Indian J. Genet., **59**(1): 77-81 (1999)

COMBINING ABILITY ANALYSIS OVER ENVIRONMENTS FOR FIBRE CHARACTERS IN UPLAND COTTON

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(Received: September 7, 1996; accepted: November 15, 1998)

ABSTRACT

In an 8 × 8 parent diallel cross of *G. hirsutum* L. evaluated in 3 environments, additive type of gene action was preponderant for ginning percentage, seed index, lint index, 2.5% span length and fibre fineness. Interaction effects of GCA and SCA with environments were highly significant for all the characters except ginning percentage and 2.5% span length respectively. The GCA effects were more stable over a range of environments, whereas the SCA affecs were much influenced by environmental variation for the traits. Parent, LRK-516 found to be good general combiner for all the characters, while G.Cot. 10 also found to be a good general combiner for all the characters except fibre fineness. Cross combinatiions G.Cot.10 × B.N. and G. 2360 × LRK-516 gave high SCA effects for seed index, lint index and 2.5% span length, while crosses H 777 × DCI - 108 and Sharda × G. 2360 for ginning percentage, seed index and lint index.

Key words: *Gossypium hirsutum*, upland cotton, combining ability over environments fibre chartacters

Combining ability studies are very important for the breeders of any crop as it helps them in the selection of parents and crosses which give highest improvement for the character under consideration and also furnish the information on additive and non-additive portions of genetic variance present in the material under study. As environment plays an important role in the expression of a character and greatly influences the combining ability estimates, the study in a single environment may not provide reliable information. The study reported was, therefore, undertaken to determine the mechanism of gene action involved in the inheritance of fibre characters in upland cotton over three environments.

MATERIALS AND METHODS

Eight genetically and geographically diverse lines of *G. hirsutum* L viz., G. Cot. 10, H 777, Sharda, DCI-108, G 2360, LRK-516, Bikaneri Narma (B.N.) and Surat Dwarf (S.D.) were crossed in all possible combinations, excluding reciprocals.

Available 28 F_1's along with their 8 parents were grown in randomized block design with 3 replications at College Farm, GAU; Junagadh in *Kharif*, 1993 in three environments (date of sowing : end of May, end of June and end of July). Each entry was represented by a single row of 10 plants spaced 60 cm apart. The rows were kept 90 cm apart. The data were recorded on five competitive plants taken randomly per row for ginning percentage, seed index, lint index, 2.5% span length and fibre fineness. The data were analysed following Griffing [1] as extended by Singh [2-3] using Model-1, Method-2.

RESULTS AND DISCUSSION

The components of variance for general combining ability (GCA) and specific combining ability (SCA) were highly significant for all the characters (Table 1). The components of variance for the GCA were larger than those for the SCA for all the traits, indicating the preponderance of additive gene action which could be exploited for the improvement of these traits by mass selection. Similar observations have been reported earlier [4-8].

Table 1. Mean sum of squares for the combining ability analysis over environments in upland cotton

Source	d.f.	Characters				
		Ginning percentage	Seed Index	Lint Index	2.5% span length	Fibre fineness
GCA	7	11.095**	6.378**	2.710**	9.325**	1.193**
SCA	28	2.066**	0.263**	0.196**	0.835**	0.063**
ENV (E)	2	38.432**	10.054**	0.808**	30.712**	0.585**
GCA × E	14	0.099	0.087**	0.041**	0.232	0.153**
SCA × E	56	0.238**	0.141**	0.062**	0.263	0.064**
Error	210	0.110	0.018	0.012	0.370	0.055

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

The interaction effects of GCA and SCA with environments were highly significant for all the characters except ginning percentage and 2.5% span length respectively. However, GCA variances were much larger than the interaction component (GCA × Environment) for all the characters. On the other hand, SCA effects were equal to SCA × Environment effects for fibre fineness. But the SCA effects were much larger than SCA × Environment effects for ginning percentage,

seed index, lint index and 2.5% span length. The results indicated that additive gene effects were stable over a range of environments whereas dominance effects were much influenced by environments. Therefore, testing for GCA for those traits at few selected environments might provide useful information. The result also indicated that selection would be effective for evolving stable genotypes for the characters under study. Since the SCA × Environment effects were less than SCA effects for all the characters except fibre fineness, it indicates that individual varieties play an important roll in fixing these characters.

Table 2. Estimates of general combining ability effects (Pooled) for five characters in upland cotton

Character / Parent	Ginning percentage	Seed Index	Lint Index	2.5% span length	Fibre finess
G. Cott.10	0.72**	0.35**	0.36**	0.23*	0.02
H 777	-0.47**	-0.06**	-0.13**	0.10	0.03
Sharda	-0.40**	-0.32**	-0.27*	0.16	-0.16**
DCI-108	0.93**	-0.48**	-0.12**	-1.04**	0.42**
G.2360	-0.48**	0.82**	0.39**	0.25*	0.06
LRK-516	0.38**	0.33**	0.28**	0.84**	-0.26**
B.N.	-0.67**	-0.44**	-0.38**	-0.49**	-0.10**
S.D.	-0.02	-0.21**	-0.13**	-0.06	0.00
SE (gi) ±	0.057	0.023	0.019	0.104	0.040

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

DCI-108 showed a highly significant and positive GCA effect for ginning percentage, but it showed negative GCA effects for seed index, lint index and 2.5% span length (Table 2). G 2360 recorded a highly significant and positive GCA effect for seed index, but it showed negative GCA effect for ginning percentage. The results indicated that the high GCA for seed index and lint index may not always result in a high GCA for ginning percentage. For 2.5% span length and fibre fineness, LRK-516 showed highly significant and positive GCA effects (for fibre fineness less value is positive direction) RK-516 showed highly significant GCA effect in desired direction for all the five characters under study, while parent G.Cot. 10 also had significant GCA effect in desired direction for all the characters except fibre fineness. Thus, both the parents (LRK-516 and G.Cot.10) seemed to be promising for exploitation for the simultaneous improvement of these characters.

Table 3. Estimates of specific combining ability effects (pooled) for five characters in upland cotton

Cross \ Character	Ginning percentage	Seed index	Lint index	2.5% span length	Fibre fineness
G.Cot.10 × H 777	1.28**	–0.02	0.25**	–0.47	0.26
× Sharda	0.09	–0.14*	–0.08	0.31	–0.01
× DCI-108	–0.06	0.26**	0.16**	0.27	–0.06
× G.2360	0.85**	–0.10	0.15**	–0.04	0.02
× LRK-516	0.49**	–0.04	0.10	–0.12	–0.38
× B.N.	0.00	0.43**	0.24**	0.86**	–0.16
× S.D.	–0.95**	0.64**	0.17**	0.36	0.13
H 777 × Sharda	–0.08	–0.04	–0.04	0.32	0.11
× DCI-108	0.53**	0.17*	0.21**	–0.03	0.15
× G.2360	–0.06	–0.14*	–0.10	–0.26	–0.20
× LRK 516	–1.09**	0.09	–0.17**	0.30	–0.05
× B.N.	0.11	–0.08	–0.03	–0.12	0.17
× S.D.	0.15	0.17*	0.14**	–0.28	–0.07
Sharda × DCI-108	0.13	–0.04	0.00	–0.04	–0.04
× G 2360	0.79**	0.15*	0.25**	0.41	0.05
× LRK-516	–0.25	0.12	0.01	0.04	0.03
× B.N	0.43**	–0.06	0.05	–0.49	0.12
× S.D.	–0.85**	0.24**	–0.02	0.41	–0.03
DCI-108 × G.2360	–0.63**	0.30**	0.08	0.33	0.08
× LRK-516	0.21	0.15*	0.16**	0.64*	0.17
× B.N.	1.00**	–0.13*	0.09	0.13	0.03
× S.D.	–0.50**	0.10	–0.04	0.62*	–0.05
G.2360 × LRK-516	0.05	0.43**	0.27**	0.81**	0.14
× B.N.	–0.86**	–0.12	–0.14**	0.23	–0.15
× S.D.	0.69**	–0.03	0.10	0.28	0.01
LRK-516 × B.N.	–0.24	0.28**	0.10	0.31	0.04
× S.D.	2.38**	0.01	0.51**	–0.12	0.08
B.N. × S.D.	0.86**	0.02	0.17**	–0.03	0.13
SE (Sij) ±	0.174	0.071	0.057	0.318	0.123

*Signifiant at 5% level **Significant at 1% level

The cross combination LRK-516 × S.D. indicated high SCA effects for ginning percentage and lint index. G.Cot. 10 × B.N., G. 2360 × LRK-516 and DCI-108 × LRK-516 showed significant SCA effects for seed index, lint index and 2.5% span length. The cross G.Cot.10 × B.N. showed the SCA effects in desired direction for fibre fineness also (not significant). The crosses H 777 × DCI-108 and Sharda × G 2360 showed significant SCA effects for ginning percentage, seed index and lint index indesired direction (Table 3). Hence these crosses may yield transgressive segregates in later generations, as they involved high × low or high × average combiners. Such crosses are likely to throw good segregates only if the allelic genetic systems are present in good combination and epistatic effects present in the crosses act in the same direction so as to maximize the desirable characteristics. The results indicate that high general combiners for various traits may be included in a multiple crossing programme and desirable segregates in early generation may be subjected to biparental mating for the accumulation of favourable genes for various traits.

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