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PERFORMANCE OF PARENTS AND THEIR HYBRIDS FOR YIELD AND ITS ATTRIBUTING TRAITS IN UPLAND COTTON (*GOSSYPIUM HIRSUTUM* L.)

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ABSTRACT

The present experiment was undertaken to evaluate 9 cotton genotypes and their 72 hybrid combinations for different yield parameters. Significance of variance in parents versus hybrids interaction provides adequacy for comparing the heterotic expression for all the characters except boll weight (0.02), ginning per cent (0.672), lint index (0.002) and seed index (2.66). Based on *per se*, parent MCU 5 possessed favourable mean values for five characters *viz*., single plant yield (87.34g/plant), boll weight (4.55g/boll), number of sympodial branches (20.09), number of bolls (24.50) and ginning per cent (34.68%). Anjali, Surabhi and MCU 7 registered significantly desirable mean values for two characters each. Hence, the above parents can be utilized for recombination breeding or pedigree breeding to improve the traits of interest. Superior mean performance for single plant yield was recorded in hybrid MCU 5 x MCU 7 (115.01g) followed by KC 2 x MCU 5 (109.63g), Anjali x MCU 5 (108.32g), Anjali x Suraj (104.64g), KC 3 x Anjali (102.65g), Khandwa 2 x Suraj (102.17g), Surabhi x Anjali (102.15g), Suraj x Surabhi (101.28g) and G.Cot 16 x Khandwa 2 (101.06g). These crosses can be advanced further and selection of desirable plant types can be made in later generations.

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INTRODUCTION

Cotton is the world's leading natural fibre crop and it is a cornerstone for textile industries worldwide. The cultivated tetraploid species *G. hirsutum*, also referred to as "upland cotton", accounts for about 95% of the global cotton production. Consequently, a great majority of world-wide cotton breeding programs have been focusing on improving upland cotton. With the increasing global demand for textile products, intense competition from synthetic fibres and textile industry's modernization by shifting to high-speed spinning technologies, the need for higher yielding upland cotton cultivars with improved fibre quality has never been more critical (Meredith, 2005). In breeding high yielding varieties of crop plants for quantitative and qualitative traits, plant breeders often faces the problem of selecting parents and crosses. Hybridization programme has been carried out to create variability for making selections. Knowledge on genetic architecture of parents, in terms of yield and quality related characters would help in identifying superior cross combinations in early generation itself.

Evaluation of genotypes is a pre-requisite for their utilization and detailed evaluation which determines the potential of genotypes in specific crop improvement programme (Jatoi *et al.*, 2010; Laxman, 2010; Patil *et al.*, 2011; Imran *et al.*, 2012 and Javaid *et al.*, 2014). Therefore, present study objective was to estimate mean performance of parents and their hybrids, to identify the potential genotypes and hybrid combinations for different yield attributing traits through 9 x 9 diallel analysis.

MATERIALS AND METHODS

This study was carried out to evaluate the *per se* performance of parents and their hybrids for yield and its attributing traits in upland cotton that was conducted during 2012-14 at the Department of Cotton, TNAU, Coimbatore. Nine parental genotypes (Suraj, Surabhi, Khandwa 2, Anjali, KC 2, KC 3, MCU 5, MCU 7 and G.Cot 16) were raised during winter 2012-2013 and also they were crossed in a complete diallel fashion. The conventional hand emasculation and pollination method developed by Doak (1934) was followed. During winter 2013-14, the parents and their seventy two F_1s were raised in a Randomized Block Design with two replications. The package of practices recommended for the cotton cultivation in Tamil Nadu was followed throughout the crop growing period. In each genotypes and their cross combinations, data were recorded on five randomly selected plants per replication for eight characters namely, plant height (cm), number of sympodial branches per plant, number of bolls per plant, boll weight (g), single plant yield (g), ginning per cent (%), lint index and seed index. The means were computed for statistical analysis using the analysis of variance technique to determine significant differences among genotypes for the traits.

RESULTS AND DISCUSSION

Analysis of variance showed highly significant differences due to genotypes for all

Table 1: Analysis of variance showing means square for yield and its attributing traits

Source	d.f	Plant height (cm)	Number of sympodial branches per plant	Number of bolls per plant	Boll weight (g)	Single plant yield (g)	Ginning percent (%)	Lint index	Seed index
Genotypes	80	358.857 **	6.747 **	14.823 **	0.255 **	277.862 **	23.179 **	0.644 **	2.368 **
Parents	8	156.155 **	11.733 **	6.476	0.186	47.231	3.712 **	0.391	1.928
Hybrids	71	374.639 **	6.023 *	14.205 **	0.266 **	296.090 **	25.690 **	0.682 **	2.414 **
Parents V_s Hybrids	1	859.956 **	18.257 *	125.434 **	0.015	828.759 **	0.672	0.002	2.660
F_1's	35	320.599 **	6.306 *	14.577 **	0.330 **	350.116 **	23.748 **	0.561 **	2.126 *
Reciprocals	35	405.372 **	5.893 *	14.043 *	0.207	248.219 **	28.337 **	0.798 **	2.711 **
F_{1Vs} reciprocals	1	1190.365 **	0.703	6.860	0.093	80.655	1.015	0.853	2.052
Error	80	14.072	3.554	7.565	0.140	41.255	0.629	0.243	1.151
Total	161	185.401	5.147	11.207	0.197	158.652	11.830	0.442	1.761

**Significant at 1 % level, *Significant at 5 % level

Table 2: Mean performance of parents for yield and its attributing traits in *Gossypium hirsutum* L.

Parents	Plant height (cm)	Number of sympodial branches per plant	Number of bolls per plant	Boll weight (g)	Single plant yield (g)	Ginning percent (%)	Lint index	Seed index
Suraj	95.03	12.50	20.00	4.51	76.60	34.50	5.35	10.14
Surabhi	103.80	15.50	20.10	4.29	80.06	33.85	4.87	9.46
Khandwa 2	96.10	12.10	18.50	3.91	75.14	30.76	4.14	9.32
Anjali	110.53	15.00	22.00	4.47	85.09	34.04	5.26	7.74
KC 2	93.70	15.63	19.50	4.34	78.70	33.03	5.17	10.47
KC 3	99.40	14.70	22.40	3.87	81.06	35.31	5.48	10.04
MCU 5	114.90	20.09	24.50	4.55	87.34	34.68	5.11	9.63
MCU 7	101.88	17.00	21.60	3.75	84.90	32.49	5.11	10.61
G.Cot 16	86.07	13.67	20.80	4.01	73.10	33.80	5.70	11.15
Grand mean	100.16	15.13	21.06	4.19	80.22	33.61	5.13	9.84
CD @ 5%	2.59	2.39	4.31	0.45	3.62	1.69	1.51	3.45
CD @ 1%	3.76	3.48	6.23	0.66	5.27	2.46	2.20	5.02

the traits indicating the presence of sufficient variability in the experimental materials (Table 1). Significance of variance in parents versus hybrids interaction provides adequacy for comparing the heterotic expression for all the characters except boll weight, ginning per cent, lint index and seed index. Parents and hybrids showed significant differences between all the characters studied except number of bolls, boll weight, single plant yield, lint index and seed index. It was also confirmed by the results reported in earlier studies of Jatoi *et al.* (2010) for its boll weight and Kumar *et al.* (2014) for its single plant yield.

Information on the *per se* performance of characters is necessary for selection of suitable parents for developing hybrids. Gilbert (1958) suggested that parents with high mean performance would be much useful in producing better offsprings in any breeding programme. In the present investigation, nine parents and their resultant 72 F_1 hybrids varies significantly each other in its yield components. The *per se* performance of parents for yield (Fig. 1) and its component traits are presented in Table 2 and compared with grand mean. The plant height ranged from 86.07 cm (G.Cot 16) to 114.90 cm (MCU 5). The genotype MCU 5 which recorded maximum plant height (114.90 cm) also had higher number of sympodial branches (20.09). Taller plants with higher number of sympodial branches were earlier recorded by Khan (2013) and Ashokkumar *et al.* (2013). The higher and lower number of bolls per plant was recorded in MCU 5 (24.50) and Khandwa 2 (18.50) respectively, similarly the boll weight was least in genotype MCU 7 (3.75 g). Single plant yield varied from G.Cot 16 (73.10 g) to MCU 5 (87.34 g) with the mean single plant yield of 80.22 g. The higher lint and seed index were noticed in genotype G.Cot 16. Maximum ginning per cent was recorded in genotype KC 3 (35.31 %) followed by MCU 5 (34.68 %).

Based on *per se*, parent MCU 5 possessed favourable mean values for five characters *viz.,* single plant yield (87.34 g/plant), boll weight (4.55 g/boll), number of sympodial branches per plant (20.09), number of bolls per plant (24.50) and ginning per cent (34.68%); Anjali possessed favourable mean values for four characters namely plant height, number of bolls per plant, boll weight and single plant yield and KC 3 for number of bolls per plant, ginning per cent and lint index; MCU 7 possessed favourable mean values for single plant yield and seed index; G.Cot 16 registered superior mean values for two characters and Suraj for three characters. None of the parents were found to be high *per se* for all the traits.

Considering the mean performance of all the parents for different traits, MCU 5 had recorded significantly superior mean values for four traits studied. This was followed by Anjali, Surabhi and MCU 7 registered significantly desirable mean values for two characters each. In general, high mean values remain as selection index in the choice of parents and the

Table 3: Mean performance of hybrids for yield and its attributing traits in *Gossypium hirsutum* L.

S. No.	Hybrids	Plant height (cm)	Sympodial branches/ plant	Number of bolls per plant	Boll weight (g)	Single plant yield (g)	Ginning percent (%)	Lint index	Seed index
1	Suraj X Surabhi	100.27	17.90	22.00	4.75	101.28	31.38	5.09	11.13
2	Suraj X Khardwa 2	89.90	13.70	24.40	4.11	98.21	32.31	5.03	10.54
3	Suraj X Anjali	69.30	12.90	19.60	4.83	83.11	36.27	5.23	9.19
4	Suraj X KC 2	87.60	15.50	19.50	4.78	91.28	33.61	5.33	10.52
5	Suraj X KC 3	74.60	13.90	24.90	3.74	76.79	32.79	5.11	10.47
6	Suraj X MCU 5	120.00	18.50	25.50	4.15	100.16	34.83	5.21	9.77
7	Suraj X MCU 7	83.90	16.20	22.90	4.59	83.38	37.48	5.83	8.89
8	Suraj X G.cot 16	107.35	14.10	23.80	4.91	96.17	34.23	5.41	10.43
9	Surabhi X Suraj	99.25	14.00	24.13	3.88	74.28	34.35	4.98	9.51
10	Surabhi X Khardwa 2	91.50	16.80	26.30	3.79	85.77	29.08	4.40	10.71
11	Surabhi X Anjali	103.67	18.50	27.77	4.22	102.15	31.52	4.60	10.09
12	Surabhi X KC 2	96.47	13.50	24.90	4.01	71.84	36.75	5.22	9.01
13	Surabhi X KC 3	101.20	20.00	25.50	4.35	93.83	32.68	5.24	10.76
14	Surabhi X MCU 5	100.38	16.00	24.00	4.18	77.98	35.64	5.86	10.61
15	Surabhi X MCU 7	98.40	14.60	25.50	4.50	94.42	33.73	5.17	10.15
16	Surabhi X G.cot 16	81.80	16.90	22.80	3.90	87.00	34.29	4.99	9.57
17	Khardwa 2 X Suraj	92.90	16.50	30.30	4.33	102.17	35.36	5.29	9.68
18	Khardwa 2 X Surabhi	101.50	18.50	25.50	4.11	93.31	34.45	5.43	10.32
19	Khardwa 2 X Anjali	89.27	17.60	27.37	3.93	85.05	36.23	5.42	9.53
20	Khardwa 2 X KC 2	93.70	15.50	20.40	4.05	79.11	26.95	3.68	9.95
21	Khardwa 2 X KC 3	79.88	16.71	21.08	3.78	67.34	35.09	4.79	8.83
22	Khardwa 2 X MCU 5	101.60	19.20	21.50	3.80	94.26	32.88	5.03	10.26
23	Khardwa 2 X MCU 7	80.23	16.08	21.43	4.37	76.88	32.35	5.61	11.74
24	Khardwa 2 X G.cot 16	86.20	15.50	21.30	4.03	78.08	30.36	4.61	10.56
25	Anjali X Suraj	111.15	17.70	25.50	4.89	104.64	37.37	6.20	10.38
26	Anjali X Surabhi	77.25	15.55	24.95	4.17	77.47	31.10	4.81	10.64
27	Anjali X Khardwa 2	82.27	14.80	21.60	4.26	69.45	37.44	5.55	9.35
28	Anjali X KC 2	71.70	17.20	21.80	4.92	81.00	30.32	4.92	11.30
29	Anjali X KC 3	105.24	16.50	24.50	3.63	70.89	30.80	4.53	10.18

Table 3: Cont....

S. No.	Hybrids	Plant height (cm)	Sympodial branches/ plant	Number of bolls per plant	Boll weight (g)	Single plant yield (g)	Ginning percent (%)	Lint index	Seed index
30	Anjali X MCU 5	110.91	18.40	28.50	4.09	108.32	30.52	4.83	10.99
31	Anjali X MCU 7	74.70	17.10	23.00	3.97	100.17	37.18	5.41	8.89
32	Anjali X G.cot 16	68.10	15.70	21.00	4.34	71.42	30.98	4.67	10.40
33	KC 2 X Suraj	112.16	17.10	26.70	4.78	95.36	33.05	5.21	10.55
34	KC 2 X Surabhi	105.53	17.50	25.00	4.79	98.54	25.00	4.31	12.90
35	KC 2 X Khardwa 2	85.70	15.70	27.40	4.27	86.31	34.82	4.91	9.28
36	KC 2 X Anjali	106.15	14.70	21.50	4.68	77.98	26.24	4.30	12.11
37	KC 2 X KC 3	90.90	17.10	24.30	4.22	85.58	37.46	5.50	8.59
38	KC 2 X MCU 5	101.84	18.60	27.00	3.69	109.63	31.13	4.37	9.66
39	KC 2 X MCU 7	87.40	16.50	21.90	4.97	95.30	35.43	4.68	8.52
40	KC 2 X G.cot 16	72.68	13.83	20.50	4.27	72.16	32.70	5.75	11.83
41	KC 3 X Suraj	71.80	14.80	21.90	4.56	73.32	37.40	5.75	9.51
42	KC 3 X Surabhi	97.30	14.10	23.40	3.55	68.83	33.26	5.33	10.68
43	KC 3 X Khardwa 2	93.90	15.00	23.50	3.90	94.71	28.06	4.01	10.28
44	KC 3 X Anjali	123.20	19.60	27.00	4.18	102.65	37.45	6.18	9.81
45	KC 3 X KC 2	120.90	19.10	25.50	3.63	96.09	33.03	5.73	11.61
46	KC 3 X MCU 5	77.10	15.20	26.20	3.94	77.61	36.93	5.33	9.10
47	KC 3 X MCU 7	98.40	18.20	27.50	4.58	97.72	36.31	5.96	10.46
48	KC 3 X G.cot 16	75.30	15.10	24.30	3.67	71.63	23.98	4.21	13.32
49	MCU 5 X Suraj	90.70	15.50	27.10	4.57	95.12	34.94	5.91	11.01
50	MCU 5 X Surabhi	118.30	19.50	22.40	4.28	89.21	31.11	5.68	12.58
51	MCU 5 X Khardwa 2	94.98	14.60	24.57	4.22	88.20	36.07	5.93	10.51
52	MCU 5 X Anjali	83.57	16.97	20.77	4.55	94.75	32.62	5.00	10.33
53	MCU 5 X KC 2	92.30	14.54	19.88	4.10	86.42	29.43	4.36	10.43
54	MCU 5 X KC 3	88.10	17.30	20.40	4.06	77.08	36.79	5.82	10.03
55	MCU 5 X MCU 7	86.97	17.50	28.20	4.39	115.01	30.19	4.55	10.55

Table 3: Cont....

S. No.	Hybrids	Plant height (cm)	Sympodial branches/ plant	Number of bolls per plant	Boll weight (g)	Single plant yield (g)	Ginning percent (%)	Lint index	Seed index
56	MCU 5 X G.cot 16	91.36	14.50	19.70	3.38	81.56	37.49	5.78	8.76
57	MCU 7 X Suraj	77.10	17.70	21.70	3.98	94.01	33.34	4.84	9.67
58	MCU 7 X Surabhi	94.90	16.20	23.80	4.33	76.14	27.45	3.91	10.33
59	MCU 7 X Khardwa 2	85.40	16.50	24.80	4.07	96.20	36.35	5.74	10.04
60	MCU 7 X Anjali	107.45	18.50	28.00	4.53	100.66	36.51	5.43	9.46
61	MCU 7 X KC 2	105.92	14.60	21.80	3.99	97.22	36.82	4.97	8.00
62	MCU 7 X KC 3	89.85	16.13	20.63	3.76	65.32	32.21	4.83	10.18
63	MCU 7 X MCU 5	117.25	15.50	26.50	4.43	99.25	37.42	4.42	7.40
64	MCU 7 X G.cot 16	88.40	14.70	19.70	4.14	58.02	31.04	4.24	9.41
65	G.cot 16 X Suraj	75.60	15.10	21.80	4.18	71.28	30.28	5.46	12.57
66	G.cot 16 X Surabhi	84.77	12.20	19.70	4.11	79.60	28.65	4.61	11.49
67	G.cot 16 X Khardwa 2	112.20	16.30	24.80	4.03	101.06	35.59	5.61	10.17
68	G.cot 16 X Anjali	92.37	16.80	24.20	4.53	89.30	36.72	5.70	9.82
69	G.cot 16 X KC 2	72.85	15.10	25.95	4.21	82.18	32.35	5.61	11.74
70	G.cot 16 X KC 3	99.83	13.80	20.50	4.70	86.97	35.83	5.31	9.50
71	G.cot 16 X MCU 5	104.31	17.50	25.50	4.02	98.28	26.54	4.14	11.46
72	G.cot 16 X MCU 7	76.50	15.70	27.60	4.15	90.67	37.10	5.86	9.93
	Grand mean	92.82	16.20	23.83	4.22	87.42	33.27	5.12	10.25
	CD @ 5%	7.90	3.91	5.41	0.77	13.53	1.60	0.95	2.03
	CD @ 1%	10.48	5.20	7.18	1.02	17.96	2.13	1.26	2.69

parents possessing high *per se* performance will result in superior hybrids. Therefore, these parents can be exploited in hybridization for improving concerned character through pedigree breeding as reported by Gul Hassan *et al.* (2000).

Hybridization is carried out to combine the favourable genes from different parent into a single genotype. These hybrids are utilized in two ways either directly using the F_1's to exploit the hybrid vigour or forwarding to further generations and selecting the superior individuals after attaining homozygosity. The utilization of hybrids in anyone of the two ways will depend upon the genetic constitution of the parents as well as the hybrids. The primary criterion to evaluate a hybrid is its mean performance. Kadambavanasundaram (1980) and Nadarajan (1986) reported that *per se* performance of hybrids appeared to be useful index for judging the hybrids. Pali and Mehta (2014) suggested that parents with good *per se* performance would result in good hybrids.

The *per se* performance of hybrids for yield and its component traits are presented in Table 3. Among the hybrids, plant height ranged from 68.10 cm (Anjali x G.Cot 16) to 123.20 cm (KC 3 x Anjali). The higher and lower number of sympodial branches per plant was recorded in G.Cot 16 x Surabhi (12.20) and Surabhi x KC 3 (20.00) respectively. Among the hybrids, number of bolls per plant ranged from 19.50 (Suraj x KC 2) to 30.30 (Khandwa 2 x Suraj). Out of seventy two hybrids, only one hybrid showed significantly higher number of bolls when compared to the grand mean. Boll weight of the hybrids varied from 3.38 g (MCU 5 x G.Cot 16) to 4.97 g (KC 2 x MCU 7).

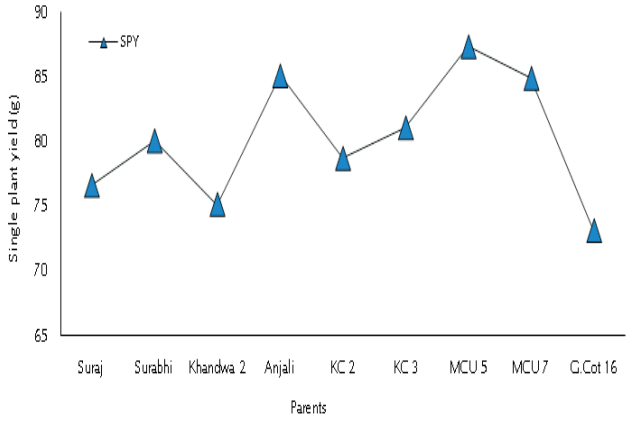

Figure 1: Mean performance of parents for single plant yield

Superior mean performance for single plant yield was recorded in genotype MCU 5 x MCU 7 (115.01 g) followed by KC 2 x MCU 5 (109.63 g), Anjali x MCU 5 (108.32 g), Anjali x Suraj (104.64 g), KC 3 x Anjali (102.65 g), Khandwa 2 x Suraj (102.17 g), Surabhi x Anjali (102.15 g), Suraj x Surabhi (101.28 g) and G.Cot 16 x Khandwa 2 (101.06 g). Among the above hybrids, Anjali x Suraj and KC 3 x Anjali showed desirable mean performance for seven and six yield contributing traits respectively. The hybrids MCU 5 x MCU 7, KC 2 x MCU 5, Anjali x MCU 5 and G.Cot 16 x Khandwa 2 showed superior mean performance for five different yield characters. The hybrids Suraj x Surabhi and Surabhi x Anjali showed superior mean performance for four characters. The higher lint and seed index were noticed in Anjali x Suraj (6.20) and KC 3 x G.Cot 16 (13.32) respectively.

Therefore in the present study, based on the mean performance, Suraj x Surabhi, Surabhi x Anjali, Khandwa 2 x Suraj, Anjali x Suraj, Anjali x MCU 5, KC 2 x MCU 5, KC 3 x Anjali, MCU 5 x MCU 7, G.Cot 16 x Khandwa 2 were considered as best ones for improving yield and its yield contributing traits.

REFERENCES

Ashokkumar, K., Senthil Kumar, K. and Ravikesavan, R. 2013. Heterosis studies for fibre quality of upland cotton in line x tester design. *Afr. J.*

Agric. Res. **8(48):** 6359-6365.

Doak, C. C. 1934. A new technique in hybridizing suggested changes in existing methods of emasculation and bagging cotton flowers. *J. Hered.* **25:** 201-204.

Gilbert, N. E. G. 1958. Diallel cross in plant breeding. *Heredity*. **12:** 477-498.

Gul Hassen, G., Mahmood, A., Razaq and Hayatullah. 2000. Combining ability in inter-varietal crosses of upland cotton. *Sarhad J. Agric.* **16:** 407-410.

Imran, M., Shakeel, A., Azhar, F. M., Farooq, J., Saleem, M. F., Saeed, A., Nazeer, W., Riaz, M., Naeem, M. and Javaid, A. 2012. Combining ability analysis for within-boll yield components in upland cotton (*Gossypium hirsutum* L.). *Genet. Mol. Res.* **11(3):** 2790-2800.

Jatoi, W. A., Baloch, M. J., Khan, N. U., Veesar, N. F. and Batool, S. 2010. Identification of potential parents and hybrids in intra-specific crosses of upland cotton. *Sarhad J. Agric.* **26(1):** 25-30.

Javaid, A., Azhar, F. M., Khan, I. A. and Rana, S. A. 2014. Genetic basis of some yield components in *Gossypium hirsutum* L. *Pak. J. Agri. Sci.* **51(1):** 143-146.

Kadambavanasundaram, M. 1980. Combining ability as related to gene action in cotton (*Gossypium hirsutum* L.). *Ph.D. Thesis*, TNAU, Coimbatore.

Khan, N. U. 2013. Combining ability analysis in intra specific F_1 diallel cross of upland cotton. *Agronomy*. **6:** 289-295.

Kumar, K. S., Ashokkumar, K. and Ravikesavan, R. 2014. Genetic effects of combining ability studies for yield and fibre quality traits in diallel crosses of upland cotton (*Gossypium hirsutum* L.). *Afr. J. Biotechnol.* **13(1):** 119-126.

Laxman, S. 2010. Diallel analysis for combining ability for seed cotton yield and its components in desi cotton (*Gossypium arboreum* L.). *J. Cotton Res. Dev.* **24:** 26-28.

Meredith, W. R. 2005. Registration of MD 52ne high fiber quality cotton germplasm and recurrent parent MD 90ne. *Crop Sci.* **45:** 806-807.

Nadarajan, N. 1986. Genetic analysis of fibre characters in *Gossypium hirsutum* L. *Ph.D. Thesis*, TNAU, Coimbatore.

Pali, V. and Mehta, N. 2014. Combining ability and heterosis for seed yield and it's attributes in linseed (*Linum usitatissimum* L.). *The Bioscan.* **9(2):** 701-706.

Patil, S. A., Naik, M. R. and Patil, A. B. 2011. Line x tester analysis for seed cotton yield and fibre quality traits in *Gossypium hirsutum* L. *Plant Archives.* **11(1):** 525-528.