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Short Communication

Genetic divergence as a function of combining ability in chilli (*Capsicum annuum* L.)

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In chilli (*Capsicum annuum* L.), where a low productivity and susceptibility to pests and diseases is a serious problem, combining ability studies is a must to go in for developing superior hybrids. In the present investigation, an attempt has been made to study the combining ability of 14 chilli genotypes by line × tester mating technique. A total of 45 hybrids were produced in line x tester design, involving 5 lines, *viz.*, RHRC-50-1, PMR-14, PMR-19, Tiwari and AVRDC-95-06 and 9 testers *viz.*, Arka Abhir, Arka Lohit, Byadgi Dabbi, Byadgi Kaddi, PMR-21, PMR-39, PMR-57, Punjab Guchhedar and Punjab Surkh during rabi 2003.

The hybrids were evaluated along with their parents and commercial check (Namdhari Seeds 1101) in a randomized block design with two replications during summer 2004. Observations were recorded on five randomly selected plants for 12 characters *viz.*, plant height (cm), number of primary branches, fruit length (cm), number of fruits per plant, fresh fruit yield per plant (g), dry fruit yield per plant(g), number of seeds per fruit, Bartlett's index for earliness, Ascorbic acid content in green fruits (mg/100g), Capsanthin content (ASTA units), Oleoresin percentage and susceptibility to virus complex (Percent Disease Index). Combining ability analysis was done according to the model given by Kempthome [1]. The parents were classified in to low (L) and high (H) general combiners; so also the crosses were also classified into high (H) and low (L) based on the method suggested by Arunachalam and Bandyopadhyay [2] and slightly modified by Mohan Rao [3].

The analysis of variance for combining ability (Table 1) revealed significant variance among females for plant height, fresh fruit yield per plant, dry fruit yield per plant and Ascorbic acid content in fresh fruits, whereas, the variance for males was significant for plant height, Bartlett's index and Ascorbic acid content. Variance for line x tester interaction was highly significant for all the characters indicating the major role of nonadditive gene action in determining the expression of most of the characters. Significant *gca* variances were observed for most of the characters except number of primary branches and number of seeds per fruit, whereas, all the characters exhibited highly significant *sca* variances. So also, dominance variance was highly significant for all the characters and additive variance was also significant in majority of the cases except number of primary branches, Bartlett's index and number of seeds per fruit. This indicates that majority of characters are governed by both additive and nonadditive gene action, the latter being the predominant one as can be seen from σ^2_A/σ^2_D ratio. This is in conformity with findings of Jagadeesh [4] and Basavaraj [5]. Only three characters, *viz.*, plant height, dry fruit yield per plant and ascorbic acid content manifested a higher magnitude of additivity in the present studies. It is beyond the scope of this short communication to give the *gca* effects of the parents. However, the overall *gca* status of the parents have been included here (Table 2). PMR-14 was found to be the best general combiner with the highest total score. Among testers, PMR-57 registered the highest overall *gca* status.

Table 2 indicates the estimates of *sca* effects for various characters of the 45 crosses along with their overall status across all the characters. The highest positive significant *sca* effect for fresh fruit yield per plant and number of fruit per plant was exhibited by the cross PMR-14 × PMR-57 followed by AVRDC-95-06 × Byadgi Dabbi. The cross PMR-19 × Arka Lohit exhibited the highest significant positive *sca* effect for dry fruit yield per plant. The hybrid which registered the highest significant negative *sca* effect for virus complex was AVRDC-95-06 × Arka Abhir followed by AVRDC-95-06 × Punjab Guchhedar.

The overall status with respect to *sca* effects was highest for the hybrid combination RHRC-50-1 × Punjab Surkh followed by PMR-14 × PMR-57. It was noted that given a cross with high overall *sca* status, the probability of finding it to be a H × L combination was higher than the probability of it being a H × H or L × L combination in that order. Similar findings have been reported by earlier workers such as Ahmed *et al.*, [6], Nandadevi *et al.*, [7] and Ahmed *et al.*, [8].

Highly significant *sca* for most of the traits studied indicates the immense scope to go for heterosis breeding in this crop. In producing superior performing crosses, established superiority of H × L and H × H combinations could be practically exploited.

Table 1. Estimates of *sca* effects and the overall *sca* status across 12 traits for 45 crosses in chilli

Sl.No.	Cross	Overall *sca*		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
		Score	Status												
1	L1×T1	205	L	−2.69	−0.15	−0.41	15.27**	−16.00**	−27.39**	11.89**	−0.03**	6.10**	−8.96**	−2.13**	−2.84
2	L1×T2	230	L	0.79	−0.70**	0.50**	−3.43	−14.62**	−14.20**	−6.18**	−0.04**	−0.98	−19.79**	−1.59**	−8.24**
3	L1×T3	228	L	−8.6**	0.83**	−1.16**	58.11*	−6.73	8.09*	−3.04	−0.02*	−8.78**	−11.04**	−1.61**	−5.04**
4	L1×T4	255	L	5.5*	0.23	0.27	−10.68	73.71**	2.56	−5.02	−0.03**	1.94	−11.52**	−0.4**	−9.84**
5	L1×T5	320	H	−5.13*	0.60*	0.26	−1.75	−13.08*	0..35**	5.12	0.04**	−8.64**	29.73**	0.12	14.36**
6	L1×T6	213	L	−12.07**	0.22	−0.25	−70.00**	−131.16**	−2.52	−9.72**	#	13.85**	−0.51	−1.35**	10.36**
7	L1×T7	251	L	−0.75	−1.2**	−0.40	−27.72**	−75.38**	−16.59**	−8.10*	0.08**	−12.73**	9.53**	2.67**	−2.24
8	L1×T8	367	H	9.61**	0.18	0.61**	24.99**	54.34**	14.68**	2.20	0.05**	−16.64**	0.14	2.10**	1.16
9	L1×T9	395	H	13.32**	−0.01	0.58**	15.20*	128.94**	−4.98	12.85**	−0.05**	25.89**	12.42**	2.18**	2.36
10	L2×T1	252	L	−2.71	−0.25	−1.27**	−35.58**	112.04**	−4.32	−18.68**	0.07**	10.55**	−0.64	1.35**	10.98**
11	L2×T2	279	H	7.06**	0.95**	0.20	−95.29**	228.95**	−21.82**	10.41**	0.05**	7.67**	−18.55**	0.55*	6.09**
12	L2×T3	273	L	−3.33	−0.65**	0.99**	−40.86**	−43.53**	−20.72**	−12.45**	0.02*	38.95**	13.06**	0.96**	9.79**
13	L2×T4	315	H	1.38	−0.87**	1.11**	−49.95**	−114.74**	30.85**	28.82**	#	−18.83**	49.12**	−1.10**	−5.01**
14	L2×T5	240	L	0.15	0.62**	−0.47*	−30.51**	−93.84**	4.95	−16.64**	−0.02*	−1.54	−25.14**	0.99**	−10.81**
15	L2×T6	295	H	−5.95*	0.28	−0.10	25.20**	48.04**	−14.89**	35.22**	0.03**	−16.60**	−1.82	0.93**	−3.81*
16	L2×T7	380	H	10.03**	−0.05	−0.30	205.55**	425.40**	44.81**	0.44	−0.12**	21.65**	1.23	1.12**	3.59*
17	L2×T8	212	L	−6.71*	0.08	0.08	51.16**	55.10**	−10.14**	−12.71**	−0.02*	−6.27**	−22.80**	−3.78**	−2.01
18	L2×T9	244	L	0.07	−0.11	−0.25	−29.73**	64.55**	−8.71*	−14.41**	−0.02*	−35.58**	5.53**	−1.02**	−8.81**
19	L3×T1	256	L	−2.35	0.30	−0.30	48.81**	108.55**	14.31**	−3.60	−0.05**	−4.62**	−11.92**	−0.21	−6.23**
20	L3×T2	325	H	−8.63**	0.79*	0.00	52.54**	48.50**	75.14**	−5.71	#	6.75**	3.33*	1.47**	10.87**
21	L3×T3	302	H	5.56*	0.32	−1.15**	−30.44**	−99.90**	−0.76	35.03	0.02*	−8.79**	2.93	1.13**	4.57**
22	L3×T4	193	L	0.11	0.72**	−1.02**	−30.23**	−72.62**	−30.54**	0.40	0.05**	−3.20	−21.33**	−2.59**	11.77**
23	L3×T5	334	H	10.06**	−0.66**	0.80	32.16**	115.01**	−22.39**	14.19**	0.05**	7.07**	11.71**	1.05**	1.97
24	L3×T6	221	L	1.86	−1.17**	0.77**	−70.18**	−99.61**	−35.25**	−12.70**	0.01	8.13**	45.52**	−1.77**	32.03**
25	L3×T7	203	L	−6.66*	0.20	0.78**	−72.08**	−151.82**	−28.65**	6.37*	−0.02*	−1.64	−11.94**	−0.10	−6.63**
26	L3×T8	308	H	6.47*	−0.33	0.68**	12.76	136.67**	11.32**	2.77	−0.06**	4.31**	−9.41**	1.38**	10.77**
27	L3×T9	295	H	−6.2*	−0.15	0.16	56.66**	15.22**	16.83**	−6.78*	0.11**	−8.02**	−8.87**	−0.36**	4.97**
28	L4×T1	352	H	7.56**	0.87**	−0.83**	31.03**	76.53**	19.22**	−5.60	#	−8.32**	−3.56*	3.05**	22.43**
29	L4×T2	331	H	5.66*	0.07	−0.23	34.93**	145.91**	−19.19**	2.16	−0.01	−5.63**	11.58**	2.93**	−3.47*
30	L4×T3	287	H	2.99	0.60*	2.31**	−107.33**	164.53**	−5.44	27.20**	−0.03**	2.60	−2.02	0.98**	−8.77**
31	L4×T4	180	L	−7.75**	−1.63**	−0.26	6.46	−58.39**	−19.52**	−16.68**	−0.06**	7.37**	−5.22**	0.08	0.43
32	L4×T5	240	L	−4.78**	−0.51*	−0.20	10.49*	38.50**	−25.21**	−0.49	0.03**	3.51	−15.80**	−4.54**	−12.37**
33	L4×T6	379	H	6.15**	0.77**	0.66**	43.30**	66.65**	25.70**	2.22	0.01	3.98*	−6.38**	−0.06	−1.37
34	L4×T7	209	L	−2.70	0.56*	−0.26	−112.78**	−53.87**	−0.83	1.04	0.08**	−14.43**	−18.45**	−5.28**	4.03*
35	L4×T8	327	H	−6.17**	−0.18	−0.21	15.77*	−6.63	21.04**	0.24	0.03**	8.56**	41.54**	2.11**	8.43**
36	L4×T9	228	L	−0.94	−0.54**	−0.99**	78.12**	−44.17**	4.23	−10.06**	−0.05**	2.35	−1.70	0.73**	−9.37**
37	L5×T1	283	H	0.19	−0.77**	2.81**	−59.54**	−57.04**	−1.82	15.99**	0.01	−3.71*	25.09**	−2.05**	−24.34**
38	L5×T2	224	L	−4.88	−1.10**	−0.47*	11.24	49.16**	−19.92**	−0.67	0.01	−7.82**	23.44**	−3.37**	−5.24**
39	L5×T3	208	L	3.38	−1.10**	−0.99**	120.52**	314.70**	18.83**	−16.73**	0.01	−23.99**	−2.94	−1.47**	−0.54
40	L5×T4	375	H	0.98	1.55**	−0.11	84.40**	172.05**	16.65**	−7.51*	0.04**	12.71**	−11.05**	4**	2.66*
41	L5×T5	277	H	−0.30	−0.05	0.33	−10.39	−46.59**	2.31	−2.17	0.00	−0.40	−0.50	2.37**	6.86**
42	L5×T6	286	H	10.01**	−0.09	−1.09**	71.68**	116.08**	26.97**	−15.01**	−0.06**	−9.36**	−36.80**	2.25**	26.86**
43	L5×T7	325	H	0.08	0.50	0.17	7.03	−114.33**	1.26	0.26	−0.01	7.16**	19.63**	1.59**	1.26
44	L5×T8	210	L	−3.21	0.25	−1.15**	−104.69**	39.49**	−36.91**	7.51*	0.00	10.04**	−9.48**	−1.81**	−18.34**
45	L5×T9	272	L	−6.25*	0.80**	0.50*	−120.25**	164.54**	−7.38*	18.36**	0.00	15.36**	−7.39**	−1.53**	10.86**
	S.E.			2.50	0.24	0.22	6.59	5.65	3.84	3.24	0.01	1.86	1.71	0.26	1.70

Characters : X1 : Plant height (cm), X2 : No. of primary branches per plant, X3: Fruit length (cm), X4: No. of fruits per plant, X5 : Fresh fruit yield per plant(g), X6 : Dry fruit yield per plant(g), X7 : No. of seeds per fruit, X8: Bartlett's index, X9 : Ascorbic acid content (mg/100 g), X10: Capsanthin content(ASTA units), X11: Oleoresin percentage, X12:Virus complex incidence(%); Parents lines: L1 : RHRC-50-1, L2:PMR-14, 13: PMR-19, L4:TIWARI, L5 : AVRDC-95-06, Overall *gca* status, L H H L H; Testers: T1 : Arka Abhlr H T2 : Arka Lohit H T3 : Byadgi Dabbi L T4: Byadgi Kaddi M T5: PMR-21 L T6 : PMR-39 L T7 : PMR-57 H T8 : Punjab Guchhedar L T9 : Punjab Surkh L. * - significant at $p = 0.05$ **-significant alp = 0.01, L : Low overall *gca/sca* status H : High overall *gca/sca* status, # : The figure is too small to be depicted in the table

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