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Combining ability analysis in chilli hybrids

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Abstract
The eighteen crosses were developed by crossing six testers with each three lines to study combining ability, crosses evaluated with the parents in randomized block design with two replications in *kharif* along with parents at instructional farm, Department of Vegetable Science, Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola and result indicated that for the all character exhibit the predominance of non-additive gene action for all character from the parental lines Jayanti, GT 1-1 and IC- 572498 show the GCA in desirable direction for yield and contributing characters and from the cross combinations days to 50% flowering concern the hybrid AKC -1-5 X IC- 572486 found negatively significantly maximum among all hybrids, the hybrids combination AKC -2-8-2 X IC- 572486, AKC -1-5 X GT-1-1 and Jayanti X GT-1-1 exhibit highest significant SCA for yield parameters this SCA effects for yield parameters the promising hybrids as they exhibited significant GCA and SCA effect in desirable directions for most of traits. The resulted promising hybrids may test for further trials and the identified parental lines could be utilized in future for chilli breeding programmes.

Keywords: Combining ability, GCA, SCA, gene action

Introduction

Chilli (*Capsicum annum* L.) is commonly cultivated for use as spice or vegetables (green fruits) in many countries. India is the leading producer, consumer and exporter of chillies. It is used as an essential condiment in foods for its pungency and red colour. Some varieties are famous for colour because of the pigment capsanthin, others are known for pungency attributed by capsaicin. The fluctuation in the market price and export, due to strong competition from other producing countries over the years, has become less remunerative for hot chilli production. Whereas market for less pungent paprika types has been growing steadily and mainly used as natural food colourant in the form of oleoresin. In India, paprika types are not suitable for all the chilli growing areas and this necessitated the development of less pungent paprika type chilli hybrids to tap the paprika oleoresin market. Chilli has been classified under self-pollinated crop, but the extent of natural out crossing has been reported upto 66. 4 percent (Singh *et al*., 12) and it has a substantial amount of genetic variance, hybrid vigour for yield (Gopalakrishnan *et al*., 4; Doshi and Shukla, 3) and quality (Sharma and Saini, 9), which can be exploited profitably through heterosis breeding. It is very much essential to find out the combining ability of the desirable genotypes to involve in breeding programme, for effective transfer of desirable genes controlling both quantitative and qualitative traits in the resultant progenies. The main objective of this investigation was to identify good general and specific combiners for yield, its component traits and quality in paprika type chilli. Because of wide variability in market and different industry preferences for peppers, varieties/F1 hybrids in different genetic backgrounds must be developed, which requires understanding the inheritance of traits, selection of appropriate parental material, and identification of suitable cross combinations that result in superior F1 hybrids/ varieties. The present study was conducted with the objective to estimate general combing ability (GCA), specific combing ability (SCA) and understanding the inheritance of different traits, which will be useful in selecting suitable breeding strategy for improving these traits. Using biometrical analytical tools, such as line X tester analysis.

Materials and Methods

The experiment was carried out at the Instructional farm, Department of Vegetable Science, Faculty of Horticulture, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, in *kharif* 2020-2021. The study comprised three lines (females), six testers (males), their resulting 18 hybrids

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and two checks Arka Harita and Arka Swetha. The seed of the following parental lines will collect from NBPGR, New Delhi and Instructional farm Department of Vegetable Science, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The observations were recorded on morphological and yield characters from five competitive plants selected randomly from each plots. The combining ability analysis was done suggested by Kempthorne (1957) [7].

Table 1: List of genotypes / parents

Sr. No.	Lines	Source	characters
1	Jayanti	Department of Vegetable science, Dr. P.D.K.V, Akola	Plant habit: bushy, fruit: light green colour, pungency: medium
2	AKC - 1-5	Department of Vegetable science,Dr. P.D.K.V, Akola	Plant habit: tall, fruit: light green colour, pungency: medium
3	AKC - 2-8-2	Department of Vegetable science, Dr. P.D.K.V, Akola	Plant habit: Tall, fruit: light green colour and long, pungency: medium
Testers			
4	GT-1-1	Department of Vegetable science, Dr. P.D.K.V, Akola	Plant habit: Tall, fruit: dark green colour, pungency: High
5	IC- 362026	NBPGR, New Delhi	Plant habit: bushy, fruit: dark green colour, pungency: medium
6	IC-362020	NBPGR, New Delhi	Plant habit: bushy, fruit: dark green colour, pungency: High
7	IC -572486	NBPGR, New Delhi	Plant habit: erect, fruit: light green colour, long wrinkled, pungency: High
8	IC -572498	NBPGR, New Delhi	Plant habit: bushy, fruit: dark green colour, blocky, pungency: High
9	IC -537595	NBPGR, New Delhi	Plant habit: erect tall, fruit: green colour, upright, pungency: High
Check			
10	Arka Harita	IIHR, Banglore	Plant habit: erect tall, fruit: light green colour, long, pendant, pungency: High
11	Arka Swetha	IIHR, Banglore	Plant habit: erect tall, fruit: dark green colour, pendant, pungency: High

Table 2: Analysis of Variance for Combining Ability

Source	DF	Plant height (cm)	Primary branches	Days to 50% flowering	Average no of fruits per plant	Average fruit weight (g)	Fruit yield per plant (g)	Fruit yield ha (q)
		1	2	3	4	5	6	7
Geno	26	125.48**	0.56**	31.23**	8549.97**	2.83**	73905.32**	1588.00**
Cross	17	107.55**	0.33**	41.12**	6460.12**	2.91**	24060.44**	570.06**
Line(c)	5	149.73**	0.60**	48.89**	5252.99**	1.71**	3558.09**	206.50**
Test(c)	2	5.71**	0.60**	3.18**	10913.18**	3.15**	164162.91**	3617.73**
LXT (c)	10	106.82**	0.13**	44.83**	6173.08**	3.47**	6291.13**	142.30**
Parent	8	107.09**	0.90**	13.34**	5463.80**	2.39**	106629.27**	2381.53**
Error	26	14.16	0.04	0.03	163.42	0.05	2821.29	43.79

Table 3: Estimates of GCA effects of parents for various characters in chilli

SN	Genotypes	Plant height (cm)	Primary branches	Days to 50% flowering	Average no of fruits per plant	Average fruit weight (g)	Fruit yield per plant (g)	Fruit yield ha (q)
Lines								
1	GT-1-1	4.29 **	0.13 0	-0.21 **	13.94 **	0.07 0	101.99 **	13.35 **
2	IC- 362020	0.25 0	0.31 **	0.15 *	65.16 **	-0.85 **	152.93 **	21.15 **
3	IC- 362026	8.10 **	0.24 **	0.25 **	32.50 **	-0.30 **	119.20 **	20.91 **
4	IC- 572486	2.47 0	0.40 **	-0.07 0	-2.39 0	0.55 **	49.31 *	5.72 0
5	IC- 572498	-4.60 **	-0.58 **	-0.52 **	-37.34 **	-0.31 **	158.41 **	-21.68 **
6	IC- 537598	-10.51 **	-0.50 **	0.40 **	-71.87 **	0.85 **	265.01 **	-39.45 **
Testers								
7	Jayanti	1.20 0	-0.17 **	-0.61 **	22.10 **	0.27 **	141.86 **	20.82 **
8	AKC -2-8-2	-3.50 **	0.08 0	0.84 **	-25.05 **	-0.23 **	148.21 **	-23.19 **
9	AKC -1-5	2.30 *	0.09 0	-0.23 **	2.95 0	-0.04 0	6.35 0	2.37 0
	SE± (Lines)	1.96	0.09	0.09	5.74	0.13	28.8	3.89
	CD @ 5% (Lines)	4.13	0.2	0.2	12.12	0.28	60.76	8.21
	CD @ 1% (Lines)	5.67	0.28	0.28	16.65	0.39	83.51	11.28
	SE± (Testers)	1.38	0.07	0.07	4.06	0.09	20.36	2.75
	CD @ 5% (Testers)	2.92	0.14	0.14	8.57	0.2	42.96	5.8
	CD @ 1% (Testers)	4.01	0.19	0.2	11.78	0.27	59.05	7.98

Table 4: Estimates of SCA effects of hybrids for various characters in chilli

S. N	Genotypes	Plant height (cm)	Primary branches	Days to 50% flowering	Average no of fruits per plant	Average fruit weight (g)	Fruit yield per plant (g)	Fruit yield ha (q)
1	Jayanti X GT-1-1	-3.53	0.07	3.68 **	-58.79 **	0.82 **	-138.84 **	-22.30 **
2	Jayanti X IC- 362020	5.56 *	-0.11	-1.43 **	30.71 **	-0.64 **	26.70	4.63 0
3	Jayanti X IC- 362026	-2.03	0.04	-2.24 **	28.08 **	-0.18 0	112.15 **	17.67 **
4	Jayanti X IC- 572486	1.62	0.22	-3.39 **	-10.49 0	0.03 0	-27.29 0	-5.85 0
5	Jayanti X IC- 572498	-2.60	-0.13	0.84 **	7.86 0	-0.23 0	-23.94 0	-3.34 0

6	Jayanti X IC- 537598	0.98	-0.09	2.55 **	2.63 0	0.20 0	51.23 0	9.19 0
7	AKC -2-8-2 X GT-1-1	-1.92	-0.11	3.56 **	7.10 0	-0.50 **	-52.05 0	-7.76 0
8	AKC -2-8-2 X IC- 362020	2.37	-0.23	-1.31 **	-27.05 **	0.80 **	17.62 0	-1.80 0
9	AKC -2-8-2 X IC- 362026	-0.44	0.34 **	-2.26 **	19.95 *	-0.30 0	34.44 0	9.56 0
10	AKC -2-8-2 X IC- 572486	-0.60	-0.21	-2.85 **	67.24 **	-1.67 **	24.23 0	5.21 0
11	AKC -2-8-2 X IC- 572498	-1.61	-0.17	1.48 **	-35.65 **	1.38 **	24.77 0	4.46 0
12	AKC -2-8-2 X IC- 537598	2.21	0.38 **	1.37 **	-31.59 **	0.29 0	-49.01 0	-9.67 0
13	AKC -1-5 X GT-1-1	3.64 0	0.55 **	2.50 **	15.04 *	0.98 **	215.80 **	34.71 **
14	AKC -1-5 X IC- 362020	0.33 0	-0.11 0	-0.62 **	5.14 0	-0.50 **	-48.37 0	-6.93 0
15	AKC -1-5 X IC- 362026	-3.97 0	-0.44 **	-1.88 **	-20.18 *	-0.48 **	-167.43 **	-27.78 **
16	AKC -1-5 X IC- 572486	0.79 0	-0.52 **	-3.49 **	-20.10 *	0.34 0	-21.85 0	-4.01 0
17	AKC -1-5 X IC- 572498	-4.05 0	0.75 **	1.02 **	18.99 *	-0.81 **	3.22 0	2.99 0
18	AKC -1-5 X IC- 537598	3.26 0	-0.23 0	2.47 **	1.11 0	0.47 **	18.63 0	1.02 0
	SE± (SCA)	3.39	0.16	0.17	9.95	0.23	49.87	6.74
	CD @ 5% (SCA)	7.15	0.35	0.35	20.99	0.49	105.24	14.22
	CD @ 1% (SCA)	9.82	0.48	0.48	28.84	0.67	144.65	19.54

Results and Discussion

The analysis revealed the existence of significant difference among genotypes for all characters studied. The analysis of variance due to the means sum of a square for the treatments was found highly significant for all the characters *viz.*, Plant height (cm), number of primary branches per plant, days to 50% flowering, average fruit weight (g), fruit yield per plant (g), fruit yield per hectare (q). The parents, hybrids, parents vs hybrids and crosses, revealed that the parents differed among themselves significantly for all characters. The mean sum of squares due to parents shows highly significant differences for all traits. The mean square due to both, gene effects were involved in the inheritance of 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 of selected parents with high GCA and those leading to high SCA of resultant crosses the estimates of GCA of parents present in table 3, among the female lines Jayanti exhibited significant negative GCA for days to 50% flowering and the females lines Jayanti show maximum GCA effects for yield and contributing traits. Among testers the maximum GCA effects was observed in GT-1-1 and IC-572486 plant height (cm), number of primary branches, average fruit weight (g), fruit yield per plant (g) and fruit yield per hectare (q) except days to 50% flowering. The tester GT 1-1 and IC- 572498 found negative GCA effect for days to 50% flowering respectively these characters were similarly reported by Chaudhary *et al*. (2013) [23] & Singh *et al*. (2015) [24].

For the exploitation of heterosis, the information of GCA should be supplemented with SCA effects of hybrids are reported in table 4. Out of eighteen F_1 seven crosses found desirable SCA and hybrids performance. The cross combinations Plant height Jayanti X IC- 362020 found maximum in plant height (cm), AKC-2-8-2 X IC- 362026, AKC -1-5 X GT-1-1 and AKC -1-5 X IC- 572498 found significantly maximum in primary branch. As per as days to 50% flowering concern the hybrid AKC -1-5 X IC- 572486 found negatively significantly maximum among all hybrids, the hybrids combination AKC -2-8-2 X IC- 572486, AKC -1-5 X GT-1-1 and Jayanti X GT-1-1 exhibit highest significant SCA for yield parameters this SCA effects for yield and contributing character found in desirable directions and found superior combiners for these studied characters and GCA: SCA variance also exhibit the predominance of non- additive

gene action, the similar result were found by Srivastava *et al.* (2005) [19] Chadchan (2008) [20] for plant height and number primary branches character. Pandey *et al.* (1981) [21] also found similar result for days to 50% flowering traits and for yield and contributing trait Shukla *et al.* (2003) [22], Chadchan (2008) [20]. This study suggested the exploitation of hybrid vigour in chilli.

Acknowledgement

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