Indian J. Genet., **56** (1): 89–93 (1996)

GENETICS OF YIELD AND YIELD COMPONENTS OVER LOCATIONS IN DESI COTTON (*GOSSYPIUM ARBOREUM*)

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(Received: February 1, 1992; accepted: July 3, 1995)

ABSTRACT

A line x tester mating set was obtained by crossing 20 diverse genotypes (female) with 3 well adapted genotypes (male) of Asiatic cotton. Sixty F_1s alongwith 23 parents were evaluated over three locations for 10 quantitative characters. The gca and sca variances showed the predominant role of additive type of gene action in the inheritance of plant height, bolls, seed-cotton yield, seed yield, lint yield and ginning (%), whereas both additive and nonadditive components of genetic variance were important in the inheritance of halo length. However, nonadditive genetic effects were predominant in the inheritance of days to flower initiation, seed and lint indices. The best general combiners for most of the characters were SD-5, RG-10, RG-8 and K7. No association between per se performance and sca effect was observed. The parent and hybrids did not show consistent performance over locations for plant height, bolls, seed-cotton yield, seed yield and lint yield.

Key words: Line x tester, additive, nonadditive, specific combining ability, general combining ability.

Combining ability studies are frequently used by the plant breeders to identify parental lines in terms of their hybrid performance and to assess the gene action involved. Combining ability estimates are greatly influenced by the environments so that studies in single environment may not provide reliable information regarding combining ability effects [1, 2]. The present investigation has been undertaken to determine the nature and magnitude of combining ability effects for yield and yield components of desi cotton and to assess the influence of environment on combining ability estimates.

MATERIALS AND METHODS

A line x tester mating design consisting of 60 F_1s involving 20 diverse genotypes used as female (G-121, RG-1, LD-135, BH-113, BH-112, SC-136, G-1, CJ-73, BH-99, BH-98, 7250,

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BH-53, BS-11, 438, 35/4, K-7, 103, RG-8, RG-10 and SD-5) and three male parents (Lohit, Shyamali and G-27) was used to study combining ability. The 60 F_1s and 23 parental lines were grown during kharif at three locations (Bulandshahr, Modipuram and Nagina) in randomized block design with three replications. The spacing was 60 cm between rows and 30 cm between plants. Each genotype was raised in a single-row plot of 5 m length. Observations were recorded on 10 random plants per row for ten quantitative traits (Table 1). Data from all three locations were used for statistical analysis following the Kempthorne model [3].

RESULTS AND DISCUSSION

Pooled analysis over three locations for all characters showed significant differences for genotypes, parents, hybrids, lines and testers for all characters. The line x tester interaction was significant for all characters except bolls/plants and seed-cotton yield/plant. The mean square due to locations was significant for plant height, bolls/plant, seed-cotton yield per plant, seed yield/plant, lint yield/plant, and halo length, indicating that the environments had variable influence on these characters. Mean squares for line x location, tester x location, and hybrid x location interactions were significant for all characters, except ginning % and seed index; days to flower initiation, ginning %, seed and lint indices; and days to flower initiation and ginning %, respectively, which indicated that the parents and hybrids were not consistent over locations for these characters. Mean squares due to line x tester x location interactions showed that the specific combining ability (sca) effects in the hybrids were not consistent over locations for bolls/plant, seed-cotton yield/plant, seed yield/plant and lint yield/plant.

Both general and specific combining ability (gca, sca) effects were significant for all characters, except bolls/plant and seed-cotton yield, indicating the importance of both additive and nonadditive genetic variance in the inheritance of these characters. These results are in partial agreement with the results reported earlier [4–7].

Degree of dominance was worked out for different characters, which indicated complete dominance for plant height and halo length; partial dominance for number of bolls, seed-cotton yield, seed yield, lint yield and ginning %; and overdominance for days to flower initiation, seed and lint indices.

The parents which were found to be good general combiners were, G-121 and SC-136 for earliness; SD-5, RG-10 and RG-8 for dwarfness; SD-5, RG-10, K-7, CJ-73 and BH-113 for bolls/plant, seed-cotton yield/plant, seed yield/plant and lint yield/plant; SD-5, RG-10, Shyamali, G-1, CJ-73 and Lohit for halo length; RG-10, SD-5, BH-113, CJ-73 and BH-98 for ginning (%); K-7, RG-8, RG-10, Lohit and BH-113 for seed and lint indices (Table 1).

Table 1. General combining ability effects estimated from pooled data of three locations for ten characters of desirable genotypes of Asiatic cotton

Parent	Days to flower	Plant height	Bolls per plant	Seed-cotton yield	Seed yield	Lint yield	Halo length	Ginning %	Seed Index	Lint Index
Females (i):										
G-121	- 1.43*	8.64**	1.70**	3.90**	2.38**	1.55**	- 1.31**	0.74**	- 0.16**	- 0.02
RG-1	1.46*	2.39**	- 1.97**	- 4.02**	- 2.27**	- 1.71**	- 0.69**	- 1.25**	- 0.11**	- 0.18**
LD-135	- 0.43	- 0.34	- 1.46**	- 2.90**	- 1.61**	- 1.25**	0.27	- 0.84**	- 0.01	- 0.10**
BH-113	0.68	0.92	2.08**	4.26**	2.46**	1.75**	0.45**	1.39**	0.10**	0.21**
SC-136	- 1.32*	14.38**	- 2.38**	- 4.75**	- 2.70**	- 2.02**	0.24	- 1.60**	0.01	- 0.18**
G-1	- 0.20	- 2.50**	- 3.20**	- 6.49**	- 3.80**	- 2.67**	0.72**	- 1.93**	- 0.01	- 0.23**
CJ-73	- 1.09	11.69**	2.42**	4.73**	2.76**	2.00**	0.60**	1.33**	0:06	0.17**
7250	- 1.09	- 2.86**	- 2.26**	- 4.58**	- 2.68**	- 1.92**	- 0.52**	- 1.42**	- 0.11**	- 0.22**
BH-53	- 0.87	- 2.63**	0.82**	2.07**	0.83**	0.83**	- 0.61**	1.36**	- 0.05	0.12**
BS-11	- 0.43	4.14**	- 2.26**	- 4.61**	- 2.59**	- 2.00**	- 0.56**	- 1.79**	- 0.11**	0.24**
438	1.46*	- 6.62**	- 2.72**	- 5.65**	- 3.37**	- 2.33**	- 0.72**	- 1.60**	0.03	- 0.14**
35/4	2.02**	0.53	- 2.69**	- 5.71**	- 3.35**	- 2.32**	0.28	- 1.32**	- 0.01	- 0.15**
K-7	1.13	11.25**	2.65**	5.28**	3.12**	2.19**	- 0.12	1.24**	0.24**	0.27**
RG-8	1.57**	- 11.54**	1.55**	3.01**	1.73**	1.29**	0.19	1.10**	0.16**	0.21**
RG-10	- 0.32	- 13.53**	2.78**	5.39**	3.05**	2.38**	0.80**	1.83**	0.15**	0.29**
SD-5	- 0.87	- 13.93**	2.78**	5.52**	3.31**	2.32**	0.90**	1.41**	- 0.07*	0.11**
Males (j):										
Lohit	- 0.38	3.31**	- 0.02	- 0.09	- 0.03	- 0.01	0.51**	0.05	0.10**	0.06*
Shyamali	- 1.36	- 2.71*	0.34	0.73	0.43	0.24	0.72**	- 0.04	- 0.05	- 0.03
G-27	1.74**	- 0.60	- 0.32	- 0.64	- 0.40	- 0.23	- 0.77**	- 0.01	- 0.05*	- 0.03
SE (gi)	0.84	1.22	0.33	0.65	0.43	0.25	0.20	0.26	0.04	0.04
SE (gj)	0.32	0.60	0.13	0.25	0.16	0.10	0.08	0.10	0.02	0.02

The estimates of sca effects indicated that high x high, high x medium, high x low, medium x low and low x low gca parents gave high sca crosses. The crosses SC-136 x Shyamali, RG-10 x Lohit, RG-8 x Lohit, K-7 x G-27, BH-53 x G-27, G-121 x Shyamali, K-7 x Lohit, K-7 x Shyamali, SD-5 x Lohit, RG-10 x G-27, 103 x Shyamali, G-1 x Lohit, LD-135 x Lohit and SD-5 x Shyamali had at least one high gca parent for these characters. Such crosses were also reported by [1, 6]. Some crosses, e.g. RG-8 x G-27, 35/4 x Shyamali, RG-8 x Shyamali, BH-113 x Lohit, and RG-1 x Lohit for earliness; BS-11 x Lohit for dwarfness;

7250 x Lohit and 35/4 x G-27 for bolls/plant, seed-cotton yield/plant, seed yield/plant and lint yield/plant; G-121 x G-27 and 438 x G-27 for halo length; BS-11 x Shyamali and 438 x Lohit for ginning % were found to be outstanding, showing high sca effects were none of the parents showed high gca effects (Table 2). This suggested that the crosses showing high sca effects involving one poor and one good or both poor general combiners could have been due to complementation of genes. Similar observations were also recorded in cotton [2, 5, 6].

Table 2. Five most superior crosses selected on the basis of sca effects and per se performance (pooled over environments) in cotton

Sca effect	Per se performance	Sca effect	Per se performance
Earliness		**Dwarfness**	
RG-8 x G-27	LD-135 x Lohit	SC-136 x Shyamali	SD-5 x Shyamali
35/4 x Shyamali	CJ-73 x Shyamali	BS-11 x Lohit	RG-10 x Lohit
RG-8 x Shyamali	7250 x Lohit	RG-10 x Lohit	RG-10 x G-27
BH-113 x Lohit	RG-8 x Shyamali	RG-8 x Lohit	RG-8 x G-27
RG-1 x Lohit	35/4 x Shyamali	K-7 x G-27	SD-5 x Lohit
Bolls/plant		**Seed-Cotton Yield/Plant**	
BH-53 x G-27	SD-5 x Shyamali	BH-53 x G-27	SD-5 x Lohit
7250 x Lohit	SD-5 x Lohit	7250 x Lohit	K-7 x Shyamali
G-121 x Shyamali	K-7 x Shyamali	K-7 x Lohit	RG-10 x Shyamali
K-7 x Lohit	RG-10 x Shyamali	RG-8 x Lohit	K-7 x Lohit
RG-8 x Lohit	K-7 x Lohit	35/4 x G-27	RG-10 x Lohit
Seed yield/plant		**Lint Yield/Plant**	
BH-53 x G-27	K-7 x Shyamali	BH-53 x G-27	K-7 x Lohit
7250 x Lohit	K-7 x Lohit	7250 x Lohit	RG-10 x Lohit
RG-8 x Lohit	RG-10 x Shyamali	K-7 x Lohit	RG-10 x Shyamali
G-121 x Shyamali	SD-5 x Lohit	35/4 x G-27	SD-5 x Lohit
K-7 x Shyamali	RG-10 x Lohit	G-121 x Shyamali	K-7 x Shyamali
Halo Length		**Ginning (%)**	
RG-10 x Lohit	RG-10 x Lohit	RG-10 x G-27	RG-10 x G-27
SD-5 x Lohit	SD-5 x Lohit	LD-135 x Lohit	K-7 x Lohit
G-121 x G-27	35/4 x Shyamali	BS-11 x Shyamali	K-7 x G-27
438 x G-27	CJ-73 x Shyamali	438 x Lohit	RG-10 x Lohit
7250 x Lohit	G-1 x Shyamali	K-7 x Lohit	SD-5 x G-27
Seed Index		**Lint Index**	
103 x Shyamali	RG-10 x Lohit	LD-135 x Lohit	RG-10 x Lohit
G-1 x Lohit	RG-8 x Lohit	G-1 x Lohit	RG-8 x Lohit
35/4 x Shyamali	K-7 x G-27	RG-8 x Lohit	K-7 x Shyamali
RG-8 x Lohit	35/4 x Shyamali	35/4 x Shyamali	SD-5 x Shyamali
LD-135 x Lohit	K-7 x Shyamali	SD-5 x Shyamali	RG-10 x G-27

A comparison between per se performance and sca effects of the five top most crosses (Table 2) revealed that, in general, there was no association between them, with few exceptions.

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