



# PERFORMANCE OF DIFFERENT BITTER GOURD (*MOMORDICA CHARANTIAL.*) STRAIN FOR GROWTH, YIELD AND QUALITY TRAITS UNDER GARHWAL HILLS

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## Abstract

The present investigation was carried out to study the performance of different bitter gourd (*Momordica charantia* L.) strains viz., PDM, VRBTG-1, VRBTG-2, VRBTG-3, VRBTG-4, VRBTG-5, VRBTG-6, VRBTG-7, VRBTG-8, VRBTG-9, KVS-7, PSPB-14, JP-1, GP-1 and MN-1 for their growth, yield and quality traits under Garhwal Himalaya conditions. The study revealed that the JP-1 showed highest vine (335.19 cm) and phosphorus content (65.0 mg/100g), whereas MN-1 showed maximum number of primary branches per vine (8.37), minimum days to first fruit harvest (70.44 days), highest fruit diameter (5.41 cm) and maximum seed/ fruit (20.12). The maximum intermodal (7.30 cm) was recorded in GP-1 and organoleptic scores for various fruit quality traits while, the lowest (7.16 nodes) number of nodes bearing first male flower and maximum number of fruit/vine (38.60) recorded in PDM strain, respectively. The KVS-7 showed minimum (10.51 nodes) number of nodes bearing first female flower and lowest days (50.57 days) to opening of first female flower, respectively. VRBTG-4 showed minimum days (44.76 days) to opening of first male flower. VTBTG-7 showed maximum fruit length (20.07), carbohydrate (11.20g/100g) and calcium (22.50 mg/100g). The VRBTG-6 showed minimum sex ratio (10:1), maximum percent of fruit setting (96.32 %), maximum fruit yield/ vine (3.10 kg), fruit yield/ plot (37.20 kg) and highest yield/ hectare (41.33 tonnes), respectively.

**Key words :** Strain, bitter gourd, organoleptic, protein, phosphorus and vitamin.

## Introduction

Bitter gourd (*Momordica charantia* L.) is one of the important commercial cucurbit belonged to family cucurbitaceae. It is known as different names such as balsam pear or bitter cucumber in English and Karela in Hindi. It is popular throughout India for its tender fruits, which are consumed as boiled, curried, stuffed or sliced and fried, before consumption. The fruits are also pickled, canned and dehydrated. Numerous medicinal properties of nearly all parts of the plant have been reported. The fruits are used as tonic, purgative, stomachic carminative, anti-helminthic, anti-inflammatory, febrifuge, vulnerary, stimulant, thermogenic, anti-diabetic etc. (Longman, 1995). The fruit acts as an anthelmintic, stomachic, antibilious and laxative. In fact, it is a tonic fruit, used in rheumatism, gout and also for diabetes. A decoction of the root extract is helpful in abortion, hemorrhoids and also in biliaesness (Khulakpam *et al.*, 2015). The green fruits are superior with regard to nutritive value and can

very well be compared with any other vegetable. The fruits contain carbohydrate, protein, vit. A, vit. C, phosphorus, calcium (Bose *et al.*, 2002). The bitterness of most cucurbits is mainly due to cucurbitacins (Decker-Walters, 1999). The bitterness of bitter gourd is due to the cucurbitacin like alkaloid momordicine and triterpene glycosides like momordicoside K and L (Jeffrey, 1980; Okabe *et al.*, 1982). These compounds lack the oxygen function at C-11 that characterizes "true" cucurbitacins (Neuwinger, 1994) and are the bitterest compounds in the plant kingdom (Johns, 1990).

The bitter gourd is particularly originated to Tropical Asia in the region of East India and South China (Walters and Decker-Walters, 1988; Miniraj *et al.*, 1993). The crop is extensively grown in China, India, Indonesia, Malaysia, Tropical Africa and South America. Karnataka, Maharashtra, Tamil Nadu and Kerala are the major bitter gourd growing states in India. It is widely cultivated annual climber. Majority of the cucurbits are either monoecious or andromonoecious (a few dioecious) with trailing habit

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and are pollinated by insects. It is a warm season crop and grown mostly during summer and *kharif* seasons in all the parts of the country including hilly parts of North India. The investigation was taken with the objectives to find out the most suitable strain in terms of growth, yield and quality of bitter gourd for future improvement programme.

### Materials and Methods

The present investigation was carried out at Horticultural Research Center, Chauras Campus, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand during *Zaid* season, in 2014-2015. There are twenty strains *viz.*, PDM, VRBTG-1, VRBTG-2, VRBTG-3, VRBTG-4, VRBTG-5, VRBTG-6, VRBTG-7, VRBTG-8, VRBTG-9, KVS-7, PSPB-14, JP-1, GP-1 and MN-1 which were sown for raising *Zaid* season bitter gourd crop. All the strains were sown on 15<sup>th</sup>, February 2014 in polythene bags, after 25 days the seedling are ready for transplanting in the main field. Seedling is transplanted with spacing of 1.50 m row to row and 50 cm plant to plant, respectively. Adopting the recommended cultivation practices for raising a healthy crop and used the trellis system for vines climbing. The experiment was laid out in randomized block design with three replications. The five randomly selected plants from each plot for the recording data on the following observations *viz.*, vine length plant (cm), number of primary branch/plant, internodal length (cm), number of nodes bearing first male flower, number of nodes bearing first female flower, days taken to opening of first male flower, days taken to opening of first female flower, sex ratio, percent of fruit setting, sex ratio, days to first fruit harvest, fruit length (cm), fruit diameter (cm), fruit thickness (mm), number of locules/ fruit, number of fruit/ plant, fruit yield/plant (kg), fruit yield/ plot (kg), fruit yield/hectare (q), number of seeds/ fruit, carbohydrate (g/100g), protein (g/100g), Vit.C (mg/100g), phosphorus (mg/ 100g), calcium (mg/100g). The obtained data were statistically analyzed according to the procedure of R.B.D. as stated by Panse and Sukhatme (1967). The significance of variation among the treatments was observed by applying ANOVA and critical difference at 5% level (CD) was calculated to compare the mean values of treatments for all the characters.

### Results and Discussion

#### Growth parameters

The analysis of variance revealed highly significant differences for all the characters studied, which indicated that the genotypes differed significantly for all the traits

studied. The data presented in table 1 revealed that the highest vine length was recorded in JP-1 (335.19 cm) followed by KVS-7 (328.17 cm) and VRBTG-4 (323.18 cm) and lowest vine length was found in PSPB-14 (275.61 cm). The variation in vine length might be due to combined effect of genetic inheritance of strain, soil condition and environmental factors highly influences the growth of plant. Similar results have also been reported by Solanki and Seth (1980) in cucumber. Maximum number of primary branches/vine was observed in MN-1 (8.37) followed by VRBTG-4 (8.33) and VRBTG-3 (7.36) while, the lowest number of primary branches/vine was recorded in JP-1 (4.55). The number of primary branches/vine is highly influences by the genetic inheritance of strain, environmental factors and number of internodes in plant, because the primary branches arise near the nodes factors conforming to reports of Sharma and Bhattarai (2006) in cucumber. The VRBTG-4 (7.33 cm) recorded highest internodal length which was superior over GP-1 (7.30 cm) and VRBTG-8 (7.25 cm), whereas the lowest internodal length was recorded in VRBTG-9 (5.28 cm). Reddy and Ramarao (1984) recorded positive and highly correlation of internodal length and yield. Minimum number of nodes bearing first male and female flower is an important character of any cucurbitaceous crops. In bitter gourd the first male flower appear at (7.16 nodes) in PDM showed minimum number of nodes followed by JP-1 (7.32 nodes) and KVS-7 (7.35 nodes). The maximum nodes were appeared in VRBTG-8 (10.76 nodes). For minimum number of nodes bearing first female flower, KVS-7 takes (10.51 nodes) followed by VRBTG-3 (10.76 nodes) and PDM (11.51 nodes) and maximum nodes were found in PSPB-12 (13.85 nodes). The differences in nodes bearing first male and female flower depends on specific strain characters environmental and soil condition also influences these characteristics of crop plant. Similar observation has been reported by Patel *et al.* (2013). Days to opening of first female flower is directly associated with the days to first fruit harvest, so that it is an important character of the crop. In bitter gourd, the VRBTG-4 takes minimum days (44.76 days) to opening of first male flower, followed by PDM (46.76 days), KVS-7 (48.79 days) and VRBTG-5 was found to be maximum days (52.73 days) to opening of first male flower. Whereas in the case of first female flower appearances KVS-7 takes (50.57 days) minimum days followed by VRBTG-4 (51.09 days), PDM (51.67 days) and maximum days taken by VRBTG-5 (58.22 days) for first female flower appearances. The variation in these characters is due to genetic features of plants, hormonal activities, environmental factors (light intensity

**Table 1 :** Performance of different Bitter gourd (*Momordica charantia* L.) strains for growth parameters.

Treatment	Plant height (cm)	No. primary branch/ vine	Internodal length (cm)	Number of nodes bearing first male flower	Number of nodes bearing first female flower	Days taken to opening of 1 <sup>st</sup> male flower	Days taken to opening of 1 <sup>st</sup> female flower
T <sub>1</sub> (PDM)	277.49	5.69	6.80	7.16	11.51	46.76	51.67
T <sub>2</sub> (VRBTG-1)	310.46	5.00	7.12	8.11	11.74	51.35	56.04
T <sub>3</sub> (VRBTG-2)	309.13	6.78	6.56	8.05	12.29	50.38	55.31
T <sub>4</sub> (VRBTG-3)	320.43	7.36	5.92	7.35	10.76	51.15	55.55
T <sub>5</sub> (VRBTG-4)	323.18	8.33	7.33	9.75	13.16	44.76	51.09
T <sub>6</sub> (VRBTG-5)	280.24	5.86	6.59	8.50	11.79	52.73	58.22
T <sub>7</sub> (VRBTG-6)	319.64	4.64	6.48	9.10	11.59	50.17	55.23
T <sub>8</sub> (VRBTG-7)	311.40	5.01	7.02	10.51	12.51	51.33	56.06
T <sub>9</sub> (VRBTG-8)	310.32	5.64	7.25	10.76	12.25	50.62	56.27
T <sub>10</sub> (VRBTG-9)	322.62	7.24	5.28	8.77	11.73	51.38	56.45
T <sub>11</sub> (KVS-7)	328.17	6.85	5.71	7.35	10.51	48.79	50.57
T <sub>12</sub> (PSPB-14)	275.61	4.90	7.13	9.87	13.85	51.33	57.11
T <sub>13</sub> (JP-1)	335.19	4.55	6.91	7.32	12.96	50.15	53.17
T <sub>14</sub> (GP-1)	310.21	5.58	7.30	8.22	13.12	49.22	55.17
T <sub>15</sub> (MN-1)	312.51	8.37	6.90	8.57	12.27	51.23	54.55
Sem±	0.691	0.846	0.520	0.122	0.200	0.426	0.387
CD 5%	2.003	0.245	0.150	0.353	0.579	0.123	0.112

and temperature) and fertility status of soil. Similar results have been reported by Sahni *et al.* (1987).

### Yield parameters

The yield parameters are presented in table 2, which indicated that, in cucurbitaceous crops sex ratio (male: female ratio) plays an important role in total yield. Sex ratio is highly affected by genetic behavior of crop, environmental factors (temperature, day length, light intensity etc.) and soil condition like, high fertile soils gives high number of male flower comparison to low fertile soils. Combined effect of soil and environmental condition is highly influences the sex ratio in this crop. The minimum sex ratio was found in VRBTG-6 (10:1) followed by GP-1 (12:1) and VRBTG-4 (13:1), whereas the maximum sex ratio was recorded in VRBTG-3 (30:1). The sex ratio positively and directly related to total yield of crop. Minimum days to first fruit harvest is directly correlated to first opening of female flower in plant, the MN-1 showed minimum (70.44 days) to first fruit harvest followed by PDM (70.73 days) and VRBTG-9 (70.92 days). VRBTG-5 (76.54 days) had taken very much time to first fruit harvesting. The variation in days to first fruit to harvesting might have been due to varietal genetic factor, environmental factor, hormonal factor and vigour of the crop. The highest number of fruits/vine was

recorded in PDM (38.60) followed by VRBTG-4 (37.15) and JP-1 (36.39). The lowest number of fruits/ vine was recorded in VRBTG-5 (31.61). The number of fruits/ vine is one of the major factors for deciding the yield of the crop. The variation in number of fruits per vine might have been due to sex ratio, fruit set percentage, genetic nature and their response to varying environmental conditions. Variation in number of fruits per vine was also reported by Srivastava and Srivastava (1976) in bitter gourd. The variation in fruit length and diameter is due to genetic behavior of crops and variable in different climatic conditions. The fruit yield is highly influenced by the length and diameter of fruit crop. Highest fruit length was recorded in VRBTG-7 (20.07 cm) followed by VRBTG-1 (20.00) and KVS-7 (17.25 cm). The lowest fruit length was observed in PDM (13.82 cm). Significantly maximum fruit diameter was found in MN-1 (5.41 cm) followed by VRBTG-9 (5.23 cm) and VRBTG-8 and GP-1 (4.97 cm). The minimum fruit diameter was recorded in PDM (3.25 cm). Ahamed *et al.* (2004) have also reported similar findings in cucumber. The lowest number of locules/ fruit was found in VRBTG-2 (3.00) followed by PDM (3.25) and VRBTG-6 (3.27), whereas highest number of locules/ fruit was recorded in VRBTG-3 (4.75). Number of locules related to number of seeds, because the number of locules influences the number of seed/fruit. Maximum

Table 2 : Performance of different Bitter gourd (*Momordica charantia* L.) strains for yield parameters.

Treatment	Sex ratio	Days taken to 1 <sup>st</sup> fruit harvesting	No. of fruits/vine	Fruit length (cm)	Fruit diameter (cm)	No. of locules/fruit	Flesh thickness (mm)	Fruit yield/vine (kg)	Fruit yield/plot (Kg)	Fruit yield/ha (t/ha)	% of fruit setting	No. of seed/fruits
T <sub>1</sub> (PDM)	15:1	70.73	38.60	13.82	3.25	3.25	4.35	1.58	21.84	24.26	78.35	17.35
T <sub>2</sub> (VRBTG-1)	17:1	73.84	35.61	20.00	3.98	4.15	5.25	2.50	30.00	33.32	78.10	16.32
T <sub>3</sub> (VRBTG-2)	14:1	71.53	36.18	16.42	3.98	3.00	4.12	1.79	21.48	23.86	79.85	14.30
T <sub>4</sub> (VRBTG-3)	30:1	71.54	34.65	16.30	4.90	4.75	4.96	2.55	30.60	33.98	82.50	18.30
T <sub>5</sub> (VRBTG-4)	13:1	71.82	37.15	17.19	4.75	4.26	5.10	2.69	32.28	35.86	85.80	12.82
T <sub>6</sub> (VRBTG-5)	16.5:1	76.54	31.61	16.95	4.50	3.85	4.35	2.10	25.20	27.97	93.30	17.35
T <sub>7</sub> (VRBTG-6)	10:1	73.83	36.18	15.88	4.30	3.27	4.25	3.10	37.20	41.33	96.32	14.15
T <sub>8</sub> (VRBTG-7)	18:1	72.80	35.32	20.07	4.85	3.50	4.11	2.68	32.16	35.73	89.32	12.35
T <sub>9</sub> (VRBTG-8)	17:1	71.09	36.04	15.87	4.97	4.00	4.65	1.86	22.32	24.79	91.50	18.52
T <sub>10</sub> (VRBTG-9)	20:1	70.92	34.38	16.88	5.23	4.25	5.05	3.51	30.12	33.46	85.62	18.10
T <sub>11</sub> (KVS-7)	15:1	71.15	35.81	17.25	4.80	3.70	3.96	2.45	29.40	32.65	89.32	15.32
T <sub>12</sub> (PSPB-14)	16:1	75.16	31.65	16.84	4.75	4.00	4.10	2.25	27.00	29.98	92.31	17.82
T <sub>13</sub> (JP-1)	22:1	73.16	36.39	15.87	4.75	3.75	3.85	2.35	28.20	31.34	93.51	18.56
T <sub>14</sub> (GP-1)	12:1	71.14	36.12	15.88	4.97	4.00	5.01	3.00	34.00	39.30	91.60	15.62
T <sub>15</sub> (MN-1)	23:1	70.44	34.25	16.38	5.41	4.00	4.82	2.10	25.20	27.96	95.60	20.12
Sem±	0.152	0.119	0.479	0.168	0.877	0.102	0.107	0.263	0.514	0.172	0.448	0.169
CD 5%	0.473	0.345	1.389	0.489	0.254	0.297	0.312	0.763	1.491	0.498	0.129	0.491

flesh thickness was found in VRBTG-1 (5.25 mm) followed by VRBTG-4 (5.10 mm) and VRBTG-9 (5.05 mm) and minimum flesh thickness was recorded in JP-1 (3.85 mm). The variation in flesh thickness is might be due to genetic nature of crop. The maximum yield/vine was recorded in VRBTG-9 (3.51 kg) followed by VRBTG-6 (3.10 kg) and GP-1 (3.00 kg). The lowest fruit yield/vine were found in VRBTG-2 (1.79 kg). The fruit length, fruit diameter and fruit yield/ vine, significantly increase the fruit yield/plot, VRBTG-6 (37.20 kg) found to be superior over other strains, followed by GP-1 (34.0 kg) and VRBTG-4 (32.28 kg). The minimum fruit yield/ plot were recorded in VRBTG-2 (21.84 kg). The highest fruit yield/ hectare was found in VRBTG-6 (41.33 t/ha) followed by GP-1 (39.30 t/ha) and VRBTG-4 (35.86 t/ha). The minimum fruit yield/hectare were recorded in VRBTG-2 (23.86 t/ha). The variation is fruit yield/ vine, fruit yield/ plot and fruit yield/hectare might be due to sex ratio, fruit set percentage, fruit length, fruit diameter, crop vigour, genetic nature of strains, environmental and soil condition. These findings are in close conformity with findings of Srivastava and Srivastava (1976) in bitter gourd. Percent of fruit setting is direct and positive relationship with yield, high fruit setting increases the yield directly The highest fruit setting was recorded in VRBTG-6 (96.32%) followed by MN-1 (95.60%) and JP-1 (93.51%). The lowest percent of fruit setting was showed by VRBTG-1 (78.10%). The variation in fruit setting is highly influenced by the environmental condition, soil condition and genetic responses of crop in different agro-climate. The less number of seed/ fruit was an important feature of edible fruit, the VRBTG-7 found minimum number (12.35) of seed/fruit, followed by VRBTG-4 (12.82) and VRBTG-6 (14.15), whereas the maximum number (20.12) of seed/fruit was recorded in MN-1. The variation of seed/fruit is totally depends on genetic characters of the crop.

### Quality parameters

Data presented in table 3 shows that the highest carbohydrate content was found in VRBTG-7 (11.20 g/ 100g) followed by PSPB-14 (11.01 g/100g) and VRBTG-8 (10.65 g/

**Table 3 :** Performance of different Bitter gourd (*Momordica charantia* L.) strains for quality parameters.

Treatment	Carbohydrate (g/100g)	Protein (g/100g)	Vitamin C (mg/100g)	Calcium (mg/100g)	Phosphorus (mg/100g)
T <sub>1</sub> (PDM)	5.20	1.50	84.0	17.75	37.66
T <sub>2</sub> (VRBTG-1)	4.80	1.82	100.0	19.32	39.00
T <sub>3</sub> (VRBTG-2)	9.12	1.70	96.0	20.84	60.00
T <sub>4</sub> (VRBTG-3)	7.85	2.08	78.0	21.53	56.00
T <sub>5</sub> (VRBTG-4)	6.82	2.05	74.0	18.73	50.00
T <sub>6</sub> (VRBTG-5)	8.52	1.89	92.0	20.43	54.00
T <sub>7</sub> (VRBTG-6)	9.11	1.95	98.0	18.52	62.00
T <sub>8</sub> (VRBTG-7)	11.20	1.78	87.0	22.50	63.00
T <sub>9</sub> (VRBTG-8)	10.65	1.80	88.0	21.45	64.00
T <sub>10</sub> (VRBTG-9)	7.62	2.10	87.0	17.10	54.00
T <sub>11</sub> (KVS-7)	9.54	2.00	92.0	16.30	59.00
T <sub>12</sub> (PSPB-14)	11.01	1.52	93.0	18.12	60.00
T <sub>13</sub> (JP-1)	5.52	1.69	78.0	19.38	65.00
T <sub>14</sub> (GP-1)	6.72	1.79	81.0	20.74	58.00
T <sub>15</sub> (MN-1)	7.52	1.83	85.0	21.00	44.00
Sem±	0.712	0.542	0.203	0.214	0.327
CD 5%	0.206	0.157	0.589	0.621	0.949

100g). The minimum carbohydrate was recorded in VRBTG-1 (4.80 g/100g). Whereas, VRBTG-9 (2.10 g/100g) showed maximum protein content, followed by VRBTG-3 (2.08 g/100g) and VRBTG-4 (2.05 g/100g), the PDM strain found minimum protein content (1.50 g/100g). Maximum vitamin-C was found in VRBTG-1 (100 mg/100g) followed by VRBTG-6 (98 mg/100g) and VRBTG-2 (96 mg/100g). The lowest vitamin-C mg/100g was found with VRBTG-4 (74 mg/100g). The calcium content was found maximum in VRBTG-7 (22.50 mg/100g) followed by VRBTG-3 (21.53 mg/100g) and VRBTG-8 (21.45 mg/100g) whereas, minimum calcium content was found in KVS-7 (16.30 mg/100g). The maximum phosphorus content was found in JP-1 (65.0 mg/100g) followed by VRBTG-8 (64.0 mg/100g) and VRBTG-7 (63.0 mg/100g). The minimum phosphorus content was recorded in PDM (37.66 mg/100g). The variation in quality parameters in different strains might be due to inheritance of parents and little influence due to environmental and soil condition. These findings are in close conformity with findings Gopalan *et al.* (1993) in bitter gourd.

### Conclusion

From the above studies, it may be concluded that different strain showed different good horticultural traits. So, VRBTG-4 showed superior for days to opening of first male flower. VRBTG-7 showed maximum fruit

length, carbohydrate and calcium content. And the strain VRBTG-6 was found superior for all yield related characters like minimum sex ratio, maximum percent of fruit setting, maximum fruit yield/vine, fruit yield/plot and highest yield/hectare, respectively. The strain VRBTG-6 and other strains could be used in future improvement programmes.

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