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Yield and yield contributing traits of bitter gourd (*Momordica charantia* L.) genotypes

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Abstract
In terms of nutritive value, bitter gourd ranks first among cucurbits and has great demand in international market, inspite of this a due attention has not been given towards a need-based crop improvement. There is a prime need for Bitter gourd improvement and to evaluate varieties suited to specific agro-ecological conditions. A study was undertaken to evaluate eight different genotypes of bitter gourd (*Momordica charantia* L.) in relation to yield and yield contributing traits. All genotypes showed relevant results for different traits. Among genotypes Prachi produced the most fruit/plant (21.78), fruit yield/plant (1.16 kg) and total fruit yield (16.44 $Mt \cdot ha^{-1}$) followed by Preeti, and these 2 genotypes had best results for high yielding parameters, Whereas for earliness Polo-71 performed best for days to first male (31.83) and female flower (30.36). They could be used to develop new hybrids and recommended to increase productivity in Bitter gourd.

Keywords: cucurbits, evaluation, hybrids, *Momordica charantia*, productivity

Introduction

Bitter gourd (*Momordica charantia* L.), 2n=22, is an annual, climber vine. It is monoecious and highly cross pollinated due to a high degree of heterozygosity (Singh *et al*., 2013) [6]. It used as a vegetable and reported to have medicinal properties (Behera *et al*., 2008) [1]. Momordicin in the fruit is responsible for the bitter taste. It is low in calories (17%) and a source of vitamins (B1, B2 and B3), vitamin C (34%); ripe fruit are rich in Vitamin A. It contains 4.0 to 10.5 of carbohydrate, 1.5 to 2.0% protein, water (83-92%), Fat (0.2-1.0%), Minerals (0.5-1.0%) and 0.8 to 1.7 of fibers (Islam *et al*., 2010) [2]. It is reported to have hypoglycemic properties, can act as a laxative, and is easily digested and has great demand in international market among fresh vegetables (Singh, 2013; Thriveni *et al*., 2015) [6, 7].

Bitter gourd can be grown under diverse tropical conditions at different levels and soil types. Fruit yield and other plant characters of bitter gourd are usually influenced by environmental conditions thus creating a genotype × environment interaction (Morakinyo and Ajibade, 2002) [3]. It is important to understand the interaction of different varieties with environmental conditions to find out a suitable variety to a particular area.

Inspite of the potential economic and medicinal importance of the crop due attention has not been given towards a need-based crop improvement programme. There is a prime need for its improvement and to develop varieties or hybrids suited to specific agro-ecological conditions. However the yield potential of bitter gourd in India is very low due to poor yielding varieties and high incidence of pests and diseases (Ngullie and Biswas, 2015) [4]. The main objective is to develop high yielding varieties with greater fruit number and weight, uniform thick cylindrical fruits free from bitterness, high female: male sex ratio, earliness and resistance to fruit fly infestation.

Objective of present experiment was: to study the growth and yield performance of different bitter gourd varieties and to evaluate different bitter gourd varieties for their quality parameters.

Material and Methods

The experiment was conducted with the bitter gourd cvs. Punjab-14, Solan Hara, Arushi-910, Charu, Prachi, Harit, Polo-71, Preeti. The experimental trial was arranged in a randomized complete block design (RCBD) with 3 replications at the vegetable research farm of the Lovely Professional University, Phagwara, Punjab, India, at 31.13 N and 75.47 E with an average elevation of 234 m during summer season, month of March – June, 2017. The normal annual rainfall is 686 mm, which is distributed over 33 days in a year. Soil type is arid brown, loamy soils with pH -7.5.

The soil was ploughed with mold board plough followed by three diskings to pulverize the soil and tilling to a good tilth. Cow dung manure 20t·ha-1 and N:P:K at 60:30:40 kg·ha-1, respectively, was applied at field preparation. Seed were treated with bavistin (2 g·kg-1 seed) to control fungal diseases by soaking for 4 hrs. Weeding was at 15-day intervals and surface flood irrigation was provided at weekly intervals. After every irrigation the soil was cultivated by hand hoeing to enhance aeration. A systemic insecticide and fungicide was used to control attack of insect pest and fungal diseases.

In each replication, genotypes were represented by 1 row and each row contain 10 plants with row to row spacing 1.5 m and plant-plant spacing of 45 cm. Data were collected from 5 plants per row for node number to first male and female flower, days to first male and female flower, vine length, internodal length, average fruit weight, fruit length, fruit diameter, number of fruit per plant, fruit yield/plant and fruit yield·ha^{-1}. The data were analysed by OPSTAT open data analysis software (Sheoran *et al*., 1998) [5].

Results and discussion

Genotype affected response (Table 1). Genotype Punjab-14 flowered on the lowest node and Preeti flowered on the highest node. The highest node to first female flower was in 'Preeti' followed by 'Charu' with the lowest node to first female flower on 'Solan Hara' followed by 'Prachi'.

Differences were found in all genotype/hybrid for days to first flower induction. 'Polo-71' took fewest days for male flower induction followed by 'Punjab-14; 'Charu' took the most days followed by 'Arushi-910' for male flower induction. Cultivar Polo-71 were the fewest days followed by 'Solan Hara'; most days was for 'Arushi-910' followed by 'Charu' for female flower induction. Days to male and female flower induction help in the development of early or late fruit yield which is beneficial for grower to get the higher price in market.

The tallest plants were for 'Charu'. The shortest plants were in 'Punjab-14' followed by 'Harit'. Vine length of bitter gourd ranged from 1.12 m-5.65 m (Yadav *et al*., 2008) [9]. The longest internodal length was in 'Charu' followed by 'Arushi-910'; the shortest internodes were in 'Solan Hara' followed by 'Punjab-14'. Vine length observed by Yadagiri *et al*. (2017) [8] ranged from 129.27-321.70 cm. The vine length and internodal length had direct negative effect towards yield. Lower internodal length is desirable for higher productivity.

The heaviest fruit were from 'Polo-71' followed by 'Prachi'; the lightest fruit were from 'Punjab-14' followed by 'Harit'. The longest fruit were from 'Solan Hara' followed by 'Charu'; the shortest fruit was in 'Punjab-14' followed by 'Prachi'. The wides fruit were in 'Arushi-910' followed by 'Prachi'; the narrowest fruit were from 'Charu' followed by 'Solan Hara'. Fruit diameter in bitter gourd ranges from 2.20-3.21 cm (Yadagiri *et al*., 2017) [8]. The fruit length and diameter directly effect the fruit weight which leads to higher fruit yield/plant and fruit ha^{-1}.

The most fruit per plant was from 'Prachi' followed by 'Preeti'; the fewest fruit per plant were from 'Solan Hara' followed by 'Charu'. The highest fruit yield/per plant was in 'Prachi' followed by 'Preeti'; the lowest fruit yield/plant was in 'Solan Hara' followed by 'Charu'. Fruit yield per plant in bitter gourd ranges from 0.57-2.68 kg (Yadav *et al*., 2008) [9]. Fruit yield ha^{-1} was affected by genotype. The highest fruit yield·ha^{-1} was in 'Prachi' followed by 'Preeti'; the lowest fruit yield ha^{-1}was in 'Solan Hara' followed by 'Charu'. Differences in fruit yield·ha^{-1}was due to the number of fruit/plant, fruit yield/vine, fruit size and fruit weight.

Table 1: Response of measured vegetative and reproductive characters of Bitter gourd genotypes.

Genotype	Node no. of first male flower	Node no. of first female flower	Days to first male flower	Days to first female flower	Vine length (m)	Internodal length (cm)	Fruit length (cm)	Fruit diameter (cm)	No. fruit/plant	Average fruit weight (kg)	Fruit yield (kg/plant)	Fruit yield (Mt·ha^{-1})
Punjab-14	9.32	12.43	32.46	33.89	2.89	7.96	9.68	4.14	10.88	48.75	0.51	7.62
Prachi	10.01	12.23	33.68	35.12	4.41	9.06	10.44	4.24	21.78	75.77	1.16	16.44
Solan Hara	11.12	11.57	34.90	33.78	4.23	7.75	19.27	3.21	6.55	51.83	0.32	4.36
Charu	13.22	22.78	37.43	38.58	5.97	10.16	18.00	3.09	6.77	52.00	0.38	4.45
Arushi-910	9.35	15.12	37.32	40.74	4.18	9.41	13.44	4.39	10.66	63.84	0.62	9.03
Preeti	22.34	25.33	34.49	34.74	4.20	9.30	13.62	3.65	20.33	55.92	1.11	16.21
Harit	12.90	16.22	35.31	34.43	3.58	9.35	15.66	3.82	14.44	51.37	0.67	10.12
Polo-71	12.76	17.01	31.83	30.36	4.04	9.38	17.88	4.19	13.58	140.78	1.08	15.39
C.D.	1.32	2.37	N/A	4.11	0.38	0.85	1.90	0.38	1.45	6.37	0.07	1.23
SE(m)	0.43	0.77	1.59	1.34	0.12	0.27	0.62	0.12	0.47	2.08	0.02	0.40
C.V.	5.89	8.06	7.96	6.60	5.12	5.34	7.30	5.60	6.25	5.33	5.75	6.64

On the basis of observations collected regarding different quantitative parameters all the eight genotypes which were used in experiment showed significantly best results. Among all eight genotypes Polo-71 was found best as early genotype in bitter gourd while Prachi showed relatively best performance for yield contributing traits. From this experiment it is found that while selecting the best hybrids for yield in bitter gourd, more emphasis should be given to number of fruit per vine, fruit flesh thickness, days to first male and female flower anthesis, fruit weight for early maturity and high yield. These two genotypes could be used to develop new hybrids and recommended to increase productivity in Bitter gourd.

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