Combining Ability Analysis in Chilli (*Capsicum annuum* L.)

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Genetic analysis was carried out through diallele method for estimation of combining ability using nine parents. The analysis revealed that parents and crosses differed significantly for general and specific combining ability effects. The relative magnitude of *gca* variances was higher than the *sca* variance, indicates the role of additive component in the expression of all the traits except green fruit yield which was found to be under the control of non-additive gene action. The parents HC-7 for green fruit yield, fruit weight, fruit length, and earliness, HC-51 for green fruit yield, number of fruit per plant and earliness were found to be the best general combiner. The crosses HC-7 x HC-51, HC-8 x HC-37 and HC-51 x HC-34 were the best specific crosses for green fruit yield and its contributing traits. These combinations may be further tested for promotion of F_1 hybrids in Chilli.

Key Words: Chilli, Combining ability, Gene action

Introduction

The chilli (also chili or chile) is a member of the nightshade family, Solanaceae. It is an important spice, condiment, vegetable crop, being cultivated since prehistoric times in Peru and Mexico. The pungency of chilli is due to capsaicin, which has medicinal value also. When chilli is eaten it makes the brain to release endorphins, a natural pain killer present in the body. The endorphin lowers blood pressure and helps to fight against cancer. Being an often cross-pollinated crop, it exhibits wide variability for different quantitative and qualitative traits. Thus, there is a wide scope of improvement through heterosis breeding among genetically diverse genotypes. Information on combining ability facilitates the choice of suitable parents for hybridization programme to develop promising F_1 hybrids. The diallele mating design helps in determining both general and specific combining ability of parents and hybrids combination, respectively. Further it helps in formulating the suitable breeding strategy for improvement. Therefore, the present study was undertaken to identify suitable potential combination in order to have superior F_1 hybrids.

Materials and Methods

The present investigation was conducted during 2007-2008 at experimental farm of Indian Council of Agricultural Research (ICAR)-Research Complex for Eastern Region (RCER), Research Centre, Ranchi. Nine diverse lines of chilli, namely, HC-7, HC-8, HC-51, HC-33, HC-23, HC-5, HC-62, HC-37 and HC-34 were crossed in all possible combinations excluding reciprocals using half-diallele mating design. The seedling of nine parents along with their 36 F_1s were transplanted on 07.05.07 in randomized block design at a spacing of 60 x 50 cm with three replications. The observations were recorded on 10 random selected plants in each treatment over replication for six characters, *viz*., green fruit yield (q/ha), fruit weight (g), fruit length (cm), fruit breadth (cm), days to 50 per cent flowering and number of fruits per plant. The genetic analysis for combining ability estimates were calculated according to method 2 and model 1 of Griffing (1956).

Results and Discussion

Highly significant variances (Table 1) were observed for general and specific combining ability effects for all the traits. However, the relative magnitude of *gca* variances was higher than the *sca* variances indicating thereby, that the additive component was of major importance in the expression of all the traits, except green fruit yield, which was found to be under the control of both additive and non-additive genetic effect, simultaneously. These findings are in close conformity of Gopalkrishnan *et al.* (1987) and Pandey *et al.* (1981).

General combining ability study had successfully led to making choice of suitable parent. This valuable information on green fruit yield and its component would

Table 1. Analysis of variance for combining ability

Source	df	Green fruit yield	Fruit weight	Fruit length	Fruit breadth	Days to first flowering	No. of fruits/ plant
gca	8	2581.28**	0.42**	2.84**	0.028**	41.37**	5284.84**
sca	27	2652.22**	0.19**	0.95**	0.019**	17.05**	2887.47**
Error	70	557.39	0.003	0.007	0.006	3.50	377.04

Table 2. Estimates of general combining ability effects of parents

Parents	Name	*Source	Green fruit yield	Fruit weight	Fruit length	Fruit breadth	Days to first flowering	No. of fruits/ plant
HC-7	Pusa Jwala	IARI	20.41**	0.28**	1.00**	-0.02**	-3.08**	-12.35**
HC-8	LC-333	Lam	3.34	-0.06**	0.04*	-0.06**	-0.65	22.01**
HC-51	HC-1-1	HARP, Ranchi	20.11**	0.01	-0.32**	-0.04**	-1.98**	19.51**
HC-33	Local Collection	HARP, Ranchi	-12.40*	0.26**	-0.10**	0.06**	0.86	12.21*
HC-23	B. Dabbi	Dharwar	3.17	-0.04**	-0.05*	0.02**	2.11**	15.16**
HC-5	KA-2	IIVR, Varanasi	-10.29	0.19**	0.38**	-0.01**	0.95*	7.54
HC-62	HC-2-1	HARP, Ranchi	-15.10*	0.06**	-0.36**	0.05**	-0.65	-31.67**
HC-37	Local Collection	HARP, Ranchi	-11.76*	-0.25**	-0.13**	-0.06**	1.60**	-11.86*
HC-34	Local Collection	HARP, Ranchi	2.52	-0.21**	-0.46**	-0.02**	0.84	-20.56**
SE (gi)			5.95	0.013	0.02	0.006	0.47	4.49

* National identity number (IC No.) of the lines utilized shall be taken in due course of time except KA-2 and Pusa Jwala

Table 3. Estimates of specific combining ability effects of crosses

Crosses	Green fruit yield	Fruit weight	Fruit length	Fruit breadth	Days to first flowering	No. of fruits/ plant
HC-7 x HC-8	-50.86**	0.39**	0.37**	0.07**	0.97	-46.25**
HC-7 x HC-51	53.99**	0.02	0.24**	-0.03**	2.31*	-28.75*
HC-7 x HC-33	34.82*	0.11**	0.36**	-0.02*	-1.79	-17.45
HC-7 x HC-23	2.59	0.20**	0.03	0.01	1.21	34.84**
HC-7 x HC-5	3.55	0.06*	0.24**	-0.01	0.61	42.22**
HC-7 x HC-62	22.12	-0.25**	-0.33**	-0.001	-1.78	27.18*
HC-7 x HC-37	20.03	-0.18**	-0.07	0.05**	-1.53	15.62
HC-7 x HC-34	-86.24**	-0.35**	-0.85**	-0.07**	-0.01	-27.42*
HC-8 x HC-51	-29.77*	0.16**	-0.85**	0.20**	-0.12	-24.85*
HC-8 x HC-33	-10.18	0.46**	0.87**	-0.03**	3.03**	-26.81*
HC-8 x HC-23	35.08*	-0.28**	0.09*	-0.05**	1.03	28.74*
HC-8 x HC-5	-2.29	-0.30**	-0.19**	-0.02*	-1.56	33.61**
HC-8 x HC-62	-12.47	-0.31**	0.06	-0.11**	-0.45	-23.67*
HC-8 x HC-37	41.68**	-0.09**	-0.29**	-0.01	-2.70**	13.51
HC-8 x HC-34	28.82*	-0.03	-0.66**	-0.05**	-0.19	45.72**
HC-51 x HC-33	-67.77**	-0.60**	-0.42**	-0.14**	2.37**	61.94**
HC-51 x HC-23	-37.52**	-0.04	-1.22**	0.18**	-0.13	-36.26**
HC-51 x HC-5	19.69	0.25**	0.89**	-0.08**	-1.73	-27.64*
HC-51 x HC-62	1.59	-0.16**	0.70**	-0.11**	0.88	12.57
HC-51 x HC-37	20.75	0.18**	0.38**	0.02*	-0.87	19.26
HC-51 x HC-34	39.05**	0.08**	0.28**	-0.05**	-2.69*	23.72*
HC-33 x HC-23	38.75**	0.23**	-0.17**	0.05**	-6.39**	30.95**
HC-33 x HC-5	14.70	-0.13**	-1.01**	0.09**	-4.07**	-23.59*
HC-33 x HC-62	9.10	-0.11**	-1.09**	0.18**	-0.71	-8.88
HC-33 x HC-37	-6.32	-0.02	0.63**	-0.06**	3.53**	26.81*

greatly help in proper classification of parental lines. On the basis of *gca* effect, parent HC-7 for green fruit yield, fruit weight, fruit length and earliness, HC-51 for green fruit yield, earliness and number of fruits per plant, HC-33 for fruit weight, fruit breadth and number of fruits per plant, HC-23 for number of fruits per plant, HC-5 and HC-62 for fruit weight were found best general combiner (Table 2). General combining ability effects include both additive and additive x additive type of gene action, which represent fixable genetic variance.

The specific combining ability effects (Table 3) exhibited that, the number of crosses that had desirable significant effect were 7 for green fruit yield, 13 for fruit weight, 16 for fruit length, 12 for fruit breadth, 2 for earliness and 11 for number of fruits per plant. The three best performing crosses showing highest specific combining ability effect in order of merit were HC-7 x HC-51, HC-8 x HC-37, HC-51 x HC-34 for green fruit yield; HC-5 x HC-62, HC-8 x HC-33, HC-7 x HC-8 for fruit weight; HC-23 x HC-34, HC-51 x HC-5, HC-8 x HC-33 for fruit length; HC-8 x HC-51, HC-51 x HC-231, HC-33 x HC-62 for fruit breadth; HC-33 x HC-23, HC-37 x HC-34, HC-33 x HC-5 for earliness and HC-62 x HC-34, HC-51 x HC-33, HC-8 x HC-34 for number of fruits per plant. The result obtained indicated that in most of the crosses, which exhibited the best *sca* effects was having at least one of the out standing parental lines for that particular trait. More or less similar observation has also been made by Srivastava *et al.* (2004). From the present study, it was also evident that the best cross combination for most of the characters generally involved one good and one poor general combiner with high *sca* effects, may be due to a complimentary type of gene action which can be fixed in the segregating generation. Contrary to this crosses with high *sca* effects involving poor x poor combiners, may be utilized for exploring of hybrid as the non-additive, non-fixable genes seems to play a major role. Among combinations based on the *sca* values the crosses, namely, HC-7 x HC-51, HC-8 x HC-37, HC-51 x HC-34 were found superior and these combinations can be further tested for promotion of F_1 hybrids in chilli.

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References

Griffing B (1956) Concept of general and specific combining ability in relation to diallele system. *Aus. J. Bio. Sci.* **9:** 463-493.

Srivastava JP, NP Singh and DK Srivastava (2004) Combining ability analysis in chilli (*Capsicum annuum* L.). *Vegetable Sci.* **31(2)**: 135-137.

Gopalkrishnan TR, DK Gopalkrishnan and KV Peter (1987). Heterosis and combining ability analysis in Chilli. *Indian J. Genet.* **47(2):** 205-209.

Pandey SC, ML Pandita and J Dixit (1981) Line and tester analysis for the study of combining ability in chilli (*Capsicum annuum* L.). *J. Res. Haryana Agric. Univ.* **11(2):** 206-212.