Pak. J. Agri. Sci., Vol. 30, No. 3, 1993

GENETIC ANALYSIS OF LINT PERCENTAGE, STAPLE LENGTH AND FIBRE FINENESS OF UPLAND COTTON

Faqir Muhammad Azhar & Asif Hayat Rana
Department of Plant Breeding & Genetics,
University of Agriculture, Faisalabad

Analysis of the data following combining ability technique showed that gca, sca and reciprocal effects were significant for the expression of the three characters studied here, except for staple length in which case gca effects remained non-significant. However, greater part of the genetic variability existed in the three characters appeared to be influenced by the genes showing non-additive effects. The data further showed that parent PO/695-FG was the best general combiner for lint percentage and staple length and E288 and PO/695-FG expressed their promise for fibre fineness.

INTRODUCTION

The conduct of genetic experiments is an essential aspect of a breeding programme. The inheritance mechanism of seed-cotton yield and its components, i.e. number of bolls plant^{-1}, boll weight, seed index and lint index had been studied by the authors (Azhar and Rana, 1993). This paper reports the genetic basis of variation in lint percentage, staple length and fibre fineness.

The previous studies revealed inconsistent pattern of inheritance of lint percentage, staple length and fibre fineness. The data reported by Ghafoor and Khan (1987) revealed that lint percentage was controlled by the genes showing non-additive effects whilst in other plant materials the genes acted cumulatively to manifest the character (Khan *et al.,* 1990) and in some cases the alleles showed overdominance (Fatih *et al.,* 1972; Khan *et al.,* 1980). For staple length the genes showed both dominance (Ghafoor and Khan, 1987) and overdominance (Khan *et al.,* 1980, 1990). Similarly, the genetic mechanism of fibre fineness was influenced by the genes which acted in both additive and non-additive fashion (Singh *et al.,* 1987) and in other study showed overdominance (Fatih *et al.,* 1972).

MATERIALS AND METHODS

The detail of the plant materials used in the present studies and the procedure of experimentation had been given in previous paper (Azhar and Rana, 1993). Lint percentage of individual plants was recorded by ginning total picked seed-cotton of plant and seed to lint ratio (lint percentage) was determined. Staple length of plants was measured by tuft method by taking the average of two tufts of each sample. To determine fineness of cotton fibre one sample was taken from a plant and blended thoroughly by using a mechanical blender. Then a subsample of lint (5 g) was placed in micronaire chamber. The lint fibres were compressed by a plunger and air current was allowed to pass through at a pressure of 40 lbs per square inch. The amount of air flow was indicated by the position of the float on the vertical tube connected with compression chamber.

The mean values of the 16 genotypes in three replications were analysed by ordinary variance technique to determine the significance of genotypic differences for the characters. For genetic interpretation, the data were analysed according to the procedure outlined in 'Method 1' and 'Model II' of combining ability technique developed by Griffing (1956).

(1942) and in some cases by reciprocal effects (Griffing, 1956).

The results of combining ability analysis showed that effects of gca were significant ($P<0.01$) for lint percentage and fibre fineness whilst effects due to sca and reciprocals were significant ($P<0.01$) for all the characters (Table 2). The comparison of the relative magnitude of the components of

Table 1. Mean sqaures from analysis of variance for lint percentage, staple length and fibre fineness

Source of variance	DF	Lint percentage	Staple length	Fineness
Blocks	2	0.61	3.45	0.04
Genotypes	15	8.54**	6.79**	0.19**
Error	30	0.52	0.42	0.02

Table 2. Mean squares from combining ability analysis for lint percentage, staple length and fibre fineness

Source of variance	DF	Lint percentage	Staple length	Fineness
gca	3	3.11**	0.61^{NS}	0.07**
sca	6	2.75**	3.33**	0.05**
Reciprocals	6	2.80**	2.06**	0.07**
Error	30	0.17	0.14	0.01

** = Significant at $P<0.01$. NS = Non-significant.

RESULTS AND DISCUSSION

The analysis of variance showed that genotypic differences were highly significant ($P<0.01$) for the three characters (Table 1). The variation in the characters may be affected by general combining ability (gca) effects, specific combining ability (sca) effects as assumed by Sprague and Tatum

variance (Table 3) revealed that non-additive genetic effects were more important in the genetic control of line percentage, staple effects were more important in the genetic control of lint percentage, length and fibre fineness because of the increasing percentages resulting from sca and reciprocal effects (Griffing, 1956). According to Falconer (1981), the characters

under study may show low heritability and suggest that the chances of improving these fibre characteristics through recurrent and single plant selection are very remote. However, this information cannot be generalised and relates only to the plant material studied here. Thus the present investigations need to be substantiated.

characters and it is interesting to note that these two combinations involved a parent which was the poorest combiner for all the characters and yet displayed their promise for the three characters. These results clearly indicated that for the production of good hybrids, the availability of parents with poor or low gca is not always necessary; in some cases the parents with poor or low gca might express their ability to nick with each other and produce hybrids showing increased performance. Similar behaviour of parental lines in hybrid combinations had already been reported by Baluch and Chang (1970) and Azhar *et al.* (1983).

Table 3. Estimates of components of variance for lint percentage, staple length and fibre fineness (Values given in the parenthesis are the percentage of variance due to respective source)

Variance components	Lint percentage	Staple length	Fineness
gca (σ^2g)	0.07 (2.22)	-0.31 (-11.27)	0.003 (4.11)
sca (σ^2_s)	1.59 (50.48)	1.96 (71.27)	0.027 (39.71)
Reciprocals (σ^2r)	1.32 (41.90)	0.96 (34.91)	0.03 (47.06)
Error (σ^2_e)	0.17 (5.40)	0.41 (5.09)	0.006 (8.82)

The comparison of the numerical values assigned to the parents (Table 4) showed that the parent PO/695-FG with maximum value for lint percentage (0.84) and staple length (0.41) proved to be the best general combiner for both the characters and differed significantly from E288 and LSS for lint percentage and staple length, respectively. As for as gca of the parents for fibre fineness is concerned, the parents E288 and PO/695-FG with their lowest values i.e. -0.03 and -0.12, respectively were shown to be the best combiners. The comparison of the numerical values of the accessions showed that LSS and ABG0904 were the poorest general combiners for the three characters, and in contrast E288 and PO/695-FG were revealed to be the best. Thus, these two lines, i.e. E288 and PO/695-FG may be the potential parents in the hybridization programme. The varietal combinations PO/695-FG x ABG0904 and E288 x LSS expressed their superiority for the three

Table 4. Estimates of gca of four parental lines for lint percentage, staple length and fibre fineness

Variety	Lint percentage	Staple length	Fineness
LSS	-0.22	-0.06	0.08
ABG0904	0.03	-0.17	0.07
E288	-0.64	-0.18	-0.03
PO/695-FG	0.84	0.41	-0.12
cd (g_i-g_j)	1.23	1.11	2.28

Table 5. Estimates of sca and reciprocal effects for lint percentage, staple length and fibre fineness. (The values given in parenthesis are for reciprocal effects for the characters)

Cross combination	Lint percentage	Staple length	Fineness
E288 x AB0904	0.28 (-1.13)	0.21 (1.48)	0.16 (-0.10)
PO/695-FG x E288	-0.01 (1.97)	-0.05 (0.44)	0.14 (-0.09)
PO/695-FG x LSS	0.04 (1.11)	0.19 (0.19)	0.13 (-0.02)
ABG0904 x LSS	0.20 (1.12)	-0.13 (-0.67)	0.12 (-0.02)
E288 x LSS	1.13 (0.59)	1.34 (1.75)	-0.10 (0.15)
PO/695-FG x ABG0904	2.41 (-0.03)	0.82 (-0.43)	-0.17 (0.42)
cd (S_{ij} - S_{ik})	1.33	1.19	0.26
cd (r_{ij}-r_{ki})	1.52	1.37	0.07

The data (Table 5) further showed that cross PO/695-FG x E288 for lint percentage, E288 x LSS for staple length and PO/695-FG x LSS and ABG0904 x LSS for fibre fineness remained the best reciprocal combinations. Significant reciprocal differences for the three characters (Table 2) suggest that mixing of single crosses with their respective reciprocals may be avoided if lint percentage, staple length, fibre fineness are used as criterion to improve the quality of cotton fibre. Similar suggestions had already been given in case of cotton (Azhar *et al.*, 1983; Azhar and Akbar, 1992) while studying the inheritance mechanism of yield and its components in this crop.

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