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COMBINING ABILITY ANALYSIS IN F1 AND F2 DIALLEL FOR YIELD AND QUALITY IN COTTON (G. hirsutum) Linn.

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ABSTRACT

Combining ability analysis was carried out in a 6x6 diallel cross of F_1 and F_2 population for three important traits of cotton corp. Seed cotton yield, ginning outturn and fibre length were found to be controlled by both additive and non-additive gene action with predominance of additive gene action. G cot 10 was found to be best general combiner for yield whereas 'Acale 4-42' for ginning outturn as well as halo length. per se performance of parents was good indicator of their general combining ability crosses showing high sca effects involved parents with high, medium and low gca effects for yield. Suitable breeding method for exploitation of the available variability is described.

Information on the nature of combining ability and type of gene action in controlling yield and fibre attributes is necessary for a rational choice of parents for hybridization and formulating efficient selection and breeding procedures aimed at improvement of cotton crop. A diallel cross involving six parents of diverse origin has been used to study gene effects and combining ability in G.hirsutum for evolving derivatives superior to the existing elite genotypes.

MATERIALS AND METHODS

Six cultivars viz., G.Col. 10, MCU.5, B 1007, Acale 4-42, Bhagya Laxmi (B.L) and AC 738 were crossed in all possible combinations (without reciprocals) to produce F1 hybrids during summer, 1978. The material was advanced by selling to derive F2 diallel Crosses during kjarif-1978. Six parents, 15 hybrids and respective F2 progenies were sown on 29.6.1979 in a randomized block design with three replications. The parents and F1 were shown in plots of single row of six mt. length consisting for 20 dibbles while F2 population was grown in plots of 5 rows. Spacing between rows and plants within rows were maintained at 60 cm and 30 cm, respectively. Recommended package of practices were followed for obtaining normal crop growth. Field observations were recorded on five random plants in parents and F1 while on 25 plants in F2 population in each replication. Ginning out-turn and halo-length were recorded in laboratory as per procedures suggested by Santhanam (1967). Combining ability analysis was carried out using method 2, model 1 as described by Griffing (1956).

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RESULTS AND DISCUSSION

Mean sum of squares due to progenies were highly significant in F1 as well as F2 diallel experiments indicting thereby presence of sufficient variability for seed cotton yield, ginning out-turn and halo-length (Table-1).

A NOVA for combining ability:

Combining ability analysis revealed that variances due to GCA and SCA were highly significant for seed cotton yield, ginning outturn and fibre length in F1 and F2 diallel (Table-2) indicating presence of both additive and non additive gene action for controlling these traits. The magnitude of GCA variance was, however higher than SCA which revealed preponderance of additive gene action. These observations are confirmity with the findings obtained by Marani (1967), Gridley (1975), Baker and Verhalen (1975) and Kalsy et al. (1981) for seed cotton yield, Singh et al.(1976), Miller and Marani (1963) A1 Rawi and Kohel (1969), Innes (1974) and Ansingkar et al. (1980) for fibre length. Under such a situation where both additive and non additive gene actions controlled the important traits, recurrent selection approach would be desirable to mop up effectively available variability for improving yield and quality.

gca effects:-

G Cot - 10 was found to be the best combiner for seed cotton yield. This parent also indicated high mean performance as compared to other parents suggesting that per se performance was good index for gca effects. B 1007 and Bhagya Laxmi exhibited significantly negative gca effects for yield in F1 and F2 diallel indicating their poor general combining ability.G Cot-10, Bhagya Laxmi, AC 738 and Acala 4-42 recorded highly significant positive gca effects for ginning outturn. B 1007 and MCU 5 exhibited poor combining ability. There was in general positive association between gca effects and per se performance of parents for ginning outturn MCU 5 recorded the highest gca effects followed by Acala 4-42 for fibre length thereby indicating their desirable effect in improving fibre length. gca effects recorded by Acala 4-42 were in the same direction for ginning outturn and fibre length suggesting that parent, Acala 4-42 could be used in breeding programme for improving ginning outturn and fibre length simultaneously.

sca effects:

G Cot 10xBhagya Laxmi, G Cot 10 x AC 738 and Acala 4.42 x Bhagya Laxmi which involved parents with high x low gca effects recorded highly significant positive sca effects in F1 diallel for seed cotton yield. MCU 5 B 1007 (medium x low) recorded.

Significant positive sca effects in F1 and F2 diallel analysis. However, intensity of sca effects was reduced in F2 generation.

G Cot 10 MCU 5 and Bhagya Laxmi x AC 738 also exhibited positive significant sca effects in F2 analysis. For ginning outturn, G cot 10xMCU 5(high x low). G cot x AC 738 (high x high) and 'Acala 4-42' x Bhagya

Tabel 1: Analysis of variance for design fo experiment

Source		d.f.	Seed cotton yield(g)	Ginning Percentage	Mean fibre length (mm)
Treatment	F_1	20	78.2**	3.57**	7.43**
	F_2	20	40.4**	3.73**	6.63**
Error	F_1	40	3.9	0.19	0.056
	F_2	40	3.1	0.47	0.037

** Significant at 1 % level.

Table 2: A NOVA for combining ability in F_1 and F_2 diallel.

Source	d.f.	Generation	Seed cotton yield/plant (g)	Ginning out turn (%)	Mean fibre length (mm)
GCA	5	F_1	67.1**	2.93**	13.27**
		F_2	37.8**	2.42**	11.34**
SCA	15	F_1	23.6**	0.59**	0.53**
		F_2	6.04**	0.84**	0.64**
Error	40	F_1	1.33	0.06	0.028
		F_2	1.02	0.15	0.018
GCA		F_1	2.85	4.95	24.86
SCA		F_2	6.26	2.88	17.59

*, ** Significant at 5% and 1%. respectively.

Table 3: Estimates of general combining ability effects in F_1 and F_2 diallel analysis.

Parent	Generation	Seed cotton yield/plant (g)	Ginning outturn (%)	Mean fibre length
G cot 10	F_1	2.43**	0.41**	-0.23**
	F_2	2.59**	0.52**	-0.28**
MCU 5	F_1	0.67	-0.81**	2.27**
	F_2	1.70**	-0.06**	2.01**
B 1007	F_1	-3.22**	-0.74**	0.02
	F_2	-3.04**	-0.76**	0.22**
Acala 4-42	F_1	1.42**	0.25**	0.36**
	F_2	0.29	0.30**	0.29**
Bhagya Laxmi	F_1	-1.50	0.44**	-1.06**
	F_2	-2.10**	0.34**	-0.73**
AC 738	F_1	0.20	0.47**	-1.36**
	F_2	0.57	0.25**	-1.51**
'SE' (gi)	F_1	0.37	0.38	0.05
	F_2	0.33	0.13	0.04

*,** significant at 5% and 1% respectively.

Table 4: Estimates of specific combining ability effects in F1 and F2 diallel analysis.

Cross	Generation	Seed cotton yield/plant (g)	Ginning outturn (%)	Mean fibre length (mm)
G cot 10	F_1	-3.40**	0.70**	0.03
MCU 5	F_2	3.80**	0.46	0.19
G cot 10	F_1	-1.93*	-0.51**	0.92**
B 1007	F_2	-1.07	-0.77**	-0.27*
G cot 10	F_1	3.52**	-1.23**	0.33**
Acala 4-42	F_2	0.89	-0.07**	-0.29**
G cot 10	F_1	6.52**	-0.45*	0.10
Bhagya Laxmi	F_2	-0.41	-0.87**	0.73**
G cot 10	F_1	6.08**	1.00**	-0.04
AC 738	F_2	-1.17	0.02	0.06
MCU 5	F_1	9.64**	0.85**	1.22**
B 1007	F_2	3.43**	-0.12**	-1.19**
MCU 5	F_1	-1.13	-1.24**	-0.47**
Acala 4-42	F_2	-0.58	-0.55	-0.88**
MCU 5	F_1	-0.59	-0.27	0.99**
Bhagya Laxmi	F_2	-2.37**	-1.12**	0.64**
MCU 5	F_1	3.27**	0.38**	0.46**
AC 7.38	F_2	-2.27**	0.30	-0.43**
B 1007	F_1	2.68**	0.65**	-0.27*

Table 4: condt...

1.	2.	3.	4.	5.
Acala 4-42	F2	-1.34	-0.55	0.21*
B 1007	F1	-0.69	0.13	0.49
Bhagya Laxmi	F2	-0.17	0.44	-0.92**
B 1007	F1	-0.09	0.28	-0.20
AC 738	F2	-0.43	0.10	2.22**
Acala 4-42	F1	4.11**	1.04**	0.50**
Bhagya Laxmi	F2	-4.24**	0.31	0.26
Acala 4-42	F1	-0.12	0.19	0.02
AC 738	F2	0.37	-0.73*	0.04
Bhagya Laxmi	F1	-2.50**	-0.43**	-0.22
AC 738	F2	1.72**	-1.27**	0.63**
SE (sij) +	F1	0.84	0.18	0.12
	F2	0.74	0.29	0.10

*, ** Significant at 5% and 1% respectively.

Laxmi (high x high) recorded significantly positive sca effects in F1 and positive but non-significant sca effects in F2. These combinations are believed to have additive x additive gene effects and could be exploited to isolate transgressive segregates in later generation. In respect of sca effects for fibre length, the results were inconsistent over generations. Only two crosses viz., MCU 5xB 1007 (high x Medium) and MCU 5 x' Bhagya Laxmi' (high x low) recorded highly significant positive sca effects in F1 and F2 analysis. 'MCU 5 x' Acale 4-42 (high x high) recorded highly significant negative sca effects indicating that the cross between the two best general combiners may not necessarily have high sca effects, as also found by Patil (1973) and singh et al.(1976). Since the crosses behaved differently as regards to their sca effects for yield, ginning outturn and fibre length, it would be advisable to resort to multiple crossing programme combining crosses showing high sca effects for individual traits and recurrent selection to be adopted in early segregating generations for effecting simultaneous improvement in yield and quality.

REFERENCES

ANSINGKAR, A.S., Vyahalkar, G.R. and P.G.Thombre, 1980 Heterosis and combining ability in G.arboreum.L.Indian j. agrio Sci. 50 (60 : 470-73

A1-RAWI, K.N. and R.J.Kohel 1969. Diallel analysis of yield and other agronomic characters in G.hirsutum L. Crop Sci. 9 : 79-82.

BAKER, J.L. and L.M.Verhalen, 1975. Heterosis and combining ability for several agronomic and fibre properties amongst selected lines of upland cotton. Cotton Gr. Rev. 52:209-23.

GRIDLEY, H.E.1975. Breeding implications from a diallel analysis in two environments of yield and component characters in upland cotton. Theoretical and applied Genetics 46 (8): 401-6.

GRIFFING, B. 1956. Concept of general and specific combining ability in relation to diallel crossing systems. Auster j. Biol. Sci. 9: 463-93.

INNES, N.L. 1974. GEnetic Variability for lint quality in upland cotton. Cotton Gr. Rev.. 51 (9): 85-98

KALSY, H.S. Garg, H.R., Vithal, B.M. and T.H. Singh, 1981 Combining ability studies in diallel cross of cotton. G.hirsutum L. Jr. Indian Soc. improve 6 (2) : 73-79

LEE, J.A., Miller, P.A. and Bawlings, J.O. 1967. Interaction of combining ability effects with environment in diallel crosses of upland cotton G.hirsutum L. Crop Sci.7: 477-81.

MARANI,A. 1967. Heterosis and combining ability in interspecific crosses of cotton. Crop Sci. 7 : 519-22.

MILLER,P.A. and A.Marani, 1963. Heterosis and combining ability in diallel crosses of upland cotton. Crop Sci.3 : 441-44

PATIL, M.S. 1973. Combining ability for some agronomic characters in G.herbaceum L Indian J. agric Sci. 3: 684-89.

SANTHANAM.M. 1967. Breeding procedures for cotton.Tech.Bull. 10 Indian Council of agricultural Research New Delhi.

SINGH, T.H., Bharadwaj, H.I. and S.S.Dhillon, 1976. The combining ability analysis in upland cotton G.hirsutum L. using Indian exotic germplasm. J.Res.PAU 12 (1) : 8-13.

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ASSOCIATION IN SEGREGATING POPULATION OF BARLEY

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ABSTRACT

Grain yield was found to have significant and positive phenotypic correlations with all the characters except days to maturity and 250-grain weight where the correlations were non-significant but positive. Yield was found negatively correlated at genotypic level with plant height, leaf area, ear length and grains/ear. The path analysis at phenotypic level indicated that plant height, tillers/plant, grains/ear and 250-grain weight, were the important yield contributing characters. Days to maturity, grains/ear and leaf area only contribute positively and directly to the grain yield at genotypic level.

The yield is a polygenically controlled character and its final expression is the sum total of effects of its various components. For improving the yielding ability of any variety the knowledge of direct and indirect effects of various yield attributed is essential. The path coefficient analysis originally proposed by Wright (1921) is helpful in partitioning the complete association into direct and indirect effects, and identifying the most important yield contributing characters. Since, the selection operates on the segregating generations to exploit artificially created variability, an attempt has, therefore, been made to study the path coefficients in F_2 generation.

MATERIALS AND METHODS

The material comprised of 45 F_2's and their 10 parents, was grown in a randomized block design with 3 replications in rabi 1985-86. Each treatment was assigned 4 rows of 3 m length. The rows and plants within a row were spaced 25 cm and 15 cm apart, respectively. The data were recorded on ten randomly selected plants/plot representing each entry for plant height, tillers/plant, leaf area, days to maturity, ear length, grains/ ear, 250-grain weight

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