STUDY OF GENE ACTION FOR SOME MORPHOLOGICAL PLANT CHARACTERS IN UPLAND COTTON

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Diallel technique was used for the study of some morphological plant characters in a diallel cross of four varieties of *G. hirsutum* L. Additive variation complicated with some non-allelic interaction was observed to be involved in the inheritance pattern of final height of the main stem, number of sympodial branches. For number of bolls plant^{-1}, additive genetic effects with partial dominance was detected. Whilst overdominance type of gene action was operative for number of monopodial branches, yield of seed cotton and boll weight.

INTRODUCTION

Cotton plant belonging to *hirsutum* species produces raw material most important in the build up of the economy of Pakistan. Consequent to the concerted efforts made over the years by the cotton breeders have brought about significant breakthrough in boosting up the total crop productivity in the recent years. According to the Cotton World Statistics (Anonymous, 1992), Pakistan has attained third position among the major cotton growing countries of the world. Although a great deal has been accomplished in the domain of cotton breeding, increasing demand of the raw material in the growing textile and other agrobased industries necessitates the plant breeders to further exploit the potential of the existing germplasm.

The availability of variation in plant characters to be improved and an understanding of genetic basis of variation is the prime requisite of the plant breeders. Such information about the plant material at hand helps the research workers in handling the segregating progenies, and provides guidelines for developing the appropriate selection protocols. With the same purpose in mind, the present studies were undertaken using a small sample of cotton genotypes.

MATERIALS AND METHODS

The present research work was carried out in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during 1990-91. For this purpose, the plant material was developed by crossing four parents i.e. AU 59, La-Okra 551, Imperial Acala and Coker 304 in all possible combinations. The F_1 seed of 12 hybrids and their four parents was planted in triplicate following Randomised Complete Block Design. The seed was dibbled in single rows each having 10 plants spaced 30 cm within the row and 75 cm between the rows. All the agronomic practices were kept constant during growth and development of plants. At maturity, central 6 plants were taken as sampling unit to measure different plant characters, the 2 plants on either end of the rows were left as guarded plants. The plant characters measured were final height of the main stem, number of monopodial branches, number of sympodial branches, number of bolls plant^{-1}, boll weight and yield of seed cotton. The means of each of the families

were analysed according to analysis of variance (Steel and Torrie, 1980). The significant genetic differences for the characters allowed the use of simple additive dominance model given by Hayman (1954) and Jinks (1954).

($P<0.01$) genotypic differences for final height of the main stem, number of monopodial branches, number of sympodial branches and number of bolls, while genetic differences for boll weight and yield of seed cotton were only significant ($P<0.05$). The

Table 1. Mean square values of the characters

S.O.V.	Df	Height of mainstem (cm)	Number of monopodial branches	Number of sympodial branches	Number of bolls plant^{-1}	Seed cotton plant^{-1}	Boll weight (g)
Genotypes	15	1391.09**	58.87**	69.78**	487.37**	0.293*	0.293**
Replications	2	527.38*	11.08**	58.40**	74.96	0.028	0.028
Error	30	207.76	2.22	11.49	110.10	0.125	0.125

*, ** = Denotes significant differences at 5% and 1% probability levels, respectively.

Table 2. Array means, Vr and Wr for some quantitative characters of four varieties of upland cotton

Character	La-Okra 551	Imperial Acala	Coker 304	AU 59	Vr	Wr
Height of main stem	93.38	80.37	86.35	104.98	437.40	365.30
Number of monopodial branches	4.95	3.42	3.90	5.04	24.09	1.50
Number of sympodial branches	12.83	8.33	10.99	14.50	19.44	2.29
Number of bolls plant^{-1}	21.91	19.98	20.55	35.86	102.31	87.72
Yield of seed cotton	70.96	67.20	59.62	117.58	1225.35	855.70
Boll weight	3.17	3.12	2.91	3.17	0.079	0.04

RESULTS AND DISCUSSION

The results of analysis of variance (Table 1) revealed highly significant

significant genotypic differences validate the genetic analysis of the data following the diallel technique. The array means, Vr and Wr for each of the characters are given in

Table 2. Using the Vr and Wr regression coefficient (b) was calculated for each of the characters and drawn in Figures 1 to 6.

while reverse was true for La Okra 551 which had the greatest number of recessive alleles.

Table 3. Concentration of dominant and recessive genes among four varieties for different characters

Character	Most dominant genes	Most recessive genes
Height of main stem	Imperial Acala	La-Okra 551
Number of monopodial branches	AU 59	La-Okra 551
Number of sympodial branches	Imperial Acala	Coker 304
Number of bolls plant^{-1}	AU 59	Coker 304
Yield of seed cotton	AU 59	Coker 304
Boll weight	La-Okra 551	Coker 304

In Vr/Wr graphs, the regression lines for final height of the main stem (b = 0.509 ± 0.273), number of monopodial branches (b = 0.724 ± 0.118) and boll weight (b = 0.553 ± 0.097) departs significantly from a unit slope, and revealed that a component of epistasis was involved in the inheritance of these characters. However, the regression line for number of sympodial branches (b = 0.741 ± 0.157), yield of seed cotton (b = 0.748 ± 0.285) and number of bolls (b = 0.668 ± 0.409) is of unit slopes which signify the absence of genic interaction in the manifestation of these traits.

The wide scatter of array points along the regression line revealed the existance of genetic diversity among the four parents studied here. The distribution of varietal points in Figure 1 suggests that Imperial Acala, being closest to the point of origin, had excess number of dominant genes and in contrast La-Okra 551 carried the maximum number of recessive genes for height of the main stem. The scatter of array points in Figure 2 for number of monopodial branches indicated that AU 59, being in close proximity to the origin, possessed the maximum concentration of dominant alleles,

For number of bolls and yield of seed cotton (Figures 4 and 5), the parent AU 59 appeared to contain the most dominant genes, whereas maximum number of recessive genes for both the characters were found in Coker 304. In case of number of sympodial branches and boll weight (Fig. 3 and 6), the parents Imperial Acala and La-Okra 551, respectively possessed maximum number of dominant genes, while Coker 304 being away contained the recessive alleles in both the characters. Depending upon the distribution of array points, the existance of dominant and recessive genes for all these six characters studied is summarised in Table 3.

The regression lines in Figures 1, 3 and 4 for final height of the main stem, number of sympodial branches and number of bolls, respectively intercepted Wr axis above the origin which suggested the action of the genes for these characters to be additive with partial dominance. However, the regression lines in Figures 2, 5 and 6 for number of monopodial branches, yield of seed cotton and boll weight, respectively intercepted the Wr axis below the origin, which signified the action of the genes for these

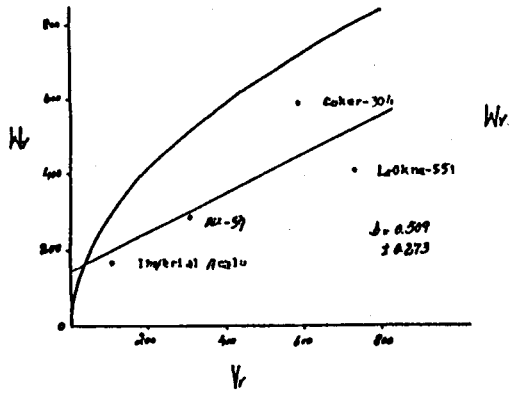

Fig. 1. Final height of the main stem (cm).

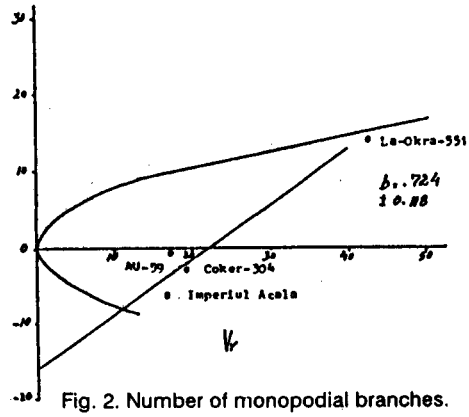

Fig. 2. Number of monopodial branches.

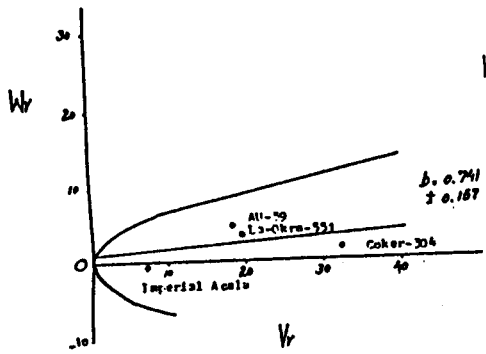

Fig. 3. Number of sympodial branches.

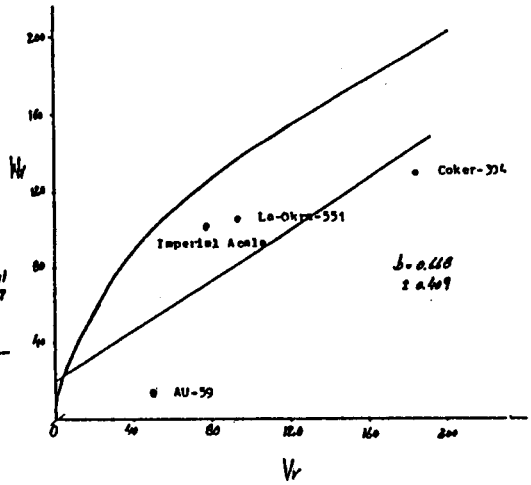

Fig. 4. Number of bolls.

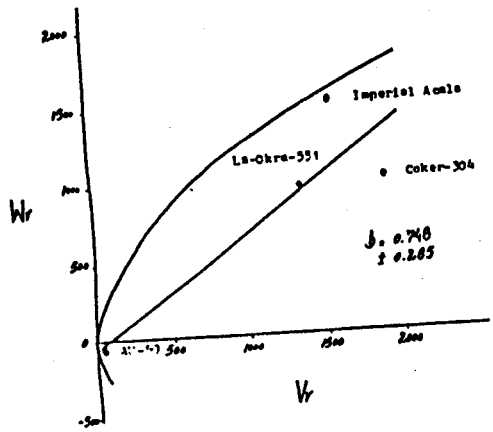

Fig. 5. Yield of seed cotton (g).

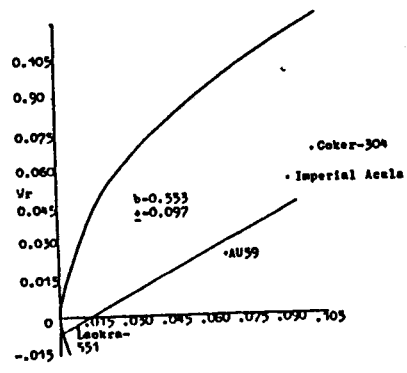

Fig. 6. Boll weight (g).

characters to be overdominant. Due to the presence of additive component in the manifestation of the final height of the main stem, number of sympodial branches and number of the bolls suggests the presence of high heritability as suggested by Falconer (1981) and, therefore, further improvement in these characters through selection may be possible from segregating material. Similar observations were made by Patil (1977), Khan *et al.* (1992) and Murtaza *et al.* (1992). Although, in the present studies, the genetic control of number of monopodial branches, yield of seed cotton and boll weight appeared to be influenced by dominance effects of genes and therefore, low heritability may be present (Falconer, 1981). There is ample evidence available which showed that in some plant material the genes controlling these characters showed over dominance (Patil, 1977; Khan *et al.*, 1990; Khan *et al.*, 1992). This information may be useful for improving cotton plant with respect to these characters.

REFERENCES

Anonymous. 1992. Cotton World Statistics. 45 (2): International Cotton Advisory Committee (ICAC), 1901. Pennsylvania Avenue, N.W., Washington, D.C., USA.

Falconer, D.S. 1981. Introduction to Quantitative Genetics. Longman House, Burn Mill, Essex, UK.

Hayman, B.I. 1954. The theory and analysis of diallel crosses. Genetics, 39: 789-809.

Jinks, J.L. 1954. The analysis of continuous variation in diallel crosses of *Nicotiana rustica* L. varieties. Genetics, 39: 767-788.

Khan, I.A., M.A. Khan, F.M. Azhar and M. Ahmad. 1990. Graphic analysis for gene action controlling different quantitative characters of upland cotton plant. Pak. J. Sci. Ind. Res. 33: 339-341.

Khan, T.M., I.A. Khan, M.A. Khan, N. Murtaza and A.M. Khan. 1992. Genetic analysis of upland cotton under Faisalabad conditions. 1. Yield of seed cotton and its components. Pak. J. Agri. Sci. 29: 170-174.

Murtaza, N., M.A. Khan, I.A. Khan, T.M. Khan and A.M. Khan. 1992. Inheritance of quantitative traits in cotton *(G. hirsutum* L.). 1. Yield and yield components. Pak. J. Agri. Sci. 29: 402-405.

Patil, M.S., 1977. Graphic representation of gene action of some quantitative characters in diploid cotton. Mysore J. Agri. Sci. 11 (2): 123-130.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. McGraw Hill Book Co., NY, USA.