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### Studies on heritability (Narrow Sense) and genetic advance analysis for growth, fruit yield and its component traits in bitter gourd (*Momordica charantia* L.)

Ramesh Rajbhar<sup>1\*</sup>, CN Ram<sup>2</sup>, Anil Kumar<sup>3</sup>, Aastik Jha<sup>3</sup>, Ashish Kumar Singh<sup>3</sup> and Vipin<sup>4</sup>

<sup>1&4</sup>Ph.D. Scholar, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, India.

<sup>2</sup>Professor & Head, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

<sup>3</sup>Assistant Professor, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

\*Corresponding author mail-[rameshrajbhar05730@gmail.com](mailto:rameshrajbhar05730@gmail.com)

#### Abstract

The present study was conducted at the Main Experiment Station (MES) of the Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) India during the *Zaid* seasons of 2022-23 (Y1) and 2023-24 (Y2). Plant material consisted of 30 F<sub>1</sub> hybrids and their 13 parents (10 lines and 3 testers) bitter gourd including 1 check namely Sagar (commercial check) in Randomized Block Design (RBD) with three replications in line x tester mating design. The crop was sown in rows spaced at 3 meters apart with a plant to plant spacing of 0.50 meter. Sowing was done on 22 February, 2022-23 and 19 February, 2023-24. Evaluation was done for different yield and quality traits. Observation was recorded for the 18 characters. High heritability coupled with high genetic advance were observed for node number to first staminate flower appearance, node number to first pistillate flower appearance, vine length, fruit length, fruit circumference, fruit weight, number of fruits per plant-1, total soluble solids, ascorbic acid, reducing sugars, non-reducing sugars, total sugar, dry matter, and fruit yield per plant<sup>-1</sup> in both the years and pooled. High heritability (narrow sense) along with high genetic advance in per cent of mean were observed for most of important economic traits showing ample scope of crop improvement by selection.

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## Introduction

Bitter gourd, which is botanically known as “*Momordica charantia* L.”, belongs to the family “Cucurbitaceae”, and is a “tropical and subtropical” important commercial vegetable crop (Jeffrey, 1990 and Singh *et al.* 2013). The crops belong to this family often called as "cucurbits". Hyde Bailey gave the word "cucurbits" for cultivated species of the Cucurbitaceae family. This family comprises about 130 genera and approximately 800 species almost uniformly spread between new and old-world tropics (Kocyanet *al* 2007, Dhiman *et al.*, 2012).

The name "*Momordica*" is derived from a Latin word, which means “to bite”, referring to the ridged edges of its seed which appears as if it has been chewed. It is believed to be originated from Tropical Asia particularly Eastern India and South China. As it has been originated from old world tropics and disseminated over new world tropics, where it firstly arrived in Brazil through the slave traders of Africa and later on spread in Central America (Miniraj *et al.* 1993). The wild species *Momordica charantia* var. *abbreviata*, a native of Asia, is reported to be the progenitor of domesticated bitter gourd (Acharya *et al.* 2019). Bitter melon is largely distributed in China, Indo-Burman (center of origin), India, Malaysia, tropical Africa, North and South America (Miniraj *et al.* 1993).

Tropical and subtropical region are suitable for its growth. In India the total area under bitter gourd cultivation is 110· 000 ha, with a production of 1369·000 MT (Anonymous, 2022).

It is also known as bitter melon, balsam pear, maiden apple, casislla, karela, bitter cucumber and African cucumber (Morton, 1967 and Acharya *et al.* 2019). Bitter gourd is well known for its high nutritive value particularly high ascorbic acid and iron content (Behera, 2004 and Bharathi and John, 2015). The fruits of bitter gourd are commonly used as a vegetable and are well known for its medicinal properties (Robinson and Decker-Walters, 1997 and Kumari *et al.* 2018). It also supplies health benefits against a range of diseases for a better life. It is a nutrient-rich vegetable contains diverse bioactive compounds such as alkaloids, phytochemicals, especially antioxidants, vitamins, and minerals. These compounds have the ability to fight against cancer, diabetes, abdominal pain, kidney (stone), fever as well as scabies (Joseph and Jini, 2013; and Saeed *et al.* 2018).

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 bitter gourd crop development program (Chinthan *et al* 2021). The development and selection of material for earliness, high yield and quality are important aspects to be addressed to strengthen the breeding material of bitter gourd for future use and for commercialization.

### **Materials and methods**

The experimental plant material comprised of 30 F<sub>1</sub> hybrids and their 13 parents (10 lines and 3 testers) of bitter gourd. These lines were evaluated in a Randomized Block Design (RBD) with three replications during *Zaid* seasons of 2022-23 (Y1) and 2023- 24 (Y2). The crop was sown in rows spaced at 3 meters apart with a plant to plant spacing of 0.50 meter. Sowing was done on 22 February, 2022-23 and 19 February, 2023-24. All the recommended agronomic package of practices and protection measures were followed to raise good crops by Main Experiment Station (MES) of the Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) India. The data were collected on the days to first staminate flower anthesis, days to first pistillate flower anthesis, node number to first staminate flower appearance, node number to first pistillate flower appearance, days to first harvest, vine length (cm), number of primary branches per plant, fruit length (cm), fruit circumference (cm), fruit weight (g), number of fruits per plant, fruit yield per plant (g), total soluble solids (%), ascorbic acid (mg/100g fresh fruit), reducing sugars (%), non-reducing sugars (%), total sugars (%), dry matter (%).

### **Results and discussion**

Kempthorne and Curnow (1961) classified heritability in narrow sense ( $h^2_{ns}$ ) into three categories viz., high (>30%), medium (10-30%), and low (<10%). The high estimates of heritability in narrow-sense (Table-1) were recorded for days to first staminate flower anthesis (60.80%, 30.40% and 41.60%), days to first pistillate flower anthesis (47.20% and 47.40%), node number to first staminate flower appearance (90.70%, 83.70% and 81.70%), node number to first pistillate flower appearance (81.70%, 95.60% and 82.70%), vine length (87.70%, 89.10% and 90.70%), number of primary branches plant<sup>-1</sup> (37.40%, 19.70% and 34.40%), fruit length (92.10%, 92.00% and 47.90%), fruit circumference

(82.40%, 84.40% and 81.60%), fruit weight (95.00%, 96.90% and 89.80%), number of fruit per plant (86.20%, 94.40% and 89.20%), days to first harvest (30.20%, 39.30% and 44.40%), total sugar (99.70%, 99.60% and 88.90%), ascorbic acid (99.50%, 99.40% and 97.70%), reducing sugars (99.70%, 99.70% and 95.40%), non-reducing sugar (99.80%, 99.80% and 84.80), dry matter (97.00%, 96.30% and 93.20%), total soluble solids (98.80%, 99.10% and 98.10%), fruit yield per plant (98.80%, 98.50% and 97.00%) and in both the years and pooled.

The highest value of genetic advance in per cent of mean was shown in number of fruits per plant, fruit yield plant-1, node number to first pistillate flower, vine length, node number to first staminate flowers; Ahmad *et al.* (2022) for fruit yield and fruit length.

Genetic advance in percent of mean was recorded high for non-reducing sugars (129.06%, 138.27% and 113.36%) and reducing sugars (115.41%, 131.14% and 117.39%), node number to first staminate flower appearance (65.83%, 56.04% and 56.99), node number to first pistillate flower appearance (40.75%, 42.45% and 39.09%), vine length (30.57%, 31.11% and 31.84%), fruit length (49.19 %, 50.86% and 26.01), fruit Circumference (32.87%, 33.72% and 32.56%), fruit weight (45.85%, 58.43% and 48.76%) number of fruits per plant<sup>-1</sup> (53.53%, 54.78% and 53.80%), total sugar (104.62%, 93.87% and 89.61%), ascorbic acid (71.86%, 66.01% and 67.79%), dry matter (22.90%, 20.93% and 21.17%) total soluble solids (51.07%, 50.00% and 50.11), and fruit yield per plant<sup>-1</sup> (103.40%, 105.61% and 102.72) in both the years and pooled.

Genetic advance in percent of mean was recorded low for number of primary branches plant<sup>-1</sup> (6.14%, 3.03% and 5.05), days to first harvest (4.75%, 5.52% and 6.62), days to first staminate flower anthesis (10.00, 6.76 and 8.34) and days to first pistillate flower anthesis (7.35, 7.25 and 7.29). Similar observations were also reported by Verma *et al.*(2022) for node number to first staminate and pistillate flower appears, average weight per fruit, number of fruits per plant, fruit length and fruit yield per plant; Lal *et al.* (2021) observed high heritability coupled with high genetic advance as per cent of mean for fruit length, reducing sugar, total sugar, node number to first female flower appearance, primary branches per plant; Singh *et al.* (2021) for vine length, number of primary branches, fruit length, number of fruits per plant and yield q/ha ;Vaidya *et al.*(2020) for number of primary branches per vine, number of fruits per vine, yield per vine.

**Table- 1: Estimates of heritability in narrow sense ( $h^2_{ns}$ ) and genetic advance in per cent of mean for eighteen characters in bitter melon over two years (Y1 = 2022, Y2 = 2023) and pooled.**

| S. No. | Parameters                                      | Heritability ( $h^2_{ns}$ %) |       |        | Genetic advance in per cent of mean |         |         |
|--------|---|------------------------------|-------|--------|-------------------------------------|---------|---------|
|        |   | Y1                           | Y2    | Pooled | Y1                                  | Y2      | Pooled  |
| 1.     | Days to first staminate flower appearance       | 60.80                        | 30.40 | 41.60  | 10.00                               | 6.761   | 8.341   |
| 2.     | Days to first pistillate flower appearance      | 47.20                        | 47.80 | 47.40  | 7.356                               | 7.253   | 7.294   |
| 3.     | Node number to first staminate flower anthesis  | 90.70                        | 83.70 | 81.70  | 65.833                              | 56.048  | 56.999  |
| 4.     | Node number to first pistillate flower anthesis | 81.70                        | 95.60 | 82.70  | 40.752                              | 42.459  | 39.099  |
| 5.     | Vine length(cm)                                 | 87.70                        | 89.10 | 90.70  | 30.957                              | 31.114  | 31.841  |
| 6.     | Number of primary branches / plants             | 37.40                        | 19.70 | 34.40  | 6.148                               | 3.083   | 5.515   |
| 7.     | Fruit length (cm)                               | 92.10                        | 92.00 | 47.90  | 49.197                              | 50.865  | 26.011  |
| 8.     | Fruit Circumference(cm)                         | 82.40                        | 84.40 | 81.60  | 32.879                              | 33.729  | 32.561  |
| 9.     | Fruit weight (g)                                | 95.00                        | 96.90 | 89.80  | 45.854                              | 58.437  | 48.767  |
| 10.    | Number of fruits per plant                      | 86.20                        | 94.40 | 89.20  | 53.533                              | 54.781  | 53.805  |
| 11.    | Days to first harvest                           | 30.20                        | 39.30 | 44.40  | 4.757                               | 5.524   | 6.625   |
| 12.    | Total Sugar (brix)                              | 99.70                        | 99.60 | 88.90  | 104.62                              | 93.873  | 89.614  |
| 13.    | Ascorbic acid (%)                               | 99.50                        | 99.40 | 97.70  | 71.869                              | 66.011  | 67.795  |
| 14.    | Reducing sugar (%)                              | 99.70                        | 99.70 | 95.40  | 115.418                             | 131.149 | 117.39  |
| 15.    | Non-reducing sugar (%)                          | 99.80                        | 99.80 | 84.80  | 129.096                             | 138.278 | 113.361 |
| 16.    | Dry matter (%)                                  | 97.00                        | 96.30 | 93.20  | 22.902                              | 20.932  | 21.173  |
| 17.    | Total Soluble Solids (%)                        | 98.80                        | 99.10 | 98.10  | 51.078                              | 50      | 50.118  |
| 18.    | Fruit yield per plant (g)                       | 98.80                        | 98.50 | 97.00  | 103.405                             | 105.611 | 102.72  |

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