https://doi.org/10.48047/AFJBS.6.5.2024. 10093-10099

AfricanJournalofBiological Sciences

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

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Article History
Volume 6, Issue 5, 2024
Received: 22 May 2024
Accepted: 03 Jun 2024
doi:*10.48047/AFJBS.6.5.2024. 10093-10099*

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 2021-22 (Y1) and 2022-23 (Y2). Plant material consisted of 30 F_1 hybrids and their 13 parents (10 lines and 3 testers) bitter gourd including 1 check namely Sagar (commercial check) in Randomized Block Design (RBD)withthreereplications 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 March, 2021-22 and 19 March, 2022-23. 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 fornode number to first staminate flower appearance, node number to first pistillate flower appearance,vine length, fruitlength, 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^{-1} 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.

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 (Kocyan*et 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 bittergourd 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 bittergourd for future use and for commercialization.

Materialsand methods

The experimental plant material comprised of 30 F_1 hybrids and their 13 parents (10 lines and 3 testers) of bitter gourd. Theselines wereevaluatedinaRandomized Block Design (RBD)withthreereplicationsduringZaid seasons of 2021-22 (Y1) and 2022-23 (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 March, 2021-22 and 19 March, 2022-23. 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 datawerecollectedon the daystofirststaminateflower anthesis, daystofirstpistillatefloweranthesis, nodenumbertofirst staminateflowerappearance, nodenumberto firstpistillateflower appearance, daystofirstharvest, vinelength (cm), numberofprimarybranchesper plant,fruitlength(cm),fruitcircumference(cm), fruitweight(g), number offruits perplant, fruityieldperplant (g),totalsoluble solids (%), ascorbicacid(mg/100gfresh fruit), reducingsugars(%), non-reducingsugars(%),totalsugars(%), drymatter(%).

Results and discussion

Kempthorne and Curnow (1961) classified heritability in narrow sense (h2ns) 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-1 (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-^{1} (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-^{1} (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-1 (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). Similarobservationswerealsoreportedby Verma *etal.*(2022) for node number to first staminate and pistillate flower appears, average weight perfruit, 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 fruitlength,reducingsugar,totalsugar,nodenumbertofirstfemaleflowerappearance,primary branches per plant; Singh *et al.* (2021) for vine length, number of primary branches, fruitlength,numberoffruitsperplantandyieldq/ha;Vaidya*etal.*(2020)fornumberofprimary branchesper vine, number offruits pervine, yieldper vine.

Table- 1: Estimates of heritability in narrow sense (h2ns) and genetic advance in per cent of mean for eighteen characters in bitter gourd over two years (Y1 = 2022, Y2 = 2023) and pooled.

S. No.	Parameters	Heritability (h^2ns %)			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 pistillateflower 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

References:

Acharya, S. K., Kaushik, R. A., Ameta, K. D., Dubey, R. B., & Upadhya, B. (2019). Heterosis and combining ability in bitter gourd (Momordica charantia L.). *Journal of Pharmacognosy and Phytochemistry*, *8*(1S), 537-544.

Ahmad, M., Singh, B., Alam, K., Wamiq, M., Ali, I., Kumar, R., & Shukla, R. 2022. Assessment of Heritability and Genetic Advance in Parent and F1 Hybrids of Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.].*Biological Forum*. 14(3): 581-583.

Anonymous, 2021-2022. Area, production and productivity of bitter gourd (*Momordica Charantia* L.) in India, Department of agriculture, Government of India.

Behera, T.K. 2004. Heterosis in bittergourd. pp. 217-221. In: P.K. Singh, S.K. Dasgupta, and S.K. Thpathi (eds.), Hybrid vegetable development. Haworth Press, New York.

Chinthan, K. N. 2021. Studies on genetic variability among local landraces of bitter gourd (*Momordica charantia* L.) for yield attributing traits under northern dry zone of Karnataka. *Journal of pharmaceutical innovation*, **10**(1): 174-178.

Dhiman K, Gupta A, Sharma DK, Gill NS, Goyal A. A Review on the Medicinally Important Plants of the Family Cucurbitaceae. *Asian Journal of Clinical Nutrition*. 2012; 4(1):16-26.

Jeffrey C (1990) A review of the Cucurbitaceae. *Bot J Linn Soc* **81**:233-47.

Joseph, B., & Jini, D. (2013). Antidiabetic effects of Momordica charantia (bitter melon) and its medicinal potency. *Asian pacific journal of tropical disease*, *3*(2), 93-102.

Kocyan, A., Zhang, L. B., Schaefer, H. and Renner, S. S. 2007. A multilocus Chloroplast phylogeny for the Cucurbitaceae and its implications for character evolution and classification. *Mol. PhylogenEvol.* 44: 533-577.

Kumari M, Kumar J, Kumari A, Singh V K, Rani N and Kumar A (2018) Genetic Variability, Correlation and Path Coefficient Analysis for Yield and Yield Attributing Traits in Bitter Gourd (*Momordica charantia* L.). *Curr J Appl* **31**:1-8.

Lal, M., Ram, C.N., Yadav, G.C. and Rao, O.P. 2021. Studies on heritability and genetic advance for the quantitative traits in bottle gourd *[Lagenaria siceraria* (Mol.) Standl.]. *Pharm Innov. J*. 10(7): 1582-1584.

Miniraj, N., Prasanna, K.P. and Peter, K.V. (1993). Bitter gourd (Momordica spp.) In Kalloo, G. and Bergh, B.O. (Eds.), Genetic improvement of vegetable plants (pp. 239–246) Oxford: Pergamon Press.

Morton, J.F. 1967. The balsam pear an edible medicinal and toxic plant. Economic Botany. 212:

57-68.

Robinson, R.W., D.S. Decker-walters. *Cucurbits*. New York Cab International, 1997. 226p. (Crop Production Science in Horticulture n°.6).

Saeed, F., Afzaal, M., Niaz, B., Arshad, M. U., Tufail, T., Hussain, M. B., & Javed, A. (2018). Bitter melon (Momordica charantia): A natural healthy vegetable. *International Journal of Food Properties*, *21*(1), 1270-1290.

Singh, A. K. Pan, R. S., and Bhavana, P. (2013). Heterosis and combining ability analysis in bitter gourd (*Momordica charantia*L.). *The Bioscan*, **8**(4): 1533-1536.

Singh, R., Singh, B., Prakash, S., Kumar, M., Kumar, V., Chand, P. and Vaishali. 2021. Genetic variability, heritability and genetic advance in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. *Ann. Hort.* 14(1): 72-78.

Vaidya, A.V., Bhalekar, M.N. and Pawar, P.K. 2020. Genetic studies in F3 progenies of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. *Int. J. Curr. Microbiol. App. Sci*. 9(7): 714-719.

Verma, A.K., Singh, K.P., Singh, L., Singh, P.K., Kumar, V., Lal, B. and Kumar, S. 2022. Studies on variability, heritability and genetic advance for growth, yield, and quality traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. *Pharm. Innov. J*. 11(3): 2428-2430.