

GRAPHIC ANALYSIS FOR GENE ACTION CONTROLLING DIFFERENT QUANTITATIVE CHARACTERS OF UPLAND COTTON PLANT

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From the results of F_1 full diallel analysis of four unrelated cotton genotypes, the nature of the gene action for yield of seed cotton, boll number, boll weight and staple length appeared to be overdominant whereas genes for lint percentage were cumulative in their effects showing non-allelic interaction. The cultivars St. 213 and AC 134 proved the best general combiners for yield and boll number. For boll weight, AUH 33 appeared to be good combiner whereas ST. 213 and Coker 310 showed their superiority for staple length and lint percentage respectively. The inheritance pattern of the characters suggested that development of F_1 hybrids involving these cultivars may show their promise for increasing cotton production.

Key words. Gene action, Cotton plant, Graphic analysis.

Introduction

The present study is a part of the efforts being made to develop an understanding about the genetic potential of plant material to be used for improvement in cotton plant. A small sample of four genotypes representing both local and exotic origins was taken from the genetic stock, and analysed following diallel technique developed by Hayman [1] and Jinks [2].

Materials and Methods

The experimental material involved in the present study was developed from crossing two local cultivars namely AC 134 and AUH 33 and the two exotics i.e., St. 213 and Coker 310.

These four parents were carefully crossed in diallel fashion to produce sufficient F_1 seed. The experiment was carried out in a glasshouse and the seeds of 16 entries including the parents were pot-planted during winter. The six earthen pots of each genotype were arranged following a completely randomized design. Sowing of the experiment was done by dibbling the seed of F_1 mixed with four seeds of desi cotton to enhance germination. After germination is complete, the plants of desi cotton were removed from the pot. The temperature in the glasshouse ranged from 80°- 120°F and it was maintained by using gas boilers and built-in electric heaters. The 16 hr natural daylength was provided by additional lighting using 400 watt mercury vapour lamps. At maturity, the data about yield of seed cotton, number of bolls per plant, boll weight, lint percentage and staple length of each plant were recorded.

Total produce of the plant was weighed (gm) to record yield of seed cotton per plant. For boll number actual count of the effective bolls of each plant was made, and for boll weight total plant yield was divided by its respective boll number.

For lint percentage total picked seed cotton of a plant was ginned and seed-lint ratio was calculated with the help of slide rule. Staple length (mm) was estimated by tuft method i.e., taking the average of two tufts of each sample.

The genotypic differences with respect to each of the characters were detected by subjecting the data to the usual analysis of variance technique. To investigate the type of gene action and distribution of genes in the four parents, the diallel table from the family means of each of the characters was prepared and variance of the components of each array (V_r) and co-variance of all the off-spring included in each parental array with the non-recurrent parent (W_r) were computed. The information about the type of gene action was extracted by erecting V_r/W_r graphs as suggested by Hayman [1] and Jinks [2]. The slope and position of the regression line with regard to array points lying within the limiting parabola ($W_r^2 = V.P. \times V_r$) indicated the degree of dominance and presence or absence of gene interaction in the expression of the character.

Results and Discussion

The results of analysis of variance (Table 1) showed that the differences among the sixteen genotypes were highly significant ($P \leq 0.01$) for yield of seed cotton, boll number and staple length while for boll weight and lint percentage these were significant ($P \leq 0.05$). These significant

TABLE 1. ANALYSIS OF VARIANCE OF SOME QUANTITATIVE CHARACTERS OF UPLAND COTTON.

Variation due to	D.F	Mean squares				
		Yield of seed cotton	Boll number	Boll weight	Staple length	Lint percentage
Genotypes	15	50.95**	5.32**	0.81*	10.12**	22.73*
Error	80	10.65	1.45	0.40	2.68	12.10

**Denotes differences significant at $P \leq 0.05$ and $P \leq 0.01$, respectively.

differences validate genetic analysis of the data following the diallel technique of Hayman [1] and Jinks [2]. The array means for different characters are given in Table 2.

TABLE 2. ARRAY MEANS OF SOME QUANTATIVE CHARACTERS OF FOUR VARIETIES OF UPLAND COTTON.

Characters	AC 134	AUH 33	St.213	Coker 310
Yield of seed cotton	11.67	10.87	11.68	9.49
Number of bolls	4.78	4.20	4.79	4.25
Boll weight	2.49	2.58	2.45	2.26
Staple length	24.10	24.38	24.75	23.90
Lint percentage	32.81	34.14	34.56	34.94

In V_r/W_r graphs (Figs. 1- 4) the regression line for yield of seed cotton ($b = 0.77 \pm 1.40$), boll number (1.26 ± 0.90), boll weight ($b = 1.12 \pm 0.02$) and staple length ($b = 0.64 \pm 0.58$) did not depart significantly from a unit slope, which signify the absence of genic interaction in the manifestation of these traits. However, significant deviation of regression line from unity ($b = 0.13 \pm 0.17$) for lint percentage (Fig. 5) revealed that a component of epistasis was involved in the inheritance of the character.

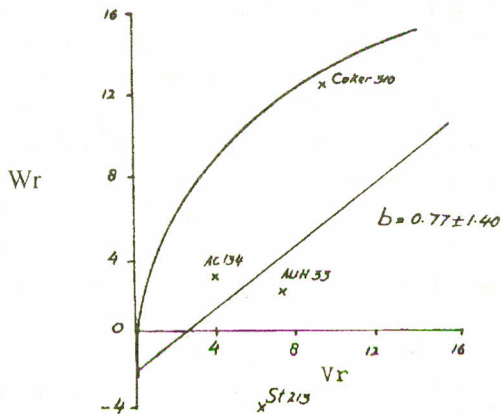


Fig. 1. Yield of seed cotton.

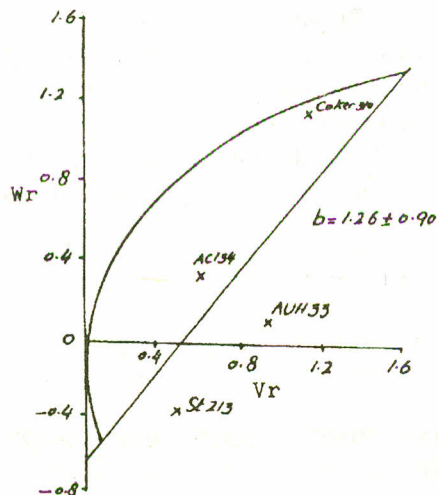


Fig. 2. No. of boll/Plant.

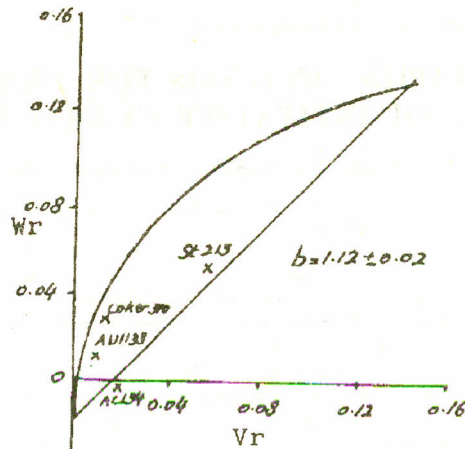


Fig. 3. Boll weight.

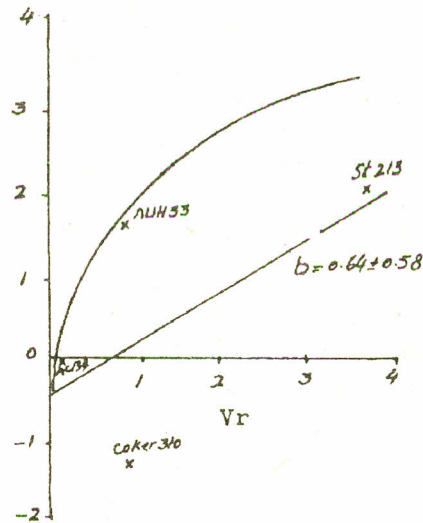


Fig. 4. Staple length.

The wide scatter of array points along the regression slope of all the characters reveals the existence of genetic diversity among the four parents used in these studies. The distribution of varietal points on the graphs suggests that AC 134 being closest to the point of origin, has excess number of dominant genes and in contrast Coker 310 carries the maximum number of recessive genes for yield of seed cotton. The scatter of array points for boll number indicates that St. 213 being in close proximity to the origin possesses maximum concentration of dominant alleles whilst reverse was true of Coker 310 which has the highest number of recessive alleles.

For boll weight and lint percentage the parent AUH 33 appeared to contain the most dominant genes whereas maximum number of recessive genes for both the characters were found in St. 213. In case of staple length, the parent AC 134 possesses maximum number of dominant genes while St. 213 being away contains the recessive

alleles. Depending upon the distribution of array points, the existence of dominant and recessive genes for all these five characters studied is summarized in Table 3.

TABLE 3. CONCENTRATION OF DOMINANT AND RECESSIVE GENES AMONG FOUR VARIETIES FOR DIFFERENT CHARACTERS.

Characters	Most dominant genes	Most recessive genes
Yield of seed cotton	AC 134	Coker 310
bolts Number	St. 213	Coker 310
Boll weight	AUH 33	St. 213
Staple length	AC 134	St. 213
Lint percentage	AUH 33	St. 213

The regression lines in Figs. 1-4 for yield of seed-cotton, boll number, boll weight and staple length intersected the W_r axis below the origin, which suggest the action of the genes for these characters to be overdominant. The absence of non-allelic interaction in the manifestation of yield of seed-cotton, boll number, boll weight, and staple length suggests that additive- dominance model of Hayman [1] and Jinks [2] was adequate for genetic analysis of the data set of these characters. However, significant deviation of regression line from unity (Fig. 5) indicated the involvement of epistatic component in the expression of lint percentage, and this complicacy in the inheritance of the character may be due to either linkage, or non-independent distribution of genes in the parental lines, as suggested by Mather *et al.* [3] and perhaps the presence of genic interaction in the hereditary pathway of lint percentage is not surprising in view of the genetic diversity of the material involved in the present investigations, as has been observed in sorghum [4].

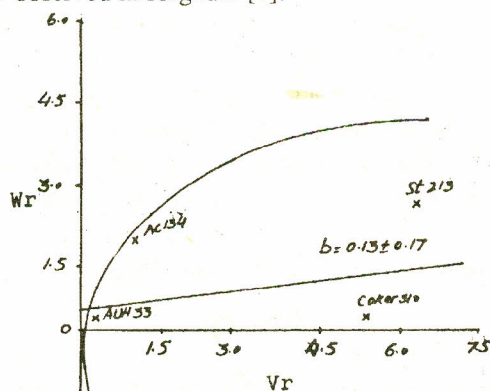


Fig. 5. Lint percentage.

Due to the presence of non-allelic interaction the heritability of lint percentage may be low, nonetheless the presence of additive component in the manifestation of the character to suggest that further improvement in lint percentage is possible by making rigorous selection from segregating material. Similar were the observations of [5-9], who noted non-allelic component in their experimental material, and suggested the workers/ breeders

to be careful and imaginative while screening their breeding population. Although in the present studies the genetic control of seed-cotton yield, boll number, boll weight and staple length did not appear to be due to genes with additive effects [6,10, 11,], there is ample evidence available which show that in some plant material the genes controlling these characters showed over-dominance [5,6,8,11-14]. This information may be useful for increasing cotton production, and in the light of present findings it may be suggested that for the development of hybrid cotton the germplasm tested here be utilized advantageously in hybridization programme, depending upon their general combining ability.

The overall comparison of the array means given in Table 2 provided a clue that St. 213 and AC 134 with their largest array means proved to be the best general combiner for yield of seed cotton and number of bolls. For boll weight AUH 33 appeared to be good general combiner whereas St. 213 and Coker 310 showed their superiority for staple length and lint percentage. This information about combining ability of the varieties may help the breeders to develop a well conceived breeding programme for improvement in yield of seed cotton.

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