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Heterosis Analysis for Growth and Yield Attributes in Sponge Gourd [*Luffa cylindrica* (Roem) L.]

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ABSTRACT: Half-diallel crosses (excluding reciprocals) were used to evaluate heterosis to increase growth, yield, and quality by identifying unique cross-combinations with desirable heterosis in sponge gourd. Forty-five hybrids and ten parents with one check variety were evaluated from July 2021 to June 2022 in a randomized block design with three replications. The growth and yield characteristics of sponge gourd hybrids showed heterotic vigour. Genetic variability was seen for all characters because of significant differences. Heterosis breeding is an important method adopted in many crops for their improvement all over the world. The magnitude of standard heterosis was found in desirable direction for early and yield traits *viz*., days to germination appearance in the cross Pant Torai-1 × Kashi Kalyani (-25%), Local Material-1 × Kashi Shreya (-25%), RCSG-2 × Kashi Shreya (-25%) and Kashi Kalyani × Pusa Chikni (-25%), days to flowering in the cross Kashi Shreya × Kashi Kalyani (-24.58%), sex ratio in the cross Pant Torai-1 × Swarna Prabha (-51.78%), for vine length in the cross Kashi Shreya × Pusa Chikni (136.55%), for number of branches in Swarna Prabha × Pusa Chikni (26.84%), for fruit length in the cross Pusa Sneha × Pusa Chikni (44.43%), for number of fruits per vine in Pusa Sneha × Local Material-2 (80.04%), for fruit weight in the cross Local Material-1 × Swarna Prabha (51.64%) and for yield in the cross Pusa Sneha × Local Material-2 (162.13%). The three best-performing F1 hybrids, *viz*., the cross Pusa Sneha × Local Material-2 (162.13%), followed by RCSG-2× Local Material-2 (106.56%), and RCSG-2 × Kashi Kalyani (104.96%), exhibited the highest standard heterosis for total yield (q/hac) in order of merit. Hence, these hybrids can be further tested under different agro-climate for commercial production.

Keywords: Sponge Gourd, Luffa cylindrica, Heterosis, Sex ratio, Half-diallal, Fruit yield.

INTRODUCTION

Luffa (*Luffa cylindrica* Roem L.), commonly called sponge gourd, loofah, vegetable sponge, bath sponge, or dishcloth gourd, has a diploid chromosome number of 2n = 2× = 26. The term "loofah," which is used in pillows, door mats, bath sponges, and other products as well as for cleaning equipment, gave rise to the genus Luffa. The genus Luffa contains seven species, although only the ridge gourd (*Luffa acutangula* (L.) Roxb.) and sponge gourd (*Luffa cylindrica* L.) are significant among commonly cultivated vegetables. Ridge gourd and sponge gourd are grown as monocrop in the garden lands and as mixed cropping in the river beds. One of the most significant members of the Cucurbitaceae family, the sponge gourd, is native to subtropical Asia, particularly India (Kalloo, 1993). It is monoecious with annual vines and a cross-pollinated crop (Joshi *et al*., 2004). Whitekar and Davis (1962) described it as a vigorous vine with slender, five angled stem, deltoid to nearly orbicular leaves in outline, but acutely pointed at the apex, usually three to seven lobed, scabrous and dentate margins. In various parts of the world, the sponge gourd is acknowledged by the names kali tori, ghia, tori, dundul, bhol, and ghiraula. For therapeutic purposes, it is currently cultivated extensively in Malaysia, Korea, Japan, India, Central America, Thailand, the Philippines, Indonesia, Taiwan, and China (Sangma *et al*., 2020). The biggest exporters of sponge gourd are Japan, whereas Brazil and the United States are the top importers. The crop is widely cultivated throughout India, particularly in Uttar Pradesh, Bihar, West Bengal, Orissa, Assam, and Kerala (Arya and Prakash 2002). However, the total estimated area of gourds in our nation is 4.05 lakh hectares. Due to their excellent nutritional content and hardy fibrous vascular system, sponge gourds have become popular for harvesting both mature green fruit and dry fruit (Partap *et al*., 2012).

Cucurbits are a kind of vegetable that have a historical background dating back to the dawn of agriculture and human civilization. Cucurbits are the food crop that produces the most biological water, is easily digestible, and is recommended even for sick and elderly people

(Singh, 2018). In addition, the fruits are medium to large in size and contain more seeds per fruit. Thus, manual development of F_1 hybrid is simple and inexpensive which enables the breeders to exploit hybrid vigour commercially in this crop. Because of their fast growth, short lifespan, and photo-insensitive nature, crops can be raised twice a year. It exhibits a wide range of variety in terms of early maturity, high fruit yield, various fruit sizes, shapes, and colours, small and long fruit cluster types, dwarf to long vine types, and other compositions in the available germplasm (Bhoomi *et al.*, 2019). Yet, there is no systematic approach for improving this crop. It has a lot of potential for improvement through hybridization. Numerous investigators have emphasised the need for parental diversity in the segregating generations to produce superior hybrids or superior segregants (Islam *et al*., 2010). Thus, efforts should be undertaken to expand the use of the diversity that has already been collected from germplasm. Consequently, the current experiment was designed to investigate sponge gourd heterosis for fruit yield and its component attributes.

MATERIAL AND METHODS

The field experiment was conducted during 2021 (August – December) and 2022 (March – June) at Vegetable Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar (Uttarakhand). Pantnagar comes under humid sub-tropical zone and situated in *tarai* region of Uttarakhand at near range of Shivalik foothills of Himalayas. Ten diverse parents (Pant Torai-1, Local Material-1, Swarna Prabha, RCSG-2, Pusa Sneha, Pusa Chikni, Local Material-2, Kashi Shreya, Kashi Kalyani, and PSG-1) of sponge gourd with one check variety, Swarna Prabha, were crossed in a half-diallal manner (excluding reciprocal) in order to create 45 hybrids, which were evaluated in a randomized block design with three replications. The data were recorded on randomly selected five plants for days to germination, days to flowering, sex ratio, vine length (m), number of branches, fruit length (cm), number of fruits, fruit weight (g), intermodal length and yield (q/ha).

Estimation of heterosis. Heterosis percent is estimated over mid parent (relative heterosis), better parent (heterobeltiosis), and standard check varieties (standard heterosis) for ten growth and yield attributes, *viz*., days to germination, days to flowering, sex ratio, vine length (m), number of branches, fruit length (cm), number of fruits, fruit weight (g), intermodal length, and yield (q/ha).

(1) Relative heterosis (%):

Per cent heterosis over mid parent (MP) = $\frac{\bar{F}_1 - \overline{MP}}{\overline{MP}} \times 100$

(2) Heterobeltiosis (%):

Per cent heterosis over better parent (BP) = $\frac{\bar{F}_1 - \overline{BP}}{\overline{BP}} \times 100$

(3) Standard heterosis (%):

Per cent heterosis over check/standard parent (SC) = $\frac{\bar{F}_1 - \overline{SC}}{\overline{SC}} \times 100$

Where,

$\bar{F}_1$ = Mean value of the F_1

$\overline{MP}$ = Mean performance of parents

$\overline{BP}$ = Mean performance of better parent

$\overline{SC}$ = Mean performance of standard check.

RESULTS AND DISCUSSION

A. Mean sum of squares

The estimates of the mean sum of squares attributed to the parents and hybrids revealed significant differences for each trait, indicating that the parents and hybrids under study had a sufficient amount of diversity (Table 1). Crosses Pant Torai-1 × Kashi Kalyani, Local Material-1 × Kashi Shreya, RCSG-2 × Kashi Shreya, and Kashi Kalyani × PSG-1 took minimum days to germinate while Pant Torai-1 × Local Material-2 took the maximum number of days to germinate. Days to germination were shorter for most of the crosses than for their parents. A hybrid of a cross between Kashi Shreya and Kashi Kalyani took the minimum period for flowering, whereas Pant Torai-1 × PSG-1 took the maximum number of days to flower. The minimum value of the sex ratio (male to female flowers) was found in the hybrid of Pant Torai-1 × Swarna Prabha, whereas the maximum value was found in the Local Material-1 × RCSG-2 hybrids. The longest length of the vine was from the hybrid Kashi Shreya × PSG-1, which is higher than their parental value, while the smallest length of the vine was from Swarna Prabha × Kashi Shreya. The cross of Local Material-1 × Pusa Chikni shows the minimum number of branches, while in the case of Swarna Prabha × PSG-1, the maximum number of branches was found. The longest fruits were from the hybrids from the crosses Pusa Sneha × PSG-1, followed by Local Material-2 × PSG-1 and Kashi Shreya × Kashi Kalyani. The shortest fruits were from the hybrids from the crosses of Local Material-1 × Kashi Shreya. The highest number of fruits was found in a hybrid of Pusa Sneha × Local Material-2, with RCSG-2 × Pusa Chikni having the lowest value. Heaviest fruit weight was shown by the hybrid of Local Material-1 × Swarna Prabha, while the lightest weight was shown by Pant Torai-1 × PSG- 6. The shortest intermodal length was found in a hybrid of Pant Torai - 1 × PSG-1, whereas in the case of Local Material-2 × Kashi Shreya, the largest values were found. The maximum value of fruit yield per hectare was found in the hybrid of Pusa Sneha × Local Material-2, followed by RCSG-2 × Local Material-2 and RCSG-2 × Kashi Kalyani. In comparison to their parents, most crosses produced higher yields. Hybrid cultivars usually provide a higher yield than open-pollinated cultivars (Quamruzzaman *et al*., 2020) and this was the case with these hybrids.

B. Heterosis

In order to take advantage of heterosis, a thorough study of the germplasm is necessary to identify heterogeneous donors with high levels of gene nicking

as well as heterotic crossings. Heterosis is an expression of the superiority of hybrids over the mean of their parents compared to the better parents or the standard check (Hayes *et al*., 1955) with respect to agriculturally useful characters. Increasing crop growth and production significantly is the main goal of heterosis breeding. Table 2-6 displays the severity of relative heterosis, heterobeltiosis and standard heterosis in 45 hybrids. The hybrid 'Swarna Prabha' was used as check or standard parent. Early maturity in sponge gourd is a desirable trait for realizing the potential economic yield in a short time and, as a consequence, fetching good prices in the market by early supply of produce. Characteristics such as days to germination and days to flowering are used as criteria for earliness, and for these traits, heterosis is desired in a negative direction. A negative direction heterosis is also desirable for traits like internodal length and sex ratio (male to female flower). Furthermore, yield components have a significant impact on yield and heterosis expression, with fruit length, average fruit weight, vine length, and number of fruits per plant all playing a significant role. Positive heterosis is therefore preferred for these qualities. Many crosses for all characteristics showed a high magnitude of heterosis, whether in a positive or negative direction.

Days to germination exhibited highly significant and negative heterobeltiosis for hybrids of RCSG-2 × Kashi Shreya, RCSG-2 × Local Material-2, RCSG-2 × Pusa Chikni, and Local Material-1 × RCSG-2, whereas fourteen crosses showed negative and highly significant over the standard check, which is desirable because there were fewer days to germinate (Table 2). A negative and significant standard heterosis was exhibited by Pant Torai-1 × Kashi Kalyani followed by Local Material-1 × Kashi Shreya, RCSG-2 × Kashi Shreya, and Kashi Kalyani × PSG-1. The hybrid Kashi Shreya × Kashi Kalyani ranked first by expressing highly significant and negative heterobeltiosis, followed by RCSG-2 × Pusa Sneha, Local Material-2 × Kashi Shreya and Pant Torai-1 × Swarna Prabha for days to flowering, but only one hybrid, cross of Kashi Shreya × Kashi Kalyani displayed negative and highly significant standard heterosis (-24.58%) in a desirable direction (Table 2). Similar findings were also reported by Patil *et al*. (2019). With respect to the sex ratio (male to female flower), heterobeltiosis ranged from -51.78 percent to 77.04 percent, and the hybrid of Pant Torai-1 × Swarna Prabha showed negative and highly significant results over mid parent, better parent and standard check followed by Local Material-1 × Local Material-2 and RCSG-2 × Kashi Shreya (Table 3). Kumar and Pandit (2022) also reported similar findings for sex ratio (male: female flower) in sponge gourd. The highest value of positive and significant heterobeltiosis was found in the hybrid of Kashi Shreya × PSG-1 followed by Swarna Prabha × Pusa Chikni, Local Material-1 × Pusa Chikni and Pant Torai-1 × Pusa Chikni for vine length (Table 3). Positive and significant standard heterosis was found in the hybrid of Kashi Shreya × PSG-1 followed by Pant Torai-1 × Pusa Chikni, Pant Torai-1 × RCSG-2 and Local Material-1 × Pusa Chikni. These findings are also in conformity with the findings of Masud *et al*. (2021) in bottle gourd and Venugopala Reddy *et al*. (2019) in sponge gourd.

For the number of branches, the cross of Swarna Prabha × PSG-1 showed positive and highly significant values for relative heterosis, heterobeltiosis, as well as standard heterosis (Table 4). A positive and significant value of heterosis over mid parent and better parent were exhibited by Local Material-2 × Kashi Shreya, Pusa Sneha × Kashi Kalyani and Pusa Sneha × Kashi Shreya. No negative value of standard heterosis was found for fruit length (Table 4). The highly significant and positive standard heterosis displayed by Pusa Sneha × PSG-1 (44.43%) for fruit length followed by Kashi Shreya × Kashi Kalyani (43.19%) and Local Material-2 × PSG-1 (42.71%). The findings are accordance with Hedau and Sirohi (2004) in ridge gourd, Chauhan *et al*. (2018) in sponge gourd. Hybrids from the crosses of RCSG-2 × Local Material-2, RCSG-2 × Kashi Kalyani, and Pusa Sneha × Local Material-2 showed highly significant and positive values over mid-parent, better parent, as well as standard check for number of fruits (Table 5). These findings are also in conformity with the findings of Venugopala Reddy *et al.* (2019) in Sponge gourd. The highest positive and significant value of heterosis for fruit weight was found in Local Material-1 × Swarna Prabha over mid-parent (61.04%), better parent (51.64%) and standard check (51.64%). Similar observations were also recorded by Islam *et al*. (2008) in sponge gourd. In case of intermodal length, negative and significant heterosis is required. None of the crosses reported significant and negative heterosis over standard check (Table 6). But cross Pant Torai-1 × PSG-1 and RCSG-2 × Local Material-2 reported significant and negative values of heterosis over better parent.

For yield (q/ha), out of 45 crosses, fifteen cross combinations displayed highly significant and positive relative heterosis in which RCSG-2 × Kashi Kalyani holded first position followed by Local Material-1 × Kashi Kalyani and RCSG-2 × Local Material-2. The hybrid between Pusa Sneha × Local Material-2 reported highly significant and positive standard heterosis followed by RCSG-2 × Local Material-2 and RCSG-2 × Kashi Kalyani (Table 6). These results are in conformity with the findings of Sanandia *et al.* (2008); Singh and Singh (2018). The hybrid RCSG-2 × Kashi Kalyani ranked first by expressing the highest value of heterobeltiosis followed by Pant Torai-1 × Swarna Prabha, Local Material-1 × Kashi Kalyani and RCSG-2 × PSG-1. Significant and positive heterobeltiosis for fruit yield per vine has been reported by Naliyadhara *et al.* (2007); Kumar *et al*. (2015; Patil *et al*. (2019); Kumar and Pandit (2022). Non-allelic interaction with the several decreasing alleles may be the cause of the negative heterosis for yield (q/ha) that was seen in some of the crosses like RCSG-2 × Pusa Chikni, Pusa Sneha × PSG-1 etc. According to the results, enhanced heterotic effect on fruit yield was largely attributed to the number of fruits per vine and fruit weight. The number of branches on each vine, vine length, and fruit length were additional characteristics that contributed in a secondary but still significant way to improved yield.

Table 1: Mean performance of parents and their hybrids for growth and yield attributes in sponge gourd.

Parents/ crosses	Days to germination	Days to flowering	Sex ratio	Vine length (m)	No. of branches	Fruit length (cm)	No. of fruits	Fruit weight (g)	Internodal length (cm)	yield (q/ha).
Pant Torai-1	5.67	44.00	12.62	6.45	2.75	22.95	39.39	173.20	8.79	73.78
Local Material-1	5.67	41.33	18.98	5.49	2.50	23.00	50.49	118.58	8.65	70.08
Swarna Prabha	6.67	39.33	15.04	4.46	3.17	20.72	72.19	134.27	8.58	91.15
RCSG-2	8.00	43.00	16.45	5.26	3.08	24.80	30.36	139.86	9.19	45.26
Pusa Sneha	6.33	41.00	16.01	6.17	2.42	27.03	98.77	166.30	7.44	182.55
Pusa Chikni	5.67	39.33	8.40	5.10	2.50	26.43	66.45	178.64	8.21	127.05
Local Material-2	5.67	40.67	13.31	5.80	2.83	23.13	80.42	158.30	9.68	134.84
Kashi Shreya	5.33	38.67	14.67	4.56	1.97	27.17	50.23	158.60	9.19	84.21
Kashi Kalyani	5.67	38.00	15.46	6.41	2.33	19.13	24.66	176.48	9.42	48.91
PSG-1	6.67	44.67	17.01	6.15	3.25	25.01	18.16	192.27	9.49	33.25
Pant Torai-1 × Local Material-1	5.67	42.00	12.69	8.09	2.33	23.12	41.16	132.71	10.20	59.23
Pant Torai-1 × Swarna Prabha	6.33	38.33	7.25	5.54	3.50	23.93	74.78	202.00	9.81	164.28
Pant Torai-1 × RCSG-2	6.00	44.67	18.26	8.85	2.43	27.09	26.42	176.93	9.84	50.02
Pant Torai-1 × Pusa Sneha	6.00	41.33	21.76	6.97	2.25	28.78	39.77	193.10	9.37	81.93
Pant Torai-1 × Pusa Chikni	5.33	43.67	22.12	9.13	2.42	22.34	21.74	184.75	8.94	43.00
Pant Torai-1 × Local Material-2	7.00	41.67	15.74	6.87	2.25	26.32	76.87	183.58	8.98	150.62
Pant Torai-1 × Kashi Shreya	5.67	40.67	11.21	7.43	2.33	21.15	27.50	183.15	10.23	53.62
Pant Torai-1 × Kashi Kalyani	5.00	45.00	17.36	5.39	2.25	24.40	53.08	177.94	9.26	101.55
Pant Torai-1 × PSG-1	6.67	59.33	28.66	7.78	3.43	23.17	19.06	140.25	8.36	30.14
Local Material-1 × Swarna Prabha	5.67	39.33	19.67	5.98	2.73	23.39	42.26	203.60	9.01	91.23
Local Material-1 × RCSG-2	5.33	44.33	33.60	7.56	2.58	27.90	20.33	160.23	9.83	35.75
Local Material-1 × Pusa Sneha	6.33	37.67	20.56	6.12	2.40	25.10	26.12	188.54	9.34	54.62
Local Material-1 × Pusa Chikni	5.33	38.33	15.86	8.55	2.17	23.70	22.93	170.46	9.38	46.78
Local Material-1 × Local Material-2	6.33	38.33	10.65	6.23	2.33	24.73	68.56	191.75	9.49	141.80
Local Material-1 × Kashi Shreya	5.00	40.00	17.26	7.06	2.75	20.73	39.94	182.10	9.00	83.17
Local Material-1 × Kashi Kalyani	6.00	40.33	15.35	5.34	2.42	25.47	62.34	184.47	8.39	127.28
Local Material-1 × PSG-1	5.67	41.00	18.54	7.45	2.25	28.02	46.60	162.45	8.54	79.47
Swarna Prabha × RCSG-2	5.33	39.33	19.27	7.03	2.67	24.13	23.15	186.38	9.75	45.92
Swarna Prabha × Pusa Sneha	5.67	38.00	19.46	6.46	3.00	23.52	53.59	180.70	9.31	110.20
Swarna Prabha × Pusa Chikni	6.00	42.67	23.19	8.32	2.81	23.85	16.61	137.71	8.93	24.34
Swarna Prabha × Local Material-2	6.67	40.67	16.07	7.00	2.58	24.05	17.87	142.98	9.18	28.36
Swarna Prabha × Kashi Shreya	5.33	38.67	19.50	4.16	2.75	22.11	49.97	172.80	8.80	88.31
Swarna Prabha × Kashi Kalyani	5.67	38.00	16.95	4.61	2.58	23.14	31.54	178.90	9.32	60.45
Swarna Prabha × PSG-1	6.67	42.33	16.63	4.75	4.02	26.02	29.10	176.50	9.42	59.45
RCSG-2 × Pusa Sneha	5.67	35.00	16.38	6.96	2.83	28.55	61.15	196.63	9.58	127.34
RCSG-2 × Pusa Chikni	5.33	45.33	16.39	5.56	3.00	26.50	16.19	164.83	9.04	28.47
RCSG-2 × Local Material-2	5.33	39.00	14.73	5.67	2.93	26.50	96.34	176.80	8.55	188.27
RCSG-2 × Kashi Shreya	5.00	40.33	8.22	6.49	2.50	25.62	55.36	188.00	9.61	112.91
RCSG-2 × Kashi Kalyani	5.67	42.33	15.67	6.86	2.50	28.91	114.82	149.63	8.91	186.81
RCSG-2 × PSG-1	6.00	43.67	13.36	7.43	3.08	26.90	39.48	176.38	9.73	75.69
Pusa Sneha × Pusa Chikni	5.67	39.67	15.00	5.58	2.75	24.01	89.20	136.79	10.09	112.71
Pusa Sneha × Local Material-2	6.33	41.33	15.39	7.10	2.83	27.23	129.97	178.46	9.61	238.93
Pusa Sneha × Kashi Shreya	5.67	38.67	17.97	5.07	2.92	26.17	20.19	194.13	9.37	45.44
Pusa Sneha × Kashi Kalyani	5.67	39.00	17.15	4.48	3.00	26.73	68.37	166.03	9.27	120.15
Pusa Sneha × PSG-1	6.33	39.67	18.41	6.94	3.25	29.93	22.96	177.50	9.74	49.14
Pusa Chikni × Local Material-2	5.67	44.00	19.47	7.40	3.07	27.26	56.64	156.55	9.60	94.97

Pusa Chikni × Kashi Shreya	6.00	42.33	13.35	5.78	2.56	28.01	79.45	175.50	9.16	148.18
Pusa Chikni × Kashi Kalyani	5.67	41.67	16.45	6.25	2.58	25.13	24.03	164.15	8.49	49.51
Pusa Chikni × PSG-1	5.33	53.00	22.01	8.28	3.13	25.93	21.46	140.45	9.03	31.18
Local Material-2 × Kashi Shreya	6.33	35.00	17.68	5.99	3.50	25.44	57.09	137.90	10.46	83.90
Local Material-2 × Kashi Kalyani	5.67	43.00	15.29	5.97	3.00	26.73	76.50	169.45	9.29	145.61
Local Material-2 × PSG-1	5.67	46.33	21.38	6.86	2.67	29.57	22.44	169.65	9.82	39.05
Kashi Shreya × Kashi Kalyani	5.33	29.67	14.50	7.84	2.38	29.67	50.29	183.13	9.54	107.35
Kashi Shreya × PSG-1	5.33	38.67	22.39	10.55	2.64	26.68	43.95	175.60	10.13	82.18
Kashi Kalyani × PSG-1	5.00	42.33	14.50	6.74	2.92	25.96	29.45	173.50	9.68	54.38
G. mean	5.83	41.19	16.93	6.52	2.73	25.33	47.96	169.85	9.27	87.72
S.E.±	0.33	2.00	1.16	0.37	0.12	0.90	3.28	7.10	0.39	5.53
C.D.at 5%	0.93	5.60	3.25	1.05	0.35	2.53	9.20	19.90	1.09	15.50
C.D.at 1%	1.23	7.40	4.30	1.39	0.46	3.34	12.17	26.32	1.44	20.50

Table 2: Estimation of heterosis (percent) for days to germination and days to flowering in sponge gourd.

Parents/crosses	Days to germination			Days to flowering		
	Relative Heterosis	Heterobeltiosis	Standard Heterosis	Relative Heterosis	Heterobeltiosis	Standard Heterosis
Pant Torai-1 × Local Material-1	0	0	-15*	-1.56	-4.55	6.78
Pant Torai-1 × Swarna Prabha	2.7	-5	-5	-8	-12.88*	-2.54
Pant Torai-1 × RCSG-2	-12.2*	-25**	-10	2.68	1.52	13.56
Pant Torai-1 × Pusa Sneha	0	-5.26	-10	-2.75	-6.06	5.08
Pant Torai-1 × Pusa Chikni	-5.88	-5.88	-20**	4.8	-0.76	11.02
Pant Torai-1 × Local Material-2	23.53**	23.53**	5	-1.57	-5.3	5.93
Pant Torai-1 × Kashi Shreya	3.03	0	-15*	-1.61	-7.58	3.39
Pant Torai -1 × Kashi Kalyani	-11.76	-11.76	-25**	9.76	2.27	14.41*
Pant Torai -1 × PSG-1	8.11	0	0	33.83**	32.84**	50.85**
Local Material-1 × Swarna Prabha	-8.11	-15*	-15*	-2.48	-4.84	0
Local Material-1 × RCSG-2	-21.95**	-33.33**	-20**	5.14	3.1	12.71
Local Material-1 × Pusa Sneha	5.56	0	-5	-8.5	-8.87	-4.24
Local Material-1 × Pusa Chikni	-5.88	-5.88	-20**	-4.96	-7.26	-2.54
Local Material-1 × Local Material-2	11.76	11.76	-5	-6.5	-7.26	-2.54
Local Material-1 × Kashi Shreya	-9.09	-11.76	-25**	0	-3.23	1.69
Local Material-1 × Kashi Kalyani	5.88	5.88	-10	1.68	-2.42	2.54
Local Material-1 × PSG-1	-8.11	-15*	-15*	-4.65	-8.21	4.24
Swarna Prabha × RCSG-2	-27.27**	-33.33**	-20**	-4.45	-8.53	0
Swarna Prabha × Pusa Sneha	-12.82*	-15*	-15*	-5.39	-7.32	-3.39
Swarna Prabha × Pusa Chikni	-2.7	-10	-10	8.47	8.47	8.47
Swarna Prabha × Local Material-2	8.11	0	0	1.67	0	3.39
Swarna Prabha × Kashi Shreya	-11.11	-20**	-20**	-0.85	-1.69	-1.69
Swarna Prabha × Kashi Kalyani	-8.11	-15*	-15*	-1.72	-3.39	-3.39
Swarna Prabha × PSG-1	0	0	0	0.79	-5.22	7.63
RCSG-2 × Pusa Sneha	-20.93**	-29.17**	-15*	-16.67**	-18.6**	-11.02
RCSG-2 × Pusa Chikni	-21.95**	-33.33**	-20**	10.12	5.43	15.25*
RCSG-2 × Local Material-2	-21.95**	-33.33**	-20**	-6.77	-9.3	-0.85
RCSG-2 × Kashi Shreya	-25**	-37.5**	-25**	-1.22	-6.2	2.54
RCSG-2 × Kashi Kalyani	-17.07**	-29.17**	-15*	4.53	-1.55	7.63
RCSG-2 × PSG-1	-18.18**	-25**	-10	-0.38	-2.24	11.02
Pusa Sneha × Pusa Chikni	-5.56	-10.53	-15*	-1.24	-3.25	0.85
Pusa Sneha × Local Material-2	5.56	0	-5	1.22	0.81	5.08
Pusa Sneha × Kashi Shreya	-2.86	-10.53	-15*	-2.93	-5.69	-1.69
Pusa Sneha × Kashi Kalyani	-5.56	-10.53	-15*	-1.27	-4.88	-0.85
Pusa Sneha × PSG-1	-2.56	-5	-5	-7.39	-11.19	0.85
Pusa Chikni × Local Material-2	0	0	-15*	10	8.2	11.86
Pusa Chikni × Kashi Shreya	9.09	5.88	-10	8.55	7.63	7.63
Pusa Chikni × Kashi Kalyani	0	0	-15*	7.76	5.93	5.93
Pusa Chikni × PSG-1	-13.51*	-20**	-20**	26.19**	18.66**	34.75**
Local Material-2 × Kashi Shreya	15.15*	11.76	-5	-11.76	-13.93*	-11.02
Local Material-2 × Kashi Kalyani	0	0	-15*	9.32	5.74	9.32
Local Material-2 × PSG-1	-8.11	-15*	-15*	8.59	3.73	17.8*
Kashi Shreya × Kashi Kalyani	-3.03	-5.88	-20**	-22.61**	-23.28**	-24.58**
Kashi Shreya × PSG-1	-11.11	-20**	-20**	-7.2	-13.43*	-1.69
Kashi Kalyani × PSG-1	-18.92**	-25**	-25**	2.42	-5.22	7.63

** indicates significant at 5%, * Indicates significant at 1%

Table 3: Estimation of heterosis (percent) for sex ratio and vine length (m) in sponge gourd.

Parents/crosses	Sex ratio			Vine length (m)		
	Relative Heterosis	Heterobeltiosis	Standard Heterosis	Relative Heterosis	Heterobeltiosis	Standard Heterosis
Pant Torai-1 × Local Material-1	-19.7*	-33.15**	-15.63	35.44**	25.36**	81.39**
Pant Torai-1 × Swarna Prabha	-47.57**	-51.78**	-51.78**	1.47	-14.2	24.14*
Pant Torai-1 × RCSG-2	25.67**	11.05	21.46*	51.21**	37.19**	98.51**
Pant Torai-1 × Pusa Sneha	51.99**	35.89**	44.71**	10.43	8.01	56.28**
Pant Torai-1 × Pusa Chikni	110.43**	75.25**	47.08**	57.99**	41.43**	104.63**
Pant Torai-1 × Local Material-2	21.45	18.31	4.7	12.05	6.4	53.96**
Pant Torai-1 × Kashi Shreya	-17.82	-23.56*	-25.43*	34.95**	15.19	66.67**
Pant Torai-1 × Kashi Kalyani	23.69*	12.34	15.47	-16.14*	-16.43*	20.93
Pant Torai-1 × PSG-1	93.47**	68.52**	90.6**	23.49**	20.56*	74.44**
Local Material-1 × Swarna Prabha	15.66	3.65	30.81**	20.09*	8.8	34.01**
Local Material-1 × RCSG-2	89.69**	77.04**	123.43**	40.65**	37.62**	69.51**
Local Material-1 × Pusa Sneha	17.52*	8.34	36.73**	5	-0.76	37.29**
Local Material-1 × Pusa Chikni	15.87	-16.42	5.48	61.36**	55.58**	91.63**
Local Material-1 × Local Material-2	-34.02**	-43.88**	-29.17**	10.24	7.29	39.61**
Local Material-1 × Kashi Shreya	2.58	-9.06	14.76	40.47**	28.58**	58.37**
Local Material-1 × Kashi Kalyani	-10.82	-19.09*	2.11	-10.22	-16.64*	19.81
Local Material-1 × PSG-1	3.05	-2.3	23.3*	27.95**	21.15*	66.97**
Swarna Prabha × RCSG-2	22.39*	17.15	28.13*	44.63**	33.67**	57.55**
Swarna Prabha × Pusa Sneha	25.37**	21.54*	29.44**	21.61*	4.75	44.92**
Swarna Prabha × Pusa Chikni	97.87**	54.2**	54.2**	73.99**	63.07**	86.47**
Swarna Prabha × Local Material-2	13.37	6.85	6.85	36.41**	20.62*	56.95**
Swarna Prabha × Kashi Shreya	31.26**	29.66**	29.66**	-7.72	-8.77	-6.65
Swarna Prabha × Kashi Kalyani	11.19	9.68	12.75	-15.24	-28.13**	3.29
Swarna Prabha × PSG-1	3.78	-2.23	10.57	-10.5	-22.78**	6.43
RCSG-2 × Pusa Sneha	0.9	-0.43	8.91	21.88**	12.86	56.13**
RCSG-2 × Pusa Chikni	31.93**	-0.34	9	7.43	5.83	24.74*
RCSG-2 × Local Material-2	-0.99	-10.44	-2.04	2.53	-2.3	27.13*
RCSG-2 × Kashi Shreya	-47.17**	-50.02**	-45.33**	32.11**	23.4*	45.44**
RCSG-2 × Kashi Kalyani	-1.79	-4.74	4.19	17.66*	7.07	53.89**
RCSG-2 × PSG-1	-20.15*	-21.46*	-11.17	30.31**	20.88*	66.59**
Pusa Sneha × Pusa Chikni	22.86*	-6.35	-0.27	-0.92	-9.51	25.19*
Pusa Sneha × Local Material-2	4.98	-3.89	2.35	18.54*	15.02	59.12**
Pusa Sneha × Kashi Shreya	17.15	12.24	19.53	-5.59	-17.88*	13.6
Pusa Sneha × Kashi Kalyani	9.01	7.12	14.08	-28.83**	-30.16**	0.37
Pusa Sneha × PSG-1	11.53	8.27	22.46*	12.69	12.48	55.61**
Pusa Chikni × Local Material-2	79.39**	46.32**	29.48**	35.74**	27.51**	65.92**
Pusa Chikni × Kashi Shreya	15.76	-8.98	-11.19	19.7*	13.4	29.67*
Pusa Chikni × Kashi Kalyani	37.88**	6.4	9.38	8.6	-2.5	40.13**
Pusa Chikni × PSG-1	73.26**	29.42**	46.38**	47.24**	34.71**	85.65**
Local Material-2 × Kashi Shreya	26.41**	20.54	17.6	15.63	3.27	34.38**
Local Material-2 × Kashi Kalyani	6.32	-1.08	1.68	-2.24	-6.86	33.86**
Local Material-2 × PSG-1	41.04**	25.7**	42.16**	14.87	11.66	53.89**
Kashi Shreya × Kashi Kalyani	-3.74	-6.19	-3.57	42.95**	22.36**	75.86**
Kashi Shreya × PSG-1	41.39**	31.67**	48.92**	97.01**	71.64**	136.55**
Kashi Kalyani × PSG-1	-10.67	-14.74	-3.57	7.35	5.15	51.12**

** indicates significant at 5%, *Indicates significant at 1%

Table 4: Estimation of heterosis (percent) for number of branches and fruit length (cm) in sponge gourd.

Parents/ crosses	Number of branches			Fruit length (cm)		
	Relative Heterosis	Heterobeltiosis	Standard Heterosis	Relative Heterosis	Heterobeltiosis	Standard Heterosis
Pant Torai-1 × Local Material-1	-11.11	-15.15*	-26.32**	0.62	0.51	11.57
Pant Torai-1 × Swarna Prabha	18.31**	10.53	10.53	9.58	4.26	15.48*
Pant Torai-1 × RCSG-2	-16.57**	-21.08**	-23.16**	13.47**	9.23	30.74**
Pant Torai-1 × Pusa Sneha	-12.9*	-18.18**	-28.95**	15.16**	6.48	38.88**
Pant Torai-1 × Pusa Chikni	-7.94	-12.12	-23.68**	-9.52*	-15.47**	7.82
Pant Torai-1 × Local Material-2	-19.4**	-20.59**	-28.95**	14.24**	13.79*	27.03**
Pant Torai-1 × Kashi Shreya	-1.2	-15.15*	-26.32**	-15.6**	-22.16**	2.08
Pant Torai-1 × Kashi Kalyani	-11.48	-18.18**	-28.95**	15.98**	6.32	17.76**
Pant Torai-1 × PSG-1	14.44**	5.64	8.42	-3.38	-7.36	11.82
Local Material-1 × Swarna Prabha	-3.53	-13.68*	-13.68*	7	1.7	12.89*
Local Material-1 × RCSG-2	-7.46	-16.22**	-18.42**	16.74**	12.5*	34.65**
Local Material-1 × Pusa Sneha	-2.37	-4	-24.21**	0.35	-7.13	21.14**
Local Material-1 × Pusa Chikni	-13.33*	-13.33	-31.58**	-4.11	-10.33*	14.38*
Local Material-1 × Local Material-2	-12.5*	-17.65**	-26.32**	7.22	6.92	19.35**
Local Material-1 × Kashi Shreya	22.95**	10	-13.16*	-17.37**	-23.71**	0.03

Local Material-1 × Kashi Kalyani	0	-3.33	-23.68**	20.91**	10.72	22.91**
Local Material-1 × PSG-1	-21.74**	-30.77**	-28.95**	16.71**	12.02*	35.22**
Swarna Prabha × RCSG-2	-14.67**	-15.79**	-15.79**	6.03	-2.69	16.47**
Swarna Prabha × Pusa Sneha	7.46	-5.26	-5.26	-1.49	-12.99**	13.5*
Swarna Prabha × Pusa Chikni	-0.94	-11.37*	-11.37*	1.17	-9.76*	15.11*
Swarna Prabha × Local Material-2	-13.89**	-18.42**	-18.42**	9.71	3.99	16.09**
Swarna Prabha × Kashi Shreya	7	-13.16*	-13.16*	-7.66	-18.62**	6.71
Swarna Prabha × Kashi Kalyani	-6.06	-18.42**	-18.42**	16.15**	11.68	11.68
Swarna Prabha × PSG-1	25.19**	23.59**	26.84**	13.78**	4.03	25.56**
RCSG-2 × Pusa Sneha	3.03	-8.11	-10.53	10.19*	5.65	37.81**
RCSG-2 × Pusa Chikni	7.46	-2.7	-5.26	3.46	0.26	27.9**
RCSG-2 × Local Material-2	-0.85	-4.86	-7.37	10.58*	6.85	27.9**
RCSG-2 × Kashi Shreya	-1.12	-18.92**	-21.05**	-1.4	-5.7	23.65**
RCSG-2 × Kashi Kalyani	-7.69	-18.92**	-21.05**	31.64**	16.59**	39.54**
RCSG-2 × PSG-1	-2.63	-5.13	-2.63	8.01	7.56	29.83**
Pusa Sneha × Pusa Chikni	11.86	10	-13.16*	-10.17*	-11.16*	15.88**
Pusa Sneha × Local Material-2	7.94	0	-10.53	8.58	0.75	31.42**
Pusa Sneha × Kashi Shreya	32.88**	20.69**	-7.89	-3.43	-3.68	26.3**
Pusa Sneha × Kashi Kalyani	26.32**	24.14**	-5.26	15.85**	-1.09	29.02**
Pusa Sneha × PSG-1	14.71**	0	2.63	15.02**	10.73*	44.43**
Pusa Chikni × Local Material-2	15**	8.24	-3.16	10.02*	3.15	31.58**
Pusa Chikni × Kashi Shreya	14.31*	2.27	-19.26**	4.51	3.09	35.18**
Pusa Chikni × Kashi Kalyani	6.9	3.33	-18.42**	10.32*	-4.92	21.28**
Pusa Chikni × PSG-1	8.99	-3.59	-1.05	0.8	-1.9	25.13**
Local Material-2 × Kashi Shreya	45.63**	23.53**	10.53	1.15	-6.37	22.78**
Local Material-2 × Kashi Kalyani	16.13**	5.88	-5.26	26.51**	15.56**	29.01**
Local Material-2 × PSG-1	-12.33*	-17.95**	-15.79**	22.85**	18.23**	42.71**
Kashi Shreya × Kashi Kalyani	10.68	2.14	-24.74**	28.17**	9.2*	43.19**
Kashi Shreya × PSG-1	1.08	-18.77**	-16.63**	2.25	-1.82	28.75**
Kashi Kalyani × PSG-1	4.48	-10.26	-7.89	17.65**	3.81	25.31**

** indicates significant at 5%, * Indicates significant at 1%

Table 5: Estimation of heterosis (percent) for number of fruits and fruit weight (gm) in sponge gourd.

Parents/ crosses	Number of fruits			Fruit weight (gm)		
	Relative Heterosis	Heterobeltiosis	Standard Heterosis	Relative Heterosis	Heterobeltiosis	Standard Heterosis
Pant Torai-1 × Local Material-1	-8.41	-18.48*	-42.98**	-9.04	-23.38**	-1.16
Pant Torai-1 × Swarna Prabha	34.04**	3.59	3.59	31.4**	16.63**	50.45**
Pant Torai-1 × RCSG-2	-24.24*	-32.92**	-63.4**	13.03*	2.15	31.77**
Pant Torai-1 × Pusa Sneha	-42.44**	-59.74**	-44.91**	13.76**	11.49*	43.82**
Pant Torai-1 × Pusa Chikni	-58.93**	-67.29**	-69.89**	5.02	3.42	37.6**
Pant Torai-1 × Local Material-2	28.31**	-4.42	6.48	10.76*	5.99	36.73**
Pant Torai-1 × Kashi Shreya	-38.63**	-45.25**	-61.91**	10.4*	5.74	36.41**
Pant Torai-1 × Kashi Kalyani	65.73**	34.75**	-26.48**	1.77	0.83	32.53**
Pant Torai-1 × PSG-1	-33.78*	-51.62**	-73.6**	-23.25**	-27.05**	4.46
Local Material-1 × Swarna Prabha	-31.1**	-41.46**	-41.46**	61.04**	51.64**	51.64**
Local Material-1 × RCSG-2	-49.71**	-59.74**	-71.84**	23.99**	14.56*	19.33**
Local Material-1 × Pusa Sneha	-65**	-73.56**	-63.82**	32.36**	13.37*	40.42**
Local Material-1 × Pusa Chikni	-60.79**	-65.5**	-68.24**	14.7*	-4.58	26.96**
Local Material-1 × Local Material-2	4.73	-14.76*	-5.03	38.51**	21.13**	42.81**
Local Material-1 × Kashi Shreya	-20.68**	-20.89*	-44.67**	31.39**	14.82*	35.63**
Local Material-1 × Kashi Kalyani	65.89**	23.46*	-13.64*	25.04**	4.53	37.39**
Local Material-1 × PSG-1	35.74**	-7.72	-35.45**	4.52	-15.51**	20.99**
Swarna Prabha × RCSG-2	-54.85**	-67.93**	-67.93**	35.98**	33.26**	38.81**
Swarna Prabha × Pusa Sneha	-37.31**	-45.75**	-25.77**	20.24**	8.66	34.58**
Swarna Prabha × Pusa Chikni	-76.04**	-76.99**	-76.99**	-11.98*	-22.91**	2.56
Swarna Prabha × Local Material-2	-76.59**	-77.78**	-75.25**	-2.26	-9.68	6.49
Swarna Prabha × Kashi Shreya	-18.37**	-30.78**	-30.78**	18.01**	8.95	28.7**
Swarna Prabha × Kashi Kalyani	-34.86**	-56.31**	-56.31**	15.14**	1.37	33.24**
Swarna Prabha × PSG-1	-35.59**	-59.69**	-59.69**	8.11	-8.2	31.45**
RCSG-2 × Pusa Sneha	-5.29	-38.09**	-15.29*	28.45**	18.24**	46.44**
RCSG-2 × Pusa Chikni	-66.55**	-75.63**	-77.57**	3.51	-7.73	22.77**
RCSG-2 × Local Material-2	73.92**	19.79**	33.45**	18.59**	11.69	31.68**
RCSG-2 × Kashi Shreya	37.38**	10.21	-23.32**	25.98**	18.54**	40.02**
RCSG-2 × Kashi Kalyani	317.34**	278.16**	59.06**	-5.4	-15.21**	11.44
RCSG-2 × PSG-1	62.7**	30.01*	-45.32**	6.21	-8.26	31.36**
Pusa Sneha × Pusa Chikni	7.98	-9.69*	23.56**	-20.69**	-23.43**	1.88
Pusa Sneha × Local Material-2	45.06**	31.58**	80.04**	9.96	7.31	32.91**
Pusa Sneha × Kashi Shreya	-72.9**	-79.56**	-72.04**	19.5**	16.73**	44.58**
Pusa Sneha × Kashi Kalyani	10.78	-30.78**	-5.29	-3.12	-5.92	23.66**
Pusa Sneha × PSG-1	-60.73**	-76.75**	-68.19**	-0.99	-7.68	32.2**
Pusa Chikni × Local Material-2	-22.87**	-29.57**	-21.54**	-7.08	-12.37*	16.6*

Pusa Chikni × Kashi Shreya	36.19**	19.56**	10.06	4.08	-1.76	30.71**
Pusa Chikni × Kashi Kalyani	-47.25**	-63.83**	-66.71**	-7.55	-8.11	22.26**
Pusa Chikni × PSG-1	-49.28**	-67.71**	-70.28**	-24.27**	-26.95**	4.61
Local Material-2 × Kashi Shreya	-12.61*	-29.01**	-20.92**	-12.97*	-13.05*	2.71
Local Material-2 × Kashi Kalyani	45.6**	-4.87	5.97	1.23	-3.98	26.2**
Local Material-2 × PSG-1	-54.48**	-72.1**	-68.92**	-3.21	-11.76*	26.35**
Kashi Shreya × Kashi Kalyani	34.3**	0.13	-30.34**	9.31	3.77	36.4**
Kashi Shreya × PSG-1	28.53*	-12.5	-39.12**	0.1	-8.67	30.78**
Kashi Kalyani × PSG-1	37.52*	19.39	-59.21**	-5.9	-9.76	29.22**

** indicates significant at 5%, * Indicates significant at 1%

Table 6: Estimation of heterosis (percent) for intermodal length (cm) and yield (q/ha) in sponge gourd.

Parents/crosses	Internodal length (cm)			yield (q/ha)		
	Relative Heterosis	Heterobeltiosis	Standard Heterosis	Relative Heterosis	Heterobeltiosis	Standard Heterosis
Pant Torai-1 × Local Material-1	16.98**	16.05*	18.84**	-17.66	-19.72	-35.02**
Pant Torai-1 × Swarna Prabha	13.01*	11.68	14.37*	99.22**	80.24**	80.24**
Pant Torai-1 × RCSG-2	9.51	7.11	14.72*	-15.96	-32.2**	-45.12**
Pant Torai-1 × Pusa Sneha	15.49**	6.64	9.21	-36.07**	-55.12**	-10.11
Pant Torai-1 × Pusa Chikni	5.22	1.78	4.23	-57.18**	-66.15**	-52.82**
Pant Torai-1 × Local Material-2	-2.73	-7.23	4.7	44.4**	11.7*	65.25**
Pant Torai-1 × Kashi Shreya	13.79**	11.28	19.23**	-32.12**	-36.33**	-41.17**
Pant Torai-1 × Kashi Kalyani	1.68	-1.73	7.89	65.53**	37.64**	11.41
Pant Torai-1 × PSG-1	-8.54	-11.91*	-2.6	-43.68**	-59.15**	-66.93**
Local Material-1 × Swarna Prabha	4.61	4.2	5.01	13.17	0.09	0.09
Local Material-1 × RCSG-2	10.22	6.96	14.57*	-38**	-48.98**	-60.77**
Local Material-1 × Pusa Sneha	16.12**	8.02	8.86	-56.76**	-70.08**	-40.07**
Local Material-1 × Pusa Chikni	11.31*	8.52	9.36	-52.54**	-63.18**	-48.68**
Local Material-1 × Local Material-2	3.55	-2	10.61	38.39**	5.16	55.57**
Local Material-1 × Kashi Shreya	0.86	-2.14	4.86	7.81	-1.24	-8.75
Local Material-1 × Kashi Kalyani	-7.16	-10.97	-2.25	113.93**	81.62**	39.64**
Local Material-1 × PSG-1	-5.77	-9.94	-0.43	53.82**	13.4	-12.81
Swarna Prabha × RCSG-2	9.77	6.13	13.68*	-32.67**	-49.62**	-49.62**
Swarna Prabha × Pusa Sneha	16.19**	8.47	8.47	-19.47**	-39.63**	20.91*
Swarna Prabha × Pusa Chikni	6.35	4.08	4.08	-77.69**	-80.84**	-73.29**
Swarna Prabha × Local Material-2	0.49	-5.23	6.95	-74.9**	-78.97**	-68.88**
Swarna Prabha × Kashi Shreya	-0.94	-4.24	2.6	0.72	-3.11	-3.11
Swarna Prabha × Kashi Kalyani	3.52	-1.1	8.59	-13.68	-33.67**	-33.67**
Swarna Prabha × PSG-1	4.24	-0.74	9.75	-4.42	-34.78**	-34.78**
RCSG-2 × Pusa Sneha	15.17**	4.21	11.62	11.8*	-30.24**	39.71**
RCSG-2 × Pusa Chikni	3.93	-1.6	5.4	-66.96**	-77.59**	-68.77**
RCSG-2 × Local Material-2	-9.4	-11.7*	-0.35	109.08**	39.63**	106.56**
RCSG-2 × Kashi Shreya	4.55	4.53	12	74.42**	34.08**	23.88**
RCSG-2 × Kashi Kalyani	-4.28	-5.45	3.81	296.75**	281.92**	104.96**
RCSG-2 × PSG-1	4.19	2.57	13.4*	92.82**	67.24**	-16.96*
Pusa Sneha × Pusa Chikni	28.88**	22.81**	17.56**	-27.19**	-38.26**	23.66**
Pusa Sneha × Local Material-2	12.21*	-0.79	11.97	50.56**	30.89**	162.13**
Pusa Sneha × Kashi Shreya	12.67*	1.92	9.21	-65.93**	-75.11**	-50.15**
Pusa Sneha × Kashi Kalyani	9.92	-1.63	8	3.82	-34.18**	31.82**
Pusa Sneha × PSG-1	15.08**	2.67	13.52*	-54.46**	-73.08**	-46.09**
Pusa Chikni × Local Material-2	7.32	-0.83	11.93	-27.47**	-29.57**	4.19
Pusa Chikni × Kashi Shreya	5.21	-0.4	6.72	40.28**	16.63**	62.57**
Pusa Chikni × Kashi Kalyani	-3.67	-9.84	-1.01	-43.73**	-61.03**	-45.68**
Pusa Chikni × PSG-1	2.03	-4.81	5.24	-61.1**	-75.46**	-65.8**
Local Material-2 × Kashi Shreya	10.82*	8.02	21.91**	-23.4**	-37.78**	-7.95
Local Material-2 × Kashi Kalyani	-2.77	-4.1	8.24	58.48**	7.99	59.75**
Local Material-2 × PSG-1	2.45	1.41	14.45*	-53.54**	-71.04**	-57.16**
Kashi Shreya × Kashi Kalyani	2.51	1.27	11.19	61.28**	27.48**	17.78*
Kashi Shreya × PSG-1	8.49	6.82	18.1**	39.93**	-2.41	-9.84
Kashi Kalyani × PSG-1	2.43	2.07	12.86*	32.37*	11.18	-40.34**

** indicates significant at 5% , * Indicates significant at 1%

CONCLUSIONS

The higher degree of heterosis variability is typically indicated by the wider range of heterosis. The majority of the characteristics (Table 2-6) had either a high or moderate range of heterosis. Relative heterosis besides epistatic effect also indicates presence of dominance effects (intra allelic interaction), while heterobeltiosis is indicative of over dominance. In such situation economic heterosis or mean performance of a cross is more reliable criteria for identifying a commercially valuable cross. The crosses between Pusa Sneha and Local Material-2, RCSG-2 × Local Material-2 that exhibit high heterosis for yield as well as high heterosis for various yield-contributing characters are more suitable because they have stronger heterotic capability when compared to other ones during the hybridization

process. To increase the quantity, quality, and earliness of sponge gourds per unit area, further research may be conducted on these crosses before they are suggested for commercial production.

FUTURE SCOPE

In this study the promising identified hybrids can be exploited commercially to increase the quantity, quality and earliness of sponge gourd per unit area.

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