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Combining ability analysis for yield-attributing traits in cytoplasmic male sterility based hybrids of chilli (*Capsicum annum*)

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ABSTRACT

The combining ability analysis was done for yield-attributing traits in CMS based hybrids of chilli (*Capscum annuum* L.) at Vasantrao Naik Marathvada Krishi Vidyapeeth, Parbhani, Maharashtra, India, during 2017-18 and 2018-19. Sixteen parents and 60 F_1s produced in line × tester mating design were used. The variance due to GCA and SCA were significant for all characters. The fruit diameter of SCA variance were non - significant. The parents, BSPRL-171, BSPRL-066, BSPRL-188, Phule Jyoti, Pusa Sadabahar, PBNC-1, and Parbhani Tejas, were good general combiner for fruit and yield. Hybrids, BSPRL-066 × Phule Jyoti, BSPRL-171 × Phule Jyoti, BSPRL-171 × Bydagi, BSPRL-171 × G-4, BSPRL-226 × Kokan Kirti and BSPRL-189 × Bydagi had good SCA effects for fruit and yield.

Key words: Combining ability, Line × tester analysis, Hybrids, Genotypes, Variance

Chilli (*Capsicum annuum* L.) 2n = 24 is an important spice-cum-vegetable crop of family Solanaceae. Studying the combining ability is important for selecting parents for hybridization. The GCA variance is due to additive variance while SCA variance is due to non-additive variance and both acts as an important diagnostic tool in selection of suitable parents. Usually local cultivars are grown due to regional preferences and hence developing region-specific high-yielding early hybrids is necessity.

MATERIAL AND METHODS

The study material consisted of six lines, viz, BSPRL-066, BSPRL-171, BSPRL-188, BSPRL-189, BSPRL-224, BSPRL-226 and ten Testers, viz, PBNC-1, Parbhani Tejas, Pusa Jwala, Phule Jyoti, Kokan Kirti, Pusa Sadabahar, Bydagi, Bydagi-341,Teja,G-4, and three hybrid controls, BSS-355, BSS-378, BSS-273. Hybridization was carried out during 2017-18 and evaluation in 2018-19 *kharif* season. The experiment was laid out in a randomized block design with two replications. The 16 parents and 60 hybrids were studied. Each entry was planted in three rows of 30 plants each with a spacing of 60 cm × 45 cm. The recommended package of practices were followed. The data on plant height, number of primary branches/ pant, day to first flowering, days to 50% flowering, number of fruits / plant, fruit yield / plant, fruit yield / plot, first fruit ripening, fruit length, fruit diameter, fruit weight / plant, dry fruit weight/ plant, dry fruit yield/ plot, number of picking/plant, pedicel length, dry fruit weight and number of seeds/ fruit were recorded from five randomly selected plants of each treatment. The combining ability analysis was computed as per Kempthorne (1957).

RESULTS AND DISCUSSION

Teja (13.83), BSPRL-224 (11.86) and Pusa Jwala (9.52) were the tallest. Similar GCA effect was recorded by Jethava *et al.* (2016), Singh and Chaudhary (2005) and Gangadhar *et al*. (2016). The number of primary branches/plant was highest in parents, Bydagi (0.98), BSPRL-171 (0.74) and Teja (0.57), supporting the findings of Singh *et al*. (2014), Gandhi *et al.* (2000) and Kumar *et al.* (2014). Days to first flowering, days to 50% flowering, and days to first fruit ripening were influenced by Bydagi (-341, -5.81), BSPRL-066 (-4.92), and Parbhani Tejas (-4.71) respectively, as reported by Ananda and Subbaraman (2004). Parent Pusa Sadabahar exhibited highest number of fruits/plant (63.78), followed by Bydagi (59.28), BSPRL-171 (58.01), and Phule Jyoti

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Table 1. Estimates of general combining ability (GCA) effects of parents in chilli

Source of variation	Plant height (cm)	Number of primary branches/ plant	Days to first flowering	Days to 50 % flowering	Days to first fruit ripening	Number of fruit/ plant	Fruit weight (g)	Fruit length (cm)	Fruit diameter (mm)
Line									
BSPRL-066	1.53***	-0.15	-5.23***	-4.92***	-7.71***	-4.33	0.82***	-0.11	0.11*
BSPRL-224	11.86***	0.23	1.99***	2.72***	1.65***	19.77***	0.61***	1.51***	0.021
BSPRL-226	-3.34***	-0.11	-1.49***	-2.38***	-0.92***	-25.35***	1.4***	1.48***	0.032
BSPRL-188	3.69***	-0.46***	3.21***	2.25***	2.16***	-81.02***	0.65***	-0.291	0.052
BSPRL-189	-12.37***	-0.25	-1.10***	-0.53***	1.29***	32.92***	-1.88***	-1.68***	-0.091
BSPRL-171	-1.37***	0.74***	2.62***	2.86***	3.52***	58.01***	-1.61***	-1.13***	-0.12*
SE	0.26	0.13	0.14	0.17	0.218	3.18	0.11	0.15	0.049
CD95%	0.51	0.26	0.28	0.3	0.43	6.30	0.23	0.30	0.097
CD99%	0.68	0.34	0.37	0.46	0.571	8.34	0.30	0.47	0.12
Gi-Gj	0.96	0.49	0.53	0.66	0.80	17.79	0.43	0.56	0.18
Tester									
Parbhani Tejas	-3.28***	-0.82***	-5.29***	-4.71***	0.77**	-65.03***	0.90***	2.05***	0.011
PBNC-1	-5.43***	-0.12**	0.74***	0.29	-1.28***	-11.25**	1.07***	1.03***	0.072
Kokan Kirti	4.87***	-0.10	-0.98***	-0.39	-3.22***	-31.61***	-0.88***	-0.93***	-0.107
Phule Jyoti	-17.58***	-0.031	-3.23***	-1.73***	-1.83***	38.30***	-1.25***	-2.28***	0.02
G-4	1.38***	0.032	4.40***	4.89***	-0.009	-14.77***	1.49***	-0.18	0.12*
Bydagi	-10.18***	0.098**	-1.29***	-0.85***	-5.04***	59.28***	-0.47**	-0.035	-0.08
Bydagi-341	8.37***	0.24	-4.54***	-5.81***	2.50***	-35.62***	-0.65***	-0.021	-0.14*
Teja	13.83***	0.57***	2.11***	-1.69***	1.27***	-5.99	0.15	0.55**	0.052
Pusa Jwala	9.52***	-0.11	2.79***	2.45***	0.32	2.93	-0.24	0.72***	0.049
Pusa sadabahar	-1.50***	0.24	5.29***	7.55***	6.51***	63.78***	-0.10	-0.89***	-0.003
SE	0.33	0.17	0.18	0.23	0.28	4.11	0.15	0.19	0.063
CD95%	0.66	0.33	0.36	0.45	0.557	8.14	0.29	0.39	0.12
CD99%	0.88	0.44	0.48	0.60	0.73	10.76	0.39	0.51	0.16
Gi-Gj	1.24	0.63	0.69	0.85	1.04	15.22	0.55	0.73	0.23

Source of variation	Plant height (cm)	Number of primary branches/ plant	Days to first flowering	Days to 50 % flowering	Days to first fruit ripening	Number of fruit/ plant	Fruit weight (g)	Fruit length (cm)	Fruit diameter (mm)
Line									
BSPRL-066	-0.15*	158.26***	33.42***	3.66***	0.106*	-2.91	0.15*	1.32***	
BSPRL-224	0.029	329.28***	75.36***	9.46***	0.008	5.91***	0.65***	2.31***	
BSPRL-226	0.46***	100.71***	11.76	3.80***	0.13**	-0.079**	-0.003	0.063**	
BSPRL-188	-0.36***	-54.76***	-7.68	-0.77***	0.28***	-0.22	-0.20*	-0.24**	
BSPRL-189	-0.059	-211.89***	-42.64***	-6.54***	-0.24***	-0.80**	-0.27***	-1.12***	
BSPRL-171	0.085	-321.61***	-70.19***	-9.60***	-0.28***	-1.87**	-0.32***	-2.34***	
SE	0.072	10.361	8.52	0.13	0.046	1.59	0.078	0.15	
CD95%	0.14	20.519	16.88	0.27	0.092	3.16	0.15	0.30	
CD99%	0.18	27.12	22.32	0.35	0.12	4.17	0.20	0.39	
Gi-Gj	0.26	38.36	31.57	0.50	0.17	5.91	0.29	0.56	
Tester									
Parbhani Tejas	-0.039	-60.45***	-1.57	-1.67***	0.18**	14.46***	-0.03	-0.60**	
PBNC-1	0.034	15.27	38.31***	0.90***	0.14*	6.73**	0.29***	0.66***	
Kokan Kirti	-0.075	-114.05***	-39.98***	-3.02***	0.011	-5.006*	-0.14**	-1.01***	
Phule Jyoti	-0.43***	-36.82***	-11.50	-0.97***	-0.14*	-9.31***	-0.16**	-1.05***	
G-4	0.28**	47.27***	19.17	1.373***	0.29***	-2.86**	0.27***	0.35	
Bydagi	0.27**	1.14	-9.33	0.144	-0.22***	-2.34*	0.55***	0.54**	
Bydagi-341	0.14	-77.75***	-57.75***	-1.93***	-0.01	-3.21**	-0.33**	-0.47**	
Teja	-0.17	20.66	-4.13	1.08***	-0.014	-1.74**	-0.24*	0.34	
Pusa Jwala	0.17	-21.89	10.24	0.08***	-0.20**	0.85	-0.21*	-0.31	
Pusa sadabahar	-0.19*	226.61***	56.53**	4.02**	-0.035	2.44**	0.012**	1.56***	
SE	0.093	13.37	11.0097	0.17	0.06	2.06	0.10	0.19	
CD95%	0.18	26.49	21.80	0.35	0.11	4.08	0.20	0.38	
CD99%	0.24	35.02	28.82	0.46	0.15	5.39	0.26	0.51	
Gi-Gj	0.34	49.53	40.76	0.65	0.22	7.63	0.37	0.72	

*, ** - Significant at 5% and 15% level, respectively

(38.30), showing highly significant positive GCA effects. These findings are supported by Jethava *et al*. (2016), Kumar *et al.* (2014) and Sitaramesmi *et al.* (2010). The Parent G-4 showed a fruit weight of (1.49) g, indicating a significant positive GCA effect, as reported by Gangadhar *et al*. (2016). Highly significant positive GCA effects were observed for parents Parbhani Tejas (2.05) and BSPRL-224 (1.51). For fruit length and pedicel length (2.05 and 0.46), Parbhani Tejas and BSPRL-226, and for dry fruit weight (0.106), BSPRL-066, and fruit diameter (0.12), Phule Jyoti, and parent BSPRL-066 (0.11), highly significant positive GCA effects were recorded. Similar results were reported by Kumar *et al.* (2014) and Jethava *et al.* (2016). Parent BSPRL-224 exhibited maximum positively significant fruit weight/plant, dry fruit weight/plant, dry fruit yield/plot, number of pickings/plant, and fruit yield/plot compared to other parents. These results are supported by Singh and Pan (2009), Singh *et al.* (2014), Gawali *et al.* (2015), and Neelavathi *et al.* (2015). Parbhani Tejas yielded highest number of seeds/fruit (14.46), followed by PBNC-1 (6.73) compared to other parents. Prasath and Ponnuswami (2008), Kumar *et al*. (2014), Neelavathi *et al*. (2015), and Meena *et al.* (2018) also support these findings.

The estimates of specific combining ability (SCA) for plant height showed a positive effect in BSPRL-188 × Teja (29.12), as reported by Singh and Chaudhary (2005) and Gangadhar *et al.* (2016). The number of primary branches/plant was observed in BSPRL-226 × PBNC-1, while days to first flowering and days to 50% flowering showed highly significant negative SCA effects in hybrid BSPRL-188 × G-4 (-10.96) and BSPRL-189 × Pusa Sadabahar (-10.87), as reported by Ananda *et al.* (2004) and Karthik *et al.* (2009). For the number of fruits/plant, the hybrid BSPRL-171 × G-4 (145.03) exhibited the maximum positive SCA effects, followed by BSPRL-224 × Kokan Kirti (118.90), as reported by Kumar *et al.* (2014) and Sitamresmi *et al.* (2010). Hybrids BSPRL-171 × Bydagi (2.72) and BSPRL-171 × G-4 (2.33) showed highly significant positive SCA effects for fruit diameter and fruit length. Kumar *et al.* (2014) supported these findings. Hybrids BSPRL-224 × Parbhani Tejas (0.97) and BSPRL-188 × G-4 (0.87) exhibited highly significant positive SCA effects for pedicel length. The fruit weight, dry fruit weight, fruit weight/plant, dry fruit weight/plant, dry fruit yield/plot, and fruit yield/plot were recorded in hybrid BSPRL-171 × Phule Jyoti and BSPRL-066 × Phule Jyoti (338.49 and 154.13), showing highly significant positive SCA effects, as reported by Gawali *et al.* (2015). Hybrid BSPRL-226 × Kokan Kirti exhibited a highly positive significant SCA effect, followed by BSPRL-066 × Pusa Sadabahar, supported by Chadchan and Mohan Kumar (2008) and Grajales *et al.* (2009). The crosses BSPRL-189 × Bydagi (0.60) and BSPRL-189 × G-4 (0.47) showed highly significant positive SCA effects for various traits, as reported by Gawali *et al.* (2015) and Kumar *et al.* (2014). The hybrid BSPRL-226 × G-4 (27.51) exhibited a positive significant SCA effect for the number of pickings/plant. The crosses BSPRL-226 × Bydagi (1.12) and BSPRL-189 × G-4 (0.72) showed highly significant positive SCA effects for dry fruit yield, while BSPRL-066 × Pusa Sadabahar (2.13) exhibited a highly positive significant SCA effect. Similar results were reported by Tembhurne *et al.* (2012), Kumar *et al.* (2014), and Meena *et al.* (2018).

CONCLUSION

The GCA and SCA variances were highly significant for all characters except fruit diameter. Among Parents, BSPRL-066, BSPRL-171, BSPRL-224, Phule Jyoti, PBNC-1, G-4, Teja, Bydagi, and Pusa Jwala, were good general combiners for fruit and yield-contributing characters. Hybrids BSPRL-066 x Teja, BSPRL-171 x Phule Jyoti, BSPRL-066 x Phule Jyoti, BSPRL-224 x Kokan Kirti,BSPRL-188 x Bydagi, BSPRL-189 x Bydagi, BSPRL-189 x Pusa Sadabahar, BSPRL-171 x Bydagi, BSPRL-171 x G-4, BSPRL-171 x PBNC-1, BSPRL-188 x Pusa Jwala, BSPRL-188 x Teja, BSPRL-066 x Konkan Kirti, BSPRL-066 x PBNC-1, BSPRL-188 x Phule Jyoti, and BSPRL-171 x Pusa Jwala, were best promising combinations for green fruit yield.

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