

## DIALLEL ANALYSIS OF FRUIT YIELD AND ITS COMPONENTS IN CHILLI

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The nature and magnitude of genetic variances involved in the inheritance of fruit yield and its components were investigated in a 8 parent diallel cross without reciprocals in chilli (*Capsicum annuum* L). The graphic, component and combining ability analyses revealed the preponderance of nonadditive genetic variation in the inheritance of all the traits.  $W_r$ -intercepts revealed the partial dominance for fruit length, fruits/plant and fruit yield/plant. The dominance components ( $H_1$ ,  $2H_2$ ) played significant role in the inheritance of all the attributes. Specific combining ability variances were higher than general combining ability for all the traits, as also revealed by average degree of dominance. Heritability estimates were quite low for all the traits. Recurrent selection by way of intermating the most desirable segregates alternatively with-selection may be employed in advanced generations.

The fundamental objective of the plant breeding is to evolve the varieties that combine productivity with quality both under favourable and stress environmental conditions. However, this superiority of the improved type is caused by certain specific gene combinations and how rapidly these specific gene combinations can be marshalled in a single plant or variety, depends on the system through which the genes in the material available are mobilized. This information, however, is scanty in chilli and research on this aspect has received only recent attention (Singh, 1982). The present study was, therefore, undertaken to determine the genetics of seven important characters in chilli.

## MATERIALS AND METHODS

Diallel crosses were made without reciprocals with eight parents, viz 'Chanchal', '8024', '6004', (long red', 'Kashmir yellow', 'Azamgarh Local', 'Sweet banana' and 'N. P. 46'. The parents and 28 F<sub>1</sub>s were transplanted on 30th August 1984 in randomized block design with three replications at College Farm. Single row plots were used. Each row had 10 plants spaced at 50 x 50 cm between and within rows. Individual plant observations were recorded for, days to flower, plant height (cm) number of branches, fruit length (cm), fruit width (cm) fruit/plant and fruit yield/plant (g). Estimates of  $V_r$ ,  $W_r$

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values, component of variation and genetic ratios were made according to Hayman (1954) and heritability estimates were worked out according to crumpacker and Allard (1962). Griffing's (1956) method II, model I was followed to compute the combining ability.

## RESULTS AND DISCUSSION

Diallel analysis furnishes an overall genetic evaluation which would be helpful in selecting the parents and their potential crosses in early segregating generation. Hayman (1954) emphasized the fulfilment of certain assumptions. Non-significant of  $t^2$  for days to flower, plant height, fruit length, fruits/plant and fruit yield/plant revealed that

all the assumptions of diallel were generally satisfied for these traits. However, some of the assumptions were not satisfied for number of branches and fruit breadth and therefore the genetic parameters for these traits may have some biased estimates to some extent (Table 1). The regression coefficient (b) deviated significantly from unity for all the traits except plant height indicating the presence of non allelic interaction for these traits. Wr-intercepts values were positive for fruit length, fruits/plant and fruit yield/plant and negative for the remaining traits indicating partial dominance for the former and overdominance for the latter, respectively. Jinks (1954) showed that overdominance effects were fre-

Table 1. Estimates of  $t^2$ , regression coefficient (b), Wr-intercepts (a) and coefficient of correlation (r) for different characters in an 8x8 diallel in chilli

Character	$t^2$	Vr Wr graph		Standardized deviation graph Coefficient of Correlation (r)
		Regression Coefficient (b)	Wr-intercept (a)	
Days to flower	2.01	0.30 $\pm$ 0.21	-0.54	0.42
plant height	2.14	0.28 $\pm$ 0.71	-3.26	0.79
Number of branches	3.87**	0.32 $\pm$ 0.17	-3.33	-0.09
fruit length	1.55	0.19 $\pm$ 0.24	0.70	0.04
Fruit breadth	58.14**	0.01 $\pm$ 0.06	-0.51	-0.24
Fruit / plant	0.65	0.02 $\pm$ 0.29	0.23	-0.34
fruit yield / plant	1.59	0.21 $\pm$ 0.24	0.75	-0.06

\*\*P < 0.01

quently artifacts caused by non-allelic interaction involving one or more parental arrays. Correlation coefficient ( $r$ ) was negative for number of branches, fruit breadth, fruits/plant and fruit yield/plant. This indicated that a higher expression of these traits was controlled by dominant genes. The positive value for the remaining suggested that higher manifestation of the attributes was controlled by recessive genes.

The estimates of genetic components and their proportions are presented in Table II. The genetic parameter  $D$ , which measures the variance due to additive genetic effects, was significant for days to flower, plant height and fruits/plant; for the remaining traits it was non-significant. The estimates of dominance components ( $H_1$  and  $H_2$ ) were highly significant for all the traits. In general,  $H_1$  was greater in magnitude than  $H_2$  suggesting that genes with positive and negative effects were not in equal proportion in the parents. Besides, the relative magnitudes of non-additive components were fairly higher than those of additive components for all the traits. The third dominance component i. e.  $h^2$  was positive for days to flower and fruits/plant and negative for remaining traits which suggested that direction of dominance was positive and negative for former and latter, respectively. The significant and positive value of  $F$  for all the traits except fruit breadth suggested an excess of dominant alleles

governing the attributes. The estimated value of  $E$  component was found significantly positive for all the traits except days to flower which showed the least influence of the environment.

The average degree of dominance  $(H_1 / D)^{1/2}$  was higher than unity for all the traits, suggesting the importance of non-additive components of genetic variation. The  $H_2 / 4H_1$  ratio revealed asymmetrical distribution of negative and positive alleles among parents because this ratio was not found to 0.25 ( $U_a = V_a = 0.25$ ) for any traits. The ratio  $(4DH_1)^{1/2} + F / (4DH_1)^{1/2} - F$ , which gives the relative value of dominant and recessive genes in the parents, was more than unity in each case, indicating higher proportion of dominant genes. The ratio  $h^2 / H_2$  is an approximate measure of the number of groups of genes which control the character and exhibit dominance. The value of this ratio was found to be at least one for all the traits. But the fact is that much reliance can not be placed on this ratio as it underestimates the number of genes and provides no information about the group of genes exhibiting little or no dominance (Gilbert, 1958).

Narrow sense heritability estimates were observed very low for all the traits. Low estimates of heritability indicated that non-additive gene action and environmental variation contributed a major part in the expression of the traits. Similar results have also been made by Singh and Singh (1970) and Singh (1976)

Table II. Estimates of genetic parameters of variance and narrow season heritability for different quantitative characters in an 8x8 diallel in chilli.

Variance components/ genetic parameters	Days to flower	Plant height	Number of branches	Fruit length	Fruit breadth	Fruits/ plant	Fruit yield/ plant
D	6.19** +1.54	29.71** +5.73	0.59 +0.39	0.13 +0.12	7.10 +5.68	3.23** +0.67	1.93 +0.70
H <sub>1</sub>	84.97** +3.55	449.20 +13.17	13.61** +0.90	8.32** +0.27	214.00** +13.06	41.91** +1.53	23.77** +1.63
H <sub>2</sub>	69.50** +3.09	368.03** +11.46	8.99** +0.79	6.44** +0.24	199.40** +11.37	32.64** +1.33	13.50** +1.43
h <sub>2</sub>	0.65 +2.07	-2.69 +7.68	-0.13 +0.53	-0.04 +0.16	-3.97 +7.62	257.00** +0.89	-0.95 +0.94
F	17.63** +3.65	87.80** +13.53	2.73** +0.93	0.93** +0.27	-15.27 +13.43	8.63** +1.57	5.85** +1.67
E	0.93 +0.51	8.16** +1.90	0.70** +0.13	0.19** +0.04	9.17** +1.89	1.51** +0.22	2.74** +0.23
[H <sub>1</sub> /D]	3.71	3.89	4.81	7.96	5.49	3.59	4.57
H <sub>2</sub> /4H <sub>1</sub>	0.21	0.20	0.17	0.19	0.23	0.19	0.14
KD/KR	2.25	2.23	2.86	2.60	0.67	2.18	3.39
ψ <sup>2</sup> /H <sub>2</sub>	0.01	-0.01	-0.02	-0.01	0.19	0.18	0.07
Heritability (n. s.)	8.01	7.01	4.11	1.57	2.74	7.61	3.76

\* P &lt; 0.05,

\*\* P &lt; 0.01

Table III. Analysis of variance for combining ability for different characters in an 8 x 8 diallel in chilli

Source of variation	d. f	Days to flower	Plant height	Number of branches	Fruit length	Fruit breadth	Fruits / plant	Fruit yield / plant
C. C. A.	7	4.69**	24.69**	1.08*	0.49	9.79	4.43**	3.21**
S. C. A.	28	5.29**	29.75**	1.89**	0.56**	18.40**	3.24**	2.68**
Error	70	0.92	8.16	0.42	0.19	9.17	1.51	1.04
C. C. A. Variance		0.37	1.65	0.07	0.03	0.06	0.29	0.22
S. C. A. Variance		4.37	21.59	1.47	0.37	9.23	1.73	1.64

\* P &lt; 0.05.

\*\* P &lt; 0.01

for number of branches, fruit number and fruit yield. In contrast, high values have been reported by Singh (1976) for the rest of the traits in Chilli.

The results of combining ability in Table III revealed that mean sum of squares due to g. c. a. and s. c. a. were highly significant for all the characters, except for fruit breadth where g. c. a. was not significant. This was in the confirmation with the study of Singh (1982) in Chilli. However, their variances clearly indicated the importance of non-additive component over additive component of variation in the inheritance of characters under study as also revealed by degree of dominance

In the present study, graphic component, combining ability and heritability estimates revealed the preponderance of non-additive gene action and considerable amount of additive genetic variation which suggested that selection should be delayed to latter generations and suitable breeding procedure would be one which mops up the additive genetic variation and at the same time maintain heterozygosity. Therefore, re-

current selection by way of inter-mating the most desirable segregates alternatively with selection will lead to the elevation of genetic ceiling by accumulating favourable additive genes in the core material.

## REFERENCES

- CRUMPACKER, D. W. and R. W. ALLARD. 1962. A diallel cross analysis of heading date in wheat. *Hilgardia* 32: 275-318.
- GILBERT N. E. G. 1958. Diallel cross in plant breeding. *Heredity* 12: 477-492.
- GRIFFING, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system *Aust. J. Bio. Sci.* 9: 463-93.
- HAYMAN, B. I. 1954. The theory and analysis of diallel crosses, *Genetics* 39: 789-809.
- JINKS, J. L. 1954. The analysis of continuous variation in a diallel cross of *Nicotiana rustica* varieties. *Genetics* 39: 767-788.
- SINGH, A. 1976. Biometrical studies in Chilli (*Capsicum annum* L.) Ph. D. thesis submitted to Kanpur University, Kanpur.
- SINGH, N. B. and B. SINGH. 1970. Interrelationship, heritability estimate and genetic advance in yield and other characters in chillies (*Capsicum annum* L.) *Madras Agric. J.*, 57: 369-373.
- SINGH, R. P. 1982. Combining ability in relation to chilli breeding. *Madras Agric. J.* 69 (2): 81-86.