ARTICLE TYPE

Combining ability analysis in Chilli (*Capsicum Annum* L.)

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Abstract

Twenty four crosses were developed by crossing three sterile male 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 were identified as good general combiners for earliness and green fruit yield per hectare. The KCMS-44 × AL was the best specific cross for green fruit yield per hectare based on specific combining ability effects. This study suggested the exploitation of hybrid vigor in chili.

Keywords: Combining ability, GCA and SCA, Additive, Non-additive gene action.

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Introduction

Chilli (*Capsicum annuum* L.) is a spice as well as a vegetable crop. Chilies are used in both green and dry form in all culinary preparations. One of the ways to improve 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 chili, especially for quantitative traits. Hand emasculation and hand pollination is highly tedious and uneconomical method of F_1 seed production in chili flowers are small and delicate in nature, resulting in flower drop and poor fruit set after emasculation and even set fruits have few numbers of seeds per fruits. The only alternative is to have male sterility in female parent to solve this problem as being practiced in a few other vegetables. Information on combining ability facilitates the choice of suitable parents for hybridization program to develop promising F_1 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 undertaken to study the potential of chili genotypes to through combining ability analysis.

Material and methods

The experimental material consisted of three crop growth monitoring system (CGMS) lines *viz.,* KCMS-31, KCMS-44 and KCMS-16} and eight testers namely 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_1 hybrids. All the 11 parents, 24 hybrids and one commercial hybrid *viz.*, Garima (BejoSheetal 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 a single row of 15 plants with a spacing of 75 cm between the rows and 45 cm between the plants within a row. Observation recorded on these parameters *viz.,* plant height (cm), days to first flowering and days to 50% flowering and percent 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 Kempthorne, 1957.

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Results and discussion

The analysis revealed the 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 (GCA) for lines, GCA for testers and specific combining ability (SCA) for hybrids. The partitioning revealed the non-significance of GCA for lines for all the characters studied, GCA for testers only for days to first flowering and SCA for hybrids for all the characters studied (Table 1). The mean square, 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.

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

Table 1: Analysis of variance for combining the ability

Sl. No	Character	Genotypes	Parents	Parents vs crosses	Crosses	Lines	Testers	Line x tester	Error	GCA: SCA
	Degrees of freedom	*34*	*10*	*1*	*23*	*2*	*7*	*14*	*34*	-
1	Plant height	104.41**	93.74**	529.01**	90.58**	56.60NS	56.05NS	112.71**	0.71	0.0136
2	Days to first flowering	44.42**	22.10**	891.53**	17.29**	14.31NS	30.73*	11.00**	2.21	0.0494
3	Days to 50% flowering	58.62**	207.27**	529.11**	54.65**	75.58NS	58.13NS	49.91**	1.44	0.0067
4	Percent fruit set (%)	163.01**	135.28**	651.93**	153.81**	202.75NS	138.06NS	154.7**	2.38	0.0004
5	Average Fruit weight (g)	77.78**	28.70**	126.63**	96.99**	68.25NS	70.30NS	114.44**	0.35	0.0106
6	Number of fruits per plant.	409.43**	169.85**	1266.57**	476.32**	446.19NS	386.50NS	525.54**	3.50	0.0065
7	Green fruit yield per ha (t)	22.80**	16.05**	172.08**	19.25**	2.44NS	14.71NS	23.91**	0.54	0.0138

*and ** indicate the significance of values at p = 0.05 and p = 0.01, respectively. NS : nonsignificant, 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 percent flowering	Percent 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**
Arka Lohit	-0.10	-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 : Nonsignificant

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

Crosses	*Plant height*	*Days to first flowering*	*Days to 50 percent flowering*	*Percent 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

estimates of GCA of parents mentioned in table 2. Among female lines, KCMS-44 exhibited significant negative GCA effects for days to first flowering, percent 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 significant negative and GCA effects for days to 50% 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 maximum and significant GCA effects for plant height, days to 50% flowering, percent fruit set, average fruit weight and a number of fruits per plant respectively. Significant GCA effects for these characters were similarly reported by Srivastava *et al.* (2005) and Prabhudeva (2003)

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_1s, nine hybrids exhibited desirable SCA effects for plant height, three crosses for days to first flowering and seven crosses for days to 50% 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 the crosses, the cross KCMS-44 x BDB for plant height, KCMS-16 x H-31for days to first flowering, KCMS-44 x VN-2 for days to 50 per cent flowering, KCMS-31 x VN-2 for percent 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 by Saritha *et al.* (2005) for plant height, Srivastava *et al.* (2005) and Vaishnav *et al.* (2009) for number of green fruits per plant, Khereba *et al.* (2008) for days to first flowering (negative) and average fruit weight in desirable directions. Hasanuzzaman*et al.* (2012) and Chandrakala (2005) for days to 50% flowering and green fruit yield per ha, respectively in chili. This study suggested the exploitation of hybrid vigor in chili.

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