The Pharma Innovation Journal 2023; 12(7): 3711-3721

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 3711-3721

www.thepharmajournal.com
Received: 20-04-2023
Accepted: 29-05-2023

Naveen Kumar Tulluru
Department of Vegetable Science, College of Horticulture, Venkataramannagudem, Dr. Y. S. R. H. U, Andhra Pradesh, India

K Uma Jyothi
Department of Vegetable Science, College of Horticulture, Venkataramannagudem, Dr. Y. S. R. H. U, Andhra Pradesh, India

M Ravindra Babu
Horticultural Research Station, Venkataramannagudem, Dr. Y. S. R. H. U, Andhra Pradesh, India

M Paratpararao
Department of Genetics and Plant Breeding, College of Horticulture, Venkataramannagudem, Dr. Y. S. R. H. U, Andhra Pradesh, India

Pulipati Gangadhara Rao
Department of Vegetable Science, College of Horticulture, Venkataramannagudem, Dr. Y. S. R. H. U, Andhra Pradesh, India

V Sekhar
Department of Statistics, College of Horticulture, Venkataramannagudem, Dr. Y. S. R. H. U, Andhra Pradesh, India

Corresponding Author:
Naveen Kumar Tulluru
Department of Vegetable Science, College of Horticulture, Venkataramannagudem, Dr. Y. S. R. H. U, Andhra Pradesh, India

Studies on heterosis for growth, yield and quality attributing characters in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.)

Naveen Kumar Tulluru, K Uma Jyothi, M Ravindra Babu, M Paratpararao, Pulipati Gangadhara Rao and V Sekhar

Abstract
The present investigation was conducted on heterosis for growth, yield and quality attributing characters in bottle gourd. Forty-five F_1 hybrids were generated by half diallel (excluding reciprocals) mating design. These F_1 hybrids along with ten parents were evaluated in randomized block design with two replications at College of Horticulture, Venkataramannagudem during 2019-2020. Observations were recorded for five randomly selected and tagged plants from each treatment for growth, yield and quality attributing characters *viz.*, vine length (cm), number of nodes per vine, internodal length (cm), number of secondary branches (lateral branches) per plant, node number at which first male flower appear, node number at which first female flower appear, days to first appearance of male flower, days to first appearance of female flower, sex ratio (m:f), days to first fruit harvest, number of fruits per vine, fruit length (cm), fruit diameter (cm), fruit volume (cc), average fruit weight (g), number of seeds per fruit, fruit yield per vine (kg), fruit yield per plot (kg), estimated yield per hectare (q), total soluble solids (°B), vitamin - C (mg/100 g). The values of F_1 hybrids averaged over two replications were used for estimating heterosis. The top four heterotic cross combinations *viz.*, Pusa Samridhi × Local Round, Pusa Samridhi × Pant Lauki-3, Pant Lauki-3 × Local Long and Kashi Ganga × Local Round were identified as promising for fruit yield per vine.

Keywords: Bottle gourd, heterosis, half diallel, growth, yield, quality

Introduction
Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) is a tropical and subtropical vine, belongs to the family cucurbitaceae with chromosome number 2n = 22. Bottle gourd is one of the cultivated annual monoecious species. It is commonly known as white flowered gourd, ghia, lauki, calabash gourd etc. It is widely grown for edible fruit. Fruit pulp is used as an antidote against certain poisons and is good for controlling constipation, night blindness and cough. Bottle gourd seeds are good sources of lipids and proteins, micro and macro nutrients and if properly utilized, could contribute in solving the problem of malnutrition and also serve as raw material for agro-based industries (Hassan *et al*., 2008) [10].

During recent years, the commercial exploitation of hybrid vigour and selection of parents on the basis of combining ability have expanded a new alley in crop improvement. Bottle gourd being monoecious in sex expression can be profitably utilized for the production of F_1 hybrid seeds at cheaper rates, as the monoecious nature of crop eliminates emasculation and higher number of hybrid seeds per cross make it more economical. The term Heterosis refers to a phenomenon in which F_1 shows increase or decrease in vigour over the parents. Shull (1908) [19] referred to this phenomenon as the stimulus of heterozygosity and hybrid vigour. The attempts of commercial production of F_1 hybrids in vegetables in general and the cucurbits in particular was started as early as 1935 in Japan and 1940 in USA (Singh and Swarup, 1971) [20]. For developing promising varieties through hybridization, the choice of parents is a matter of great concern to the plant breeder. A high yielding genotype may or may not transmit its superiority to its progenies. Therefore, the success of a breeding programme is determined by useful gene combinations in the form of high combining inbred.

Materials and Methods
The present investigation was carried out at College of Horticulture, Venkataramannagudem, Dr. Y. S. R. Horticultural University, Andhra Pradesh, India during summer and *kharif*, 2019-20.

The experimental material consisted of ten parental lines *viz*., Pusa Naveen, Pusa Samridhi, Pusa Santhusti, Pusa Sandesh, Arka Bahar, Kashi Ganga, Punjab Bahar, Pant Lauki-3, Local Round and Local Long and these were crossed in diallel fashion excluding reciprocals during summer, 2019. The resultant 45 F_1 hybrids along with ten parents and two checks were evaluated in randomized block design with two replications with spacing of 3.0 x 0.9 m during *kharif*, 2019. Observations were recorded on five randomly selected plants from each plot for growth, yield and quality parameters *viz*., vine length (cm), number of nodes per vine, internodal length (cm), number of secondary branches (lateral branches) per plant, node number at which first male flower appear, node number at which first female flower appear, days to first appearance of male flower, days to first appearance of female flower, sex ratio (m:f), days to first fruit harvest, number of fruits per vine, fruit length (cm), fruit diameter (cm), fruit volume (cc), average fruit weight (g), number of seeds per fruit, fruit yield per vine (kg), fruit yield per plot (kg), estimated yield per hectare (q), total soluble solids (^{0}B), vitamin - C (mg/100g). The values of F_1 averaged over two replications were used for estimating heterosis. The magnitude of heterosis was calculated as percentage increase or decrease of F_1 mean over the mean of better parent (BP) (Turner, 1953 and Hays *et al*. (1955) [22, 11] and per cent superiority over standard checks were calculated. The analysis of variance, for all the characters under study, was carried out by the method suggested by Panse and Sukhatme (1985) [16].

Results and Discussion

Analysis of variance for yield and yield component were presented in Table 1. In the analysis of mean squares the differences due to the treatments were significant for all the characters studied. The treatment means were further sub divided into parents, hybrids and parents versus hybrids. The parents showed significant difference for all the characters studied. The hybrids showed significant difference for all the characters studied. The parents versus hybrids showed significant differences for the characters vine length, internodal length, node number at which first female flower appear, days to first appearance of male flower, days to first appearance of female flower, sex ratio, days to first fruit harvest, number of fruits per vine, fruit length, fruit volume, average fruit weight, number of seeds per fruit and other characters are non significant.

Per cent average heterosis over mid parent, heterobeltiosis over better parent and standard heterosis in Table 2. For vine length, the average heterosis ranged from -68.30 to 122.42 per cent. The heterobeltiosis ranged from -72.61 to 109.13 per cent. Ten hybrids exhibited significant positive heterobeltiosis. The standard heterosis over check Arya F1 ranged from -70.49 to 81.08 per cent, while it ranged from -39.26 to 272.74 per cent over Warad. Similar results are reported by chaudhari *et al*. (2016) [3], Gautam *et al*. (2017) [7], shinde *et al*. (2018) [18] and Mishra *et al*. (2019) [15] in bottle gourd. For number of nodes per vine, the average heterosis ranged from -55.91 to 104.81 per cent. The heterobeltiosis ranged from -68.92 to 104.80 per cent. Seventeen hybrids exhibited significant positive heterobeltiosis. When compared to checks, Arya F1 and Warad, standard heterosis ranged from -44.45 to 158.89 per cent and -66.22 to 57.43 per cent respectively. Similar results are reported by Yadav *et al*. (2009) [23] in bitter gourd. For internodal length, the average heterosis ranged from -19.09 to 46.67 per cent. Heterobeltiosis ranged from -27.59 to 46.04 per cent. Seven hybrids exhibited significant negative heterobeltiosis. When compared to checks, Arya F1 and Warad, standard heterosis ranged from -26.89 to 41.05 per cent and from -50.73 to -4.94 per cent respectively. Similar results are reported by Chaudhari *et al*. (2016) [3] in bottle gourd.

For number of secondary branches per plant, the average heterosis ranged from -40.74 to 71.88 per cent. Heterobeltiosis ranged from -58.44 to 66.67 per cent. Four hybrids exhibited significant positive heterobeltiosis. When compared to checks, Arya F1 and Warad, standard heterosis ranged from -62.50 to 13.39 per cent and from -58.82 to 24.51 per cent respectively. These results are conformity with the findings of Arafin (2010) [2] in bottle gourd. For node number at which first male flower appear, the average heterosis ranged from -32.58 to 42.20 per cent. Heterobeltiosis ranged from -49.72 to 28.13 per cent. Twenty hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Arya F1 ranged from -27.62 to 20.95 per cent and over Warad ranged from -20.00 to 33.68 per cent. Similar results were reported by Singh *et al*. (2019) [21] in bottle gourd. For node number at which first female flower appear, the average heterosis ranged from -12.36 to 102.79 per cent. Heterobeltiosis ranged from -35.54 to 85.81 per cent. Fourteen hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Arya F1 ranged from 2.24 to 110.45 per cent and over Warad ranged from 30.48 to 168.57 per cent. Similar results were reported by Doloi *et al*. (2018) [6] and Mishra *et al*. (2019) [15] in bottle gourd.

For days to first appearance of male flower, average heterosis ranged from -18.64 to 19.73 per cent. Heterobeltiosis ranged from -27.52 to 19.73 per cent. Twenty eight hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Arya F1 ranged from -2.88 to 31.25 per cent and over Warad ranged from -5.16 to 28.17 per cent. Similar results were reported by Ray *et al*. (2015) [17], Gautam *et al*. (2017) [7] and Singh *et al*. (2019) [21] in bottle gourd. For days to first appearance of female flower, average heterosis ranged from -16.93 to 9.41 per cent. Heterobeltiosis ranged from -25.26 to 9.11 per cent. Thirty nine hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Arya F1 ranged from -8.50 to 33.42 per cent and over Warad ranged from -10.03 to 31.19 per cent. Similar results were reported by Ray *et al*. (2015) [17], Khot *et al*. (2018) [13] and Mishra *et al*. (2019) [15] in bottle gourd.

For sex ratio, the average heterosis ranged from -40.86 to 172.23 per cent. Heterobeltiosis ranged from -46.48 to 143.73 per cent. Nine hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Arya F1 ranged from -5.65 to 396.07 per cent and over Warad ranged from -38.98 to 220.85 per cent. These results are conformity with the findings of Malviya *et al*. (2017) [14], Khot *et al*. (2018) [13] in bottle gourd. For days to first fruit harvest, the average heterosis ranged from -13.68 to 4.98 per cent. Heterobeltiosis ranged from -19.27 to 2.49 per cent. Thirty two F1 hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Arya F1 ranged from -5.74 to 16.82 per cent and over Warad ranged from -1.20 to 22.44 per cent. Similar results were reported by Adarsh (2017) [1], Gautam *et al*. (2017) [7] and Mishra *et al*. (2019) [15] in bottle gourd.

For number of fruits per vine, the average heterosis ranged from -53.11 to 8.16 per cent and heterobeltiosis from -56.38 to -2.37 per cent. Standard heterosis over Arya F1 ranged from -62.10 to -13.35 per cent, over Warad it ranged from -60.79 to -10.35 per cent. Similar findings were reported by

Ghuge *et al*. (2016) [8], Doloi *et al*. (2017) [5] and Shinde *et al*. (2018) [18] in bottle gourd. For fruit length, the average heterosis ranged from -15.69 to 156.27 per cent. Sixteen hybrids exhibited significant positive heterobeltiosis and it ranges from -36.73 to 75.23 per cent. Standard heterosis over Arya F1 and Warad ranged from 84.04 to 441.55 per cent and from -58.35 to 22.56 per cent respectively. Similar significant positive standard heterosis was reported by Ghuge *et al*. (2016) [8], Doloi *et al*. (2017) [5] and Shinde *et al*. (2018) [18] in bottle gourd.

For fruit diameter, the average heterosis for fruit diameter varied from -40.08 to 40.48 per cent. Heterosis over better parent ranged from -57.66 to 34.88 per cent. Four hybrids registered significantly positive heterobeltiosis. Standard heterosis over Arya F1 ranged from -57.18 to 8.36 per cent and over Warad ranged from -12.77 to 141.52 per cent respectively. Similar findings were reported by Ghuge *et al*. (2016) [8] and Chittora *et al*. (2018) [4] in bottle gourd. For fruit volume, the average heterosis ranged from -40.78 to 22.67 per cent. Two hybrids exhibited significant positive heterobeltiosis and it ranges from -46.49 to 21.05 per cent. Standard heterosis over Arya F1 and Warad ranged from -29.89 to 58.62 per cent and from -41.35 to 32.69 per cent respectively. These results are conformity with the findings of Gopal (1992) [9] in watermelon.

For average fruit weight, Pusa Naveen x Punjab Bahar (140.66) exhibited maximum average heterosis for fruit weight. Heterobeltiosis ranged from -37.89 to 137.05 per cent. Thirty five hybrids showed significant positive heterobeltiosis. The standard heterosis ranged from 10.11 to 246.96 per cent over Arya F1, whereas it ranged from 4.47 to 229.17 per cent over Warad. Similar findings were reported by Ray *et al*. (2015) [17], Janaranjani *et al*. (2016) [12], Gautam *et al*. (2017) [7], Shinde *et al*. (2018) [18], Mishra *et al*. (2019) [15] in bottle gourd. For number of seeds per fruit, the average heterosis ranged from -38.91 to 92.98 per cent. Heterobeltiosis ranged from -41.98 to 83.20 per cent. Eleven hybrids registered significant positive heterosis over better parent. The standard heterosis over Arya F1 ranged from -21.97 to 121.65 per cent, over Warad ranged from 9.87 to 212.06 per cent. Similar findings reported by Janaranjani *et al*. (2016) [12] and Malviya *et al*. (2017) [14] in bottle gourd.

For fruit yield per vine, the average heterosis varied from -57.52 to 69.65 per cent. Heterobeltiosis ranged from -60.02 to 42.28 per cent. Ten hybrids expressed significant positive heterobeltiosis. The range of standard heterosis varied from -48.01 to 128.45 per cent and from -48.91 to 124.49 per cent over Arya F1 and Warad, respectively. Significant positive heterosis was reported by Ray *et al*. (2015) [17], Chaudhari *et al*. (2016) [3], Gautam *et al*. (2017) [7], Doloi *et al*. (2018) [6], Khot *et al*. (2018) [13], Shinde *et al*. (2018) [18] and Mishra *et al*. (2019) [15] in bottle gourd. For fruit yield per plot, the average heterosis varied from -57.54 to 69.70 per cent. Heterobeltiosis ranged from -60.06 to 42.26 per cent. Ten hybrids expressed significant positive heterobeltiosis. The range of standard heterosis varied from -48.01 to 128.60 per cent and from -48.92 to 124.61 per cent over Arya F1 and Warad, respectively. These results are conformity with the findings of Yadav *et al*. (2009) [23] in bottle gourd. For estimated yield per hectare, the average heterosis ranged from -57.54 to 69.70 per cent. For heterobeltiosis, the values varied from -60.06 to 42.25 per cent. Ten hybrids expressed significant positive heterobeltiosis. Standard heterosis ranged from -48.01 to 128.58 per cent and from -48.92 to 124.60 per cent over Arya F1 and Warad, respectively. Estimated yield per hectare is correlated with yield per vine. Similar positive heterosis was reported by Chaudhari *et al*. (2016) [3] in bottle gourd.

For total soluble solids (^{0} brix), the average heterosis ranged from -0.08 to 0.17 per cent. Heterobeltiosis ranged from -22.45 to -0.14 per cent. The standard heterosis over Arya F1 ranged from -37.92 to -1.18 per cent, over Warad ranged from -26.65 to 16.75 per cent. Similar findings were reported by Janaranjani *et al*. (2016) [12], Gautam *et al*. (2017) [7] and Doloi *et al*. (2018) [6] in bottle gourd. For Vitamin - C (mg 100g $^{-1}$), mid parental value ranged from -5.46 to 28.51 per cent. Heterobeltiosis ranged from -19.28 to 22.54 per cent. Only one hybrid registered significant positive heterobeltiosis. Standard heterosis over Arya F1 and Warad ranged from -19.16 to 16.73 per cent and from -29.57 to 1.7 per cent, respectively. The results are in conformation with Gautam *et al*. (2017) [7] in bottle gourd.

Table 1: Analysis of variance for growth, yield and yield attributing characters in 10x10 half diallel of bottle gourd

Source	d.f.	Vine length (cm)	Number of nodes per vine	Internodal length (cm)	Number of secondary branches (lateral branches) per plant	Node number at which first male flower appear	Node number at which first female flower appear	Days to first appearance of male flower
Mean Sum of Squares								
Treatments	54.00	138602.80**	821.69**	6.24**	1.69**	5.25**	30.33**	15.66**
Parents	9.00	14510.40**	1319.55**	9.60**	3.94**	17.64**	42.09**	26.67**
Hybrids	44.00	105580.20**	738.53**	5.18**	1.26**	2.83**	22.20**	12.95**
Parent Vs. Hybrid	1.00	8428.88**	0.02	22.53**	0.11	0.00	282.12**	35.95**
Error	54.00	887.11	7.73	1.27	0.26	0.21	1.21	0.62

* and ** Significance at 5% and 1% level respectively.

Source	d.f.	Days to first appearance of female flower	Sex ratio (m:f)	Days to first fruit harvest	Number of fruits per vine	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cc)
Mean Sum of Squares								
Treatments	54.00	16.41**	56.29**	14.47**	3.86**	366.76**	26.53**	357262.30**
Parents	9.00	20.82**	16.33**	20.87**	2.75**	540.31**	42.77**	255569.40**
Hybrids	44.00	13.73**	58.48**	12.19**	2.11**	293.97**	23.81**	377145.00**
Parent Vs. Hybrid	1.00	94.72**	319.26**	57.38**	90.90**	2007.53**	0.06	397658.40**
Error	54.00	0.36	1.26	0.90	0.24	5.88	0.70	12056.51

* and ** Significance at 5% and 1% level respectively.

Table 1: Analysis of variance for growth, yield and yield attributing characters in 10x10 half diallel of bottle gourd

Source	d.f.	Vine length (cm)	Number of nodes per vine	Internodal length (cm)	Number of secondary branches (lateral branches) per plant	Node number at which first male flower appear	Node number at which first female flower appear	Days to first appearance of male flower
Mean Sum of Squares								
Treatments	54.00	138602.80**	821.69**	6.24**	1.69**	5.25**	30.33**	15.66**
Parents	9.00	14510.40**	1319.55**	9.60**	3.94**	17.64**	42.09**	26.67**
Hybrids	44.00	105580.20**	738.53**	5.18**	1.26**	2.83**	22.20**	12.95**
Parent Vs. Hybrid	1.00	8428.88**	0.02	22.53**	0.11	0.00	282.12**	35.95**
Error	54.00	887.11	7.73	1.27	0.26	0.21	1.21	0.62

* and ** Significance at 5% and 1% level respectively.

Source	d.f.	Days to first appearance of female flower	Sex ratio (m:f)	Days to first fruit harvest	Number of fruits per vine	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cc)
Mean Sum of Squares								
Treatments	54.00	16.41**	56.29**	14.47**	3.86**	366.76**	26.53**	357262.30**
Parents	9.00	20.82**	16.33**	20.87**	2.75**	540.31**	42.77**	255569.40**
Hybrids	44.00	13.73**	58.48**	12.19**	2.11**	293.97**	23.81**	377145.00**
Parent Vs. Hybrid	1.00	94.72**	319.26**	57.38**	90.90**	2007.53**	0.06	397658.40**
Error	54.00	0.36	1.26	0.90	0.24	5.88	0.70	12056.51

* and ** Significance at 5% and 1% level respectively.

Source	d.f.	Average fruit weight (g)	Number of seeds per fruit	Fruit yield per vine (kg)	Fruit yield per plot (kg)	Estimated yield per hectare (q)	Total soluble solids (° B)	Vitamin-C (mg $100g^{-1}$)
Mean Sum of Squares								
Treatments	54.00	382129.50**	12408.39**	9.27**	333.89**	12717.69**	0.47**	1.20**
Parents	9.00	83605.44**	3569.02**	4.87**	175.36**	6680.30**	0.94**	2.92**
Hybrids	44.00	336818.30**	14481.55**	10.37**	373.84**	14239.10**	0.38**	0.88**
Parents Vs. Hybrid	1.00	5062538.00**	743.63**	0.08	2.93	112.00	0.00	0.00
Error	54.00	1163.39	99.04	0.57	20.86	508.67	0.00	0.01

* and ** Significance at 5% and 1% level respectively.

Table 2: Estimation of average heterosis, heterobeltiosis and standard heterosis for growth, yield and quality attributing characters in 10x 10 half diallel of bottle gourd.

Cross/ Pedigree	VL				NNPV				IL				NSBPP				NNMFA			
	AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH	
			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad
P1 X P2	41.45 **	20.94 **	-25.00 **	54.39 **	42.52 **	36.26 **	37.78 **	-16.22 **	8.96	-1.79	9.91	-25.93 **	36.30 **	33.33 *	-17.86	-9.8	25.13 **	24.48 **	13.81 **	25.79 **
P1 X P3	16.84 **	4.15	-35.41 **	32.95 **	49.99 **	44.94 **	43.33 **	-12.84 **	20.65 *	11.82	0.46	-32.30 **	28.00 *	14.29	-14.29	-5.88	24.18 **	18.95 **	7.62	18.95 **
P1 X P4	56.54 **	53.97 **	-4.52	96.54 **	51.69 **	42.11 **	50.01 **	-8.78 *	19.1	10.1	-1.08	-33.33 **	43.75 **	39.39 *	-17.86	-9.8	12.46 **	2.11	-7.62	2.11
P1 X P5	2.9	-7.06	-42.36 **	18.64 *	23.53 **	20.69 **	16.66 **	-29.05 **	10.23	-3.35	15.24	-22.33 **	42.86 **	36.36 *	-19.64 *	-11.76	11.63 *	1.05	-8.57	1.05
P1 X P6	94.66 **	48.51 **	-7.90 *	89.58 **	104.81 **	104.80 **	88.88 **	14.86 **	17.26	11.12	-0.17	-32.72 **	0.74	-1.45	-39.29 **	-33.33 **	21.05 **	21.05 **	9.52 *	21.05 **
P1 X P7	-46.28 **	-56.19 **	-56.95 **	-11.38	25.74 **	-3.25	65.56 **	0.68	17.62 *	5.6	19.23 *	-19.64 **	16.42	14.71	-30.36 **	-23.53 *	23.40 **	22.11 **	10.48 *	22.11 **

P1 X P8	-46.41 **	-60.19 **	-49.16 **	4.66	-39.35 **	-56.70 **	-6.66	-43.24 **	27.45 **	17.93	24.56 *	-16.05 *	2.94	0	-37.50 **	-31.37 **	1.04	0	-7.62	2.11
P1 X P9	-29.25 **	-52.12 **	-16.03 **	72.85 **	-12.79 **	-40.09 **	47.78 **	-10.13 **	22.05 **	4.49	31.81 **	-11.17	-1.82	-29.87 **	-3.57	5.88	-21.32 **	-39.55 **	1.9	12.63 *
P1 X P10	19.50 **	8.52	-32.70 **	38.53 **	20.65 **	9.9	23.33 **	-25.00 **	44.25 **	39.45 **	34.22 **	-9.54	71.88 **	66.67 **	-1.79	7.84	-3.6	-15.75 **	1.9	12.63 *
P2 X P3	55.82 **	48.59 **	-27.87 **	48.47 **	62.22 **	60.45 **	62.22 **	-1.35	11.43	-6.1	5.08	-29.18 **	1.96	-7.14	-30.36 **	-23.53 *	25.68 **	19.79 **	9.52 *	21.05 **
P2 X P4	-21.28 **	-31.74 **	-59.06 **	-15.73 *	-10.76 *	-12.64 *	-7.78	-43.92 **	18.85 *	-0.07	11.82	-24.64 **	29.77 *	23.19	-24.11 *	-16.67	21.04 **	9.37	0	10.53 *
P2 X P5	122.42 **	109.13 **	4.59	115.29 **	78.65 **	74.72 **	76.66 **	7.43	-4.61	-7.54	10.24	-25.70 **	11.63	4.35	-35.71 **	-29.41 **	42.20 **	28.13 **	17.14 **	29.47 **
P2 X P6	29.86 **	13.01	-50.24 **	2.44	32.19 **	26.37 **	27.77 **	-22.30 **	46.67 **	26.04 **	41.05 **	-4.94	21.74	21.74	-25.00 **	-17.65	20.42 **	19.79 **	9.52 *	21.05 **
P2 X P7	25.26 **	-9.31 **	-10.88 **	83.45 **	33.06 **	5.84	81.11 **	10.13 **	5.78	5.31	18.9	-19.87 **	25.55	24.64	-23.21 *	-15.69	23.81 **	21.87 **	11.43 *	23.16 **
P2 X P8	23.67 **	-48.68 **	-34.45 **	34.94 **	-22.81 **	-43.30 **	22.22 **	-25.68 **	-3.16	-5.88	5.33	-29.01 **	-10.79	-11.43	-44.64 **	-39.22 **	6.74	6.19	-1.9	8.42
P2 X P9	-38.17 **	-61.32 **	-32.16 **	39.63 **	-55.91 **	-68.92 **	-23.34 **	-53.38 **	-5.21	-10.56	12.82	-23.96 **	-33.63 **	-51.95 **	-33.93 **	-27.45 **	-30.40 **	-46.33 **	-9.52 *	0
P2 X P10	-3.38	-9.67	-54.27 **	-5.87	-25.00 **	-28.71 **	-20.00 **	-51.35 **	11.2	3.42	15.74	-22.00 **	-14.5	-18.84	-50.00 **	-45.10 **	-23.77 **	-33.07 **	-19.05 **	-10.53 *
P3 X P4	10.5	-0.04	-40.05 **	23.41 **	19.56 **	15.79 **	22.22 **	-25.68 **	46.43 **	46.04 **	11.99	-24.52 **	-23.29	-33.33 **	-50.00 **	-45.10 **	30.09 **	22.99 **	1.9	12.63 *
P3 X P5	26.55 **	24.69 **	-37.64 **	28.36 **	25.00 **	23.59 **	22.22 **	-25.68 **	-0.04	-17.88 *	-2.08	-34.01 **	-13.89	-26.19 *	-44.64 **	-39.22 **	30.49 **	22.99 **	1.9	12.63 *
P3 X P6	19.74 **	0.09	-51.41 **	0.01	36.05 **	31.46 **	30.00 **	-20.94 **	-6.94	-9.11	-26.89 **	-50.73 **	-21.57	-28.57 *	-46.43 **	-41.18 **	19.78 **	14.74 **	3.81	14.74 **
P3 X P7	-12.03 **	-34.29 **	-35.42 **	32.92 **	-31.69 **	-46.11 **	-7.78	-43.92 **	15.33	-3.17	9.33	-26.32 **	-2.63	-11.9	-33.93 **	-27.45 **	3.33	0	-11.43 *	-2.11
P3 X P8	-29.57 **	-51.40 **	-37.93 **	27.77 **	-48.41 **	-62.37 **	-18.89 **	-50.68 **	36.38 **	17.7	24.31 *	-16.22 *	-18.18	-25.00 *	-43.75 **	-38.24 **	11.96 **	6.19	-1.9	8.42
P3 X P9	-29.99 **	-55.31 **	-21.62 **	61.33 **	-53.70 **	-67.57 **	-20.00 **	-51.35 **	9.52	-11.95	11.07	-25.14 **	-36.13 **	-50.65 **	-32.14 **	-25.49 *	-32.58 **	-49.72 **	-15.24 **	-6.32
P3 X P10	90.37 **	86.46 **	-5.61	94.29 **	94.74 **	83.17 **	105.55 **	25.00 **	29.32 **	16.18	11.82	-24.64 **	-15.07	-26.19 *	-44.64 **	-39.22 **	-1.87	-17.32 **	0	10.53 *
P4 X P5	7.73	-1.22	-40.76 **	21.94 **	50.55 **	44.21 **	52.22 **	-7.43	0.34	-17.74 *	-1.92	-33.89 **	18.03	16.13	-35.71 **	-29.41 **	22.98 **	22.58 **	-9.52 *	0
P4 X P6	94.03 **	49.77 **	-10.18 **	84.89 **	39.33 **	30.53 **	37.78 **	-16.22 **	41.45 **	37.78 **	10.82	-25.31 **	-35.88 *	-39.13 *	-62.50 **	-58.82 **	-1.45	-10.53 *	-19.05 **	-10.53 *
P4 X P7	-28.59 **	-42.50 **	-43.50 **	16.31 *	-27.71 **	-41.56 **	0	-39.19 **	16.9	-2.06	10.57	-25.48 **	16.92	11.76	-32.14 **	-25.49 *	-4.99	-12.90 *	-22.86 **	-14.74 **
P4 X P8	-42.37 **	-57.66 **	-45.91 **	11.33	-14.88 **	-36.60 **	36.67 **	-16.89 **	17.65	1.3	6.99	-27.89 **	-6.06	-11.43	-44.64 **	-39.22 **	10.03 *	-1.03	-8.57	1.05
P4 X P9	-38.28 **	-58.59 **	-27.37 **	49.51 **	-33.76 **	-52.70 **	16.66 **	-29.05 **	-9.75	-27.59 **	-8.66	-38.44 **	-40.74 **	-58.44 **	-42.86 **	-37.25 **	-26.92 **	-47.46 **	-11.43 *	-2.11
P4 X P10	-3.44	-10.97	-46.60 **	9.92	4.09	1	13.34 *	-31.08 **	1.45	-9.08	-12.49	-41.02 **	29.03	29.03	-28.57 **	-21.57 *	-14.91 **	-31.50 **	-17.14 **	-8.42
P5 X P6	36.97 **	13.14	-43.42 **	16.47 *	55.29 **	51.72 **	46.66 **	-10.82 **	2.84	-13.9	2.66	-30.81 **	-13.18	-18.84	-50.00 **	-45.10 **	0	-9.47	-18.10 **	-9.47
P5 X P7	-15.96 **	-36.59 **	-37.69 **	28.26 **	-46.88 **	-58.44 **	-28.88 **	-56.75 **	-16.43 *	-18.65 *	-3	-34.62 **	12.5	5.88	-35.71 **	-29.41 **	23.53 **	12.90 *	0	10.53 *
P5 X P8	-18.03 **	-42.97 **	-27.16 **	49.94 **	21.71 **	-11.86 **	90.00 **	15.54 **	-9.42	-14.59	1.83	-31.37 **	10.77	2.86	-35.71 **	-29.41 **	-12.64 **	-21.65 **	-27.62 **	-20.00 **
P5 X P9	-43.94 **	-63.98 **	-36.82 **	30.04 **	-50.81 **	-65.77 **	-15.56 *	-48.65 **	-7.91	-10.43	12.99	-23.85 **	-28.97 **	-50.65 **	-32.14 **	-25.49 *	-27.56 **	-48.02 **	-12.38 **	-3.16
P5 X P10	-41.36 **	-41.71 **	-70.49 **	-39.26 **	-46.81 **	-50.50 **	-44.45 **	-66.22 **	-19.09 *	-26.89 **	-12.82	-41.25 **	0	-1.61	-45.54 **	-40.20 **	-4.9	-23.62 **	-7.62	2.11
P6 X P7	25.71 **	-16.28 **	-17.73 **	69.34 **	-2.96	-25.33 **	27.77 **	-22.30 **	23.94 **	6.12	19.82 *	-19.25 **	-0.73	-1.45	-39.29 **	-33.33 **	9.57 *	8.42	-1.9	8.42
P6 X P8	38.64 **	-12.98 **	11.14 **	128.78 **	34.30 **	-4.13	106.66 **	25.68 **	9.64	-3.43	2	-31.26 **	0.72	0	-37.50 **	-31.37 **	26.04 **	24.74 **	15.24 **	27.37 **
P6 X P9	-18.08 **	-51.42 **	-14.81 **	75.36 **	-18.03 **	-43.70 **	38.88 **	-15.54 **	-0.04	-18.15 *	3.25	-30.42 **	-13.9	-37.66 **	-14.29	-5.88	-6.62 *	-28.25 **	20.95 **	33.68 **
P6 X P10	122.32 **	82.77 **	-7.48 *	90.45 **	25.00 **	13.86 *	27.77 **	-22.30 **	15.27	5.8	1.83	-31.37 **	0.76	-4.35	-41.07 **	-35.29 **	-4.5	-16.54 **	0.95	11.58 *
P7 X P8	60.25 **	41.77 **	81.08 **	272.74 **	33.90 **	20.10 **	158.89 **	57.43 **	0.59	-2.65	9.91	-25.93 **	7.25	5.71	-33.93 **	-27.45 **	9.47 *	7.22	-0.95	9.47
P7 X P9	0.08	-21.92 **	36.94 **	181.87 **	3.19	-12.61 **	115.56 **	31.08 **	0.59	-4.69	20.23 *	-18.97 **	14.41	-17.53 *	13.39	24.51 *	-29.63 **	-46.33 **	-9.52 *	0
P7 X P10	-11.35 **	-32.84 **	-34.00 **	35.85 **	4.31	-13.64 **	47.78 **	-10.13 **	-1.83	-9.07	2.66	-30.81 **	-4.62	-8.82	-44.64 **	-39.22 **	-15.45 **	-26.77 **	-11.43 *	-2.11
P8 X P9	-68.30 **	-72.61 **	-51.96 **	-1.11	-48.56 **	-51.80 **	18.88 **	-27.71 **	-15.72 *	-22.57 **	-2.33	-34.18 **	-29.46 **	-48.70 **	-29.46 **	-22.55 *	-24.09 **	-41.24 **	-0.95	9.47
P8 X P10	-22.47 **	-45.87 **	-30.86 **	42.32 **	-40.34 **	-54.64 **	-2.23	-40.54 **	19.12 *	13.84	20.23 *	-18.97 **	3.03	-2.86	-39.29 **	-33.33 **	-15.18 **	-25.20 **	-9.52 *	0
P9 X P10	-32.47 **	-56.49 **	-23.69 **	57.07 **	-24.46 **	-45.04 **	35.56 **	-17.56 **	25.20 **	10.36	39.22 **	-6.17	-38.89 **	-57.14 **	-41.07 **	-35.29 **	-23.03 **	-33.90 **	11.43 *	23.16 **

* and ** Significance at 5% and 1% respectively.

P1= Pusa Naveen, P2= Pusa Samridhi, P3= Pusa Santhusti, P4= Pusa Sandesh, P5= Arka Bahar, P6= Kashi Ganga, P7= Punjab Bahar, P8= Pant Lauki-3, P9= Local Round, P10= Local Long. AH= average

heterosis, HB= heterobeltiosis, SH= standard heterosis. VL= Vine length (cm), NNPV= Number of nodes per vine, IL= Internodal length (cm), NSBPP= Number of secondary branches (lateral branches) per plant, NNFMFA= Node number at which first male flower appear.

Cross/ Pedigree	NNFFFA				DFAMF				DFAFF				SR				DFFH			
	AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH	
			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad
P1 X P2	34.75 **	28.23 **	18.66 *	51.43 **	-8.46 **	-11.02 **	-0.32	-2.66	-9.82 **	-9.93 **	-5.10 **	-6.68 **	55.60 **	35.75 **	93.80 **	25.35 *	-5.76 **	-6.53 **	-1.53	3.21
P1 X P3	18.30 *	13.01	3.73	32.38 **	-9.99 **	-11.02 **	-0.32	-2.66	-9.56 **	-11.76 **	-2.27	-3.90 *	20.88	4.85	51.72 **	-1.87	-3.04	-3.13	0.38	5.21 **
P1 X P4	21.24 *	20.18 *	2.24	30.48 **	2.84	-1.57	10.26 **	7.67 **	-3.08 *	-3.22	2.27	0.56	64.99 **	40.60 **	112.26 **	37.28 **	-1.23	-3.87 *	-0.38	4.41 *
P1 X P5	40.89 **	27.68 **	6.72	36.19 **	-2.99	-4.72 *	6.73 *	4.23	-1.43	-4.07 *	6.80 **	5.01 **	92.18 **	84.56 **	113.15 **	37.86 **	2.63	0.71	8.41 **	13.63 **
P1 X P6	55.08 **	47.58 **	36.57 **	74.29 **	-8.89 **	-10.15 **	3.53	1.1	-4.82 **	-7.59 **	3.4	1.67	172.23 **	143.73 **	227.82 **	112.03 **	-4.20 **	-6.96 **	2.29	7.21 **
P1 X P7	4.79	-18.41 **	22.39 **	56.19 **	-8.23 **	-11.44 **	-0.8	-3.13	-4.07 **	-6.41 **	3.67 *	1.94	106.91 **	69.43 **	182.51 **	82.72 **	-3.83 *	-4.80 **	-1.35	3.4
P1 X P8	14.88	6.92	3.73	32.38 **	-8.67 **	-10.30 **	0.48	-1.88	-4.05 **	-6.61 **	3.97 *	2.23	20.81 **	-13.71 *	114.12 **	38.49 **	-2.8	-4.62 **	2.68	7.61 **
P1 X P9	-3.95	-29.75 **	26.87 **	61.90 **	-18.64 **	-27.52 **	3.85	1.41	-9.47 **	-19.87 **	9.63 **	7.80 **	78.07 **	42.73 **	151.65 **	62.76 **	-8.59 **	-15.16 **	2.68	7.61 **
P1 X P10	41.54 **	24.32 **	37.31 **	75.24 **	-8.38 **	-10.01 **	0.8	-1.56	-12.35 **	-15.11 **	-4.53 *	-6.13 **	94.01 **	60.39 **	161.02 **	68.82 **	-8.56 **	-10.58 **	-3.06	1.6
P2 X P3	62.75 **	62.10 **	50.00 **	91.43 **	-3.5	-5.12 *	3.85	1.41	2.62	0	10.76 **	8.91 **	45.57 **	44.60 **	109.23 **	35.32 **	-0.92	-1.81	3.44	8.42 **
P2 X P4	68.07 **	61.29 **	49.25 **	90.48 **	-3	-4.55	0.96	-1.41	9.41 **	9.11 **	15.30 **	13.37 **	1.52	-1.23	49.10 **	-3.56	4.70 **	1.09	6.50 **	11.62 **
P2 X P5	102.79 **	75.81 **	62.69 **	107.62 **	-2.55	-3.56	4.17	1.72	6.54 **	3.56 *	15.30 **	13.37 **	54.19 **	39.46 **	99.10 **	28.78 **	3.59 *	2.49	10.32 **	15.63 **
P2 X P6	62.10 **	62.10 **	50.00 **	91.43 **	-1.52	-5.56 *	8.81 **	6.26 *	5.47 **	2.27	14.43 **	12.52 **	18.53	15.1	64.33 **	6.28	1.94	-0.18	9.74 **	15.02 **
P2 X P7	1.54	-17.91 **	23.13 **	57.14 **	-3.82	-4.55	0.96	-1.41	-5.25 **	-7.67 **	2.27	0.56	90.08 **	76.41 **	194.15 **	90.24 **	-7.39 **	-9.07 **	-4.21 *	0.4
P2 X P8	44.09 **	40.77 **	36.57 **	74.29 **	-2.25	-3.26	4.49	2.03	-7.34 **	-9.94 **	0.27	-1.41	-27.03 **	-42.52 **	42.63 **	-7.75	-5.93 **	-6.94 **	0.18	5.00 *
P2 X P9	-9.29	-31.40 **	23.88 **	58.10 **	-15.06 **	-26.17 **	5.77 *	3.29	-15.45 **	-25.26 **	2.27	0.56	-40.86 **	-46.48 **	-5.65	-38.98 **	-13.68 **	-19.27 **	-2.29	2.4
P2 X P10	10.29	1.35	11.94	42.86 **	-4.35 *	-5.34 *	2.24	-0.16	-7.03 **	-10.07 **	1.13	-0.56	1.85	-4.4	55.58 **	0.62	-3.94 **	-5.29 **	2.68	7.61 **
P3 X P4	24.89 **	20.33 *	10.45	40.95 **	-4.08	-7.17 **	1.6	-0.78	-7.07 **	-9.21 **	0.57	-1.11	-1.89	-3.92	45.04 **	-6.19	-4.17 **	-6.65 **	-3.44	1.2
P3 X P5	42.99 **	24.39 **	14.18	45.71 **	-1.25	-1.9	7.37 **	4.85	-5.87 **	-6.11 **	4.53 *	2.79	58.50 **	42.50 **	106.20 **	33.36 **	-2.35	-4.26 *	3.06	8.02 **
P3 X P6	19.03 *	18.55 *	9.7	40.00 **	-8.27 **	-10.57 **	3.04	0.63	-9.67 **	-10.13 **	0.57	-1.11	48.50 **	43.27 **	107.30 **	34.08 **	-5.91 **	-8.69 **	0.38	5.21 **
P3 X P7	9.26	-11.94 *	32.09 **	68.57 **	-6.38 **	-8.64 **	0	-2.35	-8.18 **	-8.18 **	1.7	0	40.69 **	31.39 **	119.08 **	41.69 **	-5.04 **	-5.91 **	-2.68	2
P3 X P8	40.71 **	36.92 **	32.84 **	69.52 **	-0.66	-1.32	8.01 **	5.48 *	-6.64 **	-6.88 **	3.67 *	1.94	-8.59	-27.64 **	79.55 **	16.12	-2.91	-4.80 **	2.48	7.40 **
P3 X P9	-3.56	-27.27 **	31.34 **	67.62 **	-16.04 **	-25.95 **	6.09 *	3.6	-16.93 **	-24.84 **	2.83	1.11	-23.71 **	-30.55 **	22.45	-20.80 *	-10.90 **	-17.38 **	0	4.81 *
P3 X P10	38.01 **	26.35 **	39.55 **	78.10 **	-3.32	-3.95	5.13 *	2.66	-8.37 **	-9.07 **	2.27	0.56	108.02 **	96.49 **	219.77 **	106.82 **	-4.15 **	-6.35 **	1.53	6.41**
P4 X P5	59.02 **	42.98 **	21.64 *	55.24 **	-1.9	-4.45	3.21	0.78	-6.27 **	-8.65 **	1.7	0	95.97 **	72.95 **	161.09 **	68.86 **	-1.67	-6.04 **	1.15	6.01**
P4 X P6	32.77 **	27.42 **	17.91 *	50.48 **	-10.75 **	-15.72 **	-2.88	-5.16 *	-15.88 **	-18.23 **	-8.50 **	-10.03 **	62.80 **	53.92 **	132.37 **	50.29 **	-9.37 **	-14.26 **	-5.74 **	-1.2
P4 X P7	2.22	-19.90 **	20.15 *	53.33 **	-3.18	-4	0	-2.35	-3.93 **	-6.14 **	3.97 *	2.23	9.21	4.05	73.48 **	12.2	-0.96	-2.64	-1.15	3.61
P4 X P8	38.52 **	30.00 **	26.12 **	60.95 **	-5.10 *	-7.57 **	-0.16	-2.5	-5.74 **	-8.14 **	2.27	0.56	-7.2	-25.37 **	85.19 **	19.78	0.56	-3.91 *	3.44	8.42**
P4 X P9	-12.36 *	-35.54 **	16.42	48.57 **	-6.85 **	-20.13 **	14.42 **	11.74 **	-13.78 **	-23.60 **	4.53 *	2.79	19.74 *	11.13	95.94 **	26.73 *	-9.42 **	-18.01 **	-0.76	4.01*
P4 X P10	67.18 **	47.97 **	63.43 **	108.57 **	1.45	-1.19	6.73 *	4.23	-4.43 **	-7.32 **	4.23 *	2.49	-4.02	-7.49	50.55 **	-2.63	-0.38	-5.12 **	2.86	7.80**
P5 X P6	73.95 **	50.81 **	39.55 **	78.10 **	-4.38 *	-7.37 **	6.73 *	4.23	-11.42 **	-11.64 **	-1.13	-2.79	134.77 **	118.18 **	193.46 **	89.80 **	-7.03 **	-8.00 **	1.15	6.01**
P5 X P7	18.49 **	-13.93 *	29.10 **	64.76 **	0.6	-1.19	6.73 *	4.23	-4.85 **	-5.09 **	5.66 **	3.90 *	30.36 **	10.33	83.95 **	18.98	1.1	-1.78	5.74 **	10.82**
P5 X P8	40.27 **	19.23 *	15.67	47.62 **	1.78	1.78	9.94 **	7.36 **	-8.65 **	-8.65 **	1.7	0	62.54 **	19.10 **	195.52 **	91.14 **	-4.26 **	-4.26 *	3.06	8.02**
P5 X P9	2.7	-29.34 **	27.61 **	62.86 **	-15.05 **	-25.50 **	6.73 *	4.23	-9.36 **	-17.80 **	12.46 **	10.58 **	1.39	-16.09	47.93 **	-4.32	-3.51 *	-8.85 **	10.32 **	15.63**
P5 X P10	71.55 **	38.51 **	52.99 **	95.24 **	19.73 **	19.73 **	29.33 **	26.29 **	-5.83 **	-6.31 **	5.37 **	3.61 *	-7.97	-21.33 *	28.03	-17.19	-2.31	-2.65	5.53 **	10.61**

P6 X P7	22.46 **	-1	48.51 **	89.52 **	-2.12	-6.82 **	7.37 **	4.85	-6.11 **	-6.58 **	4.53 *	2.79	51.81 **	37.13 **	128.65 **	47.88 **	-2.53	-6.26 **	3.06	8.02**
P6 X P8	87.40 **	83.08 **	77.61 **	126.67 **	-3.23	-6.26 **	8.01 **	5.48 *	-4.58 **	-4.82 **	6.50 **	4.72 **	86.75 **	43.99 **	257.30 **	131.09 **	-0.54	-1.57	8.21 **	13.42**
P6 X P9	54.10 **	16.53 **	110.45 **	168.57 **	1.55	-8.39 **	31.25 **	28.17 **	3.19 *	-6.21 **	28.32 **	26.18 **	-5.21	-16.45	47.31 **	-4.72	-1.82	-6.32 **	13.38 **	18.84**
P6 X P10	102.21 **	85.81 **	105.22 **	161.90 **	6.25 **	2.92	18.59 **	15.81 **	-5.81 **	-6.04 **	5.66 **	3.90 *	63.11 **	48.96 **	142.42 **	56.79 **	-3.15 *	-3.83 *	5.74 **	10.82**
P7 X P8	4.53	-13.93 *	29.10 **	64.76 **	-1.81	-3.56	4.17	1.72	-4.34 **	-4.58 **	6.23 **	4.46 *	139.14 **	99.92 **	396.07 **	220.85 **	-0.37	-3.2	4.21 *	9.22**
P7 X P9	-2.48	-10.74 *	61.19 **	105.71 **	3.37	-10.74 **	27.88 **	24.88 **	7.78 **	-2.48	33.42 **	31.19 **	81.13 **	76.21 **	210.67 **	100.94 **	4.98 **	-3.48 *	16.82 **	22.44**
P7 X P10	0.29	-12.94 *	30.60 **	66.67 **	-4.83 *	-6.53 **	0.96	-1.41	-2.79 *	-3.53 *	8.50 **	6.68 **	48.33 **	46.55 **	144.35 **	58.04 **	0.73	-2.47	5.74 **	10.82**
P8 X P9	20.43 **	-7.44	67.16 **	113.33 **	-15.31 **	-25.73 **	6.41 *	3.91	-16.66 **	-24.43 **	3.4	1.67	-26.76 **	-37.36 **	55.44 **	0.53	-7.19 **	-12.32 **	6.12 **	11.22**
P8 X P10	64.75 **	54.73 **	70.90 **	118.10 **	1.63	1.63	9.78 **	7.20 **	-4.56 **	-5.04 **	6.80 **	5.01 **	-18.81 **	-32.78 **	66.80 **	7.88	0.35	0	8.41 **	13.63**
P9 X P10	9.23	-11.98 *	58.96 **	102.86 **	1.79	-10.74 **	27.88 **	24.88 **	-12.74 **	-20.51 **	8.77 **	6.95 **	14.73	10.31	94.49 **	25.79 *	-9.34 **	-14.07 **	4.01 *	9.01**

* and ** Significance at 5% and 1% respectively.

P1= Pusa Naveen, P2= Pusa Samridhi, P3= Pusa Santhusti, P4= Pusa Sandesh, P5= Arka Bahar, P6= Kashi Ganga, P7= Punjab Bahar, P8= Pant Lauki-3, P9= Local Round, P10= Local Long. AH= average heterosis, HB= heterobeltiosis, SH= standard heterosis. NNFFFA= Node number at which first female flower appear, DFAMF= Days to first appearance of male flower, DFAFF= Days to first appearance of female flower, SR=Sex ratio (m:f), DFFH= Days to first fruit harvest.

Cross/ Pedigree	NFPV				FL				FD				FV				AFW			
	AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH	
			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad
P1 X P2	-20.74 **	-31.88 **	-39.55 **	-37.45 **	3.95	2.68	231.66 **	-24.94 **	36.88 **	22.19 *	-36.32 **	29.74 **	-11.33 **	-12.11 **	15.17 **	-3.65	43.50 **	34.09 **	103.31 **	92.88 **
P1 X P3	8.16	-2.37	-13.35 *	-10.35	34.03 **	14.53 *	269.96 **	-16.27 **	-4.47	-24.27 **	-47.05 **	7.87	-1.82	-3.57	24.14 **	3.85	-28.74 **	-37.89 **	10.11 *	4.47
P1 X P4	-32.49 **	-33.10 **	-40.63 **	-38.57 **	60.71 **	8.61	250.83 **	-20.60 **	-26.43 **	-47.27 **	-50.20 **	1.46	-21.10 **	-35.89 **	-17.47 **	-30.96 **	64.94 **	51.91 **	100.13 **	89.87 **
P1 X P5	-42.24 **	-46.03 **	-52.10 **	-50.44 **	63.85 **	47.77 **	377.32 **	8.03	19.48 *	12.15	-47.68 **	6.59	3.93	1.71	36.78 **	14.42 **	76.19 **	49.05 **	183.78 **	169.23 **
P1 X P6	-42.35 **	-46.67 **	-52.67 **	-51.03 **	27.67 **	16.07 **	358.15 **	3.69	40.48 **	34.88 **	-40.01 **	22.22 *	20.74 **	16.96 **	50.57 **	25.96 **	103.47 **	68.98 **	236.81 **	219.53 **
P1 X P7	-44.07 **	-45.39 **	-51.53 **	-49.85 **	45.27 **	-5.05	206.72 **	-30.58 **	-5.07	-34.68 **	-28.94 **	44.78 **	15.69 **	5.36	35.63 **	13.46 **	140.66 **	137.05 **	221.94 **	205.43 **
P1 X P8	-51.40 **	-54.99 **	-60.06 **	-58.67 **	-15.69 **	-30.11 **	243.13 **	-22.34 **	34.90 **	33.47 **	-44.19 **	13.7	4.83	-5	22.30 **	2.31	60.42 **	41.63 **	143.65 **	131.15 **
P1 X P9	-51.10 **	-56.38 **	-50.63 **	-48.91 **	2.24	-23.74 **	146.34 **	-44.25 **	-5.52	-33.65 **	-32.86 **	36.79 **	-23.72 **	-26.79 **	-5.75	-21.15 **	43.18 **	33.35 **	103.65 **	93.21 **
P1 X P10	-51.97 **	-53.84 **	-59.03 **	-57.61 **	14.34 **	11.87 *	261.36 **	-18.22 **	20.96 *	7.31	-43.27 **	15.57	0.45	0	28.74 **	7.69	94.26 **	83.13 **	172.47 **	158.50 **
P2 X P3	-4.83	-9.94	-35.63 **	-33.39 **	19.07 **	2.81	223.96 **	-26.68 **	1.64	-11.3	-37.98 **	26.36 **	-14.41 **	-16.67 **	9.2	-8.65 *	30.98 **	21.50 **	115.39 **	104.35 **
P2 X P4	-24.73 **	-34.81 **	-43.18 **	-41.21 **	76.64 **	20.16 **	278.60 **	-14.31 **	-31.46 **	-46.82 **	-49.77 **	2.33	-8.70 *	-26.32 **	-3.45	-19.23 **	63.47 **	41.53 **	114.60 **	103.59 **
P2 X P5	3.31	-5.6	-27.22 **	-24.69 **	24.43 **	13.47 *	257.55 **	-19.08 **	5.48	-0.05	-47.91 **	6.12	-3.9	-5.13	27.59 **	6.73	1.54	-8.80 **	73.64 **	64.73 **
P2 X P6	-3.79	-11.22	-33.01 **	-30.69 **	19.91 **	7.82	325.58 **	-3.68	-7.5	-14.28	-55.32 **	-8.98	-27.85 **	-30.70 **	-9.2	-24.04 **	22.84 **	8.14 **	115.54 **	104.49 **
P2 X P7	-31.37 **	-39.78 **	-49.09 **	-47.33 **	-3.77	-36.73 **	99.36 **	-54.88 **	34.69 **	-0.39	8.36	120.76 **	-40.78 **	-46.49 **	-29.89 **	-41.35 **	121.90 **	110.33 **	218.90 **	202.55 **
P2 X P8	6.68	-1.65	-25.63 **	-23.05 **	16.54 **	-4.34	369.66 **	6.29	4.51	-5.82	-50.92 **	0	-5.37	-14.91 **	11.49 *	-6.73	53.90 **	44.78 **	149.05 **	136.28 **
P2 X P9	-11.85 *	-31.07 **	-21.99 **	-19.28 **	36.70 **	2.81	223.96 **	-26.68 **	16.26 **	-11.93 *	-10.88 *	81.57 **	10.60 **	5.26	37.93 **	15.38 **	92.61 **	91.91 **	193.09 **	178.06 **
P2 X P10	-32.97 **	-40.35 **	-51.19 **	-49.50 **	43.74 **	42.36 **	348.57 **	1.52	10.74	9.96	-41.87 **	18.43	22.67 **	21.05 **	58.62 **	32.69 **	99.27 **	97.40 **	199.31 **	183.96 **
P3 X P4	-7.81	-16.10 *	-26.88 **	-24.34 **	30.90 **	-2.09	124.26 **	-49.24 **	20.56 **	4.91	-0.92	101.87 **	20.22 **	-0.93	22.99 **	2.88	59.83 **	29.92 **	130.33 **	118.51 **
P3 X P5	-30.71 **	-33.24 **	-48.52 **	-46.74 **	34.16 **	26.26 **	227.81 **	-25.81 **	5.28	-12.24	-38.64 **	25.01 *	-31.56 **	-34.19 **	-11.49 *	-25.96 **	16.36 **	12.36 **	113.92 **	102.95 **
P3 X P6	-26.76 **	-28.69 **	-46.19 **	-44.33 **	26.30 **	-0.2	293.92 **	-10.85 *	6.08	-13.22	-39.32 **	23.62 *	-7.51 *	-8.80 *	13.22 *	-5.29	36.39 **	28.85 **	156.82 **	143.65 **
P3 X P7	-50.47 **	-54.30 **	-61.36 **	-60.02 **	23.79 *	-11.29	103.21 **	-54.01 **	17.91 **	-3.16	5.35	114.64 **	-12.00 **	-18.52 **	1.15	-15.38 **	58.53 **	39.99 **	148.17 **	135.45 **
P3 X P8	-41.83 **	-43.43 **	-57.22 **	-55.73 **	7.3	-21.32 **	286.26 **	-12.58 **	13.99	-8.92	-36.32 **	29.74 **	4.52	-3.7	19.54 **	0	3.79	2.26	81.28 **	71.99 **
P3 X P9	-32.74 **	-45.13 **	-37.90 **	-35.74 **	17.61 *	-0.41	128.11 **	-48.37 **	15.00 **	-2.77	-1.6	100.47 **	1.42	-0.93	22.99 **	2.88	56.22 **	45.40 **	157.77 **	144.55 **
P3 X P10	-31.80 **	-36.11 **	-47.73 **	-45.91 **	22.19 **	6.37	228.75 **	-25.60 **	3.68	-8.96	-36.35 **	29.68 **	-26.03 **	-27.03 **	-6.9	-22.12 **	-0.95	-8.92 **	61.48 **	53.20 **
P4 X P5	-40.57 **	-44.00 **	-51.19 **	-49.50 **	95.19 **	40.29 **	264.23 **	-17.57 **	-22.19 **	-41.88 **	-45.11 **	11.84	-2.67	-22.22 **	4.6	-12.50 **	68.98 **	33.72 **	154.59 **	141.54 **

P4 X P6	-37.95 **	-42.11 **	-49.55 **	-47.80 **	46.71 **	-5.54	272.87 **	-15.61 **	-20.35 **	-41.42 **	-44.68 **	12.71	9.71 *	-8.57 *	10.34 *	-7.69	23.22 **	-4.1	91.15 **	81.35 **
P4 X P7	-39.44 **	-40.35 **	-48.01 **	-46.21 **	77.45 **	66.25 **	88.83 **	-57.26 **	3.45	-3.37	5.12	114.17 **	8.64	-4.35	1.15	-15.38 **	120.58 **	100.38 **	172.13 **	158.18 **
P4 X P8	-22.72 **	-27.84 **	-37.10 **	-34.92 **	30.32 **	-19.76 **	293.92 **	-10.85 *	-33.08 **	-51.73 **	-54.41 **	-7.11	-4.35	-15.38 **	-11.49 *	-25.96 **	80.43 **	48.39 **	155.27 **	142.18 **
P4 X P9	-47.93 **	-53.92 **	-47.84 **	-46.03 **	35.10 **	15.84	84.04 **	-58.35 **	-2.02	-5.29	-4.15	95.28 **	16.76 **	-1.94	16.09 **	-2.88	8.56 **	-6.30 *	43.11 **	35.77 **
P4 X P10	-21.59 **	-23.99 **	-33.75 **	-31.45 **	156.27 **	75.23 **	441.55 **	22.56 **	-5.69	-26.45 **	-30.54 **	41.52 **	18.23 **	-3.6	22.99 **	2.88	24.25 **	8.45 **	61.35 **	53.08 **
P5 X P6	-44.80 **	-45.39 **	-57.90 **	-56.44 **	34.76 **	11.70 *	340.91 **	-0.21	2.14	-0.25	-53.46 **	-5.19	-12.61 **	-17.09 **	11.49 *	-6.73	0.11	-2.13	95.07 **	85.06 **
P5 X P7	-53.11 **	-55.17 **	-62.10 **	-60.79 **	108.85 **	44.35 **	274.75 **	-15.18 **	-25.21 **	-46.57 **	-41.87 **	18.43	11.96 **	0	34.48 **	12.50 **	101.46 **	72.58 **	228.58 **	211.73 **
P5 X P8	-31.55 **	-32.20 **	-47.73 **	-45.91 **	6.5	-18.59 **	299.66 **	-9.55 *	13.56	7.67	-49.77 **	2.33	-22.12 **	-30.77 **	-6.9	-22.12 **	27.44 **	21.30 **	130.93 **	119.09 **
P5 X P9	-43.74 **	-52.71 **	-46.48 **	-44.62 **	41.55 **	14.08	196.19 **	-32.97 **	3.64	-24.29 **	-23.38 **	56.09 **	-10.00 **	-15.38 **	13.79 **	-4.81	43.35 **	29.17 **	145.92 **	133.31 **
P5 X P10	-42.44 **	-44.10 **	-54.26 **	-52.67 **	65.18 **	51.97 **	369.66 **	6.29	-1.81	-7.58	-51.14 **	-0.47	-22.81 **	-24.79 **	1.15	-15.38 **	68.37 **	49.98 **	185.54 **	170.90 **
P6 X P7	-39.77 **	-43.01 **	-51.82 **	-50.15 **	30.79 **	-18.16 **	223.02 **	-26.89 **	-20.22 **	-43.80 **	-38.87 **	24.55 *	1.52	-4.76	14.94 **	-3.85	21.82 **	2.41	104.12 **	93.65 **
P6 X P8	-38.40 **	-38.47 **	-53.47 **	-51.85 **	10.60 **	-0.24	389.77 **	10.85 *	-0.76	-3.73	-57.18 **	-12.77	-34.69 **	-39.05 **	-26.44 **	-38.46 **	18.02 **	9.94 **	119.12 **	107.88 **
P6 X P9	-15.06 **	-29.22 **	-19.89 **	-17.11 **	-7.54	-35.16 **	155.92 **	-42.08 **	-1.81	-29.33 **	-28.48 **	45.71 **	-26.92 **	-27.62 **	-12.64 *	-26.92 **	25.98 **	11.26 **	121.76 **	110.38 **
P6 X P10	-42.27 **	-44.51 **	-54.60 **	-53.03 **	36.46 **	21.65 **	380.19 **	8.68 *	0.38	-7.58	-51.14 **	-0.47	-24.07 **	-26.13 **	-5.75	-21.15 **	37.57 **	20.13 **	139.44 **	127.17 **
P7 X P8	-47.57 **	-50.34 **	-58.01 **	-56.55 **	14.97 **	-30.89 **	239.28 **	-23.21 **	-37.29 **	-56.59 **	-52.78 **	-3.79	-30.05 **	-30.43 **	-26.44 **	-38.46 **	-19.50 **	-27.97 **	23.91 **	17.55 **
P7 X P9	-43.79 **	-50.90 **	-44.43 **	-42.50 **	62.66 **	32.14 **	109.92 **	-52.49 **	12.91 **	8.97 *	18.55 **	141.52 **	9.74 *	3.88	22.99 **	2.88	40.12 **	32.36 **	102.15 **	91.78 **
P7 X P10	-38.80 **	-39.78 **	-49.09 **	-47.33 **	53.51 **	1.4	213.40 **	-29.07 **	-22.34 **	-42.30 **	-37.24 **	27.87 **	4.43	-4.5	21.84 **	1.92	45.16 **	38.83 **	106.55 **	95.96 **
P8 X P9	-29.28 **	-41.01 **	-33.24 **	-30.92 **	20.66 **	-20.15 **	292.04 **	-11.27 **	-40.08 **	-57.66 **	-57.16 **	-12.71	-10.31 *	-15.53 **	0	-16.35 **	58.33 **	49.44 **	157.08 **	143.90 **
P8 X P10	-32.44 **	-35.00 **	-46.82 **	-44.97 **	24.60 **	1.52	398.42 **	12.80 **	9.55	-1.89	-48.14 **	5.66	8.91 *	-0.9	26.44 **	5.77	116.30 **	101.69 **	246.96 **	229.17 **
P9 X P10	-39.04 **	-47.49 **	-40.57 **	-38.51 **	22.90 **	-6.96	187.55 **	-34.92 **	-4.14	-27.04 **	-26.16 **	50.44 **	-16.82 **	-19.82 **	2.3	-14.42 **	5.68 *	4.32	59.32 **	51.15 **

* and ** Significance at 5% and 1% respectively.

P1= Pusa Naveen, P2= Pusa Samridhi, P3= Pusa Santhusti, P4= Pusa Sandesh, P5= Arka Bahar, P6= Kashi Ganga, P7= Punjab Bahar, P8= Pant Lauki-3, P9= Local Round, P10= Local Long. AH= average heterosis, HB= heterobeltiosis, SH= standard heterosis. DFFH= Days to first fruit harvest, NFPV= Number of fruits per vine, FL= Fruit length (cm), FD= Fruit diameter (cm), FV= Fruit volume (cc), AFW= Average fruit weight (g).

Cross/ Pedigree	NSPF				FYPV				FYPP				EYPH				TSS			
	AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH		AH	HB	SH	
			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad			Arya F1	Warad
P1 X P2	59.44 **	46.43 **	90.25 **	167.86 **	15.17	5.19	22.85	20.72	15.07	5.11	22.86	20.72	15.08	5.11	22.86 *	20.72 *	0	-15.83 **	-25.78 **	-12.31 **
P1 X P3	-35.83 **	-41.98 **	-21.97 **	9.87	-21.55 *	-24.59 *	-4.52	-6.18	-21.64 *	-24.69 **	-4.55	-6.22	-21.64 **	-24.68 **	-4.56	-6.22	0.08	-9.86 **	-32.22 **	-19.92 **
P1 X P4	34.44 **	25.43 **	57.48 **	121.72 **	11.14	1.58	18.63	16.58	11.11	1.51	18.65	16.58	11.12	1.52	18.65	16.59	0.17	-4.52 *	-36.52 **	-25.00 **
P1 X P5	18.74 **	-0.6	60.26 **	125.64 **	3.08	-7.42	35.81 **	33.46 **	3.09	-7.4	35.90 **	33.53 **	3.09	-7.4	35.89 **	33.52 **	-0.08	-6.25 **	-35.55 **	-23.86 **
P1 X P6	68.20 **	53.53 **	102.18 **	184.66 **	19.27 *	5.97	59.28 **	56.52 **	19.25 *	5.97	59.37 **	56.58 **	19.26 **	5.97	59.36 **	56.58 **	0	-15.07 **	-26.75 **	-13.45 **
P1 X P7	92.98 **	83.20 **	121.65 **	212.06 **	34.75 **	33.55 **	55.98 **	53.28 **	34.71 **	33.47 **	56.02 **	53.29 **	34.71 **	33.48 **	56.01 **	53.29 **	-0.08	-9.89 **	-32.44 **	-20.18 **
P1 X P8	3.88	-9.60 **	32.72 **	86.87 **	-21.28 *	-25.29 **	-2.84	-4.52	-21.28 *	-25.29 **	-2.76	-4.46	-21.28 **	-25.30 **	-2.77	-4.47	0	-14.27 **	-27.71 **	-14.59 **
P1 X P9	19.45 **	14.50 **	35.73 **	91.09 **	-30.61 **	-41.86 **	0.46	-1.28	-30.57 **	-41.80 **	0.55	-1.21	-30.58 **	-41.81 **	0.53	-1.22	0.06	-22.45 **	-15.04 **	0.38
P1 X P10	2.48	-7.26 **	24.50 **	75.29 **	-6.5	-8.38	11.5	9.57	-6.53	-8.4	11.53	9.59	-6.53	-8.4	11.53	9.59	0	-2.86	-37.92 **	-26.65 **
P2 X P3	-12.35 **	-13.84 **	15.89 **	63.16 **	24.12 *	9.39	38.50 **	36.10 **	24.02 *	9.3	38.52 **	36.11 **	24.02 **	9.3	38.51 **	36.10 **	-0.07	-7.43 **	-18.37 **	-3.55 *
P2 X P4	-6.65 **	-8.23 **	19.24 **	67.89 **	30.00 **	29.90 *	25.61 *	23.44 *	30.02 **	29.99 *	25.69 *	23.49 *	30.02 **	29.99 **	25.68 **	23.49 *	0	-12.30 **	-22.66 **	-8.63 **
P2 X P5	0.94	-8.86 **	46.95 **	106.89 **	3.78	-13.96	26.23 *	24.04 *	3.8	-13.92	26.33 *	24.12 *	3.79	-13.93 *	26.31 **	24.11 *	0.07	-10.96 **	-21.48 **	-7.23 **
P2 X P6	-3.48	-4.13	26.26 **	77.76 **	16.81 *	-4.08	44.17 **	41.67 **	16.80 *	-4.07	44.27 **	41.75 **	16.80 *	-4.07	44.25 **	41.74 **	0	-1.1	-12.78 **	3.05
P2 X P7	20.20 **	16.07 **	50.80 **	112.32 **	53.47 **	41.31 **	62.12 **	59.31 **	53.45 **	41.35 **	62.19 **	59.36 **	53.44 **	41.33 **	62.17 **	59.34 **	0.07	-7.43 **	-18.37 **	-3.55 *

P2 X P8	8.86 **	2.6	50.63 **	112.08 **	63.32 **	42.28 **	85.05 **	81.84 **	63.28 **	42.26 **	85.16 **	81.92 **	63.27 **	42.25 **	85.14 **	81.92 **	0	-2.19	-13.75 **	1.9
P2 X P9	41.15 **	34.96 **	75.36 **	146.90 **	69.65 **	32.22 **	128.45 **	124.49 **	69.70 **	32.32 **	128.60 **	124.61 **	69.70 **	32.32 **	128.58 **	124.60 **	-0.05	-9.80 **	-1.18	16.75 **
P2 X P10	-8.79 **	-10.26 **	20.48 **	69.63 **	33.80 **	19.97 *	46.01 **	43.48 **	33.75 **	19.96 *	46.07 **	43.52 **	33.76 **	19.96 *	46.06 **	43.52 **	0	-13.76 **	-23.95 **	-10.15 **
P3 X P4	-11.66 **	-14.60 **	14.86 **	61.71 **	50.69 **	32.89 **	68.25 **	65.34 **	50.69 **	32.83 **	68.34 **	65.40 **	50.70 **	32.84 **	68.33 **	65.40 **	0.08	-5.71 **	-29.11 **	-16.24 **
P3 X P5	-8.27 **	-15.87 **	35.64 **	90.97 **	-19.53 *	-25.04 **	9.97	8.06	-19.56 *	-25.05 **	10	8.08	-19.55 **	-25.04 **	10	8.09	0.15	-4.14 *	-27.93 **	-14.85 **
P3 X P6	-22.40 **	-23.21 **	3.28	45.41 **	-0.19	-8.06	38.19 **	35.80 **	-0.25	-8.09	38.22 **	35.80 **	-0.24	-8.09	38.21 **	35.80 **	-0.07	-6.48 **	-19.33 **	-4.70 **
P3 X P7	-28.21 **	-31.81 **	-8.29 *	29.12 **	-20.50 *	-24.23 *	-4.06	-5.73	-20.54 *	-24.30 *	-4.07	-5.74	-20.55 **	-24.30 **	-4.07	-5.75	0	-0.14	-24.92 **	-11.29 **
P3 X P8	-38.91 **	-41.47 **	-14.08 **	20.98 **	-39.59 **	-40.39 **	-22.47	-23.81 *	-39.65 **	-40.45 **	-22.49	-23.84 *	-39.65 **	-40.44 **	-22.49 *	-23.84 *	-0.07	-5.48 **	-20.30 **	-5.84 **
P3 X P9	15.18 **	8.34 **	45.72 **	105.16 **	6.81	-7.46	59.89 **	57.12 **	6.78	-7.45	59.90 **	57.11 **	6.78	-7.45	59.89 **	57.10 **	0	-15.69 **	-7.63 **	9.14 **
P3 X P10	-7.35 **	-7.43 **	24.50 **	75.29 **	-32.12 **	-33.43 **	-15.72	-17.18	-32.13 **	-33.46 **	-15.68	-17.15	-32.13 **	-33.46 **	-15.68	-17.15	-0.08	-7.57 **	-30.50 **	-17.89 **
P4 X P5	-1.56	-12.45 **	41.16 **	98.75 **	2.02	-15.37	24.16 *	22	2.08	-15.33	24.26 *	22.09	2.08	-15.34 *	24.24 *	22.08 *	-0.08	-1.72	-32.44 **	-20.18 **
P4 X P6	1.83	-0.54	30.98 **	84.41 **	-22.01 **	-35.92 **	-3.68	-5.35	-22.02 **	-35.95 **	-3.67	-5.35	-22.02 **	-35.94 **	-3.67	-5.35	0	-11.46 **	-23.63 **	-9.77 **
P4 X P7	-18.63 **	-20.11 **	0.3	41.22 **	33.84 **	23.33 *	41.49 **	39.04 **	33.85 **	23.32 *	41.50 **	39.03 **	33.85 **	23.31 **	41.49 **	39.02 **	-0.08	-5.73 **	-29.32 **	-16.50 **
P4 X P8	1.34	-6.00 *	38.00 **	94.30 **	41.43 **	23.29 *	60.35 **	57.57 **	41.41 **	23.23 *	60.39 **	57.59 **	41.40 **	23.22 **	60.37 **	57.58 **	0	-10.57 **	-24.60 **	-10.91 **
P4 X P9	-19.54 **	-21.79 **	-1.8	38.26 **	-44.62 **	-56.81 **	-25.38 *	-26.68 *	-44.65 **	-56.84 **	-25.43 *	-26.73 *	-44.65 **	-56.84 **	-25.43 **	-26.73 **	0.06	-19.61 **	-11.92 **	4.06 *
P4 X P10	6.77 **	3.31	38.70 **	95.28 **	-2.18	-12.22	6.83	4.97	-2.14	-12.21	6.89	5.03	-2.14	-12.21	6.88	5.02	0	-1.94	-34.80 **	-22.97 **
P5 X P6	-7.96 **	-16.39 **	34.80 **	89.79 **	-44.75 **	-45.41 **	-17.94	-19.37	-44.76 **	-45.43 **	-17.93	-19.36	-44.76 **	-45.43 **	-17.93	-19.36 *	0.07	-10.09 **	-22.45 **	-8.38 **
P5 X P7	6.63 **	-6.68 **	50.46 **	111.83 **	-4.9	-15.26	24.31 *	22.16	-4.87	-15.25	24.38 *	22.21	-4.87	-15.25 *	24.38 *	22.21 *	0	-4.15 *	-28.14 **	-15.10 **
P5 X P8	-31.80 **	-34.85 **	5.04	47.89 **	-12.94	-17.88 *	20.48	18.39	-12.9	-17.83 *	20.6	18.49	-12.90 *	-17.83 **	20.59 *	18.49	0.07	-9.17 **	-23.42 **	-9.52 **
P5 X P9	3.92	-9.84 **	45.37 **	104.67 **	-17.71 **	-23.92 **	31.44 **	29.16 *	-17.68 **	-23.88 **	31.52 **	29.22 *	-17.68 **	-23.88 **	31.50 **	29.21 **	0.12	-18.53 **	-10.74 **	5.46 **
P5 X P10	-9.44 **	-17.02 **	33.79 **	88.37 **	-2.74	-11.03	30.52 *	28.26 *	-2.76	-11.04	30.56 *	28.28 *	-2.75	-11.04	30.56 **	28.28 **	0.08	-3.44	-33.62 **	-21.57 **
P6 X P7	32.69 **	27.30 **	67.64 **	136.03 **	-25.93 **	-34.69 **	-1.84	-3.54	-25.91 **	-34.69 **	-1.78	-3.49	-25.91 **	-34.69 **	-1.79	-3.5	0.07	-6.48 **	-19.33 **	-4.70 **
P6 X P8	-23.19 **	-27.14 **	6.97	50.60 **	-27.35 **	-32.24 **	1.84	0.08	-27.32 **	-32.21 **	1.94	0.16	-27.33 **	-32.22 **	1.93	0.16	0	-1.12	-14.72 **	0.76
P6 X P9	34.13 **	27.43 **	67.81 **	136.27 **	9.85	2.71	77.45 **	74.38 **	9.86	2.75	77.51 **	74.41 **	9.86	2.74	77.49 **	74.40 **	-0.05	-10.69 **	-2.15	15.61 **
P6 X P10	12.36 **	11.29 **	49.40 **	110.35 **	-24.27 **	-31.48 **	2.99	1.21	-24.28 **	-31.49 **	3.03	1.23	-24.29 **	-31.49 **	3.02	1.23	0	-12.95 **	-24.92 **	-11.29 **
P7 X P8	-26.53 **	-32.99 **	-1.63	38.50 **	-57.52 **	-60.02 **	-48.01 **	-48.91 **	-57.54 **	-60.06 **	-48.01 **	-48.92 **	-57.54 **	-60.06 **	-48.01 **	-48.92 **	0.07	-5.48 **	-20.30 **	-5.84 **
P7 X P9	-19.47 **	-20.29 **	-3.56	35.79 **	-21.95 **	-35.06 **	12.19	10.25	-21.92 **	-35.03 **	12.25	10.29	-21.92 **	-35.03 **	12.24	10.29	0	-15.78 **	-7.73 **	9.01 **
P7 X P10	5.94 *	0.7	35.20 **	90.35 **	-11.19	-13.74	4.98	3.17	-11.16	-13.72	5.05	3.22	-11.17	-13.73	5.04	3.21	0.08	-7.31 **	-30.50 **	-17.89 **
P8 X P9	-5.50 *	-14.60 **	25.38 **	76.52 **	13.19	-0.8	71.40 **	68.43 **	13.22	-0.75	71.47 **	68.48 **	13.22 *	-0.74	71.47 **	68.49 **	-0.06	-11.57 **	-3.11 *	14.47 **
P8 X P10	-17.65 **	-21.17 **	15.73 **	62.95 **	46.39 **	41.69 **	84.28 **	81.09 **	46.37 **	41.65 **	84.36 **	81.14 **	46.37 **	41.65 **	84.35 **	81.14 **	0.14	-11.97 **	-25.78 **	-12.31 **
P9 X P10	-3.98	-9.60 **	21.36 **	70.87 **	-35.73 **	-45.23 **	-5.37	-7.01	-35.73 **	-45.22 **	-5.36	-7.01	-35.73 **	-45.22 **	-5.36	-7.01	0.06	-20.78 **	-13.21 **	2.54

* and ** Significance at 5% and 1% respectively.

P1= Pusa Naveen, P2= Pusa Samridhi, P3= Pusa Santhusti, P4= Pusa Sandesh, P5= Arka Bahar, P6= Kashi Ganga, P7= Punjab Bahar, P8= Pant Lauki-3, P9= Local Round, P10= Local Long. AH= average heterosis, HB= heterobeltiosis, SH= standard heterosis. NSPF= Number of seeds per fruit, FYPV= Fruit yield per vine (kg), FYPP= Fruit yield per plot (kg), EYPH= Estimated yield per hectare (q), TSS= Total soluble solids (°B).

Table 2: Cont…

Cross/ Pedigree	Vit-C			
	AH	HB	SH	
			Arya F1	Warad
P1 X P2	0.03	-13.02 **	-7.79 **	-19.66 **
P1 X P3	28.51 **	22.54 **	5.84 **	-7.79 **
P1 X P4	0.04	-2.92	-19.16 **	-29.57 **
P1 X P5	-0.03	-19.28 **	2.86 *	-10.39 **
P1 X P6	0.03	-10.14 **	-11.62 **	-23.00 **
P1 X P7	0.00	-14.10 **	-6.27 **	-18.34 **
P1 X P8	-0.03	-11.72 **	-9.73 **	-21.36 **
P1 X P9	0.03	-14.61 **	-5.41 **	-17.59 **
P1 X P10	-0.03	-9.04 **	-13.08 **	-24.27 **
P2 X P3	0.03	-9.24 **	-3.77 **	-16.16 **
P2 X P4	0.00	-10.73 **	-5.35 **	-17.54 **
P2 X P5	0.00	-8.40 **	16.73 **	1.70
P2 X P6	0.00	-3.61 **	2.19	-10.97 **
P2 X P7	0.03	-1.39	7.60 **	-6.25 **
P2 X P8	0.00	-1.78	4.14 **	-9.27 **
P2 X P9	0.00	-2.14	8.39 **	-5.56 **
P2 X P10	-0.06	-4.99 **	0.73	-12.24 **
P3 X P4	0.04	-1.76	-15.15 **	-26.07 **
P3 X P5	0.03	-16.09 **	6.93 **	-6.84 **
P3 X P6	-0.03	-6.12 **	-7.66 **	-19.55 **
P3 X P7	0.00	-10.42 **	-2.25	-14.84 **
P3 X P8	0.03	-7.73 **	-5.66 **	-17.81 **
P3 X P9	-0.03	-11.04 **	-1.46	-14.15 **
P3 X P10	-0.03	-4.84 **	-9.06 **	-20.77 **
P4 X P5	0.00	-17.33 **	5.35 **	-8.21 **
P4 X P6	0.00	-7.67 **	-9.18 **	-20.88 **
P4 X P7	0.03	-11.82 **	-3.77 **	-16.16 **
P4 X P8	0.00	-9.28 **	-7.24 **	-19.18 **
P4 X P9	0.00	-12.41 **	-2.98 *	-15.47 **
P4 X P10	-0.07	-6.49 **	-10.64 **	-22.15 **
P5 X P6	-5.39 **	-16.18 **	6.81 **	-6.94 **
P5 X P7	-5.17 **	-11.98 **	12.17 **	-2.28
P5 X P8	-5.30 **	-14.65 **	8.76 **	-5.25 **
P5 X P9	-5.11 **	-11.31 **	13.02 **	-1.54
P5 X P10	-5.46 **	-17.28 **	5.41 **	-8.16 **
P6 X P7	-0.03	-4.96 **	3.71 **	-9.64 **
P6 X P8	0.00	-1.90	0.30	-12.61 **
P6 X P9	0.00	-5.60 **	4.56 **	-8.90 **
P6 X P10	-0.06	-1.48	-3.10 *	-15.58 **
P7 X P8	0.03	-3.12 *	5.72 **	-7.90 **
P7 X P9	-0.03	-0.77	9.91 **	-4.24 **
P7 X P10	-0.03	-6.24 **	2.31	-10.86 **
P8 X P9	0.00	-3.84 **	6.51 **	-7.21 **
P8 X P10	-0.06	-3.33 *	-1.16	-13.88 **
P9 X P10	0.00	-6.86 **	3.16 *	-10.12 **

* and ** Significance at 5% and 1% respectively.

P1= Pusa Naveen, P2= Pusa Samridhi, P3= Pusa Santhusti, P4= Pusa Sandesh, P5= Arka Bahar, P6= Kashi Ganga, P7= Punjab Bahar, P8= Pant Lauki-3, P9= Local Round, P10= Local Long. AH= average heterosis, HB= heterobeltiosis, SH= standard heterosis. Vit-C= Vitamin –C (mg $100g^{-1}$).

Conclusion

The present investigation reveals that the cross combinations combinations *viz.*, Pusa Samridhi × Local Round, Pusa Samridhi × Pant Lauki-3, Pant Lauki-3 × Local Long and Kashi Ganga × Local Round were identified as promising for fruit yield per vine.

References

1. Adarsh A, Kumar R, Kumar A, Neetunand, Singh HK. Estimation of gene action and heterosis in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). Environment & Ecology. 2017;35(2A):936-44.
2. Arafin MSU. Variability and heterosis in bottle gourd. M. Sc. (Genetics and Plant Breeding) Thesis, Bangabandhu Sheik Mujibur Rahman Agricultural University, Bangladesh; c2010.
3. Chaudhari GV, Nagare PK, Sawant SN, Potdukhe NR. Heterosis in bottle gourd. Advances in Life Sciences. 2016;5(24):11235-39.
4. Chittora A, Kaushik RA, Ameta KD, Dubey RB, Dhakar, R. Heterosis in ridge gourd (*Luffa acutangula* L. Roxb.) for fruit yield and quality traits. Electronic Journal of Plant Breeding. 2018;9(4):1428-35.
5. Doloi N, Patel JN, Acharya RR. Heterosis studies in

bottle gourd [*Lagenaria siceraria* (Mol) Standl.]. Vegetos. 2018;31(1):1-3.
6. Doloi N, Patel JN, Patel NJ. Heterosis for fruit yield and its component traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Vegetable Science. 2017;44(2):107-09.
7. Gautam DK, Yadav GC, Kumar P, Kumar V, Singh M. Estimation of heterosis for growth, yield and quality traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. International Journal of Current Microbiology and Applied Sciences. 2017;6(8):789-802.
8. Ghuge MB, Syamal MM, Karcho S. Heterosis in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Indian Journal of Agricultural Research. 2016;50(5):466-470.
9. Gopal YH. Heterosis in watermelon (*Citrullus lanatus* (Thunb.) Mansf.). M. Sc. (Agri.) Thesis, Andhra pradesh Agricultural University, Rajendranagar; c1992.
10. Hassan LG, Sani NA, Dangoggo SM, Ladan MJ. Nutritional value of bottle gourd (*Lagenaria Siceraria*) Seeds. Global Journal of Pure and Applied Sciences. 2008;14(3):301-306.
11. Hayes HK, Immer FR, Smith DC. Methods of plant breeding. Mcgraw Hill Book Co. Inc., New York; c1955. p. 439.
12. Janaranjani KG, Kanthaswamy V, Kumar, SR. Heterosis, combining ability and character association in bottle gourd for yield attributes. International Journal of Vegetable Sciences; c2016. p. 1-26.
13. Khot RK, Evoor S, Gasti VD, Koulagi S, Masuthi DA. Estimation of heterosis in advanced lines of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] for growth, earliness and yield parameters. International Journal of Current Microbiology and Applied Sciences. 2018;7(9):3375-3384.
14. Malviya AV, Bhanderi DR, Patel AI, Jadav NK, Patel UV. Heterosis for fruit yield and its components in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Trends in Biosciences. 2017;10(2):783-87.
15. Mishra S, Pandey S, Kumar N, Pandey VP, Singh T. Studies on the extent of heterosis for the quantitative characters in kharif season bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. Journal of Pharmacognosy and Phytochemistry. 2019;8(1):29-38.
16. Panse VG, Sukhtme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi; c1985.
17. Ray PK, Yadav GC, Baranwal DK, Singh HK. Genetic estimates and gene action for obtaining heterotic hybrids in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. The Bioscan. 2015;10(2):801-806.
18. Shinde S, Bhalekar MN, Gaikwad SS. Heterosis studies in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] in summer season. Trends in Biosciences. 2018;11(19):2840-4284.
19. Shull LH. What is Heterosis? Genetica. 1908;33:430-446.
20. Singh H, Swarup V. Exploitation of hybrid vigour in vegetable. I.C.A.R. Technical bulletin (Agri.). 1971;30:40.
21. Singh VB, Singh SP. Study of heterosis for yield and its component traits in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). Journal of Pharmacognosy and Phytochemistry. 2019;8(3):3678-3681.
22. Turner JH. A study of heterosis in upland cotton-I, yield of hybrid compared with varieties. II. Combining ability and inbreeding effects. Agronomy Journal. 1953;43:487-490.
23. Yadav M, Chaudhary R, Singh DB. Heterosis in bitter gourd (*Momordica charantia* L.). Journal of Horticulture Sciences. 2009;4(2):170-173.