GENETIC ANALYSIS OF UPLAND COTTON UNDER FAISALABAD CONDITIONS. I. YIELD OF SEED COTTON AND ITS COMPONENTS

Tariq Manzoor Khan, Iftikhar A. Khan, Manzoor A. Khan, Naveed Murtaza & Arif Manzoor Khan
Department of Plant Breeding & Genetics, University of Agriculture, Faisalabad
Cotton Research Institute, Faisalabad.

A complete diallel set of crosses among six cultivars of cotton were analysed to evaluate the gene action controlling the phenotypic manifestation of yield of seed cotton and its components. Additive type of gene action was observed for number of bolls, while over-dominance type in case of boll weight and yield of seed cotton. No epistatic effects were observed in the inheritance of these characters.

INTRODUCTION

Cotton is one of the most important cash crop of Pakistan. Since independence in 1947 efforts have been underway to improve the genetic architecture of cotton plant and as a result a large number of varieties, like AC134, L11, 149F, B557, MNH 93, NIAB 78, CIM 70 and S 12 were evolved. Due to these varieties, our per acre yield of lint has increased from 165 lb acre^{-1} in 1947 to 542 lb acre^{-1} in 1991 (Anonymous, 1991). Apart from this, country had experienced two serious cotton production debacles in the past, first in 1976-77 and the second in 1983-84 when our national production decreased to almost 50% (Anonymous, 1991). This fluctuating behaviour of prevailing genotypes of our cotton plant might be due to the fact that some of them are not adequately adapted to our local environmental conditions. Therefore, to have our cotton plant more productive per unit area and to resist minor fluctuations in the prevailing environmental conditions, it is important to breed the future cotton varieties under these conditions and to incorporate desirable genes from exotic types to our local ones. In addition to this, a comprehensive information about the gene action involved in the inheritance pattern of various plant traits is very important to achieve such goals.

Studies indicating genetic behaviour of various cotton cultivars have been conducted in different cotton growing countries of the world by a number of workers such as Jain (1980), Singh *et al.* (1982), Khan *et al.* (1983), Mirza and Khan (1984) and Rehman *et al.* (1988). They reported the genetic basis of different plant traits of upland cotton and emphasized the importance of such studies for further breeding.

It was, therefore, planned to have such information from a 6 x 6 diallel cross experiment involving exotic varieties and a local type strain.

MATERIALS AND METHODS

The experimental materials consisted of six cultivars of cotton including one local (272/79) and five exotic (Aleppo 45, Okra, Coker 5110/111, Brace 81/6 and BPA/66). The material fulfilled the assumptions of

diallel analysis. These parents were crossed for all possible combinations to make a complete diallel set of crosses during November 1985 in greenhouse. The resulting 30 F_1 alongwith their corresponding parents were raised in randomized complete block design with four replications during 1986-87 in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Each genotype comprised of a single row of 10 plants spaced 30 cm apart, keeping 75 cm distance between the rows. The middle six plants from each row observed for the studies and two on either side were left as non-experimental. Fertilizers were applied @ NPK 140-40-0 lbs $acre^{-1}$ with nitrogen split in three stages, before sowing, with first and second irrigations. The field was irrigated four times during the growing season. Manual weeding was carried out and insect pests were controlled with appropriate insecticides.

RESULTS AND DISCUSSION

The analysis of variance (Table 1) showed highly significant variance for all the three characters. Th mean values of parents (selfs) and F_1 hybrids are presented in Table 2, while the variance (vr) and covariance (Wr) graphs for the characters are shown in Figure 1 to Figure 3.

For number of bolls $plant^{-1}$ (Fig. 1) indicated additive type of gene action with partial dominance controlling the inheritance pattern of this character as the regression line with a unit slope intercepted the Wr axis above the origin. From the position of array points on the regression line, 272/79 seemed to have maximum dominant genes and Brace 81/6 the recessive ones because of their closest and the farthest position from the origin, respectively. The results are in accordance with the findings of Singh *et al.* (1982), Mirza and Khan (1984) and Rehman *et al.* (1988) who reported additive gene effects for the phenotypic manifestation of number of bolls $plant^{-1}$. This type of gene action reveals the possibility of improvement in this character through simple selection procedures.

Table 1. Mean square values of the characters

S.O.V.	Df	Number of bolls	Boll weight	Yield of seed cotton
Variety	35	130.04**	0.967**	2047.13**
Replications	3	672.13	5.53	3486.27
Error	105	36.48	0.20	607.51

** = Highly significant.

The data in respect to number of bolls, boll weight and yield of seed cotton were obtained from each marked plant. The data collected were statistically analysed for their variances following Steel and Torrie (1980). For genetic analysis, diallel cross technique developed by Hayman (1954 and Jinks (1954) was used.

Table 2. Mean values for parents and F_1 hybrids

Genotype/ Crosses	Number of bolls	Boll weight (g)	Yield of seed cotton (g plant^{-1})
Aleppo 45	10.45	4.12	43.05
Okra	18.80	3.19	69.91
Coker 5110/III	11.49	4.00	47.01
272/79	25.78	3.68	85.27
Brace 81/6	7.70	4.83	37.44
BPA/66	20.17	3.49	66.40
Aleppo 45 x Okra	16.98	3.99	69.91
Aleppo 45 x Coker 5110/III	12.28	4.24	53.27
Aleppo 45 x 272/9	22.55	4.44	83.15
Aleppo 45 x Brace 81/6	11.93	4.37	47.77
Aleppo 45 x BPA/66	19.85	4.97	94.87
Okra x Coker 5110/III	18.23	4.34	75.55
Okra x 272/79	27.95	3.54	92.89
Okra x Brace 81/6	16.68	4.60	78.53
Okra x BPA/66	21.53	4.01	87.12
Coker 5110/III x 272/79	24.76	4.37	113.53
Coker 5110/III x Brace 81/6	11.93	4.88	57.36
Coker 5110/III x BPA/66	16.52	4.64	84.31
272/79 x Brace 81/6	22.61	4.18	99.14
272/79 x BPA/66	24.81	3.80	95.70
Brace 81/6 x BPA/66	18.80	4.63	87.76

A perusal of Figure 2 revealed over-dominance type of gene action controlling inheritance pattern of boll weight as the regression line with a unit slope passed through Wr axis below the origin. The distribution of array points on the regression line showed that Brace.81/6, being closer to the origin, possessed the maximum dominant genes, while BPA/66 being away from the origin possess the maximum recessive ones. Over-dominance for boll weight has been observed by Jain (1980), Singh *et al.* (1982) and Khan *et al.* (1983) in diallel analysis of various cotton cultivars. Moreover, over-dominance is manifested where most of the progenies score more than the parents which in other words is heterosis. Therefore, heterosis also contributed in the phenotypic expression of this character in the present studies.

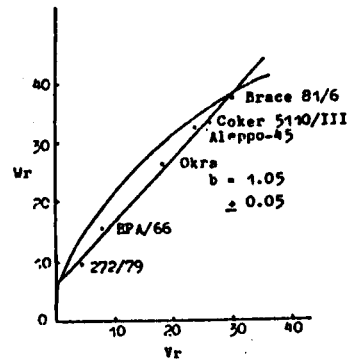

Fig. 1. Vr/Wr graph for number of bolls per plant.

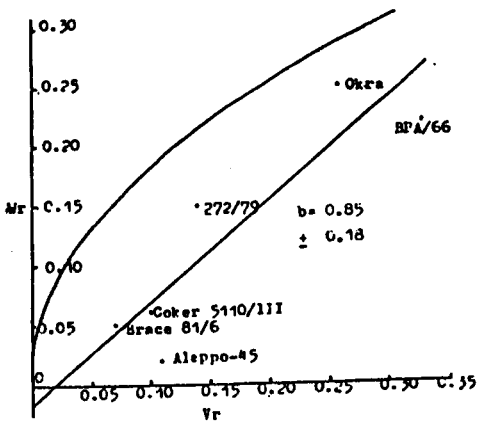

Fig. 2. Vr/Wr graph for boll weight.

Yield of seed cotton (Fig. 3) was found to be controlled by over-dominance type of gene action as the regression line with a unit slope cut the Wr axis on negative side. It is obvious from the position of the array points on the regression line that BPA/66 being nearer to the origin contain the maximum

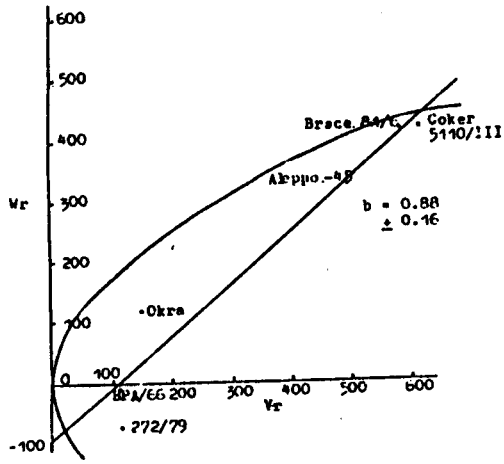

Fig. 3. Vr/Wr graph for yield of seed cotton.

dominant genes, while Coker 5110/III being farther possessed the maximum recessive genes. Like boll weight, this character has also been reported to be controlled by over-dominance type of gene action by Singh *et al.* (1982), Khan *et al.* (1983) and Rehman *et al.* (1988). Heterosis also played a role in the expression of yield of seed-cotton. In this study, we had seen (Table 2) that genotype 272/79 contributed genes which gave maximum number of bolls and yield of seed cotton plant^{-1}. Its cross with Okra gave maximum number of bolls (27.95) while its cross with Coker gave best yield of seed cotton plant^{-1} (113.53 g). As for as boll weight was concerned, cross Aleppo 45 x BPA/66 gave maximum boll weight (4.97 g). So these crosses would be the obvious choices for selection as these would be expected to produce wide genetic variability in segregating generations and these would, therefore, offer wider scope of selection for number of bolls, boll weight and yield of seed cotton.

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