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Variability Parameters of Yield and Quality Attributes in Bitter Gourd (*Momordica charantia* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment of the present research work was conducted during *summer season* of 2018-19 and 2019-20 at Horticulture Research Farm-I, Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya-Vihar, Rae Bareli Road, Lucknow (U.P.), India. The analysis of variance clearly reveals significant differences among the genotypes for all characters. The observations recorded on various characters showed that the estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient variation (GCV) for all characters. The high phenotypic as well as genotypic coefficient of variation were observed in marketable fruit yield per plant (39.36%) followed by average fruit weight (29.73%) and number of branches per plant (27.18%). High estimates of heritability were recorded for different characters *viz.,* average fruit weight (98.6%) followed by total soluble solids (97.8%), total sugars (97.7%) and days to anthesis of first pistillate flowers (97.2%). The parameters which observed were found to be very high estimate value of genetic advance in per cent of mean of (60.14%) average fruit weight (60.14%) followed by titratable acidity (53.73%), number of branches per plant (53.47%), total soluble solids (52.81%) and marketable fruit yield per plant (47.87%).

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Keywords: Bitter gourd; genotypes; variability; heritability; genetic advance.

1. INTRODUCTION

Bitter gourd (*Momordica charantia* L.; 2n=2x=22) is a commercial and medicinal vegetable, belongs to the family Cucurbitaceae. It is an annual as well as perennial herbaceous creeper. It is also known as bitter melon, maidan apple and balsam pear [1].The crop is highly cross pollinated due to monoecious in nature. The bitter gourd is specifically used as folk medicine for diabetes. Recent research has established that it contains a hypoglycemic or insulin-like principle, designated as 'plant insulin' which has been found highly beneficial in lowering the blood and urine sugar level. A majority of diabetics usually suffer from malnutrition as they are usually under-nourished. It contains alkaloids *viz*., momordicin and cucurbitacin, while skeleton is rich in momordicosides-glycosides of tetracyclic triterpinoides with cucurbitane(Chandravandna and Chandra, 1990). The fruits of bitter gourd are reported to have cooling, stomachic, appetitising, carminative, antipyretic antiheliminthic, aphrodisiac and vermifuge properties [2].*Variability parameters like genotypic and phenotypic coefficient of variation, heritability and genetic advance of yield components and quality characters are paramount significance in formulating an appropriate breeding strategy aimed at exploiting the inherent variability of the original population. Phenotypic variability changes under different environmental conditions, while genetic variability remains unchanged and more useful to a plant breeder for exploitation in selection or hybridization.* With this background, the present investigation was carried out with 20 bitter genotypes.

2. MATERIALS AND METHODS

The experimental material comprised of 20 genotypes of bitter gourd obtained from various institutes. Evaluation of genotypes was carried out at the Horticulture Research Farm-I of the Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University Vidya-vihar Rae Bareli Road, Lucknow (U.P.), India during the *summer season* of 2018-19 and 2019-20. Geographically Lucknow is situated at 26^0 76' North latitudes, 80^0 92' East longitudes and the altitude of 123 meters above mean sea level (MSL). The experiment was laid out in Randomized Complete Block Design (RCBD) and replicated thrice at individual plot size of 3.0 m × 2.0 m. Plant-to-plant and row-to-row distances were maintained as 0.5 m and 2.5 m, respectively. The field had sandy clay loam soil, low in organic carbon (0.12%) and slightly alkaline in nature (pH 8.2). Intercultural practices were carried out on a regular basis across the cropping season to ensure optimum growth and development of plants. Healthy seedlings were maintained per pit. All conventional agronomic methods were used. Similarly for recording on the crop, observations, 15 physical characters and 6 chemical characters in the field as well as laboratory conditionswere considered *viz*., node number to first staminate flowers, node number to first pistillate flowers, days to anthesis of first staminate flowers, days to anthesis of first pistillate flowers, days to first fruit harvest, vine length (m), fruit length (cm), nodes per plant, number of branches per plant, number of seeds per plant, fruit diameter (cm), number of fruits per plant, seed weight per fruit (g), average fruit weight (g), ascorbic acid (mg/100g), reducing sugar (%), non-reducing sugar (%), total sugars (%), total soluble solids (T.S.S.) (^{0}Brix), titratable acidity (%) and marketable fruit yield per plant (kg). The data so obtained were analyzed statistically as suggested byPanse and Sukhatme, [3].

3. RESULTS AND DISCUSSION

3.1 Analysis of Variance

A perusal of data given in **Table-1** clearly revealed that there were genotypic variations on the different parameters of various genotype of bitter. Analysis of variance also showed that the mean of square due to the genotypes were highly significant for all 21 characters at indicating that genotypes differed significantly and genetic improvement is possible by selection. Similar to the present findings, significant differences for various characters were also reported by Islam et al. [4], Gupta et al. [5], Yadav et al. [6], Pathak et al. [7] and Singh et al. [8] in bitter gourd.

3.2 Coefficient of Variation

The estimates of genotypic and phenotypic of variation for 21 characters of bitter gourd genotypes have been given in Table 2. Since variability is helpful to measure the extent of

Table1. Analysis of variance for 21 characters in bitter gourd (Pooled data)

S. No.	Characters	Source of variation		
		Replication	Genotypes	Error
	Degree of freedom	2	19	38
			Pooled data	
1.	Node no. to Iststaminate flowers	1.46	25.18**	1.48
2.	Node no. to Ist pistillate flowers	6.16*	30.35**	1.39
3.	Days to anthesis of Ist staminate flowers	3.99*	109.04**	1.25
4.	Days to anthesis of Ist pistillate flowers	9.00**	218.09**	1.04
5.	Days to Istfruit harvest	2.51	227.45**	4.79
6.	Vine length (m)	0.11	3.56**	0.08
7.	Fruit length (cm)	0.09	64.72**	1.08
8.	Nodes per plant	34.36**	510.87**	2.98
9.	No. of branches per plant	8.11**	140.04**	1.09
10.	No. of seeds per fruit	4.31*	97.63**	1.14
11.	Fruit diameter (cm)	0.24	11.73**	0.41
12.	No. of fruits per plant	6.05**	48.13**	1.23
13.	Seeds weight per fruit (g)	0.21	1.29**	0.25
14.	Average fruit weight (g)	27.47*	3547.16**	8.11
15.	Ascorbic acid (mg/100g)	5.57	160.27**	2.03
16.	Reducing sugar (%)	0.02	0.07**	0.08
17.	Non-reducing sugar (%)	0.04	0.07**	0.04
18.	Total sugars (%)	0.07	0.19**	0.07
19.	T.S.S (^{0}Brix)	0.09	5.16**	0.01
20.	Titratable acidity (%)	0.02	0.04**	0.01
21.	Marketable fruit yield per plant (kg)	1.02	4.99**	0.52

and significant at 5% and 1% probability levels, respectively*

variability present in particular character. It also provides measure to compare the variability present among various metric traits. The estimates of phenotypic coefficient of variation (PCV) showed higher than genotypic coefficient variation (GCV) for all the characters.

The high PCV and GCV values greater than 20% are regarded as high values between 10% and 20% to be medium whereas values less than 10% are considered to low. Based on this delineation PCV and GCV recorded in this study, marketable fruit yield per plant (39.36%) followed by average fruit weight (29.73%), number of branches per plant (27.18%), titratable acidity (27.06%), total soluble solids (26.21%), fruit diameter (23.58%), non-reducing sugar (22.26%) and number of fruits per plant (21.56%). Whereas, node number to first staminate flowers (19.37), seeds weight per fruit (19.16%), number of seeds per fruit (18.92%), fruit length (17.48%), vine length (17.15%), total sugars (12.58%), days to first fruit harvest (12.24%) and days to anthesis of first staminate flowers (11.09%) recorded moderate coefficient of variation. The character ascorbic acid (6.15%) had lowest coefficient of variation. Narayan et al. (2006), Raja et al. (2007), Singh et al. [8] and Yadagiri et al. [9] in bitter gourd and reported similar trend of variation for genotypic coefficient of variation and phenotypic coefficient of variation of various characters studied which is in conformity with the present findings and Nadarajanet al. [10].

3.3 Heritability in Broad Sense Percent

Results of the heritability in broad sense was presented in Table 2. It clearly indicate that the estimates of heritability in broad sense ranged from 41.5 per cent (seeds weight per fruit) to 98.6 per cent (average fruit weight). High estimates of heritability (>60%), moderate (31-60%) and low (0-30%) were recorded for different characters *viz.,* average fruit weight (98.6%) followed by total soluble solids (97.8%), total sugars

Table2. Estimates of range, grand mean, phenotypic and genotypic coefficient of variation (PCV, GCV), heritability in broad sense, genetic advance (GA) as per cent of mean for 21 characters in bitter gourd (Pooled data)

S. No.	Characters	Range		Grand mean	Variations		Heritability in broad sense (%) (h^2bs)	Genetic advance	Genetic advance percent of mean
		Min.	Max.		PCV (%)	GCV (%)			
					Pooled data				
1.	Node no. to Ist staminate flowers	7.33	15.16	12.14	19.37	16.58	73.2	3.55	29.24
2.	Node no. to Ist pistillate flowers	7.83	16.50	12.09	20.60	18.16	77.7	3.99	32.99
3.	Days to anthesis of Iststaminate flowers	33.68	51.43	39.50	11.09	10.72	93.5	8.44	21.37
4.	Days to anthesis of Istpistillate flowers	32.59	55.05	42.41	14.38	14.18	97.2	12.21	28.80
5.	Days to Ist fruit harvest	43.66	63.50	52.85	12.24	11.52	88.5	11.80	22.34
6.	Vine length (m)	3.25	5.80	4.71	17.15	16.15	88.6	1.47	31.32
7.	Fruit length (cm)	13.90	24.39	19.54	17.48	16.65	90.8	6.39	32.69
8.	Nodes per plant	40.83	73.00	56.46	16.57	16.29	96.6	18.62	32.98
9.	No. of branches per plant	8.16	24.83	18.11	27.18	26.52	95.5	9.68	53.47
10.	No. of seeds per fruit	16.16	31.00	21.92	18.92	18.29	93.4	7.98	36.41
11.	Fruit diameter (cm)	3.52	9.42	6.42	23.58	21.39	82.3	2.56	39.97
12.	No. of fruits per plant	9.16	20.16	13.94	21.56	20.05	86.5	5.35	38.42
13.	Seeds weight per fruit (g)	2.54	4.22	3.37	19.16	12.33	41.5	0.55	16.36
14.	Average fruit weight (g)	53.66	126.83	82.25	29.73	29.5	98.6	49.69	60.41
15.	Ascorbic acid (mg/100g)	79.50	95.50	86.65	6.15	5.92	92.9	10.19	11.76
16.	Reducing sugar (%)	0.54	0.98	0.82	14.00	13.52	93.3	0.22	29.91
17.	Non-reducing sugar (%)	0.30	0.72	0.50	22.26	21.87	96.5	0.22	44.25
18.	Total sugars (%)	1.13	1.71	1.40	12.58	12.44	97.7	0.35	25.33
19.	T.S.S. (^{0}Brix)	2.41	5.31	3.56	26.21	25.92	97.8	1.88	52.81
20.	Titratable acidity (%)	0.11	0.32	0.23	27.06	26.56	96.4	0.12	53.73
21.	Marketable fruit yield per plant (kg)	1.61	5.24	2.85	39.36	30.24	59.0	1.36	47.87

(97.7%), days to anthesis of first pistillate flowers (97.2%), nodes per plant (96.6%), non-reducing sugar (96.5%), marketable fruit yield per plant (96.4%), number of branches per plant (95.5%), vine length (88.6%), days to first fruit harvest (88.5%), number of fruits per plant (86.5%) and fruit diameter (82.3%), node number to first pistillate flowers (77.7%), node number to first staminate flowers (73.2%). Moderate estimate of heritability was recorded for marketable fruit yield per plant (59.09%) and seeds weight per fruit (41.5%). Results obtained here in agreement with the findings of Islam et al. [4], Dalamu and Behera [11], Chakraborty et al. [12], Pathak et al. [7] and Yadagiriet al. [9].

3.4 Genetic Advance as Per Cent of Mean

Genetic advance as per cent was categorized as high (>20%), moderate (10-20%) and low (0-10%). Maximum value of genetic advance in per cent of mean was shown by average fruit weight (60.14%), while ascorbic acid (mg/100g) exhibited minimum value (11.76%) for this parameter. The parameter which observed high estimate value of genetic advance were average fruit weight (60.14%) followed by titratable acidity (53.73%), number of branches per plant (53.47%), total soluble solids (52.81%), marketable fruit yield per plant (47.87%), non-reducing sugar (44.25%), fruit diameter (39.97%), number of fruits per plant (38.42%), node number to first staminate flowers (29.24%) followed by days to anthesis of first pistillate flowers (28.80%), reducing sugar (26.91%), total sugars (25.33%), days to first fruit harvest (22.34%) and days to anthesis of first staminate flowers (21.35%) Moderate genetic advance as per cent of mean was found for seeds weight per fruit (16.36%) and ascorbic acid (11.76%). Higher magnitudes of genetic variability, heritability and genetic advance indicates that selection can be practiced for these traits. Similar kind of results in bitter gourd was also reported by Raja et al. (2007), Chakraborty et al. [12], Gupta et al. [5], Pathak et al. [7] and Yadagiriet al. [9] and Nadarajanet al. [10].

4. CONCLUSION

The study concludes that the estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient variation (GCV) for all characters. The high phenotypic as well as genotypic coefficient of variation were observed in marketable fruit yield per plant (39.36%) followed by average fruit weight (29.73%) and number of branches per plant (27.18%).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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