Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(4): 3400-3402
Received: 04-05-2019
Accepted: 08-06-2019

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Varietal evaluation in bitter Gaurd (*Momordica charantia* L.) for better growth flowering and higher yield

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Abstract
The experiment was carried out in vegetable Research Farm Department of Horticulture Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and sciences, Prayagraj (U.P.) during summer 2018. to evaluate the available genotypes, to estimate the correlation coefficient, to work out the path coefficient analysis and genetic divergence for fruit yield and its component traits of 12 genotypes, with three replications in Randomized Block Design. Analysis of variance in the present investigation indicated that the genotypes evaluated differed significantly among all the treatment for all the twelve traits. The genotypes CH-65, followed by Padama, Pusa Visesh, produced higher fruit yield per plant. These genotypes also exhibited average mean performance for number of fruits per plant. Node number to anthesis of first staminate flower comes on earlier node on Priya followed by Priyanka, Satya, and Ageti Karela, where Node number to anthesis of first pistillate flower appears on earlier node in Vishanu followed by Ratana, and Phule Karela showed earlier development of pistillate flower. The higher magnitude of coefficient of variation at phenotypic as well as genotypic levels were observed for phenotypic in number of fruit per plant followed by fruit yield per plant (kg), vine length (m), fruit length (cm), node no. to anthesis of first staminate flower, average fruit weight (g), node number to anthesis of first pistillate flower, number of nodes per vine and lower value in days of first fruit harvest followed by days to anthesis of first pistillate flower, days to anthesis of first staminate flower, fruit diameter. The phenotypic correlation coefficients between different characters were generally similar in magnitude and nature to the corresponding genotypic correlation coefficient. The significant and positive correlation with yield per plant was observed at phenotypic level with average fruit weight and number of fruits per plant. The analysis of path coefficient revealed appreciable amount of direct positive effect of number of fruits per plant and fruit yield per plant followed by vine length on fruit yield per plant. Major cluster in divergence analysis contained genotypes of heterogeneous origin, thereby, indicating no parallelism between genetic and geographic diversity. Therefore, crosses between members of clusters separated by high inter-cluster distance are likely to produce desirable segregates. The very high inter cluster value was also observed between cluster III to cluster VI followed by cluster II to cluster VI, cluster II to cluster V, cluster V to cluster VI and cluster I to clustre VI. In this context minimum intra-cluster distance was recorded between cluster III and maximum intra-cluster distance was recorded for cluster VI.

Keywords: Varietal evaluation, bitter guard, better growth, higher yield *Momordica charantia* L.

Introduction
Bitter Gaurd (*Momordica charantia* L. 2n = 2 x = 22) is one of the most nutritive and commercially important vegetable crop among the cucurbits grown throughout the country, from plain to an altitude of 1500 m and some parts of world. It has occupied third position next to onion and okra in the export trade. It is also known as bitter melon, bitter cucumber, karela, cassilla, maiden apple and balsam pear (Morton, 1967) [6]. It contains alkaloids *viz*., momordicin and cucurbitacin while skeleton is rich in momordicosides-glycosides of tetracyclic triterpinoides with cucurbitane (Chandravandna and Subhash Chandra, 1990) [2]. The fruit of bitter gourd are reported to have cooling, stomachic, appetitising, carminative, antipyretic antiheliminthic, aphrodisiac and vermifuge, properties (Blatter *et al.*, 1935) [1]. They have antiviral therapy for HIV infection and as acytostatic in certain cancers. It is also known from its antidiabetic properties due to its latent, oxygen free radical with scavenging activity of fruit juice (Shreejayan and Rao, 1991) [10]. China, Tropical Africa and North and South America. Wild *Momordica charantia* var. abbreviata, a native of Asia, may be the progenitor to domesticated (Degener, 1947) [3]. In spite of such a large production, the per capita per day supply of vegetables could not rise above 175 g in the country which is lower than the recommended dietary allowance (RDA) of 350 to 400 g per capita per day for a balanced diet (Rai and Pandey, 2007) [8]. The vegetable requirement of our country is estimated to be 220 million tones by 2020 (Singh, 2004) [9].

The present study aimed at to evaluate the correlation coefficients and path coefficients in order to formulate selection criteria for evolving high yielding genotypes and to estimate the contribution of yield components on yield and their association in Bitter gourd.

Materials and Methods

The field experiment was conducted at the Main Experiment Station Farm, Department of Horticulture Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and sciences, Prayagraj (U.P.) during summer 2018 Geographically, Prayagraj, falls under humid sub-tropical climate and is located in between 24.47^0 and 26.56^0 N latitude and 82.12^0 and 83.98^0 E longitude at an altitude of 113 m above the mean sea level in the Gangetic Alluvial Plains of Eastern Uttar Pradesh. All the recommended practices were followed to raise good crop of Bitter gourd. The observations were recorded on Observation were recorded on five randomly selected plants from each genotype each replication for number of fruits per plant followed by fruit yield per plant (kg), vine length (m), fruit length (cm), node no. of first staminate flower and in case of high genetic advance in per cent of mean were observed for no. of fruits per plant, followed by fruit yield (kg) and vine length The statistical analysis and variance due to different sources was worked out according to Panse and Sukhatme (1967) [7] Genotypic and phenotypic correlation (Al Jibouri *et al*., 1958). The phenotypic and genotypic correlation coefficients were calculated from phenotypic and genotypic variances and co variances and path coefficients analyses were worked out as suggested by Dewey and Lu (1959) [4].

Results and Discussion

The phenotype of a plant was result of infection of large number of factors. Hence final yield was the sum of several component factors. There fore, it was important to know the extent and nature of inter-relationship revealing between yield and its component characters and also among themselves. Also it necessary to know association of grain yield characters among themselves. This would be obtaining from simple correlation coefficient which helps a breeder in determining the direction and number of characters to be considers in improving yield. The present study, genotypic and phenotypic coefficient was worked out for yield characters. The estimates of the genotypic and phenotypic correlation coefficients among 13 characters (Table) indicated that the genotypic correlations were higher than the corresponding phenotypic correlations. It revealed the prominence of additive and the additive x additive gene action (Falconer 1981) [5]. The results of the investigation, recorded on node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days of first fruit harvest, number of nodes per vine, vine length (m), fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant and fruit yield per plant (kg). The data recorded on all twelve quantitative characters were subjected to analysis of variance to test the significance of difference among the genotypes. Analysis of variance presented in Table showed that the mean square due to genotypes were highly significant for all the twelve characters. The node number to anthesis of first staminate flower ranged from 6.53 (Ratana) to 14 (CH-65), out of 12 genotypes, while its general mean was 9.25. Seven genotypes *viz*., CH-65 (14.00) had highest node number for first staminate anthesis. The node number to anthesis of first pistillate flower ranged from 10.00 (Ramali Karela) to 16.67 (CH-65), out of 12 genotypes, while its general mean was 12.50. Genotypes *viz*., Ramali Karela (10.00), (11.67) and Priyanka (11.76) had significantly lower node number of first pistillate flower anthesis while, genotypes *viz*., Padama (14.60), Priya (15.16), CH-65 (16.70) had highest node number to anthesis of first pistillate flower.

Days to anthesis of first staminate flower ranged from 34.57 (Padama) to 51.47 days. Where as ratana (51.47 days), Vishnu (51.00), Phule Kerela (49.16 days), Swarnima (46.10 days) and Ageti Karela (45.90) took significantly more number of days for first staminate flower anthesis. Days to anthesis of first pistillate flower ranged from 41.10 (Ramali Karela) to 61.33 days (CH-65), out of 12 genotypes. Days taken to first fruit harvest among the test genotypes ranged from 52.13 (Ramali Karela) to 75.67 days (CH-65). Among the 12 genotypes, three genotypes *viz.*, Ramali Karela (52.13 days), Swarnima (55.10 days) and Phule Karela (55.26 days) No. of nodes per vine ranged from 38.10 nodes (Ratana) to 68.33 nodes (Vishnu). Four genotypes *viz.*, CH-65 (68.33) followed by Padama (65.93), Pusa Vishesh (64.66), Priya (63.66),

The vine length ranged from 1.73 m (Ramali Karela) to 4.07 m (CH-65), five genotypes namely CH-65 (4.07), Padama, Ageti Karela (3.53m), Satya (3.63) and Pusha vishesh (3.83m). Fruit length (cm) among the genotypes ranged from 9.67 (Ramali Karela) to 21.77cm (CH-65). Three genotypes *viz*., CH-65(21.77 cm), Pusa Vishesh (21.10 cm) and Padama (21.00 cm), showed significantly higher fruit length. The fruit diameter (cm) ranged from 2.80 (Ramali Karela) to 4.20 cm (CH-65). Pusa Vishesh (4.03), Priya, Satya, Priyanka (4.06 cm) were significantly higher fruit diameter. Number of fruits per plant ranged from 17.30 (Ramli Karela) to 34.40 (CH-65). Padama (32.40), and Pusha Vishesh (28.50) had significantly higher number of fruit per plant. Average fruit weight (g) ranged from 43.20g (Ramali Karela) to 125.30g (CH-65), (118.10g) and Ageti Karela (113.00g). The fruit yield per plant ranged from 0.67kg (Ramali Karela) to 2.77kg (Ch-65), Priyanka (2.47kg), Vishnu (2.31kg) produced significantly higher yield per plant (kg).

Table 1: Mean performances of 12 genotypes of bitter gourd

S. No.	Characters	Node No. of 1st Staminate Flower Appearance	Node No. of 1st Pistillate Flower Appearance	Days to Anthesis of 1st Staminate Flower Appearance	Days to Anthesis of 1st Pistillate Flower	Days to 1st Fruit harvest	No. of nodes Per Vine.	Vine Length (m)	Fruit Length (cm)	Fruit Diameter (cm)	No. of fruits Per Plant	Average fruit Weight (gm)	Marktable fruit Yield/Plant (kg)
1	Priya	8.10	15.16	34.56	43.67	55.27	63.66	2.43	14.63	4.06	20.40*	118.10	2.08**
2	Priyanka	9.43	11.76	36.00	43.50	58.40	63.56	2.70	13.06	4.06	21.10	68.17	2.47
3	Satya	7.96	11.67	36.20	52.36	65.20	62.57**	3.63**	12.76	4.06	21.10	66.43**	1.38
4	Agethi Karela	7.63	11.63	43.90	52.90	63.83	42.60	2.10	15.06	3.50	19.80	113.00	1.37
5	Vishnu	6.86*	11.26	51.00	51.13	66.00	68.33	2.03	14.67*	3.30	19.10	121.00**	2.31**
6	Ratna	6.53*	11.67	51.47*	54.83*	55.26	38.10	1.90	12.10	3.03	18.20	67.20*	1.27
7	Phule Karela	12.07	11.90	49.16	41.86	55.10	38.10	1.80**	11.00	2.93	18.03	58.40	1.26
8	Swarnima	10.30	10.73	46.10	41.93	55.13	44.80	1.73	10.93	2.86	17.40	58.33	0.94

9	Ramli Karela	12.17	10.00	46.10	41.10	52.13	44.53	4.07	9.67**	2.80	17.30	43.20	0.67
10	Ch -65	14.00	16.67	39.00	61.33	75.67	58.33	3.53	21.77	4.20	34.46	125.30	2.77
11	Padma	8.23	14.40	34.37**	45.17	68.20*	65.93	3.53	21.00**	4.10	32.40	123.50**	2.65
12	Pusa Visesh	7.76	13.20	44.27	51.23	67.20	64.66	3.83	21.10	4.03	28.50**	123.36	2.61**
Mean		9.25	12.50	42.67	48.41	61.43	54.59	2.77	14.08	3.57	20.14	92.16	1.85
C.V.		9.72	9.43	6.99	6.31	5.63	5.93	8.45	9.23	8.26	8.33	7.84	9.235
S.E.		0.54	0.71	1.68	1.72	1.98	1.83	0.13	0.88	0.18	1.14	3.99	0.092
C.D. 5%		1.53	2.02	4.75	4.85	5.60	5.17	0.38	2.48	0.50	3.22	11.28	0.262
C.D. 1%		2.03	2.68	6.32	6.46	7.45	6.88	0.50	3.30	0.66	4.28	15.01	0.348
Range Lowest		6.53	10.00	34.57	41.10	52.13	38.10	1.73	9.67	2.80	17.30	43.20	0.671
Range Highest		14.00	16.70	51.47	61.33	75.67	68.33	4.07	21.77	4.20	34.40	125.30	2.772

Conclusion

On the basis of results shown in the present investigation it was concluded that the high magnitude of heritability (In broad sense) coupled with high genetic gain was observed for most of traits exhibiting additive genetic effect. The genotypes CH-65, followed by Padama, Pusa Visesh, Priya and Priyanka produced higher marketable fruit yield per plant which indicated that these genotypes may be sown for higher yield and indicated good response to selection owing to their high heritability, variability and genetic advance showing additive gene effect. These genotypes can be used for improvement of yield and component traits by selection.

Acknowledgements

The present work is part of the M.Sc. thesis. We acknowledge the department of Horticulture of Shuats for providing field and laboratory facilities to conduct experiments.

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