Original Research Article

Performance of Different Hybrids of Bitter Gourd (*Momordica charantia* L.) in terms of Growth, Yield and Quality in Prayagraj Agro-Climatic Condition

ABSTRACT

Bitter gourd botanically known as *Momordica charantia* (L.) is an important commercial cucurbitaceous vegetable belonging to the family Cucurbitaceae, with a diploid chromosome number, 2n=22. It is variously known as balsam pear, bitter melon, bitter gourd, and African bitter gourd. Therefore, the present investigation was carried out at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during the *Zaid* season 2023 with a view to check performance of different genotypes of bitter gourd under Prayagraj agro climatic conditions. The experiment was laid in Randomized block design with 12 hybrids with 3 replications. Genotypes comprised of H_1 (AVT-II 2020/BIGHYB-1); H_2 (AVT-II 2020/BIGHYB-2); H_3 (AVT-II 2020/BIGHYB-3); H_4 (AVT-II 2020/BIGHYB-4); H_5 (AVT-II 2020/BIGHYB-5); H_6 (AVT-II 2020/BIGHYB-6); H_7 (AVT-II 2020/BIGHYB-7); H_8 (AVT-II 2020/BIGHYB-8); H_9 (AVT-II 2020/BIGHYB-9); H_{10} (Shriram Samridhi); H_{11} (Alpine F_1 Hybrid) and H_{12} (F_1 Hybrid Aman). From the present investigation, it is concluded that among twelve hybrids of Bitter gourd, hybrid AVT-II 2020/BIGHYB-6 performed best in terms of growth & yield. The vine length was recorded 3.45 m, fruit yield was 122.48 q/ha. In the economic analysis of the hybrid AVT-II 2020/BIGHYB-6.

Keywords: *Momordica charantia*, Hybrids, Growth, Fruit Yield and Quality.

Introduction

Bitter gourd botanically known as*Momordica charantia*(L.) is an important commercial cucurbitaceous vegetable belonging to the family Cucurbitaceae, with a diploid chromosome number, 2n=22. It is variously known as balsam pear, bitter melon, bitter gourd, and African bitter gourd (**Heiser, 1979**). Bitter gourd is grown in different varieties in different countries. In India the main varieties are India long green, India long white and Hybrid India baby whereas Japan is famous for Japan Green Spindle, China is for green lover and Hong Kong for its Hong Kong Green. In Bangladesh mainly two varieties are grown i.e., Uchee (small) and Korolla (long) (**Alam*et al.*, 2015**). The bitter gourd plant is perennial with climbing and flowering vine grows up to 5 m and fruits are elongated with ridges on surface (**Lee *et al.*, 2009**). The young fruit is emerald green

and later changes to orange-yellow when it is ripened (**Kandangath*et al.*, 2015**). The shape and size of bitter gourds vary due to varieties, climatic factors, regions but in general bitter gourds are 1.0 to 9.8 inch long and 1.0 to 5.9 inch wide with round, oval, oblong and club in shape and colour varies from dark green to white. In India the length of bitter gourd ranges from 2.4 to 3.9 inch and dark green in colour with ridges on its surface (**Kumar *et al.*, 2016**). The bitter gourd fruit gets mature after 45-80 days and harvesting is carried out after 60 days and continues up to 150 days from the planting (**Islam *et al.*, 2011**). The shelf life of fresh bitter gourd is only 4 days at natural conditions, and it can be stored up to 3-4 weeks in cold storage (0 to 7 °C) (**Wang *et al.*, 2007**). The bitter gourd is highly nutritious due to presence higher amount of protein, ascorbic acid, calcium, iron, and phosphorus (**Dandawate *et al.*, 2016**), also important source of glucosides, carbohydrate, charantin, steroidal, saponin, momordium, vitamins, protein and minerals. The protein content in bitter gourd is fractioned into albumin (49.3 per cent), globulin (29.3 per cent) and glutelin (3.1 per cent) (**Horax*et al.*, 2010**). The seeds of the bitter gourd contain 35 to 40 per cent of oil and fatty acid i.e., 3.33 per cent MUFA (monosaturated fatty acid) and 36.71 per cent SFA (saturated fatty acids) (**Liu *et al.*, 2010**). Bitter gourd contains high amount of Vitamin A, Vitamin C and vitamins B1,B2, B3 and B12 (**Joseph and Jini, 2013**). According to **NHB, 2022,** area under bitter gourd production in India accounts to 96.85 million ha with production of 1332.55 million tonnes in year 2021-22. Madhya Pradesh ranks first in area and production of bitter gourd in year 2021-22 followed by Chhattisgarh and Tamil Nadu. The production of bitter gourd in Uttar Pradesh is 89.73 million tonnes for year 2021-22. It has many uses in ayurvedic medicines.Study was undertaken to estimate the performance of different hybrid varieties of Bitter gourd (*Momordica charantia*) under Prayagraj Agro-climatic condition. The varieties were evaluated based on growth, yield and quality of varieties, shelf life and economics of different Bitter gourd hybrid varieties. Yield is a complex character and their interactions. For any effective selection programme, it would be desirable to consider the relative magnitude of association of various characters yield.

MATERIALS AND METHODS

The present investigation entitledwas done to understand the plant growth, fruit yield and quality of fruit of different F_1 hybrids of bitter gourd. The investigation was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during the winter season of 2022-23.The experiment was laid in Randomized block design with 12 Hybrids and 3 replications. Hybrids comprised of H_1 (2020/BIGHYB-1), H_2

(2020/BIGHYB-2), H_3 (2020/BIGHYB-3), H_4 (2020/BIGHYB-4), H_5 (2020/BIGHYB-5), H_6 (2020/BIGHYB-6), H_7 (2020/BIGHYB-7), H_8 (2020/BIGHYB-8) H_9 (2020/BIGHYB-9), H_{10} (Shriram Samridhi), H_{11} (Alpine F_1 Hybrid) and H_{12} (F_1 Hybrid Aman). Observations were recorded at different stages of growth for parameters like vine length, days to flower emergence, fruit length, fruit diameter and yield per vine and quality parameters like TSS and vitamin C content. The data were statistically analysed by the method suggested by Fisher and Yates, 1936. The experimental site is levelled land with sandy loam soil of uniform fertility status with low clay and high sand percentage. Soil samples were collected randomly from depth of 0-30 cm and the soil was analysed for pH found to be slight neutral (6.9), organic carbon was 0.36%, available nitrogen was 212.56 kg ha^{-1}, available phosphorus was 14.59 kg ha^{-1}, and available potassium was 225.10 kg ha^{-1}. The preparation of the experimental field involved several steps to ensure optimal conditions for cultivation. Initially, a Tractor drawn disc plough was used to plough the field. Following this primary ploughing, two cross harrowing sessions were conducted, and the field was then planked. To achieve a uniform surface, a leveller was employed to thoroughly level the field before proceeding with the experimental layout. This sequence of activities was undertaken to create an environment conducive to the study's objectives and to promote consistent and reliable results. To maintain a weed-free field, regular and shallow cultivation was performed frequently. This process aimed to eliminate weeds, enhance soil aeration, and support healthy root development. Furthermore, two to three hoeing sessions and earthing up were conducted to meticulously control weed growth and maintain the crop's weed-free status. Around FYM 40 t/ha as basal was applied to field and 35 kg of N/ha at 30 days after sowing. NPK are required for hybrid bitter gourd is 150:75:75 kg NPK/ha, accordingly urea, DAP, MOP was applied in field. Light irrigation was provided at critical stages of crop growth, such as just after transplanting, pre flowering, fruit formation.

RESULTS AND DISCUSSION

Growth Parameters

The data pertaining to Vine length and number of branches per vine significantly varied among different Hybrids. The hybridAVT-II 2020/BIGHYB-6 had the longest vines overall, measuring 3.45m, while AVT-II 2020/BIGHYB-9 had the second longest, measuring 3.36 m. In AVT-II 2020/BIGHYB-8, shortest vine length of 2.51 m was noted.HybridAVT-II 2020/BIGHYB-6 of bitter gourd likely exhibits a longer vine length compared to other hybrids due to its specific genetic makeup and environmental interactions. Genetic factors may include traits favouring vine elongation, such as genes related to internode elongation, cell

expansion, or hormone regulation. These genetic traits could contribute to increased cell division and elongation, resulting in longer vines. Moreover, AVT-II 2020/BIGHYB-6 might possess alleles promoting vine growth under varying environmental conditions, ensuring consistent elongation throughout the growing season. Environmental factors like temperature, light intensity, and soil fertility can also influence vine length by affecting plant hormone levels and physiological processes. Therefore, the combination of favourable genetic attributes and environmental conditions likely contributes to the longer vine length observed in hybridAVT-II 2020/BIGHYB-6, potentially leading to increased yield and productivity in bitter gourd cultivation.Research on bitter gourd (**Kumari*et al.*, 2019;Kumar and Topno, 2022**) reported similar results.

Earliness parameters

With 46.20 days, the hybrid AVT-II 2020/BIGHYB-1 was earlier most for male flowering overall; AVT-II 2020/BIGHYB-5 and Shriram Samridhi came second most early in number of days to first male flowering, with 51.80 days. The maximum days to first male flowering (53.67 days) was observed in AVT-II 2020/BIGHYB-8. With 50.80days, the hybridAVT-II 2020/BIGHYB-5was earlier most for female flower appearance overall; AVT-II 2020/BIGHYB-7came second most earlyin number of days to first female flower appearance, with 51.60days. The maximumdays to first female flower appearance (53.83 days) was observed in AVT-II 2020/BIGHYB-8.With 54.67days, the hybridAVT-II 2020/BIGHYB-5was earlier most for fruit harvest overall; AVT-II 2020/BIGHYB-7came second most earlyin number of days to first fruit harvest, with 57.00days. The maximumdays to first fruit harvest (61.67 days) was observed in AVT-II 2020/BIGHYB-3.

HybridAVT-II 2020/BIGHYB-5 of bitter gourd likely exhibits early flowering and maturity compared to other hybrids due to a combination of genetic attributes and environmental influences. Genetic factors within AVT-II 2020/BIGHYB-5 may include alleles that accelerate the onset of male flower development, such as genes involved in floral initiation and hormone regulation. These genetic traits may trigger the expression of male flower buds at an earlier stage of plant development. Additionally, environmental cues like temperature, light duration, and soil moisture can impact flowering and maturity time by modulating hormone levels and gene expression patterns. Consequently, the genetic predisposition of AVT-II 2020/BIGHYB-5, in conjunction with favourable environmental conditions, likely promotes early flowering and maturity, facilitating timely pollination and fruit set. This trait could confer advantages in bitter gourd cultivation, such as extended fruiting periods and improved yield potential.Similar findings were reported in studies on bitter

gourdby **Kumar and Topno, 2022; Triveni*et al.*, 2022**.

Yield parameters

The current study discovered that hybrid differences for the number of fruits per plant were statistically significant. The hybrid AVT-II 2020/BIGHYB-2 had maximum number of fruits per plant (28.07 fruits), followed by F_1 hybrid Aman (26.07 fruits). In AVT-II 2020/BIGHYB-8, the minimum number of fruits per plant (22.73 fruits) was noted.The hybrid Shriram Samridhi exhibited the longest fruit (13.57 cm), at par with AVT-II 2020/BIGHYB-6 (12.90 cm). The minimum fruit length (7.33 cm) was observed in AVT-II 2020/BIGHYB-1.The hybridAVT-II 2020/BIGHYB-5 exhibited the maximum fruit diameter (40.67 mm), at par with AVT-II 2020/BIGHYB-3 (40.00mm). The minimum fruit diameter (34.00 mm) was observed in Alpine F_1 hybrid.

HybridAVT-II 2020/BIGHYB-1 of bitter gourd likely exhibits longer fruits compared to other hybrids due to specific genetic traits and environmental influences. Genetic factors within AVT-II 2020/BIGHYB-1 may include alleles that regulate fruit development processes such as cell elongation, fruit expansion, and hormone signalling pathways. These genetic characteristics result in fruits with extended lengths during growth and maturation stages. The significance of longer fruits in hybridAVT-II 2020/BIGHYB-1 lies in its potential to enhance marketability and consumer preference. Longer fruits typically offer more edible portions, providing better value for consumers and potentially commanding higher prices in the market. Additionally, longer fruits may contribute to increased yield per plant, thereby improving overall productivity and profitability in bitter gourd cultivation. Therefore, the genetic predisposition of hybridAVT-II 2020/BIGHYB-1 for longer fruits presents a desirable trait with economic benefits for growers and consumers alike.The findings were earlier reported in studies on bitter gourdby **Ramya*et al.*, 2020; Kumar and Topno, 2022; Triveni*et al.*, 2022**.

The hybrid AVT-II 2020/BIGHYB-6 exhibited the maximum fruit weight (53.13 grams) at par with AVT-II 2020/BIGHYB-2 having 47.60 grams. The minimum fruit weight (35.60 grams) was observed in AVT-II 2020/BIGHYB-3.The highest fruit yield per plant (1.38 kg/plant) was displayed by the hybrid AVT-II 2020/BIGHYB-6, which was comparable to AVT-II 2020/BIGHYB-2 with 1.34 kg/plant. In AVT-II 2020/BIGHYB-3, the lowest fruit yield per plant (0.82 kg/plant) was recorded.

HybridAVT-II 2020/BIGHYB-6 of bitter gourd likely achieves maximum fruit yield per plant compared to other hybrids due to its advantageous genetic traits and favourable environmental interactions. Genetic factors within AVT-II 2020/BIGHYB-6 may include alleles associated with high fruit set, vigorous growth, and efficient resource utilization.

These genetic characteristics contribute to the production of a greater number of fruits per plant. The significance of maximum fruit yield per plant in hybridAVT-II 2020/BIGHYB-6 lies in its potential to increase profitability and meet market demand. Higher fruit yield translates to greater marketable produce per unit area, enhancing overall productivity and economic returns for growers. Additionally, increased yield per plant can help meet consumer demand, maintain market competitiveness, and ensure food security. Therefore, the genetic predisposition of hybridAVT-II 2020/BIGHYB-6 for maximum fruit yield per plant presents a desirable trait with significant implications for commercial bitter gourd cultivation and sustainable agriculture.The findings were earlier reported in studies on bitter gourdby **Ramya*et al.*, 2020; Kumar and Topno, 2022**.

Quality parameters

The highest TSS (4.30 °Brix) was displayed by the hybrid AVT-II 2020/BIGHYB-9, which was comparable to Shriram Samridhi with 4.27 °Brix. In AVT-II 2020/BIGHYB-8, the lowest TSS (2.93 °Brix) was recorded.The highestascorbic acid content (1.67mg) was displayed by the hybridAVT-II 2020/BIGHYB-1, which was comparable to AVT-II 2020/BIGHYB-6 and F_1 hybrid Amanwith 1.53mg. In AVT-II 2020/BIGHYB-3, the lowestascorbic acid content (0.93mg) was recorded.The findings were earlier reported in studies on bitter gourdby **Poornima*et al.*, 2022; Triveni*et al.*, 2022**.

CONCLUSIONS

From the present investigation, it is concluded that among twelve hybrids of Bitter gourd, hybrid AVT-II 2020/BIGHYB-6 performed best in terms of growth & yield. The vine length was recorded 3.45 m, fruit yield was 122.48 q/ha. In terms of quality, hybrid AVT-II 2020/BIGHYB-5 was found to be best for purpose of chips. In the economic analysis of the hybrid AVT-II 2020/BIGHYB-6.

Table 1 Performance of different Hybrids of bitter gourd for various vine length, flowering and yield parameters studied

Hybrid Notation	Hybrid details	Vine length (cm)	Days to first male flower appearance	Days to first female flower appearance	Days to first fruit harvest	No of fruits per plant	Fruit length (cm)
H_1	AVT-II 2020/BIGHYB-1	2.82	46.20	53.67	59.67	24.07	7.33
H_2	AVT-II 2020/BIGHYB-2	3.17	53.20	53.67	60.33	28.07	10.80
H_3	AVT-II 2020/BIGHYB-3	2.65	53.27	55.30	61.67	23.07	11.73
H_4	AVT-II 2020/BIGHYB-4	-	-	-	-	-	-
H_5	AVT-II 2020/BIGHYB-5	3.01	51.80	50.80	56.67	25.87	11.87
H_6	AVT-II 2020/BIGHYB-6	3.45	52.90	54.60	60.33	25.93	12.90
H_7	AVT-II 2020/BIGHYB-7	2.94	52.37	51.60	57.00	23.07	11.57
H_8	AVT-II 2020/BIGHYB-8	2.51	53.67	53.83	61.33	22.73	12.87
H_9	AVT-II 2020/BIGHYB-9	3.36	52.90	52.90	57.67	25.47	11.70
H_{10}	Shriram Samridhi	3.14	51.80	52.97	57.33	25.30	13.57
H_{11}	Alpine F_1 Hybrid	3.02	52.90	53.80	58.00	25.23	12.80
H_{12}	F_1 hybrid Aman	3.19	52.57	52.77	58.33	26.07	10.93
'F' Test		**S**	**S**	**S**	**S**	**S**	**S**
SE d (±)		**0.22**	**1.19**	**1.15**	**1.27**	**0.80**	**0.83**
CD. at 5%		**0.45**	**2.49**	**2.40**	**2.65**	**1.66**	**1.73**
CV (%)		**8.76**	**2.00**	**2.64**	**2.64**	**3.91**	**8.74**

Table 2 Performance of different Hybrids of bitter gourd for various yield and quality parameters studied

Hybrid Notation	Hybrid details	Fruit diameter (mm)	Fruit weight (grams)	Fruit yield per plant (kg/plant)	TSS [°Brix]	Ascorbic acid content (mg)
H_1	AVT-II 2020/BIGHYB-1	37.67	37.57	0.90	3.37	1.67
H_2	AVT-II 2020/BIGHYB-2	39.33	47.60	1.34	3.07	1.37
H_3	AVT-II 2020/BIGHYB-3	40.00	35.60	0.82	3.27	0.93
H_4	AVT-II 2020/BIGHYB-4	-	-	-	-	-
H_5	AVT-II 2020/BIGHYB-5	40.67	47.13	1.22	3.50	1.27
H_6	AVT-II 2020/BIGHYB-6	39.33	53.13	1.38	3.90	1.53
H_7	AVT-II 2020/BIGHYB-7	39.67	38.03	0.88	4.17	1.50
H_8	AVT-II 2020/BIGHYB-8	35.83	36.83	0.84	2.93	1.27
H_9	AVT-II 2020/BIGHYB-9	39.33	46.13	1.17	4.30	1.07
H_{10}	Shriram Samridhi	36.00	43.93	1.11	4.27	1.37
H_{11}	Alpine F_1 Hybrid	34.00	41.13	1.04	3.03	1.10
H_{12}	F_1 hybrid Aman	35.33	37.47	0.98	4.13	1.53
'F' Test		**S**	**S**	**S**	**S**	**S**
SE d (±)		**2.04**	**1.92**	**0.07**	**0.15**	**0.14**
CD. at 5%		**4.26**	**4.01**	**0.15**	**0.32**	**0.29**
CV (%)		**6.60**	**5.57**	**8.32**	**5.13**	**12.87**

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