Genetics of Yield and its Contributing Traits in Upland Cotton (*Gossypium hirsutum* L.)

R.P. Bhardwaj and C.J. Kapoor
Rajasthan Agricultural University, Agricultural Research Station, Sriganganagar-335001, Rajasthan, INDIA

ABSTRACT

Line x tester analysis involving three males (testers) and fourteen females (lines) with adaptable and broad genetic base was conducted for yield and its contributing traits in upland cotton. Additive genetic variance and non-additive genetic variance primarily controlled seed cotton yield and lint index. Boll number, boll weight and ginning percentage were controlled by additive genetic variance. However, seed index was controlled by non-additive genetic variance.

Introduction

The use of parents of known superior genetic worth for hybridisation insures greater success. This could require extensive and detailed genetic studies of existing germplasm and newly evolved promising lines. The lines that perform well in combinations are eventually of great importance to plant breeders.

The present study is an attempt to make use of line x texter analysis to estimate the combining ability effects for seed cotton yield and other traits in diverse lines of upland cotton.

Material and Methods

The experimental material comprised three male parents (IRMA-323, Yugo 78-38 and Aleppa-40), fourteen females parents (RST-9, HS-6, F-505, Pusha 31-1, Bikaneri Narma, Ganganagar Ageti, LH 1134, H 974, RST-19, F-846, LH-900, RS-716, H-777, RS-875) and their forty two crosses. The experiment was conducted in a randomised block design with three replications at the Agricultural Research Station, Sriganganagar during kharif, 1996. Each entry had a single, six row metre long with inter row and inter plant spacing of 67.5 x 30 cm, respectively. Recommended cultural practices and full plant protection measures were used. Observations on seed cotton yield, boll number, boll weight, ginning percentage (G.P), seed index and lint index were recorded on five competitive plants in each row. Combining ability analysis was done according to the method outlined by Kempthorne (1957).

Results and Discussion

The analysis of variance revealed highly significant differences among all traits under study, indicating considerable genetic diversity (Table 1).

The mean squares due to general combining ability of males was larger than mean squares due to general combining ability of females for all the traits under investigation (Table 2). Both were highly significant. Mean squares due to specific effects were significant for each trait except boll weight.

The data on combining ability effects for seed cotton yield of parental varieties revealed that male parent IRMA-323 and female parents RST-9 and F-505 were the best parents. Strain IRMA-323 had favourable genes for seed cotton yield and boll number, while it was a negative combiner for ginning percentage.

Strain Yugo 78-38 was a negative combiner for seed cotton yield but it was the best combiner for boll weight, ginning percentage, seed index and lint index. Among the fourteen female parents, RST-9 and F-505 were good general combiners for seed cotton yield and boll weight. RST-9 was a good general combiner for seed index while strain F-505 was a good general combiner for lint index.

Pusa 31-1 was a good general combiner for boll weight, ginning percentage, seed index and lint index but it was negative combiner for yield and boll number (Table 3).

The best cross combinations for different characters usually did not combine the best male and female parents. Four cross combinations (F-846 x IRMA-323, LH-1134 x Aleppa-40, Ganganagar Ageti x Yugo 78-38 and HS-6 x IRMA-323) showed conspicuous specific combining ability (Table 3).

Additive genetic variance and non-additive genetic variance control these seed cotton yield and lint index characters. The yield components boll number, boll weight and ginning percentage were controlled by additive genetic variance. Non-additive genetic variance was dominant for seed index only. Several workers have reported both additive and non-additive variance for yield and other characters although relative importance of one over the other varied from study to study (Singh, *et al.* 1969; Singh and Gupta, 1970; Singh, Gupta and Phul, 1971; Kumar, *et al.* 1974; Bhardwaj *et al.*, 1979; Bhandari *et al.*, 1981; Kumar, *et al.*, 1984; Jagtap *et al.*, 1992 and Dhorajia *et al.*, 1995).

Proceedings of the World Cotton Research Conference-2. Athens, Greece, September 6-12, 1998. pp.214-216.

The most crucial phase in a hybridisation program is the selection of suitable parents in this study and genetic variance plays an important role. In most cases, all good combining parents for seed cotton yield were also good combiners for other yield components i.e. boll number and boll weight. This was true for general combining ability as well as for specific combining ability. Strain IRMA-323 was a good general combiner for seed cotton yield and boll number. RST 9 and F-505 was a good general combiners for seed cotton yield and boll weight. F 846 x IRMA 323, LH 1134 x Aleppa 40, Ganganagar Ageti x Yugo 78-38 and HS 6 x IRMA-323 were the best cross combinations for seed cotton yield.

As the major portion of genetic variation was additive in nature, significant advances in yield could be made by using simple pedigree and other methods to exploit this variance.

Acknowledgement

We are grateful to Dr. M.S., Manohar, Director and Dr. Ram Deo, Associate Director Research, Rajasthan Agricultural University, Bikaner, Rajasthan for providing facilities and to ICAR under whose aegis the work was carried out at the Agriculture Research Station, Sriganganagar.

References

Bhardwaj, R.P. and S.N. Chaturvedi. (1979): Studies on gene effects in a cross of inter variatal hirsutum. Madras Agric. J. 66(1):14-18.

Bhandari, D.R. (1978): Line x Tester analysis of combining ability and its interactions with environment in American cotton. Madras Agri. J.; 64(4):218-225.

Bhandari, D.R., R.P. Bhardwaj. and Chakresh Kumar. (1981): Diallel analysis of combining ability in interspecific crosses of American cotton. J. Indian Soc. Cotton Improv. (1):18-24.

Dhorajia, V.K., K.V. Pethani and K.B. Kathiria. (1995): Genetic architecture of yield and its components in upland cotton. J. Indian Soc. Cotton Improv. Vol. 20(2):124-128.

Gupta, M.P., and R.B. Singh. (1974): Combining ability in upland cotton- Ginning and fiber characters. Indian J. Genet. 34 (3):422-426.

Jagtap, J.G., S. Holkar and S.W. Telang. (1992): L x T Analysis for some attributes in upland cotton. J. Indian Soc. Cotton Improv. Vol. 17(2):109-114.

Kempthorne, O. (1957): An Introduction to Genetical Statistics. John Wiley and Sons. Inc. New York.

Kumar, C., P. Joshi and R.P. Bhardwaj. (1984): Combining ability analysis for yield and other quantitative characters in Upland cotton. J. Indian Soc. Cotton Improv. March :

Kumar, P., R.S. Pathak and R.K. Singh. (1974): Heterosis and combining ability in upland cotton. Indian J. Agri. 44:145-150.

Singh, R.B., M.P. Gupta, P.L. Tikku, R.S. Tomer, Dharampal and D.S. Bisley. (1969): Line x Tester analysis of heterosis and combining ability in upland cotton. Heredity 1:175-184.

Singh, T.H., S.P. Gupta and P.S. Phul. (1971): Line x Tester analysis of combining ability in cotton. Indian J. Genet. 31:316-321.

Table 1 . Analysis of variance for yield and their related traits in upland cotton.

Source	d.f.	Yield/ plant	Boll/ plant	Boll wt.	G.P.	Seed index	Lint index
M.S.S. Progenies	58	890.12**	300.1**	0.293**	3.120**	0.900**	0.400**
M.S.S. error	116	610.3	105.5	0.130	0.310	0.330	0.050

Table 2 . Combining ability analysis of variance for yield and its related traits in upland cotton.

Source	d.f.	Yield/ plant	Boll/ plant	Boll wt	G.P.	Seed index	Lint Index
Female (Lines)	13	978.900**	320.130**	0.400**	4.130**	0.920**	0.440**
Males (Tester)	2	5330.750**	1997.830**	0.540*	7.310**	1.300**	0.750**
Female x Male	26	530.120**	130.400*	0.130	0.800*	0.400**	0.090**
Error	82	230.800	70.600	0.130	0.300	0.120	0.035
δ_2 G.C.A.		102.900	45.340	0.015	0.180	0.030	0.020
δ_2 S.C.A.		90.800	20.290	0.005	0.135	0.090	0.021
$\frac{\delta_2 \text{ G.C.A.}}{\delta_2 \text{ S.C.A.}}$		1.001	2.097	3.250	1.400	0.300	0.900

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

Table 3. Best general combining parents and best cross combinations for different traits in upland cotton.

Characters	Best female parents	Best male parents	Best cross combinations
Seed cotton yield	RST 9 F 505	IRMA 323	F 846 x IRMA 323, LH 1134 x Aleppa 40, Ganganagar Ageti x Yugo 78-38, HS 6 x IRMA 323
Boll number	F 846	IRMA 323	F 846 x Aleppa 40, HS 6 x IRMA 323, Pusa 31-1 x Yugo 78-38
Boll weight	RST 9 HS 6 F 505 Pusa 31-1	Yugo 78-38	RST 9 x IRMA 323
Ginning percentage	RST 9 HS 6 LH 1134 Pusa 31-1	Aleppa 40 Yugo 78-38	Ganganagar Ageti x Yugo 78-38, RS 716 x Aleppa- 40, H 974 x Yugo-78-38
Seed index	RST 9 HS 6 Pusa 31-1 LH 900	Yugo 78-38	Pusa 31-1 x Aleppa 40, H 777 x IRMA 323, RST 19 x Yugo 78-38,, Bikaner Narma x IRMA 323
Lint index	Ganganagar Ageti Pusa 31-1 F 505 LH 1134	Yugo 78-38	F 505 x IRMA 323, LH 1134 x Aleppa 40, RST 9 x Yugo 78-38, H 974 x IRMA 323, RS 875 x Yugo 78-38