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COMPARISON OF GENE ACTION CONTROLLING SOME ECONOMIC CHARACTERS IN UPLAND COTTON UNDER DIFFERENT CONDITIONS

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An F_1 full diallel cross of 6 parental lines was used to investigate the type of gene action for the yield of seed cotton, boll number and boll weight under normal and presowing seed treatment at 60^o. The results indicated predominance of additive gene action for yield and its components under both situations except boll weight, for which gene action was altered to overdominance under treated conditions. Non-allelic interaction was pronounced for yield and boll number. The presence of overdominance for boll weight suggested that development of F_1 hybrids will be of paramount importance to increase the yield of seed cotton.

INTRODUCTION

Cotton yield is a complex phenomenon affected by many factors. Although a great deal has been accomplished in cotton breeding by way of the evolution of high potential varieties with wider adoptation, yet there is need for further efforts for genetic improvement of cotton. Cotton being a sensitive plant is prone even to the slightest alteration in environment. Evidently, the conduct of the study to ascertain the genetic behaviour of yield and its components under different environmental conditions is imperative for any crop improvement programme.

The diallel cross technique developed by Hayman [5] and Jinks [6] is a common statistical tool which is used to obtain information on the type of gene action involved in various quantitative characters in an early generation of the crosses. The genes responsible for yield and its components have been reported to be additive and non-additive in action [2, 3, 4, 7, 10, 11 and 12]. Khan *et al.* [8] advocated that yield and boll number were governed by loci with additive effects with varying degrees of dominance. They also reported that yield was influenced by overdominance whereas genes for boll number and boll weight appeared additive in action [9]. Similarly Singh *et al.* [13] studied inheritance pattern for five yield related characters of cotton, and reported additive gene action for the manifestation of boll number. Bhatade and Bhale [1] recorded that additive effects of the genes had a major influence on boll weight and seeds per boll.

The purpose of the present study was to obtain some information about the genetic basis of yield and other economic characters under different conditions. Such information would further help in the formulating future breeding programme.

MATERIALS AND METHODS

Four exotics, namely Acala 4-42, Dingdung, DPSL and Dixiking and two local cultivars, i.e., AU 14 and AC 134 were selected for the present investigations. The six parental lines were field planted in the research area of the Department and were crossed in all possible combinations to produce a sufficient number of F_1 seeds. During the next crop year, half of the seed of thirty hybrids and six parents was treated at 60^o for 24 h, while the second half was kept untreated. Two sets of experiment were planted in May, 1980 in randomized complete block design with 3 replications. Fourteen plants of each progeny were grown in each row of about 3 m length, the row-to-row distance being 60 cm. At maturity, the ten central plants were taken as the experimental unit. Two plants at either end of the row were discarded.

The yield of seed-cotton per plant was recorded. Effective bolls per plant were also counted and total seed cotton per plant was divided by respective boll number to obtain the weight of seed cotton per boll (boll weight).

The family averages in each replication were counted and subjected to usual analysis of variance technique to establish the level of significance among the hybrids and the parents. Critical differences among the means were tested by LSD test. For genetic analysis, the necessary diallel tables for each character were prepared from the family memo. Two statistics, i.e. variance ($V\gamma$) of the family means. and co-variance (Wr) of these means with non-recurrent parental values were calculated and information about the type of gene action was inferred by erecting Vr/Wr graphs, as described by Hayman [5] and Jinks [6].

RESULTS AND DISCUSSION

The mean squares for the yield of seed cotton, number of bolls and boll weight are provided in Table 1. The varietal array means of all the characters under normal and treated conditions are presented in Table 2 and Vr/Wr graphic representations are shown in Fig. 1–6. The important observations derived from the analysis are described here.

YIELD OF SEED COTTON

We found that genotypic differences under normal conditions were highly significant. Under treated conditions, the probability was significant (Table 1). The regression line deviated significantly (b = 0.004 ± 0.270) from the unit slope, indicating the existence of strong genic interaction for this character (Fig. 1). The regression line intersected the Wr axis just above the origin which indicated the action of the genes to be cumulative in nature. The wider scatter of the array points in the graphical analysis indicate wide genetic diversity among the parents for this trait. The parent Acala 4-42, being closer to the point of origin, contained an excess of dominant genes, whereas Dixiking being situated farthest from the origin carried the maximum number of recessive alleles for the yield of seed cotton.

We found that presowing temperature treatment did not alter the mechanism for the manifestation of yield per plant except that varietal distribution along the regression line was disturbed. DPSL shifted towards the origin and possessed the maximum number of dominant genes while Dingdung being away had recessive genes. While studying the gene action in upland cotton, Khan *et al.* [7] and Moneium *et al.* [11] also demonstrated consistent gene action in different environments for the yield of seed cotton. These results appeared to be in great accord with those of Desai *et al.* [4], Khan *et al.* [8]

Table 1. Mean square values of some economic characters in upland cotton.

Source of variation	D.F.	Yield per plant		Boll number		Boll weight	
		Normal	Treated	Normal	Treated	Normal	Treated
Replications	2	16.70	214.06	21.12	0.18	0.03	0.89
Genotypes	35	200.37**	301.86*	44.47**	62.37*	0.26*	1.18*
Error	70	46.25	186.47	23.05	35.71	0.14	0.10
Cd_1		11.08	22.27	7.83	9.74	0.60	0.52
Cd_2		14.73	29.58	10.40	12.95	0.80	0.69

*, ** = Significant and highly significant respectively.

Table 2. Varietal array means of some economic characters in upland cotton under different conditions

Characters	AU 14	Acala 4-42	Dingdung	Dixiking	DPSL	AC 134
Yield of seed cotton/plant (g)	30.91 (38.42)	33.92 (28.34)	28.59 (30.73)	31.78 (27.32)	29.89 (27.63)	26.47 (24.97)
Number of bolls per plant	14.32 (18.65)	16.50 (13.51)	13.47 (17.12)	13.06 (13.91)	12.98 (13.77)	13.44 (14.57)
Boll weight (g)	2.26 (2.08)	2.01 (2.14)	2.06 (1.95)	2.08 (2.00)	1.89 (2.06)	1.89 (1.95)

The values given in the parenthesis are for treated conditions.

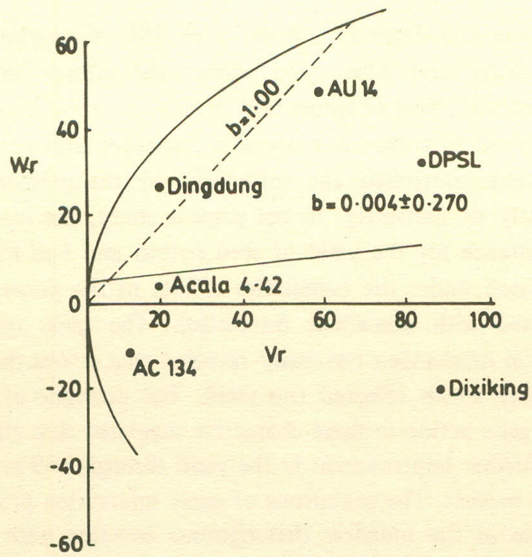

Fig. 1. Yield of Seed Cotton (Normal)

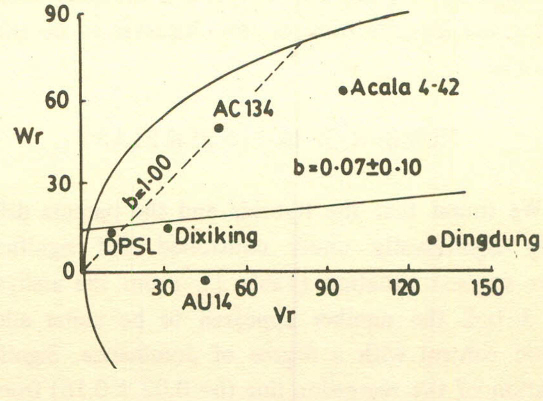

Fig. 2. Yield of Seed Cotton (Treated)

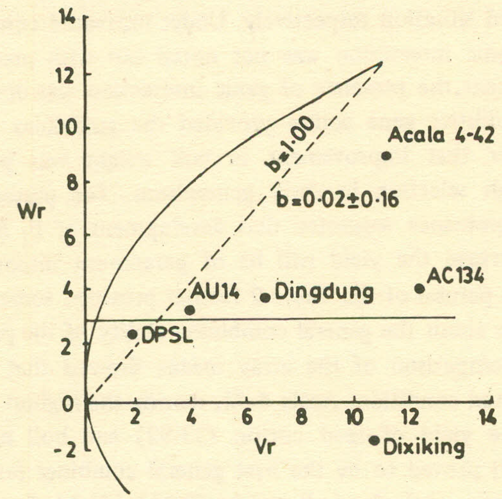

Fig. 3. Boll Number (Normal).

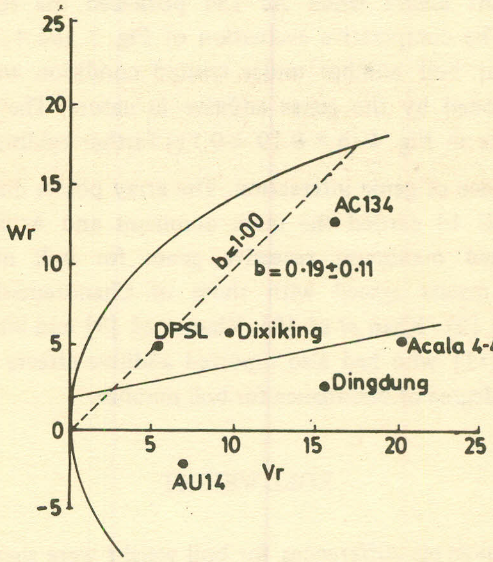

Fig. 4. Boll Number (Treated).

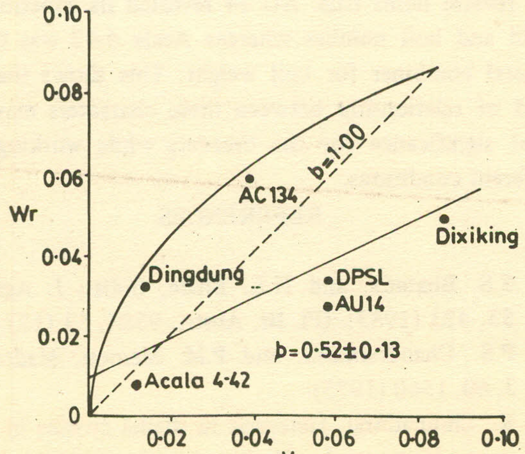

Fig. 5. Boll Weight (Normal)

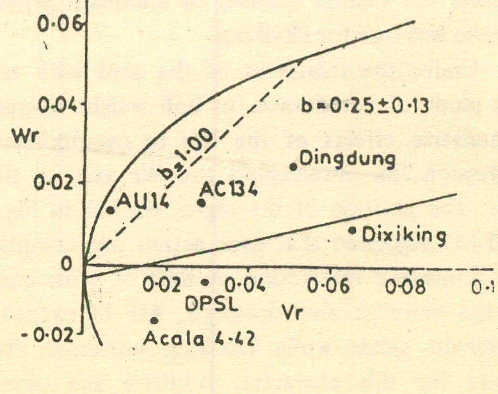

Fig. 6. Boll Weight (Treated)

and Singh *et al.* [12] who also found the genes responsible for the manifestation of the character to be additive in action.

NUMBER OF BOLLS PER PLANT

We found that the hybrids and the parents differed highly significantly under controlled and significantly under stressed situation (Table 1). From the analysis of Fig. 3 boll the number appeared to be under additive genetic control with a degree of dominance. Significant deviation of the regression line (b= 0.02 ± 0.16) from the unity revealed non-allelic interaction for this character. The parent DPSL, being close to the origin had maximum dominant alleles while Ac 134 possessed the recessive ones. The comparative evaluation of Fig. 3 and 4, indicated that boll number under treated condition was also conditioned by the genes additive in nature. The regression line in Fig. 4 (b = 0.19 ± 0.11) further exhibited the prevalence of genic interaction. The array points displayed that AU 14 carried the most dominant and Acala 4-42 contained maximum recessive genes for boll number. These results agreed with those of Chandramathi and Memon [2], Khan *et al.* [8], Khan *et al.* [9] and Moneium *et al.* [11] who had also reported additive effects of loci with a degree of dominance for boll number.

BOLL WEIGHT

Genotypic differences for boll weight were significant under both situations (Table 1). A study of Fig. 5 indicates that boll weight appears to be under the additive control of the genes as the regression line with unit slope cuts the Wr axis just above the origin. The varietal distribution along the regression line indicates great genetic diversity among the parents for boll weight. Acala 4-42, appears to possess the highest number of dominant genes while the reverse was true for Dixiking.

Under the treatment of the seed with temperature, the mode of inheritance for boll weight altered from the cumulative effects of the loci to overdominance as the regression line intercepted the Wr axis on the negative side. The position of the regression line in Fig. 6 (b = 25 ± 0.13) suggested that gene action was complicated with the non-allelic interaction. A shift of genic concentration in the varieties also occurred. AU 14 carried the most dominant genes while Dixiking possessed the recessive alleles for this character. Additive and overdominance type of genetic mechanism had also been reported by Bhatade and Bhale [1], Khan *et al.* [8], Khan *et al.* [9] and Mirza and Khan [10], hence the present findings agreed with those of earlier reports.

Yield in cotton is a complex character which is polygenically controlled and influenced by the environment directly or indirectly. In the present study, the mode of inheritance for the yield of seed cotton and boll number appeared under the cumulative effects of the genes complicated with non-allelic interaction. The same type of genetic mechanism obviously revealed that it was the boll number which affected the yield. The presence of additive gene action in these characters suggested that chances for further improvement in the yield through boll number were present. The prevalence of genic interaction provided a clue to the breeders that rigorous selection with great care and imagination should be exercised to pinpoint the desirable segregates of the crosses.

The inheritance pattern for boll weight was under additive and overdominance gene action under normal and stressed situation respectively. Under untreated conditions the genic interaction was not noted out with presowing treatment, the presence of genic interaction was observed. The additive gene action provided the guidelines to the breeder that improvement in boll weight was possible through selection in early generations. The presence of overdominance suggested that development of F_1 hybrids to increase the yield will be of paramount importance.

A perusal of the Table 2 further provided some information about the general combining ability of the parents. The comparison of the array means showed that under untreated condition, Acala 4-42, scoring the highest values for the yield of seed cotton (33.92) and boll number (16.50) proved to be the best general combiner for these characters while for boll weight (2.26) AU 14 showed its promise. But with the temperature treatment of the seed, the reverse holds true. AU 14 revealed its superiority for yield and boll number whereas Acala 4-42 was the best general combiner for boll weight. This shows that some kind of relationship between these characters may be of great significance for the breeders while working under different conditions.

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