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Gene Action Study in Some Fibre Traits in Cotton *(Gossypium hirsutum* L.)

[1]Muhammad Shahid Mukhtar, [2]Tariq Manzoor Khan and [2]Abdus Salam Khan
[1]Plant Biotechnology Division, NIBGE, Faisalabad, Pakistan
[2]Plant Breeding and Gentles, University of Agriculture Faisalabad, Pakistan

Abstract: A complete diallel cross experiment involving four cotton genotypes was conducted to ascertain the genetic basis of variation in some fibre traits. Additive type of gene action with partial dominance was observed for fibre fineness, fibre uniformity ratio and fibre elongation whereas over dominance type of gene action was operative for fibre strength and fibre maturity. Non allelic interaction was absent in the inheritance of all these traits. It is suggested that partial dominance with additive gene action for the characters under study, selection would be very useful in the early segregating generation.

Key words: Genetic variation, fibre characteristics, over dominance, genetic basis

Introduction

Fibre properties of cotton in Pakistan must continually be improved to cope with the needs of new spinning and weaving technology in world trade competition. Now a days the major emphasis is given to develop cotton varieties with improved fibre characters, without disturbing yield, as these traits go a long way in determining the demand of cotton varieties in the textile industry because the quality of the fabrics depends upon the quality of fibre. So a breeding programme must be launched in such a way to determine the action, interaction and linkage relationship of the genes controlling various plant traits. The diallel cross technique provides an elegant method for the estimation of genetic parameters in terms of components of total variance. To have such information in diallel cross analysis in upland cotton by many workers like Turan (1982), Ma *et al*. (1963), Green and Culp (1990), Khan *et al.* (1991), Murtaza *et al*. (1995), Nadarajan and Rangasamy (1992), Ji and Zhou (1994), May and Green (1994) and Khan *et al*. (1995).

Materials and Methods

The present research was carried out in the glass house and experimental area of department of Plant Breeding and Genetic, University of Agriculture Faisalabad during the year 1997-98. The experimental material comprised of a complete set of diallel crosses among four cotton genotypes viz CIM-1100, CIM-443, VH-57 and CIM-444. The parents were eathern pots placed in glasshouse, at flowering all possible crosses were attempted. The F_0 seeds of twelve hybrids along with their parents were planted in the field using triplicated randomized complete block design during 1998. Each of the entries in a replication was spaced in plant to plant and row to row distance using 30 cm and 75 cm respectively. The recommended agronomic practices were constantly employed for all the treatments. After picking and ginning the seed cotton sample, fibre fineness fibre uniformatiy ratio and fibre elongation was measured with the help HVI 900-A, a fibre testing system developed by M/S Zellweger Uster Switzerland (Zellweger, 1982) while fibre strength was determined by Pressley strength tester using the flat bundle method as specified by ASTM Committee (1977). Fibre maturity percentage was determined in terms of Maturity index as suggested by Firuql *et al*. (1972).
The data thus collected for the above mentioned characters was subjected to Fischer and Yates (1968) analysis of variance technique as reported by Steel and Torrie (1980). For genetic analysis, diallel cross technique developed by Hayman (1954) and Jinkes (1954) was used. The presence or absence of epistatic effects was observed by the following formula given by Hayman (1954) and used by Singh and Chaudhary (1977):

$$t = \frac{1-b}{SE(b)}$$

Results and Discussion

Analysis of variance indicated significant differences among parents and their F_1 progenies for all the five characters. While the variance (Vr) and Covariance (Wr) graphs for these characters are shown in Fig.1 to Fig. 5.

The results of diallel analysis are presented and discussed as under: An examination of Fig. 1 indicates that regression line passes through Wr-axis above the origin, showing additive type of gene action with partial dominance for the fibre fineness. The line does not deviate significantly from the unit slope revealing the absence of non-allelic interaction. The regression line shows that CIM-443, being nearest to the origin possessed maximum diminant gene while VH-57 located farthest from the origin carried most recessive alleles. These findings are supported by the results of Khan *et al*. (1991), Murtaza *et al*. (1995), Nadarajan and Rangasamy (1992) and Khan *et al*. (1995).
Inheritance pattern for fibre strength is operated by over dominance type of gene action (Fig. 2) as the regression line cuts the Wr-axis below the origin. Absence of non-allelic interaction is confirmed because the line does not deviate significantly from the unit slope. The distribution of the varietal points in Fig. 2 suggests that CIM-444 contains the most dominant genes, Whereas maximum numbers of recessive genes are found in VH-57. Several workers like Turan (1982), Ma *et al*. (1963), Green and Culp (1990) and May and Green (1994) also reported over dominance type of gene action for this trait.
A persual of Fig. 3 shows that regression line passes through Wr-axis above the origin indicating additive type of gene action with partial dominance in the phenotypic expression of this trait. The regression line does not deviate significantly from the unit slope, suggesting the absence of epistasis. The scatter of array points in Fig. 3 for fibre uniformity ratio indicates that VH-57 possesses maximum numbers of dominant genes, while CIM-1100 being away contains the recessive alleles for this character. Additive type of gene action for this trait was

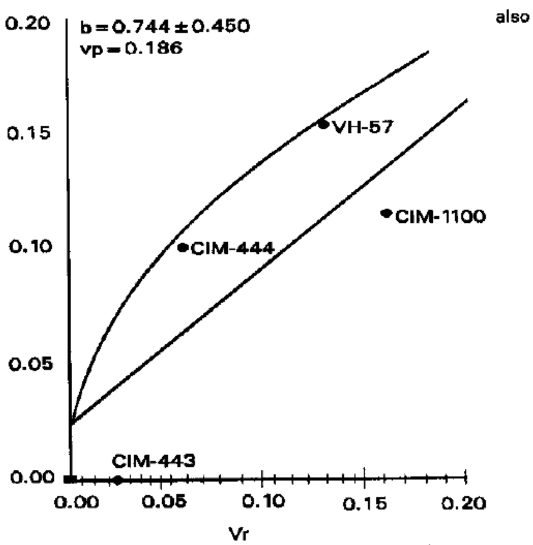

Fig. 1: Vr-Wr graph for fibre fineness (micronaire/inch)

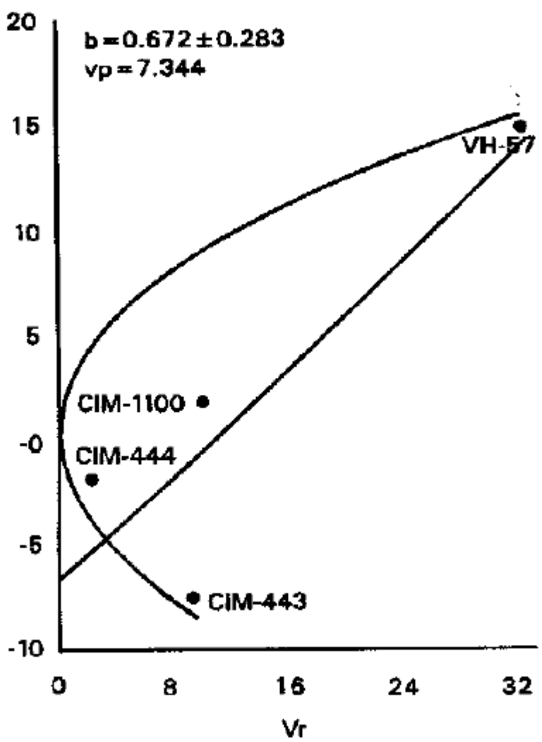

Fig. 2: Vr-Wr graph for fibre strength (000 ibs/inch^2)

Table 1: Mean square values of the cotton fibre characters

Soy	df	Fibre fineness	Fibre strength	Fibre uniformity	Fibre elongation	Fibre muturity
Replication	2	0.059	22.871	0.113	0.043	0.902
Genotypes	15	0.449**	53.024**	5.216**	1.272**	3.892**
Error	30	0.0609	6.6334	0.2067	0.032	1.0838

reported by Green and clup (1990), Nadarajan and Rangasamy (1992) and Ji and Zhou (1994).

Figure 4 reveals that regression line intercepts above the origin and signifying additive type of gene action with partial dominance for fiber elongation. The absence of epistasis is

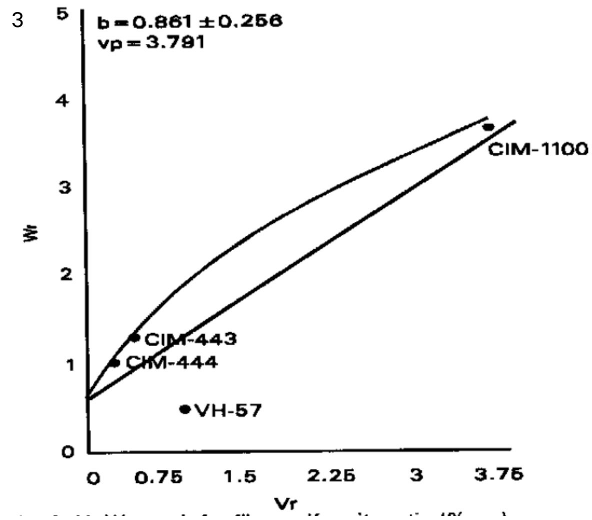

Fig. 3: Vr-Wr graph for fibre uniformity ratio (%age)

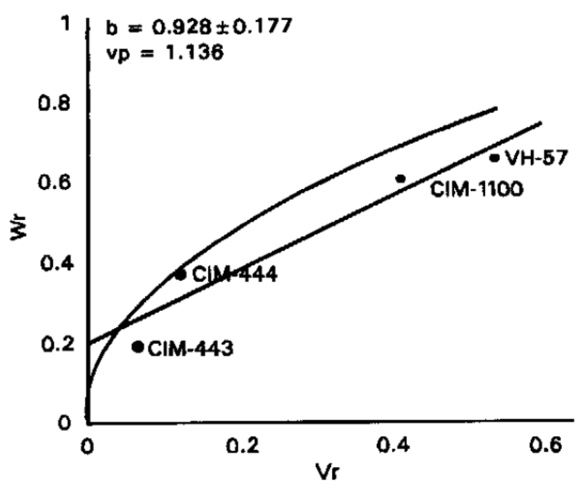

Fig. 4: Vr-Wr graph for fibre elongation (%age)

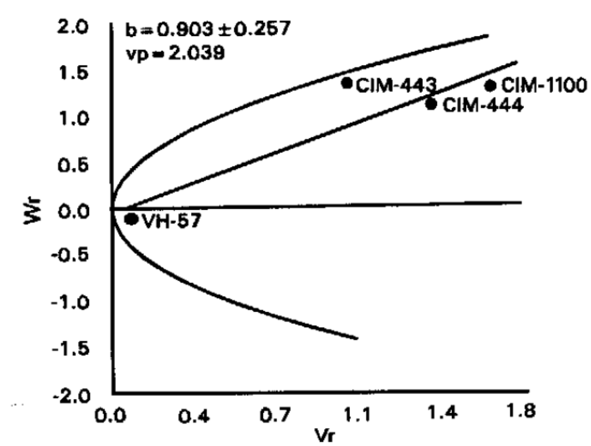

Fig. 5: Vr-Wr graph for fibre maturity (36 age)

concluded as the line does not significantly deviate from the unit slope. Position of array points depicts that CIM-443 being closer to origin contained highest number of dominant genes, unlike VH-57 which carries maximum number of recessive genes to express fibre elongation. Although results disagreed with Green and Culp (1990), Ji and Zhou (1994) and May and Green (1994) which showed over dominance type of gene action. This controversy may be due to differences in genetic material experimented under different ecological conditions. Fibre maturity shows over dominance type of gene action as the interception of the regression line of Wr-axis below the point of origin (Fig. 5). The regression line does not deviate significantly from the unit slope, depictng absence of epistasis. The relative distribution of the array points on regression line indicates that VH-57 nearest to the origin possesses most of the dominant genes while CIM-1100 away the origin occupies the recessive position. Over dominance type of gene action was also reported for this trait. On an overall basis it is observed that additive type of gene action with partial dominance and absence of epistasis for the characters like fibre fineness, fibre uniformity ratio and fibre elongation. This situation is quite helpful to a plant breeder to improve such characters through simple selection, so CIM-443 may be used for further evaluation in the breeding programme to improve these traits for better quality varieties. Most of the characters, on the other hand the characters like fibre strength and fibre maturity is goverened by over dominance type of gene action. Overdominance occurs when most of the progenies score more than that of their parents. Therefore,the progenies showing necrotic effect viz. CIM-444 and VH-57 can be selected for further exploitation particularly in the programme of developing hybrid cottons.

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