

Productive and Qualitative Response of Bitter gourd (*Momordica charantia L.*) cultivars by adopting different patterns like Horizontal and Vertical

Muhammad Irfan Ashraf, Shoukat Sajad*, Rao Ali Zaffar

¹Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan.

*Corresponding author's Email: imshoukat@outlook.com

Abstract: Vegetables play an important role in human diet and nutrition that provide minerals, carbohydrates, vitamins and proteins in appropriate quantity needs for the growth and development. Bitter gourd, a summer crop vegetable, is mostly used as a commercial vegetable crop on large scale in Asia specifically in Pakistan and India. The experiment was performed to evaluate the growth and yield parameters of bitter gourd by adopting different techniques like horizontal and vertical pattern. The germplasm of bitter melon cultivars (cvs) were collected from different sources. Seeds were sown on the raised beds in Vegetable Research Area of Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Data were collected from vegetative and reproductive parameters of bitter melon varieties by standard procedures. The research was conducted according to randomized complete block design (RCBD) along with three replications. Every variety acted as a treatment unit. Data were evaluated by ANOVA techniques and means were compared by using LSD test at 5% probability level. Treatments were included cultivars and cultivation method to predict the experiment. Number of days taken to first flower, number of days taken to first harvesting, fruit weight, fruit diameter, number of branches per vine at maturity, final vine length, number of leaves per vine, thousand seed weight was parameter which taken for experiment. Number of days taken by flower gave good value in gohri cultivar. Number of fruit per vine by cultivar gohri gave maximum value. Fruit weight in cv gohri given determined value. Fruit diameter value was worthy by cultivar gohri. Fruit length in cv Faisalabad long was maximum. number of branches per vine at maturity, final vine length, number of leaves per vine, thousand seed weight gave maximum value by cv gohri, cv Faisalabad long, cv black cobra respectively. By that research genotypes and cultivation practice of cultivar vertical method are best method to enhance the quality and yield of bitter gourd.

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Keywords: Productive; Qualitative; Response; Bitter gourd; *Momordica charantia L.*; cultivar; adopt; pattern; Horizontal; Vertical

Introduction

Bitter gourd belongs to the family 'Cucurbitace' which contains around 118 genera and 825 species (EI-Batran et al., 2006). Bitter melon is considered as vegetable crop and mostly grown in March till September in tropics including large areas of Pakistan (Tahir & Haider, 2005). Bitter melon is considered as vegetable crop and mostly grown in March till September in tropics including large areas of Pakistan (Tahir & Haider, 2005). From nutritious perspective, biting gourd can be considered as sustenance rich natural product vegetable and noteworthy distinction has been seen in intense gourd for protein, starches, zinc, magnesium, calcium, iron, phosphorous, and ascorbic corrosive substance, has seen in biting gourd. For instance the rough protein content (11.420 g/kg) of astringent gourd natural product is higher than that of tomato and cucumber (Xiang et al., 2000). Sharp gourd has been utilized as a part of numerous genuine ailments like AIDS, HIV, diabetes and fever (Wang et al., 2011). There could be numerous reasons which

can be ^{ascribed} for the decrease of sharp gourd creation in Pakistan, for example, imbalanced utilization of composts which is exceptionally basic in severe gourd makers (Bakhsh et al., 2007). Bitter gourd species have the characteristics of weak stems and requirement of trellis for supporting of the climbing vines (Ram et al., 2002). By the adaptation of staking and trellising practices, a tremendous increase in fruit size and fruit yield along with an ease in cultural protocols is reported to occur and a reduction in fruit rot is observed. Bitter gourd vines started to decay if spread them on the ground. For inducing early cropping, different techniques are adopted like the removal of lateral branches at the firstly production wire in trellis. In the same way, removal of the top portion of the main runner is also done when it gains the height to the top wire. About firstly ten nodes removal of lateral branches has a good impact on the total yield. In the absence of pruning practices, mostly female flower produced between 10th and 40th or height ranges at 0.5-2 m (Rascoand Castillo., 1990). In

Darwin, Bitter gourd is mostly grown on fences that range in 1-2 m height or usually overhead trellising. At 2 m height trellising produced more yield in comparison with 1 m high trellises (Abusaleha and Dutta 1994). Trellising or overhead produce a significant increase in marketable bitter melon (Huyskens et al., 1992). Trellising is reported to increase yield and quality parameters of cucumber and in addition for controlling of foliar and fruit diseases (Konsier and Strides, 1973). Increase in photosynthetic activity rate leads towards the increased yield (Hanna. et al., 1987). Unproductive branches side of Bitter gourd should be trimmed off as it climbs to top of trellis (Palada and Chang, 2003).

Cucumber (*Cucumissativus* L.) and Luffa sponge gourd have same growth pattern. Yield can be increase by the process of training cucumber to vertical trellising rather than to allow grow on ground surface. Surface of earth have problem of sun burn and nematode so it is better to grow on vertical trellising. When the humidity level increased than condition of fungi attack is more favorable (Hanna et al., 1987; Russo et al., 1991).

Ram et al. (2002) reported that *Momordica* species stem structure is weak and training to trellising for supporting of climbing vine. Fruit production and fruit size of cultivar will be increased by staking and trellising and the problem of fruit rot will be reduced and culture practice make easier. There are following trellising method for the better production of bitter gourd. PVC pipes, bamboo poles, wood stakes and other material which are suitable for training to trellising of cultivar. These trellising method provide extra care for fruit and keep the fruit above the ground

level. Trellising scheme performed both in tunnel and lean to management.

Material and Methods

The experiment will be conducted at Vegetable Research Area, Institute of Horticultural Sciences, University of Agriculture Faisalabad. Five cultivars (i.e. Pallavi, Black Cobra, Advanta, Faisalabad long and Gohri) of bitter gourd collected from different sources, will be sown directly on 10 feet long and 5 feet wide bed. Seeds will be sown on both side of the beds and recommended doses of fertilizers will be applied when required. One side of bed will be used for horizontal growth of wine on the soil bed while the other will be used for the trellising. One month later after sowing, five bamboos along with tires will be inserted in one side of soil bed and will fix the net supported with plastic wires. After that, trellising will be done according to the prescribed standard schedule. Similarly, standard plant protection measures will be applied when required, to keep diseases and insects under control. When the fruit was ready to harvest, 4-5 days duration will be maintained as a period between picking and further quality parameters will be analyzed.

The observation were taken on number of days taken to first flower, number of days taken to first harvesting, fruit weight, fruit diameter, number of branches per vine at maturity, final vine length, number of leaves per vine, thousand seed weight were parameter which taken for experiment.

Result and discussion

4.2. Number of days taken to first flower

Table 4.2a: Analysis of variance for Productive and qualitative response of Bitter gourd (*Momordicacharantia* L.) cultivars by adopting different patterns like horizontal and vertical on number of days of first flowering

SOV	DF	SS	MS
Replication	2	10.374	5.1870
Cultivation Method	1	63.656	63.6563**
Treatment	4	79.533	19.8833**
C × T	4	0.725	0.1813 ^{ns}
Error	18	36.986	2.0548
Total	29	191.275	

SOV= Source of variance, DF= Degree of freedom; SS = Sum of square, MS = Mean sum of square, *, ** = Significant at $p \leq 0.05$ and $p \leq 0.001$; ns= Non-significant.

Table 4.2b: Effect of treatments on No. of days taken to first flower

Treatments	Vertical	Horizontal	Mean
Gohri	42.3a	44.9a	43.6A
Faisalabad long	39.0a	41.6a	40.3B
Black Cobra	37.2a	40.3a	38.8B
Advanta	38.1a	41.4a	39.8B
Pallavi	38.8a	41.8a	40.3B
Mean	39.1B	42.0A	
LSD	Treatments = 1.73; Cultivation method= 1.09; C × T=NS		

Figures sharing the same letter do not differ significantly at $P \leq 0.05$. NS= Non-significant

Data concerning number of days taken to first flower were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. Cultivar and treatments were also highly significant. But interaction between cultivation methods and varieties was non-significant (Table 4.2a). Maximum mean value of number of days taken to first flower was observed in horizontal (42.0) and minimum mean value was noted in vertical (39.1). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value number of days taken to first flower was observed in cultivar gohri (43.6) and minimum mean value of number of days taken to first flower in cobra cultivar (38.8). Mean values of all treatments were arranged into descending order in Table 4.2b for comparison. From varieties treatments, black cobra gives higher result then other varieties. Flowering was not affected by the method of trellising. Number of days of first flowering was almost same in all cultivar. Our results are similar with the finding of Verma et al. (1984) who described that plant flowering typically occurs between 37 to 43 days after sowing.

4.3. No. of days taken to first harvesting

Data concerning number of days taken to first harvesting were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. Cultivars and treatments were non-significant. And interaction between cultivation methods and varieties was also non-significant (Table 4.3a). Maximum mean value was observed in horizontal (68.4) and minimum mean value was noted in vertical (65.5). From cultivation methods, horizontal method gives better result than vertical.

Maximum value of number of days taken to first harvesting was observed in cultivar faisalabad long (67.7) and minimum value of number of days taken to first flower in advanta cultivar (66.6). Mean values of all treatments were arranged into descending order in Table 4.3b for comparison. From varieties treatments, black cobra gives higher result then other varieties.

Days to first harvesting was not affected by the method of trellising. Number of days of first harvesting was almost same in all cultivar. Our results regarding number of days of harvesting with the finding of Gadam et al. (1996) who described that first harvesting typically occurs between 56 to 65 days after sowing.

Table 4.3a: Analysis of variance for Productive and qualitative response of Bitter gourd (*Momordica charantia* L.) cultivars by adopting different patterns like horizontal and vertical on number of days of first harvesting

SOV	DF	SS	MS
Replication	2	1.874	0.9370
Cultivation Method	1	69.616	69.6163**
Treatment	4	5.227	1.3067 ^{ns}
C × T	4	0.065	0.0163 ^{ns}
Error	18	24.813	1.3785
Total	29	101.595	

SOV= Source of variance, DF= Degree of freedom; SS = Sum of square, MS = Mean sum of square, *, ** = Significant at $p \leq 0.05$ and $p \leq 0.001$; ns= Non-significant.

Table 4.3b: Effect of treatments on No. of days taken to first harvest

Treatments	Vertical	Horizontal	Mean
Gohri	65.2a	68.2a	66.7A
Faisalabad long	66.1a	69.3a	67.7A
Black Cobra	65.6a	68.6a	67.1A
Advanta	65.1a	68.1a	66.6A
Pallavi	65.1a	68.1a	66.6A
Mean	65.5B 68.4A		
LSD	Treatments = NS; Cultivation method= 0.90; C × T= NS		

Figures sharing the same letter do not differ significantly at $P \leq 0.05$. NS= Non-Significant.

4.5. Fruit weight (g)

Data concerning fruit weight were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. Varieties treatments were also highly significant. But interaction between cultivation methods and varieties was non-

significant (Table 4.4a). Maximum mean value of number of fruit per vine was observed in vertical (68.7) and minimum mean value of number of fruit per vine in horizontal (45.4). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value number of fruit weight as observed in cultivar gohri (77.9) and minimum value of fruit weight in cultivar pallavi (39.2). Mean values of all treatments were arranged into descending order in Table 4.5b for comparison. From varieties treatments, black cobra gives higher result then other varieties.

It was observed that the stacked method was better than unstacked method with reference to production of fruits. Number of fruit was affected by the method of trellising. Number of fruit was not same in both type of cultivation method. Our results regarding number of days of harvesting with the finding of Jame et al. (2003).

Table 4.5a: Analysis of variance for Productive and qualitative response of Bitter gourd (*Momordicacharantia* L.) cultivars by adopting different patterns like horizontal and vertical on fruit weight

SOV	DF	SS	MS
Replication	2	172.6	86.28
Cultivation Method	1	4083.3	4083.3**
Treatment	4	5500.7	1375.19**
C × T	4	195.7	48.93 ^{ns}
Error	18	821.2	45.62
Total	29	10773.5	

SOV= Source of variance, DF= Degree of freedom; SS = Sum of square, MS = Mean sum of square, *, ** = Significant at $p \leq 0.05$ and $p \leq 0.001$; ns= Non-significant

Table 4.5b: Effect of treatments on fruit weight (g)

Treatments	Vertical	Horizontal	Mean
Gohri	94.0a	61.9a	77.9A
Faisalabad long	77.0a	52.5a	64.7B
Black Cobra	67.4a	45.1a	56.3C
Advanta	57.7a	36.4a	47.1D
Pallavi	47.4a	30.9a	39.2D
Mean	68.7A	45.4B	
LSD	Treatments = 8.19; Cultivation method= 5.18; C × T= NS		

Figures sharing the same letter do not differ significantly at $P \leq 0.05$. NS= Non-Significant.

4.6. Fruit diameter (mm)

Data concerning fruit diameter were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. Varieties and treatments were also highly significant. But interaction between cultivation methods and varieties was non-significant (Table 4.4a). Maximum mean value of number of fruit per vine was observed in vertical (24.9) and minimum mean value of number of fruit per vine in horizontal (21.8). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value fruit diameter was observed in cultivar gohri (28.3) and minimum value of fruit diameter in cultivar pallavi (18.6). Mean values of all treatments were arranged into descending order in Table 4.5b for comparison. From varieties treatments, black cobra gives higher result then other varieties.

It was observed that the staked method was better than unstacked method with reference to production of fruits. Number of fruit was affected by the method of trellising. Number of fruit was not same in both type of cultivation method. Our results regarding number of days of harvesting were similar with the finding of Jame et al. (2003).

Table 4.6a: Analysis of variance for Productive and qualitative response of Bitter gourds (*Momordicacharantia* L.) cultivars by adopting different patterns like horizontal and vertical on fruit diameter (mm)

SOV	DF	SS	MS
Replication	2	1.705	0.8523
Cultivation Method	1	72.696	72.6963**
Treatment	4	347.03	93.6008**
C × T	4	1.275	0.3188ns
Error	18	10.582	0.5879
Total	29	460.662	

S.O.V= Source of variance, DF= Degree of freedom; SS = Sum of square, MS = Mean sum of square, *, *** =Significant at $p \leq 0.05$ and $p \leq 0.001$; ns= Non-significant

Table 4.6b: Effect of treatments on fruit diameter (mm)

Treatments	Vertical	Horizontal	Mean
Gohri	29.7a	27.0a	28.3A
Faisalabad long	27.6a	24.6a	26.1B
Black Cobra	25.1a	21.3a	23.2C
Advanta	22.3a	19.0a	20.7D
Pallavi	20.0a	17.2a	18.6E
Mean	24.9A	21.8B	
LSD	Treatments = 0.58; Cultivation method= 0.93; C × T= NS		

Figures sharing the same letter do not differ significantly at $P \leq 0.05$. NS= Non-Significant.

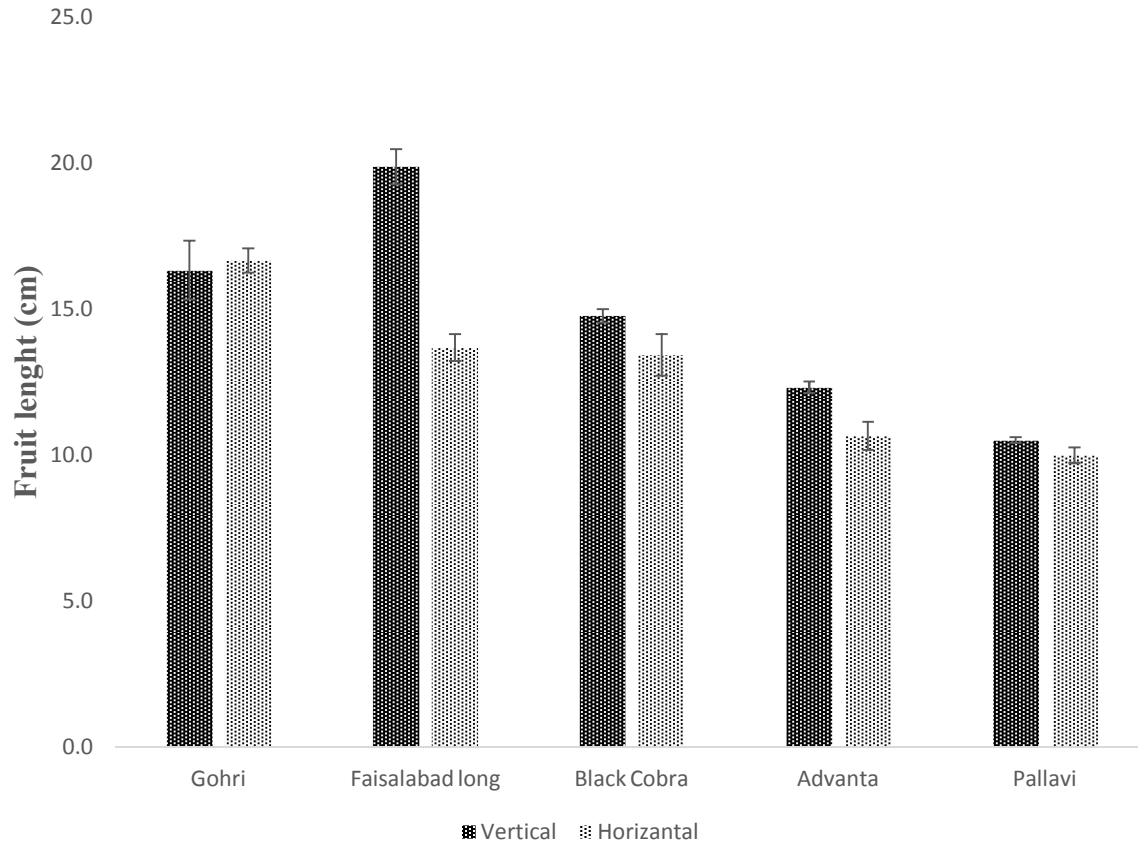
4.7. Fruit length (cm)

Data concerning fruit length were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were significant. Varieties and treatments were highly significant. But interaction between cultivation methods and varieties was non-significant (Table 4.6a). Maximum mean value of fruit length was observed in vertical (14.8) and minimum mean value of fruit length in horizontal (12.9). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value fruit length was observed in cultivar Faisalabad long (16.8) and minimum value

of fruit length in cultivar pallavi (10.3). Mean values of all treatments were arranged into descending order in Table 4.4b for comparison. From varieties treatments black cobra gives higher result then other varieties.

The fruit length was greater in staked as compared to unstaked. It was observed that the staked method was better than unstaked method with reference to length of fruits. Length of fruit was affected by the method of trellising. Length of fruit was not same in both type of cultivation method. Our results are similar to the finding of Jame et al. (2003).

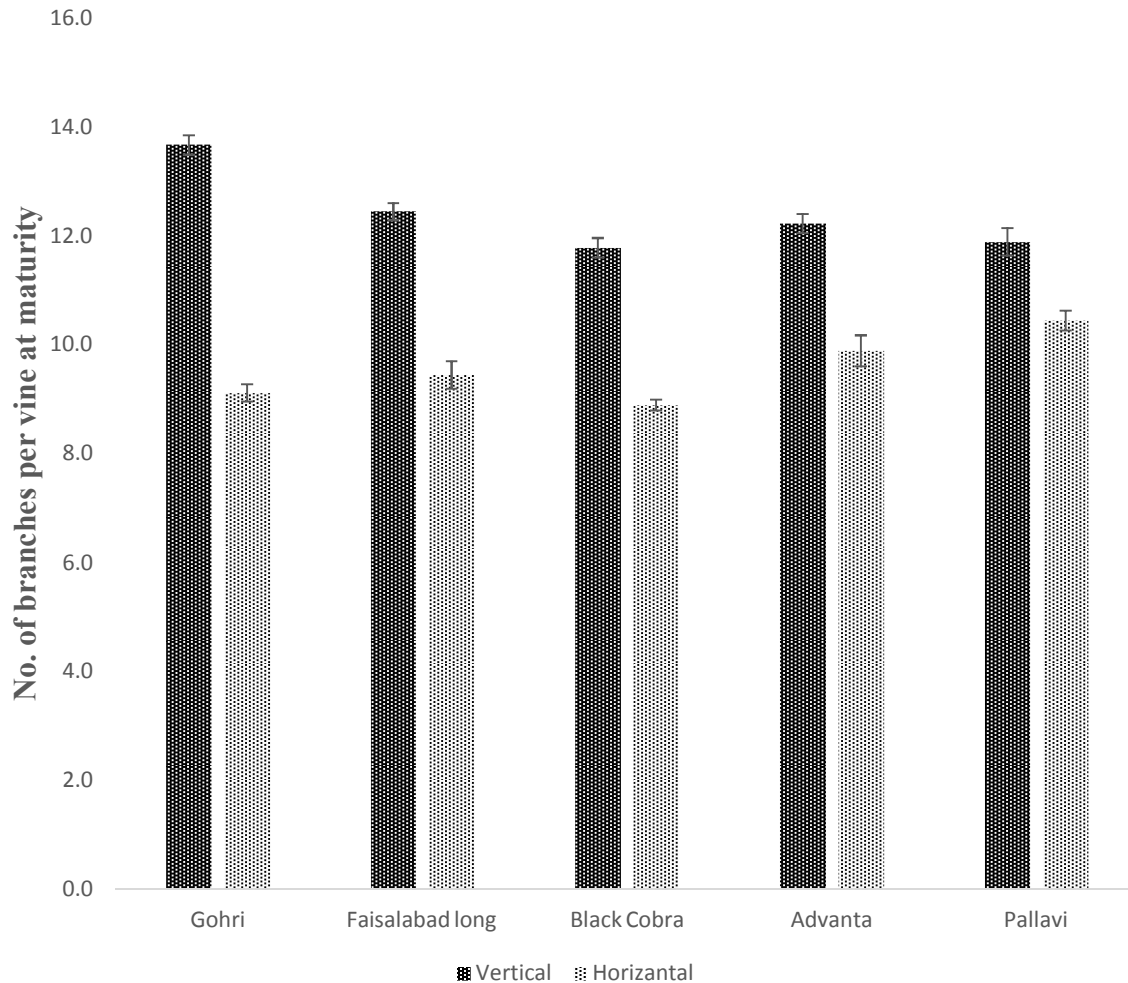


4.8. No. of branches per vine at maturity

Data concerning number of branches per vine at maturity were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. And varieties treatments were non-significant. Interaction between cultivation methods and varieties was also non-significant (Table 4.7a). Maximum mean value of number of branches per vine at maturity was observed in vertical (12.4) and minimum mean value of number of branches per vine at maturity in horizontal (9.6). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value number of branches per vine at maturity was observed in cultivar gohri (11.4) and minimum value of number of branches per vine at maturity in cultivar black cobra (10.3). Mean values of all treatments were arranged into descending order in Table 4.4b for comparison. From varieties treatments, black cobra gives higher result then other varieties.

Number of branches was affected by the method of trellising. Number of branches almost same in all the cultivars. Our results closely related with the finding of Gedam et al. (1996) who described that number of branches typically occurs between 7 to 14.



4.9. Final vine length (cm)

Data concerning final vine length were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. Varieties and treatments are non-significant. Interaction between cultivation methods and varieties was also non-

significant (Table 4.8a). Maximum mean value of final vine length was observed in vertical (323) and minimum mean value of final vine length in horizontal (254.8). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value final vine length was observed in cultivar Faisalabad long (293) and

minimum value of final vine length in cultivar pallavi (276.5). Mean values of all treatments were arranged into descending order in Table 4.8b for comparison.

From varieties treatments, black cobra gives higher result then other varieties.

Table 4.9a: Analysis of variance for Productive and qualitative response of Bitter gourd (*Momordica charantia* L.) cultivars by adopting different patterns like horizontal and vertical on vine length

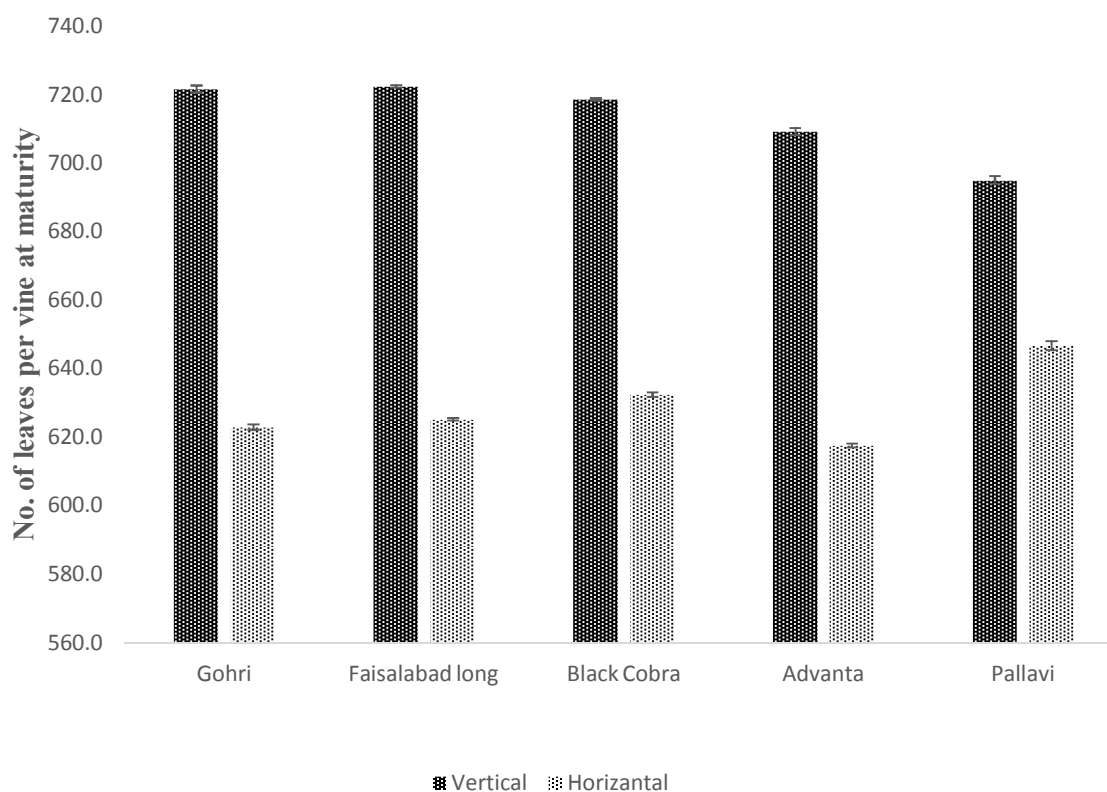
SOV	DF	SS	MS
Replication	2	1951.3	975.6
Cultivation Method	1	34897.9	34897.9**
Treatment	4	1736.0	434.0 ^{ns}
C × T	4	4568.4	1142.1 ^{ns}
Error	18	10699.2	594.4
Total	29	53852.9	

SOV= Source of variance, DF= Degree of freedom; SS = Sum of square, MS = Mean sum of square, *, *** = Significant at $p \leq 0.05$ and $p \leq 0.001$; ns= Non-significant.

Table 4.9b: Effect of treatments on final vine length (cm)

Treatments	Vertical	Horizontal	Mean
Gohri	331.9a	241.3a	286.6A
Faisalabad long	342.1a	243.9a	293.0A
Black Cobra	323.9a	254.0a	289.0A
Advanta	324.9a	274.3a	299.6A
Pallavi	292.4a	260.7a	276.5A
Mean	323.0A	254.8B	
LSD	Treatments = NS; Cultivation method= 18.7; C × T= NS		

Figures sharing the same letter do not differ significantly at $P \leq 0.05$. NS= Non-Significant.



4.10. No. of leaves per vine at maturity

Data concerning number of leaves per vine were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. Varieties treatments were non-significant. Interaction between cultivation methods and varieties was also non-significant (Table 4.9a). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value of number of leaves per vine was observed in vertical (713) and minimum mean value of number of leaves per vine in horizontal (629). Maximum mean value number of leaves per vine was observed in cultivar black cobra (675.6) and minimum value of number of leaves per vine in cultivar pallavi (671). Mean values of all treatments were arranged into descending order in Table 4.4b for comparison. From varieties treatments, black cobra gives higher result then other varieties.

It was observed that the staked method was better than unstacked method with reference to production of fruit. Vegetative features such as vine length and

number of leaves was almost same in staked and unstacked methods.

4.16. Thousand Seed weight (g)

Data concerning thousand seed weight were analyzed statistically and the results are given in Table as analysis of variance. Cultivation methods (vertical and horizontal) were highly significant. Varieties as well as treatments were also highly significant. But interaction between cultivation methods and varieties was non-significant (Table 4.15a). Maximum mean value of thousand seed weight was observed in vertical (142) and minimum mean value of thousand seed weight in horizontal (130.7). From cultivation methods, horizontal method gives better result than vertical.

Maximum mean value thousand seed weight was observed in cultivar gohri (139.4) and minimum value of thousand seed weight in cultivar pallavi (132.8). Mean values of all treatments were arranged into descending order in Table 4.15b for comparison. From varieties treatments, black cobra gives higher result then other varieties.

Table 4.16: Analysis of variance for Productive and qualitative response of Bitter gourd (*Momordicacharantia L.*) cultivars by adopting different patterns like horizontal and vertical on thousand seed weight

SOV	DF	SS	MS
Replication	2	3.95	1.975
Cultivation Method	1	964.47	964.467**
Treatment	4	157.30	39.326**
C × T	4	9.13	2.283 ^{ns}
Error	18	53.64	2.980
Total	29	1188.50	

SOV= Source of variance, DF= Degree of freedom; SS = Sum of square, MS = Mean sum of square, *, *** = Significant at $p \leq 0.05$ and $p \leq 0.001$; ns= Non-significant.

Table 4.16: Effect of treatments on thousand seed weight (g)

Treatments	Vertical	Horizontal	Mean
Gohri	144.6a	134.3a	139.4A
Faisalabad long	143.8a	132.6a	138.2A
Black Cobra	141.0a	130.9a	135.9B
Advanta	141.6a	129.1a	135.3B
Pallavi	139.2a	126.4a	132.8C
Mean	142.0A	130.7B	
LSD	Treatments = 1.32; Cultivation method= 2.09; C × T=NS		

Figures sharing the same letter do not differ significantly at $P \leq 0.05$. NS= Non-Significant.

Conclusion

During the period of this study, the data were collected on various parameters like number of days taken to germination, number of days taken to first flowering, number of days taken to first harvesting, fruit length, fruit diameter, number of fruit per vine, number of leaves per vine.

It is concluded that the vertical method of sowing is better than the horizontal method of sowing. From

the above research we concluded that for bitter gourd crop the vertical method is better than horizontal method of sowing because the flow of air and light is maximum in vertical method of sowing as compared to horizontal method of sowing. Another advantage of vertical method of sowing is less chance of fruit rot and disease dissemination as compared to horizontal method of sowing for bitter gourd crop.

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