



# Evaluation of Advance Generation Breeding Lines of Bitter Gourd for Yield and Quality Traits

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The present study was conducted at the College of Horticulture and Forestry, Punjab Agricultural University, Ludhiana during the summer season of 2021 and 2022. Plant material consisted of 49 advance breeding lines of bitter gourd including 2 checks namely Punjab-15 (local check) and Prachi (commercial check) in simple lattice design of 7x7 with two replications. Evaluation was done for different yield and quality traits. Among the test entries, range for marketable yield per plant varied from 476.61 to 2102.86 and it was highest in PAUBG-1521 (2102 g/plant) followed by PAUBG-200, PAUBG-211, PAUBG-208 and PAUBG-1514 performed better over the checks and lowest in PAUBG-222 (476.02 g/plant). Number of fruits per plant, fruit length, fruit

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weight, total soluble sugar, non-reducing sugar and momordicine content was highest in PAUBG-1521 (33.56), (14.23 cm), (61.18 g) (9.29 g/100g), (7.25 g/100g) and (50.21 mg/100g) respectively.

**Keywords:** Bitter gourd; advance breeding lines; marketable yield; earliness; biochemical parameters.

## 1. INTRODUCTION

Bitter gourd (*Momordica charantia* L.) is a popular summer season vegetable crop of family cucurbitaceae. It is commonly known as bitter melon, karela and balsam pear etc. It is believed to be originated in tropical Asia, particularly eastern India state. In India, the leading bittergourd producing states are Uttar Pradesh, Orissa, Maharashtra, Andhra Pradesh, Tamilnadu, Kerala Gujarat, Rajasthan and Punjab. The genus *Momordica* derives its name from the Latin word 'mordeo' (momordi = to bite) in allusion to the bitten appearance of the grooved margins of the seeds. Among the cultivated cucurbits, bitter gourd (*Momordica charantia* L.) is one of the most important vegetables grown throughout the country. It belongs to family–Cucurbitaceae, subfamily cucurbitodeae, tribe- Joliffeae and subtribe Thalithaneae. Bitter gourd belongs to genus *Momordica* which includes approximately 59 species [1].

It is an ancient medicinal vegetable crop due to presence of different kinds of biochemicals which act as antioxidant, antimicrobial, antidiabetic antiviral, anti-hepatotoxic and antiulcers [2]. Bitter taste of fruits and other plant parts is due to the presence of momordicine alkaloid. The fruits of bittergourd possesses antidiabetic properties due to the presence of hypoglycaemic substance "charantin" and it helps in reducing blood sugar (Jeffrey 1980 and Okabe et al [3]

Fruit yield is the most important component in crop improvement and is directly influenced by the other yield related variables. Desirable genotypes should be chosen based on yield as well as other yield related characteristics. Information on the yield and yield-related contributing factors is important for selection of the available genetic stocks in bittergourd crop development program [4]. The development and selection of material for earliness, high yield and quality are important aspects to be addressed to strengthen the breeding material of bittergourd for future use and for commercialization. Objective of present experiment was to study evaluation of bittergourd advance lines with

desirable agronomic traits and important quality traits.

## 2. MATERIALS AND METHODS

The experimental plant material comprised of 49 advance breeding lines of bitter gourd. These lines were evaluated in a simple lattice design of 7x7 with two replications during spring summer season of 2021 and 2022. Seeds of each bittergourd entry will be sown in plug trays filled with the mixture of cocopeat, vermiculite and perlite in the ration of 3:1:1 from last week of February to first week of March. Seeds of each bittergourd entry were sown in plug trays filled with the mixture of cocopeat, vermiculite and perlite in the ratio of 3:1:1 in 3<sup>rd</sup> week of February. Ten plants of each entry per replication were transplanted in 4<sup>th</sup> week of April on raised beds of width 1.5 m at plant to plant spacing 45 cm. The crop will be raised using recommended Package of Practices of Vegetables by Punjab Agricultural University, Ludhiana.

The data were collected on the anthesis of first male flower, anthesis of first female flower, node at which first male flower appear, node at which first female flower appear, anthesis of 50 *per cent* female flower, anthesis of 50 *per cent* male flower, internodal length, fruit weight, fruit length, fruit breadth, number of fruits per plant, vine length, marketable yield/plant, number of seeds *per* fruit, 100 seed weight. moisture content, total soluble sugar, reducing sugar, non-reducing sugar, vitamin c content, carotene content, momordicine content and phenols. The data were analysed by SAS open data analysis software.

## 3. RESULTS AND DISCUSSION

Days to first male flower the range was 53.17 to 61.34 days in genotypes PAUBG-93 and PAUBG-370 respectively. Days to first female flower the range was 60.50 to 75.86 days in genotypes PAUBG-400 and Punjab Kareli-1 respectively. Similarly, Saranyadevi et al [5] recorded that the days to first male flower after transplanting the range was 20.66 to 30.21 days in genotypes MC-18 and MC-1 respectively.

Similar findings were communicated by Priyadarshini *et al* [6] recorded that the days to first female flower the range was 38.83 to 60.50 days in genotypes MCM-11 and MCM-18 respectively.

PAUBG-336 (60.50) reported minimum days to anthesis of 50 *per cent* male flower followed by PAUBG-265 (61.50) and PAUBG-366 (74.50) took the maximum days to anthesis of 50 *per cent* male flower followed by PAUBG-370 (73.25). Genotypes PAUBG-400 (64.75) were the minimum days to anthesis of 50 *per cent* female flower followed by PAUBG-394 (65) and maximum days was PAUBG-210 (78.75) followed by Punjab Kareli-1 (77.75). Similarly, Adarsh *et al* [7] recorded that the days to 50% flowering highest in the genotype Konkan tara (54.02) and minimum in Pusa Aushadhi (38.12).

Genotype PAUBG-218 (1.56) flowered on the lowest node and PAUBG-265 (7.0) flowered on the highest node. The highest node to first female flower was in PAUBG-265 (11.52) followed by PAUBG-210 (10.64) with the lowest node to first female flower on PAUBG-128 (4.45) followed by PAUBG-239 (4.47). Similar observation where node number 1st pistillate flower (10.21days) was observed early in Pusa Aushadhi bitter gourd variety [7].

The maximum internodal length was in PAUBG-400 (11.46 cm) followed by PAUBG-390 (11.12 cm) and the minimum internodal length in Punjab-14 (4.40 cm) followed by PAUBG-239 (4.50 cm). Similarly, results were recorded to Thakur *et al* [8] where the longest internodal length was in genotypes Charu (10.16 cm) followed by Arushi 91 (9.41 cm) while the shortest internodes were in Solan Hara (7.75 cm) followed by Punjab-14 (7.96 cm).

The average individual fruit weight was maximum in variety PAUBG-1521 (61.18 g) and minimum in line PAUBG-281 (25.80 g). Similar trends were observed to Priyadarshini *et al* [6] where the highest individual fruit weight was noted in MCM-21 (9.37 g) followed by MCM-19 (9.08 g) and the lowest was MCM-20 (3.19 g).

In case of fruit length was maximum in PAUBG-1521 (14.23 cm) followed by Punjab Kareli-1 (13.07 cm) and minimum in the genotypes PAUBG-281 (5.46 cm). The results are in-line with Priyadarshini *et al* [6] reporting that the longest fruit was noted in MCM-17 (8.22 cm) followed by MCM-19 (5.51 cm) fruit length in bitter gourd.

Fruit breadth was maximum in line PAUBG-331 (4.84 cm) followed by PAUBG-218 (4.40 cm) and minimum in line Punjab Kareli-1 (1.62 cm) followed by PAUBG-344 (2.74 cm). Triveni *et al* [9] recorded similar results in bitter gourd where maximum fruit width was observed in IC 113875 (5.82 cm), while the minimum was recorded in IC 85626 (4.21 cm).

Number of fruits *per* plant was highest in PAUBG-1521 (33.56) followed by PAUBG-200 (32.94) and minimum in genotype PAUBG-301 (8.01). Similar results were observed as Priyadarshini *et al* [6] where the genotypes MCM-23 (89.67) was found to greatest number of fruits.

Marketable yield/plant was maximum in PAUBG-1521 (2102 g) followed by PAUBG-200 (2092) and minimum in PAUBG-222 (476.61 g). Similar results were recorded by Thakur *et al* [8] where the highest fruit yield/*per* plant was in 'Prachi' followed by 'Preeti'; the lowest fruit yield/*per* plant was in 'Solan Hara' followed by 'Charu'. Fruit yield *per* plant in bitter gourd ranges from 0.57-2.68 kg.

Vine length was maximum in Punjab-15 (436.63 cm) followed by PAUBG-394 (435.71 cm) and minimum in Punjab-14 (216.58 cm) followed by PAUBG-93 (250.83 cm). Similarly, Adarsh *et al* [7] recorded that vine Length was observed highest in bitter kathi (294 cm).

The maximum number of seeds were observed in line PAUBG-226 (39.42) followed by PAUBG-213 (35) and minimum in genotype PAUBG-204 (6.85) followed by PAUBG-128 (7.95). Priyadarshini *et al* [6] showed that similar results were found among the thirty genotypes, with the highest number of seeds *per* fruit being observed in MCM-22 (13.80) followed by MCM-11 (12.27), MCM-17 (11.80) in bitter gourd.

Hundred seed weight was recorded maximum in PAUBG-358 (24.99 g) followed by PAUBG-353 (22.37 g) and minimum in PAUBG-581 (9.45 g) followed by PAUBG-238 (13.55 g). The similar results were noticed to Priyadarshini *et al* (2018) where the highest 100 seed weight was observed in MCM-21 (13.17) followed by MCM-22 (12.71), MCM-23 (12.01) in bittergourd.

The maximum moisture content was observed in line PAUBG-120 (93.18) followed by PAUBG-209(92.93) and minimum in genotype PAUBG-344 (86.44) followed by PAUBG-366(86.66). Similar results were recorded by Sidhu



Genotypes	Anthesis of 1 <sup>st</sup> flower	Anthesis of 1 <sup>st</sup> ♂ flower	Anthesis of 1 <sup>st</sup> ♀ flower	Anthesis of 50% ♂ flower	Anthesis of 50% ♀ flower	Node at which 1 <sup>st</sup> flower appears	Node at which 1 <sup>st</sup> ♀ flower appears	Internodal length (cm)	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Number of fruits/plants	Marketable yield (g)	Vine plant length (cm)	Number of seeds/plants	Hundred seed weight (g)	Moisture (g/100g)	Total soluble sugar (g/100g)	Reducing sugar (g/100g)	Non reducing sugar (g/100g)	Total phenol (mg/100g)	Momordicine (mg/100g)	Carotene (mg/100g)	Vitamin C (mg/100g)
Punjab-15	69.67	71.92	70.50	76.75	2.11	8.64	10.31	57.41	10.26	3.71	20.06	1181.98	436.63	13.92	16.93	89.86	1.89	1.59	0.30	1.19	30.03	0.26	82.10	
Punjab kareli-1	61.79	75.86	73.50	77.75	5.13	9.11	8.00	44.31	13.07	1.62	26.58	1159.47	247.67	9.68	17.56	89.75	3.69	1.79	1.38	1.73	35.89	0.45	111.75	
Prachi	63.84	66.83	67.50	72.25	3.46	7.65	8.56	48.29	8.41	4.28	27.22	1032.83	354.38	22.55	16.53	87.66	7.85	1.04	6.81	1.73	40.29	0.64	113.71	
CD (5%)	5.21	6.73	5.67	4.93	0.45	1.51	0.70	4.50	1.58	0.54	2.73	128.23	52.82	2.28	1.93	2.34	0.47	0.13	0.18	0.10	2.12	0.051	6.79	
CD (1%)	6.96	9.00	7.58	6.60	0.61	2.02	0.93	6.05	2.11	0.73	3.65	171.40	70.61	3.05	2.58	3.13	0.63	0.18	0.24	0.13	2.84	0.068	9.07	

et al (2017) where the maximum mean was observed in line PBBG-31 (96.05) and minimum in genotype WBBG-6 (88.54) with an overall mean of (91.71).

The total soluble sugars were maximum in the genotypes PAUBG-1521 (9.29) followed by PAUBG-353 (8.07) and minimum in PAUBG-127 (1.00) followed by PAUBG-128 (1.19). Similar results were recorded by Adarsh et al (2019).

The reducing sugar was maximum in the genotypes PAUBG-208 (3.76) followed by PAUBG-120 (3.47) and minimum in PAUBG-200 (0.44) followed by PAUBG-222 (0.69). Similar results were recorded to Sidhu et al (2017) where the treatment mean ranged from 0.575 for PBBG-10 to 2.4 for PBBG-9 variety.

Non-reducing sugar was lowest in the genotype PAUBG-226 (0.22) followed by Punjab-15 (0.30) and PAUBG-1521 showed highest mean of (7.51) followed by PAUBG-353 (6.85). Similar results were recorded by Sidhu et al (2017) where the genotype PBBG-1 showed lowest mean value of 0.6 in the genotype PBBG-7 and PBBG-6 showed highest mean value of 2.35 and the grand mean was 1.60.

The Total phenol was maximum in genotype PAUBG-93 (1.98) followed by PAUBG-353 (1.92) and minimum in PAUBG-390 (0.71). Similar results were noted by Adarsh et al (2019) where total phenol was highest in the genotype BRBTW (9.17 mg/100g) and lowest total phenol was observed in Jhalari (1.31 mg/100g).

The line PAUBG-229 showed highest content of total carotene (1.99 mg/100g) followed by PAUBG-222 (1.49 mg/100g) and lowest was observed in variety PAUBG-215 (0.14mg/100 g). Behera and Kaur (2006) obtained similar results where DBTG-8 had the highest total carotenoids content (3.2 mg), followed by DBTG-9 (3.0 mg), DBTG-101 (2.9 mg), DBTG-6 (2.8 mg), DBTG-4 (2.7 mg), and DBTG-2 (2.7 mg) (2.6 mg).

The line PAUBG-1521 recorded maximum momordicine content (50.21 mg/100g) followed by PAUBG-208 (48.48 mg/100g) and minimum was observed PAUBG-353 (14.43 mg/100g). Similar results were also recorded by Sathish et al [10] where the maximum momordicine content (1.98 mg-g-1) was recorded in progeny P1 x P4 while minimum in P2 x P4 (1.87 mg-g-1).

The Vitamin C content was highest in PAUBG-1514 (130.95 mg/100g) followed by PAUBG-213

(125.44 mg/100g) and was lowest in PAUBG-331 (30.94 mg/100g). Similar results have been noted by Behera and Kaur [11] where the highest amount of ascorbic acid was found in genotype DBTG-3 (122.07 mg) followed by DBTG-8 (120.53 mg) and lowest was DBTG-5 (92.15) [12-14].

#### 4. CONCLUSION

Bitter gourd (*Momordica charantia* L.) is one of the important members among the cultivated cucurbits. The present investigation was undertaken to evaluate 49 advance generation breeding lines of bittergourd for horticultural and biochemical traits. The genotypes viz. PAUBG-1521 followed by PAUBG-200, PAUBG-211, PAUBG-208 and PAUBG-1514 performed better over the checks (Punjab-15 and hybrid Prachi) in terms of marketable fruit yield. It can be concluded that, as a wide range of variation for almost all the economically important traits was present in this crop, so there is a vast scope for improvement through different breeding procedure.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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