	-9.09 *	-12.16 **	12.07 *
Surabhi x SOCC 11	0.00	-4.80 **	15.14 **	-16.36 **	-28.13 **	18.97 **
Surabhi x SOCC 17	-4.43 **	-10.48 **	8.27 **	-7.10 *	-16.28 **	24.14 **
Surabhi x TCH 1641	3.27 *	-5.68 **	14.08 **	-1.31	-9.18 *	8.05
Surabhi x TCH 1644	-1.88	-8.73 **	10.39 **	10.34 **	5.26	37.93 **
Surabhi x TCH 1646	2.79	-3.49 *	16.73 **	-3.70	-5.80	12.07 *
SVPR 2 x F 776	-4.81 **	-9.17 **	4.58 *	0.00	-2.35	43.10 **
SVPR 2 x F 1861	1.31	-1.74	9.33 **	4.40	-2.35	43.10 **
SVPR 2 x SOCC 11	3.37 *	1.13	10.56 **	-9.39 **	-14.58 **	41.38 **
SVPR 2 x SOCC 17	0.50	0.00	5.63 **	-6.43 *	-6.98	37.93 **
SVPR 2 x TCH 1641	2.24	0.00	4.58 *	32.87 **	11.76 **	63.79 **
SVPR 2 x TCH 1644	-0.76	-1.01	3.52	-3.11	-8.24 *	34.48 **
SVPR 2 x TCH 1646	2.76	1.99	8.27 **	-3.31	-14.12 **	25.86 **

*, **, Significant at 5 and 1% level,respectively; di, relative heterosis; dii, heterobeltiosis; diii, standard heterosis.

quality traits except micronaire value. Of the 28 hybrids, MCU 12 x TCH 1644 and SVPR 2 x TCH 1646 for 2.5% span length, MCU 5 x SOCC 17 and Surabhi x F 776 for bundle strength exhibited highest in itself performance, and heterotic effect was found to be utilized for directional choice. Increasing the fibre quality traits are a valuable addition to cotton cultivars or hybrids, and it will be useful for textile industries.

REFERNECES

Baloch MJ (2004). Genetic variability and heritability estimates of some polygenic traits in upland cotton. Pak. J. Sci. Indust. Res. 42(6):451-454.

Baloch MZ, Ansari BA, Memon N (2003). Performance and selection of intraspecific hybrids of spring wheat (*Triticum aestivum* L.). Pak. J. Agric. Agril. Engg. Vet. Sci. 19(1):28-31.

Basal H, Turgut I (2003). Heterosis and combining ability for yield components and fiber quality parameters in a half diallel cotton (*G. hirsutum*L.) population. Turk. J. Agric. For. 27(2):207-212.

Basal H, Turgut I (2005). Genetic analysis of yield components and fibre strength in upland cotton (Gossypium hirsutum L.). Asian J Plant Sci 27(4):207-212.

Bolek Y, Cokkizgin H, Bardak A (2011). Combining ability and heterosis for fiber quality traits in cotton. Plant Breed. Seed Sci. 62(1):3-16.

Carvalho LD, Moraes CF, Cruz CD (1994). Combining ability and heterosis in upland cotton. Revista. Ceres. 41(3):514–527.

Chaudhari PN, Borole DN, Tendulkar AV, Narkhede BN (1992). Heterosis for economic traits in intra-specific crosses of desi cotton. J. Maharashtra Agric. Univ. 17(2):273-276.

Copur O (2006). Determination of yield and yield components of some cotton cultivars in semi-arid conditions. Pak. J Biol. Sci. 9(14):2572-2578.

Ehsan F, Nadeem A, Tahir MA, Majeed A (2008). Comparitive yield performance of new cultivars of cotton (*Gossypium hirsutum* L.). Pak. J. Life Soc. Sci. 6(1):1-3.

Fehr WR (1987). Principles of cultivar development. Theory and technique. Macmillan Pub. Co. Inc. New York. USA. pp. 115-119.

Ganapathy S, Nadarajan N (2008). Heterosis studies for oil content, seed cotton yield and other economic traits in cotton *(G. hirsutum* L.). Madras Agric. J. 95(7-12):306-310.

Iqbal M, Chang M, Iqbal MZ (2003) Breeding behavior effects for yield, its components and fibre quality in intraspecific crosses of cotton (G. *hirsutum* L.). OnLine. J. Biol. Sci. 4:451-459.

Iraddi V, Kajjidoni ST (2009). A Comparative study on heterosis for productivity and fibre quality traits in intra-herbaceum and interspecific (*G. herbaceum* x *G. arboreum*) crosses of diploid cotton. J. Res. Angrau. 37(3-4):35-43.

Karademir C, Karademir E, Ekinci R, Gencer O (2009). Combining Ability Estimates and Heterosis for Yield and Fiber Quality of Cotton in Line x Tester Design. Not. Bot. Hort. Agrobot. Cluj. 37(2):228-233.

Karademir C, Karademir E, Gencer O (2011). Yield and Fiber Quality of F 1 and F 2 Generations of Cotton (Gossypium hirsutum L.) Under Drought Stress Conditions. Bulg. J. Agric. Sci. 17(6):795–805.

Karademir E, Gencer O (2010). Combining Ability and Heterosis for Yield and Fiber Quality Properties in Cotton (G. hirsutum L.) obtained by Half Diallel Mating Design. Not. Bot. Hort. Agrobot. Cluj. 38(1):222-227.

Kempthrone O (1957). An introduction to genetic statistics. John Wiley and Sons, Ist edition, New York, USA. 456-471.

Khan UQ (2002). Studies of heterosis in fibre quality traits of cotton. Asian J. Plant Sci. 1(5):593-595.

Khan WS, Khan AA, Naz AS, Ali S (1989). Performance of six Punjab commercial varieties of Gossypium hirsutum L. under Faisalabad conditions. The Pak. Cottons. 33(2):60-65.

Khan N, Basal H, Hassan G (2010). Cottonseed oil and yield assessment via economic heterosis and heritability in intraspecific cotton populations. Afr. J. Biotechnol. 9(44):7418–7428.

Kohel RJ (1999). Cotton germplasm resources and the potential for improved fibre production and quality. Cotton Fibres, The Haworth Press, Inc., NY, USA. pp. 167-182.

Munro JM (1987) Cotton: Tropical Agriculture series, 2nd edition. Longman Scientific and technical JohnWilley Sons Inc, New York, USA, P. 161.

Niagun HG, Khadi BM (2001). Progeny analysis of fibre characteristics of DCH 32 an interspecific cotton hybrid. J . Genet. Breed. 55(2):209-216.

Percy RG, Cantrell RG, Zhang J (2006). Genetic variation for agronomic and fiber properties in an introgressed recombinant inbred population of cotton. Crop Sci. 46(3):1311-1317.

Preetha S, Raveendran TS (2008). Combining ability and heterosis for yield and fibre quality traits in line x tester crosses of Upland cotton (*G. hirsutum*. L). Int. J. Plant Breed. Gene. 2(2):64-74.

Rahman S, Khan MA, Ayub M, Khan MA (1993). Heterosis and heterobeltiosis for lint percentage, seed and lint indices and stable length in different cross combination of five cotton cultivars. Pakistan J. Agric. Res. 14 (2-3):115-120.

Rauf S, Khan TM, Nazir S (2005). Combining ability and heterosis in (*G. hirsutum* L.) Int. J. Agric. Biol. 7(1):109-113.

Singh P (1982). Note on useful heterosis in upland cotton. Indian J. Agric. Sci. 52(1):29-31.

Soomro AR (2000). Assessment of useful heterosis in glandless *Gossypium hirsutum* cotton strains through their performance in hybrid combination. Pakistan J. Bot. 32(1):5–68.

Tuteja OP, Banga M (2011). Effects of cytoplasm on heterosis for agronomic traits inupland cotton (*Gossypium hirsutum).*Indian J. Agric. Sci. 81(11):23-29.

Tuteja OP, Kumar S, Hasan H, Singh M (2005). Heterosis and interrelationship between seed cotton yield and qualitative characters in upland cotton (*Gossypium hirsutum*). Indian J. Agric. Sci. 75(3):167-171.

Yuan YL, Zhang TZ, Guo WZ, Pan JJ, Kohel RJ (2005). Diallel analysis of superior fibre quality properties in selected upland cottons. Acta Gene. Sinica. 32(1):79-85.

Zhang ZS, Li XB, Liu DJ, Huang SL, Zhang FX (2002). Study on heterosis utilization of upland cotton (*G. hirsutum* L.) lines with high fibre quality. Cotton Sci. 14(1):264-268.