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Research Article

Heterosis studies in interspecific cotton hybrids (*Gossypium hirsutum* L. × *Gossypium barbadense* L.) under irrigated condition

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Abstract
The present study was undertaken to assess the extent of heterosis for seed cotton yield and its attributing traits in 24 interspecific hybrids of cotton developed by crossing 8 lines with 3 testers in line × tester mating design during *kharif*, 2017-18 at Agricultural Research Station Dharwad Farm. Significant heterosis was observed for the characters under study indicating the presence of genetic diversity among the parental lines. Except for number of sympodia per plant and boll weight, the mean sum of squares of parents *vs* crosses was significant for all the characters indicating presence of heterosis for these traits. None of the crosses was superior for all the traits studied. However, the cross CPD-462 x SBYF-425 was the best as it had the highest mean performance for economically important characters. Majority of the crosses exhibited significantly positive mid parent, better parent heterosis for all important yield contributing characters except ginning outturn. Most of the hybrids expressed significant standard heterosis for all the characters except boll weight and ginning outturn over the checks.

Keywords
Heterosis, Lines, Testers, Interspecific hybrid, Line × Tester.

Introduction

Cotton, the King of fiber, is an important cash crop exercising profound influence on economics and social affairs of the world. In India, the crop is being grown in an area of 12.3 million hectares, producing 28.50 million bales with a productivity of 504 kg ha^{-1}. In Karnataka, cotton is being grown in an area of 5.65 lakh hectares with production and productivity of 19.0 lakh bales and 572 kg ha^{-1} respectively (Anon., 2018). The yield levels of barbadense ELS cotton have are not progressing on account of biotic and abiotic stresses over a period of changing climatic conditions. To overcome this barrier in productivity of barbadense cotton and fiber quality of hirsutum cotton, there is a necessity to develop interspecific hybrids which combine the yield advantage of hirsutum and fiber qualities of barbadense as *Gossypium hirsutum* and *Gossypium barbadense* are genetically diverse species. Heterosis is the superiority of the hybrid over the mid or better parent or over standard check and is the result of allelic or non-allelic interactions of genes under influence of particular environment. Heterosis breeding is mainly responsible for increased production of cotton. Cotton being an often cross pollinated crop, is amenable for heterosis breeding.

Materials and Methods

The experimental material consisted of 37 genotypes comprising of eight lines, three testers (Table1) and their resultant twenty four hybrids produced in line x tester mating design and were evaluated along with two standard checks. The experimental material was sown in Randomised Block Design with three replications during *kharif*, 2017-18 at Agricultural Research Station Dharwad. Three rows of each 4.2 m length were assigned to each genotype with plants having 60 cm intra and 90 cm inter row spacing. Five plants were randomly selected from each replication in each genotype and the average value was computed for plant height, number of monopodia, number of sympodia, boll weight, number of bolls per plant, ginning outturn, seed index, lint index and seed cotton yield. The trait, days to 50 per cent flowering was recorded on plot basis and fiber quality of respective genotypes was tested by HVI instrument. Analysis of variance techniques suggested by Panse and Sukhatme (1978) was followed to test the differences between the genotypes for yield and yield related traits. The per cent heterosis of all F_1 crosses over their mid parent (MP), better parent (BP) and standard checks (SC) were computed as per the method suggested by Turner (1953) and Hayes *et al*. (1955).

Results and Discussion

The analysis of variance for eleven characters studied in 24 interspecific crosses (*G. hirsutum* L. *G. barbadense* L.) is presented in Table 2. Analysis of variance for treatments revealed highly significant genotypic differences for most of the characters except for number of sympodia per plant. Parents recorded significance for all characters except sympodial length at 50 per cent plant height. However, lines *vs* testers recorded significance for days to 50 per cent flowering, plant height, boll weight, number of bolls per plant, seed cotton yield, ginning outturn and lint index indicating that testers were divergent from the lines justifying the choice of parents. For parents *vs* hybrids, all the characters except number of sympodia per plant and boll weight revealed significant genotypic differences indicating significant average or mid parent heterosis.

The range of mid parent heterosis, better parent heterosis and standard heterosis over check hybrids DCH-32 and DHB-1071 for different characters are presented in Table 3. Out of 24 F_1 hybrids, 21 hybrids had significant positive heterosis over mid and better parent for plant height. All 24 hybrids recorded significant positive heterosis over mid parent for number of bolls/plant while 21 hybrids recorded significant positive better parent heterosis. Among 24 hybrids, 6 and 2 hybrids recorded significantly positive relative heterosis and heterobeltosis for average boll weight, respectively. The perusal of data on performance of hybrids with respect to heterosis revealed that eleven hybrids manifested significantly positive relative heterosis over their mid parent for seed cotton yield per plant; while four hybrids depicted significantly positive heterobeltosis for the same. The highest magnitude of mid and better parent heterosis for seed cotton yield was exhibited by the hybrid CPD-462 × SBYF-425. It was observed that hybrids showing high relative and better parent heterosis for seed cotton yield in general also manifested heterotic effects for its contributing characters *viz.*, plant height, average boll weight and total number of bolls per plant (Table 3). This study thus substantiates the findings of Baloch *et al*. (1993), Eswari *et al*. (2016) and Isong *et al.* (2017).

Improvement in yield is one of the important objectives, so the superiority of hybrids over best cultivated hybrid is essential for increasing its commercial value. In the present study, promising hybrids DCH-32 and DHB-1071 have been used as standard check hybrids. The estimates of standard heterosis (SH) over DCH-32 and DHB-1071 ranged from -43.61 to 106.48 and -45.39 to 99.95 per cent for seed cotton yield, respectively. Out of 24 F_1 hybrids, three hybrids out yielded the best standard check hybrid DHB-1071 for seed cotton yield. The hybrid CPD-462 × SBYF-425 exhibited maximum seed cotton yield (1239.38 kg/ha) and highest standard heterosis (99.95 %) over the best check DHB-1071. All the characters studied in the present study exhibited significant mid parent and better parent heterosis in majority of the crosses indicating predominance of non additive gene action in the genetic control of these traits. Similar results were reported by Punitha and Raveendran (2000), Tausif (2008), Karademir *et al.* (2009), Patel *et al.* (2012), Alkuddsi *et al.* (2013) and Gohil *et al.* (2017).

The results of heterosis also indicated that, no single hybrid was superior in respect of all the traits. However, considering the hybrids with significant heterosis over mid parent, better parent, standard check and *per se* performance, three crosses *viz.*, CPD-462 × SBYF-425, FLT-36 × SBYF-425, and FLT-31 × SBYF-425 exhibited significantly higher standard heterosis over both the standard checks.

Further, it was noticed that all the superior hybrids for most characters studied had CPD-462 (among lines) and SBYF-425 (among testers) as one of the parents in their cross combinations. Hence, these parents can be utilized in realizing superior heterosis for full exploitation of economically important traits in the crop.

References

Alkuddsi, Y., Patil, S. S., Manjula, S. M., Patil, B. C., Nadaf, H. L. and Nandihalli, B. S., 2013, Combining ability for yield and yield attributing characters in line × tester interspecific hybrids (*G. hirsutum* L. × *G. barbadense* L.) for confirmation of heterotic groups. *Cotton Genom. Genet.*, **4**(2): 13-32.

Anonymous, 2018, Annu. Rep. ICAR - All India Coordinated Research Project on cotton, **14**(1): 2-5.

Baloch, M. J., Lakho, A. R. and Soomro, A. H., 1993, Heterosis in interspecific cotton hybrids. *Pak. J. Bot*., **25**(1): 13-20.

Eswari, K. B., Kumar, S., Gopinath. and Rao, M. V. B., 2016, Heterosis and combining ability studies for improvement of seed cotton yield and fibre quality traits in inter and intraspecific hybrids of allotetraploid cotton. *Int. J. Curr. Res.*, **8**(7): 34546-34553.

Gohil, S. B., Parmar, M. B. and Chaudari, D. J., 2017, Study of heterosis in interspecific hybrids of cotton (*Gossypium hirsutum* L. × *Gossypium barbadense* L.). *J.Pharmacogn. Phytochem.*, **6**(4): 804-810.

Hayes, H. K., Immer, F. R. and Smith, D.C., (1955), Methods of Plant Breeding. Mc. Graw Hill Book Co., Inc, NEW YORK (U.S.A.).

Isong, A., Balu, A. and Ravikesavan, R., 2017, Study on heterosis and combining ability in interspecific hybrids of cotton (*G. hirsutum* × *G. barbadense*). *Int. J. Curr. Res*., **7**(5): 16590-16595.

Karademir, C., Karademir, E., Ekinci, R. and Gencer, O., 2009, Combining ability estimates and heterosis for yield and fibre quality of cotton in Line × Tester design. *Nott. Bot. Hort. Agrobot. Cluj.,* **37***(*2): 228-233.

Panse, V. G. and Sukhatme, P. V., 1978, Statistical methods for agricultural workers, 2nd Edn., Indian Council of Agricultural Research, New Delhi (India).

Patel, N. A., Patel, B. N., Bhatt, J. P. and Patel, J. A., 2012, Heterosis and combining ability for seed cotton yield and components traits in interspecific cotton hybrids (*G. hirsutum* L. × *G. barbadense* L.). *Madras Agric. J.,* **99**(10-12): 649-656.

Punitha, D. and Raveendran, T. S., 2000, Combining ability for yield and fibre quality in interspecific (*G. hirsutum* × *G. barbadense*) colour linted cotton crosses. *J. Indian Soc. Cotton Improv.,* **25**(2): 81-85.

Tausif, K., 2008, Genetic studies on improving productivity and quality traits involving interspecific (H×B) crosses and barbadense genotypes. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

Turner, J. R., 1953, A study of heterosis in upland cotton. II. Combining ability and inbreeding effects. *Agron. J.,* **43**: 487-490.

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Table 1. Experimental material used in the study

Lines (*G. hirsutum* L.)	Testers (*G. barbadense* L.)
1. FLT-36	1. BCS-23-18-7
2. FLT-44	2. GIZA-70
3. FLT-31	3. SBYF-425
4. FLT-28	
5. SG-1	
6. SG-2	
7. EL-4	
8. CPD-462	

Table 2. Analysis of variance for Line × Tester involving parents and their interspecific crosses (H × B) with respect to yield and its component characters

Source of variation	d.f.	Mean sum of squares										
		Days to 5 0 % flowering	Plant height (cm)	Number of monopodia per plant	Number of sympodia per plant	Boll weight (g)	Number of bolls per plant	Sympodial length at 50 % plant height	Ginning outturn (%)	Seed index (g)	Lint index (g)	Seed cotton yield (kg/ha)
Replication	2	15.90	687.84	0.17	18.64	0.23	37.37	114.99	38.07	2.93	0.16	19720.99
Genotypes (crosses + parents)	34	144.89**	1052.08**	0.68**	23.38	0.49**	151.72**	119.87**	19.62**	0.97**	4.04**	175787.29**
Parents (lines + testers)	10	287.42**	454.18**	0.35**	65.98	1.23**	50.17**	26.70*	10.02*	1.08**	1.82**	325522.54**
Lines	7	115.57**	391.50**	0.27**	83.96**	0.65**	28.79*	36.78	4.82	0.69	0.85*	197950.56**
Testers	2	3.11	323.21	0.62**	4.09	0.16	0.66	1.92	23.72**	2.74**	0.56	4345.83
Lines *vs* testers	1	2059.00**	1154.93**	0.30	63.92	7.47**	298.87**	5.67	19.08**	0.51	11.08**	1860879.79**
Parents *vs* crosses	1	1840.12**	22831.70**	11.24**	0.65	0.28	3812.53**	2076.75**	361.73**	0.52*	78.39**	17003.97*
Crosses	23	9.21	365.09**	0.37**	5.84	0.17*	36.70*	75.30**	8.91	0.95**	1.78**	117588.62**
Error	68	6.26	132.79	0.09	19.25	0.08	10.38	34.63	4.11	0.34	0.35	9100.36

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Table 3. Mean performance and heterosis over mid-parent, better-parent, and standard checks in interspecific (H × B) crosses for yield and its component characters at ARS Dharwad, 2017-18

Sl. No	Crosses	Days to 50 (%) flowering					Plant height (cm)				
		Mean	H_{mp}	H_{bp}	Standard heterosis over DCH-32	Standard heterosis over DHB-1071	Mean (cm)	H_{mp}	H_{bp}	Standard heterosis over DCH-32	Standard heterosis over DHB-1071
1	FLT-36 × BCS-23-18-7	77.00	-12.83**	-21.69**	-2.12	-1.70	166.40	23.26**	10.93	6.80	6.67
2	FLT-36 × GIZA-70	78.00	-12.69**	-22.26**	-0.85	-0.43	169.20	29.89**	12.80*	8.60	8.46
3	FLT-36 × SB-YF-425	76.33	-14.23**	-23.41**	-2.97	-2.55	152.53	8.46	1.69	-2.10	-2.22
4	FLT-44 × BCS-23-18-7	78.67	-11.44**	-20.00**	0.00	0.43	154.07	25.84**	23.38**	-1.11	-1.24
5	FLT-44 × GIZA-70	82.00	-8.72**	-18.27**	4.24	4.68	149.40	26.93**	19.65*	-4.11	-4.23
6	FLT-44 × SB-YF-425	78.67	-12.10**	-21.07**	0.00	0.43	157.00	22.59**	19.60**	0.77	0.64
7	FLT-31 × BCS-23-18-7	76.00	-13.64**	-22.71**	-3.39	-2.98	163.53	32.13**	28.23**	4.96	4.83
8	FLT-31 × GIZA-70	77.00	-13.48**	-23.26**	-2.12	-1.70	154.47	29.77**	21.12*	-0.86	-0.98
9	FLT-31 × SB-YF-425	75.67	-14.66**	-24.08**	-3.81	-3.40	158.80	22.72**	20.98**	1.93	1.79
10	FLT-28 × BCS-23-18-7	78.33	-10.13**	-20.34**	-0.42	0.00	163.47	26.16**	17.49*	4.92	4.79
11	FLT-28 × GIZA-70	75.67	-14.18**	-24.58**	-3.81	-3.40	168.40	34.90**	21.03**	8.09	7.95
12	FLT-28 × SB-YF-425	77.00	-12.33**	-22.74**	-2.12	-1.70	162.93	20.51**	17.11*	4.58	4.44
13	SG-1 × BCS-23-18-7	80.00	-15.04**	-18.64**	-1.69	2.13	180.87	46.33**	42.19**	16.09*	15.94*
14	SG-1 × GIZA-70	75.67	-20.49**	-24.58**	-3.81	-3.40	166.53	40.10**	30.92**	6.89	6.75
15	SG-1 × SB-YF-425	77.00	-18.80**	-22.74**	-2.12	-1.70	144.80	12.05	10.31	-7.06	-7.18
16	SG-2 × BCS-23-18-7	77.67	-18.25**	-21.02**	-1.27	-0.85	169.10	26.60**	14.93**	8.54	8.40
17	SG-2 × GIZA-70	79.00	-17.71**	-21.26**	0.42	0.85	183.20	42.20**	24.51**	17.59**	17.44**
18	SG-2 × SB-YF-425	75.67	-20.91**	-24.08**	-3.81	-3.40	173.30	24.50**	17.78**	11.23	11.09
19	EL-4 × BCS-23-18-7	81.00	-7.25**	-17.63**	-2.97	3.40	164.07	38.18**	36.72**	5.31	5.17
20	EL-4 × GIZA-70	77.00	-12.83**	-23.26**	-2.12	-1.70	156.80	37.54**	33.48**	0.64	0.51
21	EL-4 × SB-YF-425	75.00	-14.77**	-24.75**	-4.66	-4.26	176.47	41.89**	34.43**	13.26*	13.12*
22	CPD-462 × BCS-23-18-7	76.67	-16.06**	-22.03**	-2.54	-2.13	135.20	4.91	-1.84	-13.22*	-13.33*
23	CPD-462 × GIZA	78.33	-15.16**	21.93**	-0.42	0.00	160.00	28.89**	16.17*	2.70	2.56
24	CPD-462 × SB-YF-425	77.33	-15.94**	22.41**	-1.69	-1.28	158.07	17.52**	14.76*	1.45	1.32
	DCH-32 (C)	78.67					155.40				
	DHB-1071 (C)	78.33					146.00				
Range	Minimum	75.67	-20.91	-24.75	-4.66	-4.26	135.20	4.91	-1.84	-13.22	-13.33
	Maximum	82.00	-8.72	-17.63	4.24	4.68	183.20	46.33	42.19	17.59	17.44
	C.V.	3.11					7.56				
	CD at 5 %	4.05	3.56	4.11	4.11	4.11	18.79	16.40	18.93	18.93	18.93

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Sl. No	Crosses	Number of monopodia per plant					Number of sympodia per plant				
		Mean	H_{mp}	H_{bp}	Standard heterosis over		Mean (cm)	H_{mp}	H_{bp}	Standard heterosis over	
					DCH-32	DHB-1071				DCH-32	DHB-1071
1	FLT-36 × BCS-23-18-7	1.93	27.61	13.73	11.54	-6.75	26.00	20.18	8.94	47.17*	51.75*
2	FLT-36 × GIZA-70	2.07	79.71**	21.57	19.23	-0.32	21.93	-1.05	-8.10	24.15	28.02
3	FLT-36 × SB-YF-425	2.34	49.57**	37.84*	35.19*	13.02	23.73	4.09	-0.56	34.34	38.52
4	FLT-44 × BCS-23-18-7	1.93	57.18**	45.36*	11.54	-6.75	20.93	1.29	-4.56	18.49	22.18
5	FLT-44 × GIZA-70	1.97	127.36**	74.04**	13.46	-5.14	21.53	1.57	-1.82	21.89	25.68
6	FLT-44 × SB-YF-425	1.90	48.24**	32.56	9.62	-8.36	21.20	-2.90	-3.34	20.00	23.74
7	FLT-31 × BCS-23-18-7	2.27	45.92**	27.58	30.77*	9.32	23.87	7.67	-4.28	35.09	39.30
8	FLT-31 × GIZA-70	2.10	76.72**	18.20	21.15	1.29	25.60	12.78	2.67	44.91*	49.42*
9	FLT-31 × SB-YF-425	1.48	-7.58	-16.51	-14.42	-28.46*	22.40	-4.00	10.16	26.79	30.74
10	FLT-28 × BCS-23-18-7	2.47	105.84**	85.46**	42.31**	18.97	23.20	8.24	-1.14	31.32	35.41
11	FLT-28 × GIZA-70	1.90	128.00**	78.12**	9.62	-8.36	22.87	4.10	-2.56	29.43	33.46
12	FLT-28 × SB-YF-425	1.87	49.33**	30.23	7.69	-9.97	22.27	-1.47	-5.11	26.04	29.96
13	SG-1 × BCS-23-18-7	1.41	19.61	6.27	-18.46	-31.83*	24.47	32.73	26.12	38.49	42.80*
14	SG-1 × GIZA-70	1.42	73.47**	37.10	-18.27	-31.67*	23.87	25.83	16.61	35.09	39.30
15	SG-1 × SB-YF-425	2.07	67.57**	44.19*	19.23	-0.32	21.53	9.86	-0.92	21.89	25.68
16	SG-2 × BCS-23-18-7	1.93	46.10**	45.36*	11.54	-6.75	22.27	-18.83	37.22**	26.04	29.96
17	SG-2 × GIZA-70	1.93	101.74**	46.84*	11.54	-6.75	21.60	-22.77*	39.10**	22.26	26.07
18	SG-2 × SB-YF-425	1.32	-4.24	-8.14	-24.04	-36.50**	21.53	-24.71*	39.29**	21.89	25.68
19	EL-4 × BCS-23-18-7	2.60	113.99**	95.49**	50.00**	25.40*	24.00	18.42	13.56	35.85	40.08
20	EL-4 × GIZA-70	2.07	143.14**	87.88**	19.23	-0.32	23.20	11.54	9.78	31.32	35.41
21	EL-4 × SB-YF-425	1.54	21.58	7.44	-11.15	-25.72*	24.27	13.22	11.56	37.36	41.63
22	CPD-462 × BCS-23-18-7	2.30	59.35**	47.75**	32.69*	10.93	21.53	6.60	2.54	21.89	25.68
23	CPD-462 × GIZA	2.38	121.02**	53.10**	37.50*	14.95	23.47	13.18	11.75	32.83	36.96
24	CPD-462 × SB-YF-425	2.36	57.86**	51.61**	36.15*	13.83	24.13	12.95	11.04	36.60	40.86
	DCH-32 (C)	1.73					17.67				
	DHB-1071 (C)	2.07					17.13				
Range	Minimum	1.32	-7.58	-16.51	-24.04	-36.50	20.93	-24.71	-8.10	18.49	22.18
	Maximum	2.60	128	95.49	50	14.95	26.00	32.73	39.29	47.17	51.75
	C.V.	16.47					18.85				
	CD at 5 %	0.48	0.43	0.50	0.50	0.50	6.89	6.24	7.21	7.21	7.21

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Sl. No	Crosses	Boll weight (g)					Number of bolls per plant				
		Mean	H_{mp}	H_{bp}	Standard heterosis over		Mean (cm)	H_{mp}	H_{bp}	Standard heterosis over	
					DCH-32	DHB-1071				DCH-32	DHB-1071
1	FLT-36 × BCS-23-18-7	3.40	-15.27**	-29.10**	-9.57	-12.06	26.67	126.85**	56.56**	-2.34	9.17
2	FLT-36 × GIZA-70	3.67	-3.80	-23.54**	-2.48	-5.17	21.83	87.01**	28.18	-20.04*	-10.62
3	FLT-36 × SB-YF-425	4.03	0.46	-15.97**	7.17	4.22	26.60	119.53**	56.16**	-2.59	8.90
4	FLT-44 × BCS-23-18-7	3.77	1.89	-9.52	0.18	-2.58	21.73	153.55**	103.75**	-20.41*	-11.03
5	FLT-44 × GIZA-70	3.33	-4.91	-20.16**	11.50	-14.04*	31.52	271.23**	195.53**	15.44	29.05**
6	FLT-44 × SB-YF-425	4.23	14.47*	1.60	11.60	9.39	24.40	173.13**	128.75**	-10.64	-0.11
7	FLT-31 × BCS-23-18-7	3.53	-7.83	-20.30**	12.49*	-8.70	27.20	118.09**	47.29**	-0.39	11.35
8	FLT-31 × GIZA-70	3.83	5.55	-13.53*	-6.11	-0.95	22.60	82.38**	22.38	-17.24	-7.48
9	FLT-31 × SB-YF-425	3.87	0.91	-12.78*	1.86	0.09	22.73	77.14**	23.10	-16.75	-6.93
10	FLT-28 × BCS-23-18-7	3.77	1.80	-9.60	2.75	-2.67	23.20	171.93**	119.14**	-15.04	-5.02
11	FLT-28 × GIZA-70	3.60	2.91	-13.60*	0.09	-6.98	26.77	216.70**	152.83**	-1.98	9.58
12	FLT-28 × SB-YF-425	4.03	9.06	-3.20	-4.34	4.22	19.52	119.45**	84.35**	-28.53**	-20.10
13	SG-1 × BCS-23-18-7	3.70	-5.13	-18.98**	-1.68	-4.39	18.13	92.81**	47.03*	-33.59**	-25.76*
14	SG-1 × GIZA-70	3.83	3.65	-16.06**	1.86	-0.95	21.74	133.17**	76.30**	-20.37*	-10.99
15	SG-1 × SB-YF-425	3.84	-1.75	-16.13**	1.77	-1.03	22.72	132.66**	84.24**	-16.78	-6.97
16	SG-2 × BCS-23-18-7	3.83	17.30**	16.18*	1.77	-1.03	23.97	163.90**	105.08**	-12.23	-1.88
17	SG-2 × GIZA-70	3.67	19.70**	11.22	-2.57	-5.25	21.07	134.03**	80.26**	-22.85*	-13.76
18	SG-2 × SB-YF-425	3.93	20.33**	19.11**	4.34	1.46	24.58	160.25**	110.30**	-10.00	0.61
19	EL-4 × BCS-23-18-7	3.83	4.45	-6.59	1.77	-1.03	24.97	182.48**	122.92**	-8.57	2.21
20	EL-4 × GIZA-70	3.57	3.03	-12.93*	-5.14	-7.75	25.33	189.25**	126.19**	-7.23	3.71
21	EL-4 × SB-YF-425	4.10	11.96*	0.08	9.03	6.03	25.80	180.40**	130.33**	-5.53	5.61
22	CPD-462 × BCS-23-18-7	3.53	0.43	-7.02	-6.20	-8.79	26.80	145.01**	74.03**	-1.86	9.72
23	CPD-462 × GIZA	3.37	1.81	-11.15	-10.36	-12.83*	25.53	135.15**	65.80**	-6.49	4.53
24	CPD-462 × SB-YF-425	4.07	15.75**	7.11	8.06	5.08	34.00	200.88**	120.78**	24.51*	39.19**
	DCH-32 (C)	3.82					27.31				
	DHB-1071 (C)	3.85					24.43				
Range	Minimum	3.33	-15.27	-29.10	-10.36	-12.83	18.13	77.14	22.38	-33.59	-25.76
	Maximum	4.10	20.33	19.11	12.49	9.39	34.00	271.23	195.53	24.51	39.19
	C.V.	10.03					14.81				
	CD at 5 %	0.62	0.41	0.46	0.46	0.46	5.04	4.58	5.29	5.29	5.29

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Sl. No	Crosses	Sympodial length at 50 % plant height					Ginning outturn (%)				
		Mean	H_{mp}	H_{bp}	Standard heterosis over		Mean (cm)	H_{mp}	H_{bp}	Standard heterosis over	
					DCH-32	DHB-1071				DCH-32	DHB-1071
1	FLT-36 × BCS-23-18-7	50.11	23.90*	17.14	0.67	13.03	29.05	-12.67**	-14.66**	-10.29	-10.86*
2	FLT-36 × GIZA-70	56.00	41.17**	35.85**	12.50	26.32*	26.81	-17.55**	-21.24**	-17.21**	-17.74**
3	FLT-36 × SB-YF-425	47.44	18.94	13.86	-4.67	7.02	33.13	-5.97	-9.07	2.32	1.67
4	FLT-44 × BCS-23-18-7	55.45	25.70**	22.01*	11.39	25.07*	30.03	-9.87*	-12.06*	-7.27	-7.86
5	FLT-44 × GIZA-70	46.56	7.44	2.45	-6.47	5.02	27.25	-16.33**	-20.20**	-15.84**	-16.38**
6	FLT-44 × SB-YF-425	44.89	41.58**	35.70**	23.89*	39.10**	31.35	-11.16**	-13.95**	-3.18	-3.79
7	FLT-31 × BCS-23-18-7	56.22	36.02**	31.43**	12.95	26.82*	30.70	-10.38*	-14.77**	-5.21	-5.81
8	FLT-31 × GIZA-70	48.33	19.17	17.25	-2.90	9.02	29.67	-11.46*	-17.63**	-8.39	-8.97
9	FLT-31 × SB-YF-425	47.55	16.61	14.13	-4.47	7.26	33.86	-6.54	-7.08	4.55	3.89
10	FLT-28 × BCS-23-18-7	47.56	13.08	11.17	-4.46	7.27	31.08	-5.28	-6.19	-4.03	-4.64
11	FLT-28 × GIZA-70	51.56	24.90*	24.73*	3.58	16.29	30.07	-6.22	-9.24	-7.15	-7.74
12	FLT-28 × SB-YF-425	53.89	29.86**	29.34*	8.26	21.56	30.75	-11.60**	-15.62**	-5.05	-5.66
13	SG-1 × BCS-23-18-7	51.67	31.36**	20.78	3.80	16.54	32.41	-5.67	-10.52*	0.07	-0.56
14	SG-1 × GIZA-70	51.56	33.72**	25.07*	3.58	16.29	31.58	-6.03	-12.80**	-2.48	-3.10
15	SG-1 × SB-YF-425	61.67	15.76	7.74	-9.82	1.26	31.48	-13.35**	-13.61**	-2.80	-3.42
16	SG-2 × BCS-23-18-7	48.00	12.07	11.92	-3.57	8.27	32.40	-5.82	-10.79*	0.06	-0.57
17	SG-2 × GIZA-70	54.67	29.99**	27.47*	9.82	23.31*	28.86	-14.27**	-20.56**	-10.89*	-11.46*
18	SG-2 × SB-YF-425	54.67	29.31**	27.48*	9.83	23.32*	31.37	-13.76**	-13.90**	-3.12	-3.73
19	EL-4 × BCS-23-18-7	45.22	2.39	-0.73	-9.15	2.01	30.93	-7.21	-9.49	-4.50	-5.10
20	EL-4 × GIZA-70	45.45	4.74	-0.24	-8.70	2.51	28.20	-13.45**	-17.47**	-12.92*	-13.47*
21	EL-4 × SB-YF-425	60.67	39.11**	33.17**	21.88*	36.84**	30.02	-14.97**	-17.61**	-7.30	-7.89
22	CPD-462 × BCS-23-18-7	42.11	9.23	-1.56	-15.40	-5.02	31.15	-9.12*	13.63**	-3.80	-4.41
23	CPD-462 × GIZA	49.22	23.40*	19.41	-1.11	11.03	29.37	-12.41**	-18.57**	-9.31	-9.88
24	CPD-462 × SB-YF-425	48.55	21.05*	16.53	-2.46	9.52	31.70	-12.56**	-13.00**	-2.11	-2.73
	DCH-32 (C)	49.78					32.38				
	DHB-1071 (C)	44.33					32.59				
Range	Minimum	42.11	2.39	-0.73	-15.40	-5.02	26.81	-17.55	-21.24	-17.21	-17.74
	Maximum	60.67	41.58	35.85	23.89	39.10	33.86	-5.28	13.63	4.55	3.89
	C.V.	12.05					6.33				
	CD at 5 %	9.36	8.37	9.67	9.67	9.67	3.28	2.88	3.33	3.33	3.33

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Sl. No	Crosses	Seed index (g)					Lint index (g)				
		Mean	H_{mp}	H_{bp}	Standard heterosis over		Mean (cm)	H_{mp}	H_{bp}	Standard heterosis over	
					DCH-32	DHB-1071				DCH-32	DHB-1071
1	FLT-36 × BCS-23-18-7	10.84	-3.19	-6.47	-9.278	-7.88	4.43	-20.95**	-21.30*	-22.45**	-22.67**
2	FLT-36 × GIZA-70	13.79	21.60**	16.04**	15.49**	17.26**	5.08	-719	-9.01	-11.14	-11.40
3	FLT-36 × SB-YF-425	12.78	9.94**	2.68	6.98	8.61*	6.34	-0.26	-11.12	10.96	10.64
4	FLT-44 × BCS-23-18-7	12.57	17.76**	8.46*	5.22	6.83	5.40	0.78	-4.08	-5.48	-5.76
5	FLT-44 × GIZA-70	12.03	11.20**	1.23	0.75	2.30	4.51	-13.65	-15.85	-21.05*	-21.28*
6	FLT-44 × SB-YF-425	13.35	20.27**	7.29	11.78**	13.49**	6.10	-0.22	-14.53*	6.71	6.40
7	FLT-31 × BCS-23-18-7	12.56	13.01**	8.43	5.19	6.80	5.57	-4.21	-7.16	-2.51	-2.79
8	FLT-31 × GIZA-70	13.77	22.19**	15.82**	15.27**	17.03**	5.80	2.11	-3.33	1.52	1.22
9	FLT-31 × SB-YF-425	13.08	13.32**	5.14	9.55*	11.22**	6.72	2.33	-5.79	17.61*	17.27*
10	FLT-28 × BCS-23-18-7	13.38	19.48**	15.51**	12.06**	13.77**	6.07	10.46	7.81	6.24	5.93
11	FLT-28 × GIZA-70	13.32	17.37**	12.09**	11.55**	13.26**	5.72	6.71	6.71	0.12	-0.17
12	FLT-28 × SB-YF-425	14.42	23.96**	15.86**	20.71**	22.56**	6.41	2.61	-10.14	12.19	11.86
13	SG-1 × BCS-23-18-7	12.41	6.64	6.16	3.94	5.53	5.97	-2.69	-10.09	4.49	4.19
14	SG-1 × GIZA-70	12.20	3.45	2.61	2.12	3.68	5.64	-6.11	-15.15*	-1.40	-1.69
15	SG-1 × SB-YF-425	13.36	10.73**	7.39	11.89**	13.60**	6.18	-10.26	-13.36	8.16	7.85
16	SG-2 × BCS-23-18-7	12.19	10.11*	5.24	2.09	3.66	5.88	0.86	-2.38	2.80	2.50
17	SG-2 × GIZA-70	12.76	13.66**	7.32	6.81	8.44*	5.18	-9.05	-14.01	-9.45	-9.71
18	SG-2 × SB-YF-425	12.98	12.85**	4.31	8.68*	10.34*	5.93	-9.86	-16.91*	3.73	3.43
19	EL-4 × BCS-23-18-7	13.10	17.70**	13.06**	9.68*	11.36**	5.86	4.89	4.02	2.51	2.21
20	EL-4 × GIZA-70	13.36	18.41**	12.37**	11.83**	13.54**	5.26	-3.52	-5.05	-7.99	-8.26
21	EL-4 × SB-YF-425	13.86	19.88**	11.36**	16.02**	17.80**	5.94	-6.34	-16.81*	3.85	3.55
22	CPD-462 × BCS-23-18-7	12.04	9.45*	3.94	0.84	2.38	5.48	-4.83	-6.90	-4.08	-4.36
23	CPD-462 × GIZA	12.19	9.26*	2.52	2.04	3.60	5.09	-9.60	-13.64	-11.02	-11.28
24	CPD-462 × SB-YF-425	12.95	13.25**	4.04	8.40*	10.06*	6.01	-7.68	-15.74*	5.19	4.88
	DCH-32 (C)	11.94					5.72				
	DHB-1071 (C)	11,76					5.73				
Range	Minimum	10.84	-3.19	-6.47	-9.27	-7.88	4.43	-20.95	-21.30	-22.45	-22.67
	Maximum	13.86	23.96	15.86	20.71	22.56	6.72	10.46	7.81	17.61	17.27
	C.V.	4.72					10.19				
	CD at 5 %	0.94	0.84	0.97	0.97	0.97	0.95	0.83	0.95	0.95	0.95

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Sl. No	Crosses	Seed cotton yield (kg/ha)				
		Mean	H_{mp}	H_{bp}	Standard heterosis over	
					DCH-32	DHB-1071
1	FLT-36 × BCS-23-18-7	607.65	-4.94	-44.07**	1.24	-1.97
2	FLT-36 × GIZA-70	364.78	-41.35**	-66.43**	-39.23**	-41.15**
3	FLT-36 × SB-YF-425	875.45	32.66**	-19.42**	45.85**	41.23**
4	FLT-44 × BCS-23-18-7	626.30	29.19*	-19.46	4.34	1.04
5	FLT-44 × GIZA-70	403.25	-13.74	-48.14**	-32.82*	-34.94**
6	FLT-44 × SB-YF-425	559.89	10.76	-28.00**	6.72	-9.67
7	FLT-31 × BCS-23-18-7	759.30	18.52	-30.30**	26.50*	22.50
8	FLT-31 × GIZA-70	469.71	-24.65*	-56.88**	-21.75	-24.22
9	FLT-31 × SB-YF-425	814.71	23.19*	-25.21**	35.73**	31.44*
10	FLT-28 × BCS-23-18-7	573.07	23.59	-22.0*	-4.52	-7.55
11	FLT-28 × GIZA-70	469.30	5.13	-36.18**	-21.81	-24.29
12	FLT-28 × SB-YF-425	430.01	-11.23	-41.53**	-28.36*	-30.63*
13	SG-1 × BCS-23-18-7	514.30	52.60*	6.68	-14.32	-17.03
14	SG-1 × GIZA-70	698.26	118.39**	44.84**	16.33	12.65
15	SG-1 × SB-YF-425	491.26	37.32	1.90	-18.15	-20.75
16	SG-2 × BCS-23-18-7	732.90	154.72**	91.11**	22.10	18.24
17	SG-2 × GIZA-70	539.67	99.56**	40.72	-10.09	-12.94
18	SG-2 × SB-YF-425	730.41	136.80**	90.46**	21.69	17.84
19	EL-4 × BCS-23-18-7	338.50	-13.91	-43.05**	-43.61**	-45.39**
20	EL-4 × GIZA-70	465.23	23.77	-21.73	-22.49	-24.95
21	EL-4 × SB-YF-425	654.42	58.11**	10.09	9.03	5.58
22	CPD-462 × BCS-23-18-7	753.56	74.71**	12.36	25.55	21.57
23	CPD-462 × GIZA	515.15	24.43	-23.19	-14.17	-16.89
24	CPD-462 × SB-YF-425	1239.38	174.18**	84.80**	106.48**	99.95**
	DCH-32 (C)	600.22				
	DHB-1071 (C)	619.85				
Range	Minimum	338.50	-41.35	66.43	-43.61	-45.39
	Maximum	1239.38	174.18	84.80	106.48	99.95
	C.V.	15.65				
	CD at 5 %	154.07	135.77	156.78	156.78	156.78

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