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Per se performance of bitter gourd (*Momordica charantia* L.) genotypes under temperate conditions of Kashmir

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Abstract
The present investigation was conducted during *kharif* 2016-17 to evaluate a set of ten lines of bitter gourd (*Momordica charantia* L.) viz., NDBG-1, NDBG-3, NDBG-4, NDBG-5, NDBG-6, NDBG-7, NDBG-12, NDBG-17, Pant Karela-1 and PBTH-52. The lines were evaluated in RCBD with three replications at three locations viz., Vegetable Experimental Farm, Division of Vegetable Science, SKUAST-Kashmir, Shalimar; Faculty of Agriculture, Wadura and KVK Malangpora during 2017. A wide range of variability was observed for most of the maturity and yield attributes under study. The mean and the confidence interval for various traits depicted a wide range of variability among the lines which divulges a good scope of selecting the desirable lines for further improvement.

Keywords: Bitter gourd, *per se* performance, mean, temperate conditions

Introduction
Bitter gourd (*Momordica charantia* L.) with $2n = 2x=22$ is an important commercial cucurbit belonging to the family Cucurbitaceous. It is considered to be the native of Tropical Asia especially Eastern India and Southern China (Miniraj *et al.* 1993) [2]. It is popular throughout India for its tender fruits which are consumed as fried, cooked, stuffed, curried, pickles and is used in various herbal medicine systems because of its disease preventing and health promoting phyto-chemical compounds like dietary fiber, vitamins, flavonoids and antioxidants. Together, these compounds help act as protective scavengers against oxygen-derived free radicals and reactive oxygen species (ROS) that play a role in aging, cancers and degenerative disease.
The choice of parents is considered as an important aspect for improving yield and its attributes and for this selection of desirable parents is of utmost importance. The selection is effective only when variability is present in the experimental material. In our country, a wide range of variability in vegetative and fruit characters is available in bitter gourd. The common approach of selecting genotypes is purely on the basis of *per se* performance.

Materials and Methods
The present investigation was conducted during *kharif* 2016-17 to evaluate a set of ten lines of bitter gourd (*Momordica charantia* L.) at three locations viz., Vegetable Experimental Farm, Division of Vegetable Science, SKUAST-Kashmir, Shalimar; Faculty of Agriculture, Wadura and KVK Malangpora during 2017. The experimental material consisted of ten lines viz., NDBG-1, NDBG-3, NDBG-4, NDBG-5, NDBG-6, NDBG-7, NDBG-12, NDBG-17, Pant Karela-1 and PBTH-5. During *Kharif* 2017 the set of ten lines were evaluated in RCBD with three replications at a spacing of 0.5×1 m^2 at all the three locations. The recommended package of practices was adopted to raise a healthy crop. Five randomly plants in each treatment over the replications were selected and labelled and were used for recording the observations. The observations were recorded on node to first male flower appearance, node to first female flower appearance, days to anthesis of first male flower, days to anthesis of first female flower, days to first fruit harvest, vine length, fruit length (cm), fruit diameter (cm), number of fruits plant^{-1}, average fruit weight (g), fruit yield plant^{-1} (kg), fruit yield hectare^{-1}(q) and number of seeds fruit^{-1}.

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Results and Discussion

The average performance (pooled over environments E_1, E_2 and E_3) of the lines for different traits used in the study is presented in Table1. From the table it is clear that the line PBTH-52 had the lowest nodal position (6.5) for node to first male flower appearance followed by NDBG-5 (6.60) and NDBG-12 (6.68) with a mean value of 7.32. The line NDBG-12 produced first female flower at lowest node (8.05) followed by PBTH-52 (8.20) and NDBG-5 (8.80) with an overall mean of 9.56. Number of days taken to anthesis of first male flower was lowest in NDBG-7 (50.43 days) followed by NDBG-5 (51.43 days) and NDBG-4 (51.90 days) with a mean of 54.83 days. NDBG-7 (58.40 days) followed by NDBG-5 (60.56 days) and NDBG-4 (61.68 days) took lowest number of days to anthesis of first female flower with mean of 63.86 days. Lowest number of days to first fruit harvest were taken by NDBG-7(69.18 days) followed by NDBG-6 (70.48days) and NDBG-5 (70.50 days) with an average value of 74.91 days. Highest vine length was attained in NDBG-1(194.85 cm) followed by NDBG-4 (179.73 cm) and NDBG-3 (170.03 cm). The vine length of lines averaged to 158.56 cm. Highest fruit length was recorded in Pant Karela-1(16.23 cm) followed by NDBG-1 (15.25 cm) and NDBG-4 (14.33 cm). However the mean performance of lines was 12.74 cm. Fruit diameter was highest in NDBG-4 (4.98 cm) followed by NDBG-7 (4.27 cm) and NGBG-6 (4.12 cm) with a mean value of 3.84cm. Among lines highest number of fruits plant^{-1} was observed in NDBG-5 (10.50) followed by NDBG-7 (9.90) and NDBG-1 (9.25). However the number of fruits plant^{-1} averaged to 8.45cm for lines. Highest average fruit weight was observed in NDBG-4 (145.50g) followed by Pant Karela-1(112.50g) and NDBG-1(99.50g) with a mean of 107.01g. Data pertaining to fruit yield plant^{-1} revealed that among lines maximum fruit yield plant^{-1} was observed in NDBG-4(1.03 kg) followed by NDBG-5 (0.99 kg) and Pant Karela-1(0.96 kg) with an overall mean of 0.79kg. Highest

fruit yield hectare^{-1} was observed in NDBG-4 (206.50 q) followed by NDBG-5 (198.00 q) and Pant karela-1 (192.77 q) with an overall mean of 158.35 q. Maximum number of seeds fruit^{-1} was observed in NDBG-4 (21.33) followed by NDBG-1 (17.50) and NDBG-5 (16.26) with a mean of 15.13. The confidence interval at 95% (Low-High) for node to first male flower appearance, node to first female flower appearance, days to anthesis of first male flower, days to anthesis of first female flower, days to first fruit harvest, vine length, fruit length (cm), fruit diameter (cm), number of fruits plant^{-1}, average fruit weight (g), fruit yield plant^{-1} (kg), fruit yield hectare^{-1}(q), number of seeds fruit^{-1} was 6.85-7.80, 8.62-10.52, 52.13-57.54, 61.50-66.23, 71.48-77.96, 141.29-175.84, 11.02-14.47, 3.46-4.22, 7.63-9.27, 80.29-110.21, 0.67-0.91, 133.82-182.87 and 13.08-17.18 respectively. NDBG-4, NDBG-5, Pant Karela-1, NDBG-1 and NDBG-12 recorded good mean performance for yield and yield attributes. The lines NDBG-7, NDBG-5, NDBG-6, PBTH-52 and NDBG-4 recorded good *per se* performance for earliness. Thus it was found that there exists a wide range of variability for different traits in the present set of material. The basic requirement for the successful breeding programme is the presence of genetic variation in the population. Then the second step is the selection of the desirable types from that variable population. *Per se* performance is a good index of selection as it depicts the observable variability of the population. In the present set of material the overall mean and confidence interval revealed a wide range of variability for different traits which indicates a great scope of selecting the genotypes for crop improvement for the respective traits. Sufficient amount of variability was observed by Nalawade *et al*. 2011 [4] for various yield traits; Islam *et al.* 2014 and for fruit length, fruit diameter and average fruit weight, node to first male and female flower appearance; Thangamani and Pugalendhi 2013 [7] in bitter gourd, Muthaiah *et al.* 2017 [3] in ridge gourd and Singh *et al.* 2018 in bitter gourd for maturity and yield traits.

Table 1: Average performance of lines for different maturity, yield traits in bitter gourd (*Momordica charantia* L.). (Pooled over environments)

Parents	Node to first male flower appearance	Node to first female flower appearance	Days to anthesis of first male flower	Days to anthesis of first female flower	Days to first fruit harvest	Vine length (cm)	Fruit length (cm)
Lines							
NDBG-1	7.00	10.88	58.21	66.91	80.30	194.85	15.25
NDBG-3	7.28	9.70	62.13	69.90	83.30	170.03	9.43
NDBG-4	8.65	12.50	51.90	61.68	73.35	179.73	14.33
NDBG-5	6.60	8.80	51.43	60.56	70.50	143.87	8.87
NGBG-6	7.88	9.91	53.28	62.95	70.48	128.73	13.71
NDBG-7	7.68	8.82	50.43	58.40	69.18	169.90	11.16
NDBG-12	6.68	8.05	59.01	66.10	75.95	169.38	13.70
NDBG-17	7.55	9.25	53.46	64.35	73.45	145.00	11.76
Pant Karela-1	7.41	9.58	55.30	64.57	77.28	167.31	16.23
PBTH-52	6.50	8.20	53.18	63.21	73.44	116.86	13.04
CI-95% (Low-High)	6.85-7.80	8.62-10.52	52.13-57.54	61.50-66.23	71.48-77.96	141.29-175.84	11.02-14.47
Mean	7.32	9.56	54.83	63.86	74.91	158.56	12.74

Table 1: Contd…Average performance of parents (lines and testers) for different maturity and yield traits in bitter gourd (*Momordica charantia* L.). (Pooled over environments)

Parents	Fruit diameter (cm)	Number of fruits plant^{-1}	Average fruit weight (g)	Fruit yield plant^{1} (kg)	Fruit yield hectare^{-1}(q)	Number of seeds fruit^{-1}
Lines						
NDBG-1	3.40	9.25	99.50	0.92	184.95	17.50
NDBG-3	3.58	7.90	83.15	0.65	130.25	13.51
NDBG-4	4.98	7.10	145.50	1.03	206.50	21.33
NDBG-5	3.48	10.50	94.55	0.99	198.00	16.26
NGBG-6	4.12	8.15	90.15	0.73	146.75	11.96
NDBG-7	4.27	9.90	71.25	0.70	140.50	11.86

NDBG-12	3.38	8.45	89.90	0.75	150.22	15.86
NDBG-17	3.28	7.05	80.25	0.56	112.87	15.66
Pant Karela -1	4.11	8.55	112.50	0.96	192.77	14.06
PBTH-52	3.81	7.65	85.75	0.60	120.65	13.33
CI-95%(Low-High)	3.46-4.22	7.63-9.27	80.29-110.21	0.67-0.91	133.82-182.87	13.08-17.18
Mean	3.84	8.45	95.25	0.79	158.35	15.13

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