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COMBINING ABILITY AND GENE ACTION IN INDIGENOUS BITTER GOURD (*Momordica charantia* L.)

R.S. Verma[1] and M. K. Singh[2*]

[1] *Department of Vegetable Science, N. D. U. A. & T., Kumarganj, Faizabad-224229, U.P. India*

[2] *Krishi Vigyan Kendra, East Kameng, Pampoli-790 102, Arunachal Pradesh*

**E-mail: mr.mksingh2008@rediffmail.com*

ABSTRACT : The investigation was carried out to get information regarding magnitude of combining ability and nature of gene action for fruit yield and several other yield attributing traits. The trial was designed by following line × tester mating design involving 12 lines and 3 testers and their 36 hybrids tested in two environments viz., summer and rainy season 2010 at Research Farm of Department of Vegetable Science, N.D. University of Agriculture & Technology, Kumarganj, Faizabad, UP. Estimate of *gca* effects among the lines NDBT-13, NDBT-15 and NDBT-19 during both seasons and NDBT-10 during summer season and among the testers Kalyanpur Sona during summer season and Pusa Do Mausami during rainy season were identified as superior donar for fruit yield per plant and its yield contributing traits like number of fruits per plant and average fruit weight. Eight crosses in the both seasons for fruit yield per plant displayed desirable significant *sca* effects. Among these eight crosses the best cross combinations based on desirable *sca* effects for fruit yield per plant were NDBT-19 × Pusa Do Mousami in summer season while NDBT-8 × Pusa Do Mousami, NDBT-15 × NDBT-12 and NDBT-10 × Pusa Do Mousami in rainy season. These crosses are associated with number of fruits per plant, average fruit weight, fruit diameter and other component traits in both seasons.

Key words : *Gene action, gca, sca, Momordica charantia.*

Bitter gourd (*Momordica charantia* L.) is one of the most nutritive and commercially important vegetable grown throughout the country. The importance of bitter gourd has been recognized due to its high nutritive value and medicinal properties. Bitter gourd still remains an unexploited crop from genetic and breeding point of view. In bitter gourd, Indian variability is quite distinct that of African/S.E. Asian region. Wide range of variability in respect of vegetative and fruit character is available. Lot of varieties and F_1 hybrids have been developed. It is a monoecious and highly cross pollinated crop which has been known to offer good potentialities for increased yield. Considering these facts, it is essential and desirable to carry out a successful breeding programme utilizing the land races available in Indian subcontinent. Therefore, this study was conducted to generate information about general and specific combining ability effects for different economic characters.

MATERIALS AND METHODS

The present investigation consisted of 36 F_1's (derived through line × tester mating design) and their patents i.e., 12 lines (NDBT-1, NDBT-2, NDBT-3, NDBT-4, NDBT-5, NDBT-6, NDBT-7, NDBT-8, NDBT-10, NDBT-13, NDBT-15 and NDBT-19) and 3 testers (Kalyanpur Sona, NDBT-12 and Pusa Do Mausami) for estimating the *gca* (general combining ability) and *sca* (specific combining ability) for the 14 characters, the whole experimental materials were evaluated in complete randomized block design (RBD) with three replications for two seasons, namely summer (S) season and rainy (R) season 2010 at Research Farm of Department of Vegetable Science, N.D. University of Agriculture & Technology, Kumarganj, Faizabad, UP. The sowing was done with a 3.0 m for row length spaced 3.0 m apart where 0.5 m plant to plant spacing was maintained. All the recommended agronomic package of practices and plant protection measures were followed to raise a good and healthy crop. Among the observations were recorded on plot basis for 14 characters *viz.* node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days to first fruit harvest, fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant, fruit yield per plant (kg), number of primary branches per plant, number of nodes per plant, inter-nodal length (cm) and vine length (m). The data were recorded on 10 randomly selected plants. The estimation of combining ability and gene action were carried out as per the procedure given by Kempthorne (1).

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RESULTS AND DISCUSSION

The general combining ability of parents (Table 1) indicated that four lines i.e. NDBT-10, NDBT-13, NDBT-15 and NDBT-19 had significant and positive *gca* effects during both seasons and among the testers, Kalyanpur Sona and PDM had significant and positive *gca* effects during summer and rainy seasons, respectively, for fruit yield per plant. Furthermore, these four lines were found to be a good general combiner for number of fruits per plant during rainy season and during summer. The lines NDBT-13 and NDBT-19 were found positively significant for summer and rainy both season for traits like days to anthesis of first pistilate flower, days to first fruit harvest, number of nodes per plant, inter-nodal length and vine length. NDBT-13 was also good combiner for node number of first staminate flower, fruit length, fruit diameter and average fruit weight during both seasons. Among the 12 lines, two lines NDBT-13 and NDBT-19 were found significantly positive for the most of the characters. The line

Table 1: Estimate of *gca* effects parents for 14 characters during summer and rainy seasons in bitter gourd.

Characters	Node no. to anthesis of first staminate flower		Node no. to anthesis of first pistillate flower		Days to anthesis of first staminate flower		Days to anthesis of first pistillate flower		Days to first fruit harvest		Fruit length (cm)		Fruit diameter (cm)	
Lines	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**
NDBT-1	-0.56	-1.92**	-2.16**	-1.21**	-0.20	-2.81**	0.83	-3.53**	0.14	-3.68**	-0.04	-0.69**	0.23**	-0.06
NDBT-2	-1.00**	-1.81**	-3.49**	-1.88**	-1.20**	-2.48**	-4.06**	-4.53**	-4.64**	-5.01**	-0.78**	0.25	-0.39**	-0.34**
NDBT-3	-1.11**	-0.69	-0.49	-0.10	-1.54**	-1.26**	-0.61	-2.08**	0.03	-2.68**	0.41*	0.39	0.38**	0.30**
NDBT-4	0.11	0.86*	0.84*	1.12**	-0.43	-0.48	-1.28*	-3.08**	-1.86**	-2.68**	0.42*	-0.59*	0.16**	0.10
NDBT-5	-0.11	0.08	0.06	-0.99*	-1.76**	-1.93**	-1.28*	-0.86	-1.34*	0.21	0.16	-0.59*	-0.09	-0.03
NDBT-6	1.00**	1.75**	0.40	-0.10	0.02	-0.93**	-1.63**	-0.08	-0.86	0.32	-0.27	-0.54*	-0.25**	0.08
NDBT-7	0.08	0.86*	-0.16	-0.10	-1.31**	-1.26**	-0.17	0.81	-0.64	1.10	-0.61**	0.12	0.04	-0.13
NDBT-8	0.67	2.31**	-0.16	1.12*	-0.87*	2.74**	-0.50	-0.97*	-0.42	-0.45	-0.41*	-0.05	-0.56**	-0.41**
NDBT-10	1.00**	0.75	0.95**	1.90**	3.69**	2.41**	2.17**	4.58**	2.81**	4.55**	-0.12	0.70**	0.01	-0.05
NDBT-13	-0.78*	-1.81**	0.51	0.12	-0.76	-1.48**	1.83**	2.69**	2.36**	2.77**	0.86**	1.25**	0.57**	0.63**
NDBT-15	-0.11	-1.25**	1.40**	-0.99*	1.69**	2.30**	1.06	3.03**	1.03	2.21	0.31	-0.69**	-0.05	0.06
NDBT-19	0.89*	0.86*	2.40**	1.12*	2.69**	5.19**	3.61**	4.03**	3.36**	3.32**	0.07	0.44	-0.03	-0.18*
E(gi)Lines	**0.35**	**0.40**	**0.42**	**0.45**	**0.42**	**0.43**	**0.61**	**0.48**	**0.65**	**0.56**	**0.20**	**0.24**	**0.05**	**0.08**
SE(gi-gj) Lines	**0.50**	**0.57**	**0.59**	**0.63**	**0.60**	**0.61**	**0.86**	**0.68**	**0.93**	**0.79**	**0.28**	**0.34**	**0.08**	**0.12**
Testers														
K. Sona	-0.47**	-0.58**	-0.57**	-0.21	-0.34	-0.59**	-1.42**	0.75**	-1.22**	0.96**	-0.42**	-0.44**	-0.02	-0.08*
NDBT-12	0.56**	0.92**	0.29	0.37	-0.43*	-0.06	-0.14	-0.69**	-0.14	-0.87**	0.05	0.18	-0.02	-0.07
PDM	-0.08	-0.33	0.29	-0.16	0.77**	0.66**	1.56**	-0.06	1.36**	-0.09	0.37*	0.26*	0.04	0.15**
SE(gi) Testers	**0.17**	**0.20**	**0.21**	**0.22**	**0.21**	**0.21**	**0.30**	**0.24**	**0.32**	**0.28**	**0.10**	**0.12**	**0.02**	**0.04**
SE(gi-gj) Testers	**0.25**	**0.28**	**0.29**	**0.31**	**0.30**	**0.30**	**0.43**	**0.34**	**0.46**	**0.39**	**0.14**	**0.17**	**0.04**	**0.06**

Table 1: (Contd……)

Characters	Average fruit weight (g)		Number of fruits per plant		Fruit yield per plant (kg)		No.of primary branches per plant		No. of nodes per plant		Internodal length (cm)		Vine length (m)	
Lines	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**	**Summer**	**Rainy**
NDBT-1	-10.07**	-12.21**	-1.98**	-2.98**	-0.30**	-0.39**	1.67**	0.77*	-1.39	-1.94*	-1.03**	-0.89**	-0.53**	-0.62**
NDBT-2	2.59**	2.79**	-1.53**	-0.93*	-0.09**	-0.04	-0.68*	2.33**	5.28**	3.72**	-1.18**	-0.83**	-0.40**	-0.23**
NDBT-3	2.70**	3.79**	-4.05**	-2.17**	-0.32**	-0.14**	-3.67**	-3.20**	2.50**	2.83**	-0.57**	-0.49**	-0.19**	-0.03**
NDBT-4	-2.52**	-3.99**	0.22	0.32	-0.01	-0.04	1.34**	0.88*	2.94**	0.39	-0.53**	-0.50**	-0.20**	-0.18**
NDBT-5	0.70	-0.88	-0.87*	-2.30**	-0.03	-0.16**	1.50**	1.88**	2.06*	1.28	-0.46**	-0.66**	-0.21**	-0.26**
NDBT-6	-3.74**	-3.66**	1.50**	-2.25**	0.02	-0.24**	0.13	0.22	-2.28*	-2.39**	-0.56**	-0.64**	-0.42**	-0.52**
NDBT-7	-2.07**	-1.88	-0.16	-0.88*	-0.05*	-0.11**	0.28	-2.10**	-6.83**	-5.72**	0.38**	0.36**	-0.03	-0.13**
NDBT-8	-3.96**	-3.44**	0.23	1.16**	-0.04	0.02	0.04	-1.54**	-9.17**	-9.06**	0.59**	0.68**	-0.04	-0.05
NDBT-10	0.70	1.68	2.03**	0.86*	0.19**	0.08**	-1.25**	-1.29**	3.72**	3.06**	1.20**	1.11**	0.65**	0.63**
NDBT-13	10.93**	12.79**	1.69**	1.97**	0.36**	0.38**	0.21	-0.49	8.17**	9.94**	0.59**	0.28**	0.74**	0.67**
NDBT-15	9.26**	8.90**	-1.06**	1.77**	0.07**	0.30**	-0.38	-0.22	-11.72**	-8.61**	0.49**	0.47**	-0.28**	-0.23**
NDBT-19	-4.52**	-3.88**	3.97**	5.49**	0.22**	0.34**	0.82*	2.82**	6.72**	6.50**	1.08**	1.12**	0.90**	0.94**
SE(gi)Lines	0.85	0.93	**0.39**	0.43	0.02	0.03	0.34	0.38	0.89	0.87	0.07	0.05	0.04	0.03
SE(gi-gj) Lines	1.21	1.32	0.55	0.61	0.03	0.04	0.48	0.54	1.27	1.23	0.10	0.07	0.06	0.05
Testers														
K.Sona	-0.07	-0.05	1.52**	-1.25**	0.11**	-0.11**	-1.10**	0.08	-0.69	-0.56	-0.02	-0.05*	-0.03	-0.05**
NDBT-12	0.48	-0.16	-0.59**	-0.59**	-0.03**	-0.04**	0.75**	0.96**	-0.31	-0.42	-0.01	0.01	-0.07**	-0.01
PD M	-0.41	0.20	-0.94**	1.84**	-0.08**	0.16**	0.35*	-1.04**	1.00*	0.97*	0.03	0.04	0.08**	0.06**
SE(gi) **Testers**	0.42	0.46	0.19	0.21	0.01	0.01	0.17	0.19	0.44	0.43	0.03	0.02	0.02	0.01
SE(gi-gj) Testers	0.60	0.66	0.27	0.30	0.01	0.02	0.24	0.27	0.63	0.61	0.05	0.03	0.03	0.02

*Significant at 5 per cent probability level; **Significant at 1 per cent probability level

NDBT-15 was also found to be a good combiner for days to anthesis of first staminate flower, average fruit weight and inter-nodal length during both the seasons and also found to be a good combiner for days to anthesis of first pistillate flower, number of fruits per plant during rainy season, along with node number to anthesis fruit pistillate flower in summar season. NDBT-2 was found good combiner with earliness in desirable traits like node no. of anthesis of first staminate flower, node no. to anthesis of pistillate flower, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days to first fruit harvest and less fruit diameter, inter-nodal length and vine length. Among the testers, Kalyanpur Sona was to be found good combiner for node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower in both seasons and for days to anthesis of first pistillate flower, days to fruit harvest, number of fruits per plant and fruit yield per plant in summer seasons. Pusa Do Mousami was also found to be a good combiner for fruit length, fruit diameter and vine length in both the seasons and for fruit yield per plant and number of fruits per plant in rainy season. Similar results were observed in bitter gourd by Ram *et al.* (3), Kumar et al. (2) and Sundaram (4). The high significant positive *sca* effects in respect of fruit yield per plant were observed in a cross NDBT-3 × Pusa Do Mousami followed by NDBT-1 × Kalyanpur Sona, NDBT-4 × NDBT-12, NDBT-19 × Pusa Do Mousami and NDBT-7 × Kalyanpur Sona in summer season, and NDBT-15 × NDBT-12 followed by NDBT-10 × Pusa Do Mousami, NDBT-1 × Kalyanpur Sona, NDBT-8 × Pusa Do Mousami, NDBT-7 × Kalyanpur Sona in rainy season, while as NDBT-1 × Kalyanpur Sona and NDBT-7 × Kalyanpur Sona were found desirable in both seasons. However, the best crosses varied with the characters. Based on *sca* effects NDBT-19 × Pusa Do Mousami in summer season NDBT-8 × Pusa Do

Mousami, NDBT-15 × NDBT-12 and NDBT-10 × Pusa Do Mousami in rainy season were found to be the best specific combiners for fruit yield per plant. The cross NDBT-19 × Pusa Do Mousami exhibited significant highest *sca* effects for other characters like number of fruits per plant in summer season. NDBT-3 × Pusa Do Mousami was also found to be having the highest significant *sca* effects for fruit diameter and number of fruits per plant in both seasons, NDBT-1 × Kalyanpur Sona also found alongwith the significant *sca* effect for number of primary branches per plant and number of nodes per plant in summer season. NDBT-4 × NDBT-12 was also found to be having significant sca effects for node number to anthesis of first pistillate flower and vine length in both seasons while as for days to anthesis of first pistillate flower, days to first harvest and fruit length in summer season was concerned, NDBT-7 × Kalyanpur Sona was found having significant *sca* effects for days to anthesis of first pistillate flower, days to anthesis of first staminate flower, days to first fruit harvest, number of fruits per plant, number of nodes per plant and vine length during summer season along with having significant *sca* effects for days to anthesis of first pistillate flower, days to first harvest, number of fruits per plant, number of primary branches per plant, number of nodes per plant and vine length. The cross NDBT-6 × Pusa Do Mousami had significant *sca* effects for days to anthesis of first staminate flower and days to first fruit harvest in rainy season. Highest *sca* effect for days to first harvest was observed in cross combination NDBT-12 × Pusa Do Mousami followed by NDBT-13 × Kalyanpur Sona in rainy season, highest *sca* effects were observed in cross NDBT-8 × Pusa Do Mousami followed by NDBT-6 × NDBT-12, NDBT-10 × NDBT-12, NDBT-7 × NDBT-12 and NDBT-1 × Kalyanpur Sona in

Table 2 : Estimate of *sca* effects of 36 F_1 hybrids for 14 characters during summer and rainy seasons in bitter gourd.

S. No.	Character	Node no. to anthesis of first staminate flower		Node no. to anthesis of first pistillate flower		Days to anthesis of first staminate flower		Days to anthesis of first pistillate flower		Days to first fruit harvest		Fruit length (cm)		Fruit diameter (cm)	
	Hybrids	Summer	Rainy	Summer	Rainy	Summer	Rainy	Summer	Rainy	Summer	Rainy	Summer	Rainy	Summer	Rainy
1.	NDBT-1 x K. Sona	-0.63	-0.86	-0.53	-0.56	-0.99	-3.51**	0.63	-1.19	0.55	-0.51	0.61	-0.12	0.24*	-0.00
2.	NDBT-1 x NDBT-12	-0.66	-0.02	1.60**	-0.14	-0.57	0.62	-0.63	-0.08	-0.52	-1.35	0.02	0.29	0.20*	0.23
3.	NDBT-1 x PDM	1.30*	0.88	-1.46*	0.71	1.56*	2.89**	0.00	1.27	-0.02	1.87	-0.69*	-0.16	-0.44**	-0.22
4.	NDBT-2 x K. Sona	0.13	0.02	0.12	1.10	1.00	1.51*	-0.13	1.13	-1.00	-0.55	1.35**	0.11	0.13	0.05
5.	NDBT-2 x NDBT-12	-0.55	-0.80	0.93	-0.48	0.42	-0.04	1.91	0.58	3.25**	1.31	-0.94**	0.70	0.27**	0.39**
6.	NDBT-2 x PDM	0.41	0.77	-1.06	-0.62	-1.49*	-1.43	-1.77	-1.72*	-2.28*	-0.79	-0.45	-0.84*	-0.40**	-0.44**
7.	NDBT-3 x K. Sona	-0.08	-0.41	0.46	0.99	-1.65*	-1.07	-0.58	1.02	-0.66	1.48	-0.02	-0.42	-0.24*	-0.24
8.	NDBT-3 x NDBT-12	-0.77	-0.25	-1.49*	-0.25	0.75	1.39	-1.52	-0.19	-2.08	-0.68	-0.70*	-1.54**	-0.31**	-0.20
9.	NDBT-3 x PDM	0.86	0.67	0.93	-0.73	0.89	-0.32	2.11**	-0.83	2.75*	-0.79	0.72*	1.96**	0.55**	0.44**
10.	NDBT-4 x K. Sona	1.69**	3.02**	2.24**	2.10**	-0.76	0.14	2.08	-0.63	1.55	-0.51	-1.64**	1.48**	0.13	0.10
11.	NDBT-4 x NDBT-12	0.02	0.19	-1.62*	-2.48**	0.98	0.28	-1.86	0.80	-2.29*	0.64	1.31**	-0.89*	-0.21*	0.11
12.	NDBT-4 x PDM	-1.69**	-3.22**	-0.62	0.37	-0.21	-0.43	-0.22	-0.16	0.63	-0.12	0.33	-0.58	0.08	-0.21
13.	NDBT-5 x K. Sona	0.91	0.80	0.24	0.21	-0.10	-0.74	1.08	-0.19	1.33	-0.40	2.24**	-0.04	0.80**	0.98**
14.	NDBT-5 x NDBT-12	-0.11	-1.02	-0.28	-1.37	-1.50*	-0.93	-0.52	0.25	-0.08	0.42	-1.82**	-0.60	-0.74**	-0.76**
15.	NDBT-5 x PDM	-0.80	0.22	0.04	1.15	1.45	1.67*	-0.55	-0.05	-1.25	-0.01	-0.41	0.64	-0.06	-0.21
16.	NDBT-6 x K. Sona	-1.29*	0.80	0.57	2.32**	0.45	1.25	-1.91	2.02*	-1.77	2.58**	-0.51	-0.52	-0.38**	-0.39
17.	NDBT-6 x NDBT-12	0.77	-1.69*	-0.28	-1.59	0.20	-0.26	1.80	0.80	1.80	0.31	1.06**	-0.14	0.43**	0.27
18.	NDBT-6 x PDM	0.41	0.88*	-0.27	-0.73	-0.65	-0.99	0.11	-2.83**	-0.02	-2.79**	-0.55	0.66	-0.04	0.12
19.	NDBT-7 x K. Sona	-0.19	-0.63	-0.53	-0.67	-1.54*	-2.07**	-5.36**	-3.19**	-6.00**	-4.29**	-0.07	-0.10	0.34**	0.22
20	NDBT-7 x NDBT-12	-0.22	-0.13	0.26	1.07	1.87*	1.06	3.69**	-1.41	3.25**	-1.12	1.73**	0.59	0.51**	0.57**

Table 2 (Cond…….)

		1		2		3		4		5		6		7	
21.	**NDBT-7 x PDM**	0.41	0.77	0.26	-0.39	-0.32	1.00	1.66	4.61**	2.75*	5.42**	-1.65**	-0.49	-0.86**	-0.79**
22.	**NDBT-8 x K. Sona**	-1.86**	-0.08	-0.87	-1.89*	-1.99**	0.92	1.63	-0.75	1.77	0.59	-0.20	1.14**	-0.11	-0.30
23.	**NDBT-8 x NDBT-12**	2.77**	1.75*	-0.39	0.85	0.75	-1.93*	-2.82**	-0.97	-0.97	0.42	-0.94**	0.26	-0.24*	-0.62**
24.	**NDBT-8 x PDM**	-0.91	-1.66*	1.26	1.04	1.23	1.00	0.66	1.72*	-0.80	-1.01	1.08**	-1.40**	0.36**	0.92**
25.	**NDBT-10 x K.Sona**	-0.52	-0.19	0.68	0.99	6.12**	5.92**	1.63	0.69	1.55	0.59	-0.11	-0.37	-0.33**	-0.33
26.	**NDBT-10 x NDBT-12**	1.77**	1.63*	-0.84	-0.25	-3.12**	-2.60**	0.69	-1.19	-0.19	-1.57	0.54	0.20	-0.03	0.03
27.	**NDBT-10 x PDM**	-1.25*	-1.44*	0.15	-0.73	-2.99**	-3.32**	-2.83**	0.50	-1.36	0.98	-0.43	0.17	0.37**	0.29
28.	**NDBT-13 x K. Sona**	1.68**	1.36*	-1.53*	-0.89	0.23	0.48	1.30	6.25**	1.00	6.37**	0.49	0.78	0.48**	0.51**
29.	**NDBT-13 x NDBT-12**	-1.64**	-0.47	0.93	1.51	0.31	0.95	0.02	-0.97	0.91	-1.12	-1.05**	-0.73	-0.09	-0.10
30.	**NDBT-13 x PDM**	-0.13	-0.88	0.60	-0.62	-0.54	-1.43	-1.33	-5.27**	-1.91	-5.24**	0.55	-0.05	-0.38**	-0.40**
31.	**NDBT-15 x K. Sona**	0.25	-0.86	-0.42	-1.78*	-0.21	-1.96*	-0.25	-3.08**	0.33	-4.40**	-0.62	-0.38	-0.54**	-0.12
32.	**NDBT-15 x NDBT-12**	0.88	1.63*	0.37	1.62*	-0.12	1.50*	-1.19	1.36	-1.75	2.75**	0.69*	1.18**	-0.07	-0.15
33.	**NDBT-15 x PDM**	-1.13	-0.77	0.04	0.15	0.34	0.45	1.44	1.72*	1.41	1.64	-0.03	-0.70	0.61**	0.28
34.	**NDBT-19 x K.Sona**	-0.08	-2.97**	-0.42	-1.89*	-0.54	-0.85	-0.13	-2.08*	1.33	-0.85	-1.49**	-1.52**	-0.52**	-0.48**
35.	**NDBT-19 x NDBT-12**	-2.44**	-0.80	0.71	1.51	-0.12	-0.04	-0.08	1.02	-1.41	-0.01	0.01	0.77	0.31**	0.23
36.	**NDBT-19 x PDM**	2.52**	3.77**	-0.28	0.37	0.67	0.89	0.22	1.05	0.08	0.87	1.48**	0.76	0.20*	0.25
$SE_{(Sij-Skl)}$		0.86	0.99	1.03	1.10	1.05	1.06	1.49	1.19	1.61	1.37	0.49	0.59	0.14	0.21
$SE_{(Sij-Sik)}$		1.80	2.06	2.16	2.29	2.18	2.22	3.12	2.48	3.36	2.86	1.02	1.24	0.30	0.43

*Significant at 5 per cent probability level; ** Significant at 1 per cent probability level

summer season. Highest positive and significant *sca* effects were observed in a cross combination NDBT-3 × Pusa Do Mousami followed by NDBT-13 × NDBT-12 in summer season, while NDBT-15 × NDBT-12 followed by NDBT-1 × Kalyanpur Sona in rainy season for fruit diameter. For fruit length highest significant *sca* effect was observed in a cross combination NDBT-5 × Kalyanpur Sona followed by NDBT-7 × NDBT-12 in summer, while as NDBT-3 × Pusa Do Mousami followed by NDBT-4 × Kalyanpur Sona in rainy season were the desirable crosses. Similar results als were observed in bitter gourd by Ram *et al.* (3), and Sundharaiya and Arumugan, (5).

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