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Combining Ability in Relation to Chilli Breeding

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Combining abilities of F_1 and F_2 generations of crosses involving six diverse cultivars of chilli (*Capsicum annuum* L.) were analysed for six traits. General combining ability variances were higher than specific combining ability for all the characters. Parents '5417', '6004' and '6439' were found good general combiners for fruit yield and other traits in both generations Five hybrids, *viz*, '5403' x '5417', '6004, x '7204', '6000' x '5417', '6004' x 5403' and 'Chanchal' x '5417' were identified as promising and their use in hybrid breeding programme in chilli would be most advantageous.

The plant breeder is interested primarily in identifying parental combinations that are likely to produce superior segregates or to release higher heterotic F_1 hybrids. In self-pollinated crop like chilli, selection procedures usually followed are based on the pure line concept and the pedigree method. No serious attempts have been made to study the genetic architecture of yield and its component characters in this crop. It is in tnis context that the present investigation was undertaken to get the information on combining ability for yield and its components in Chilli by diallel analysis,

MATERIAL AND METHODS

Six Chilli cultivars, '6004', '5403', '5439', '7204', 'Chanchal' and '5417, were crossed in all possible combinations without reciprocals. The parents, 15 F_1s and 15 F_2s were transplanted on 10th August 1979 in compact family block design with three replications at College Farm. Randomization was done between and within families in each replication. Single row plots were used for parents and F_1s. There were two rows/plot in F_2. Each row had 10 plants spaced at 50 x 50cm between and within rows. Individual plant observations were recorded on 21 (parents and F_1) and 42 (F_2) plants for days to flower, plant height, fruit length, fruit thickness, number of fruits/plant and fruit yield/plant. The combining ability analysis was done according to Model I, Method 2 of Griffing 1956).

RESULTS AND DISCUSSION

The results of combining ability in Table 1 revealed that variances due to g.c.a. and s.c a. were highly significant for all the characters in each generation, except for days to flower in F_1 were s.c.a. variance was not significant. However, the variances due to g.c.a. were higher than those for s c.a. in both F_1 and F_2 generations. Combining ability analysis, therefore, suggests that additive genetic variance is playing more important role in the inheritance of these characters, Earlier studies by Gill *et al*, (1973). Lippert (1975) and Singh (1976) also showed predominantly additive genetic control for one or more of these characters.

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The estimates of g.c.a. effects (Table II) revealed that the parents '5417' and '7204' for early flowering; '6004', '5439' and '5403' for tallness; '6004' and '5403' for longer fruits, '5417' and '5439' for fruit thickness; '5417', '6004' and 'Chanchal' for more, number of fruits and '6004', '5439' '5417' and 'Chanchal' for fruit yield were good general combiners in both F_1 and F_2 generations. Similar were the findings of Singh (1976) for some of these parents in Chilli. As '5417', '6004' and 'Chanchal' in both the analyses are superior for many traits, an intermating population involving all possible crosses among themselves subjected to biparental mating in early generations will be expected to offer the maximum promise in breeding for high fruit yield. For long term approach, the value of developing populations may be emphasized and use of Jensen's (1970) method is suggested.

The s.c.a. effects for the different characters are given in Table III. The specific combining ability effects were lower in magnitude for several traits. It is expected because of halfing of heterozygosity and dissipation to some extent of linkage imbalance to non-additive gene effects. Considering the s. c. a. effects over both generations, the cross combinations '5403' X '5417', '6004' X '7204', '6004' X '5417', '6004' X '5403', and 'Chanchal' X '5417 in both sets showed maximum and significantly desirable s. c. a effects for many characters including yield. Most of the superior combinations involved at least one good general combiner and combining ability of the parents may be considered a reliable guide in the prediction of yield potential of a cross Such a parallelism was also reported by Singh and Singh (1978) in Chilli. Like the finding of Venkateswarlu (1979) in pea, it was noted that the two superior parents of smilar attributes related to either through geographic proximity, selection history or pedigree may give poor or negative estimates of s, c, a, effects, *viz*. '6004' X 'Chanchal' for number of fruits/plant and *vice-versa* is also true in case of '5403' X '5439' for the same and some other characters also. Hence, it is not necessary that parents having higher estimates of g. c. a. effects would also give higher s. c. a. effects.

However, for fruit yield it is difficult to bring together all the desirable genes by this method due to non-additive genetic variation and also some genetic barriers. In order to utilize them efficiently, *inter se* crossing of the desirable F_1s in all possible combinations should be undertaken for multiple parents input into a central gene pool which will further supplement speedy recombinations and also in breaking strong genetic barriers if present (Jensen, 1970).

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Table 1. Analysis of variance for six characters in F_1 and F_2

Source	d f.		Days to flower	Plant height	Fruit length	Fruit breadth	Fruits/ plant	Yield plant
G. C. A.	5	F_1	45.62**	950 47**	22.21**	13 58**	340.57	1058.32**
		F_2	79 20**	695.31**	99.20**	7.05**	239 06**	1043 1***
S. C. A.	15	F_1	1.69	192 91**	3.58**	1.60**	24.93**	27.90**
		F_2	6.01**	224 85**	5 01**	3.01**	15.28**	66.264*
Error	40	F_1	1.58	0.18	0.01	0.01	0.10	0.04
		F_2	0 67	0.24	0 69	0.17	0.12	0.67

** Significant at 1 percent level.

Table II. Estimates of g. c. a. effects for six characters in F_1 and F_2

PARENT		Days to flower	Plant heigth	Fruit length	Fruit breadh	Fruits/ plant	Yield/ plant
6004	F_1	3.62**	7.62**	1.78**	-0.62**	6.44**	9.02**
	F_2	3.86**	6.92**	2.16**	-0.26	3.73**	8.17**
6403	F_1	0.32	0.91**	1.95**	-1.64**	-5.68**	-5.39**
	F_2	-0.29	1.17**	1.62**	-0.11	-6.05**	-4.77**
6439	F_1	1.38**	3.05**	-1.14**	-0.80**	-6.08**	7.92**
	F_2	0.96**	3.93**	-0.90**	-0.78**	-6.97**	9.78**
7204	F_1	-1.25**	-4.16**	-2.23**	-0.89**	0.04	-8.83**
	F_2	-2.39**	-3.86**	-2.31**	-1.58**	0.13	-6.96**
Chanchal	F_1	1.77**	-2.01**	0.33**	0.42**	0.34**	1.76**
	F_2	2.50**	-1.86**	0.17	-0.01	2.56**	1.19**
6417	F_1	-3.24**	-5.41**	-0.66**	1.94**	4.93**	6.58**
	F_2	-4.65**	-5.31**	-0.75**	1.19**	6.61**	5.67**
S. E. (gi)	F_1	0.25	0.08	0.03	0.01	0.06	0.04
	F_2	0.27	0.16	0.21	0.13	0.11	0.26

** Significant at 1 percent level.

Table III. Estimates of s. c. a. effects for six characters in F_1 and F_2

Cross		Days to flower	Plant height	Fruit length	Fruit breadth	Fruits/ plant	Yield/ plant
'6004' × '5403'	F_1	-0.24	3.91**	1.70**	1.64**	6.05**	10.13**
	F_2	-1.01	2.35**	-0.06	1.81**	5.36*	8.04**
× '5439'	F_1	0.25	4.07**	-2.36**	0.08	8.47**	-9.31**
	F_2	3.43**	4.19**	1.42**	-0.18	-1.02**	-1.57*
× '7204'	F_1	-0.42	6.40**	2.66**	-0.39**	6.32**	3.46**
	F_2	-2.07**	4.24**	2.74**	0.80*	3.08**	5.02**
× 'Chanchal'	F_1	-3.58**	1.69**	-1.11**	1.31**	-1.97**	4.73**
	F_2	2.13**	-3.64**	-0.35	0.59	-1.43**	4.32**
× '5417'	F_1	-1.90**	-4.52**	0.83**	1.11**	5.18**	6.84**
	F_2	-1.83*	-3.05**	1.35*	1.34**	1.61**	6.56**
'5403' × '5439'	F_1	-1.02*	-0.37	2.32**	0.31**	4.51**	-6.26**
	F_2	-1.21	-0.60	1.95**	1.83**	0.77**	4.45**
× '7204'	F_1	-0.53	-1.09**	-0.34**	1.01**	3.39**	-9.80**
	F_2	-1.60*	-1.34**	-0.23	0.05	-1.21**	-3.17**
× 'Chanchal'	F_1	1.50*	2.95**	-0.01	-0.47**	5.20**	-3.85**
	F_2	1.69*	1.21**	0.38	2.57**	4.11**	-2.54**
× '5417'	F_1	-3.65**	0.01	0.65**	-0.82**	2.57**	4.64**
	F_2	-3.84**	0.64	1.21*	0.76*	5.23**	7.34**
'5439' × '7204'	F_1	-1.34*	-1.25**	0.62**	1.46**	5.64**	7.39**
	F_2	-0.71	0.30	0.13	-0.53	-2.36**	5.51**
× 'Chanchal'	F_1	1.22	-1.46**	1.07**	1.20**	2.64**	2.34**
	F_2	0.49	-0.25	-0.31	-0.06	-2.94**	2.81**
× '5417'	F_1	3.11**	3.96**	0.47**	1.57**	3.33**	2.97**
	F_2	-2.63**	1.65**	1.11*	-2.42**	2.35**	1.05
'7204' × 'Chanchal'	F_1	0.73	1.84**	-1.65**	-0.29**	0.39*	-11.46**
	F_2	0.35	3.15**	-1.45**	-1.38**	-2.69**	-13.91**
× '5417'	F_1	-0.80	1.23**	-1.25**	-0.27**	-0.21	-10.31**
	F_2	-0.49	0.53	-1.19*	-2.57**	0.15	-2.75**
'Chanchal' × '5417'	F_1	-1.85**	2.17**	3.39**	0.97**	2.46**	8.15**
	F_2	-0.43	3.55**	2.3**	0.95*	3.5**	7.99**
S. E. (Sij)	F_1	0.68	0.22	0.07	0.07	0.15	0.10
	F_2	0.74	0.43	0.57	0.25	0.30	0.75

*, **, : Significant at 5 and 1 percent, respectively.