INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2000/02–1-2–121–124

Genetic studies of some important Quantitative Characters in *Gossypium hirsutum* L.

SHAKIL AHMAD, TARIQ MANZOOR KHAN AND ARIF MANZOOR KHAN
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad-38040, Pakistan

ABSTRACT

A 4 x 4 diallel cross experiment was conducted to obtain genetic information on some morphological and economic characters. Plant height, number of sympodial branches, number of monopodial branches per plant and number of bolls per plant were controlled by over dominance type of gene action while number of seeds per boll and yield of seed cotton were controlled by additive type of gene action with partial dominance. From the distribution of array points on regression line it is clear that B-255 had maximum dominant genes for plant height and recessive genes for number of bolls per plant and number of seeds per boll. Albacala had maximum dominant genes for number of monopodial branches, number of bolls per plant and yield of seed cotton. Bombosa had maximum dominant genes for number of seeds per boll. The genotypes possessing maximum dominant genes could be used for further breeding programmes for important characters.

Key Words: Genetics; Quantitative characters; *Gossypium hirsutum* L.

INTRODUCTION

Amongst agricultural commodities of Pakistan cotton is the main source of foreign exchange earning. A great deal of research work has already been done to increase its production and inspite of significant improvement the average yield is still low compared to other cotton growing countries. This emphasizes to exploit the genetic resources especially exotic germplasm having desirable characters which could be incorporated in our local plant material following appropriate breeding strategies which requires primarily the inheritance and genetic mechanisms governing various characters of economic importance.

Waldia *et al.* (1980), Singh *et al.* (1982), Ahmad *et al.* (1983), Bhatade and Bhale (1983), Khan and Ghafoor (1986), Sandhu and Mittal (1988) and Khan *et al.* (1995) reported that plant height, number of sympodial branches, number of monopodial branches, number of bolls per plant and number of seeds per boll and yield of seed cotton were controlled by over-dominant type of gene action. While Zhou *et al.* (1983), Waldia *et al.* (1984), Shah *et al.* (1993), Khan *et al.* (1995) and Saeed *et al.* (1996) reported additive type of gene action for the control of these characters. This paper reports results of genetic studies of some important quantitative characters in *Gossypium hirsutum* L.

MATERIALS AND METHODS

Four lines of cotton (*Gossypium hirsutum* L.) *viz.*, Albacala, Bombosa, B-255 and F-268 were grown in the glasshouse under controlled temperature and light conditions during December, 1995 and were crossed in all possible combinations including reciprocals. The parents were also selfed. The seeds of F_1 crosses including reciprocal and parents were sown in the field during June 1996 in a Randomized Complete Block Design with three replications. Ten plants per family were grown for each replication, out of which eight were treated as experimental plants. The distance between and within rows were 75 and 30 cm, respectively. At maturity data on height of the main stem, number of sympodial and monopodial branches, number of bolls per plant, number of seeds per boll and yield of seed cotton were recorded. Statistical analysis was performed using Steel and Torrie (1980). For genetic analysis diallel techniques (Hayman, 1954 a, 1958; Jinks, 1954, 1955, 1956) were applied. All the crosses were arranged into arrays. Variance (Vr) of the family mean within an array and covariance (Wr) of these means with non-recurrent parental values were calculated from each diallel table. Information on gene interaction was obtained by plotting the covariance (Wr) of each array against its variance (Vr). The slope and the position of the regression line fitted to the array points within a limiting parabola, $Wr^2 = Vp \times Vr$, indicated the degree of dominance and the presence or absence of gene interaction.

RESULTS AND DISCUSSION

Plant height. The average values for plant height for F_1 progenies and parents revealed that differences among various genotypes were highly significant (Table I). It also shows that regression line passes through the Wr-axis below the origin which indicates overdominance

type of gene action (Fig.1a). As the regression does not deviate significantly from a unit slope hence there is no non-allelic interaction. From the position of array points it is indicated that B-255 being nearer to the origin possesses maximum dominant genes while Bombosa being away possesses recessive genes. Similar results have been reported by Waldia *et al.* (1980), Ahmad *et al.* (1983), Khan and Ghafoor (1986).

Fig. 1. V_r/W_r graphs for (a) plant height, (b) sympodial branches, (c)monopodial branches, (d) bolls/plant, (e) seeds/boll, (f) seed cotton

Table I. Mean squares from analysis of variance

S.O.V.	df	Plant height	Sympodial branches	Mmonopodial branches	Bolls per plant	Seeds per boll	Yield of seed cotton
Replications	2	20.17	0.175	0.085	0.015	9.255**	1.28
Genotypes	15	132.22**	1.93**	0.88**	2.82**	16.42**	43.82**
Error	30	39.67	0.12	0.08	0.24	1.32	7.06

Number of sympodial branches. The differences for number of sympodial branches among genotypes are highly significant (Table I). The regression line cut, Wr-axis below the origin, signifying overdominance type of gene action (Fig. 1b). The regression line does not deviate significant from unit slope hence there appears to be no epistatic effect. From the position of array points on the regression line Bombosa had the maximum dominant genes while Albacala had maximum recessive genes being away from the origin. Similar results have been reported by Singh (1980), Ahmad *et al.* (1983) and Khan and Ghafoor (1986).

Number of monopodial branches. For number of monopodial branches the differences among various genotypes are highly significant (Table I). The regression line intercepts the Wr-axis below the origin, hence signifies overdominance type of gene action (Fig.1c). As the regression line does not deviate significantly from the unit slope indicating no non-allelic interaction. From the position of array points on regression line it is clear that Albacala being closer to the origin possesses maximum dominant genes while Bombosa being away from the origin have most recessive genes. Similar results have already been reported by Singh *et al.* (1982), Ahmad *et al.* (1983) and Shah *et al.* (1993). However the results of Zhou *et al.* (1983) and Azhar *et al.* (1994) do not agree with these observations. This may be due to variation in environmental conditions and cotton genotypes used in this study.

Number of bolls per plant. Highly significant differences were observed for number of bolls per plant among the parents and their hybrids (Table I). The regression line intercepts the Wr axis below the origin indicating overdominance type of gene action (Fig.1d). The line does not deviate significantly from the unit slope indicating absence of non-allelic interaction. From the distribution of array points on the regression line it is clear that Albacala being nearer to the origin had maximum dominant genes while B-255 being away from the origin had the most recessive alleles. Khan *et al.* (1995) and Anwar and Khan (1974) reported that this character was overdominantly controlled while according to Khan *et al.* (1979) and Saeed *et al.* (1996) found additive genes involved.

Number of seeds per boll. Mean values for number of seeds per boll showed that the differences among the genotypes were highly significant (Table I). The regression line intercepts the Wr-axis above the origin revealing additive type of gene action with partial dominance (Fig.1e). As the line does not deviate significantly from the unit slope hence absence of non-allelic interaction. From the position of array points on the regression line it is clear that Bombosa being nearest to the origin had maximum dominant genes while B-255 away from the origin occupies maximum recessive genes. These results are quite in agreement with those of Bhatade and Bhale (1983). But Singh (1980), Ahmad *et al.* (1983) and Waldia *et al.* (1984) reported contradictory results with these findings. This may be due to variation in environmental conditions and cotton genotypes used in this study.

Yield of seed cotton. Highly significant differences were observed for yield of seed cotton among the parents and their hybrids (Table I). The regression line intercepts the Wr-axis above the origin revealing additive type of gene action with partial dominance (Fig 1f). As the line does not deviate significantly from 100 unit slope hence their appears no non-allelic interaction. From the position of array points an regression line it is clear that Albacala being nearest to the origin had maximum dominant genes while Bombosa away from the origin occupies maximum recessive genes. These results are in agreement with Sandhu and Mittal (1988). But Waldia *et al.* (1980) and Khan *et al.* (1995) contradictory results with these findings. This may be due to variation in environmental conditions and cotton genotypes used in this study.

REFERENCES

Ahmad, A.A., K.M. Al-Rawi and S.R. Hussain, 1983. Diallel analysis for combining ability and gene action among five varieties of Upland cotton in Iraq. *Iraqui J. Agric. Sci.,* 1: 133–48 (*Pl. Br. Abst.,* 54: 5276; 1984).

Anwar, M.M., and M.A. Khan, 1974. Diallel analysis of some important characters in inter-varietal crosses of cotton (*Gossypium hirsutum* L.). *Pak. J. Agric. Sci.*, 11: 138–47.

Azhar, F.M., N. Khan and S.K. Ajmal, 1994. Genetic basis of variation in upland cotton. *J.Agri. Res.,* 32: 9–16.

Bhatade, S.S., and N.L. Bhale, 1983. Combining ability for seed and fibre characters and its interaction with location in *Gossypium hirsutum* L. *Indian J. Agric. Sci.,* 53: 9584; 1983).

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

Hayman, B.I., 1954b. The analysis of variance of diallel crosses. *Biometrics,* 10: 235–44.

Hayman, B.I., 1958. The theory and analysis of diallel crosses. *Genetics,* 42: 336–55.

Jinks, J.L., 1954. The analysis of continuous variation in diallel cross of *Nicotiana rustica* L. varieties. *Genetics,* 39: 767–88.

Jinks, J.L., 1955. A survey of genetical basis of heterosis in a variety of diallel crosses. *Heredity,* 9: 223–38.

Jinks, J.L., 1956. The F_2 and backcross genetics from a set of diallel crosses. *Heredity,* 10: 1–30.

Khan, M.D., F.M. Azhar, N. Ahmed and M.G. Khan, 1979. Genetic behaviour of *Gossypium hirsutum* L. under Multan conditions. *J. Agri. Res.,* 17: 75–85.

Khan, M.A. and A.Ghafoor, 1986. Gene action and combining ability estimates for yield and its components in Upland cotton (*Gossypium hirsutum* L.). *The Pak. Cottons.*, 30: 52-60.

Khan, A.A., M.A. Khan and K. Aziz, 1995. Diallel analysis of some agronomic characters in *Gossypium hirsutum* L. *J. Agri. Res.*, 33: 403–12.

Saeed, F.T., A. Salam, and M. Ikram, 1996. Gene action in intra-specific hybrids of *Gossypium hirsutum* L. for yield parameters. *J. Agri. Res.,* 34: 65–71.

Sandhu, B.S. and V.P. Mittal, 1988. Genetic analysis of yield and its components in desi cotton. *Indian J. Agri. Res*., 22: 105–9 (*Pl. Br. Abst.*, 59: 9544; 1989).

Shah, S.A.H., M.A. Khan, M.A.Khan and S. Ahmad, 1993. Diallel analysis for gene action and combining ability in cotton. *Pak. J. Agri. Res.,* 14: 101–3.

Singh, M., 1980. Genetic of some quantitative characters in upland cotton (*Gossypium hirsutum* L.). *Indian J. Agric. Sci.*, 50: 106–7 (*Pl. Br. Abst.,* 51: 10716; 1981).

Singh, T.H., L.S. Sandhu, L.S. Randhawa and P.S. Nagi, 1982. Combining ability studies in desi cotton (*Gossypium arboreum* L.). *Crop Improvement,* 9: 37–41.

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

Waldia, R.S., B.R. More and D.S. Jatasra, 1980. Line x tester analysis for yield and economic attributes in *Gossypium hirsutum* L. *Indian J. Agric. Sci.,* 50: 745–7 (*Pl. Br. Abst.,* 52: 5883; 1982).

Waldia, R.S., B.R. More and J.S. Yadava, 1984. Combining ability for yield and its components in desi cotton. *Haryana Agri. Univ. J. Res.,* 14: 151–6.

Zhou, Y.Y., R.T. Wang and C.G. Liu, 1983. Genetic analysis of characters in the progeny of an intervarietal hybrid of Upland cotton. *Acta Agric. Univ. Pek.,* 9: 27–34 (*Pl. Br. Abst.,* 54: 3321; 1984).

(Received 10 January 2000; Accepted 02 April 2000)