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GENETIC COMPONENTS OF VARIATION IN UPLAND COTTON (*G. hirsutum* L)

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ABSTRACT

A ten parent diallel cross analysis involving bollworm tolerant donor lines of upland cotton was studied for component of variance analysis for seven traits. Both additive and non-additive gene action were important for all the traits except seed index. However the role of dominance was major for all the traits studied. Dominance was ambidirectional for all the traits studied. Epistasis influenced the performance of number of bolls and seed cotton yield. Narrow sense heritability was high for days to 50 per cent flowering, boll number and seed cotton yield/plant while moderate for boll weight, seed index, lint index and ginning percentage. The number of genes controlling inheritance of the traits were established. Any form of recurrent selection may be followed for exploiting all the three types of gene actions.

KEY WORDS : Diallel analysis, upland cotton, heritability, genetic components, bollworm.

INTRODUCTION :

Though several reports on the nature of gene action involved in the inheritance of yield and its component traits are available in literature, understanding of genetic architecture of every material is essential for planning a sound breeding programme for attaining genetic improvement in cotton. Henjce studies were undertaken to elicit information on the genetics of yield and its attributes in cotton.

MATERIALS AND METHODS

The investigations were carried out at Regional Agricultural Research Station, Lam Farm, Guntur during Kharif 1992-93 and 1993- 94. Ten bollworm tolerant donor lines which were procured from CICR, Nagpur were involved crosses in diallel

fashion (without reciprocals). Hybrids along with their parents were evaluated in randomized block design with three replications during 1993-94 Kharif. Normal agronomic practices recommended to the region were followed. Observations on days to 50 per cent flowering, number of bolls/plant, boll weight, ginning perentage, boll damage, locule damage, seed index, lint index and seed cotton yield per plant were made on five randomly selected plants in each replication. The data were subjected to analysis (Singh and Chaudhary, 1977) and the genetic components of variation were estimated as per the method proposed by Hayman (1954 a,b).

RESULTS AND DISCUSSION

The analysis of variance was significant for all the traits studied (Table I). The estimates of genetic parameters and their rations for yield and its components are presented in table II. The data showed that days to 50 percent flowering, number of bolls per plant, boll weight, ginning percentage, lint index, locule damage and seed cotton yield were govened by additive factors as evident from the significant D and the results are in confirmity with the findings of Singh and Singh (1980) ; Amalraj and Gowande (1985) and Jagtap and Kolhe (1986).

The significant D, H_1 and h^2 components for all the traits studied (except D in case of seed index, boil damage) exhibited the role of both additive and dominance factors. These results are in agreement with Gupta and Singh (1970) ; Amalraj and Gowande (1985) ; Jagtap and Kolhe (1986, 1987) and Patil *et al.*,., (1990). The ratio $(H_1/D)^{1/2}$ provides an overall measure of the mean degree of dominance over all the loci. The estimated value of more than one showed the preponderance of overdominance. Similar results were earlier reported by Singh and Singh (1980) ; Jagtap and Kolhe (1987). The distribution of genes with positive and negative effects was asymmetrical as shown by the ratio $H_2/4H_1$ of less than 0.25 for all the traits studied except boll and locule damage where symmetrical distribution was observed. Singh and Singh (1980) for lint index and seed index ; Jagtap and Kolhe (1987) for all the above traits studied, also observed unequal proportion of positive and negative alleles.

The proportion of recessive alleles was high for number of bolls/plant and seed cotton yield per plant as evinced by KD/KR ratio of less than unity while the ratio of more than one and positive F, for rest of the characters studied revealed the existance of high frequency dominant alleles. The ratio h^2/H_2 indicated that inheritance of days to 50 percent flowering, number of bolls/plant, ginning percentage and lint index appeared to be controlled by single gene or one group of genes. The ratio also showed that the traits boll weight and seed index were controlle dby 2-3 gene groups whereas boll and locule damage, seed cotton yield per plant by 2 groups of genes.

The heritability estimates in narrow sense were high for days to 50 percent flowering, bolls/plant and seed cotton yield per plant establishment the importance of additive gene action. Jagtap and kolhe (1986) also reported high narrow sense heritability estimates for days to 50 per cent flowering, boll number and moderate values for

Table 1. Analysis of variances for combing ability

Source	df	Mean sum of squares								
		Days to 50% flowering	Boll number/ plant	Boll weight	Ginning percentage	Seed cotton yield/plant	Seed Index	Lint index	Boll damage	Locule damage
Replications	2	1.35	0.33	0.004	5.28	1.44	0.10	0.01	6.81	2.39
Treatments	54	22.05**	261.82**	0.62**	4.37**	3612.27**	1.12**	0.41**	50.39**	43.34**
Parents	9	31.44**	220.58**	0.55**	5.74**	1883.37**	0.40*	0.29**	37.17**	34.38**
Hybrid	44	18.88**	264.43**	0.44**	4.05**	3583.25**	0.93**	0.39**	52.57**	36.01**
Parents vs Hybrids	1	76.61**	517.80**	9.55**	6.22**	20449.15**	16.03**	2.28**	559.48**	446.45**
Error	108	0.67	2.66	0.02	0.77	29.85	0.19	0.02	4.33	3.55
Total	164	7.71	87.96	0.22	2.01	1209.08	0.50	0.15	22.49	16.64

* Significant at 5%** Significant at 1% level

Table 2. Estimates of genetic parameter, standard errors and ratios in cotton

Parameter	Days to 50% flowering	Boll number / plant	Boll weight	G.P. (%)	Seed cotton yield/ plant	Seed Index	Lint Index	Boll Index	Locule damage
D	10.254*	72.653*	0.177*	1.627*	618.013*	0.070	0.091*	10.932*	10.283*
	(±0.996)	(±11.400)	(±0.085)	(±0.195)	(±182.122)	(±0.078)	(±0.036)	(±8.968)	(±4.298)
F	2.503	39.007	0.316	0.333	-817.114	0.088	0.104	3.806	5.964
	(±2.298)	(±26.304)	(±0.196)	(±0.451)	(±420.210)	(±0.179)	(±0.084)	(±20.691)	(±9.916)
H_1	11.978*	117.238*	0.806*	2.331*	1855.512*	1.130*	0.488*	62.766*	45.078*
	(±2.120)	(±23.367)	(±0.181)	(±0.416)	(±387.664)	(±0.165)	(±0.078)	(±19.089)	(±9.148)
H_2	9.940*	77.298*	0.548*	1.793*	1348.878*	0.852*	0.379*	60.677*	42.816*
	(±1.802)	(±20.624)	(±0.154)	(±0.353)	(±329.471)	(±0.140)	(±0.066)	(±16.223)	(±7.775)
h^2	10.031*	68.036*	1.259*	0.718*	2695.768*	2.093*	0.299*	73.326*	58.507*
	(±1.206)	(±13.805)	(±0.103)	(±0.237)	(±220.535)	(±0.094)	(±0.044)	(±10.859)	(±5.204)
E	0.226	0.872	0.005	0.285*	9.777	0.563*	0.006	1.459	1.177
	(±0.300)	(±3.437)	(±0.026)	(±0.059)	(±54.912)	(±0.023)	(±0.011)	(±2.704)	(±1.296)
$(H1/d)^{1/2}$	1.081	1.270	2.132	1.197	1.733	4.021	2.310	2.396	2.094
$H_2/4H_1$	0.207	0.165	0.170	0.192	0.182	0.188	0.194	0.242	0.237
$\frac{(4DH_1)^{1/2}+F}{(4DH_1)^{1/2}-F} = (KD/KR)$	1.255	0.651	2.440	1.187	0.448	1.372	1.651	1.157	1.322
h^2/H_2	1.009	0.880	2.296	0.401	1.999	2.458	0.789	1.208	1.366
Heritability (NS)	64.40	79.00	29.40	55.50	73.70	32.00	32.60	21.70	21.70
t^2	3.208	6.532*	8.275**	4.461*	4.451*	1.571	0.956	0.093	0.020
r (Yr(Wr+Vr)	0.667*	0.119	0.493	0.850**	0.077	-0.447	- 0.436	-0.514	0.171

* Significant at 5% ** Significant at 1% level

ginning percentage ; Gupta and Singh (1970) and Gururaja Rao *et al.*, (1977) for lint index. The analysis of test of homogenity (t^2) was non-significant for days to 50 per cent flowering, seed index, lint index, boll damage, locule damage and thus indicated that the data fulfilled the basic assumptions of Hayman (1954 ab) for diallel analysis. whereas it indicated the presence of epistasis for number of bolls/plant, boll weight, ginning percentage and seed cotton yield/plant by their significant t^2 values. The above finding is in confirmity with the Singh *et al.*, (1980), Amalraj and Gowande (1985), who also reported the presence of epistasis for boll number and seed cotton yield. The order of dominance was not unidirectional for all the traits except days to 50 percent flowering and ginning percentage as revealed by their nonsignificant correlation (r) between parental measurement (Yr) and parental order of dominance (Wr + Vr).

Since epistasis was also detected for some of the traits studies, a breeding procedure which may map up the fixable gene effects (additive, additive x additive, complementary epistasis) and at the same time maintains considerable heterozygosity for exploiting the dominant gene effects. Some form of recurrent selection which may allow intermating of the selects in the different cycles would be effectie in exploiting three kinds of gene action. Intermating in early generations may break the undesirable linkages and subsequently lead to the establishment of useful recombinants.

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PHYSIOLOGY OF PARENTS AND HYBRID BLACKGRAM FOLLOWING GAMMA IRRADIATION

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ABSTRACT

Gamma rays induced high rate in blackgram photosynthesis and total chlorophyll content in parents and F_1 hybrid. Chlorophyll a and b was maximum in hybrid followed by Vamban 1 and Co 5. The ratio of chlorophyll a/b, showed a positive trend during mutagenesis, however declined at higher doses. In both parents and hybrid, the rate of respiration gradually increased, while flagging subsequently.

KEY WORDS : Gamma rays, photosynthesis, chlorophyll, respiration, blackgram

In blackgram (*Vigna mungo* (L.) Hepper), like any other species, the gene complexes of parents produce considerable variability in hybrid (Ahmed John, 1995 a and 1997), and subjecting the heterozygous material to mutagenic treatment can further enhance the variability. The potential physical mutagen like gamma rays caused severe breakdown of the genetic system (Ahmed John, 1995b) and induce physiological variations in crop plants. Such investigations help to unravel the sequency and the interrelation of changes (Ahmed John, 1995c). So far no work has been made on the comparative physiology of blackgram following gamma irradiation. Accordingly the present investigation undertaken to analyse the physiology of parents and their F_1 hybrid of blackgram following gamma irradiation.

MATERIALS AND METHODS

Conventional hybridization using the method of rapid hand pollination were adopted for producing the hybrid seeds. The crossing was effected using the variety Co 5 as ovule parent and Vamban 1 as pollen parent. The dry seeds of blackgram parents Co 5, Vamban 1 and their F_1 hybrid (Co 5 x Vamban 1) were treated with 30, 40 and 50 krad of gamma irradiation at the School of Genetics, Tamil Nadu Agricultural University, Coimbatore, in a 60 Co gamma source. Five samples of 250 seeds were taken for each treatment and control. The irradiated seeds were sown in the field along with control in five replications laid out in factorial randomized block design. The experiment was conducted at 40 days old blackgram plants. The data were gathered from five replications and were analysed (Panse and Sukhatme, 1967). The photosynthesis and respiration (Umbreit et al. 1965), and chlorophyll content (Arnon, 1949) were studied with reference to gamma irradiation in parents and their F_1 hybrid of blackgram.

RESULTS AND DISCUSSION

Photosynthesis controls the gas exchange and water balance in between the plant leaves and environment. The photosynthetic rate was found to increase during gamma irradiation, which is presented in Table 1. The maximum increase of 15.22 per cent in hybrid was recorded at 40 krad, however the level slightly decreased in both parents and hybrid at 50 krad of gamma irradiation. There are reports about the increase of photosynthesis with final decrease in rice (Ahmed John, 1996). Photosynthetic increase is correlated with the