Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6430

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 499-503 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Genetic Variability, Heritability and Genetic Advance for Yield and Quality Attributes in Bitter Gourd (*Momordica charantia* L.)

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Received: 17.03.2018 | Revised: 22.04.2018 | Accepted: 26.04.2018

ABSTRACT

The present experiment was carried out entitled " Genetic variability, heritability and genetic advance for yield and quality attributes in bitter gourd (Momordica charantia L.)" during summer season of the year 2014-2015 at Horticulture Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya- Vihar, Rae Bareli Road, Lucknow-226025 (U.P.) India. The experiment was laid out in Randomized Block Design with three replications. The experimental materials consisting fifteen genotypes of bitter gourd i.e.HABG-22, NDBT-07, NDBT-09, Meghana-2, Selection-5, Preethi, Phul Ujjwala, Priya, Nakhara, Pant Karela-1, Hirkani, VRBT-23, Pusa Vishesh, Pusa Ashaudhi and Arka Harit. The maximum phenotypic and genotypic variance, genetic advance was observed for weight per fruit (gm). The highest of PCV and GCV, GA percent of mean was estimated for fruit yield per plant (kg) and more heritability for primary branches per plant.

Key words: *Genetic variability, Heritability, Genetic advance, Yield*

INTRODUCTION

Bitter gourd (*Momordica charantia* L.) is an important cucurbitaceous crop due to its potential to return profit, nutritional value, and production potential. It is also known as bitter melon, bitter gourd, bitter cucumber, bitter squash, balsam pear, karela, cassilla and maiden apple. It is adapted to a wide range of environments and can be grown tropical and sub tropical climate. The center of origin of this crop is India, with a secondary center of diversity in China and South East Asia[5]. It is highly cross-pollinated and monoecious in nature, with separate yellow male and female flowers, and exhibits large variations for fruit and vegetative characters. It is a common cucurbit of wild flora of tropical Africa which offers great resources for breeding of cultivated bitter gourd for desirable qualitative traits, tolerance to biotic and abiotic factors etc. Fruits contain a reasonable amount of different nutrients such as proteins, carbohydrates, fats, minerals and vitamins (A, B2, and C). It contains considerable amount of water (83-92%), carbohydrates (4.0-10.5%), protein (1.52.0%), fat (0.2-1.0%), minerals (0.5-1.0%) and fiber (0.8-1.7 %).

Cite this article: Kumar, D., Kumar, S., Meena, R.K., Kumar, M. and Vilas, R., Genetic Variability, Heritability and Genetic Advance for Yield and Quality Attributes in Bitter Gourd (*Momordica charantia* L.), *Int. J. Pure App. Biosci.* **6(2):** 499-503 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6430

In India, *Momordica charantia* have relatively broad phenotypic species variation (i.e., sex expression, growth habit, maturity, and fruit shape, size, colour and surface texture[1]. Estimates of heritability have to be considered with conjunction with genetic advance and change in mean value among successive generation, alone it do not provide idea about expected gain in next generation. For a successful planning of breeding improvement program, the analysis of variability among the traits and their association of a particular character in relation to yield and yield attributing traits it would be great importance.

It also gives an estimate of genetic advance a breeder can expect from selection applied to a population and help in deciding on what breeding method to choose. High heritability and high genetic advance for a given trait indicates that it is governed by additive gene action and, therefore, provides the most effective condition for selection[7]. It is possible to develop high-yielding open pollinated varieties, or hybrids, by utilizing existing variability[8] and this technique could be used in improvement of bitter gourd. Before aiming at an improvement of yield, it is necessary to have information on genetic variability and heritability, in respect of important characters associated with yield. Therefore, the present study was taken up to obtain information on the range of variability for different important economic traits.

MATERIAL AND METHODS

The present investigation was done at Horticulture Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Vidya- Vihar, Rae Bareli Road, Lucknow during the year 2014-15. Lucknow is characterized by sub-tropical climate with hot, dry summer and cold winter. The soil of experimental farm was saline with soil pH 8.2, Electrical conductivity 4.0 and sodium exchangeable percentage 15.0. During the period of experiment, meteorological observations were recorded from Indian Institute of Sugarcane Research, Lucknow. The experiment was laid out in Randomized Block Design Twelve genetically diverse germplasm lines as females of bitter gourd were crossed with the three testers as male to constitute thirty six crosses. These crosses along with fifteen parents constituted the total experimental materials for this present investigation. The lines were collected from Indian Institute of Vegetable Research, Varanasi considering the genetic constitution, the three tester namely Pusa Vishesh, Pusa Ashaudhi and Arka Harit were chosen which were the popular commercial varieties grown in Uttar Pradesh. Out of fifteen genotypes, twelve (HABG-22, NDBT-07, NDBT-09, Meghana-2, Selection-5, Preethi, Phul Ujjwala, Priya, Nakhara, Pant Karela-1, Hirkani and VRBT-23) were used as a lines and three (Pusa Vishesh, Pusa Ashaudhi and Arka Harit) used as a testers. Each of the twelve lines (female parents) was crossed to all three testers (male parents) giving rise to 36 F_1's in line x testers during season 2014-15. The crosses were made by hand emasculation followed by pollination. Lines and testers were also maintained during season 2014-15. Observations were recorded on four randomly selected plants from each entry and the average of these four plants was worked out for the purpose of statistical computation. The observation was recorded on five randomly selected plants per replication for each germplasm on sixteen important characters including fruit yield per vine. Observations were recorded like Days to 50% germination, days to first male flower anthesis, days to first female flower anthesis, node number to first male flower, node number to first female flower, vine length (m), nods per vine, primary branches per plant , days to first picking, length of fruit (cm), fruit diameter (cm), weight per fruit (gm), fruits per plant, fruit yield per plant (kg), number of fruit per vine and fruit yield per vine (kg)) were

recorded. The data were analyzed as per methods suggested by Panse and Sukhatme for analysis of variance, Burton for variability, Lush for heritability (Broad Sense) and Johnson *et al*., for genetic advance in per cent of mean.

RESULTS AND DISCUSSION

The extent of variability present in germplasm of bitter gourd was measured in terms of range, SEM, phenotypic variance (σ^2p), phenotypic coefficient of variation (PCV), genotypic (σ^2G) variance, genotypic coefficient variation (GCV), heritability (broad sense) and genetic advance (GA) (Table-1& 2). All the varieties differed significantly with respect of different characters studied.

Mean performance of bitter gourd germplasm for different characters are showed in Table-1 and the coefficient of variation, heritability and genetic gain value are presented in Table-2. The phenotypic coefficient of variation (PCV) was higher than their respective genotypic coefficient of variation (GCV) for all the traits under study.

The widest range was recorded for weight per fruit (81.95-106.22) followed by fruits per plant (12.90-24.65), nodes per vine (25.49-36.96), length of fruit (11.49-22.68), days to first picking (48.34-57.58), days to first male flower anthesis (28.60-37.03), number of fruit per vine (19.71-28.01), days to first female flower anthesis (38.97-45.07), node number to first female flower (11.17-17.20) and primary branches per plant (10.83-16.77) while lowest range were recorded in fruit yield per vine (1.17-1.94).

Phenotypic coefficient of variation was higher for fruit yield per plant (31.97%) followed by fruit diameter (24.64%), node number to first male flower (21.81%), fruits per plant (20.87%), vine length (19.01%), fruit yield per vine (18.77%) and length of fruit (17.76%) whereas, it was moderate for primary branches per plant (16.00%) followed by node number to first female flower(13.41%) and low was recorded for number of fruits per vine (12.29%) followed by nodes per vine (9.35%), days to first male flower anthesis (8.85%), days to 50% germination (8.67%) and weight per fruit (7.91%) and it was lowest recorded for days to first female flower anthesis (4.48 %).

Highest genotypic coefficient of variation was observed for fruit yield per plant (30.52 %) followed by fruit diameter (21.39%), fruits per plant (20.16%), node number to first male flower(19.17%), length of fruit(16.49%) and vine length(16.06%) it was moderate for primary branches per plant (15.49 %) followed by node number to first female flower(12.69%) and fruit yield per vine (11.55 %) while, it was showed low rate for number of fruit per vine (10.75 %) followed by nodes per vine(8.10%), days to first male flower anthesis (6.36%) and lowest was recorded for days to first female flower anthesis (3.36 %).

Heritability value in broad sense is presented in table-2. The highest heritability was recorded for primary branches per pant (0.94%) followed by fruit per plant (0.93%), fruit yield per plant (0.91%), node number to first female flower (0.90%), length of fruit (0.86%), weight per fruit (0.83%) , days to first picking (0.79 %), number of fruit per vine(0.77%), fruit diameter(0.75 %) and vine length (0.71%), whereas, minimum was recorded for days to 50% germination (0.28%).

The maximum genetic advance (%) was recorded for fruit yield per plant (60.02%) followed by fruits per plant (40.11%), fruit diameter (38.25%), node number to first male flower (34.71%), length of fruit (31.52%), primary branches per plant (30.91%), vine length (27.96%), node number to first female flower (24.74%), number of fruit per vine (19.38%), nodes per vine (14.47%), weight per fruit (13.50%), whereas, minimum was recorded for days to 50% germination (4.95%).

Table 1: Mean performance of bitter gourd germplasms for different characters

Germplasms	Days to 50% Germination	Days to first male flower anthesis	Days to first female flower anthesis	Node number to first male flower	Node number to first female flower	Vine length (m)	Nodes per vine	Primary branches per Plant	Days to first picking	Length of f fruit(cm)	Fruit diameter (cm)	Weight per fruit(g)	Fruits per plant	Fruit yield per plant (kg)	Number of fruit per vine	Fruit yield per vine (kg)
HABG-22	8.99	35.63	41.02	3.40	11.60	3.37	25.49	13.50	57.58	14.37	3.23	84.91	14.17	1.00	22.54	1.49
NDBT-07	9.53	35.50	40.93	5.53	11.17	5.10	33.42	16.07	52.43	15.17	3.10	92.30	18.05	1.10	22.62	1.17
NDBT-09	8.78	34.17	41.47	6.80	12.67	4.03	32.46	12.33	55.40	15.30	2.53	81.95	19.19	1.04	26.85	1.62
Meghana-2	9.32	34.63	40.20	5.90	15.07	2.70	35.39	10.93	57.33	12.44	3.30	102.50	17.81	1.46	26.30	1.25
Selection-5	9.28	31.53	40.80	6.53	13.13	3.20	31.12	15.33	55.32	14.73	3.35	99.18	15.46	1.42	26.46	1.22
Preethi	10.38	37.03	43.27	3.67	14.63	3.43	30.87	16.07	48.34	16.19	4.21	90.82	24.48	1.36	19.71	1.33
Phul Ujjwala	10.29	32.50	41.70	4.93	15.20	4.00	32.75	11.27	52.40	15.82	4.28	106.22	23.52	1.74	20.83	1.33
Priya	9.38	32.17	45.07	7.70	17.20	4.00	32.65	12.13	53.62	22.68	5.29	102.12	20.82	1.24	21.75	1.44
Nakhara	9.61	35.97	42.57	4.97	14.37	2.90	33.14	16.17	55.05	11.98	5.23	91.74	12.90	1.63	20.58	1.40
Pant Karela-1	10.01	29.63	43.33	5.67	15.97	3.40	35.27	16.77	52.31	16.86	5.43	101.85	16.77	2.22	25.33	1.60
Hirkani	10.24	34.10	42.87	4.70	16.23	3.80	36.96	15.50	52.37	16.33	4.80	96.54	18.09	1.70	23.57	1.40
VRBT-23	10.95	32.30	42.30	5.60	12.37	3.30	36.48	14.33	54.43	11.49	3.83	101.69	15.36	1.70	23.72	1.19
Pusa Vishesh	10.00	32.50	38.97	5.47	13.27	3.07	35.57	10.83	50.13	16.19	4.91	103.63	22.86	2.35	26.08	1.36
Pusa Ashaudhi	9.68	28.60	39.70	5.83	16.43	3.20	35.10	16.57	56.15	16.16	5.03	99.51	24.65	2.54	27.62	1.57
Arka harit	9.02	31.00	41.43	5.40	13.63	3.10	34.15	12.43	50.68	16.03	5.16	102.46	23.39	2.47	28.01	1.94
SEM	0.41	1.18	0.72	0.33	0.36	0.21	0.90	0.32	0.76	0.59	0.30	1.84	0.60	0.09	0.83	0.12
CD at 5%	1.20	3.42	2.07	0.95	1.03	0.60	2.60	0.94	2.20	1.71	0.87	5.32	1.73	0.27	2.40	0.35

Table 2: Estimates of variability, heritability and genetic advance as per cent of mean for sixteen characters in bitter gourd

S. No.	Character	Range		Mean	Variance		PCV (%)	GCV (%)	h^2 (%)	Genetic Advance	GA % of mean
		Min.	Max.		Phenotypic	Genotypic					
1.	Days to 50% germination	8.78	10.95	9.70	0.71	0.20	8.67	4.56	0.28	0.48	4.95
2.	Days to first male flower anthesis	28.60	37.03	33.15	8.61	4.44	8.85	6.36	0.52	3.12	9.41
3.	Days to first female flower anthesis	38.97	45.07	41.71	3.50	1.96	4.48	3.36	0.56	2.16	5.18
4.	Node number to first male flower	3.40	7.70	5.47	1.42	1.10	21.81	19.17	0.77	1.90	34.71
5.	Node number to first female flower	11.17	17.20	14.20	3.63	3.25	13.41	12.69	0.90	3.51	24.74
6.	Vine length(m)	2.70	5.10	3.51	0.44	0.32	19.01	16.06	0.71	0.98	27.96
7.	Nodes per vine	25.49	36.96	33.39	9.74	7.32	9.35	8.10	0.75	4.83	14.47
8.	Primary branches per plant	10.83	16.77	14.02	5.03	4.72	16.00	15.49	0.94	4.33	30.91
9.	Days to first picking	48.34	57.58	53.57	8.27	6.54	5.37	4.77	0.79	4.68	8.74
10.	Length of fruit(cm)	11.49	22.68	15.45	7.53	6.49	17.76	16.49	0.86	4.87	31.52
11.	Fruit diameter (cm)	2.53	5.43	4.25	1.09	0.82	24.64	21.39	0.75	1.62	38.25
12.	Weight per fruit(gm)	81.95	106	97.16	59.06	48.93	7.91	7.20	0.83	13.12	13.50
13.	Fruit per plant	12.90	24.65	19.17	15.99	14.93	20.87	20.16	0.93	7.69	40.11
14.	Fruit yield per plant (kg)	1.00	2.54	1.66	0.28	0.26	31.97	30.52	0.91	1.00	60.02
15.	Number of fruit per vine	19.71	28.01	24.13	8.80	6.73	12.29	10.75	0.77	4.68	19.38
16.	Fruit yield per vine (kg)	1.71	1.94	1.42	0.07	0.03	18.77	11.55	0.38	0.21	14.63

PCV and GCV: Phenotypic and genotypic coefficient of variation, h2: Heritability in broad sense, GA: Genetic Advance

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