

## ORIGINAL ARTICLE

# Combining ability analysis in Chilli (*Capsicum annum L.*)

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### ABSTRACT

Twenty four crosses were developed by crossing three male sterile lines with each of eight testers to study the combining ability. Crosses were evaluated along with the parents in randomized block design with two replications. Results indicated that female line KCMS-44 and tester AL exhibited good general combiner for earliness and green fruit yield per hectare. The cross KCMS-44 x AL was best specific cross for green fruit yield per hectare on the basis of specific combining ability effects. This study suggested the exploitation of hybrid vigor in chilli.

Keywords:

Hybrid vigor, Chilli, heterosis breeding, CGMS lines

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### INTRODUCTION

Chilli (*Capsicum annum L.*) a spice as well as vegetable crop. Chillies are used in both green and dry form in all culinary preparations. One of the ways to improve the production and productivity is to harness the potential of heterosis breeding. The quantum jump in yield achieved through heterosis, has been reported for many of the economic attributes in chilli, especially for quantitative traits. The Hand emasculation and hand pollination is highly uneconomical method of F<sub>1</sub> seed production in chilli as it is tedious process and chilli flowers are small and delicate in nature, resulting in flower drop and poor fruit set after emasculation and even set fruits have few number of seeds per fruits. The only alternative is to have male sterility in female parent to solve this problem as being practiced in few other vegetables. Information on combining ability facilitates the choice of suitable parents for hybridization programme to develop promising F<sub>1</sub> hybrids. Line x Tester design helps in determining both general and specific combining abilities of parents and hybrid combinations, respectively. The present study was, therefore under taken to study the potential of chilli genotypes to through combining ability analysis.

### MATERIAL AND METHODS

The experimental material consisted of three CGMS lines { KCMS-31, KCMS-44 and KCMS-16 } and eight testers { Byadagi Dabbi (BDB), Pant C-1 (PC1), Ujjwal (UJ), Vietnam-2 (VN-2), Arka Lohit (AL), PMR534, H-31 and LCA234 }. These parents were crossed in a Line x Tester design to get 24 F<sub>1</sub> hybrids. All the 11 parents, 24 hybrids and one commercial hybrid viz., Garima (Bejo Sheetal Seeds Pvt. Ltd.,) were sown in rows spaced at ten cm apart during the last week of July 2012. Five weeks old healthy seedlings of 35 entries and one commercial hybrid as check were transplanted during the second week of September 2012 in the experimental blocks in randomized block design with two replications. Each entry was represented by single row of 15 plants with spacing of 75 cm between the rows and 45 cm between the plants within row. Observation recorded on these parameters viz., plant height (cm), days to first flowering and days to 50 per cent flowering and per cent fruit set. Yield parameters viz., average fruit weight (g), number of green fruit per plant and green fruit yield per hectare (t/ha). Combining ability analysis was done as suggested by earlier researcher [1].

**RESULTS AND DISCUSSION**

The analysis revealed existence of significant differences among genotypes for all the characters studied. The mean square (MS) due to parents vs crosses was significant for all the characters studied. The total genetic variability among the hybrids further divided into GCA lines, GCA testers and SCA hybrids. The partitioning revealed the non-significance of GCA lines for all the characters studied, GCA testers only for days to first flowering and SCA hybrids for all the characters studied (Table 1). The MS due to both, additive and non-additive gene effects were involved in the inheritance of the traits studied. Estimates of variance components, viz., GCA : SCA, which was less than unity for all the characters, revealed the predominance of non-additive gene effects.

**Table 1. Analysis of variance for combining ability**

Sl. No	Character	Degrees of freedom	1	2	3	4	5	6	7
	GCA : SCA	-	0.0136	0.0494	0.0067	0.0004	0.0106	0.0065	0.0138
	Error	34	0.71	2.21	1.44	2.38	0.35	3.50	0.54
	Line x Tester	14	112.71**	11**	49.91**	154.7**	114.44**	525.54**	23.91**
	Testers	7	56.05NS	30.73*	58.13NS	138.06NS	70.3NS	386.5NS	14.71NS
	Lines	2	56.6NS	14.31NS	75.58NS	202.75NS	68.25NS	446.19NS	2.44NS
	Crosses	23	90.58**	17.29**	54.65**	153.81**	96.99**	476.32**	19.25**
	Parents vs Crosses	1	529.01**	891.53**	529.11**	651.93**	126.63**	1266.57**	172.08**
	Parents	10	93.74**	22.1**	207.27**	135.28**	28.7**	169.85**	16.05**
	Genotypes	34	104.41**	44.42**	58.62**	163.01**	77.78**	409.43**	22.80**
	Character		Plant height	Days to first flowering	Days to 50 per cent flowering	Per cent fruit set (%)	Average Fruit weight (g)	Number of fruits per plant	Green fruit yield per ha (t)

\*and \*\* indicate significance of values at  $p=0.05$  and  $p=0.01$ , respectively. NS :Non significant, DAT : Days after transplanting

**Table 2. Estimates of GCA effects of parents for various characters in chilli.**

Parents	Plant height	Days to first flowering	Days to 50 per cent flowering	Per cent fruit set (%)	Average Fruit weight (g)	Number of fruits per plant.	Green fruit yield per ha (t)
LINES							
KCMS-31	1.61**	0.31	-2.45**	-3.12**	-2.38**	-4.28**	-0.28
KCMS-44	-2.06**	-1.06**	0.79**	3.87**	1.18**	5.89**	0.44*
KCMS-16	0.45*	0.75*	1.66**	-0.75*	1.20**	-1.61**	-0.16
TESTERS							
ByadagiDabbi	4.12**	4.52**	6.27**	-2.02**	-5.00**	-3.78**	-1.63**
Pant C-1	1.97**	0.02	-0.72*	3.64**	-1.93**	-6.13**	-1.08**
H-31	3.22**	-0.14	2.27**	-10.68**	6.68**	-2.52**	-2.13**
PMR534	-3.99**	2.02**	1.27**	-1.02*	-1.86**	-3.09**	0.64**
Ujjwal	0.72**	-1.81**	-2.22**	2.97**	0.79**	-8.43**	0.24
LCA234	-2.96**	-1.31**	-2.89**	2.47**	0.98**	-0.58	0.52**
Vietnam-2	-2.97**	-0.97*	-2.06**	1.14**	-1.13**	14.47**	0.72**
ArkaLohit	-0.1	-2.31**	-1.89**	3.47**	1.46**	10.09**	2.72**
CD at 5%(lines)	0.85	0.76	0.61	0.78	0.30	0.95	0.37
CD at 5%(testers)	1.13	1.01	0.82	1.05	0.40	1.28	0.50

\*and\*\*indicate significance of values at p=0.05 and p=0.01, respectively NS :Non significant

**Table 3: Estimates of SCA effects of hybrids for various characters in chilli**

Crosses	Plant height	Days to first flowering	Days to 50 per cent flowering	Per cent fruit set (%)	Average Fruit weight (g)	Number of fruits per plant.	Green fruit yield per ha (t)
KCMS-31 x BDB	-7.13**	2.35*	2.29**	-2.54**	4.14**	-5.14**	-2.64**
KCMS-31 x PC1	-2.08**	0.35	1.29	-1.70	-4.29**	4.82**	-1.99**
KCMS-31 x H-31	-6.04**	0.52	-4.20	0.62	12.45**	-15.26**	-2.39**
KCMS-31 x PMR534	6.78**	-0.14	-0.70	-11.54**	-2.05**	-10.71**	1.31*
KCMS-31 x UJ	-2.98**	-1.31	0.79	-9.04**	-6.20**	-5.79**	2.91**
KCMS-31 x LCA234	6.60**	-1.31	-1.54	4.95**	-4.94**	18.27**	3.18**
KCMS-31 x VN-2	-0.61	0.35	5.62**	14.79**	5.02**	8.21**	-0.91
KCMS-31 x AL	5.45**	-0.81	-3.54**	4.45**	-4.12**	5.59**	0.53**
KCMS-44 x BDB	12.09**	-1.71	0.04	-3.04**	1.15**	-12.16**	3.12**
KCMS-44 x PC1	6.89**	0.22	-4.95**	-3.20**	8.47**	-20.87**	4.07**
KCMS-44 x H-31	4.83**	2.39*	2.54**	1.12	-12.30**	1.53	-1.22**
KCMS-44 x PMR534	-4.23**	-2.77**	-4.45**	3.95**	-1.22**	4.10**	1.23**
KCMS-44 x UJ	0.64	2.06*	4.54**	0.45	10.39**	5.88**	0.03
KCMS-44 x LCA234	-13.66**	3.06**	7.20**	-3.54**	0.80	-3.41*	-1.74**
KCMS-44 x VN-2	-2.55**	-2.77*	-6.12**	2.79*	-4.56**	7.02**	0.30
KCMS-44 x AL	-4.02**	-0.43	1.20	1.45	-2.73**	17.91**	-5.79**
KCMS-16 x BDB	-4.96**	-0.58	-2.33**	5.58**	-5.29**	17.30**	-0.47
KCMS-16 x PC1	-4.81**	-0.58	3.66**	4.91**	-4.18**	16.05**	-2.07**
KCMS-16 x H-31	1.20	-2.91**	1.66	-1.75	-0.15	13.72**	3.62**
KCMS-16 x PMR534	-2.55**	2.91**	5.16**	7.58**	3.27**	6.61**	-2.55**
KCMS-16 x UJ	2.33**	-0.75	-5.33**	8.58**	-4.18**	-0.08	-2.95**
KCMS-16 x LCA234	7.06**	-1.75	-5.66**	-1.41	4.13**	-14.86**	-1.43**
KCMS-16 x VN-2	3.17**	2.41*	0.50	-17.58**	-0.45	-15.23**	0.61
KCMS-16 x AL	-1.43*	1.25	2.33**	-5.91**	6.86**	-23.51**	5.26**
CD at 5%	1.21	2.14	1.72	1.09	0.85	2.69	1.40
CD at 1%	1.63	2.87	2.32	2.22	1.14	3.61	1.89

\*and\*\*indicate significance of values at p=0.05 and p=0.01, respectively NS : Non significant

BDB :ByadagiDabbi PC1 : Pant C-1 UJ : Ujjwal VN-2 : Vietnam-2 AL : ArkaLohit

The estimates of general and specific combining ability effects provide a basis for selected parents with high general combining ability and those leading to high specific combining ability of the resultant

crosses. The estimates of general combining ability of parents reported (Table 2). Among female lines KCMS-44 exhibited negative and significant gca effects for days to first flowering, per cent fruit set, number of fruits per plant and green fruit yield per ha. The female line KCMS-31 showed maximum gca effects for plant height and also exhibited negative and significant gca effects for days to 50 percent flowering. Among testers AL exhibited maximum and significant gca effects for days to first flowering and green fruit yield per ha. Testers BDB, LCA-234, PC-1, H-31 and VN-2 exhibited significant and maximum gca effects for plant height, days to 50 per cent flowering, per cent fruit set, average fruit weight and number of fruits per plant respectively. Significant gca effects for these characters were similarly reported by earlier researcher [2,3 and 4].

For exploitation of heterosis the information of gca should be supplemented with sca and hybrid performance. Estimates of SCA effects of hybrids are reported in table 3. Out of 24 F<sub>1</sub>s, nine hybrids exhibited desirable SCA effects for plant height, three crosses for days to first flowering and seven crosses for days to 50 per cent flowering, nine crosses for per cent fruit set and average fruit weight, 12 crosses for number of fruits per plant and eight crosses for green fruit weight per ha. Among crosses, the cross KCMS-44 x BDB for plant height, KCMS-16 x H-31 for days to first flowering, KCMS-44 x VN-2 for days to 50 per cent flowering, KCMS-31 x VN-2 for per cent fruit set, KCMS-31 x H-31 for average fruit weight, KCMS-31 x LCA234 for number fruits per plant and KCMS-44 x AL for green fruit yield per ha were exhibited highest and significant sca in desirable direction and these crosses were found to be a superior combiner for these characters. Similar results for these characters have been reported in earlier studies for plant height,] and for number of green fruits per plant, for days to first flowering (negative) and average fruit weight in desirable directions [2,5 and 6]. Hasanuzzaman *et al.* [3] and Chandrakala [1] for days to 50 per cent flowering and green fruit yield per ha respectively in chilli. This study suggested the exploitation of hybrid vigor in chilli.

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