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Research Note

Combining ability studies in bitter gourd (*Momordica charantia* L.)

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Abstract
The investigation was carried out to get information on combining ability in bitter gourd through line x tester analysis in which 12 inbred lines (as females), 3 testers (as male) and 36 crosses were studied in a Randomized Block Design with three replications. The inbred lines L_9, L_2 and L_4 exhibited positive significant gca effects indicating their good general combining ability for yield per vine and other yield contributing characters. Among the testers, T_1 was considered good general combiner for yield, fruit length, fruit weight, number of primary branches, number of fruits per vine and ascorbic acid content. Therefore, these are proposed for their further utilization in hybrid breeding programmes aimed at improving the desired traits.

Key Word: Combining ability, GCA effect, SCA effect, Bitter gourd

Bitter gourd (*Momordica charantia* L.) is one of the most important, nutritious vegetables known for its bitter principle. In India, it is grown throughout the country as rainy and summer season vegetable. It is a highly cross pollinated crop and its monoecious nature has resulted in wider variation in several qualitative and quantitative characters. Apart from possessing a wide range of genetic variability in terms of vegetative and fruit characters, it is a cross-pollinated crop, which envisages its improvement through heterosis breeding (Ram et al., 1999). But in hybrid breeding programme the breeder often faces the problem of selecting parents and crosses. At this juncture information on the relative importance of general (GCA) and specific combining ability (SCA) may be of great value to the breeder. Therefore, the present investigation was carried out to obtain information about the GCA and SCA of parents and hybrids, respectively in bitter gourd.

The present investigation was carried out during 2015-16, in three environments *viz.,* Kharif 2015 (E_1), Summer 2016 (E_2) and Kharif 2016 (E_3) at Horticulture farm, Rajasthan College of Agriculture, Udaipur (Rajasthan). The experimental material comprised of 12 inbred lines *viz.*, IC-599421 (L_1), IC-599431 (L_2), IC-566983 (L_3), IC-599423 (L_4), IC-599410 (L_5), IC-68344 (L_6), IC-596981 (L_7), IC-599434 (L_8), IC-599429 (L_9), IC-599424 (L_{10}), IC-50520 (L_{11}), IC-50527 (L_{12}) and 3 testers *viz.*, Pusa Do-Mosmi (T_1), Pusa Vishesh (T_2), Pusa Rasdar (T_3) and their 36 F_1s with 3 checks *viz.*, Apoorva, Charles, US-6214. These 36 F_1s were obtained by crossing 12 inbred lines and 3 testers in line x tester mating. Observations were recorded on 15 characters, *viz.*, days to anthesis of first male flower, days to anthesis of first female flower, node at which first female flower appeared, days to maturity, fruit length, fruit diameter, fruit weight, number of male flower per vine, number of female flower per vine, vine length, number of primary branches, number of fruits per vine, number of seeds per fruit, yield per vine and ascorbic acid content were subjected to statistical analysis for combining ability estimation for different traits was calculated according to model suggested by Kempthrone (1957).

Significance of parents can be judged through *per se* performance and general combining ability (gca) of parents to obtain a desirable recombinant. In the present investigation, estimates of GCA effects revealed that inbred lines L_9, L_2 and L_4 exhibited positive significant gca effects indicating their good general combining ability for yield per vine. The results are in consonance with the findings of Munshi and Sirohi (1994), Tewari *et al.* (2001), Panda *et al.* (2008), Thangamani *et al.* (2011), Kumara *et al.* (2011) and Laxuman *et al.* (2012) for yield per plant in bitter gourd. Among the testers, T_1 was considered good general combiner for yield, fruit length, fruit weight, number of primary branches, number of fruits per vine, ascorbic acid content and TSS. The tester T_2 was considered good general combiner for specific gravity and number of female flower per vine. Whereas, tester T_3 was good general combiner for days to maturity and number of seeds per fruit. The high general combining ability effects observed, is due to additive gene effect and additive x additive gene effects (Griffing, 1956 and Sprague, 1966). Overall picture of general combining ability revealed that among parental lines, L_2, L_4, L_9 and T_1 which were good general combiners for yield per vine also were good general combiners for other component characters like number of fruits per plant (L_2, L_9 and T_1), number of primary branches (L_9, T_1 and T_2), fruit weight (L_9 and T_1), fruit diameter (L_4) and fruit length (L_4, L_9 and T_1) Table 1).

A perusal of SCA effects revealed with regard to days to flowering, six hybrids *viz.*, L_3 xT_1, L_{11} x T_1, L_4 x T_2, L_5 x T_2, L_2 x T_3 and L_6 x T_3 exhibited negative significant sca for days to anthesis of first male flower, while four hybrids *viz.*, L_7 x T_1, L_8 x T_1, L_4 x T_2, and L_6 x T_3 exhibited negative significant sca effects for days to anthesis of first female flower across the environments. Significant negative sca effects for days to anthesis of male and female flower were reported by Ram *et al.* (1999) and Khattra *et al.* (2000). For yield per vine, cross combinations *viz*., L_4 x T_1, L_5 x T_1, L_8 x T_1, L_{11} x T_1, L_7 x T_2, L_{10} x T_2, L_{12} x T_2, L_2 x T_3, L_6 x T_3, L_7 x T_3, L_9 x T_3 and L_{12} x T_3 exhibited significant sca effects in positive direction over the environments. Among these, four hybrids *viz*., L_5 x T_1, L_8 x T_1, L_{11} x T_1 and L_{10} x T_2 exhibited positive significant sca effects in all the environments as well as on pooled basis (Table 2). The four hybrids hybrids *viz*., L_5 x T_1, L_8 x T_1, L_{11} x T_1 and L_{10} x T_2 exhibiting significant sca effects for yield per vine, also exhibited significant sca effect for yield contributing characters *viz*., fruit length (L_8 x T_1, L_{11} x T_1 and L_{10} x T_2), fruit diameter (L_8 x T_1), fruit weight (L_8 x T_1 and L_{10} x T_2), number of female flower per vine (L_8 x T_1 and L_{11} x T_1), vine length (L_5 x T_1, L_8 x T_1 and L_{11} x T_1), number of primary branches (L_5 x T_1, L_8 x T_1 and L_{10} x T_2) and number of fruits per vine (L_5 x T_1, L_8 x T_1, L_{11} x T_1 and L_{10} x T_2).

These results indicated that the gca effects were mostly reflects the sca effects of the cross combinations as it is apparent that in almost all the hybrids which showed best sca effect, the parents involved either both or one of the parents with good gca effect for this trait. This indicated that there was strong tendency of transmitting the favourable alleles from parents to off-springs. Munshi and Sirohi (1994) and Shafiullah and Sikdar (2007) also reported similar type of results. The cross combinations which involved G × A and G × P having higher heterotic values besides higher *per se* performance suggested the possibility of exploiting these crosses for yield improvement through heterosis breeding. However with respect to crosses with G × G and G × A general combiners, pedigree selection could be more profitable. The G × P and P × P gca combination in these crosses indicated the importance of dominant gene and the complimentary gene effects. Venkateshwarlu and Singh (1982) suggested that high × low gca combination could produce transgressive segregants if the additive genetic system present in the good combiner and complementary epistatic effect act in the same direction to maximize the desirable plant attributes.

References

Griffing, J.B., 1956. Concept of general and specific combining ability in relation to diallel cropping systems. *Aust. J. Biol. Sci.* **9**: 463-493.

Kempthorne, O. 1957. An introduction to genetical statistics. John Willey and Sons Inc, New York, pp. 323-331.

Khattra, A. S., Singh, R. and Thakur, J. C. 2000. Combining ability studies in bitter gourd in relation to line × tester crossing system. *Veg. Sci.* **27**: 148-151.

Kumara, B.S., Puttaraju, T.B., Hongal, S., Prakash, K., Jainag, K. and Sudheesh, N.K. 2011. Combining ability studies in bitter gourd (*Momordica charantia* L.) for quantitative characters. *Asian J. Hort.*, **6**: 135-40.

Laxuman, S. A., Patil, P. M., Salimath, P. R., Dharmatti, A. S., and Nirmalayenagi. 2012. Heterosis and combining ability analysis for productivity traits in bitter gourd (*Momordica charantia* L.*) Karnataka Journal of Agricultural Sciences*, **25** (1): 9-13.

Munshi, A.D., and Sirohi, P.S. 1994. Combining ability estimates in bitter gourd (Momordica charantia L.). *Vegetable Science*, **21**(2): 132-136.

Panda, A., Singh, D.K. and Bairagi, S.K. 2008. Study of combining ability for the production of bitter gourd hybrids. *Prog. Hort.* **40**: 33-37.

Ram, D., Kalloo, G. and Singh, M. 1999. Combining ability of quantitative characters in bittergourd (*Momordica charantia*). *Ind. J. Agri. Sci.* **69**: 122-125.

Shafiullah, M. and Sikdar, B. 2007. Relative importance of gene effects in bitter gourd (*Momordica charantia* L.). *Bangladesh Journal of Botany*, **36**(2): 189-191.

Sprague, G.F., 1966. Quantitative genetics in plant improvement. ***In***: Plant Breeding: A symposium held at the Iowa state university, K.J. Fery (Ed.), Iowa State University Press, Ames, Iowa, U.S.A., pp. 315-354.

Tewari, D., Ram, H.H. and Jaiswal, H. R. 2001. Studies on heterosis and combining ability in indigenous bitter gourd (*Momordica charantia* L.) for fruit yield. *Veg. Sci.* **28**: 106-108.

Thangamani, C., Pugalendhi, L., Sumathi, T., Kavitha, C. and Rajashree, V. 2011. Estimation of combining ability and heterosis for yield and quality characters in bitter gourd *(Momordica charantia L.). Electronic Journal of Plant Breeding*, **2**(1): 62-66.

Venkateshwarlu, S. and Singh, R.B., 1982. Combining ability in pigeon pea. *Indian Journal of Genetics*, **42**:11-14.

Table 1. GCA effects of parents for different characters in bitter gourd

SI. NO.	Parents	Days to anthesis of first male flower	Days to anthesis of first female flower	Node at which first female flower appeared	Days to maturity	Fruit length	Fruit diameter	Fruit weight	Number of male flower per vine
1.	T1	-0.31	-0.25	-0.06	0.10	0.86**	0.09	4.41**	-9.90**
2.	T2	0.35	0.39	0.14**	1.00**	0.00	-0.05	-2.07**	8.78**
3.	T3	-0.05	-0.14	-0.08	-1.10**	-0.86**	-0.04	-2.33**	1.12
4.	L1	0.16	-1.38*	-0.27**	-3.65**	0.15	-0.32**	-3.41**	11.54**
5.	L2	-0.98	-0.60	-0.10	-3.27**	-0.07	-0.10	-1.29	1.30
6.	L3	2.81**	1.75**	-0.53**	1.58*	-0.79**	0.18	-5.94**	15.40**
7.	L4	3.66**	5.56**	0.22*	5.25**	2.56**	0.39**	13.56**	17.38**
8.	L5	-0.59	-0.18	-0.03	-0.21	0.14	0.28**	4.79**	-16.90**
9.	L6	-1.42*	-0.83	0.86**	0.04	-2.34**	-0.19	-10.12**	16.26**
10.	L7	0.14	0.38	1.17**	-0.16	-0.84**	-0.03	1.22	-20.36**
11.	L8	-0.87	-2.81**	0.37**	-1.78**	-0.72**	0.17	1.45	-28.92**
12.	L9	-0.78	-0.85	-1.38**	0.63	2.93**	-0.11	11.17**	17.07**
13.	L10	-2.41**	-1.00	-0.70**	-1.62*	-2.05**	-0.09	-8.06**	-24.57**
14.	L11	0.24	0.76	0.88**	2.66**	-0.26	0.08	-4.09**	7.34*
15.	L12	0.05	-0.79	-0.49**	0.53	1.29**	-0.25**	0.72	4.47

*, ** Significant at 5 and 1 per cent, respectively

Table 1 conti….

SI. NO.	Parents	Number of female flower per vine	Vine length	Number of primary branches	Number of fruits per vine	Number of seeds per fruit	Yield per vine	Ascorbic acid content
1.	T1	-0.81**	-0.04	0.15**	0.14	1.18**	92.26**	1.86**
2.	T2	0.74*	0.03	0.15**	-0.06	-0.49**	-43.26**	0.14
3.	T3	0.07	0.01	-0.30**	-0.08	-0.70**	-49.00**	-2.00**
4.	L1	2.32**	-0.01	0.09	1.93**	-2.07**	25.42	-7.23**
5.	L2	2.14**	-0.02	-0.01	2.43**	-1.74**	83.45**	8.85**
6.	L3	3.03**	-0.00	0.41**	3.34**	-1.43**	33.63	-2.75**
7.	L4	-0.81	-0.08	0.12	-2.18**	5.89**	80.72**	-1.40**
8.	L5	-1.84**	0.18**	0.82**	-0.93*	1.92**	29.06	-4.83**
9.	L6	2.29**	0.19**	-0.16	0.62	-3.05**	-133.69**	-6.68**
10.	L7	-3.45**	-0.02	-0.13	-2.21**	0.59	-95.72**	11.35**
11.	L8	-2.35**	-0.04	0.09	-2.28**	-0.16	-63.73**	-5.62**
12.	L9	2.62**	-0.17**	0.36**	3.73**	1.91**	414.91**	5.67**
13.	L10	-3.84**	-0.01	-0.37**	-3.35**	-2.04**	-265.63**	4.14**
14.	L11	-0.09	-0.10*	-0.72**	0.22	-1.23**	-36.16	- 10.08**
15.	L12	-0.02	0.08	-0.50**	-1.32**	1.42**	-72.27**	8.57**

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Table 2. SCA effects of hybrids for different characters in bitter gourd

Sl. No	Hybrids	Days to anthesis of first male flower	Days to anthesis of first female flower	Node at which first female flower appeared	Days to maturity	Fruit length	Fruit diameter	Fruit weight	Number of male flower per vine	Number of female flower per vine	Vine length	Number of primary branches
1.	L1 x T1	-0.15	-1.52	-0.52**	1.36	0.80*	-0.05	-0.47	-14.22*	1.04	-0.02	-0.21
2.	L2 x T1	1.85	1.09	-1.64**	2.47	3.52**	0.13	4.10*	-16.42**	-1.41	0.21*	-0.60**
3.	L3 x T1	-2.68*	-2.25	-0.48**	-4.24**	4.17**	-0.04	10.81**	12.54*	-2.03	-0.25**	0.38*
4.	L4 x T1	1.00	-0.26	0.75**	-0.65	-2.12**	0.75**	-2.53	6.30	1.50	-0.29**	-1.04**
5.	L5 x T1	3.10**	2.90*	2.38**	5.84**	-1.91**	-0.38*	-0.44	3.40	1.80	0.21*	0.40*
6.	L6 x T1	1.82	3.55**	-1.56**	2.52	-2.40**	0.04	-5.54**	-19.13**	-2.53*	0.09	0.52**
7.	L7 x T1	-1.25	-2.66*	-1.85**	-3.30*	-0.52	0.03	-7.14**	-4.83	-0.86	-0.04	0.23
8.	L8 x T1	-0.20	-3.23*	0.78**	-3.37*	1.03**	0.59**	12.36**	34.49**	2.73**	0.32**	1.38**
9.	L9 x T1	0.92	2.26	0.16	2.47	-0.99**	-0.44*	0.66	-18.71**	0.07	0.08	0.25
10.	L10 x T1	-1.10	-0.40	0.51**	-2.35	-1.29**	0.13	-5.51**	-29.52**	-1.35	-0.26**	-0.68**
11.	L11 x T1	-2.87*	0.80	0.04	0.67	1.81**	-0.64**	-1.59	49.14**	4.33**	0.28**	-0.79**
12.	L12 x T1	-0.43	-0.29	1.43**	-1.41	-2.09**	-0.11	-4.71**	-3.05	-3.29**	-0.34**	0.15
13.	L1 x T2	0.55	1.42	2.02**	-1.58	1.29**	-0.45*	5.93**	-3.56	-3.02**	-0.13	0.79**
14.	L2 x T2	0.61	-0.13	0.69**	-2.45	-3.59**	0.08	-5.19**	0.30	3.67**	-0.11	-0.38*
15.	L3 x T2	1.33	-1.59	-0.94**	1.21	-1.50**	-0.01	-2.90	13.91*	-0.84	-0.08	1.04**
16.	L4 x T2	-3.34**	-4.60**	0.44**	-1.31	2.37**	-0.48*	0.97	6.61	0.33	0.29**	-0.44*
17.	L5 x T2	-2.63*	-1.86	-1.37**	-2.93*	3.27**	0.68**	9.46**	-29.23**	-1.30	0.08	-0.76**
18.	L6 x T2	0.98	-0.05	1.53**	1.24	1.20**	0.01	2.96	7.57	-0.13	0.22*	-0.51**
19.	L7 x T2	-1.30	0.75	-0.47**	0.35	-1.10**	-0.16	-0.90	-24.84**	0.17	-0.14	-0.36*
20.	L8 x T2	-1.60	1.32	0.69**	0.28	-2.30**	0.06	-9.78**	-7.90	-1.24	-0.08	-1.10**
21.	L9 x T2	0.38	0.01	0.35*	0.23	0.62	0.20	-3.01	4.60	-2.92**	-0.00	1.01**
22.	L10 x T2	1.95	1.31	-1.42**	3.03*	1.34**	-0.12	5.90**	15.78*	1.65	-0.11	1.24**
23.	L11 x T2	2.69*	1.60	-0.60**	0.97	0.94**	0.12	4.49**	-0.64	0.39	-0.18*	0.35*
24.	L12 x T2	0.37	1.82	-0.92**	0.97	-2.52**	0.07	-7.92**	17.39**	3.25**	0.23**	-0.88**
25.	L1 x T3	-0.41	0.09	-1.50**	0.22	-2.08**	0.50*	-5.46**	17.78**	1.98	0.15	-0.58**
26.	L2 x T3	-2.46*	-0.96	0.95**	-0.02	0.07	-0.21	1.09	16.12**	-2.26*	-0.10	0.98**
27.	L3 x T3	1.35	3.84**	1.42**	3.04*	-2.67**	0.06	-7.91**	-26.46**	2.87**	0.32**	-1.42**
28.	L4 x T3	2.35*	4.86**	-1.19**	1.96	-0.25	-0.26	1.56	-12.90*	-1.82	-0.00	1.48**
29.	L5 x T3	-0.47	-1.04	-1.01**	-2.90*	-1.35**	-0.29	-9.01**	25.83**	-0.50	-0.29**	0.35*
30.	L6 x T3	-2.80*	-3.50**	0.03	-3.76**	1.20**	-0.05	2.58	11.56	2.66*	-0.31**	-0.01
31.	L7 x T3	2.55*	1.91	2.32**	2.95*	1.62**	0.13	8.04**	29.66**	0.69	0.17	0.13
32.	L8 x T3	1.80	1.90	-1.47**	3.09*	1.27**	-0.65**	-2.59	-26.60**	-1.48	-0.24**	-0.28
33.	L9 x T3	-1.30	-2.27	-0.51**	-2.70*	0.37	0.24	2.36	14.10*	2.84**	-0.08	-1.26**
34.	L10 x T3	-0.85	-0.91	0.90**	-0.68	-0.04	-0.02	-0.39	13.74*	-0.30	0.38**	-0.56**
35.	L11 x T3	0.18	-2.40	0.56**	-1.65	-2.76**	0.52**	-2.90	-48.50**	-4.72**	-0.10	0.44*
36.	L12 x T3	0.06	-1.53	-0.51**	0.44	4.62**	0.04	12.63**	-14.34*	0.04	0.10	0.74**