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Estimation of Heterosis for Yield and Quality traits in Bitter Gourd (*Momordica charantia L.)*

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A B S T R A C T

Seven genetically dissimilar parental lines i.e., Pusa Ausadhi, Jhalri, Kathi No.1, Pusa Rasdar, BRBT Local, Konkan Tara, Solan Hara were crossed in a diallel (half) pattern to get 21 hybrid to investigate extent of heterosis fruit yield and quality traits in bitter gourd at vegetable research farm, Bihar agricultural university, Bihar during summer season 2016 and 2017. The cross combination Pusa Ausadhi X BRBT Local exhibited maximum heterosis over standard check for yield and yield attributing trait like number of primary branch, vine length, fruit length and fruit weight. In case of quality parameter, BRBT Local X Konkan Tara exhibit highest magnitude of heterosis for ascorbic acid and chlorophyll content.

Introduction

Bitter gourd (*Momordica charantia* L.) is a tender, edible fruit in the genus of *Momordica* which is a climbing vine belongs to the family cucurbitaceae. The genus *Momordica* has about 80 species among which *Momordica charantia* L. is most cultivated species having chromosome number 2n = 22.Eastern India or southern China consider as the center of origin of bitter gourd (Walters and Decker-Walters 1988; Miniraj *et al.*, 1993). Bitter gourd is also known as 'karela' in Hindi which may be Dravion origin (Turner, 1966). Due to its pharmaceutical, antidiabetic property and high nutritive value in terms of ascorbic acid and iron it is considered as prized vegetable among cucurbits (Behera 2004).

Bitter gourd is highly cross pollinated crop and bears staminate and pistilate flowers separately on the same plant, i.e. monoecious which offers considerable amount of variability. In spite of the economic and medicinal importance of the crop, due

attention was not paid towards a need based crop improvement programmed. Now a day, gradually the cultivation of bitter gourd has become popular, because of the growing awareness of the health among consumer. Varieties and hybrids of bitter gourd have been developed by the effort of many breeders but there is also need for its improvement to develop varieties or hybrids suited for earliness, high yield, improved postharvest quality, uniformity, and wider adaptability and resistant to disease and pest. Heterosis is the superiority of F1 Hybrid over the mean of the parents or over the better parent (BP) or over the standard check (Hayes *et al.,* 1956) regarding traits.

The main aim of heterosis breeding is to achieve higher yield with better quality. The commercial exploitation of hybrid vigour depends on the ease with which the technique employed and cost of seed production. Bitter gourd being monoecious can be profitably utilized for the production of F1 hybrid seeds at cheaper price. High number of hybrid seeds per cross makes it more economical. Further, the crop being cultivated at wider spacing, the seed requirement per hectare for commercial cultivation would be low and cost effective. bitter gourd offers greater scope for exploitation of hybrid vigour on commercial scale to increase the productivity and production. The heterosis expressed types of gene action which helps in selection of breeding methodology for crop improvement. There are several scientists who worked on heterosis and obtained varying degree of existence of heterosis. Pal and Singh (1946); Lawende and Patil, 1989, Laxman *et al.,* 2012 and Rani *et al.,* 2014) and Thangamani and Pugalendhi (2012). The present experiment was undertaken to identify potential parental combinations that are likely to produce superior hybrids having qualities with maximum yield.

Materials and Methods

The present investigation was conducted at the research farm, Department of Horticulture (Vegetable and Floriculture) of Bihar Agricultural College, Sabour, Bhagalpur (Bihar) during two summer season of 2016 and 2017. The experimental material for this experiment comprised of seven promising and diverse genotypes i.e., PusaAusadhi, Jhalri, Kathi No.1, PusaRasdar, BRBT Local, Konkan Tara, Solan Hara NBGH 167 (Standard check). They were crossed in all possible combination in diallel fashion excluding reciprocals to get 21 hybrids. All the 29 treatments (7 parents, 21 F_1 hybrids with one check) were grown in randomized block design with three replications with spacing of 2.0 m × 0.5 m in plot size 4.0 m X 3 m. The recommended agronomic practices were adopted for raising the better crops. Observations were recorded on 20 economically important traits *viz;* node number at which first male flower appear, node number at which first female flower appear, Days taken to first male flower appear, Days taken to first female flower appear, days to 50% flowering, internodal length (cm), number of primary branches per plant, vine length (cm), number of fruits per plant, fruit weight (g), fruit length (cm), fruit diameter (cm), number of seeds per fruit, fruit fly infestation %, yield of marketable fruits per plant (g), TSS (^{0}Brix), ascorbic acid (mg/100g), and chlorophyll content (mg/100gm) carotenoid content (mg/100gm) and total phenol content.

The present experiment was conducted to estimate the level of heterosis per cent over better parent and standard variety among crosses F1 hybrids of seven varieties. This knowledge would be useful to investigate the performance and relationship of F1 hybrids and parents and to select suitable parents and population for designing an effective crop

improvement programme. The heterosis was determined as per cent increase or decrease of F1 values over the better parent (BP) and the standard variety. Data were taken for both consecutive year 2016 and 2017 and the pooled mean data was subjected to calculation of heterosis. These were calculated the method suggested by Falconer and Mackay (1996).

Results and Discussion

The negative magnitude of heterosis were considered desirable for node number of 1st male flower appears, node number of 1st female flower appears, days to 1st male flower appears, days to 1st female flower appears, days to 50% flowering, internodal length, fruit andfruit fly Infestation %. However, for the rest of characters, positive estimates of heterosis were desirable.

Magnitude of heterosis over BP (better parent) and SV (standard variety) for different characters was estimated and given in Table No. 01

For node number of 1st male flower appears, heterosis over better parent ranged varied from -24.48 % to 5.44 % while, standard heterosis for this trait varied from -30.17 to 4.29 %. Out of 21 hybrids only 7 hybrids exhibited highly significant negative heterosis over better parent whereas, 10 hybrids was found to contain highly significant negative heterosis in desirable direction over standard check variety NBGH 167.

The hybrid Pusa Rasdar X Konkan Tara exhibited maximum heterosis over standard variety for this trait.For node number at which 1st female flower five hybrids exhibited highly significant negative heterosis over better parent whereas, six hybrids was found to contain highly significant negative heterosis in desirable direction over standard check variety NBGH 167. For days taken to 1st female flowering two hybrids was found to contain highly significant negative heterosis over better parent, whereas, five hybrids was exhibited highly significant negative heterosis over standard variety in desirable direction.

For days taken to 50 % flowering, only three hybrids was found to contain significant negative heterosis over better parent, whereas, only one hybrid namely Pusa Ausadhi X BRBT Local (-6.17 %) showed negative significant heterosis in desirable direction over standard variety. Similar findings of negative and high heterosis for these traits were reported by Jadhav *et al.,* (2009) Laxuman *et al.,* (2012) and Bhatt *et al*., (2016).

For internodal length the extent of heterosis over better parent range varied from -23.89 % (PusaRasdar X BRBT Local) to 12.42 % (Jhalri X BRBT Local). The economic heterosis for this trait varied from -23.04 % (PusaAusadhi X Konkan Tara) to 23.30 % (Jhalri X BRBT Local). Six hybrids were exhibited highly significant negative heterosis over better parent whereas, nine hybrids showed highly significant negative heterosis over standard check in desirable direction. Short internodal length may cause maximum number of node number of male or female flower and may participate more number of fruits per plant and cause more yield.

For number of primary branch per plant only one hybrid i.e., PusaAusadhi X BRBT Local (8.51%) was found to contain highly significant positive heterosis over better parent, and fourteen hybrids was exhibited highly significant positive heterosis over standard variety in desirable direction. Similar result was supported by Tewari and Ram (2001). Heterosis regarding growth parameters is related to earliness, high vigour and yield and thus they are strongly

associated. The hybrid Kathi No.1 and BRBT Local (39.25 %) followed by PusaAusadhi (33.99%) were showed maximum vine length among all the hybrids. This result was also reported by Singh *et al.,* (2013) and Kadansamy (2015). The ideal plant type should have maximum vine length, maximum number of primary branches which may leads higher yields (Sirohi and Choudhury, 1978).

Yield attributing traits i.e., fruit length, fruit diameter, fruit weight, number of fruits per vine play pivotal role in yield of any crop. Hence these traits positive heterosis is desirable. For fruit length, out of 21 hybrids, four hybrids was found to contain significant positive heterosis over better parent, whereas, five hybrids exhibited highly significant positive heterosis over standard variety in desirable direction. The cross PusaAusadhi X BRBT Local showed maximum positive and significant heterosis (29.34 %) over standard check. Similar results were recorded by Ranpise *et al.,* (1992) for standard heterosis (26.02 %) in bitter gourd.

For fruit weight only two hybrids, were exhibited highly significant positive heterosis over better parent whereas, six hybrids showed highly significant positive heterosis over standard check in desirable direction.

The cross PusaAusadhi × BRBT Local showed significant and positive heterosis of (31.92 %) over mid parent, 10.55 per cent over better parent and 44.23 per cent showed positive and significant heterosis of over the commercial check. Similar results were reported by Singh and Kumar (2002), Yadav *et al.,* (2009) and Laxman *et al.,* (2012).

For fruit diameter, the cross combination PusaRasdar X BRBT Local (38.94 %) showed highly significant positive heterosis over standard variety. Similar finding were reported by Laxman *et al.,* (2012) in the crosses PusaVishesh X IC 68310 (38.10 %) for fruit diameter. For number of fruits per plant, the cross combination PusaAusadhi X Konkan Tara showed maximum and positive heterosis 28.21 %over better parent. Rainpise *et al.,* observed 32.70 percent, 9.0 % by Mishra *et al.,* (1994) and 53.84 % by Singh *et al.,* (2001) for standard heterosis in bitter gourd.

The one of the important parameters like fruit yield per vine, our results exhibited highly significant positive heterosis in desirable direction, six hybrid over better parent and six hybrids over standard variety out of 21 hybrids which shown positive as well as high significant heterosis. The hybrid PusaAusadhi X BRBT Local exhibited maximum heterosis over better parent (25.38 %) and (26.88%) over standard check respectively. Our results are also conformity with the results of Mishra *et al.,* 1999 Jadav *et al.,* 2009 and Thangamani and Pugalendhi (2013).

The other traits like number of seeds per fruit which was varied from -29.62 per cent (Kathi No.1 X PusaRasdar) to 38.57 % (BRBT Local X Konkan Tara). While as, Heterosis over better parent which was ranged from -42.98 % (Konkan Tara X Solan Hara) to 8.78 % (BRBT Local X Konkan Tara). Similar results were found by earlier scientist Celine and Sirohi (1996).

Data regarding to Fruit fly infestation, our results confined that therelative heterosis ranged from 2.43 % (Kathi No.1 X Solan Hara) to31.56 % (Kathi No.1 X Konkan Tara) respectively. While as, Heterobeltiosis ranged was noted from -2.26 % (PusaAusadhi X BRBT Local) to 25.19 % (Kathi No.1 X BRBT Local) respectively.

The important traits regarding to biochemical attributes; such as TSS, Ascorbic acid, total chlorophyll content, Carotenoids and total phenolic compound.

Table.1 Estimation of heterosis for quantitative and qualitative traits of bitter gourd

Characters	Node Number at 1st male flower appears		Node Number at 1st Female flower appears		Days to Ist Male flower appears		Days to Ist Female flower appears		Days to 50% Flowering	
Hybrids	BPH	SH	BPH	SH	BPH	SH	BPH	SH	BPH	SH
PusaAusadhi X Jhalri	-24.48**	-25.98**	-17.47**	-14.28**	1.51	-4.60	-6.92	-11.51*	-1.88	-3.71
PusaAusadhi X Kathi No. 01	0.00	-7.20	4.07	-1.89	-4.02	-7.09*	-13.72**	-15.14**	-3.99	-3.40
PusaAusadhi X PusaRasdar	6.08	-27.02**	3.56	-17.14**	4.97	-2.84	-5.97	-11.85**	-7.75*	-5.48
PusaAusadhi X BRBT Local	-23.48**	-21.82**	-25.21**	-15.22**	0.00	-3.89	-4.07	-6.91	-10.05**	-6.17*
PusaAusadhi X Konkan Tara	-12.23**	-24.95**	-7.70	-19.99**	-3.96	-5.32	-15.51**	-15.79**	1.24	0.29
PusaAusadhi X Solan Hara	-17.39**	-20.75**	-25.65**	-19.97**	5.39	-3.20	-5.09	-14.15**	-1.80	0.31
Jhalri X Kathi No. 01	3.19	1.15	5.49	9.56*	1.84	-1.42	-1.44	-3.06	1.22	1.84
Jhalri X PusaRasdar	-9.58*	-11.37**	-5.53	-1.89	0.38	-5.66	0.69	-4.28	-3.61	-1.24
Jhalri X BRBT Local	-5.10	-3.05	-0.83	12.41**	-1.85	-5.67	-1.36	-4.28	-6.21*	-2.16
Jhalri X Konkan Tara	-8.52*	-10.33**	-1.86	1.92	-1.80	-3.19	-4.28	-4.61	1.86	0.91
Jhalri X Solan Hara	-2.12	-4.06	0.90	8.61	4.53	-1.76	2.42	-2.63	-3.31	-1.24
Kathi No. 01 X PusaRasdar	4.47	-3.05	0.01	-5.72	-3.29	-6.38*	-4.69	-6.26	-1.81	0.61
Kathi No. 01 X BRBT Local	2.07	4.29	-6.72	5.74	0.38	-2.83	-2.00	-3.62	-1.77	2.47
Kathi No. 01 X Konkan Tara	2.26	-5.10	6.07	0.00	-0.72	-2.12	-1.32	-1.65	2.76	3.39
Kathi No. 01 X Solan Hara	5.44	1.15	2.66	10.50*	1.48	-1.76	-2.33	-3.94	0.92	3.09
PusaRasdar X BRBT Local	-20.39**	-18.67**	-17.66**	-6.66	4.43	0.37	2.71	-0.34	-3.84	0.31
PusaRasdar X Konkan Tara	-18.34**	-30.17**	-5.51	-18.08**	3.24	1.78	-1.98	-2.31	0.00	2.47
PusaRasdar X Solan Hara	-16.31**	-19.71**	-12.42**	-5.73	4.59	-3.20	2.11	-4.28	-2.71	-0.31
BRBT Local X Konkan Tara	-5.10	-3.05	-3.35	9.56*	2.16	0.72	0.66	0.33	-2.07	2.16
BRBT Local X Solan Hara	-4.06	-1.98	3.35	17.15**	-1.11	-4.95	-3.40	-6.26	1.47	5.85
Konkan Tara X Solan Hara	-5.47	-9.31*	1.78	9.56*	0.00	-1.41	-2.64	-2.96	-3.01	-0.93
Comparison of Hybrid with	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**
Better Parent		0.608	0.811	2.127	1.388	3.639	2.260	5.926	1.659	4.349
Checks		0.608	0.811	2.127	1.388	3.639	2.260	5.926	1.659	4.349

Cont…

Characters	**Inter Nodal Length (cm)**		**Primary Branches per plant**		**Number of fruits per plant**		**Fruit Length (cm)**		Fruit Weight	
Hybrids	BPH	SH	BPH	SH	BPH	SH	BPH	SH	BPH	SH
PusaAusadhi X Jhalri	-15.16**	-6.95	-10.18*	22.38**	-3.88	18.64**	0.21	2.51	4.33	-7.97
PusaAusadhi X Kathi No. 01	-4.82	-9.45*	-7.63	25.85**	3.43	27.66**	2.64	-2.51	9.64	-3.29
PusaAusadhi X PusaRasdar	4.61	-12.87**	-15.21**	15.52**	-6.90	14.91**	-12.51*	-16.91**	-2.34	0.29
PusaAusadhi X BRBT Local	-20.15**	-14.11**	8.51*	53.44**	-32.78**	-17.03**	9.27*	29.24**	10.55**	44.23**
PusaAusadhi X Konkan Tara	-4.47	-23.04**	-11.43**	20.68**	-5.50	28.21**	-5.41	-10.17*	-0.58	-12.31*
PusaAusadhi X Solan Hara	-14.83**	-20.13**	-16.50**	13.76*	-6.47	15.44**	-15.66**	-19.90**	-2.61	-14.10**
Jhalri X Kathi No. 01	2.91	12.87**	-5.48	18.92**	0.43	23.95**	6.30	8.74	-8.70	-19.78**
Jhalri X PusaRasdar	-18.94**	-11.10*	-12.10*	0.00	-15.53**	4.26	10.11*	12.64**	-10.50*	-8.08
Jhalri X BRBT Local	12.42**	23.30**	-18.30**	15.52**	-0.86	22.35**	-1.71	16.26**	-36.52**	-17.18**
Jhalri X Konkan Tara	-2.79	6.62	-7.83	1.71	-8.63*	23.96**	-10.17*	-8.11	6.81	-22.27**
Jhalri X Solan Hara	-5.21	3.96	1.70	5.17	-1.29	21.83**	0.46	2.76	-3.36	-29.14**
Kathi No. 01 X PusaRasdar	-9.96*	-14.34**	5.52	32.76**	7.34	24.47**	23.60**	-4.79	-13.96**	-11.64*
Kathi No. 01 X BRBT Local	-4.07	3.19	7.30	51.73**	-3.20	12.25*	-4.69	12.73**	0.51	31.13**
Kathi No. 01 X Konkan Tara	-0.57	-5.41	1.38	27.56**	-18.84**	10.11	10.44	-14.94**	9.99	-3.36
Kathi No. 01 X Solan Hara	4.33	-0.75	-8.18	15.52**	-5.05	10.11	13.37*	-12.68**	2.47	-9.97
PusaRasdar X BRBT Local	-23.89**	-18.13**	-12.24**	24.09**	-5.27	-13.83**	-14.39**	1.26	-1.93	27.96**
PusaRasdar X Konkan Tara	3.68	-13.65**	-3.05	10.29	-35.70**	-12.76*	-2.62	-26.75**	15.34**	18.45**
PusaRasdar X Solan Hara	11.45*	4.51	-3.06	10.28	-5.71	-3.71	3.56	-22.10**	-0.92	1.75
BRBT Local X Konkan Tara	3.04	10.84*	1.21	43.11**	-21.98**	5.85	5.46	24.73**	-5.35	23.49**
BRBT Local X Solan Hara	10.03*	18.36**	-10.98**	25.88**	-23.43**	-21.81**	-4.94	12.44*	-9.65*	17.88**
Konkan Tara X Solan Hara	-12.85**	-18.28**	1.56	12.07*	-14.52**	15.96**	2.01	-24.96**	13.31	-16.93
Comparison of Hybrid with	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**
Better Parent	0.291	0.762	0.563	1.477	1.644	4.311	0.664	1.742	3.194	8.375
Checks	0.291	0.762	0.563	1.477	1.644	4.311	0.664	1.742	3.194	8.375

Cont…										
Characters	Fruit Diameter		Number of seed per fruit		Vine Length		Yield/Vine		Fruit Fly Infestation	
Hybrids	BPH	SH	BPH	SH	BPH	SH	BPH	SH	BPH	SH
PusaAusadhi X Jhalri	2.41	-0.95	-19.37**	-17.62**	-7.66	8.02	6.29	7.56	-1.53	-7.19
PusaAusadhi X Kathi No. 01	-15.35**	2.00	-35.83**	-15.39**	-17.03**	1.70	14.93**	16.30**	15.03**	-8.04
PusaAusadhi X PusaRasdar	-13.57**	20.54**	-23.28**	-27.51**	0.17	-3.47	11.70**	13.03**	3.44	-17.31**
PusaAusadhi X BRBT Local	2.44	37.95**	-12.28**	9.88*	3.93	33.99**	25.38**	26.88**	-2.26	-21.87**
PusaAusadhi X Konkan Tara	-1.57	-4.37	-20.95**	-25.30**	-7.27	-6.31	14.33**	15.69**	0.87	-19.36**
PusaAusadhi X Solan Hara	-6.00	-9.08	-24.21**	6.59	-3.56	-12.23*	-6.77	-5.65	24.14**	-0.76
Jhalri X Kathi No. 01	-22.73**	-6.89	-9.14*	19.79**	-4.35	17.24**	0.91	-1.89	1.42	-4.41
Jhalri X PusaRasdar	-21.58**	9.37	-30.11**	-28.59**	4.28	21.99**	1.64	-9.32*	2.36	-3.52
Jhalri X BRBT Local	-26.55**	-1.09	-21.93**	-2.21	-2.55	25.64**	-1.91	-1.24	8.58	2.34
Jhalri X Konkan Tara	-5.34	-8.04	-34.40**	-32.97**	-4.13	12.16*	0.80	-4.30	-1.19	-6.87
Jhalri X Solan Hara	-7.33	-12.89**	-30.47**	-2.21	1.70	18.97**	0.44	-16.86**	8.99	2.73
Kathi No. 01 X PusaRasdar	-24.04**	5.94	-42.52**	-24.21**	-14.19**	5.18	10.32*	7.26	25.09**	-13.10**
Kathi No. 01 X BRBT Local	0.88	35.85**	-14.16**	13.18**	8.02	39.25**	23.99**	24.83	25.19**	-13.03**
Kathi No. 01 X Konkan Tara	-22.89**	-7.09	-30.00**	-7.70	-16.27**	2.64	7.94	4.95	24.00**	-13.86**
Kathi No. 01 X Solan Hara	-15.79**	1.47	-10.15**	26.38**	-10.17*	10.11	-2.65	-5.35	-2.07	-25.41**
PusaRasdar X BRBT Local	-0.38	38.94**	-29.82**	-12.09*	-17.48**	6.39	1.11	1.81	23.48**	-17.84**
PusaRasdar X Konkan Tara	-13.19**	21.07**	-22.39**	-35.18**	2.42	3.48	2.00	-3.15	9.43	-27.19**
PusaRasdar X Solan Hara	-13.81**	20.21**	-42.21**	-18.72**	-7.86	-11.21	-1.13	-11.79**	11.57*	-15.01**
BRBT Local X Konkan Tara	-5.97	26.63**	8.78*	36.27**	1.21	30.49**	22.30**	23.14**	8.01	-30.79**
BRBT Local X Solan Hara	-3.32	30.19**	7.04*	50.56**	-0.38	28.43**	-2.93	-2.27	15.35**	-12.14**
Konkan Tara X Solan Hara	-9.20	-11.79*	-42.98**	-19.79**	6.33	7.43	-0.80	-5.82	19.31**	-9.12*
Comparison of Hybrid with	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**
Better Parent	0.148	0.387	0.620	1.625	10.695	28.043	7.298	19.137	1.000	2.622
Checks	0.171	0.447	0.716	1.877	12.349	32.381	8.427	22.097	1.155	3.028

Characters	Total Soluble Solids (TSS)		Ascorbic Acid		Total chlorophyll		Carotenoids		Total Phenol	
Hybrids	BPH	SH	BPH	SH	BPH	SH	BPH	SH	BPH	SH
PusaAusadhi X Jhalri	-9.02**	13.35**	-6.81	-20.47**	-23.14**	-23.14**	0.86	59.14**	4.85	-6.16**
PusaAusadhi X Kathi No. 01	-1.15	8.16*	-18.82**	-7.81**	-24.37**	-24.37**	-6.85**	71.98**	-7.21**	0.29
PusaAusadhi X PusaRasdar	-7.29*	1.45	-17.46**	-17.08**	2.34	2.34	-4.81	50.19**	-2.37	-2.73
PusaAusadhi X BRBT Local	-7.73*	24.81**	-34.09**	-11.98**	-21.58**	-21.58**	-24.29**	19.46**	1.53	-9.14**
PusaAusadhi X Konkan Tara	-2.04	10.60**	-27.30**	0.24	-29.51**	-29.51**	-1.16	98.25**	-4.31	-0.41
PusaAusadhi X Solan Hara	2.10	11.72**	-10.90**	-15.61**	-11.05*	-11.05*	-11.10**	40.27**	-3.04	-13.22**
Jhalri X Kathi No. 01	5.27	31.15**	-14.50**	-2.90	-28.83**	-28.83**	-40.25**	10.31*	-18.99**	-12.44**
Jhalri X PusaRasdar	3.39	28.81**	-5.91	-5.48	3.61	3.61	20.75**	36.96**	-20.12**	-20.41**
Jhalri X BRBT Local	12.94**	52.76**	-27.86**	-3.67	-8.71**	-8.71**	5.25	-6.42	-1.83	-20.90**
Jhalri X Konkan Tara	2.14	27.25**	-27.53**	-0.08	-21.87**	-21.87**	-33.27**	33.85**	-12.60**	-9.05**
Jhalri X Solan Hara	-2.02	22.06**	-6.43	-11.39**	-11.68**	-11.68**	3.29	9.92*	-0.93	-28.05**
Kathi No. 01 X PusaRasdar	2.15	10.83**	-3.58	9.51**	-18.87**	-18.87**	-0.84	83.07**	2.53	10.82**
Kathi No. 01 X BRBT Local	-4.11	29.70**	1.89	36.05**	2.07	2.07	-7.48**	70.82**	-28.41**	-22.62**
Kathi No. 01 X Konkan Tara	-2.59	9.97*	4.46	44.02**	-9.36**	-9.36**	29.10**	158.95**	7.21**	15.87**
Kathi No. 01 X Solan Hara	2.87	11.61**	0.37	13.99**	-41.31**	-41.31**	10.33**	103.70**	-5.99**	1.60
PusaRasdar X BRBT Local	-20.83**	7.08	-7.74**	23.20**	-16.87**	-16.87**	20.58**	36.77**	-1.90	-2.26
PusaRasdar X Konkan Tara	4.63	18.13**	-8.48**	26.18**	-25.99**	-25.99**	3.30	107.20**	0.14	4.22
PusaRasdar X Solan Hara	-5.97	-1.93	22.81**	23.37**	-7.24*	-7.24*	31.90**	49.61**	2.54	2.16
BRBT Local X Konkan Tara	1.64	37.49**	15.10**	58.68**	9.68**	9.68**	-12.42**	75.68**	-3.68	0.23
BRBT Local X Solan Hara	6.47*	44.01**	1.67	35.76**	-12.59**	-12.59**	21.39**	29.18**	-0.57	-19.88**
Konkan Tara X Solan Hara	10.05**	24.25**	8.50**	49.59**	-16.36**	-16.36**	15.13**	130.93**	5.38*	9.67**
Comparison of Hybrid with	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**	**C.D. 95%**	**C.D. 99%**
Better Parent	0.155	0.407	1.873	4.911	0.022	0.057	0.032	0.084	2.534	6.646
Checks	0.179	0.470	2.163	5.671	0.025	0.066	0.037	0.097	2.927	7.674

In better parents heterosis of bitter gourd, the range were varied from -20.83 % (PusaRasdar X BRBT Local) to 12.94 % (Jhalri X BRBT Local) for TSS, Ascorbic acid ranged varied from -34.09 % (PusaAusadhi X BRBT Local) to 22.81 % (PusaRasdar X Solan Hara), the total chlorophyll content varied from -41.31 % (Kathi No.1 X Solan Hara) to 9.68 % (BRBT Local X Konkan Tara), the Carotenoids ranged varied from -40.25 % (Jhalri X Kathi No.1) to 31.90 % (PusaRasdar X Solan Hara) and the total phenol contents ranged varied from -28.41 % (Kathi No.1 X BRBT Local) to 7.21 % (Kathi No. 1 X Konkan Tara) respectively.

In economic parents of heterosis of bitter gourd, the ranged varied from -1.93 % (PusaRasdar X Solan Hara) to 52.76 % (Jhalri X BRBT Local) for TSS traits, Ascorbic acid varied from -20.47 % (PusaAusadhi X Jhalri) to 58.68 % (BRBT Local X Konkan Tara), chlorophyll content varied from -32.33 % (PusaAusadhi X Solan Hara) to 70.91 % (BRBT Local X Konkan Tara), carotenoid content varied from -6.42 % (Jhalri X BRBT Local) to 158.95 % (Kathi No.1X Solan Hara) and the total phenolic contents varied from -28.05 % (Jhalri X Solan Hara) to 15.87 % (Kathi No.1 X Konkan Tara) respectively.

In findings related to biochemical attributes the similar results was recorded with earlier scientists Mamun *et al.,* (2015) for ß-carotenoid, total soluble solid and phenol content, Behera *et al.,* (2010) and Dhillon *et al.,* (2016) for ascorbic acid, ß-carotene in bitter gourd.

In conclusion the for crop improvement programme, heterosis breeding is one of the important tools to produce superior hybrids having qualities with maximum yield. From the present investigation it is concluded that the cross combination PusaAusadhi X BRBT Local exhibited maximum heterosis over standard check for yield and yield attributing trait like number of primary branch, vine length fruit length and fruit weight. In case of quality parameter, BRBT Local X Konkan Tara exhibit highest magnitude of heterosis for ascorbic acid and chlorophyll content.

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