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Quantification of parents and diallel derived progenies contributing towards heterosis in sponge gourd [*Luffacylindrica* (Roem) L.]

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ABSTARACT

The experiment was conducted at ICAR-IIVR, Varanasi (U.P.) to examine the variability of parents, diallel derived progenies and identify the suitable contributing lines for yield and desired horticultural traits to improve productivity in sponge gourd. Sixty three diverse genotypes were evaluated initially and out of these 10 lines (VR-11, EC- 381651, NSG-28, VR-15, VR-156, VR-104, PusaSupriya, VR-44, VR-103 and VR- 116) were selected as parents and which were then crossed in a diallel design without reciprocals during 2006-07. The forty five F_{1s} along with ten parents were evaluated in randomized block design with three replications for horticultural traits and compared to standard variety PusaChikani. The data were collected on 12 agro-morphological characters. As per mean value, parents like EC-381651 (days to 1^{st} flowering of female bud, days to first harvesting, vine length, fruits per vine), VR-116 (node to emerges of 1^{st} female bud), VR-11 (fruit length and, fruit weight) and VR-156 (yield per vine)expressed stable performance for different horticultural traits in this crop.A wide range of variation in the estimates and heterosis (Mid Parent and Better Parent)observed positive (yield) and negative (earliness) direction, which expressed usefulness of parents in development of hybrids.Days to early emergence of male and female flower at lower node should be considered for yield improvement. The parents which contributed significantly in expression of heterosis are VR-10, VR-103, EC381651VR-11 and VR-156 for all the traits under studies.

Keywords: Sponge gourd, progenies, variabilityheterotic effect (MP and BP), fruit yield

INTRODUCTION

Sponge gourd [*Luffacylindrica* (Roem) L.] syn. *L.aegyptica* Mill.) a member of family of *Cucurbitaceae*is commercially cultivated during summer and rainy season vegetable in India.It is known for its nutritional (fruits per 100 g edible portion-tough skin removed, edible portion 80% is: water 93.2 g, energy 18 kcal, protein 1.2 g, fat 0.2g, carbohydrate 2.9 g, fibre 2.0 g, Ca 36 mg, P 19 mg, Fe 1.1 mg, carotene 120 µg. thiamine 0.02 mg, riboflavin 0.06 mg, niacin 0.4 mg) and certain medicinal uses. It is quite useful in asthma, skin diseases, blood circulation and splenic enlargement. In this crop several ecotypes are available in differrent niches of the country and growers are more interested to raise the crop as per local demands.The breeding efficacy and improvement in this crop is based on availability of trait specific genotypes/lines. Choice of parents is considered an important aspect in any breeding programmeaimed in improving yield and desirable horticultural attributes because the high yielding parent may not necessarily transfer its superiority to the progenies in the crosses. It is therefore necessary to evaluate and identify promising lines and cross derived progeniesusing appropriate mating design. The diallel mating design is very useful in developing inbreds and preliminary evaluation of progenies.Heterosis breeding depends mainly on choice of superior homozygous parents. In India, little attention has been given for the genetic improvement of sponge gourd, which is evidenced by paucity of adequate sponge gourd hybrids. Therefore, the present study was conducted to evaluation of diallel progenies and estimates the heterosis (Mid Parent and Better Parent) for yield and its attributes.

MATERIAL AND METHODS

Experimental materials for the present investigation comprised of 10 diverse group of parents (VR-11, EC- 381651, NSG-28, VR-15, VR-156, VR-104, PusaSupriya, VR-44, VR-103 and VR- 116) and for this study crosses were made in a diallel design without reciprocals. The F_1 seeds along with their respective parents were sown at ICAR-Indian Institute Vegetable Research, Varanasi (U.P.) under two Zaid seasons in a randomized block design with three replications. Seeds were sown in rows spaced

2.50 m apart with a plant to plant spacing of 0.50 m. all the recommended agronomical practices, protection measures and recommended dose of manures and fertilizers were applied to raise good crop. The observations were recorded on 5 randomly selected plants in each of the parents, and F_1s in a replication leaving two border plants at both the ends. Twelve characters, viz. days to first flowering of female bud, days to first flowering of male bud, node to emergence of first female bud, node to emergence of first male bud, days to first harvesting, length of vine (m), number of branches/plant, length of fruit (cm), diameter of fruit (cm), weight of fruit (g.), number of fruits/ vine and fruit yield/ vine (kg). The statistical procedure adopted for analysis as proposed by Jinks and Hayman (1953).

RESULTSAND DISCUSSION

The analysis of variance revealed significant differences due to treatments, crosses and interaction (parents' vs crosses) for all the characters under study during *kharif* and summer (Table 1). The exploitation of heterosis requires an intensive evaluation of germplasm to find out diverse donors with high nicking of genes and further identification of heterotic crosses. In the present study, contribution of individual inbreds towards heterosis over mid parents (MP) and better parents (BP) expressed greatly for several horticultural traits (Table 2 and 3).

Days to flowering

The relative heterosis (MP) for Days to first flowering of female bud ranged from –3.89 (NSG-28 X VR- 116) to 105.17 (EC-381651 X PusaSupria), better parent from–8.72 (NSG-28 X VR- 116) to 80.30 (EC-381651 X PusaSupriya) whereas, check heterosis ranged from -19.05 (NSG-28 X VR- 116) to 41.68 (EC-381651 X PusaSupriya), respectively. The significantly highest relative (MP) heterosis for days to first flowering of male bud was observed with 85.58 (VR-156 X VR-116) and significantly lowest value was associated with 3.03 (PusaSupriya X VR-44). Significantly the highest positive heterobeltiosis (BP) was noticed with 74.47 (VR-11 X VR- 156) and significantly highest negative heterobeltiosis was found with the –10.29 (NSG-28 X VR- 156). Significantly highest positive check parent value was found to be 35.90 (EC-381651 X PusaSupriya) to – 21.79 (NSG-28 X VR- 116). The above results are in conformity with the findings of Singh, *et al.* (2001), Sadat *et al.* (2008), Bhatt *et al.* (2010) and Singh and Singh, 2018.

First emergence of flower bud on node

The relative Heterosis (MP) ranged for node to first emergence of female bud from 69.23 (VR-156 X VR-116) was the highest relative heterosis and lowest value was obtained –52.54 (EC-381651 X VR-104). Heterobeltiosis ranged from 39.39 (EC-381651 X PusaSupriya) to –57.58 (EC-381651 X VR-104) and check was found to be 8.45 (VR-156 X VR-116) to –60.65 (EC-381651 X VR-104) and (NSG-28 X VR-104).The heterosis per cent over mid parent fornode to first emergence of male bud ranged from 144.44 (VR-11 X VR-116) to –62.32 (VR-11 X VR- 44) and heterosis per cent over better parent ranged from 100 (VR-11 X VR- 116) to – 72.34 (VR-11 X VR- 44) and heterosis per cent over check (PusaChikani) lies between 64.29 (VR-156 X VR-116) to – 67.86 (VR-104 X VR-103).

Days to first harvest

The significantly highest relative heterosis was observed for days to first harvesting with 87.00 (EC-381651 X PusaSupriya) and highest negative significantly value was associated with–3.68 (NSG-28 X VR-116). Significantly the highest positive heterobeltiosis was noticed with 67.10 (EC-381651 X PusaSupriya) and significantly highest negative was found with the –7.10 (NSG-28 X VR-116), heterosis per cent over check parent (PusaChikani) lied between 36.32 (EC-381651 X PusaSupriya) to –17.37 (NSG-28 X VR-116).

Vine length

The relative heterosis ranged for Vine length (m) from 43.54 (PusaSupriya X VR-103) to –40.47 (NSG-28 X VR-156). Heterobeltiosis ranged from 42.86 (PusaSupriya X VR-103) to – 38.33. (VR-156 X PusaSupriya), heterosis per cent over check parent (PusaChikani) lied between 4.05 (PusaSupriya X VR-116) to –56.76 (NSG-28 X VR-156) which is similar to the finding of Singh *et al.* (2014).

Table 1: Analysis of variance in a 10 x 10 diallel crosses for different horticultural traits

Source of variation	d.f.	Days to first flowering of Female bud	Days to first flowering of male bud	Node to Emergence of first Female bud	Node to Emergence of first male bud	Days to first harvest	Vine Length	No. of Branches/ plant	Fruit length	Fruit diameter	Fruit weight (g.)	No. of fruit/ vine	yield /vine
Parents (P)	9	94.00**	85.41**	40.37**	44.45**	85.37**	1.26**	8.74**	60.92**	0.26**	4635.55**	4.00*	0.46**
F_1's	44	103.20**	115.12**	49.12**	19.05**	105.82**	1.54**	6.65**	33.86**	0.12**	1916.52**	8.16**	0.46**
P vs F_1's	1	5701.42**	5840.81**	267.30**	42.43**	5657.17**	0.28*	476.80**	56.88**	0.09	578.00	20.21**	0.26**
F_2's	44	63.54**	90.41**	36.70**	13.32**	84.00**	1.09**	3.94**	37.64**	0.11**	1904.40**	5.15**	0.34**
P vs F_2's	1	4.00*	7.88**	77.25**	18.91**	16.48**	7.82**	798.51**	41.48**	0.21**	651.00	62.55**	0.89**
Replication	2	170.08**	49.00**	281.24**	31.92**	194.32**	0.10	0.40	41.64**	0.22**	2415.08**	7.94*	0.02
Error	198	0.47	0.24	2.24	0.37	4.78	0.05	1.10	2.16	0.02	189.00	1.91	0.03

**, ** significant at 5% and 1% level, respectively*

Table 2: Mean performance of parents for different horticultural traits

Parents	Days to 1st flowering of female bud	Days to 1st flowering of female bud	Node to emerges of 1st female bud	Node to emergence of 1st male bud	Days to first harvesting	Vine length (m)	Number for branches per vine	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruits per vine	Yield per vine (kg)
VR-11	36.67	31.33	19.33	7.33	44.00	4.47	11.33	28.00	4.07	201.67	7.67	1.54
EC-381651	33.33	34.67	22.00	13.00	40.67	4.57	9.33	18.00	4.00	111.67	11.67	1.29
NSG-28	49.67	45.33	19.33	9.00	56.33	3.17	11.00	21.67	4.10	136.67	10.00	1.37
VR-15	35.67	38.33	18.33	5.67	44.00	2.90	10.67	17.67	3.77	106.67	9.33	1.00
VR-156	34.67	30.67	21.33	8.67	41.67	4.00	11.33	26.33	4.07	198.33	10.33	2.03
VR-104	46.67	41.67	17.00	4.33	52.67	3.10	10.33	24.67	3.57	153.33	8.67	1.32
PusaSupriya	44.00	45.33	20.00	6.67	51.67	3.47	13.00	26.33	3.20	146.67	10.67	1.57
VR-44	43.00	42.67	20.67	15.67	50.00	4.63	15.00	27.00	3.93	191.67	9.67	1.84
VR-103	39.33	35.67	18.67	4.00	46.33	3.50	12.00	15.33	3.70	103.33	9.00	0.92
VR-116	44.67	38.677	9.00	4.67	52.33	4.13	9.33	24.67	4.10	190.00	10.67	2.03

Branches/vine

The heterosis per cent over mid parent ranged for number of branches/vine from 3.23 (VR-156 X VR-116) to –66.20 (VR-15 X PusaSupriya), heterosis per cent over better parent ranged from –5.88 (VR-156 X VR-116) to –69.23 (EC-381651 X PusaSupriya and VR-15 X PusaSupriya) and heterosis par cent over check parent (PusaChikani) observed between 300 (VR-156 X VR-116) to 50 (EC-381651 X PusaSupriya and VR-15 X PusaSupriya) which is similar to the report of Kumar *et.al*. (2007).

Fruit length

The highest obtained relative relative value for fruit length (cm) was 40 (EC-381651 X VR-103), while significantly negative relative heterosis expressed – 44.30 (VR-156 X Pusa Supriya). The highest significant heterobeltiosis 29.63 was found with (EC-381651 X VR-103). The significantly highest negative heterobeltiosis – 44.30 (VR-156 X PusaSupriya) and heterosis per cent over check parent (PusaChikani) traits was 7.69 (VR-156 X VR-104), which was significantly highest among the crosses. The negative over check parent (PusaChikani) traits was noticed – 43.59 (VR-156 X PusaSupriya) which is similar to the finding of Singh *et al.* (2014).

Fruit diameter

The highest significantly positive heterosis per cent over mid parent for fruit diameter (cm)was observed with EC-381651 X PusaSupriya (12.04) followed by VR-15 X PusaSupriya (11.96). While significant negative heterosis per cent over mid parent was found with NSG-28 X VR-15 (-15.25). The significantly highest heterobeltiosis 9.91 was found with VR-104 X VR-103 and the significant negative heterobeltiosis –19.51 was obtained with NSG-28 X PusaSupriya, followed by –14.29 (NSG-28 X VR-156). The highest positive and negative check value heterosis 21.83 and–30.28 were obtained with VR-15 X VR-116 and NSG-28 X PusaSupriya, respectively (Singh *et al.,* 2014).

Fruit weight

The highest significant positive heterosis per cent over mid parent for fruit weight (g) was noticed in EC-381651 X VR-103 (59.69), while negative value was with VR-156 X PusaSupriya (-41.06). The highest significant heterobeltiosis value 53.73 was observed in EC-381651 X VR-103. The negative heterobeltiosis for this traits was noticed in VR-15 X VR-116 (-135.00) followed by VR-44 X VR-116 and PusaSupriya X VR-44 (-120.00) and VR-104 X VR-44 (-110.00). The significantly highest check parent (PusaChikani) heterosis value was with NSG-28 X VR-103 (-54.69) followed by EC-381651 X VR-15 (53.13) which is inconformity with results of Singh *et al.* (2009) and Ram *et al.,* (2007).

Fruits/vine

The significant highest positive heterosis per cent over mid parent for number of fruits/vine was noticed in VR-104 X VR-44 (45.45) followed by VR-11 X VR-156 (44.44) and negative heterosis was observed with VR-156 X VR-103 (-27.59). Significantly, The highest heterobeltiosis VR-104 X VR-103 (40.74) and all the check parent heterosis (166.67) were noticed with EC-381651 X NSG-28, EC-381651 X VR-156, NSG-28 X VR-156 and VR-104 X VR-44, followed S by (160) were noticed with VR-11 X EC-381651, VR-11 X VR-156 and VR-11 X PusaSupriya whereas, negative heterobeltiosis (-32.26) were noticed with VR-156 X VR-103 followed by (-28.57) EC-381651 X VR-15, respectively (Singh and Singh, 2018).

Yield/vine

The highest and significantly positive heterosis per cent over mid parent for yield/vine (kg) was observed with VR-104 X VR-103 (91.69) followed by EC-381651 X VR-103 (70.24). While significant negative heterosis per cent over mid parent was found with VR-156 X PusaSupriya (-41.96). The significantly highest heterobeltiosis value 62.72 was found with VR-104 X VR-103 and the significant negative heterobeltiosis –48.52 was obtained with VR-156 X PusaSupriya followed by –42.46 (VR-156 X VR-103). The highest positive check value heterosis 116.25 (VR-11 X VR-156) followed by 111.25 (EC-381651 X VR-156) and negative check value heterosis –22.19 (EC-381651 X VR-15) followed by –18.12 (NSG-28 X VR-15), respectivelyand results are inconformity with Bhardwaj *et al.,* (2009).

Table 3**:** Magnitude of contribution over Mid Parentsand Better Parentsfor different traits

F_{1s} (Crosses)	Days to 1st flowering of female bud	Days to 1st flowering of male bud	Node to emergence of female bud	Node to emergence of Male bud
	MP/BP	MP/BP	MP/BP	MP/BP
VR11 x EC381651	49.52**/ 42.73**	47.47**/ 40.38**	-20.97**/ -25.76**	-37.7**/ -51.28**
VR11 x NSG28	35.14**/ 17.45**	45.22**/ 22.79**	-29.31**/ -29.31**	-34.69**/ -40.74**
VR11 x VR15	36.41**/34.55**	33.97**/ 21.74**	-22.12**/ -24.14**	-2.56**/ -13.64**
VR11 x VR156	49.53**/45.45**	76.34**/ 74.47**	-36.07**/ -39.06**	-41.67**/ -36.36**
VR11 x VR104	43.20**/27.86**	57.08**/ 37.60**	-37.61**/ -1.38**	2.86**/ -18.18**
VR11 x P.S.	42.15**/ 30.30**	52.17**/ 28.68**	-40.68**/ -41.67**	-23.81**/ -27.27**
VR11 x VR44	37.24**/ 27.13**	50.45** / 30.47**	-40.00**/ -41.94**	-62.32**/ -72.34**
VR11 x VR103	35.96**/31.36**	57.21**/ 47.66**	-24.56**/ -25.86**	17.65*/ -9.09**
VR11 x VR116	39.34**/ 26.87**	55.24**/ 40.52**	8.24**/ -20.69**	144.44**/ 100.00**
EC381651 x NSG28	26.10**/ 5.37**	21.67**/ 7.35**	-40.32**/ -43.94**	-66.67**/ -71.79**
EC381651 x VR15	41.06**/ 36.45**	24.20**/ 18.26**	-12.4**/ -19.70	-42.86**/ -58.97**
EC381651 x VR156	52.94**/ 50.00**	60.20**/ 50.96**	-35.38**/ -36.36**	-56.92**/ -64.1**
EC381651xVR104	35.83**/16.43**	34.50**/ 23.20**	-52.14**/ -57.58**	-46.15**/ -64.1**
EC381651 x P.S.	105.17**/ 80.30**	76.67**/ 55.88**	46.03**/ 39.39**	15.25**/ -12.82**
EC381651 x VR44	28.38**/ 19.95**	32.76**/ 20.31**	-50.00**/ -51.52**	-58.14**/ -61.70**
EC381651 x VR103	73.39**/ 60.17**	59.24**/ 57.01**	14.75**/ 6.06**	56.86**/ 2.56**
EC381651 x VR116	57.26**/ 37.31**	80.91**/ 71.55**	-18.28**/ -42.42**	-35.85**/ -56.41**
NSG28 x VR15	28.13**/ 10.07**	21.12**/ 11.76**	-20.35**/ -22.41**	4.55**/ -14.81**
NSG28 x VR156	24.11**/ 5.37**	7.02**/ -10.29**	-27.87**/ -31.25**	-16.98**/ -18.52**
NSG28 x VR104	10.73**/ 7.38**	24.90**/ 19.85**	-48.62**/ -51.72**	-10.00**/ -33.33**
NSG28 x P.S.	28.11**/ 20.81**	40.44**/ 40.44**	-30.51**/ -31.67**	-31.91**/ -40.74**
NSG28 xVR44	3.60**/ -3.36*	3.79**/ 0.74	-20.00**/ -22.58**	-40.54**/ -53.19**
NSG28 x VR103	14.61**/ 2.68*	27.57**/ 13.97**	-21.05**/ -22.41**	-33.33**/ -51.85**
NSG28 x VR116	-3.89**/ -8.72**	6.35**/ -1.47	5.88**/ -22.41**	-21.95**/ -40.74**
VR15 x VR156	58.29**/	48.79**/ 33.91**	-27.73**/ -24.14**	-16.28**/ -30.77**
VR15 x VR104	37.65**/ 21.43**	48.33**/ 42.40**	-13.21**/ -16.36	33.33**/ 17.65**
VR15 x P.S.	55.65**/ 40.19**	28.29**/ 18.38**	-28.70**/ -31.67**	13.51**/ 5.00**
VR15 x VR44	31.36**/ 20.16**	30.04**/ 23.44**	-21.37**/ -25.81**	-37.5**/ -57.45**
VR15 x VR103	59.11**/ 51.69**	69.37**/ 63.48**	-4.50**/ -5.36**	10.34**/ -5.88**
VR15 x VR116	29.46**/ 16.42**	33.33**/ 32.76**	24.39**/ -7.27**	41.94**/ 29.41**
VR156 x VR104	31.97**/ 15.00**	41.94**/ 23.20**	-33.91**/ -40.63**	-12.82**/ -34.62**
VR156 x P.S.	60.17**/ 43.18**	38.60**/ 16.18**	-8.06**/ -10.94**	-30.43**/ -38.46**
VR156 x VR44	48.50**/ 34.11**	62.73**/ 39.84**	-41.27**/ -42.19**	-39.73**/ -53.19**
VR156 x VR103	67.57**/ 57.63**	63.82**/ 52.34**	-11.67**/ -17.19**	5.26**/ -23.08**
VR156 x VR116	56.30**/ 38.81**	85.58**/ 66.38**	69.23**/ 20.31**	130.0**/ 76.92**
VR104 x P.S.	24.26**/ 20.71**	27.97**/ 22.79**	-26.13**/ -31.67**	15.15**/ -5.00**
VR104 x VR44	27.88**/ 22.86**	32.02**/ 30.47**	-20.35**/ -27.42**	-33.33**/ -57.45**
VR104 x VR103	25.58**/ 15.71**	25.00**/ 16.00**	-17.76**/ -21.43**	-28.00*/ -30.77**
VR104 x VR116	38.69**/ 35.71**	63.49**/ 57.60**	-7.69**/ -29.41**	33.33**/ 28.57**
P.S.x VR44	18.77**/ 17.42**	3.03**/ 0.01	-42.62**/ -43.55**	-52.24**/ -65.96**
P.S.x VR103	44.00**/ 36.36**	37.45**/ 22.79**	-25.86**/ -28.33**	-12.50**/ -30.00**
P.S.x VR116	39.85**/ 38.81**	23.02**/ 13.97**	56.32**/ 13.33**	41.18**/ 20.00**
VR44 x VR103	44.13**/ 37.98**	42.13**/ 30.47**	-8.47**/ -12.90**	-25.42**/ -53.19**
VR44 x VR116	12.55**/ 10.45**	26.23**/ 20.31**	1.12/ -27.42**	-44.26**/ -63.83**
VR103 x VR116	26.19**/ 18.66**	29.15**/ 24.14**	27.71**/ -5.36**	46.15**/ 35.71**
S.E.D.	0.54/ 0.62	0.39/ 0.45	1.32/ 1.53	0.48/ 0.55
C. D 5%	1.07/ 1.23	0.77/ 0.89	2.62/ 3.03	0.94/ 1.09
C. D 1%	1.41/ 1.63	1.02/ 1.18	3.47/ 4.08	1.25/ 1.44
VR11 x EC381651	40.16**/ 34.85**	3.32**/ 2.19**	-32.26**/ -38.24**	-13.04 **/ -28.57 **
VR11 x NSG28	30.23**/ 15.98**	16.16**/ -0.75**	-49.25 **/ -50.00 **	-11.41 **/ -21.43 **
VR11 x VR15	28.03**/ 28.03**	-2.26**/ -19.40**	-36.36 **/ -38.24 **	-25.55 **/ -39.29 **
VR11 x VR156	40.86**/ 37.12**	6.30**/ 0.75**	-26.47 **/ -26.47 **	-12.88 **/ -15.48 **

VR11 x VR104	37.24**/ 25.95**	23.35**/ 4.48**	-26.15 **/ -29.41 **	-13.92 **/ -19.05 **
VR11 x P.S.	35.19**/ 25.16**	7.56**/ -4.48**	-53.42 **/ -56.41 **	-7.98**/ -10.71 **
VR11 x VR44	30.5**/ 22.67**	1.83**/ 0.01	-36.71 **/ -44.44 **	-18.79 **/ -20.24 **
VR11 x VR103	29.89**/ 26.62**	-1.26**/ -11.94**	-25.71 **/ -27.78 **	-20.00 **/ -38.10 **
VR11 x VR116	32.18**/ 21.66**	-0.78**/ -4.48**	-25.81 **/ -32.35 **	-22.78 **/ -27.38 **
EC381651 x NSG28	22.34**/ 5.33**	13.79**/ -3.65**	-37.70 **/ -42.42 **	7.56**/ -1.54
EC381651 x VR15	33.07**/ 28.03**	-13.39**/ -29.20**	-40.00 **/ -43.75 **	-8.41**/ -9.26**
EC381651 x VR156	43.32**/ 41.60**	10.12**/ 3.28**	-19.35 ** / -26.47 **	3.76**/ -12.66 **
EC381651 x VR104	31.43**/ 16.46**	21.74**/ 2.19**	-8.47**/ -12.90**	-3.12**/ -16.22 **
EC381651 x P.S.	87.00**/ 67.10**	2.07**/ -10.22**	-64.18 **/ -69.23 **	-29.32 **/ -0.51 **
EC381651 x VR44	23.53**/ 12.00**	-2.17**/ -2.88**	-42.47 **/ -53.33 **	9.63 **/-8.64 **
EC381651 x VR103	60.92**/ 51.08**	-0.83**/ -12.41**	-37.50 **/ -44.44 **	40.00 **/ 29.63 **
EC381651 x VR116	46.95**/ 30.57**	-1.15**/ -5.84**	-32.14 **/ -32.14 **	7.81**/ -6.76**
NSG28 x VR15	22.26**/ 8.88**	12.09**/ 7.37**	-32.31 **/ -33.33 **	-8.47**/ -16.92 **
NSG28 x VR156	20.41**/ 4.73**	-40.47**/ -32.63**	-61.19 **/ -61.76 **	-9.72 **/ -17.72 **
NSG28 x VR104	10.70**/ 7.10**	12.77**/ 11.58**	-28.13 **/ -30.30 **	0.72/ -5.41**
NSG28 x P.S.	24.07**/ 18.93**	-0.50**/ -4.81**	-47.22 **/-51.28 **	4.17**/ -5.06**
NSG28 x VR44	5.33**/ -0.59	-8.55**/ -23.02**	-46.15 **/ -53.33 **	-1.37/ -11.11 **
NSG28 x VR103	14.29**/ 4.14**	-10.00**/ -14.29**	-53.62 **/-55.56 **	-6.31**/ -20.00 **
NSG28 x VR116	-3.68**/ -7.10**	-7.76**/ -18.55**	-27.87 **/ -33.33 **	-5.04**/ -10.81 **
VR15 x VR156	52.53**/ 48.48**	-12.08**/ -24.17**	-39.39 **/ -41.18 **	-24.24 **/ -36.71 **
VR15 x VR104	31.72**/ 20.89**	11.11**/ 7.53**	-26.98 **/ -28.13 **	-19.69 **/-31.08 **
VR15 x P.S.	44.95**/ 34.19**	-18.85**/ -25.48**	-66.20 **/ -69.23 **	-10.61 **/ -25.32 **
VR15 x VR44	24.11**/ 16.67**	-13.27**/ -29.50**	-50.65 **/ -57.78 **	-19.40 **/ -33.33 **
VR15 x VR103	43.91**/ 40.29**	-2.08**/ -10.48**	-55.88 **/ -58.33 **	-7.07**/ -13.21 **
VR15 x VR116	17.65**/ 8.28**	-10.90**/ -24.19**	-33.33 **/ -37.50 **	-13.39 **/ -25.68 **
VR156 x VR104	28.62**/ 15.19**	24.88**/ 10.83**	-20.00 **/ -23.53 **	9.80 **/ 6.33**
VR156 x P.S.	52.14**/ 37.42**	-33.93**/ -38.33**	-58.90 **/ -61.54 **	-44.30 **/ -44.30 **
VR156 x VR44	43.27**/ 31.33**	4.25**/ -2.88**	-44.30 **/ -51.11 **	3.75**/ 2.47*
VR156 x VR103	56.82**/ 48.92**	-0.44**/ -6.67**	-14.29* */ -16.67* *	-0.80/ -21.52 **
VR156 x VR116	46.10**/ 31.21**	18.03**/ 16.13**	3.23**/ -5.88**	-7.19**/ -10.13 **
VR104 x P.S.	22.68**/ 21.52**	16.75**/ 10.58**	-40.00 **/ -46.15 **	-1.96**/- .06**
VR104 x VR44	25.32**/ 22.15**	-12.07**/ -26.62**	-26.32 **/ -37.78 **	-4.52**/ -8.64 **
VR104 x VR103	23.91**/ 16.46**	30.30**/ 22.86**	-55.22 **/ -58.33 **	23.33 **/ 0.01
VR104 x VR116	35.87**/ 35.44**	22.58**/ 7.26**	-35.59 **/ -38.71 **	1.35/ 1.35
P.S.x VR44	15.41**/ 13.55**	16.87**/ 2.16**	-59.52 **/ -62.22 **	-5.00**/ -6.17**
P.S.x VR103	38.78**/ 31.61**	43.54**/ 42.86**	-46.67 **/ -48.72 **	12.00 **/ -11.39 **
P.S.x VR116	32.69**/ 31.85**	35.09**/ 24.19**	-40.30 **/-48.72 **	-11.11 **/-13.92 **
VR44 x VR103	39.10**/ 34.00**	-4.51**/ -16.19**	-50.62 **/ -55.56 **	-2.36*/-23.46 **
VR44 x VR116	10.10**/ 7.64**	-16.35**/ -20.86**	-28.77 **/ -42.22 **	-14.84 **/ -18.52 **
VR103 x VR116	23.65**/ 16.56**	-7.42**/ -14.52**	-40.62 **/ -47.22 **	11.67 **/ -9.46 **
S.E.D.	0.59/ 0.68	0.12/ 0.14	0.82/ 0.94	0.96/ 1.11
C. D 5%	1.16/ 1.34	0.24/ 0.28	1.62/ 1.87	1.91/ 2.21
C. D 1%	1.53/ 1.77	0.32/ 0.36	2.14/ 2.48	2.53/ 2.92

Note: P.S= PusaSupriya, MP (Over Mid Parents) and BP (Over Better Parents)
, significant at 5% & 1% level, respectively*

The overall assessment of the study indicated the importance of additive as well as non-additive genes in the population. It is concluded that the type of variation and genetic association observed in the present investigation can be best utilized by deferring selection to the later generations specifically to develop superior varieties and hybrids of sponge gourd by advancing segregating material through seed descent or bulk pedigree methods.

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