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Studies on Heterosis in Bitter Gourd (*Momordica charantia* L.)

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A B S T R A C T

The present investigation entitled studies on heterosis for yield and its components of bitter gourd (*Momordica charantia* L.) using 9 parents and 1 standard variety and their 36 crosses for 11 quantitive traits was carried out in summer and rainy seasons of 2015. The analysis of variance for experimental design revealed the existence of adequate genetic variability in experimental material for all traits under study. Variance due to parents Vs F1's were significant for all characters, except days taken to opening of first female flower,days taken to first fruit set, fruit weight and total fruits yield per vine, thereby indicating the presence of overall average heterosis for all characters. Heterosis was worked –out over better parent and standard check Pusa hybrid-1. The highest desirable heterobeltiosis for yield its component characters was observed in order of male: female ratio (37.36 %), number fruit per vine (20.00%), total fruits yield per vine (9.68 %) and ascorbic acid (2.50%). The standard heterosis (over best check Pusahybrid-1 was observed in order of days taken to opening of first female flower(-5.45), days taken to first fruits set (-5.45), male: female ratio (107.47%), number of fruits per vine (50.00%), fruit length (27.59%), fruit weight (3.33), fruit diameter (4.35%), total fruits yield per vine (21.43%). Panipat Local x Phule Green, Phule Green x Pusa Do Mausami and Punjab-14 x Pusa Do Mausami. Panipat Local x Phule Green was superior in respect of days taken to opening first female flower, vine length, days to first fruit harvest, fruit length. Phule Green x Pusa Do Mausami was took fruit length, fruit weight, fruit diameter and total fruits yield per vine. Punjab-14 x Pusa Do Mausami was better with regard to superior for number of node at which first female flower appeared, number of fruits per vine and days to first fruit harvest.

Keywords

Bitter gourd, *Momordica charantia*, Heterosis and Harvest

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Introduction

Bitter gourd (*Momordica charantia* L.) is an important nutritive and commercial cucurbits belonging to the Cucurbitaceae. In terms of nutritive value, bitter gourd ranks first among cucurbits due to high value of vitamins and minerals. It is highly cross pollinated due to monoecious nature and has high degree of heterozygosity. Due to efforts of vegetable breeders, improved varieties and hybrids have been developed. Crops improvement involves strategies for enhancing yield potentiality and quality components. In bitter gourd full exploitation of heterosis through development of hybrids has not been successfully commercialized due to one or the other reason. Variability found in shape, size and colour of fruits in most conspicuous which offers tremendous scope for heterosis breeding for yield enhancement. Crossing nature and heterosis in cross pollinated crops

has been known to offer good potentialities for increased yield.

Materials and Methods

The present investigation was undertaken involving different diverse genotypes/cultivars of bitter gourd were crossed in all possible combinations excluding reciprocals. The 36 F_1 hybrids along with their nine parents were evaluated during kharif 2015 in a RBD with three replications at Horticulture Farm, S.K.N. College of Agriculture, Jobner Rajasthan. Observation were recorded on five randomly selected tagged plants from each treatment for yield and yield attributing traits *viz.*, vine Length(m), days taken to opening of first female flower, days taken to first fruits set, number of node at which first female flower appeared, male : female ratio, number of fruit per vine, days to first fruit harvest, fruit length (cm) at harvest, fruit weight (g), fruit diameter (cm), total fruits yield per vine (kg) and ascorbic acid (mg)/100 (g). Heterosis over better parents and commercial check, were computed following standard statistical procedure Fonseca and Patterson (1968) was applied to compute heterosis estimates.

Results and Discussion

The analysis of variance for experimental design revealed the existence of adequate genetic variability in experimental material for all traits under study. Variance due to parents Vs F1's were significant for all characters, except days taken to opening of first female flower, days taken to first fruit set, fruit weight and total fruits yield per vine, thereby indicating the presence of overall average heterosis for all characters (Table 1). Heterosis was computed as per cent increase or decrease in F_1 valves over the better parents used over the best standard (SV) (Table 2). In the present investigation the relative magnitude of heterosis over the better parents and standard variety (Pusa Hybrid-1) was studied for 11 characters (Table 1) days taken to openings of first female flower revealed that high degree of standard heterosis for in cross combination Punjab-14 x Pant karela-1 and kalyanpur Sona x Pant karela-1.The heterosis over better parent and standard variety for days taken to first fruit set among the cross revealed that 9 cross showed negative significant heterosis over the better parents, high degree of standard heterosis was observed in Punjab-14 x Pant karela-1 and kalyanpur Sona x Pant karela-1. These results are in conformity with those of Verma and Singh (2014).For number of node at which first female flower appeared heterosis over better parent and all 36 crosses and standard variety showed highly significant heterosis in negative direction by Ram *et al.*, (1999).

For vine length 17 crosses showed over better parent and 27 crosses standard variety highly significant heterosis in negative direction. The cross Punjab-14 x kalyanpur Baramasi showed highly significant heterosis both over better parent and standard variety. Conformity evidence for above mentioned characters has also been given by Singh *et al.*, (2013) and Kumara *et al.*, (2011). For male: Female 10 cross over better parent and 21 crosses standard variety highly significant heterosis in positive direction. The Highest heterosis was observed over better parent in cross Phule Green x Pant Karela-1 and Arka Harit x Phule Green over standard variety (Thangamani *et al.*, 2011). For number of fruit per plant heterosis was showed by 5 cross over better parent and 19 cross over standard variety. The Highest standard heterosis Punjab-14 x Pusa Vishesh, Punjab-14 x Pusa Do Mousami, kalyanpur Baramasi x kalyanpur Sona, kalyanpur Sona x Pant Karela-1 for number of fruits per plant was recorded (Mangal *et al.*, 1984 and Khattra *et al.*, 2000).

Table.1 Analysis of variance showing mean sum of square for different characters in bitter gourd

S.No.	Characters	d.f	Source					
			Replication	Genotypes	Parents	F_1s	P Vs F_1	Error
			2	44	8	35	1	88
1	Days taken to opening of first female Flower		10.722	41.066**	51.083**	39.333**	21.604	6.683
2	Days taken to first fruit set		22.176	35.948**	49.833**	33.454**	12.153	7.233
3	Number of node at which first female flower appeared		0.286	1.521**	0.750**	1.569**	6.016**	0.130
4	Vine length (m) at harvest		0.043	0.163**	0.124**	0.159**	0.598**	0.036
5	Male:female ratio		0.448	46.933**	25.418**	48.623**	159.870**	3.572
6	Number of fruit/ vine		1.274	13.492**	8.250**	14.423**	22.820**	1.577
7	Days to first fruit harvest		20.545	128.918**	198.750**	115.542**	38.399*	7.955
8	Fruit length (cm) at harvest		2.814	35.456**	78.870**	25.800**	26.136**	1.845
9	Fruit weight (g)		13.926	52.145**	98.333**	42.590**	17.066	8.490
10	Fruit diameter (cm)		0.069	0.817**	0.930**	0.702**	3.950**	0.144
11	Total fruits yield per vine(kg)		0.002	0.020**	0.031**	0.017**	0.006	0.002
12	Ascorbic acid (mg/100 g)		0.003	0.015**	0.022**	0.012**	0.091**	0.003

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

Table.2 Magnitude of heterosis (%) over better parent and commercial check for various yield and yield parameters in bitter gourd

Hybrids	Days taken to opening of first female flower		Days taken to first fruit set		Number of node at which first female flower appeared		Vine length at harvest(m)	
	BP	CC	BP	CC	BP	CC	BP	CC
Punjab-14 x Arka Harit	-11.90*	-32.73**	-9.30	-29.09**	-20.00**	-42.86**	0.00	0.00
Punjab-14 x Panipat Local	-10.64*	-23.64**	-10.64*	-23.64**	-20.00**	-42.86**	-12.50*	-12.50*
Punjab-14 x Phule Green	-8.00	-16.36**	-4.00	-12.73**	20.00**	-14.29**	-6.25	-6.25
Punjab-14 x Pusa Vishesh	-10.00*	-18.18**	-8.00	-16.36**	-20.00**	-42.86**	-12.50*	-12.50*
Punjab-14 x Pusa Do Mausami	-8.00	-16.36**	-9.80*	-16.36**	0.00	-28.57**	-18.75**	-18.75**
Punjab-14 x Kalyanpur Barahmasi	-2.22	-20.00**	0.00	-18.18**	-40.00**	-57.14**	-31.25**	-31.25**
Punjab-14 x Kalyanpur Sona	0.00	-27.27**	2.44	-23.64**	-20.00**	-42.86**	-18.75**	-18.75**
Punjab-14 x Pant Karela-1	-21.74**	-34.55**	-22.92**	-32.73**	-20.00**	-42.86**	-12.50*	-12.50*
Arka Harit x Panipat Local	-10.64*	-23.64**	-8.51	-21.82**	-20.00**	-42.86**	-13.33*	-18.75
Arka Harit x Phule Green	-10.01*	-18.19**	-10.01*	-18.19**	-20.00**	-42.86**	-6.67	-12.50*
Arka Harit x Pusa Vishesh	-10.00*	-18.18**	-8.00	-16.36**	-25.00**	-57.14**	-20.00**	-25.00**
Arka Harit x Pusa Do Mausami	-8.00	-16.36**	-9.80*	-16.36**	-20.00**	-42.86**	-7.14	-18.75**
Arka Harit x Kalyanpur Barahmasi	-6.67	-23.64**	-2.22	-20.00**	-20.00**	-42.86**	-13.33*	-18.75**
Arka Harit x Kalyanpur Sona	0.00	-23.64**	2.33	-20.00**	25.00**	-28.57**	7.69	-12.50*
Arka Harit x Pant Karela-1	-10.87*	-25.45**	-12.50**	-23.64**	-40.00**	-57.14**	-14.29*	-25.00**
Panipat Local x Phule Green	-4.00	-12.73**	-4.00	-12.73**	0.00	-28.57**	0.00	-6.25
Panipat Local x Pusa Vishesh	-12.00**	-20.00**	-10.00*	-18.18**	-20.00**	-42.86**	-6.67	-12.50*
Panipat Local x Pusa Do Mausami	-8.00	-16.36**	-9.80*	-16.36**	0.00	-28.57**	0.00	-6.25
Panipat Local x	-4.26	-18.18**	-4.26	-18.18**	-20.00**	-42.86**	-6.67	-12.50*

Kalyanpur Barahmasi								
Panipat Local x Kalyanpur Sona	-6.38	-20.00**	-4.26	-18.18**	-20.00**	-42.86**	-13.33*	-18.75**
Panipat Local x Pant Karela-1	-6.38	-20.00**	-6.25	-18.18**	-20.00**	-42.86**	-6.67	-12.50
Phule Green x Pusa Vishesh	0.00	-9.09*	0.00	-9.09*	0.00	-28.57**	6.67	0.00
Phule Green x Pusa Do Mausami	-4.00	-12.73**	-1.96	-9.09*	-20.00**	-42.86**	-6.67	-12.50*
Phule Green x Kalyanpur Barahmasi	0.00	-9.09*	0.00	-9.09*	-20.00**	-42.86**	-6.67	-12.50*
Phule Green x Kalyanpur Sona	-6.00	-14.55**	-4.00	-12.73**	-20.00**	-42.86**	-13.33*	-18.75**
Phule Green x Pant Karela-1	-10.00*	-18.18**	-8.00	-16.36**	-40.00**	-57.14**	-20.00**	-25.00**
Pusa Vishesh x Pusa Do Mausami	4.00	-5.45	1.96	-5.45	0.00	-28.57**	0.00	-6.25
Pusa Vishesh x Kalyanpur Barahmasi	-4.00	-12.73**	-4.00	-12.73**	-20.00**	-42.86**	-6.67	-12.50*
Pusa Vishesh x Kalyanpur Sona	-6.00	-14.55**	-4.00	-12.73**	25.00**	-28.57**	-6.67	-12.50*
Pusa Vishesh x Pant Karela-1	-8.00	-16.36**	-6.00	-14.55**	-20.00**	-42.86**	-13.33*	-18.75**
Pusa Do Mausami x Kalyanpur Barahmasi	-4.00	-12.73**	-5.88	-12.73**	0.00	-28.57**	0.00	-6.25
Pusa Do Mausami x Kalyanpur Sona	-8.00	-16.36**	-7.84	-14.55**	-20.00**	-42.86**	-7.14	-18.75**
Pusa Do Mausami x Pant Karela-1	-10.00*	-18.18**	-9.80*	-16.36**	-40.00**	-57.14**	-14.29*	-25.00**
Kalyanpur Barahmasi x Kalyanpur Sona	-6.67	-23.64**	-4.44	-21.82**	-20.00**	-42.86**	-13.33*	-18.75**
Kalyanpur Barahmasi x Pant Karela-1	-4.35	-20.00**	-8.33	-20.00**	0.00	-28.57**	-6.78	-12.60*
Kalyanpur Sona x Pant Karela-1	-21.74**	-34.55**	-22.92**	-32.73**	-40.00**	-57.14**	-14.29*	-25.00**

*Singnificant at 5% ** Singnificant at 1% BP Better Parent CC Commerical Check

Hybrids	Male : Female ratio		Number of fruits per vine		Days to first fruit harvest		Fruit length at harvest(cm)	
	BP	CC	BP	CC	BP	CC	BP	CC
Punjab-14 x Arka Harit	-28.57**	7.88	13.33	41.67**	-3.45	7.69	-9.86	-26.44**
Punjab-14 x Panipat Local	-36.40**	-7.63	13.33	41.67**	-9.23*	13.46**	-39.60**	-29.89**
Punjab-14 x Phule Green	-15.80	4.81	0.00	25.00**	-13.85**	7.69	-52.48**	-22.99**
Punjab-14 x Pusa Vishesh	-20.74	-5.48	20.00**	50.00**	3.45	15.38**	-20.25**	-27.59**
Punjab-14 x Pusa Do Mausami	-25.77**	0.41	20.00**	50.00**	0.00	11.54*	-38.89**	-24.14**
Punjab-14 x Kalyanpur Barahmasi	7.20	18.59	6.67	33.33**	-13.85**	7.69	-26.37**	-22.99**
Punjab-14 x Kalyanpur Sona	4.51	-0.08	0.00	25.00**	-1.72	9.62*	-11.84	-22.99**
Punjab-14 x Pant Karela-1	22.42	7.39	0.00	25.00**	-3.45	7.69	-26.74**	-27.59**
Arka Harit x Panipat Local	18.30*	78.67**	0.00	16.67	-21.54**	-1.92	-27.72**	-16.09*
Arka Harit x Phule Green	37.36**	107.47**	6.67	33.33**	-18.46**	1.92	-41.84**	-5.75
Arka Harit x Pusa Vishesh	-10.71	34.85**	0.00	16.67	-3.64	1.92	-12.66	-20.69**
Arka Harit x Pusa Do Mausami	30.49**	97.10**	7.14	25.00**	-5.45	0.00	-22.22**	-3.45
Arka Harit x Kalyanpur Barahmasi	13.79	71.87**	-6.67	16.67	-18.46**	1.92	-10.99	-6.90
Arka Harit x Kalyanpur Sona	1.43	53.20**	7.14	25.00**	-1.82	3.85	-10.53	-21.84**
Arka Harit x Pant Karela-1	24.23**	87.63**	-7.14	8.33	-3.64	1.92	-17.44**	-18.39**
Panipat Local x Phule Green	-2.46	41.66**	-20.00**	0.00	1.54	26.92**	-26.95**	18.39**
Panipat Local x Pusa Vishesh	20.57**	75.10**	15.38	25.00**	1.54	26.92**	-18.81**	-5.75
Panipat Local x Pusa Do Mausami	19.43*	73.44**	-7.69	0.00	-1.54	23.08**	-3.70	19.54**
Panipat Local x Kalyanpur Barahmasi	29.71**	88.38**	-6.67	16.67	-4.62	19.23**	0.00	16.09*
Panipat Local x Kalyanpur Sona	2.40	48.71**	-7.69	0.00	0.00	25.00**	-17.82**	-4.60
Panipat Local x Pant Karela-1	22.06**	77.26**	25.00**	25.00**	-1.54	23.08**	0.99	17.24**
Phule Green x Pusa Vishesh	-6.67	16.18	-13.33	8.33	0.00	25.00**	-33.33**	8.05
Phule Green x Pusa Do Mausami	1.96	37.93**	-13.33	8.33	-6.15	17.31**	-21.28**	27.59**
Phule Green x Kalyanpur Barahmasi	20.80	50.37**	0.00	25.00**	0.00	25.00**	-28.37**	16.09*
Phule Green x Kalyanpur Sona	8.87	35.52**	6.67	33.33**	-4.62	19.23**	-34.04**	6.90
Phule Green x Pant Karela-1	43.33**	78.42**	-13.33	8.33	-3.08	21.15**	-27.66**	17.24**
Pusa Vishesh x Pusa Do Mausami	-23.31*	3.73	-15.38	-8.33	-1.82	3.85	-20.37**	-1.15
Pusa Vishesh x Kalyanpur Barahmasi	-0.70	18.42	-33.31**	-16.64	-15.38**	5.77	-7.69	-3.45
Pusa Vishesh x Kalyanpur Sona	-0.56	18.59	-23.08**	-16.67	-7.27	-1.92	2.53	-6.90

Pusa Vishesh x Pant Karela-1	4.38	24.48	0.00	8.33	-5.45	0.00	-3.49	-4.60
Pusa Do Mausami x Kalyanpur Barahmasi	-3.62	30.37*	-20.00**	0.00	-26.15**	-7.69	-4.63	18.39**
Pusa Do Mausami x Kalyanpur Sona	26.56**	71.20**	-7.69	0.00	-15.38**	-15.38**	-15.74**	4.60
Pusa Do Mausami x Pant Karela-1	9.94	48.71**	15.38	25.00**	0.00	-13.46**	-6.48	16.09*
Kalyanpur Barahmasi x Kalyanpur Sona	1.05	11.78	20.00**	50.00**	1.54	26.92**	-2.20	2.30
Kalyanpur Barahmasi x Pant Karela-1	20.41	33.20*	6.67	33.33**	1.54	26.92**	3.30	8.05
Kalyanpur Sona x Pant Karela-1	-2.34	-6.64	38.46**	50.00**	1.92	1.92	-2.33	-3.45

*Singnificant at 5% ** Singnificant at 1% BP Better Parent CC Commerical Check

Hybrids	**Fruit weight (g)**		**Fruit diameter (cm)**		**Total fruit yield per vine(kg)**		**Ascorbic acid (mg/100g)**	
	BP	CC	BP	CC	BP	CC	BP	CC
Punjab-14 x Arka Harit	-3.57	-10.00*	-9.09	-13.04	9.68**	21.43**	2.56	-2.44
Punjab-14 x Panipat Local	-9.68*	-6.67	-15.38*	-4.35	-6.45*	3.57	-2.50	-4.88
Punjab-14 x Phule Green	-27.27**	-20.00**	-50.00**	-43.48**	-6.45*	3.57	5.13	0.00
Punjab-14 x Pusa Vishesh	-3.70	-13.33**	-9.52	-17.39*	-9.68**	0.00	2.56	-2.44
Punjab-14 x Pusa Do Mausami	-12.90**	-10.00*	-33.33**	-39.13**	-3.23	7.14*	5.13	0.00
Punjab-14 x Kalyanpur Barahmasi	-3.70	-13.33**	-33.33**	-39.13**	0.00	10.71**	0.00	-4.88
Punjab-14 x Kalyanpur Sona	3.85	-10.00*	-23.81**	-30.43**	-6.45*	3.57	0.00	-4.88
Punjab-14 x Pant Karela-1	-11.11*	-20.00**	-18.18*	-21.74**	-9.68**	0.00	2.56	-2.44
Arka Harit x Panipat Local	-6.45	-3.33	-7.69	4.35	3.23	14.29**	-5.00	-7.32
Arka Harit x Phule Green	-12.12**	-3.33	-26.92**	-17.39*	-9.68**	0.00	2.78	-9.76
Arka Harit x Pusa Vishesh	-3.57	-10.00*	-4.55	-8.70	-6.45*	3.57	2.78	-9.76
Arka Harit x Pusa Do Mausami	-3.23	0.00	-9.09	-13.04	-12.90**	-3.57	5.56	-7.32
Arka Harit x Kalyanpur Barahmasi	-10.71*	-16.67**	-13.64	-17.39*	-16.13**	-7.14*	0.00	-12.20
Arka Harit x Kalyanpur Sona	-14.29**	-20.00**	-13.64	-17.39*	-16.13**	-7.14*	2.78	-9.76
Arka Harit x Pant Karela-1	-7.14	-13.33**	-9.09	-13.04	-12.90**	-3.57	5.56	-7.32

Panipat Local x Phule Green	-9.09*	0.00	-19.23**	-8.70	-9.68**	0.00	0.00	-2.44
Panipat Local x Pusa Vishesh	-9.68*	-6.67	-23.08**	-13.04	-16.13**	-7.14*	-2.50	-4.88
Panipat Local x Pusa Do Mausami	0.00	3.33	-11.54	0.00	-6.45*	3.57	2.50	0.00
Panipat Local x Kalyanpur Barahmasi	-6.45	-3.33	-19.23**	-8.70	-12.90**	-3.57	0.00	-2.44
Panipat Local x Kalyanpur Sona	-12.90**	-10.00*	-23.08**	-13.04	-12.90**	-3.57	0.00	-2.44
Panipat Local x Pant Karela-1	-6.45	-3.33	-19.23**	-8.70	-6.45*	3.57	2.50	0.00
Phule Green x Pusa Vishesh	-12.12**	-3.33	-19.23**	-8.70	0.00	3.57	2.86	-12.20
Phule Green x Pusa Do Mausami	-6.06	3.33	-15.38*	-4.35	3.45	7.14*	0.00	-14.63*
Phule Green x Kalyanpur Barahmasi	-15.15**	-6.67	-26.92**	-17.39*	-6.90*	-3.57	5.71	-9.76
Phule Green x Kalyanpur Sona	-15.15**	-6.67	-23.08**	-13.04	-6.90*	-3.57	0.00	-14.63*
Phule Green x Pant Karela-1	-9.09*	0.00	-26.92**	-17.39*	-3.45	0.00	2.86	-12.20
Pusa Vishesh x Pusa Do Mausami	-3.23	0.00	-9.52	-17.39*	-3.57	-3.57	8.57	-7.32
Pusa Vishesh x Kalyanpur Barahmasi	0.00	-10.00**	-9.92	-21.67**	0.00	-7.14*	0.00	-14.63*
Pusa Vishesh x Kalyanpur Sona	-3.70	-13.33**	-10.53	-26.09**	-7.69*	-14.29**	2.86	-12.20
Pusa Vishesh x Pant Karela-1	0.00	-10.00*	-13.64	-17.39*	-13.79**	-10.71**	0.00	-14.63*
Pusa Do Mausami x Kalyanpur Barahmasi	-6.45	-3.33	0.00	-8.70	0.00	0.00	0.00	-21.95**
Pusa Do Mausami x Kalyanpur Sona	-3.23	0.00	-9.52	-17.39*	-3.57	-3.57	3.13	-19.51**
Pusa Do Mausami x Pant Karela-1	-6.45	-3.33	-9.09	-13.04	-3.45	0.00	-3.12	-24.39**
Kalyanpur Barahmasi x Kalyanpur Sona	0.00	-10.00*	15.00	0.00	3.85	-3.57	3.33	-24.39**
Kalyanpur Barahmasi x Pant Karela-1	3.70	-6.67	-4.55	-8.70	-10.34**	-7.14*	-3.33	-29.27**
Kalyanpur Sona x Pant Karela-1	3.70	-6.67	-4.55	-8.70	-6.90*	-3.57	10.00	-19.51**

*Singnificant at 5% ** Singnificant at 1% BP Better Parent CC Commerical Check

For days to fruit harvest 9 and 2 cross over better parent and standard variety showed negative heterosis, Pusa Do Mousami x kalyanpur Baramasi over better parent and Pusa Do Mousami x kalyanpur Sona showed standard heterosis for days to fruit harvest. For fruit length heterosis 9 cross over standard variety showed positive significant heterosis. Panipat Local x Phule Green and kalyanpur Baramasi showed high degree of standard heterosis.

Chaubey and Ram (2004) For fruit weight none of cross over better parent and standard variety showed positive and significant heterosis likewise for fruit diameter none of cross over better parent and standard variety showed positive and significant heterosis by Talekar *et al.,* (2013) and Naliyadhara *et al.,* (2010). For total fruit yield per vine 1 and 5 cross over better parent and standard variety showed positive and significant heterosis.

The high degree of standard heterosis was observed in cross Punjab-14 x Arka Harit by Thangamani *et al.,* (2011).For Ascorbic content heterosis none of cross over better parent and standard variety showed heterosis in any direction while highest standard heterosis was observed in cross kalyanpur Baramasi x Pant Karela-1.

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