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Evaluation of advance generation breeding lines of bitter gourd for unique morphological features

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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 2021-22. 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 morphological traits. The observations were recorded for seven morphological characters. Morphological characterization showed wide variability for fruit shape and fruit skin colour. In case of fruit shape eighteen genotypes possessed spindle, twenty-five genotypes elliptical, five genotypes conical and one genotype globular fruit shape. Colour of fruit skin varied from dark green to milky white. Six genotypes namely PAUBG-236, PAUBG-301, PAUBG-331, PAUBG-265, PAUBG-336 and Prachi had dark green, 38 green, PAUBG-338 light green and four genotypes milky white fruit skin colour.

Keywords: Advance breeding lines, bitter gourd, evaluation, genotypes, morphological traits

1. Introduction
Bitter gourd (*Momordica charantia* L.) is a popular summer season vegetable crop. 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, Tamil Nadu, 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 (Schaefer and Renner, 2010) [6].
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 (Welthinda *et al.*, 1986) [9[]. Bitter taste of fruits and other plant parts is due to the presence of momordicine alkaloid. The fruit of bitter gourd posseses antidiabetic properties due to the presence of hypoglycaemic substance "charantin" and it helps in reducing blood sugar (Jeffrey, 1980 and Okabe *et al.*, 1982) [3, 5].
It is cultivated throughout India for its tender fruits which are used as fried, cooked, stuffed, in curries and pickles. It is a rich source of vitamins, phosphorous, iron and has medicinal value specially to cure blood disease, diabetes, asthmaetc (Yawalker, 1980) [10]. Bitter gourd flowers grow singly in the axil of a leaf. Male flowers are yellow in colour, small in size placed on long thin pedicel of the plant and appear earlier to female flowers. The pistillate flowers are larger in size as compared to male flower and can be easily recognized by the presence of oblong to long size ovary of green colour. Flower having 5 calyx, 5 corolla and three filament (Behera *et al.*, 2010) [1].

2. Materials and Methods
The investigation on evaluation of advance generation breeding lines of bitter gourd for unique morphological features was undertaken during the year 2021-22. They were evaluated at the was carried out at the experiment Vegetable Research Farm, Department of Vegetable Science, Punjab Agricultural University, Ludhiana (Punjab).

Plate I: General view of the experimental area

Morphological characters
Morphological characterization of germplasm lines under investigation were accomplished as per the guidelines of Srivastava *et al.* (2011) [8].

Plant vigour: Recorded after 30 days of sowing

Stem shape: Recorded at near maturity stage (recorded from the cross section)

Flower colour: Recorded at flowering stage

Fruit shape: Recorded at marketable stage

Fruit surface: Recorded at marketable stage

Nature of tubercles: Recorded at marketable stage

Fruit skin colour: Recorded at marketable stage

Table 1: Morphological characterization of bitter gourd

S.No.	Character	Category
1.	Plant vigour	Poor/good/High/Others
2.	Stem shape	Round/Angular/Others
3.	Flower colour	Yellow/ Light Yellow/Creamish yellow/Others
4.	Fruit shape	Spindal/Elliptical/Conical/Globular/Others
5.	Fruit surface	Light tubercle/Deep tubercle/Others
6.	Nature of tubercles	Prominent/Non-prominent/Others
7.	Fruit skin colour	Green/Milky white/Light Green//Dark Green/Others

3. Results and Discussion

3.1 Morphological characterization of the germplasm

Morphological characterization of the germplasm lines under study was accomplished for seven morphological characters as per the guidelines of Srivastava *et al.*, (2011) [8].

3.1.1 Plant vigour

Twelve genotypes viz., Punjab Kareli-1, Punjab-14, PAUBG-200, PAUBG-208, PAUBG-218, PAUBG-226, PAUBG-239, PAUBG-282, PAUBG-331, PAUBG-336, PAUBG-358 and PAUBG-394 observed to be high, seven good, twenty medium and nine poor in term of plant vigour trait.
Sidhu and Pathak (2016) [7] also observed similar results, where nine genotypes showed good, nine medium and four poor for plant vigour trait.

3.1.2 Stem shape

All the genotypes showed round stem shape. Out of 36 genotypes evaluated by Sidhu and Pathak (2016) [7] found 35 genotypes showed round stem shape except *Momordica subangulata* which possessed angular stem shape.

3.1.3 Flower colour

Flower of 42 genotypes having yellow colour, two genotypes namely PAUBG-200 and PAUBG-400 having creamish yellow and five genotypes having light-yellow colour.
Similar results have been discovered by Sidhu and Pathak (2016) [7] where colour of the flower was white in *Momordica subangulata* whereas all other genotypes possess yellow flower colour.

3.1.4 Fruit shape

Eighteen genotypes possessed spindle, twenty-five genotypes elliptical, five genotypes conical and one genotype globular fruit shape.
Goo *et al.* (2016) [2] also found similar results depicting eight lines viz., KSI 1, KSI 2, KSI 3, KSI 4, KSI 5 and KSI 6 of spindle and Indonesia line KSI 7 and KSI 8 of cylindrical fruit shape.

3.1.5 Fruit skin colour

Colour of fruit skin varied from dark green to milky white. six genotypes namely PAUBG-236, PAUBG-301, PAUBG-331, PAUBG-265, PAUBG-336 and Prachi had dark green, 38 green, PAUBG-338 was observed light green in one genotype and four genotype showed milky white fruit skin colour. Karaman *et al.* (2018) also found variation for bitter gourd fruit skin colour from dark green to light green. They reported two genotypes of dark green, six medium green and four of light green colour.

3.1.6 Fruit surface

Light tubercles were present in variety Punjab-14 and the rest forty-eight genotypes had deep tubercles. Similar findings were repoted by Sidhu and Pathak (2016) [7] discovered that the fruit surface of CHBG-4 and CHBG-6 was light while the rest of the genotypes have deep tubercles.

3.1.7 Nature of tubercles

Nature of tubercles was prominent in thirty-four genotypes while it was non-prominent in fifteen genotypes. Similar results were also found by Goo *et al.* (2016) [2] where nature of tubercles was medium in three genotype and five genotypes had large tubercles.

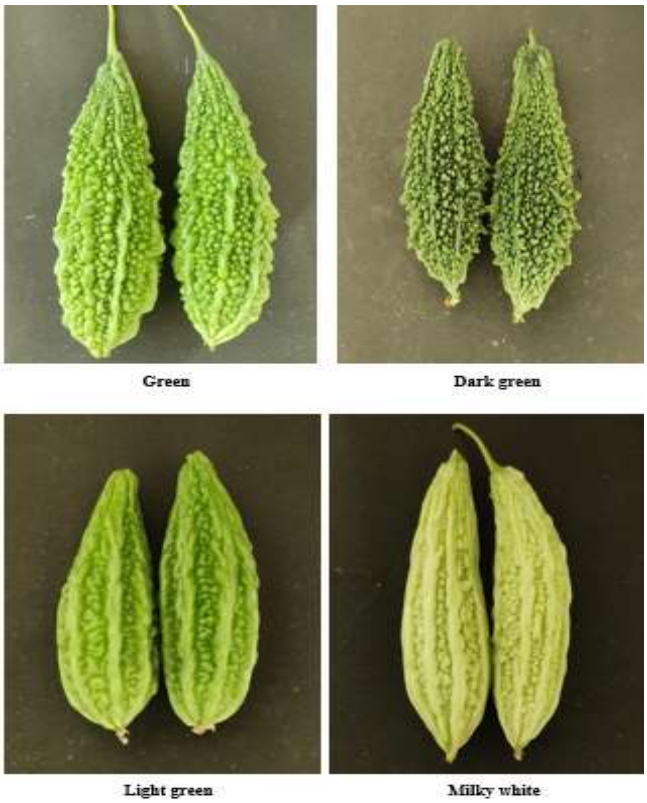

Plate II: Fruit skin colour of bitter gourd

Plate III: Fruit shape of bitter gourd

Deep tubercles Light tubercles

Plate IV: Fruit surface of bitter gourd

Table 2: Morphological characterization of bitter gourd germplasm lines

Sr. No.	Name	Plant vigour	Stem shape	Flower colour	Fruit shape	Fruit skin colour	Fruit surface	Nature of tubercles
1	PAUBG-93	Medium	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
2	PAUBG-120	Medium	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
3	PAUBG-127	Poor	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
4	PAUBG-128	Medium	Round	Yellow	Elliptical	Green	Deep tubercles	Non-prominent
5	PAUBG-200	High	Round	Creamish yellow	Elliptical	Milky white	Deep tubercles	Non-prominent
6	PAUBG-204	Medium	Round	Yellow	Elliptical	Milky white	Deep tubercles	Prominent
7	PAUBG-208	High	Round	Yellow	Spindle	Milky white	Deep tubercles	Non-prominent
8	PAUBG-209	Medium	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
9	PAUBG-210	Medium	Round	Yellow	Spindle	Green	Deep tubercles	Non-prominent
10	PAUBG-211	Medium	Round	Yellow	Spindle	Green	Deep tubercles	Non-prominent
11	PAUBG-213	Medium	Round	Yellow	Elliptical	Green	Deep tubercles	Non-prominent
12	PAUBG-215	Medium	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
13	PAUBG-218	High	Round	Yellow	Conical	Green	Deep tubercles	Non-prominent
14	PAUBG-219	Medium	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
15	PAUBG-222	Poor	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
16	PAUBG-226	High	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
17	PAUBG-227	Poor	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
18	PAUBG-229	Poor	Round	Yellow	Spindal	Green	Deep tubercles	Prominent
19	PAUBG-236	Medium	Round	Yellow	Elliptical	Dark green	Deep tubercles	Prominent
20	PAUBG-238	Good	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
21	PAUBG-239	High	Round	Yellow	Globular	Green	Deep tubercles	Prominent
22	PAUBG-265	Poor	Round	Yellow	Elliptical	Dark green	Deep tubercles	Non-prominent
23	PAUBG-281	Medium	Round	Yellow	Conical	Green	Deep tubercles	Prominent
24	PAUBG-282	High	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
25	PAUBG-301	Poor	Round	Yellow	Conical	Dark green	Deep tubercles	Non-prominent
26	PAUBG-331	High	Round	Yellow	Elliptical	Dark green	Deep tubercles	Prominent
27	PAUBG-336	High	Round	Yellow	Elliptical	Dark green	Deep tubercles	Non-prominent
28	PAUBG-338	Medium	Round	Yellow	Elliptical	Light green	Deep tubercles	Non-prominent
29	PAUBG-341	Good	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
30	PAUBG-344	Good	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
31	PAUBG-351	Poor	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
32	PAUBG-353	Medium	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
33	PAUBG-358	High	Round	Yellow	Conical	Green	Deep tubercles	Prominent
34	PAUBG-366	Medium	Round	Yellow	Spindle	Green	Deep tubercles	Non-prominent
35	PAUBG-370	Good	Round	Light yellow	Elliptical	Green	Deep tubercles	Non-prominent
36	PAUBG-375	Good	Round	Yellow	Elliptical	Green	Deep tubercles	Non-prominent
37	PAUBG-390	Medium	Round	Light yellow	Spindle	Green	Deep tubercles	Prominent
38	PAUBG-394	High	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
39	PAUBG-321	Poor	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
40	PAUBG-337	Poor	Round	Yellow	Conical	Green	Deep tubercles	Prominent
41	PAUBG-400	Good	Round	Creamish yellow	Elliptical	Milky white	Deep tubercles	Prominent
42	PAUBG-407	Medium	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
43	PAUBG-581	Medium	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
44	PAUBG-1514	Medium	Round	Light yellow	Elliptical	Green	Deep tubercles	Prominent
45	PAUBG-1521	Good	Round	Yellow	Spindle	Green	Deep tubercles	Prominent
46	Punjab-14	High	Round	Yellow	Spindle	Green	Light tubercles	Non-prominent
47	Punjab-15	Good	Round	Light yellow	Spindle	Green	Deep tubercles	Prominent
48	Punjab kareli-1	High	Round	Yellow	Elliptical	Green	Deep tubercles	Prominent
49	Prachi	Medium	Round	Light yellow	Elliptical	Dark green	Deep tubercles	Prominent

4. Conclusions

In the present study 49 genotypes based on 7 morphological characters showed the presence of limited variation in the germplasm lines under study in respect of some characters viz., plant vigour, fruit surface, nature of tubercles, stem shape and flower colour. However wide variability was observed for fruit shape and fruit skin colour.

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