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Original Research Article

Studies on General and Specific Combining Ability for Yield and Its Contributing Traits in Sponge Gourd [*Luffa cylindrica* (Roem) L.]

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A B S T R A C T

The present investigations were carried out in two years with aims to determine combining ability in per cent of mean involving 14 parental lines and their 40 F_1 hybrids. The experiments were laid out in RBD with three replications. Analysis of variances for combining ability revealed that the partitioning of variances due to lines × testers showed highly significant differences for all the characters except fruit circumference (cm) in both the years and number of primary branches per plant in Y_1. Variances due to lines showed highly significant differences for all the traits except vine length (m) in both the years and days to anthesis of first pistillate flower in Y_2. The variances due to testers were also highly significant for all the characters except node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, node number of first fruit harvest, average fruit weight (g), number of fruits per plant and average fruits yield per plant (kg) in both the years. Lines NDSG-55, NDSG-18, NDSG-1 and NDSG-21 and testers Pusa Chikni showed desirable and significant gca effects for average fruit yield per plant and Lines NDSG-1 and NDSG-18 were found good general combiners for average fruit yield per plant and were also found good general combiners for 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 first fruit harvest, node number of first fruit harvest, number of fruits per plant, fruit circumference (cm) and number of primary branches per plant in both the years. Among forty crosses the best seven crosses *viz*., NDSG-63 X Pusa Chikni, NDSG-24 X Pusa Chikni, NDSG-2 X NDSG-12, NDSG-18 X NDSG-11, NDSG-2 X NDSG-11, NDSG-10 X NDSG-15 and NDSG-10 X NDSG-12 showed significant and positive sca effects for average fruit yield per plant as well as some other yield components were found common over both the years. Combining ability analysis elucidated higher magnitude of variances due to sca (σ^2s) than variance due to gca (σ^2g) indicating preponderance of non-additive gene action for almost characters.

Keywords

Sponge gourd, general combining ability, specific combining ability, yield per plant, hybrid

Introduction

Sponge gourd is one of the most important cucurbit, both as rainy and summer season vegetable which is grown throughout the country and world. Luffa [*Luffa cylindrica* (Roem) L. syn. L. *aegyptica* Mill.] commonly called as sponge gourd. It belongs to the family Cucurbitaceae with diploid chromosome number 2n = 2x = 26 which includes about 118 genera and 825 species. It originated in subtropical Asian region particularly India (Kaloo, 1993). Sponge gourd is an annual and monoeceous cucurbit plant and it has a gelatinous compound luffien. Among vegetables, cucurbits are associated with the origin of agriculture and dawn of human civilization. In food crops, cucurbits are largest producer of biological water and easily digestive and recommended even to sick and frail patients. Its flowers are yellow in colour and showy having five petals. The inflorescences of staminate flowers are raceme, while pistillate flowers are solitary and short long pendunculate. Sponge gourd is an annual plant, produces fruits containing a fibrous vascular system having vigorous vines with cylindrical ten angled fruits, (Whitaker and Davis, 1962).

The main goal of research on cucurbitaceous vegetables in India is to improve productivity on sustainable basis through developing biotic and abiotic resistant variety/hybrid coupled with quality attributes. The tender fruits are rich in vitamin A, vitamin C and iron (Yawalkar, 2004). In spite of such a large production, the per capita per day supply of vegetables could not rise above 175 g in the country which is lower than the recommended dietary allowance (RDA) of 350 to 400 g per capita per day for a balanced diet (Rai and Pandey, 2007). The vegetable requirement of our country is estimated to be 220 million tonnes by 2020 (Singh, 2004).This target can best be achieved through use of improved varieties and hybrids technology in combination with superior crop management skills. It has certain medicinal uses. The cooked fruits are easily digestible and very appetizing, therefore, it is recommended to the patients suffering from malaria or other seasonal fevers. It is quite useful in asthma, skin diseases and splenic enlargement. Researchers discovered that its regular consumption is helpful for rheumatism, backache, internal haemorrhage, chest pains as well as haemorrhoids. The blood circulation the sponge induces on the skin has been credited as a relief for rheumatic and arthritic sufferers.

Among the various mating designs, line x tester cross analysis techniques has been most frequently used to determine nature and magnitude of hybrid vigour, combining ability and gene action involved in expression of yield and its contributing traits. In India, little attention has been given for the genetic improvement of sponge gourd. An understanding of the nature and magnitude of gene action with combining ability would, therefore, be of great importance in breeding high yielding sponge gourd varieties.

Materials and Methods

In the present study 54 genotypes (10 lines, 4 testers and 40 F_1's) were evaluated along with fourteen parents in Randomized Block Design with three replications at the Main Experiment Station of the Department of Vegetable Science, N.D. University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) India under two *Zaid* seasons during 2014 (Y_1) and 2015 (Y_2). The treatments were sown in rows spaced 2.50 meters apart with a plant to plant spacing of 0.50 meter. All the recommended agronomic package of practices, protection measures and recommended dose of manures and fertilizers were applied to raise a good crop. Observations were recorded on all the six plants maintained carefully in each plot for fourteen quantitative 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, node number of first fruit harvest, days to first fruit harvest, number of primary branches per plant, inter nodal length (cm), vine length (m), fruit length (cm), fruit circumference (cm), average fruit weight (g), number of fruits per plant and average fruits yield per plant (kg). The combining ability analysis was carried out by Kempthorne (1957) and further elaborated by Arunachalam (1974). Line × tester analysis was used to estimate general combining ability (gca) and specific combining ability (sca) variances and their effects using the observations taken on F_1 generation. In this mating system, a random sample of 'l' lines is taken and each line is mated to each of the 't' testers (Singh and Chaudhary, 1977).

Results and Discussion

The understanding of inheritance of various characters and identification of superior parents are important pre-requisites for launching an effective and efficient breeding programme. It is not always necessary that parents with high mean performance for yield and other traits would produce desirable F_1's and/or segregants. The selection of a few parents having high genetic potential as per breeding objectives is essential because analyzing and handling of very large number of crosses resulting from numerous parents available in germplasm collections of a crop would be an impractical and perhaps impossible task. Combining ability analysis is useful technique for understanding of genetic worth of parents and their crosses for further exploitation in breeding programmes. In addition, it also provides the idea about gene effects involved in inheritance of different characters which is essential for deciding suitable breeding strategy. Among the various techniques of combining ability analysis, line × tester analysis (Kempthorne, 1957) has been widely utilized for screening the germplasm to identify valuable donor parents and promising crosses in many crops including sponge gourd.

The analysis of variance for combining ability in Y_1 and Y_2 for fourteen characters had been presented in table-1. In the present study, analysis of variances for combining ability revealed that the partitioning of variances due to lines × testers showed highly significant differences for all the fourteen characters in both the years (Y_1 and Y_2) except days to anthesis of first pistillate flower. Variances due to lines were significant for all fourteen traits in both the years (Y_1 and Y_2) except node number to anthesis of first pistillate flower. The variances due to testers were also highly significant for, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days to first fruit harvest, number of primary branches per plant, inter nodal length, vine length, fruit length and fruit circumference in both the years. Similar finding was also reported by Kumar and Singh (1997) and Khattra *et al.,* (2000). General combining ability study helps in making the choice of the parents and also helps in the isolation of suitable germplasm for further improvement. General combining ability is primarily a function of additive and additive × additive gene action. For illustrating genetic worth of parents for hybridization programme, the general combining ability (gca) effects of 14 parents (10 lines and 4 testers) for fourteen characters in Y_1 and Y_2 had been presented in table-2 and consolidated in table-3 and table-4.

The significant and positive gca effects for fruit yield per plant were exhibited by four lines and one testers which in order of merit were NDSG-55, NDSG-1, NDSG-21 and NDSG-18 among lines and Pusa Chikni among testers in both the years.

Table.1 Analysis of variance for combining ability following line × tester mating design for 14 characters in sponge gourd (Y_1=2013-14 and Y_2=2014-15)

Sources of variation	Years	*df*	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	Node no. of first fruit harvest	Days to first fruit harvest	No.of primary branches per plant
Replications	Y_1	2	0.161	0.466	0.152	3.648	0.127	10.299	0.021
	Y_2	2	0.158	0.448	4.381	0.518	0.142	17.285	0.448
Lines	Y_1	9	2.961**	10.946 *	83.277 **	53.936 **	13.404 *	92.851 **	4.394 **
	Y_2	9	2.528**	10.361 **	70.205 **	31.388	8.979 *	66.372 **	4.676**
Testers	Y_1	3	1.088	4.853	132.093 **	313.175 **	8.097	328.241**	17.287**
	Y_2	3	0.774	3.526	237.54 **	392.636**	5.907	386.584 **	19.230 **
Lines × Testers	Y_1	27	0.777**	3.654 **	10.661 **	16.411 **	4.574 **	12.927 *	0.822 **
	Y_2	27	0.787 **	3.203 **	11.051 **	21.791**	3.495 **	13.927**	0.709
Error	Y_1	78	0.092	0.263	3.414	3.783	0.251	7.094	0.142
	Y_2	78	0.099	0.279	3.163	3.970	0.259	6.486	0.165

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Sources of variation	Years	*Df*	Inter nodal length (cm)	Vine length (m)	Fruit length (cm)	Fruit circumference (cm)	Average fruit weight (g)	No. of fruits per plant	Average fruits yield per plant (kg)
Replications	Y_1	2	0.409	0.055	1.122	0.298	88.502	2.457	0.028
	Y_2	2	0.020	0.079	0.834	0.361	12.132	1.569	0.020
Lines	Y_1	9	7.046 **	4.754	115.325 **	1.541 **	3209.642 **	301.579 **	1.643 **
	Y_2	9	7.230**	4.510	99.674 **	1.728**	2001.250 **	271.944**	1.860 *
Testers	Y_1	3	23.340 **	9.547 *	97.525**	7.459 **	1029.363	32.280	0.489
	Y_2	3	24.854 **	7.316 *	115.151**	9.529**	1534.964	10.390	1.092
Lines × Testers	Y_1	27	1.391**	2.635**	8.539 **	0.276	611.333 **	18.436**	0.500**
	Y_2	27	1.749 **	2.298**	7.904**	0.362	561.026 **	29.237 **	0.763 **
Error	Y_1	78	0.202	0.060	2.258	0.266	57.833	2.786	0.042
	Y_2	78	0.193	0.066	2.372	0.251	57.137	2.573	0.034

*, ** Significant at 5% and 1% probability levels, respectively.

Table.2 Estimates of general combining ability (gca) effects of parents (lines and testers) for 14 characters in sponge gourd (Y_1=2013-14 and Y_2=2014-15)

S. No.	Lines	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		Node no. of first fruit harvest		Days to first fruit harvest		No.of primary branches per plant	
		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
1.	NDSG-1	0.52**	0.44**	-0.42*	-0.33*	1.92**	2.95**	2.90**	2.24**	-0.34*	-0.40*	4.64**	4.12**	-0.82**	-0.73**
2.	NDSG-2	0.58**	0.38**	1.13**	0.95**	4.01**	3.94**	4.05**	2.98**	1.30**	1.07**	3.06**	2.97**	-0.52**	-0.52**
3.	NDSG-4	-0.23*	-0.17	-0.87**	-1.21**	-3.31**	-2.62**	-2.02**	-1.62**	-0.80**	-0.58**	1.28	0.65	0.03	-0.03
4.	NDSG-6	0.23*	0.57**	-0.71**	-0.84**	0.34	-0.44	-0.86	-1.10	-0.91**	-0.87**	-1.86*	-2.82**	0.71**	0.57**
5.	NDSG-10	-1.05**	-0.93**	-1.30**	-0.95**	-1.75**	-2.02**	-2.78**	-1.75**	-1.30**	-1.14**	-4.67**	-2.70**	-0.23*	-0.37**
6.	NDSG-18	-0.50**	-0.45**	-0.69**	-0.65**	-4.93**	-3.88**	-0.83	-0.72	-1.21**	-0.66**	-2.82**	-0.93	0.97**	1.15**
7.	NDSG-21	0.10	0.08	1.40**	1.19**	1.27*	1.15*	0.78	-0.82	1.44**	1.15**	0.87	1.02	-0.70**	-0.69**
8.	NDSG-24	-0.06	-0.22*	-0.02	0.35*	1.37*	0.80	-0.42	-0.02	0.76**	0.31	1.03	0.96	0.62**	0.66**
9.	NDSG-55	0.04	-0.01	0.37*	0.20	0.26	-0.34	0.39	1.18*	0.04	0.05	-1.45	-1.84*	0.00	0.01
10.	NDSG-63	0.38**	0.30**	1.12**	1.30**	0.82	0.46	-1.21*	-0.37	1.00**	1.08**	-0.08	-1.44	-0.06	-0.05
	SE (gi) lines	0.10	0.10	0.16	0.16	0.56	0.54	0.58	0.59	0.16	0.16	0.78	0.77	0.11	0.12
	SE(gi – gj)	0.15	0.14	0.23	0.23	0.79	0.77	0.82	0.83	0.23	0.23	1.10	1.09	0.16	0.18
	Testers														
1.	NDSG-11	-0.08	-0.16*	-0.59**	-0.49**	-2.93**	-3.93**	-4.69**	-5.29**	-0.77**	-0.65**	-4.27**	-4.34**	0.44**	0.50**
2.	NDSG-12	-0.11	-0.05	0.09	0.01	0.98**	1.45**	2.68**	2.91**	0.15	0.21*	1.88**	1.97**	-1.00**	-1.05**
3.	NDSG-15	0.28**	0.22**	0.19	0.21*	1.91**	2.49**	1.22**	1.15**	0.31**	0.12	-0.82	-1.38**	-0.15*	-0.19*
4.	Pusa Chikni ©	-0.09	-0.01	0.31**	0.27*	0.05	-0.01	0.80*	1.23**	0.31**	0.33**	3.22**	3.75**	0.71**	0.74**
	SE(gi) testers	0.07	0.06	0.10	0.10	0.35	0.34	0.37	0.37	0.10	0.10	0.49	0.49	0.07	0.08
	SE(gi – gj)	0.09	0.09	0.15	0.14	0.50	0.48	0.52	0.53	0.15	0.15	0.70	0.69	0.10	0.11

*, ** Significant at 5% and 1% probability levels, respectively.

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S. No.	Lines	Inter nodal length (cm)		Vine length (m)		Fruit length (cm)		Fruit circumference (cm)		Average fruit weight (g)		No. of fruits per plant		Average fruits 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
1.	NDSG-1	-1.19**	-1.10**	-0.67**	-0.61**	0.54	0.53	-0.23	-0.18	6.09**	8.53**	1.99**	0.29	0.38**	0.32**
2.	NDSG-2	-0.81**	-0.76**	-0.30**	-0.48**	2.86**	3.25**	-0.20	-0.25	-9.00**	-4.88*	-2.21**	-2.94**	-0.38**	-0.41**
3.	NDSG-4	-0.76	-0.79**	0.32**	0.29**	4.08**	3.88**	-0.18	-0.33*	17.49**	8.77**	-5.51**	-4.72**	-0.34**	-0.36**
4.	NDSG-6	-0.05**	0.04	-0.17*	-0.09	3.79**	3.11**	0.63**	0.65**	6.92**	9.37**	-1.06*	-0.87	0.04	0.04
5.	NDSG-10	1.14**	1.34**	-0.45**	-0.46**	-3.75**	-4.03**	-0.10	0.00	27.01**	18.29**	-8.36**	-7.00**	-0.53**	-0.54**
6.	NDSG-18	0.26*	-0.08	-0.02	0.04	-1.52**	-1.51**	0.38*	0.47**	-32.36**	-26.24**	9.16**	9.40**	0.23**	0.41**
7.	NDSG-21	0.58**	0.64**	-0.22**	-0.26**	-1.38**	-0.88*	-0.42**	-0.49**	0.36	5.80**	1.49**	0.45	0.30**	0.28**
8.	NDSG-24	0.65**	0.60**	1.43**	1.31**	-4.02**	-3.33**	-0.12	-0.14	-7.20**	-3.48	-0.84	-0.92*	-0.12	-0.18**
9.	NDSG-55	0.59**	0.54**	-0.51**	-0.43**	-2.78**	-2.55**	-0.23	-0.13	0.98	-3.59	5.39**	5.79**	0.59**	0.63**
10.	NDSG-63	-0.41**	-0.41**	0.58**	0.70**	2.18**	1.52**	0.47**	0.41*	-10.28**	-12.56**	-0.02	0.53	-0.17**	-0.18**
	SE (gi) lines	0.13	0.13	0.07	0.07	0.43	0.43	0.16	0.16	2.24	2.18	0.47	0.45	0.06	0.06
	SE(gi – gj)	0.18	0.18	0.10	0.10	0.61	0.61	0.22	0.23	3.17	3.09	0.66	0.64	0.09	0.08
	Testers														
1.	NDSG-11	-0.19*	-0.34**	-0.40**	-0.35**	2.58**	2.69**	-0.24*	-0.16	-6.28**	-6.08**	1.35**	0.55	-0.03	-0.05
2.	NDSG-12	-0.29**	-0.29**	0.35**	0.34**	-0.32	0.07	0.74**	0.83**	-3.26*	-5.46**	0.12	0.11	-0.03	-0.19**
3.	NDSG-15	1.26**	1.34**	-0.56**	-0.49**	-1.60**	-1.85**	-0.16	-0.23*	2.84*	2.58	-1.14**	-0.83**	-0.12**	-0.03
4.	Pusa Chikni ©	-0.79**	-0.71**	0.60**	0.50**	-0.66*	-0.92**	-0.34**	-0.44**	6.70**	8.95**	-0.33	0.18	0.18**	0.27**
	SE(gi) testers	0.08	0.08	0.05	0.05	0.27	0.27	0.10	0.10	1.42	1.38	0.29	0.28	0.04	0.04
	SE(gi – gj)	0.11	0.11	0.06	0.06	0.39	0.39	0.14	0.14	2.01	1.95	0.42	0.40	0.06	0.05

*, ** Significant at 5% and 1% probability levels, respectively.

Table.3 Estimates of specific combining ability (sca) effects of crosses for 14 characters in sponge gourd (Y_1=2013-14 and Y_2=2014-15)

S. No.	Crosses	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		Node no. of first fruit harvest	
		Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
1	NDSG-1 X NDSG-11	-0.23	-0.46*	-0.46	-0.10	-0.36	1.37	0.34	-0.33	-0.07	0.05
2	NDSG-1 X NDSG-12	-0.97**	-0.78**	-0.17	-0.30	-0.31	-1.04	-0.93	-0.63	-0.56	-0.77*
3	NDSG-1 X NDSG-15	0.76**	0.39	0.83**	0.50	2.00	0.98	4.49**	2.90*	0.75*	0.41
4	NDSG-1 X Pusa Chikni	0.44*	0.85**	-0.20	-0.09	-1.34	-1.32	-3.89**	-1.94	-0.12	0.31
5	NDSG-2 X NDSG-11	0.83**	0.76**	0.25	0.45	3.72**	2.48*	1.62	0.46	-0.38	0.15
6	NDSG-2 X NDSG-12	-0.64**	-0.62**	-1.79**	-1.18**	-2.37*	-3.30**	0.02	1.73	-1.70**	-2.01**
7	NDSG-2 X NDSG-15	0.13	0.18	-0.45	-0.54	-0.05	0.42	-1.76	-1.54	0.07	0.85*
8	NDSG-2 X Pusa Chikni	-0.32	-0.32	1.99**	1.26**	-1.30	0.39	0.12	-0.65	2.00**	1.01**
9	NDSG-4 X NDSG-11	-0.09	-0.08	0.55	0.51	-0.09	-0.53	1.39	3.44**	-0.01	0.20
10	NDSG-4 X NDSG-12	0.01	0.04	-0.90**	-1.39**	1.99	1.56	-1.98	-4.83**	-1.57**	0.41
11	NDSG-4 X NDSG-15	0.18	0.10	0.27	0.49	0.30	0.78	2.74*	3.03*	1.17**	-0.64
12	NDSG-4 X Pusa Chikni	-0.11	-0.07	0.08	0.39	-2.21	-1.82	-2.14	-1.64	0.40	0.02
13	NDSG-6 X NDSG-11	-0.04	0.35	0.82*	1.17**	1.66	2.02	2.26	1.21	0.60	0.83
14	NDSG-6 X NDSG-12	-0.08	0.10	-0.86*	-0.56	0.44	-0.32	-3.84**	-3.39**	-0.59	-1.26**
15	NDSG-6 X NDSG-15	0.16	0.13	-0.05	-0.96**	0.55	1.60	2.08	3.81**	-0.72*	-0.08
16	NDSG-6 X Pusa Chikni	-0.03	-0.57**	0.09	0.35	-2.66*	-3.30**	-0.50	-1.63	0.71*	0.52
17	NDSG-10 X NDSG-11	0.63**	0.71**	0.38	-0.11	-1.69	-0.73	-0.61	0.73	0.72*	0.33
18	NDSG-10 X NDSG-12	-0.27	-0.44*	-0.33	-0.45	-0.37	-1.47	0.78	1.30	-0.17	-0.43
19	NDSG-10 X NDSG-15	-0.57**	-0.44*	0.47	1.09**	0.40	1.72	-0.99	-2.91*	0.67*	1.09**
20	NDSG-10 X Pusa Chikni	0.21	0.18	-0.52	-0.54	1.66	0.48	0.82	0.88	-1.23**	-0.98**
21	NDSG-18 X NDSG-11	-0.02	-0.34	-0.26	-0.15	-0.51	-0.34	-2.23	-3.84**	-0.24	0.21
22	NDSG-18 X NDSG-12	0.01	0.25	-0.61	-0.79*	-0.42	0.19	2.97*	5.53**	-0.86*	-0.68*
23	NDSG-18 X NDSG-15	-0.12	-0.22	0.90**	1.02**	-0.78	-1.16	-2.44*	-1.84	1.25**	0.67*
24	NDSG-18 X Pusa Chikni	0.13	0.31	-0.03	-0.08	1.71	1.31	1.71	0.15	-0.15	-0.20
25	NDSG-21 X NDSG-11	-0.28	-0.50*	-0.79*	-0.95**	0.56	-1.59	0.93	0.63	-0.88**	-0.50
26	NDSG-21 X NDSG-12	0.04	0.15	3.07**	2.78**	-1.72	-0.17	1.16	0.63	3.37**	2.81**
27	NDSG-21 X NDSG-15	0.28	0.55**	-1.19**	-0.78*	-2.41*	-2.32*	-2.35*	-2.64*	-0.96**	-1.00**
28	NDSG-21 X Pusa Chikni	-0.04	-0.19	-1.09	-1.04**	3.58**	4.08**	0.26	1.38	-1.53**	-1.31**
29	NDSG-24 X NDSG-11	-0.22	-0.30	0.00	-0.35	-1.61	-2.18*	-2.21	-2.90*	0.80*	-0.65*
30	NDSG-24 X NDSG-12	0.41	0.18	0.39	1.12**	2.54*	2.38*	1.86	1.87	0.81*	1.72**
31	NDSG-24 X NDSG-15	0.12	0.15	-0.47	-0.74*	-1.35	-0.87	-2.02	-1.20	-1.38**	-1.13**
32	NDSG-24 X Pusa Chikni	-0.31	-0.02	0.07	-0.04	0.41	0.67	2.36*	2.22	-0.22	0.06
33	NDSG-55 X NDSG-11	-0.39	-0.04	-0.35	-0.23	0.20	-0.50	-1.02	1.04	-0.35	-0.26
34	NDSG-55 X NDSG-12	0.68**	0.40*	1.94**	1.34**	-0.68	0.19	1.34	-0.43	1.59**	0.84*
35	NDSG-55 X NDSG-15	0.05	0.07	-0.33	-0.06	0.06	-0.39	-1.57	-1.60	-0.77*	-0.10
36	NDSG-55 X Pusa Chikni	-0.34	-0.43*	-1.25**	-1.05**	0.42	0.71	1.25	0.99	-0.47	-0.48
37	NDSG-63 X NDSG-11	-0.19	-0.09	-0.14	-0.24	-1.89	-0.01	-0.46	-0.45	-0.18	-0.36
38	NDSG-63 X NDSG-12	0.80**	0.73**	-0.75*	-0.57	0.89	1.98	-1.36	-1.78	-0.33	-0.62
39	NDSG-63 X NDSG-15	-0.99**	-0.90**	0.02	-0.03	1.27	-0.77	1.80	1.98	-0.09	-0.07
40	NDSG-63 X Pusa Chikni	0.38	0.26	0.86*	0.84*	-0.27	-1.20	0.01	0.24	0.60	1.06**
	SE (S_{ij})	**0.21**	**0.20**	**0.33**	**0.32**	**1.11**	**1.08**	**1.16**	**1.18**	**0.33**	**0.33**
	SE (S_{ij} – S_{kl})	**0.30**	**0.28**	**0.46**	**0.46**	**1.58**	**1.53**	**1.64**	**1.67**	**0.46**	**0.46**

*, ** Significant at 5% and 1% probability levels, respectively

Cont....

S. No.	Crosses	Days to first fruit harvest		No. of primary branches per plant		Inter nodal length (cm)		Vine length (m)	
		Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
1	NDSG-1 X NDSG-11	0.48	3.41*	0.27	0.28	0.58*	0.78**	0.26	-0.07
2	NDSG-1 X NDSG-12	-1.33	-3.24*	-0.29	-0.37	0.41	0.47	0.00	0.04
3	NDSG-1 X NDSG-15	2.90	1.85	0.12	0.17	-0.54*	-0.53*	0.08	0.16
4	NDSG-1 X Pusa Chikni	-2.04	-2.01	-0.11	-0.09	-0.45	-0.72**	-0.34*	-0.13
5	NDSG-2 X NDSG-11	1.90	0.49	0.64**	0.60*	0.67*	0.48	-0.04	0.13
6	NDSG-2 X NDSG-12	-0.22	1.51	-0.22	0.01	-0.20	-0.17	-0.20	-0.16
7	NDSG-2 X NDSG-15	-0.15	-0.87	-0.51*	-0.48	0.85**	0.97**	-0.05	0.06
8	NDSG-2 X Pusa Chikni	-1.53	-1.13	0.09	-0.14	-1.33**	-1.29**	0.29*	-0.03
9	NDSG-4 X NDSG-11	-1.89	-3.49*	0.29	0.21	-0.25	-0.06	-0.89**	-0.84**
10	NDSG-4 X NDSG-12	-2.91	-0.94	-0.31	-0.18	-0.18	-0.27	1.65**	1.54**
11	NDSG-4 X NDSG-15	-0.51	-0.12	-0.06	-0.10	1.07**	1.03**	-0.94**	-0.97**
12	NDSG-4 X Pusa Chikni	5.31**	4.55**	0.08	0.07	-0.64*	-0.69**	0.17	0.27
13	NDSG-6 X NDSG-11	1.98	0.78	0.71**	0.61*	0.07	-0.06	0.12	0.04
14	NDSG-6 X NDSG-12	1.70	1.37	0.09	0.32	-0.56*	-0.43	-0.10	-0.09
15	NDSG-6 X NDSG-15	-0.34	-0.05	-0.40	-0.40	0.42	0.31	0.45**	0.64**
16	NDSG-6 X Pusa Chikni	-3.34*	-2.11	-0.40	-0.53*	0.08	0.18	-0.48**	-0.59**
17	NDSG-10 X NDSG-11	1.76	2.63	-0.45*	-0.28	0.95**	1.05**	-0.23	-0.12
18	NDSG-10 X NDSG-12	-2.53	-2.61	0.02	-0.17	-0.42	-0.30	0.35*	0.25
19	NDSG-10 X NDSG-15	0.40	0.60	0.00	-0.06	-0.73**	-0.86**	-0.10	-0.09
20	NDSG-10 X Pusa Chikni	0.36	-0.62	0.44	0.51*	0.19	0.11	-0.03	-0.05
21	NDSG-18 X NDSG-11	-0.16	0.22	-0.21	-0.20	-0.74**	-1.84**	-0.43**	-0.46**
22	NDSG-18 X NDSG-12	-1.14	-1.29	-0.24	-0.25	0.53*	0.89**	-0.68**	-0.42**
23	NDSG-18 X NDSG-15	1.55	2.10	0.01	0.15	-0.35	-0.01	-0.27	-0.19
24	NDSG-18 X Pusa Chikni	-0.25	-1.03	0.44	0.30	0.57*	0.97**	1.37**	1.08**
25	NDSG-21 X NDSG-11	-2.01	-0.29	0.02	0.28	-0.22	0.14	-0.33*	-0.32*
26	NDSG-21 X NDSG-12	2.17	1.66	0.26	-0.08	0.24	0.00	0.15	0.05
27	NDSG-21 X NDSG-15	-0.63	-2.15	-0.13	-0.04	-0.40	-0.56*	0.00	-0.15
28	NDSG-21 X Pusa Chikni	0.46	0.79	-0.16	-0.16	0.38	0.42	0.17	0.42**
29	NDSG-24 X NDSG-11	-0.94	-1.97	-0.26	-0.51*	-0.29	-0.19	-1.31**	-1.06**
30	NDSG-24 X NDSG-12	1.61	1.75	0.24	0.24	0.38	0.24	-0.56**	-0.59**
31	NDSG-24 X NDSG-15	-1.36	0.34	0.39	0.38	-0.67*	-0.63*	1.11**	0.87**
32	NDSG-24 X Pusa Chikni	0.70	-0.12	-0.37	-0.11	0.58*	0.58*	0.76**	0.78**
33	NDSG-55 X NDSG-11	-1.36	-2.00	0.62**	0.44	-0.43	-0.26	0.00	-0.02
34	NDSG-55 X NDSG-12	1.39	0.59	-0.17	-0.18	0.30	0.03	0.35*	0.42**
35	NDSG-55 X NDSG-15	-0.95	-1.00	0.11	0.20	-0.51*	-0.29	0.09	0.01
36	NDSG-55 X Pusa Chikni	0.91	2.41	-0.56*	-0.46	0.64*	0.52*	-0.43**	-0.41**
37	NDSG-63 X NDSG-11	0.24	0.23	-1.62**	-1.43**	-0.33	-0.05	2.84**	2.74**
38	NDSG-63 X NDSG-12	1.26	1.19	0.62**	0.65*	-0.50	-0.46	-0.98**	-1.05**
39	NDSG-63 X NDSG-15	-0.91	-0.70	0.47*	0.19	0.86**	0.58*	-0.37*	-0.35*
40	NDSG-63 X Pusa Chikni	-0.59	-0.72	0.54*	0.60*	-0.03	-0.08	-1.49**	-1.35**
	SE (S_{ij})	**1.56**	**1.54**	**0.23**	**0.25**	**0.26**	**0.25**	**0.14**	**0.14**
	SE ($S_{ij} – S_{kl}$)	**2.21**	**2.17**	**0.32**	**0.35**	**0.36**	**0.35**	**0.20**	**0.20**

*, ** Significant at 5% and 1% probability levels, respectively.

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S. No.	Crosses	Fruit length (cm)		Fruit circumference (cm)		Average fruit weight (g)		No. of fruits per plant		Average fruits yield per plant (kg)	
		Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
1	NDSG-1 X NDSG-11	0.69	0.76	-0.16	-0.33	-1.43	4.16	1.91*	0.25	0.18	0.14
2	NDSG-1 X NDSG-12	1.27	1.39	0.26	0.22	11.71*	10.47*	-4.26**	-4.35**	-0.25*	-0.3**9
3	NDSG-1 X NDSG-15	-1.50	-0.60	-0.04	-0.09	-5.85	4.64	2.19*	1.53	0.11	0.33**
4	NDSG-1 X Pusa Chikni	-0.46	-1.56	-0.06	0.19	-4.44	-19.27**	0.15	2.58**	-0.04	-0.08
5	NDSG-2 X NDSG-11	2.04*	1.98*	-0.30	-0.23	-0.51	-0.26	1.11	1.60	0.34**	0.24*
6	NDSG-2 X NDSG-12	2.55**	1.84*	0.29	-0.01	0.63	1.99	4.24**	3.71**	0.52**	0.62**
7	NDSG-2 X NDSG-15	-0.85	-0.61	-0.10	0.08	-0.50	3.92	0.23	0.69	-0.06	0.08
8	NDSG-2 X Pusa Chikni	-3.75**	-3.21**	0.11	0.16	0.38	-5.65	-5.5**8	-6.00**	-0.80**	-0.95**
9	NDSG-4 X NDSG-11	-0.12	-0.32	0.15	0.05	-10.03*	1.45	-2.76**	-0.78	-0.33**	-0.24*
10	NDSG-4 X NDSG-12	-0.57	0.34	0.08	0.10	-3.42	-4.67	1.54	1.43	0.06	0.07
11	NDSG-4 X NDSG-15	-0.87	-0.01	0.15	0.25	-1.75	-2.64	1.59	2.57**	0.19	0.46**
12	NDSG-4 X Pusa Chikni	1.56	-0.01	-0.38	-0.40	15.19**	5.86	-0.38	-3.21**	0.07	-0.29*
13	NDSG-6 X NDSG-11	2.38**	2.96**	-0.06	-0.09	2.74	-4.78	-0.31	1.54	0.13	0.23*
14	NDSG-6 X NDSG-12	-2.15*	-1.02	-0.64*	-0.58	-10.52*	-12.26**	2.82**	3.01**	0.09	0.14
15	NDSG-6 X NDSG-15	1.42	-1.80*	0.56	0.48	-6.28	-8.06	1.21	1.79	0.13	0.18
16	NDSG-6 X Pusa Chikni	-1.65	-0.13	0.14	0.19	14.06**	25.10**	-3.73**	-6.33**	-0.35**	-0.56**
17	NDSG-10 X NDSG-11	1.02	0.30	-0.30	-0.28	-13.32**	-7.33	-0.97	-3.50**	-0.36**	-0.47**
18	NDSG-10 X NDSG-12	-0.41	-0.01	0.29	0.34	9.79*	6.08	0.12	1.93*	0.42**	0.43**
19	NDSG-10 X NDSG-15	-0.74	-0.13	-0.04	-0.11	23.96**	19.91**	0.28	0.78	0.31*	0.27*
20	NDSG-10 X Pusa Chikni	0.13	-0.16	0.04	0.04	-20.43**	-18.66**	0.57	0.79	-0.38**	-0.24*
21	NDSG-18 X NDSG-11	-1.47	-1.33	0.35	0.55	16.69**	6.27	1.74	3.43**	0.50**	0.48**
22	NDSG-18 X NDSG-12	0.23	-1.60	-0.12	0.00	-11.70*	-9.58*	-1.30	-3.37**	-0.48**	-0.60**
23	NDSG-18 X NDSG-15	-0.50	0.55	0.05	0.05	-1.96	2.14	-0.65	-2.76**	-0.22	-0.09
24	NDSG-18 X Pusa Chikni	1.74*	2.38**	-0.28	-0.60	-3.02	1.17	0.21	2.69**	0.20	0.21
25	NDSG-21 X NDSG-11	-2.45**	-2.53**	0.12	0.02	7.10	8.89*	-0.49	-0.81	0.23	0.05
26	NDSG-21 X NDSG-12	-1.01	-0.27	0.14	0.27	-8.39	-5.06	0.27	-0.81	-0.28*	-0.15
27	NDSG-21 X NDSG-15	0.63	0.21	-0.15	0.05	0.31	6.24	-0.37	-1.70	-0.08	-0.08
28	NDSG-21 X Pusa Chikni	2.83**	2.59**	-0.11	-0.33	0.99	-10.07*	0.59	3.32**	0.13	0.17
29	NDSG-24 X NDSG-11	-0.17	-0.31	0.20	0.17	-18.11**	-6.60	0.20	-1.51	-0.34**	-0.46**
30	NDSG-24 X NDSG-12	-0.23	-0.48	-0.25	-0.18	13.80**	12.48**	-1.10	-0.07	0.05	0.10
31	NDSG-24 X NDSG-15	0.30	0.36	-0.14	-0.13	-12.40**	-24.22**	-1.18	0.73	-0.37**	-0.51**
32	NDSG-24 X Pusa Chikni	0.10	0.43	0.20	0.15	16.71**	18.34**	2.08*	0.85	0.66**	0.87**
33	NDSG-55 X NDSG-11	-0.88	-1.12	-0.23	-0.21	23.85**	15.85**	1.54	-0.25	0.23	0.48**
34	NDSG-55 X NDSG-12	-0.44	-1.43	0.36	0.37	-6.51	-6.43	-1.19	1.15	-0.07	-0.08
35	NDSG-55 X NDSG-15	1.06	1.59	-0.37	-0.41	12.00**	4.56	-3.31**	-1.94*	0.11	-0.17
36	NDSG-55 X Pusa Chikni	0.26	0.96	0.24	0.24	-29.33**	-13.98**	2.95**	1.04	-0.27*	-0.23*
37	NDSG-63 X NDSG-11	-1.04	-0.39	0.23	0.35	-6.96	-17.65**	-1.98*	0.04	-0.58**	-0.45**
38	NDSG-63 X NDSG-12	0.77	1.24	-0.41	-0.53	4.61	6.97	-1.15	-2.62**	-0.06	-0.15
39	NDSG-63 X NDSG-15	1.04	0.45	0.09	-0.18	-7.55	-6.47	0.00	-1.68	-0.13	-0.49**
40	NDSG-63 X Pusa Chikni	-0.76	-1.31	0.10	0.37	9.89*	17.16**	3.13**	4.27**	0.77**	1.09**
	SE (S_{ij})	**0.86**	**0.87**	**0.31**	**0.32**	**4.49**	**4.37**	**0.93**	**0.90**	**0.12**	**0.11**
	SE ($S_{ij} - S_{kl}$)	**1.22**	**1.23**	**0.44**	**0.45**	**6.35**	**6.18**	**1.32**	**1.27**	**0.18**	**0.16**

*, ** Significant at 5% and 1% probability levels, respectively.

Table.4 Specific combining ability of promising crosses for fruit yield per plant in Y_1 and Y_2 in sponge gourd (Y_1=2013-14 and Y_2=2014-15)

S. No.	Characters	Y_1		Y_2	
		Cross with significant effects	**gca effect of parents**	**Cross with significant effects**	**gca effect of parents**
1.	**Node no.to anthesis of first staminate flower**	NDSG-63 X NDSG-15(-0.99), NDSG-1 X NDSG-12 (-0.97), NDSG-2 X NDSG-11 (0.83), NDSG-2 X NDSG-12 (-0.64)	H × L L × A L× A L × A	NDSG-63 X NDSG-15 (-0.90), NDSG-1 X NDSG-12 (-0.78), NDSG-2 X NDSG-12 (-0.62), NDSG-6 X Pusa Chikni (-0.57)	H × L L × A L × A L × A
2.	**Node no.to anthesis of first pistillate flower**	NDSG-2 X NDSG-12 (-1.79), NDSG-55 X Pusa Chikni (-1.25), NDSG-21 X NDSG-15 (-1.19), NDSG-4 X NDSG-12 (-0.90), NDSG-6 X NDSG-12 (-0.86)	L × L L × L L × L H × L H × L	NDSG-4 X NDSG-12 (-1.39), NDSG-2 X NDSG-12 (-1.18), NDSG-21 X Pusa Chikni (-1.04), NDSG-6 X NDSG-15 (-0.96), NDSG-21 X NDSG-11 (-0.95)	H × L L × L L × L H × L L × H
3.	**Days to anthesis of first staminate flower**	NDSG-6 X Pusa Chikni (-2.66), NDSG-21 X NDSG-15 (-2.41), NDSG-2 X NDSG-12 (-2.37)	L× L L × L L × L	NDSG-2 X NDSG-12 (-3.30), NDSG-6 X Pusa Chikni (-3.30), NDSG-21 X NDSG-15 (-2.32), NDSG-24 X NDSG-11 (-2.18)	L × L L × L L × L L × H
4.	**Days to anthesis of first pistillate flower**	NDSG-1 X Pusa Chikni (-3.89), NDSG-6 X NDSG-12 (-3.84), NDSG-18 X NDSG-15 (-2.44), NDSG-21 X NDSG-15 (-2.35)	L × L A × L A × L L × L	NDSG-4 X NDSG-12 (-4.83), NDSG-18 X NDSG-11 (-3.84), NDSG-6 X NDSG-12 (-3.39), NDSG-10 X NDSG-15 (-2.91), NDSG-21 X NDSG-15 (-2.64)	H × L A × H A × L H × L A × L
5.	**Node no. of first fruit harvest**	NDSG-2 X NDSG-12 (-1.70), NDSG-4 X NDSG-12 (-1.57), NDSG-21 X Pusa Chikni (-1.53), NDSG-24 X NDSG-15 (-1.38), NDSG-10 X Pusa Chikni (-1.23)	L × L H × L L × L L × L H × L	NDSG-2 X NDSG-12 (-2.01), NDSG-21 X Pusa Chikni (-1.31), NDSG-6 X NDSG-12 (-1.26), NDSG-24 X NDSG-15 (-1.13), NDSG-21 X NDSG-15 (-1.00)	L × L L × L H × L L × L L × L
6.	**Days to first fruit harvest**	NDSG-6 X Pusa Chikni (-3.34)	H × L	NDSG-4 X NDSG-11 (-3.49), NDSG-1 X NDSG-12 (-3.24)	L × H L × L

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7.	**No.of primary branches per plant**	NDSG-6 X NDSG-11 (0.71), NDSG-2 X NDSG-11 (0.64), NDSG-55 X NDSG-11 (0.62), NDSG-63 X NDSG-12 (0.62)	H × H L × H L × H L × L	NDSG-63 X NDSG-12 (0.65), NDSG-6 X NDSG-11 (0.61), NDSG-2 X NDSG-11 (0.60), NDSG-63 X Pusa Chikni (0.60)	L × L H × H L × H L × H
8.	**Inter nodal length (cm)**	NDSG-2 X Pusa Chikni (-1.33), NDSG-18 X NDSG-11 (-0.74), NDSG-10 X NDSG-15 (-0.73), NDSG-24 X NDSG-15 (-0.67)	H × H L × H L × L L × L	NDSG-18 X NDSG-11 (-1.84), NDSG-2 X Pusa Chikni (-1.29), NDSG-10 X NDSG-15 (-0.86), NDSG-1 X Pusa Chikni (-0.72)	A × H H × H L × L H × H
9.	**Vine length (m)**	NDSG-63 X NDSG-11 (2.84), NDSG-4 X NDSG-12 (1.65), NDSG-24 X NDSG-15 (1.11), NDSG-24 X Pusa Chikni (0.76)	H × L H × H H × L H × H	NDSG-63 X NDSG-11 (2.74), NDSG-4 X NDSG-12 (1.54), NDSG-18 X Pusa Chikni (1.08), NDSG-24 X NDSG-15 (0.87), NDSG-24 X Pusa Chikni (0.78)	H × L H × H A × H H × L H × H
10.	**Fruit length (cm)**	NDSG-21 X Pusa Chikni (2.83), NDSG-2 X NDSG-12 (2.55), NDSG-6 X NDSG-11 (2.38)	L × L H × L H × H	NDSG-6 X NDSG-11 (2.96), NDSG-21 X Pusa Chikni (2.59), NDSG-18 X Pusa Chikni (2.38), NDSG-2 X NDSG-12 (1.84)	H × H L × L L × L H × A
11.	**Fruit circumference (cm)**	---	---	---	---
12.	**Average fruit weight (g)**	NDSG-10 X NDSG-15 (23.96), NDSG-55 X NDSG-11 (23.85), NDSG-24 X Pusa Chikni (16.71), NDSG-18 X NDSG-11 (16.69), NDSG-6 X Pusa Chikni (14.06)	H × H A × L L × H L × L H × H	NDSG-6 X Pusa Chikni (25.10), NDSG-10 X NDSG-15 (19.91), NDSG-24 X Pusa Chikni (18.34), NDSG-63 X Pusa Chikni (17.16), NDSG-55 X NDSG-11 (15.85)	H × H H × A L × H L × H L × L
13.	**No. of fruits per plant**	NDSG-2 X NDSG-12 (4.24), NDSG-63 X Pusa Chikni (3.13), NDSG-55 X Pusa Chikni (2.95), NDSG-6 X NDSG-12 (2.82), NDSG-24 X Pusa Chikni (2.08)	L × A L × L H × L L × A L × A	NDSG-63 X Pusa Chikni (4.27), NDSG-2 X NDSG-12 (3.71), NDSG-18 X NDSG-11 (3.43), NDSG-21 X Pusa Chikni (3.32), NDSG-6 X NDSG-12 (3.01)	A × A L × A H × A A × A L × A
14.	**Average fruits yield per plant (kg)**	NDSG-63 X Pusa Chikni (0.77), NDSG-24 X Pusa Chikni (0.66), NDSG-2 X NDSG-12 (0.52), NDSG-18 X NDSG-11 (0.50), NDSG-10 X NDSG-12 (0.42)	L × H L × H L × L H × L L × L	NDSG-63 X Pusa Chikni (1.09), NDSG-24 X Pusa Chikni (0.87), NDSG-2 X NDSG-12 (0.62), NDSG-18 X NDSG-11 (0.48)	L × H L × H L × L H × L

H=Higher, A=Average and L=Lower

On the basis of gca effects and mean performance, lines NDSG-55 was found good combiner for average fruit yield per plant, days to first fruit harvest in both the years along with number of fruits per plant in $Y_{1;}$ NDSG-1 for average fruit weight and average fruits yield per plant in both the years along with number of fruits per plant in Y_1; NDSG-18 for number of fruits per plant, average fruits yield per plant in both the years. NDSG-21 for average fruits yield per plant in both the years along with number of fruits per plant in Y_1 and average fruit weight in Y_2; Pusa Chikni for number of primary branches per plant, inter nodal length, vine length, average fruit weight and average fruits yield per plant in both the years; NDSG-2 for number of fruits per plant, average fruits yield per plant in both the years and NDSG-6 for inter nodal length, vine length and fruit circumference in both the years along with average fruit weight in Y_1 and days to first fruit harvest in $Y_{2.}$ (Sundhariya and Venkatesan, 2007; Dev *et al.*, 2010; Yadav and Kumar (2012) and Jadhav *et al.*, (2010).

Significant gca values indicated the importance of additive and additive × additive gene effect as earlier reported by Griffing (1956). In view of this, these parents offered the best possibilities for the development of improved lines of sponge gourd through hybridization programme. On the basis of mean performance and gca effects it had been found that there is perfect relationship between *per se* performance and gca effect of the parents. The above six parents (NDSG-21, NDSG-1, NDSG-55 and NDSG-18 among lines and Pusa Chikni among testers) in both the years showed positive and significant gca effects for average fruit yield per plant may serve as valuable parents for hybridization programme or multiple crossing programme for obtaining high yielding variety or transgressive segregants for developing varieties of sponge gourd.

Thus, NDSG-21, NDSG-1, NDSG-55 and NDSG-18 among lines and Pusa Chikni among testers emerged as the most useful parent as these parents were found good general combiner along with high *per se* performance for most of the traits studied. Hence, these parents may also be recommended for exploitation in hybridization programme aimed at improving the yield components for which they were good general combiner.

The sca effects represent non-additive gene action which is non-fixable. Specific combining ability effects helps in the identification of superior cross combinations for development of promising varieties/hybrids. The crosses showing high sca effects involving parents with high gca effects may give rise desirable segregants in future generation. The specific combining ability effects of the forty crosses for fourteen traits in both the years have been presented in table-5. Perusal of table-5 revealed that significant positive and negative sca effects were observed for all the characters. However, none of the crosses showed significant sca effect for all the traits. Further, sca effects were found to vary in nature and magnitude for all the characters with the change of seasons. This varying magnitude of sca effects over seasons may be due to environmental effects and genotypes, respectively. Singh *et al.*, (2006) and Banik *et al.*, (2010) also reported similar results.

In general, the crosses showing significant and desirable sca effects were associated with better *per se* performance for respective traits (table-6 and table-7). However, the crosses having high sca effects in desirable direction did not always have high mean performance for the characters in question. Thus, the sca effect of the crosses may not be directly related to their *per se* performance. This may be attributed to the fact that *per se* performance is a realized value whereas sca effect is an estimate of F_1 performance over parental one. Therefore, both *per se* performance along with sca effects should be considered for evaluating the superiority of a cross although the former may be more important if development of F_1 hybrids is the ultimate objective. The critical examination of results revealed that the crosses exhibiting high order significant and desirable sca effects for different characters involved parents having all types of combinations of gca effects (table-7) such as high × high (H × H), high × average (H × A), high × low (H × L), average × average (A × A), average × low (A × L) and low × low (L × L).

The foregoing observations clearly indicated that there was no particular relationship between positive and significant sca effects of crosses with gca effects of their parents for the characters under study and also advocated by previous workers in sponge gourd (Maurya *et al.,* (2004) and Ranpise *et al.,* (2001).

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