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Yield and Fibre Quality Improvement in Cotton (*Gossypium spp)* Using Interspecific Hybridization

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Interspecific cotton hybrids were developed by crossing eight lines and seven testers and were tested in a line x tester mating design for nine quantitative characters. The parents TCH 1218, TCH MCU 13, TCH BS 279 and TCH 1715 among the lines and ICB 114, ICB 134, ICB CCB 1 and DB 1 among the testers contributed most of the promising hybrids exhibiting high heterotic vigour for most of the characters. Nine hybrids such as TCH 1716 x ICB 134, TCH 1716 x ICB 114, TCH 1716 x CCB 1, TCH 1716 x DB 1, TCH 1715 x CCB 6, TCH 1734 x CCB 6, BS 279 x DB 1, BS 279 x ICB 134, BS 279 x ICB 114 were judged to be promising for seed cotton yield based on their high heterosis percentage and *per se* performance. Among the 56 F_1 hybrids studied, TCH 1218 x ICB 114, TCH 1218 x CCB 1, TCH1218 x DB 1, MCU 13 x DB 1, TCH 1715 x CCB 1, BS 279 x ICB 137 and TCH 1716 x ICB 114 were superior for yield, yield component and fibre quality traits. These hybrid combinations could be exploited in heterosis breeding.

Key words: Cotton, heterobeltiosis, heterosis breeding, heterotic viguor, relative heterosis,

Cotton, the "White Gold" is an important commercial and industrial crop of many countries. Information on the magnitude of heterosis is also desirable, since the hybrid cotton occupies majority of the area in India. Heterosis study is one of the method widely utilized for the selection of superior cross combination. Increasing F_1 hybrid value over the mid parental value is more relevant for exploitation of heterosis for commercial purpose. On the global level, India is the first country to make pioneering efforts to exploit the phenomenon of heterosis in cotton available both in the interspecific and intra specific hybrids at commercial scale. Hence, the present investigation was taken up to assess the extent of relative heterosis and heterobeltiosis for nine characters in 56 cotton hybrids developed through line x tester analysis.

Materials and Methods

The parental material for this study consisted of eight *Gossypium hirsutum L.* lines viz., TCH 1218, MCU 9, MCU 12, MCU 13, BS 279, TCH 1734, TCH 1715 and TCH 1716 as female and seven *Gossypium barbadense L.* testers such as ICB 163, ICB 137, ICB 114, ICB 134, CCB 1, CCB 6 and DB 1 as male. Each line was crossed with each tester in a Line x tester fashion (Kempthorne, 1957) during *kharif* 2010. The parents and their 56 F_1 hybrids were raised in a randomized block design with three replications at Department of Cotton, TNAU, Coimbatore. Each parent and hybrid was raised in six rows with a row length of 6m spaced 120 cm between rows and 60 cm between plants. Data on five randomly selected plants in each genotype were collected for plant height (cm), number of sympodia/ plant, number of bolls/plant, boll weight (g), seed index, lint index, fibre length (mm), fibre strength (g/ tex) and seed cotton yield (kg/ha) . The relative heterosis and heterobeltiosis were calculated as the per cent deviation of mean of the F_1 hybrid from the mid and better parental value respectively. The performance of hybrids over mid parent (di) and better parent (dii) was estimated following Fonseca and Patterson (1968) standard procedures using't' test, (Snedecor and Cochran,1967) and tested for its significance.

Results and Discussion

In the present study, superiority of the F_1 hybrids was observed over mid parent and better parent for all the nine characters. Heterosis over mid and better parents for each of the characters studied are presented in Table 1 and 2 respectively. Seed cotton yield is a complex trait, dependent on many other component traits such as plant height, number of sympodia per plant, number of bolls per plant, boll weight etc., Highly significant positive relative and better parent heterosis was observed for seed cotton yield in the cross TCH 1716 x ICB 137 (122.2 and 79.6) followed by TCH 1715 x CCB 6 (103.8 and 95.4), TCH 1716 x ICB 114 (75.5 and 74.9), MCU 13 X ICB 134 (87.9 and 55.9) and MCU 13 X CCB 6 (72.7 and 70.4). These top ranking five hybrids over relative and better parent heterosis for seed cotton yield were depicted in Fig.1. Out of 56 hybrids, 26 hybrids showed highly significant relative heterosis and heterobeltiosis for seed cotton yield. This is in

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Table 1. Mid parent heterosis of 56 cotton hybrids

Hybrids	Plant height (Cm)	No. of sympodia	No. of bolls	Boll weight (g)	Seed index	Lint index	Fibre length (mm)	Fibre strength (g/tex)	yield (kg/ha)
TCH 1218 x ICB 163	-57.0**	-58.0**	-61.0**	-65.6**	-55.9**	-56.1**	-50.4**	-50.7**	-67.9**
TCH 1218 x ICB 137	-65.0**	-47.0**	-45.0**	-63.8**	-63.3**	-63.4**	-54.7**	-50.5**	-43.5**
TCH 1218 x ICB 114	39.5**	-63.0**	-56.0**	-22.3**	1.9	33.6**	5.2	1.4	-49.3**
TCH 1218 x ICB 134	61.0**	23.3*	17.0	20.0*	9.3	-6.3	7.3	1.6	-4.5
TCH 1218 x CCB 1	-3.0	31.6**	0.0	4.6	21.2*	11.9	5.2	2.8	-23.4**
TCH 1218 x CCB 6	87.0**	0.3	0.0	7.2	-1.1	-10.0	-1.5	-3.4	6.3
TCH 1218 x DB 1	33.0**	36.0**	4.0	30.2**	4.0	-7.4	4.4	-5.4	-17.2**
MCU 9 x ICB 163	10.0	-4.0	2.0	-11.7	0.0	2.0	-0.08	-1.3	-36.3**
MCU 9 x ICB 137	10.0	3.0	28.0	-16.0*	-6.3	-8.7	-10.9	-5.7	-18.6**
MCU 9 x ICB 114	10.0	3.0	45.0**	-8.1	-0.8	16.4	-2.6	6.4	-17.1**
MCU 9 x ICB 134	17.0*	3.0	83.0**	0.7	4.4	-11.2	0.2	-6.0	-27.9**
MCU 9 x CCB 1	22.0**	-7.0	60.0**	-1.9	9.8	9.2	3.4	3.0	-3.0
MCU 9 x CCB 6	8.0.	6.0	7.0	0.6	0.8	-1.3	3.4	-7.4	7.1
MCU 9 x DB 1	11.0	-12.0	47.0**	14.5	3.5	-3.9	5.6	-1.9	34.0**
MCU 12 x ICB 163	23.0**	2.0	-3.0	-23.9**	18.9*	2.4	18.0*	13.4	13.9**
MCU 12 x ICB 137	4.0	-2.0	67.0**	-17.3**	-10.5	-5.8	8.3	8.2	4.8
MCU 12 x ICB 114	4.0	-2.0	-12.0	-4.5	7.0	22.9**	7.8	9.2	20.5**
MCU 12 x ICB 134	11.0	13.0	-7.0	1.2	12.9	-13.2	7.0	-1.6	36.2**
MCU 12 x CCB 1	21.0**	28.0*	-10.0	-10.5	22.1*	7.6	9.2	0.6	21.6**
MCU 12 x CCB 6	15.0*	12.0	-13.0	-6.9	12.7	-1.7	5.1	-2.6	-21.2**
MCU 12 x DB 1	14.0	24.0*	-4.0	6.7	9.1	14.6	2.0	-5.0	8.1*
MCU 13 x ICB 163	30.0**	-8.0	-5.0	-13.4	0	15.3*	9.5	-11.0	-6.8
MCU 13 x ICB 137	24.0**	-9.0	18.0	-6.2	-1.2	10.8	-6.9	-19.3*	66.3**
MCU 13 x ICB 114	63.0**	-13.0	30.0*	-23.2**	4.7	15.7	3.3	-10.6	1.4
MCU 13 x ICB 134	54.0**	19.0	58.0**	-1.2	12.7	-9.1	15.9*	-3.3	87.9**
MCU 13 x CCB 1	37.0**	16.0	14.0	-7.2	5.5	-1.9	15.6*	2.8	-15.0**
MCU 13 x CCB 6	63.0**	13.0	25.0*	-3.5	6.0	-5.2	11.2	9.7	72.7**
MCU 13 x DB 1	92.0**	15.0	14.0	33.3**	25.8 **	11.3	11.5	-0.6	-23.3**
BS 279 x ICB 163	2.5	-3.0	93.0**	-19.2**	3.5	-10.6	17.5*	12.1	-14.7**
BS 279 x ICB 137	13.0	3.0	2.0	-8.1	-3.1	-14.0	17.1*	21.4**	-2.0
BS 279 x ICB 114	10.6	-7.0	77.0**	-12.4	4.0	0.9	5.4	5.7	27.2**
BS 279 x ICB 134	21.5**	6.0	46.0**	-1.9	13.3	-11.7	17.2	11.7	75.0**
BS 279 x CCB 1	16.0*	7.0	69.0**	-5.5	8.9	-5.4	16.1*	23.8**	13.5**
BS 279 x CCB 6	24.5**	18.0	58.0**	3.0	2.3	-3.2	15.4*	40.2**	35.6**
BS 279 x DB 1	14.1	16.0	81.0**	14.8	-11.4	-9.7	12.5	13.7	47.7**
TCH 1734 x ICB 163	10.0	22.0	58.0**	-23.0**	-9.8	-16.1*	14.2	21.4**	18.5**
TCH 1734 x ICB 137	10.0	24.0*	118.0**	-16.5*	-16.2*	-13.4	4.7	21.0*	-1.4
TCH 1734 x ICB 114	9.5	21.0	129.0**	-10.8	19.0*	7.9	7.1	13.1	-45.2**
TCH 1734 x ICB 134	9.0	12.0	-9.0	-2.3	17.1*	8.7	9.5	8.9	59.6**
TCH 1734 x CCB 1	2.0	10.0	17.0	-20.2**	3.4	8.2	9.0	19.5*	-24.0**
TCH 1734 x CCB 6	19.0*	6.0	13.0	-17.7*	-6.7	5.0	11.9	4.8	76.4**
TCH 1734 x DB 1	17.5*	18.0	41.0*	1.2	1.9	-5.7	3.6	-4.8	-0.9
TCH 1715 x ICB 163	11.0	-9.0	49.0*	-29.6**	8.6	-1.6	12.1	12.4	20.9**
TCH 1715 x ICB 137	-5.0	38.0**	65.0**	-17.9*	-4.7	-9.0	1.9	-1.6	44.5**
TCH 1715 x ICB 114	2.0	10.0	80.0**	-16.4*	23.7	16.6	17.7*	10.6	32.1**
TCH 1715 x ICB 134	-8.0	13.0	15.0	1.2	26.8**	4.9	13.3	1.6	49.8**
TCH 1715 x CCB 1	5.0	15.0	23.0	1.2	27.6**	19.2*	15.1*	5.3	35.4**
TCH 1715 x CCB 6	2.5	21.0	86.0**	3.6	3.4	0.0	13.2	2.7	103.8**
TCH 1715 x DB 1	6.0	-13.0	30.0	14.0	-2.1	-10.3	11.0	2.5	10.6*
TCH 1716 x ICB 163	0.3	-14.0	39.0*	-13.5*	1.4	2.4	18.3*	4.0	26.6**
TCH 1716 x ICB 137	0.3	6.0	61.0**	-12.1	-20.5**	0.8	-9.1	-16.2*	122.2**
TCH 1716 x ICB 114	2.0	-3.0	30.0**	-18.8*	3.9	7.2	20.5*	-2.2	75.5**
TCH 1716 x ICB 134	2.0	10.0	91.0**	-1.2	3.1	0.0	8.9	-3.3	-9.8
TCH 1716 x CCB 1	1.5	-21.0*	85.0**	-10.9	-12.5	11.5	-3.3	-13.2	46.7**
TCH 1716 x CCB 6	10.0	6.0	90.0**	1.2	11.3	3.4	12.9	-2.6	41.1**
TCH 1716 x DB 1	10.5	-6.0	58.0**	5.6	3.6	-1.7	10.4	-5.3	34.0**

* Significant at 5.0 per cent level; **Significant 1.0 per cent level

agreement with earlier findings of Das and Shanmugavalli (1996) and Swati *et al*. (2007). The hybrid TCH 1716 x ICB 137 showed maximum percentage of mid parent heterosis for seed cotton yield (122.2). Rauf *et al*. (2005) evaluated heterosis of 20 crosses for yield and yield component traits and found that most of the crosses manifested highly significant heterosis for seed cotton yield and Desalegn *et al*. (2004) found that F_1 hybrids showed an overall yield advantage over the parental mean of 26.4%.

Plant height plays an important role in determining the morphological framework relating to plant type, duration and productivity in cotton. In this direction, 21 hybrids recorded positive significant over mid parent and 14 over better parent heterosis. These findings are in agreement with the studies of Patil and Meshram (2002) and Bhatade *et al.* (1992). Range of heterosis for plant height varied from -65.0 to 92.0 for mid parent heterosis and -65.0 to 73.0 for better parent heterosis.

The range of heterosis over mid parent for number of bolls per plant was -61.0 to 129.0 per cent and -70.0 to 118.0 per cent for better parent. 29

Table 2. Better parent heterosis of 56 cotton hybrids

Hybrids	Plant height (Cm)	No. of sympodia	No. of bolls	Boll weight (g)	Seed index	Lint index	Fibre length (mm)	Fibre strength (g/tex)	yield (kg/ha)
TCH 1218 x ICB 163	-57.0**	-59.0**	-70.0**	-70.9**	-57.3**	-57.8**	-53.8**	-51.6**	-74.3**
TCH 1218 x ICB 137	-65.0**	-50.0**	-59.0**	-65.4**	-64.1**	-63.7**	-56.4**	-51.8**	-61.3**
TCH 1218 x ICB 114	33.0**	-64.0**	-65.0**	-24.6**	-11.6	8.0	-1.3	-2.5	-59.3**
TCH 1218 x ICB 134	51.0**	11.0	-2.0	14.4	2.0	-7.0	3.2	-2.5	-36.6**
TCH 1218 x CCB 1	-4.0	22.0*	-12.0	3.9	12.9	-2.4	2.8	0.6	-38.2**
TCH 1218 x CCB 6	73.0**	-7.0	-16.0	6.4	-1.6	-13.6	-6.6	-4.2	-21.0**
TCH 1218 x DB 1	20.0**	22.0*	-17.0	10.5	2.5	-10.4	3.7	-12.1*	-31.2**
MCU 9 x ICB 163	10.0	-8.0	-17.0	-24.5**	-6.6	-6.6	-6.1	-2.4	-47.1**
MCU 9 x ICB 137	8.0	-6.0	1.0	-19.0*	-11.9	-14.1	-13.6*	-7.6	-42.9**
MCU 9 x ICB 114	4.0	-2.0	22.0	-9.8	-10.8	-1.78	-8.0	1.4	-31.3**
MCU 9 x ICB 134	10.0	-11.0	63.0**	-5.1	1.3	-16.5*	-2.8	-10.5	-51.1**
MCU 9 x CCB 1	19.0**	-17.0*	51.0**	-3.8	6.3	0.0	1.9	0.0	-19.1**
MCU 9 x CCB 6	-0.5	-7.6	-4.0	0.0	-2.5	-2.6	-1.2	-8.9	-18.1**
MCU 9 x DB 1	-0.1	-24.0**	24.0*	-3.8	0.8	-5.9	5.4	-9.5	15.2**
MCU 12 x ICB 163	20.0**	-3.0	-26.0**	-29.0**	4.7	-5.1	17.5*	9.9	4.1
MCU 12 x ICB 137	3.0	-2.0	22.0*	-22.1**	-20.7**	-10.2	5.2	5.8	-20.9**
MCU 12 x ICB 114	1.0	-5.4	-32.0**	-11.5	2.0	2.6	7.8	0.0	10.1**
MCU 12 x ICB 134	6.0	5.0	-24.0*	-12.6	9.1	-17.3*	3.9	-10.0	-1.2
MCU 12 x CCB 1	21.0**	23.0*	-22.0*	-20.0**	18.3*	-2.6	4.4	-6.2	11.7**
MCU 12 x CCB 6	9.0	7.0	-28.0**	-15.7	2.5	-1.7	3.7	-8.2	-34.5**
MCU 12 x DB 1	5.0	16.0	-25.0**	-16.8	0.0	13.6	-3.9	-15.7**	2.9
MCU 13 x ICB 163	2.0	-9.0	-28.0**	-20.9**	-6.2	5.9	6.9	-13.8	-15.1**
MCU 13 x ICB 137	-1.0	-12.0	-12.0	-9.8	-6.7	4.7	-12.0	-21.0**	45.0**
MCU 13 x ICB 114	33.0**	-14.0	1.0	-27.4**	-6.2	-2.6	0.3	-18.1**	-7.5
MCU 13 x ICB 134	27.0**	8.0	30.0*	-13.1	8.9	-14.1	9.7	-11.6	55.9**
MCU 13 x CCB 1	9.4	9.0	-2.0	-15.3*	1.7	-10.6	7.7	-4.1	-22.9**
MCU 13 x CCB 6	35.0**	5.0	3.0	-10.9	2.9	-6.0	6.7	3.5	70.4**
MCU 13 x DB 1	64.0**	5.0	-10.0	5.4	23.1**	9.4	2.3	-11.7	-32.8**
BS 279 x ICB 163	-1.0	-14.0	80.0**	-27.2**	-1.9	-12.5	12.4	1.0	-17.1**
BS 279 x ICB 137	11.0	-4.0	-9.0	-10.2	-7.5	-14.7*	8.5	10.3	-22.7**
BS 279 x ICB 114	8.0	-17.0	70.0**	-15.9*	-7.8	-19.3**	0.3	-9.5	23.5**
BS 279 x ICB 134	17.0*	5.0	41.0**	-12.5	8.3	-12.4	8.7	-4.5	32.2**
BS 279 x CCB 1	15.0*	2.0	54.0**	-12.5	3.9	-18.6*	6.0	7.6	10.9*
BS 279 x CCB 6	18.0*	14.0	53.0**	-3.4	0.4	-8.5	8.5	23.2**	19.0**
BS 279 x DB 1	5.0	14.0	75.0**	-7.9	-12.4	-13.9	1.2	-5.4	45.5**
TCH 1734 x ICB 163	6.0	10.0	55.0**	-25.4**	-15.2	-19.2**	13.3	10.1	18.1**
TCH 1734 x ICB 137	8.0	18.0	113.0**	-24.2**	-20.7**	-14.1	0.6	10.7	-20.8**
TCH 1734 x ICB 114	7.0	11.0	118.0**	-20.3**	6.2	-12.8	5.6	-2.5	-45.5**
TCH 1734 x ICB 134	5.0	10.0	-19.0	-18.4**	12.9	7.8	5.2	-6.3	22.8**
TCH 1734 x CCB 1	0.7	7.0	-1.0	-31.0**	-0.4	-5.6	3.0	4.5	-24.1**
TCH 1734 x CCB 6	14.0	4.0	0.0	-28.1**	-9.2	0.8	9.1	-7.2	58.3**
TCH 1734 x DB 1	9.0	16.0	33.0	-23.3**	0.0	-8.8	-3.5	-20.4**	-4.8
TCH 1715 x ICB 163	10.0	-15.0	34.0	-36.3**	-4.3	-8.8	10.5	8.4	13.1**
TCH 1715 x ICB 137	-8.0	33.0**	55.0**	-20.2**	-15.5	-13.3	-2.7	-4.2	22.9**
TCH 1715 x ICB 114	-4.4	2.0	57.0**	-20.2**	18.0	-2.6	15.3*	0.9	23.7**
TCH 1715 x ICB 134	-15.0*	8.0	-5.0	-10.1	22.5*	0.0	8.1	-7.4	21.4**
TCH 1715 x CCB 1	2.0	14.0	-3.0	-6.7	23.6**	7.826	8.1	-2.2	26.1**
TCH 1715 x CCB 6	-6.0	20.0	53.0**	-3.3	-5.9	0.0	9.6	-3.5	95.4**
TCH 1715 x DB 1	-5.70	-16.0	13.0	-8.9	-10.3	-11.1	2.7	-9.3	-0.5
TCH 1716 x ICB 163	-2.0	-18.0	35.0	-21.8**	-3.5	-5.1	15.6*	0.8	26.1**
TCH 1716 x ICB 137	0.10	6.0	50.0**	-14.6*	-23.9**	-3.9	-14.1*	-18.1	79.6**
TCH 1716 x ICB 114	-1.60	-7.0	29.0**	-22.4**	-8.2	-10.4	17.1*	-10.4	74.9**
TCH 1716 x ICB 134	-2.0	3.0	77.0**	-12.3	-1.7	-4.7	3.1	-11.6	-30.3**
TCH 1716 x CCB 1	1.0	-24.0*	62.0**	-17.9*	-16.9	0.9	-9.9	-19.2**	45.3**
TCH 1716 x CCB 6	3.0	1.3	75.0**	-5.6	9.7	3.4	8.5	-8.2	27.4**
TCH 1716 x DB 1	1.0	-12.3	56.0**	-15.7*	3.0	-2.5	1.3	-16.0**	27.8**

* Significant at 5.0 per cent level; **Significant 1.0 per cent level

hybrids recorded significant positive heterosis for mid parent heterosis whereas 23 recorded over better parent heterosis. Maximum heterosis for number of bolls/plant over mid and better parent heterosis was observed in the hybrid TCH 1734 × ICB 114 followed by TCH 1734 × ICB 137.

The range of heterosis for boll weight was observed from -65.6 to 33.3 and -70.9 to 14.45 per cent over mid and better parent respectively. Similar trends were evident from the studies of Reddy (2001) and Punitha and Ravikeshavan (2004). With respect to economic traits included in the study, majority of the hybrids recorded significant positive heterosis over mid and better parental heterosis for the traits lint index and seed index. The range of heterosis varied from -63.3 to 27.6 for mid parent heterosis and -64.1 to -23.9 for better parent heterosis for the trait seed index. The hybrids *viz.,* TCH 1715 × CCB 1, MCU 13 × DB1 and TCH 1715 × ICB 134 also exhibited significant positive heterosis for this trait. The results of seed index were in agreement with Rauf *et al*. (2005) and Desalegn *et al*. (2004). Out of 56 crosses, TCH 1218 × ICB 114, MCU 12 × ICB 114, MCU 13 × ICB 163 and TCH 1715 × CCB 1 recorded significant positive mid parental heterosis for lint index. However the range was observed between -63.4 and 33.6 for mid parent heterosis and -63. 7 and 13.6 for better parental heterosis respectively and these findings were in accordance

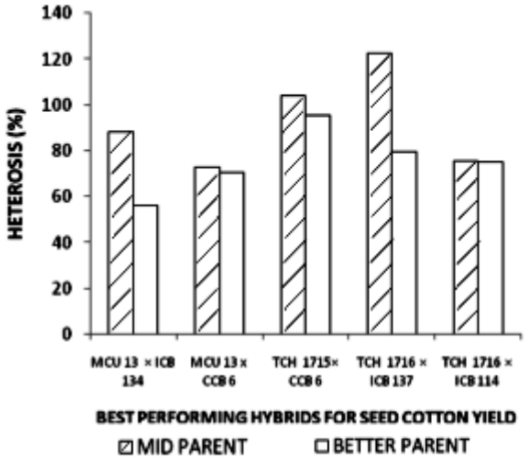

Fig 1. Mid and better parent heterosis for seed cotton yield of best performing hybrids

with Laxman and Ganesh (2003) and Manickam and Gururajan (2004).

With regard to fibre length, relative heterosis ranged from -54.7 to 20.5 and heterobeltiosis from–56.4 to 17.5 per cent. Out of the 56 hybrids, 11 hybrids over mid parents, 4 over better parents recorded significant positive heterosis for 2.5% span length indicating that hybrids possessed better halo length than their parents. The hybrid MCU 12 × ICB 163 recorded the maximum positive relative heterosis of 18.0 per cent and the hybrid TCH 1716 × ICB 114 showed the maximum better parent heterosis of 17.1 per cent. These findings are in accordance with the results obtained by Kajjidoni (1984 and 1997). The hybrid BS 279 × CCB 6 recorded the highest mid and better parental heterosis for fibre strength. Range of relative heterosis varied from - 50.7 to 40.2 and the better parent heterosis varied from -51.8 to 23.2. Six hybrids recorded positive significant mid parental heterosis.

In the present study, TCH 1218, MCU 13, BS 279 and TCH 1715 among the lines and ICB 114, ICB 134, CCB 1 and DB 1 among the testers contributed to most of the promising hybrids exhibiting high heterotic vigour for yield and fibre quality characters. Involvement of these parents for crossing program may be fruitful for developing desirable hybrids combining high yield potential, high lint index as well as superior fibre properties. The hybrids TCH 1218 x ICB 114, TCH 1218 x CCB 1, TCH 1218 x DB 1, MCU 13 x DB 1, TCH 1715 x CCB 1, BS 279 x ICB 137 and TCH 1716 x ICB 114 exhibited significant heterosis for yield and yield related components like number of bolls/plant, number of sympodia/plant, seed index, lint index and the fibre quality characters like fibre length and fibre strength in desirable direction. From the study, it showed that these crosses could be further evaluated and exploited for commercial cultivation.

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