

## Combining ability for characters related to yield and earliness in bitter gourd (*Momordica charantia* L.)

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**Abstract :** An experiment was under taken to study the combining ability analysis using ten parental lines and their 90  $F_1$  hybrids of bitter gourd obtained from full diallel analysis for yield and its contributing characters. The mean squares due to GCA and SCA were signified for all the characters. The ratio of  $\sigma^2_g/\sigma^2_s$  was less for yield of fruits per vine, ascorbic acid content and iron content thereby indicating preponderance of non-additive (dominance) variance in expression of these traits. Out of the ten parents, CO-1 and Preethi were the best general combiners as it showed desirable GCA effects in favourable direction for most of the traits. Regarding the SCA effects MC-105 x MC-10 showed highest SCA effects for total fruit yield per plant and number of fruits per plant. For days to first harvest Preethi x CO-1 showed desirable SCA effects in favourable direction. Hence these parents may be used as one of the parents in bitter gourd breeding programme.

**Keywords:** Combining ability, Yield, Bittergourd

### Introduction

Bitter gourd is an important crop of India. It is a rich source of nutrients and ranks first among all cucurbits for its nutritive value and the plant extracts have been used traditionally to cure diabetics (Dey *et al.*, 2010). It offers much scope of improvement through heterosis breeding among genetically diverse genotypes. Information on combining ability facilitates the choice of suitable parents for hybridization programme to develop promising  $F_1$  hybrids. The diallel cross helps in determining both general and specific combining abilities of parents and hybrid combinations respectively. Further it helps in formulating the breeding methodology for crop improvement. Hence, the present study was undertaken

to identify the productive parents with early fruitfulness and potential hybrids of bitter gourd through combining ability analysis.

### Materials and Methods

The experimental material comprised of ten purelines viz., CO-1, Green Long, Priyanka Preethi, Karala Rakshuse (KR), Uchha Small Long (USL) and Uchha Bolder (UB) MC-30, MC-105 and MC-10 were chosen from germplasm collection maintained at Research Farm, Department of Vegetable Crops, Horticultural College and Research Institute, Coimbatore. The parent UB is round and very small fruited type while other parents are medium to long fruited type. Ten pure lines were crossed in all possible combinations, including reciprocals to produce  $F_1$  seeds by hand pollination using the method Diallel cross (Method I, Model 1 Griffing (1956)).

During August-November, 2007, all the 90 cross combinations and 10 parents were sown in randomized block design with three replications. Five plants were selected and tagged for recording the observations on different characters viz., days to first female flower appearance, node of first female flower appearance, number of female flower per vine, sex ratio, days to first harvest, fruit length, fruit girth, individual fruit weight, fruit flesh thickness, number of fruits per vine, yield of fruits per vine, ascorbic acid and iron content. All the cultural operations and plant protection measures were carried out as per schedule of crop. The combining ability analysis was calculated as method suggested by Griffing (1956).

### Results and Discussion

In the present study, mean squares due to GCA and SCA were significant for all the characters. This indicates variation in parents and crosses and thus significant combination of additive and non-additive gene effects in the expression of the characters. The ratio of  $\sigma^2_g/\sigma^2_s$  was lesser than one for the characters viz., yield of fruits

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per vine, ascorbic acid content and iron content thereby indicating preponderance of non-additive (dominance) variance in expression of these traits. The variance due to reciprocal effects was also significant for all the characters studied (Table 1). The reciprocal variation might be due to cytoplasmic inheritance and its interaction with nuclear genes. Similar significant reciprocal effects were reported earlier in bitter melon by Gopalakrishnan (1986).

**Table 1.** Analysis of variance for combining ability

S. No.	Character	Mean squares of			GCA/SCA
		GCA	SCA	RCA	
1	Days to first female flower appearance	23.77**			1.75
2	Node of first female flower appearance	35.46**	9.07**	9.17**	3.91
3	Number of female flowers per vine	1219.11**	44.33**	23.97**	27.50
4	Sex ratio	244.16**	17.17**	13.63**	14.22
5	Days to first harvest	119.47**	32.07**	48.65**	3.73
6	Fruit length	154.18**	12.56**	17.44**	12.28
7	Fruit girth	10.94**	3.89**	5.87**	2.81
8	Individual fruit weight	3179.44**	127.97**	195.47**	24.85
9	Fruit flesh thickness	0.027**	0.013**	0.015**	2.08
10	Number of fruits per vine	1383.10**	58.85**	36.68**	23.50
11	Yield of fruits per vine	0.241**	0.287**	0.254**	0.84
12	Ascorbic acid content	98.21**	275.36**	325.72**	0.36
13	Iron content	0.090**	0.172**	0.134**	0.52

\*\* Significant at 1 per cent level

Estimates of general combining ability effects (Table 2) showed that the parent CO-1 was good general combiner for most of the traits viz., days to first female flower appearance, days to first harvest, fruit length, fruit girth, individual fruit weight, fruit flesh thickness, yield of fruits per vine, ascorbic acid content and iron content. The parent Preethi was also found to be good general combiner for nine characters viz., days to first female flower appearance, node of first female flower appearance, sex ratio, fruit girth, individual fruit weight, fruit flesh thickness, yield of fruits per vine, ascorbic acid and iron content. The parents Uchha Bolder and Karala Rakshuse were good general combiner for eight and six characters respectively. Parents Green Long, MC-105 and MC-10 were good general combiners for varying set of five characters each, followed by MC 30 for four characters, Priyanka for three characters and Uchha Small Long for two characters. The results are in line with the earlier findings of Lawande and Patil (1990).

From specific combining ability effects (Table 3 & 4), it was observed that out of 90 cross combinations, 31 for days to first female flower appearance, 43 for node of first female flower appearance, 46 for number of female flowers per vine, 52 for sex ratio, 31 for days to first harvest, 35 for fruit length, 42 for fruit girth, 38 for individual fruit weight, 28 for fruit flesh thickness, 39 for numbers of fruits per vine, 37 for yield of fruits per vine, 42 for ascorbic acid content and 30 for iron content exhibited significant SCA effects in desirable direction, indicating presence of non-additive type of gene interaction. Thus it indicates the possibility of exploitation of hybrid vigour in these characters.

**Table 2.** Estimates of *gca* values of parents for ancillary characters of bitter melon

Parents	Days to first female flower appearance	Node of first female flower appearance	Number of female flowers per vine	Sex ratio	Days to first harvest	Fruit length	Fruit girth	Individual fruit weight	Fruit flesh thickness	Number of fruits per vine	Yield of fruits per vine	Ascorbic acid content	Iron content
CO -1	-1.91**	1.04**	-4.66**	1.86**	-3.38**	4.06**	0.29**	1.98**	0.06**	-2.42**	0.11**	2.20**	0.06**
Green Long (GL)	-0.28**	1.01**	-4.30**	2.81**	-3.13**	2.36**	-0.29**	5.68**	0.00	-4.46**	-0.11**	0.73**	0.00
Priyanka	0.48**	1.63**	-5.33**	2.68**	-0.08	0.66**	0.50**	5.74**	0.00	-4.21**	-0.09**	-3.98**	-0.07**
Preethi	-0.49**	-2.05**	-1.66**	-0.37**	1.95**	-2.07**	1.25**	7.60**	0.03**	-1.57**	0.13**	1.46**	0.14**
Karala Rakshuse (KR)	-1.19**	0.55**	-2.88**	1.80**	-0.04	0.03	0.26**	3.76**	0.04**	-3.90**	-0.10**	0.91**	0.05**
Uchha Small Long (USL)	1.68**	0.36**	-2.17**	-1.02**	3.00**	-1.09**	-1.10**	-6.79**	-0.08**	-1.85**	-0.12**	-1.89**	0.04**
Uchha Bolder (UB)	-0.62**	-2.19**	21.81**	-7.10**	-4.41**	-6.05**	-1.12**	-32.44**	-0.03**	24.52**	0.20**	0.70**	-0.02**
MC - 30	0.35**	1.12**	-0.76**	-1.47**	1.27**	2.49**	-0.68**	10.61**	0.00	-2.43**	0.14**	-0.13	-0.07**
MC - 105	0.74**	-0.81**	0.06	-0.31**	2.36**	-0.56**	0.56**	2.57**	-0.03**	-2.86**	-0.03**	1.68**	-0.04**
MC-10	1.23**	-0.66**	-0.1	1.13**	2.47**	0.17**	0.32**	1.27**	0.01**	-0.81**	-0.03**	-1.50**	-0.10**
SE (g)	0.10	0.04	0.08	0.04	0.13	0.04	0.03	0.18	0.001	0.07	0.004	0.17	0.003

\* Significant at 5 percent level,

\*\* Significant at 1 percent level

**Table 3.** Estimates of sca values of hybrids for ancillary characters of bitter gourd

S. No.	Hybrids	Days to first female flower appearance	Node of first female flower appearance	Number of female flowers per vine	Sex ratio	Days to first harvest	Fruit length	Fruit girth
1	CO -1 x GL	-3.45**	1.61**	-1.52**	-0.04	0.11	1.56**	0.25**
2	CO -1 x Priyanka	1.16**	1.63**	4.44**	0.95**	0.23	2.26**	-0.38**
3	CO -1 x Preethi	2.32**	-0.09	-2.41**	0.79**	2.33**	-0.87**	0.06
4	CO -1 x KR	5.13**	-1.78**	-1.87**	3.72**	-3.12**	0.68**	-1.44**
5	CO -1 x USL	2.13**	-3.19**	-2.41**	-0.43**	8.50**	-1.50**	0.56**
6	CO -1 x UB	0.54	-0.27*	-1.64**	-3.20**	-8.34**	-6.74**	-0.41**
7	CO -1 x MC - 30	-1.64**	4.08**	1.09**	-0.53**	3.88**	-0.98**	0.65**
8	CO -1 x MC - 105	-1.02**	-5.09**	-0.41	2.40**	-2.60**	4.68**	0.55**
9	CO -1 x MC - 10	-1.12**	-1.37**	-0.14	2.14**	-3.10**	-0.66**	-0.13
10	GL x CO -1	2.17**	-1.13**	-2.52**	-1.11**	-0.4	-2.09**	-0.70**
11	GL x Priyanka	1.62**	-0.76**	-2.87**	2.86**	-2.36**	1.20**	1.79**
12	GL x Preethi	4.25**	-1.79**	4.10**	-3.91**	-2.81**	1.18**	0.24**
13	GL x KR	2.73**	-0.51**	0.17	-0.22	1.63**	1.33**	0.53**
14	GL x USL	1.36**	0.2	-4.18**	2.07**	0.97*	1.45**	-2.61**
15	GL x UB	-3.40**	-3.51**	1.89**	-4.19**	3.94**	-2.99**	-1.24**
16	GL x MC - 30	-3.88**	-2.56**	-0.28	0.27*	-0.83*	-4.63**	-0.93**
17	GL x MC - 105	-2.00**	0.57**	2.81**	-2.64**	3.62**	-0.48**	-0.98**
18	GL x MC - 10	-2.95**	0.24*	2.16**	-1.50**	-4.75**	-1.56**	0.82**
19	Priyanka x CO -1	-2.60**	1.87**	5.19**	-6.70**	-5.87**	-2.00**	0.74**
20	Priyanka x GL	0.37	1.35**	3.26**	-2.85**	-4.17**	1.25**	4.55**
21	Priyanka x Preethi	0.87**	1.01**	-3.28**	2.36**	1.18**	1.28**	1.49**
22	Priyanka x KR	0.29	3.28**	0.78**	-0.67**	1.02**	-1.57**	-2.36**
23	Priyanka x USL	-0.44	1.97**	0.36	-0.83**	-1.39**	-2.70**	-1.85**
24	Priyanka x UB	-0.24	-3.04**	-0.27	-2.31**	-3.09**	-1.34**	0.42**
25	Priyanka x MC - 30	-0.05	0.80**	5.73**	-4.54**	4.26**	-0.98**	0.78**
26	Priyanka x MC - 105	-3.36**	-0.18	0.50*	-1.10**	1.61**	-0.90**	-0.56**
27	Priyanka x MC - 10	-4.27**	0.08	0.95**	-1.86**	0.66	1.95**	0.82**
28	Preethi x CO -1	-0.71*	-4.08**	6.85**	-7.78**	-8.65**	1.25**	1.75**
29	Preethi x GL	-0.95**	-1.00**	-6.28**	1.55**	4.25**	-4.80**	-0.35**
30	Preethi x Priyanka	-6.17**	-5.95**	3.11**	-2.57**	2.40**	-4.40**	-1.30**
31	Preethi x KR	-0.96**	-0.24*	-1.23**	-1.13**	4.55**	-0.99**	0.89**
32	Preethi x USL	-1.25**	-1.60**	1.23**	-0.50**	1.27**	0.18	-0.46**
33	Preethi x UB	0.58*	0.32**	4.25**	-0.71**	-1.01**	0.44**	0.82**
34	Preethi x MC - 30	-2.22**	0.14	8.68**	-3.85**	-5.73**	-4.15**	0.53**
35	Preethi x MC - 105	-1.42**	-1.79**	-4.34**	2.66**	6.59**	-1.71**	-1.34**
36	Preethi x MC - 10	-1.33**	1.39**	1.56**	1.69**	4.55**	1.82**	-0.18*
37	KR x CO -1	2.26**	-2.12**	2.43**	-0.18	2.88**	-1.50**	-2.45**
38	KR x GL	3.07**	-2.10**	1.79**	-2.89**	0.90*	-2.45**	-2.95**
39	KR x Priyanka	-0.59	-3.40**	6.91**	-5.46**	-6.42**	-5.15**	0.15
40	KR x Preethi	-3.03**	1.60**	0.5	0.02	2.12**	0	0.55**
41	KR x USL	0.78**	-1.59**	6.45**	-3.86**	-0.86*	1.43**	0.39**
42	KR x UB	-0.77**	1.67**	-1.65**	-2.31**	0.94*	5.44**	0.12
43	KR x MC - 30	-5.25**	-1.67**	-0.15	-0.86**	1.69**	-0.59**	2.48**
44	KR x MC - 105	-1.20**	0.14	1.41**	-2.14**	0.98*	-5.76**	-0.75**
45	KR x MC - 10	2.01**	2.23**	2.31**	-1.69**	0.48	1.57**	-0.93**

46	USL x CO -1	0.36	-3.48**	-0.01	0.36*	1.46**	-3.40**	0.20*
47	USL x GL	4.59**	-1.66**	3.81**	-5.89**	10.50**	-2.25**	-0.45**
48	USL x Priyanka	1.53**	-2.00**	0.88**	-0.82**	10.85**	0.60**	-1.00**
49	USL x Preethi	-1.72**	1.89**	2.63**	-0.64**	6.26**	1.05**	1.55**
50	USL x KR	2.98**	1.40**	-2.34**	0.05	11.60**	0.1	-2.10**
51	USL x UB	1.60**	2.74**	-2.80**	0.72**	3.00**	2.21**	5.17**
52	USL x MC - 30	1.60**	-1.40**	1.33**	1.23**	-0.31	0.57**	-1.82**
53	USL x MC - 105	1.60**	0.83**	2.95**	-0.42**	-1.85**	-0.92**	-0.51**
54	USL x MC - 10	1.60**	-1.82**	-1.02**	1.78**	3.01**	1.19**	0.32**
55	UB x CO -1	-3.51**	0.07	-6.21**	-0.81**	3.40**	-1.00**	-1.50**
56	UB x GL	0.55	-0.70**	0.52	-1.24**	-4.09**	1.75**	0.80**
57	UB x Priyanka	0.75*	-2.49**	-2.25**	-1.25**	3.23**	-2.00**	-0.25**
58	UB x Preethi	2.22**	3.47**	-2.35**	-0.65**	1.83**	1.65**	1.30**
59	UB x KR	3.83**	-1.02**	0.17	-0.36*	-2.51**	-3.05**	0.60**
60	B x USL	-3.69**	-1.96**	-0.77**	0.33*	-7.11**	-2.40**	-2.80**
61	UB x MC - 30	-0.45	2.39**	-7.84**	1.32**	1.36**	2.44**	1.11**
62	UB x MC - 105	1.97**	1.59**	-7.38**	0.85**	4.35**	3.44**	-1.89**
63	UB x MC - 10	3.71**	1.15**	-10.24**	0.87**	2.70**	-1.65**	-1.15**
64	MC - 30 x CO -1	-0.41	-2.27**	5.63**	-4.88**	1.88**	-2.70**	0.50**
65	MC - 30 x GL	1.44**	-1.06**	3.93**	-5.66**	8.04**	-3.05**	-2.85**
66	MC - 30 x Priyanka	-2.90**	1.06**	5.39**	-3.10**	0.82	1.70**	-1.95**
67	MC - 30 x Preethi	-0.61	1.63**	-6.57**	1.50**	8.06**	5.00**	1.45**
68	MC - 30 x KR	-0.38	-3.34**	2.21**	-2.51**	3.39**	-3.35**	1.50**
69	MC - 30 x USL	1.07**	-1.91**	5.29**	-2.72**	-1.39**	-6.00**	0.85**
70	MC - 30 x UB	2.01**	0.61**	0.58*	0.28*	5.35**	1.20**	2.75**
71	MC - 30 x MC - 105	4.15**	0.51**	-3.10**	2.98**	2.45**	-0.15	0.57**
72	MC - 30 x MC - 10	8.71**	-1.62**	-0.28	1.27**	5.18**	-1.19**	-2.19**
73	MC - 105 x CO -1	0.44	5.58**	3.18**	-2.92**	4.38**	-7.10**	-4.85**
74	MC - 105 x GL	-0.19	-2.22**	4.55**	-1.90**	2.49**	2.25**	-0.01
75	MC - 105 x Priyanka	-1.49**	-2.12**	0.45	1.76**	1.59**	-1.92**	-0.75**
76	MC - 105 x Preethi	1.56**	2.41**	3.11**	-1.95**	-5.02**	2.69**	-1.87**
77	MC - 105 x KR	4.98**	0.04	-0.83**	0.59**	-2.32**	-0.57**	-1.48**
78	MC - 105 x USL	6.88**	0.28*	4.88**	-2.68**	-2.81**	-5.85**	0.40**
79	MC - 105 x UB	1.23**	0.04	0.56*	0.50**	7.63**	1.45**	-2.00**
80	MC - 105 x MC - 30	-5.95**	1.20**	0.49	0.93**	4.73**	-0.50**	-1.90**
81	MC - 105 x MC - 10	4.23**	1.85**	9.50**	-4.33**	-5.11**	0.78**	3.06**
82	MC - 10 x CO -1	2.35**	-0.50**	1.83**	-0.93**	3.68**	-5.70**	2.17**
83	MC - 10 x GL	0.17	-1.96**	3.99**	-2.32**	-2.88**	0	2.70**
84	MC - 10 x Priyanka	0.25	-1.50**	4.17**	-0.92**	1.82**	-1.89**	-1.40**
85	MC - 10 x Preethi	-0.84**	2.06**	6.93**	-3.51**	-1.88**	0.35*	-0.15
86	MC - 10 x KR	1.24**	-0.06	3.36**	0.64**	-1.59**	1.50**	0.30**
87	MC - 10 x USL	1.48**	0.12	1.94**	-0.14	-2.08**	0	2.20**
88	MC - 10 x UB	6.07**	0.25	-0.58*	0.94**	6.13**	0.2	0.50**
89	MC - 10 x MC - 30	-0.99**	1.11**	-0.13	0.90**	-0.95*	-2.50**	-1.10**
90	MC - 10 x MC - 105	0.05	1.52**	0.15	0.43**	8.97**	-2.09**	-0.60**
	SE (s <sub>ij</sub> )	0.29	0.12	0.24	0.13	0.39	0.12	0.09
	SE (r <sub>ij</sub> )	0.32	0.13	0.27	0.14	0.43	0.13	0.09

\* Significant at 5 per cent level

\*\* Significant at 1 per cent level

**Table 4.** Estimates of sca values of hybrids for ancillary characters of bitter gourd

S.No.	Hybrids	Individual fruit weight	Fruit flesh thickness	Number of fruits per vine	Yield of fruits per vine	Ascorbic acid content	Iron content
1	CO -1 x GL	6.89**	0.01**	-2.29**	-0.41**	-2.29**	-0.29**
2	CO -1 x Priyanka	3.00**	0.13**	6.21**	0.49**	20.78**	0.13**
3	CO -1 x Preethi	2.15**	0	5.72**	0.53**	0.63	-0.17**
4	CO -1 x KR	-2.75**	-0.01*	-1.42**	-0.17**	4.18**	-0.15**
5	CO -1 x USL	-11.27**	-0.06**	-4.00**	-0.38**	-0.61	0.19**
6	CO -1 x UB	3.94**	-0.09**	-12.56**	-0.29**	-0.71	-0.01
7	CO -1 x MC - 30	8.62**	0.04**	0.68**	0.04**	-18.21**	-0.38**
8	CO -1 x MC - 105	1.57**	0.04**	-2.79**	-0.26**	-26.33**	-0.11**
9	CO -1 x MC - 10	-1.32*	-0.05**	5.88**	0.14**	7.78**	0.39**
10	GL x CO -1	0.04	-0.09**	2.10**	0.07**	-0.4	-0.19**
11	GL x Priyanka	2.90**	0.01*	2.00**	0.17**	-1.61**	-0.23**
12	GL x Preethi	-10.60**	0.03**	5.69**	0.28**	-0.5	0.03**
13	GL x KR	-7.23**	0.06**	-0.50*	-0.34**	-10.55**	-0.12**
14	GL x USL	-0.36	-0.06**	-1.29**	-0.02	-11.95**	0.01
15	GL x UB	-12.08**	-0.01	-0.3	0.07**	8.66**	0.09**
16	GL x MC - 30	1.84**	-0.11**	-1.88**	-0.17**	3.26**	-0.19**
17	GL x MC - 105	6.93**	-0.02**	-3.35**	-0.34**	-8.02**	0.30**
18	GL x MC - 10	-1.40*	0.07**	2.57**	0.27**	7.07**	-0.11**
19	Priyanka x CO -1	6.42**	0	8.77**	0.72**	11.65**	0.50**
20	Priyanka x GL	9.88**	0.08**	-3.40**	-0.19**	13.20**	0.20**
21	Priyanka x Preethi	3.36**	-0.04**	-2.60**	-0.27**	-19.87**	-0.01
22	Priyanka x KR	-3.04**	-0.07**	1.19**	-0.31**	-24.83**	-0.11**
23	Priyanka x USL	-11.19**	-0.12**	-1.55**	-0.42**	-8.23**	-0.03**
24	Priyanka x UB	-7.63**	0.01**	-2.71**	-0.01	13.62**	-0.08**
25	Priyanka x MC - 30	-2.46**	0.05**	2.22**	0.10**	1.07*	0.02*
26	Priyanka x MC - 105	-6.99**	-0.09**	-1.09**	-0.12**	-4.05**	-0.20**
27	Priyanka x MC - 10	3.44**	-0.07**	-2.22**	-0.12**	-3.82**	-0.09**
28	Preethi x CO -1	2.64**	0.03**	2.81**	0.16**	9.05**	0.31**
29	Preethi x GL	-4.82**	-0.07**	-9.11**	-0.97**	-17.54**	-0.80**
30	Preethi x Priyanka	2.47**	-0.09**	0.34	-0.25**	7.67**	-0.04**
31	Preethi x KR	7.45**	-0.01*	-8.31**	-0.55**	-1.73**	-0.50**
32	Preethi x USL	-9.92**	-0.12**	-4.05**	-0.45**	-3.33**	-0.37**
33	Preethi x UB	0.07	0.06**	7.39**	0.19**	0.28	-0.10**
34	Preethi x MC - 30	-5.44**	0.11**	8.70**	0.84**	8.78**	0.47**
35	Preethi x MC - 105	-0.27	-0.08**	-5.73**	-0.53**	-8.44**	-0.06**
36	Preethi x MC - 10	3.84**	-0.05**	-5.38**	-0.58**	5.48**	-0.23**
37	KR x CO -1	3.43**	0	2.46**	0.06**	9.95**	0.19**
38	KR x GL	2.07**	-0.09**	1.12**	0.03*	22.25**	-0.13**
39	KR x Priyanka	-11.96**	0	0.36	-0.08**	7.06**	-0.01
40	KR x Preethi	-0.4	-0.03**	-1.50**	-0.01	8.20**	0.13**
41	KR x USL	24.22**	0.13**	7.13**	1.09**	8.98**	0.38**
42	KR x UB	-7.78**	0.12**	2.61**	0.13**	7.48**	-0.22**
43	KR x MC - 30	-3.41**	0	3.51**	0.26**	0.73	-0.03**
44	KR x MC - 105	3.74**	-0.14**	-0.82**	-0.07**	29.90**	0.10**
45	KR x MC - 10	-3.35**	-0.04**	-1.97**	-0.42**	-16.42**	-0.36**
46	USL x CO -1	16.30**	-0.05**	-4.00**	-0.10**	11.15**	-0.37**

47	USL x GL	-5.76**	-0.10**	-3.67**	-0.44**	14.85**	0.02*
48	USL x Priyanka	-21.35**	-0.14**	4.66**	0.05**	-23.55**	0.17**
49	USL x Preethi	-14.46**	-0.16**	0.77**	-0.14**	8.80**	-0.08**
50	USL x KR	-2.86**	-0.07**	-10.65**	-1.20**	-18.36**	-0.73**
51	USL x UB	6.71**	0.06**	0.3	0.20**	3.38**	0.05**
52	USL x MC - 30	16.34**	0	-3.41**	-0.07**	1.53**	0.04**
53	USL x MC - 105	-0.73	-0.01	3.13**	-0.19**	-2.19**	-0.49**
54	USL x MC - 10	-9.56**	0.03**	-0.25	-0.07**	1.29*	0.22**
55	UB x CO -1	-3.27**	-0.04**	-13.29**	-0.55**	0.45	0.12**
56	UB x GL	14.85**	-0.10**	-1.03**	0.30**	8.55**	0.17**
57	UB x Priyanka	-11.44**	0	-1.45**	-0.18**	-5.80**	-0.32**
58	UB x Preethi	-3.78**	-0.05**	-1.94**	-0.26**	-9.80**	-0.29**
59	UB x KR	10.67**	0	-0.50*	-0.04**	-4.85**	-0.02*
60	B x USL	8.93**	-0.09**	-0.32	0.13**	-9.25**	-0.07**
61	UB x MC - 30	9.50**	-0.08**	-5.92**	0.06**	-4.11**	-0.10**
62	UB x MC - 105	8.55**	0.01*	-0.96**	0.29**	1.41**	-0.12**
63	UB x MC - 10	4.57**	-0.06**	-10.15**	-0.18**	-17.16**	-0.27**
64	MC - 30 x CO -1	7.13**	-0.02**	0.80**	0.16**	15.15**	-0.13**
65	MC - 30 x GL	-3.03**	-0.22**	3.50**	0.40**	11.85**	0.21**
66	MC - 30 x Priyanka	12.22**	0.09**	2.85**	0.28**	4.05**	0.05**
67	MC - 30 x Preethi	-10.00**	-0.06**	-7.85**	-1.18**	-14.50**	-0.48**
68	MC - 30 x KR	-5.49**	-0.05**	1.86**	-0.04**	-10.90**	0.03**
69	MC - 30 x USL	-14.00**	-0.05**	1.46**	0.19**	12.10**	-0.01
70	MC - 30 x UB	3.72**	0.02**	-0.59*	-0.08**	-7.95**	-0.26**
71	MC - 30 x MC - 105	-9.33**	-0.07**	-2.53**	-0.61**	0.11	-0.19**
72	MC - 30 x MC - 10	-3.62**	-0.06**	-3.13**	-0.53**	-6.51**	-0.37**
73	MC - 105 x CO -1	0.09	-0.04**	2.79**	0.25**	-7.70**	0.21**
74	MC - 105 x GL	0.86	-0.12**	4.39**	0.09**	22.45**	0.06**
75	MC - 105 x Priyanka	6.85**	0.01*	3.81**	0.27**	8.40**	-0.25**
76	MC - 105 x Preethi	-4.67**	-0.05**	3.92**	0.01	-14.86**	0.06**
77	MC - 105 x KR	2.14**	-0.10**	-0.50*	-0.06**	11.45**	0.19**
78	MC - 105 x USL	-31.22**	-0.10**	6.81**	-0.15**	19.24**	-0.09**
79	MC - 105 x UB	0.42	-0.12**	-0.67**	0	10.05**	0.23**
80	MC - 105 x MC - 30	-7.28**	0.03**	0.85**	-0.07**	6.55**	-0.04**
81	MC - 105 x MC - 10	-2.53**	0.10**	13.24**	1.17**	3.98**	0.44**
82	MC - 10 x CO -1	5.68**	-0.16**	-3.56**	-0.64**	-4.94**	-0.16**
83	MC - 10 x GL	1.37*	0.03**	10.47**	0.65**	10.94**	-0.23**
84	MC - 10 x Priyanka	-2.02**	-0.09**	3.26**	0.33**	-20.85**	-0.22**
85	MC - 10 x Preethi	-5.22**	-0.01*	5.06**	0.17**	2.00**	-0.40**
86	MC - 10 x KR	-2.51**	-0.06**	0.91**	-0.04**	-9.45**	-0.21**
87	MC - 10 x USL	23.36**	-0.10**	2.36**	0.30**	-0.45	-0.09**
88	MC - 10 x UB	-12.70**	-0.07**	-1.91**	-0.38**	-16.50**	0.25**
89	MC - 10 x MC - 30	-7.45**	0.15**	-0.82**	-0.12**	-22.15**	-0.06**
90	MC - 10 x MC - 105	5.11**	-0.10**	-5.19**	-0.25**	-17.82**	-0.47**
	SE (s <sub>ij</sub> )	0.56	0.003	0.21	0.01	0.51	0.01
	SE (r <sub>ij</sub> )	0.62	0.004	0.23	0.01	0.56	0.01

\* Significant at 5 percent level

\*\* Significant at 1 percent level

The SCA effects showed that best specific combination was MC-105 x MC-30 for days to first female flower appearance, CO-1 x MC-105 for node of first female flower appearance, Priyanka x CO-1 for sex ratio and iron content, Preethi x CO-1 for days to first harvest, Karala Rakshuse x Uchha Bolder for fruit length, Uchha Small Long x Uchha Bolder for fruit girth, Karala Rakshuse x Uchha Small Long for individual fruit weight, MC-10 x MC-30 for fruit flesh thickness, MC-105 x MC-10 for numbers of female flowers per vine, number of fruits per vine, and yield of fruits per vine and Karala Rakshuse x MC-105 for ascorbic acid content. From these studies, it is evident that SCA effects of certain crosses were related with GCA of their parents, as the best cross combination for most of the characters involved at least one parent with high or average GCA effects for particular traits. Similar results have been reported by Munshi and Sirohi (1993) and Mishra *et al.* (1994) in this crop.

Among the cross combinations studied, MC-105 x MC-10 was found to be the best cross since, it has significant SCA effects for three important characters *viz.*, number of female flowers per vine, number of fruits per vine and yield of fruits per vine followed by Karala Rakshuse x Uchha Small Long for individual fruit weight and yield of fruits per vine. With respect to earliness Preethi x CO-1 has favourable SCA effects for days to first harvest. These three cross combinations with desirable SCA could be well utilised in heterosis breeding as reported by Sirohi and Choudhury (1977) and Tewari *et al.* (2001) in bitter gourd. These cross combinations can be well exploited to increase yield potential with earliness of this crop in future breeding programme of bitter gourd.

## सारांश

एक प्रयोग के तहत संयोजन क्षमता के विश्लेषण का उपयोग करते हुए दस पैतृक लाइनों और उनसे प्राप्त 90 F1 संकर करैले का पूर्ण डायलल उपज एवं उनके वर्ण योगदानों का विश्लेषण किया गया।

जी.सी.ए. एवं एस.सी.ए. के कारण सभी वर्ण का मीन स्ववायर महत्वपूर्ण था।  $\sigma^2 g/\sigma^2$  का अनुपात प्रति वेन में फलो की उपज, एस्कार्विक एसिड कन्टेन्ट और लौह कन्टेन्ट जिससे (प्रभुत्व) गैर एडेक्टिव वैरियन्स तत्वों की अभिव्यक्ति की प्रधानता का संकेत कन्टेन्ट के अनुसार फलों की उपज के लिए कम था। दस पैतृक के अलावा सी.ओ.-1 और प्रीती सबसे अच्छा सामान्य कम्वाइन्स थे। और इसने अधिकांश लक्षणों के रूप में अनुकूल दिशा में वांछनीय जी.सी.ए. प्रभाव दिखाया था। एस.सी.ए. प्रभाव के बारे में एम.सी. 105 x एम.सी.-10 प्रति पौधे कुल उपज और प्रति पौधे फल की संख्या के लिए उच्चतम एस.सी.ए. प्रभाव दिखाया। प्रथम तुड़ाई के दिन प्रीती x सी.ओ.-1 ने अनुकूल दिशा में वांछनीय एस.सी.ए. प्रभाव दिखाया। इसलिए इन पैतृक में से एक पैतृक करैला प्रजनन कार्यक्रम के रूप में इस्तेमाल किया जा सकता है।

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