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COMBINING ABILITY ANALYSIS FOR QUANTITATIVE TRAITS IN BOTTLE GOURD [*LAGENARIA SICERARIA* (MOL.) STANDL.]

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Abstract

The present investigation were undertaken to obtain information about general and specific combining ability in parents and F_1 generation, respectively of eight parental diallel cross (excluding reciprocals) of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] at Department of Vegetable science, N.D. University of Agriculture & Technology, Kumarganj, Faizabad. Parental line P_2 emerged good general combiner for fruit circumference, number of fruits per plant and fruit yield per plant while parent P_8 showed highly significant general combining ability effect for vine length, number of primary branches per plant and fruit length. The parent P_7 was the best general combiner for all the traits studied except average fruit weight. The cross P_2 x P_3 had highest specific combining ability effects for fruit yield along with number of fruits per plant. The highest specific combining ability for number of branches per plant was indicated by cross P_5 x P_8 while P_1 x P_3 was the best specific combiner for vine length.

Key words **:** *Lagenaria siceraria*, combining ability analysis, GCA (general combining ability) and SCA (Specific combining ability).

Introduction

In the cucurbitaceous vegetable crops, bottle gourd is a cultivated annual monoecious species, belongs to the family cucurbitaceae, having chromosome number 2n = 22, with its high yield potential and adoptability to diverse climatic condition in India. Homozygous are considered an important aspect in any breeding programme aimed improving yield and its related attributes. The diallel mating design is very useful for preliminary evaluation of genetic studies through hybridization programme. Hence a study was undertaken to identify the best combiners among the existing germplasm as well as gene action of different quantitative characters in 8 x 8 diallel set without reciprocal to facilitate the formulation of sound breeding programme.

Materials and Methods

The experimental materials comprised of eight inbred lines namely, Pusa Naveen (P_1), NDBG-504 (P_2), NDBG-509 (P_3), NDBG-525 (P_4), NDBG-601 (P_5), NDBG-603 (P_6), NDBG-624 (P_7) and NDBG-625 (P_8) and 28 hybrids derived from the diallel mating design (excluding reciprocals). The parents and F_1's were grown during summer (*Zaid*) crop seasons of 2008 (Y_1) and 2009 (Y_2) in Randomized Block Design with three replications. The experiment was conducted in single row of 3 meters long with row to row spacing of 3 meters and plant to plant spacing of 50 cm. aparts at Department of Vegetable Science, N.D. University of Agriculture & Technology, Kumarganj, Faizabad. Six plants were maintained in each plot. The recommended agronomic practices were followed to raise a good crops. The observations were recorded for vine length (m), number of primary branches per plant, fruit length (cm), fruit circumference (cm), number of fruits per plant, average fruit weight (kg) and fruit yield per plant (kg). Combining ability variances and their effects were worked out according to Griffing (1956 b).

Results and Discussion

The mean squares due to general combining ability (gca) and specific combining ability (sca) were highly significant for all the characters indicating importance of both additive and non-additive genetic components of variance (Table-1). Similar results were also reported by Khattra *et al.* (1994). Estimates of general combining ability (gca) and specific combining ability (sca) are given in Table-2 and 3, respectively. In respect to vine length parents P_3 (0.38 and 0.25), P_8 (0.32 and 0.25) and P_7 (0.04 and 0.06) during both the years showed significantly positive gca effects. Fourteen and eight crosses were showed highly significant positive sca effects in Y_1 and Y_2, respectively, among these crosses the highest positive sca effects were in cross P_1 x P_3 (1.40 and 1.65) during the both years. For increase number of branches, the best combiners were P_8 (1.10 and 1.32), P_5 (0.95 and 1.32), P_7 (0.83 and 0.34), P3 (0.75 and 0.76) and P6 (0.65 and 0.22) during both the years. The three best crosses showed positive and high sca effects were P_5 x P_8 (4.52), P_6 x P_8 (3.70) and P_3 x P_4 (2.92) in the first year (Y_1), while P_6 x P_8 (3.91), P_5 x P_8 (3.03) and P_4 x P_5 (1.53) in the second year (Y_2). Therefore, these crosses can be utilized further selection in programme. Similar results reported by Maurya *et al.* (1993). P_8, P_4 and P_7 were the best combiner for fruit length during both the season. The best three crosses showed positive and high sca effects for fruit length were P_2 x P_4, P_2 x P_8 and P_2 x P_7. These crosses can be utilized for development of hybrids while P_8 can be developed as high yielding inbreds for this character. The best combiner for fruit circumference were P_7 (0.15 and 0.47) followed by P_2 (0.26 and 0.17) in both the years. Seven and twelve crosses were observed highly significant positive sca effects in Y_1 and Y_2, respectively among these crosses the three best crosses were P_2 x P_4 (2.05 and 0.69), P_6 x P_8 (1.93 and 0.77) and P_2 x P_3 (1.16 and 1.30) over both the years. For increase number of fruits per plant, the best combiner was P_7 with high significant positive gca effects (0.50 and 0.37) followed by P_2 (0.42 and 0.41) during the both years. The best crosses with high sca effects were P_2 x P_3 (1.67 and 1.03) followed by P_7 x P_8 (1.06 and 0.41) during the both years. The parent of these crosses showed high x low gca effects, therefore, heterosis breeding exploit great promise for improving this character. The best combiner for average fruit weight were P_4 (0.04 and 0.01) and P_5 (1.01 and 0.04) during the both years. The best crosses with high sca effects were P_4 x P_6 (0.12 and 0.04) followed by P_2 x P_3 (0.11 and 0.08) and P_1xP_5 (0.06 and 0.10) over the both years. The parents P_7 (0.54 and 0.44), P_2 (0.28 and 0.47), P_6 (0.13 and 0.15) and P_5 (0.08 and 0.05) were found to be good general combiners for fruit yield per plant during both the years. Eleven crosses were observed highly significant sca effects during both years among them top three crosses were P_2 x P_3 (2.56 and 1.68), P_4 x P_6 (1.15 and 1.31) and P_4 x P_7 (1.00 and 0.94). The similar results have been reported by Singh *et al.* (1996), Bhave *et al.* (2004).

Among the parents, P_2 showed good general combiner for fruit circumference, number of fruits per plant and fruit yield per plant, while P_8 showed highly significant general combining ability for vine length, number of primary branches per plant and fruit length. The parent P_7 was the best general combiner for all the traits studied except average fruit weight. The cross P_2 x P_3 had highest sca effects for fruit yield along with number of fruits per plant. The highest specific combining ability for number of branches per plant was shown by cross P_5 x P_8. For vine length P_1 x P_3 was the best specific combiner. So, the parent P_2, P_7 and cross combination P_2 x P_3, P_5 x P_8 and P_1 x P_3 must be used in appropriate breeding programme to develop the good yield potential in bottle gourd.

Table 1: Analysis of variance (mean squares) for combining ability analysis for seven quantitative traits in bottle gourd over two years (Y_1, Y_2)

Source of Variation	d.f.	Vine length (m)		Number of primary branches per plant		Fruit length (cm)		Fruit circumference (cm)		Number of fruits per plant		Average fruit weight (kg)		Fruit yield per plant (kg)	
		Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
GCA	7	0.97**	0.33**	16.92**	17.12**	13.45**	17.25**	0.58**	0.51**	1.11**	0.79**	0.009**	0.005**	1.08**	1.26**
SCA	28	0.52**	0.43**	5.69**	5.84**	7.43**	8.95**	0.57**	0.79**	0.40**	0.36**	0.005**	0.007**	0.67**	0.72**
Error	70	0.04	0.09	0.58	0.64	0.87	0.61	0.16	0.17	0.09	0.05	0.001	0.002	0.08	0.05

*, ** Significant at 5 per cent and 1 per cent probability level, respectively.

Table 2: Estimates of general combining ability effects of parents for seven traits in bottle gourd over two years (Y_1, Y_2)

Source of Variation	Vine length (m)		No. of primary branches per plant		Fruit length (cm)		Fruit circumference (cm)		Number of fruits per plant		Average fruit weight (kg)		Fruit yield per plant (kg)	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
P_1	-0.35**	-0.13**	-0.29**	-0.04	-1.87**	-2.12**	-0.35**	-0.12**	-0.07**	-0.10**	0.01**	0.00	-0.05**	-0.13**
P_2	-0.55**	-0.27**	-1.94**	-1.78**	-0.57**	-0.55**	0.26**	0.17**	0.42**	0.41**	-0.03**	0.00	0.28**	0.47**
P_3	0.38**	0.25**	0.75**	0.76**	-0.44**	-0.17**	-0.22**	-0.18**	-0.45**	-0.40**	-0.01**	-0.03**	-0.49**	-0.57**
P_4	0.07**	-0.02*	-2.06**	-2.14**	0.99**	1.96**	-0.21**	-0.04**	-0.37**	-0.16**	0.04**	0.01**	-0.16**	-0.12**
P_5	0.12**	-0.08**	0.95**	1.32**	-0.51**	-1.14**	0.33**	-0.01	0.04**	-0.13**	0.01**	0.04**	0.08**	0.05**
P_6	-0.03**	-0.05**	0.65**	0.22**	-0.12	-0.06	-0.01	-0.22**	-0.03**	0.12**	0.03**	0.00	0.13**	0.15**
P_7	0.04**	0.06**	0.83**	0.34**	0.57**	1.06**	0.15**	0.47**	0.50**	0.37**	0.00	0.00	0.54**	0.44**
P_8	0.32**	0.25**	1.10**	1.32**	1.96**	1.01**	0.05**	-0.06**	-0.04**	-0.11**	-0.05**	-0.03**	-0.33**	-0.28**
SE (gi)	0.004	0.008	0.051	0.056	0.076	0.053	0.014	0.015	0.008	0.004	0.0002	0.0002	0.007	0.004
SE (gi-gj)	0.009	0.019	0.117	0.128	0.175	0.121	0.032	0.034	0.018	0.009	0.0004	0.0003	0.015	0.009

*, ** Significant at 5 per cent and 1 per cent probability level, respectively.

Table-3: Estimates of specific combining ability effects of crosses for seven traits in bottle gourd over two years (Y_1 and Y_2)

Parents	Vine length (m)		Number of primary branches per plant		Fruit length (cm)		Fruit circumference (cm)		Number of fruits per plant		Average fruit weight (kg)		Fruit yield per plant (kg)	
	1		2		3		4		5		6		7	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
P_1 x P_2	0.39**	-0.03	-2.54**	-3.06**	0.38	-1.44**	-0.17	0.04	0.05	0.72**	-0.01**	-0.12**	0.01	0.11**
P_1 x P_3	1.40**	1.65**	1.11*	2.39**	2.49**	-1.35**	-0.26*	-0.56**	-0.11	0.50**	0.03**	-0.07**	-0.02	0.18**
P_1 x P_4	0.94**	0.80**	-0.98*	-2.37**	-1.86**	0.18	-0.07	0.92**	-0.27**	-0.46**	0.04**	0.04**	-0.11	-0.36**
P_1 x P_5	-0.56**	-0.36*	-1.10*	-0.33	1.41*	3.79**	0.77**	1.37**	-0.13	-0.20**	0.06**	0.10**	0.18**	0.28**
P_1 x P_6	-0.89**	-0.51**	2.35**	2.44**	-1.88**	-3.18**	0.54**	-0.31*	0.49**	0.08*	-0.11**	-0.06**	-0.03	-0.21**
P_1 x P_7	0.26**	-0.20**	0.80	-0.85	1.93**	0.76	-0.33*	-0.50**	0.68**	0.46**	0.01**	-0.04**	0.84**	0.31**
P_1 x P_8	-0.66**	-0.74**	-3.58**	-2.50**	-1.07	3.39**	0.13	0.31*	0.07	-0.17**	0.02**	0.11**	0.24**	0.36**
P_2 x P_3	0.13**	0.15*	1.70**	2.30**	1.13	1.58**	1.16**	1.30**	1.67**	1.03**	0.11**	0.08**	2.56**	1.68**
P_2 x P_4	0.24**	0.52**	1.56**	1.00	3.83**	4.62**	2.05**	0.69**	-0.26**	-0.32**	-0.05**	0.05**	-0.56**	-0.08**
P_2 x P_5	-1.67**	-0.65**	1.33**	2.25**	-1.42*	-1.33**	0.00	-0.42**	-0.12	0.40**	0.03**	0.01**	0.03	0.44**
P_2 x P_6	-0.22**	-0.52**	-0.71	-1.32*	-0.92	-2.02**	-0.23	-0.16	0.24**	0.03	0.05**	0.04**	0.53**	0.22**
P_2 x P_7	0.87**	0.91**	-0.55	2.39**	2.63**	4.43**	-0.51**	0.85**	-0.50**	0.03	-0.01**	0.05**	-0.67**	0.46**
P_2 x P_8	-0.16**	0.00	-1.16*	-1.93**	4.04**	3.91**	-0.01	0.92**	0.07	-0.75**	0.01**	0.15**	0.12*	-0.12**
P_3 x P_4	-0.10**	-0.82**	2.92**	1.52**	2.54**	1.13*	-0.64**	-0.33*	0.56**	-0.01	-0.21**	0.02**	-0.35**	0.06
P_3 x P_5	-0.34**	-0.47**	-4.02**	-3.47**	-1.24	-2.25**	-0.30*	-0.32*	-0.40**	0.25**	0.05**	-0.04**	-0.21**	0.09*
P_3 x P_6	-0.33**	-0.37**	-0.45	-1.48**	1.78*	5.61**	0.04	-0.40**	-0.46**	-0.25**	0.05**	-0.05**	-0.34**	-0.57**
P_3 x P_7	-0.66**	0.00	1.87**	2.68**	1.09	2.30**	0.11	1.36**	-0.85**	-0.80**	0.07**	0.07**	-0.63**	-0.62**
P_3 x P_8	-0.34**	-0.62**	-5.06**	-4.80**	-1.92**	-2.86**	-0.26*	-0.45**	-0.34**	-0.28**	-0.03**	0.01**	-0.47**	-0.27**
	1		2		3		4		5		6		7	
P_4 x P_5	-1.24**	-0.43**	2.52**	1.53**	0.54	0.22	0.09	1.05**	0.05	0.16**	0.03**	-0.02**	0.21**	0.06
P_4 x P_6	0.45**	-0.43**	-1.26**	-1.97**	2.64**	0.92	0.85**	0.36**	0.43**	0.93**	0.12**	0.04**	1.15**	1.31**
P_4 x P_7	-0.46**	-0.43**	0.23	-1.59**	1.36	1.35**	-0.44**	-1.07**	0.55**	0.92**	0.06**	-0.02**	1.00**	0.94**
P_4 x P_8	0.12**	0.57**	-0.47	2.43**	2.58**	1.11*	-0.84**	-0.36**	0.51**	0.46**	0.06**	0.07**	0.88**	0.90**
P_5 x P_6	0.06*	-0.14	-0.26	-1.20*	0.72	0.77	-0.35**	0.00	0.50**	0.69**	-0.03**	0.10**	0.43**	1.46**
P_5 x P_7	0.70**	-0.12	-3.33**	-2.43**	2.90**	-1.20*	-0.04	-0.70**	0.01	0.03	0.03**	-0.06**	0.25**	-0.28**
P_5 x P_8	0.64**	0.99**	4.52**	3.03**	-1.35	0.08	-0.27*	1.28**	0.94**	0.72**	-0.09**	-0.02**	0.50**	0.73**
P_6 x P_7	-0.47**	-0.07	-0.98*	-2.39**	0.08	-0.86	-0.24	0.03	-0.56**	-0.75**	-0.13**	-0.10**	-1.30**	-1.41**
P_6 x P_8	0.26**	0.90**	3.70**	3.91**	2.92**	2.56**	1.93**	0.77**	-0.12	-0.24**	0.03**	0.06**	0.04	0.02
P_7 x P_8	0.50**	-0.23**	0.41	-0.33	0.97	-0.44	0.39**	-1.21**	1.06**	0.41**	-0.09**	0.02**	0.56**	0.53**
SE (Sij)	0.035	0.080	0.484	0.526	0.721	0.498	0.134	0.139	0.075	0.040	0.001	0.002	0.064	0.037
SE (Sij-Sik)	0.078	0.175	1.061	1.150	1.580	1.090	0.295	0.305	0.165	0.089	0.003	0.003	0.141	0.081

*, ** - Significant at 5 per cent and 1 per cent probability levels, respectively.

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