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RESEARCH ARTICLE

Combining ability studies for fibre quality traits in upland cotton (*Gossypium hirsutum* L.)

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SUMMARY

An investigation was carried out to assess the combining ability and nature of gene action in respect of seed cotton yield and its component traits in 54 new hybrids developed by crossing 9 lines with 6 testers of upland cotton in line × tester mating design in Randomized Block Design with two replications during *Kharif* 2010 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The variance among the lines (2.5 % span length and micronaire), testers and line × tester interaction (2.5 % span length, fibre strength and micronaire) were highly significant for the characters indicating predominance of non-additive gene action in genetic control of these traits. Magnitude of sca variance was higher than the gca variance for majority of the traits. The ratio of gca/ sca variance indicated preponderance of non-additive type of gene action, which is an integral component of the genetic architecture of different characters in the material used in cotton. L_1 and L_9 among the lines and T_1 and T_2 among the testers were identified as good general combiners indicating their ability in transmitting additive genes in the desirable direction to their progenies. Highly significant *sca* effects were observed in most of the hybrids for all the characters studied and good specific combiners for different characters involved parents with high × high, high × low, low × high and low × low general combinations.

Key Words : Combining ability, Upland cotton, Span length, Fibre strength

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With the advent of modern ginning and spinning systems, the textile industry demands an optimum combination of values of fibre properties suitable for every class of fibre length. Thus, the demands of modern spinning system have imposed the breeders to realign breeding strategies to develop productive genotypes having optimum fibre strength matching the length and counts for which the yarn is spun. Thus, the improvement of a new variety with high yield and fiber quality parameters is the unique target of all cotton breeders.

In any plant breeding programme, selection of parents on the basis of phenotypic performance alone is not a sound procedure, since phenotypically superior lines may yield poor recombinants in the segregating generations. It is, therefore, essential that parents should be chosen on the basis of their combining ability effects (Sprague and Tatum, 1942). Combining ability provides necessary information on nature and magnitude of gene action involved which helps for selection of parents for breeding programme. Genetic constitution and divergence among the parents involved in hybridization governs the nature of gene action in that hybrid. The line × tester mating design helps in

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assessing the combining ability of parents there by selection of superior parents as well as cross combinations (Kempthorne, 1957). Accordingly, the present study was carried out to assess the nature of combining ability and gene action in respect of seed cotton yield and its component traits in 54 hybrids and their 15 parents comprising 9 lines and 6 testers of upland cotton.

MATERIAL AND METHODS

The experimental material used in the present investigation comprised of 54 new hybrids derived through line × tester mating design and their 15 parents (9 lines and 6 testers) which were grown in Randomized Block Design with two replications during *Kharif* 2009 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The parents used in the study namely L_2, L_8, L_6 and T_5 are having good fibre strength and S:L ratio. Each entry was grown in two rows of 1.8 m length following the recommended spacing of 90cm × 60cm. In each entry, three competitive plants were randomly tagged and observations were recorded on 2.5 per cent span length, fibre strength, micronaire, elongation percentage, uniformity ratio and maturity ratio. The mean values of these characters were used for combining ability analysis as per the method suggested by Kempthorne (1957) and Arunachalam (1974).

RESULTS AND DISCUSSION

The variance among the lines in respect of their general combining ability were highly significant for 2.5 per cent span length and micronaire, where as variance among testers was significant for 2.5 per cent span length, fibre strength and micronaire (Table 1). The variance due to line × tester interaction was also significant for 2.5 per cent span length, fibre strength and micronaire indicating predominance of non-additive gene action in the genetic control of all these characters. Magnitude of sca variance was higher than the gca variance for majority of the traits. The ratio of gca/sca variance indicated preponderance of non-additive type of gene action, which is an integral component of the genetic architecture of different characters in the material used in cotton.

Estimates of gca effects indicated that, none of the parents was a good general combiner for all the traits studied. However, the line L_1 was a good general combiner for fibre strength, micronaire and maturity ratio, whereas L_3 and L_9 were good general combiner for 2.5 per cent span length (Table 2). Among the testers, T_2 was good general combiners for 2.5 per cent span length and fibre strength. While, T_3 and T_1 having desirable significant gca effects for fibre strength and micronaire, respectively. The results implies that two lines and testers were good general combiners indicating their ability in transmitting additive genes in the desirable direction to their progenies and hence, these superior parents can be utilized for production of superior genotypes in segregating populations by concentration of desirable genes with additive effect.

The cross combinations *viz*., '$L_4 \times T_3$, $L_9 \times T_3$, $L_2 \times T_6$, $L_1 \times T_3$ and $L_6 \times T_2$ for 2.5 per cent span length; '$L_8 \times T_2$, $L_9 \times T_5$, $L_5 \times T_1$ and $L_4 \times T_5$' for fibre strength; '$L_8 \times T_5$ and $L_9 \times T_6$' for micronaire were good specific combiners (Table 3), as indicated by the *per se* performance and *sca* effects. Similar results were reported by Surana *et al*. (1997), Ahuja and Dhayal (2007), Patel *et al. (*1997), Ahuja and Tuteja (2003), Lukange *et al.* (2007), Ashok and Ravikesavan (2008), Faqir and Muhammad *(*2008).

In general, maximum crosses showing significant sca effects were invariably associated with better *per se* performance for respective traits (Table 3). The good specific combiners for different characters involved parents with high × high, high×low, low×high and low×low general combinations.

In majority of the cases, the crosses exhibiting high sca effects were found to have both or one of the parents as good general combiners for the characters studied revealing non-additive gene action in the genetic control which was in accordance with the results of Muthuswamy *et al.* (2003). The some of the crosses recorded high yield as well as these are having desirable fibre strength and those crosses possess the matching span length and fibre strength which is

Table 1: Analysis of variance for combining ability for seven fibre quality characters in upland cotton

Source of variation	DF	2.5% span length (mm)	Fibbre strength (g/tex)	Micronaire value	Elongation Percentage	Maturity ratio	Uniformity ratio	Seed cotton yield (q/ha)
Replication	1	0.29	1.08	0.04	0.018	0.0043	3.704	8.51
Hybrids	53	4.53**	2.78**	0.13**	0.022	0.0009	3.352	16.77**
Lines	8	4.23**	0.77	0.17**	0.035	0.0012	1.771	33.31**
Testers	5	3.08**	3.2**	0.07*	0.004	0.0009	0.556	17.05**
Line x Tester	40	4.77**	2.84**	0.12**	0.022	0.0009	4.018	13.43**
Error	53	0.71	0.81	0.03	0.073	0.0008	2.628	4.89

* and ** Indicate significance of value at P=0.05 and 0.01, respectively

Table 2: General combining ability effects of parents for fibre quality traits in upland cotton *(Gossypium hirsutum* L.)

	2.5% span length (mm)	Fibbre strength (g/tex)	Micronaire value	Elongation percentage	Maturity ratio	Uniformity ratio	Seed cotton yield (q/ha)
Females							
L_1	-0.66 **	0.33	0.24 **	0.064	0.022 *	0.222	1.97 **
L_2	-0.04	0.14	0.05	0.014	0.000	-0.028	0.4
L_3	0.66 **	-0.59 *	0.02	0.089	-0.003	-0.694	-1.93 **
L_4	0.21	0.08	-0.07	0.022	-0.006	-0.028	-1.02
L_5	0.4	0.2	0.06	-0.044	-0.002	-0.361	1.75 **
L_6	-0.68 **	-0.70 **	-0.18 **	-0.069	-0.010	0.639	-2.07 **
L_7	-0.41	0.65 *	-0.12 *	-0.053	-0.010	0.056	-0.07
L_8	-0.44	-0.15	0	-0.028	0.001	0.306	-1.17
L_9	0.96 **	0.04	0	0.006	0.009	-0.111	2.16 **
S.E.$\pm$	0.22	0.26	0.04	0.077	0.008	0.439	0.66
C.D. @ 5 %	0.45	0.51	0.09	0.155	0.017	0.880	1.33
C.D. @ 1 %	0.59	0.68	0.12	0.207	0.022	1.173	1.78
Males							
T_1	-0.39	0.07	0.09 *	0.022	0.008	0.000	-1.60 **
T_2	0.49 *	0.75 **	-0.09 *	-0.011	-0.012	0.056	0.58
T_3	0.56 **	-0.14	0.02	-0.017	0.003	-0.111	0.08
T_4	-0.29	-0.52 *	0.03	0.000	0.004	-0.278	0.48
T_5	-0.23	0.03	0	0.011	-0.001	0.222	1.09 *
T_6	-0.13	-0.19	-0.04	-0.006	-0.002	0.111	-0.64
S.E.$\pm$	0.18	0.21	0.04	0.063	0.007	0.358	0.54
C.D. @ 5 %	0.36	0.42	0.07	0.127	0.014	0.719	1.09
C.D. @ 1 %	0.49	0.56	0.10	0.169	0.018	0.958	1.45

* and ** Indicate significance of values at P=0.05 and 0.01, respectively

Table 3: Best specific combinations (crosses), their *per se* performance and *sca* effects and *gca* effects of parents for different characters

Characters	Crosses	*Per se* performance	*sca* effect	*gca* effects of parents
2.5% span length	$L_4 \times T_3$	33.30	3.20 **	H × H
	$L_9 \times T_3$	32.10	1.25 *	H × H
	$L_2 \times T_6$	32.00	2.84 **	L × L
	$L_1 \times T_3$	31.80	2.58 **	L × H
	$L_6 \times T_2$	31.80	2.66 **	L × H
Fibre strength	$L_8 \times T_2$	26.10	1.66 *	L × H
	$L_9 \times T_5$	25.90	1.99 **	H × H
	$L_5 \times T_1$	25.50	1.39 *	H × H
	$L_4 \times T_5$	25.30	1.35 *	H × H
	$L_1 \times T_1$	25.40	1.16	H × H
Micronaire value	$L_1 \times T_4$	4.29	0.22	H × H
	$L_8 \times T_5$	4.22	0.43 **	H × H
	$L_9 \times T_6$	4.06	0.31 *	H × L
	$L_3 \times T_3$	4.05	0.21	H × H
	$L_5 \times T_5$	4.02	0.17	H × H
Elongation Per centage	$L_3 \times T_2$	5.90	0.11	H × L
	$L_4 \times T_1$	6.00	0.11	H × H
	$L_2 \times T_4$	5.95	0.10	H × L
Maturity Ratio	$L_9 \times T_1$	0.73	0.034	H × H
	$L_9 \times T_6$	0.74	0.029	H × L
	$L_6 \times T_6$	0.71	0.022	L × L
Uniformity Ratio	$L_8 \times T_2$	50	2.53*	H × H
	$L_6 \times T_5$	50	2.03	H × H
	$L_4 \times T_6$	49	1.81	L × H

* and ** Indicate significance of values at P=0.05 and 0.01, respectively

necessary for modern ginning and spinning machines.

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