Plant Archives Vol. 24, No. 1, 2024 pp. 232-236 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.1.033

STUDIES ON GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN BITTER GOURD (*MOMORDICA CHARANTIA* L.) GERMPLASM LINES

K. Rajendar Sagar[1]*, B. Ramesh Babu[2], M. Ravindra Babu[3], M. Paratpara Rao[4] and V. Sekhar[5]

[1]Department of Vegetable Science, College of Horticulture, Dr.Y.S.R. Horticultural University, Venkataramannagudem - 534 101, Andhra Pradesh, India.
[2]Department of Fruit Science, H.R.S., Dr. Y.S.R. Horticultural University, Venkataramannagudem - 534 101, Andhra Pradesh, India.
[3]Department of Vegetable Science, H.R.S., Dr.Y.S.R. Horticultural University, Venkataramannagudem-534101, Andhra Pradesh, India.
[4]Department of Plant Breeding and Genetics, College of Horticulture, Dr.Y.S.R. Horticultural University, Venkataramannagudem - 534 101, Andhra Pradesh, India.
[5]Department of Statistics, College of Horticulture, Dr.Y.S.R. Horticultural ,University, Venkataramannagudem - 534 101, Andhra Pradesh, India.
*Corresponding authors E-mail : kalapalasagar27@gmail.com
(Date of Receiving-16-11-2023; Date of Acceptance-22-01-2024)

ABSTRACT

A field investigation is done in which thirty-six genotypes of bitter gourd were evaluated to estimate the genetic variability, heritability and genetic advance for various traits under study. Randomized complete block design is followed and the genotypes are replicated twice. The highest phenotypic and genotypic coefficients of variability were recorded for average fruit weight (g) (27.87) followed by fruit yield per plant (kg) (26.78), number of seeds per fruit, titrable acidity and reducing sugars. High heritability coupled with high genetic advance as percent of mean observed in number of primary branches per vine, vitamin-C, average fruit weight, fruit yield per plant, While, moderate heritability along with high genetic advance as percent of mean was observed in fruit yield per plant, average fruit weight, fruit length, number of primary branches per vine.

Key words : Bitter gourd, Genotypic coefficient of variability, Genetic advance, Heritability and Phenotypic coefficient of variability.

Introduction

Bitter gourd (*Momordica charantia* L.; 2n=2x=22) is one of the important commercial cucurbitaceous vegetable cultivated in India. It is also known as bitter melon, bitter gourd, bitter cucumber, bitter squash, balsam pear, Karela, cassilla and maiden apple. The term “cucurbits” is given by Hyde Bailey for cultivated species of family Cucurbitaceae. Bitter gourd (*Momordica charantia* L.) belongs to the family Cucurbitaceae, genus *Momordica* Family Cucurbitaceae includes about 118 genera and 825 species. *Momordica* is a large genus with approximately 80 known species of annual and perennial climbers of which *Momordica charantia* L. is widely cultivated. The other species grown for edible fruits are *M. cochinchinensis* (giant spine gourd or kakrol), *M. dioica* (kartoli), *M. tuberose* and *M. balsamina* (balsam apple). The wild species *M. charantia* var. *abbreviate* of Asia is perhaps the progenitor of the cultivated bitter gourd.

The bitterness in bitter gourd is due to momordicine (momordicosides-glycosides of tetracyclic triterpenoid’s with cucurbitane skeleton) an alkaloid, which is different from cucurbitacins present in other cucurbits. It is bitter to taste, the Karela juice (Bitter Gourd) is abundant amount of essential nutrients. Not only is it highly nutritional, in addition to, considered a wonder working of health drink. Karela juice has innumerable health benefits. It is an essential tonic for diabetic patients. Not only patients, but in fact, everyone can get some or the other benefit out of this juice. The immature fruits and tender vine tips are used in a variety of culinary preparations. The fruits are soaked in salt water to remove of their bitterness and then boiled, fried or pickled.

The fruit of bitter gourd is higher nutritional value compared to other cucurbits except vitamin C. Fruits are considered as a rich source of vitamins and minerals and 88 mg vitamin C and 210 IU vitamin A per 100 g. Fruits are used after cooking and delicious preparations are made after stuffing and frying. The vine tips are an excellent source of vitamin A. The medicinal value of the gourd in the treatment of infectious diseases and diabetes is attracting of scientists worldwide.

Materials and Methods

The experiment was carried out at college farm, College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari Dist. during *Rabi*, 2021–22. The experiment was laid out in Randomized Block Design (RBD) with 36 genotypes in 2 replications. Genotypes were collected from NBPGR regional station Thrissur. The experimental site was well prepared, cultural practices include training, pruning, weeding, irrigation, fertilizer application and plant protection measures were followed for the healthy growth of crop.

Observations on growth parameters were recorded up to 3 months of planting. Data on yield and yield attributes were collected at appropriate stages. The magnitude of phenotypic co-efficient of variation (PCV) and genotypic co-efficient of variation (GCV) present in a trait was calculated by using the formula suggested by Burton (1952). Genotypic variance and phenotypic variances are calculated using the method suggested by Johnson *et al*. (1955). Heritability (broad sense) is calculated as per the procedure developed by Johnson *et al*. (1955) and Hanson *et al.* (1956). Genetic advance at 5% selection intensity was worked out by using the formula given by Lush (1949). The list of genotypes along with their source are presented in Table 1.

Results and Discussion

The PCV was ranged from 2.54 to 27.87 (data presented in Table 2) and it was higher than genotypic co-efficient variation (GCV) for all traits studied. The PCV was highest in average fruit weight (g) (27.87) followed by fruit yield per plant (kg) (26.78). The traits like titrable acidity (%) (15.29), reducing sugars (%) (15.46) and number of fruits per plant (14.30) exhibited moderate value for this parameter. The other traits like

Table 1 : List of genotypes of bitter gourd used in the experiment.

S. no.	Genotype	NBPGR accession number	Source
1	VBGC-1	IC33275	NBPGR, Thrissur
2	VBGC-2	IC44413	NBPGR, Thrissur
3	VBGC-3	IC44418	NBPGR, Thrissur
4	VBGC-4	IC44419	NBPGR, Thrissur
5	VBGC-5	IC44420A	NBPGR, Thrissur
6	VBGC-6	IC44423	NBPGR, Thrissur
7	VBGC-7	IC44424	NBPGR, Thrissur
8	VBGC-8	IC44426	NBPGR, Thrissur
9	VBGC-9	IC68232	NBPGR, Thrissur
10	VBGC-10	IC68275	NBPGR, Thrissur
11	VBGC-11	IC68309	NBPGR, Thrissur
12	VBGC-12	IC68314	NBPGR, Thrissur
13	VBGC-13	IC68335	NBPGR, Thrissur
14	VBGC-14	IC470554	NBPGR, Thrissur
15	VBGC-15	IC470556	NBPGR, Thrissur
16	VBGC-16	IC470557	NBPGR, Thrissur
17	VBGC-17	IC470558	NBPGR, Thrissur
18	VBGC-18	IC470559	NBPGR, Thrissur
19	VBGC-19	IC213307	NBPGR, Thrissur
20	VBGC-20	IC213308	NBPGR, Thrissur
21	VBGC-21	IC264770	NBPGR, Thrissur
22	VBGC-22	IC469512	NBPGR, Thrissur
23	VBGC-23	IC427433	NBPGR, Thrissur
24	VBGC-24	IC433630	NBPGR, Thrissur
25	VBGC-25	IC427694	NBPGR, Thrissur
26	VBGC-26	IC541218	NBPGR, Thrissur
27	VBGC-27	IC541435	NBPGR, Thrissur
28	VBGC-28	IC596980	NBPGR, Thrissur
29	VBGC-29	IC599421	NBPGR, Thrissur
30	VBGC-30	IC599424	NBPGR, Thrissur
31	VBGC-31	IC599429	NBPGR, Thrissur
32	VBGC-32	IC599434	NBPGR, Thrissur
33	VBGC-33	IC541436	NBPGR, Thrissur
34	Amalapuram Local	Local germplasm	Amalapuram (East Godavari)
35	Venkatarama-nnagudem Local	Local germplasm	Venkatarama-nnagudem (West Godavari)
36	Arka Harit (check)	-	IIHR, Bengaluru

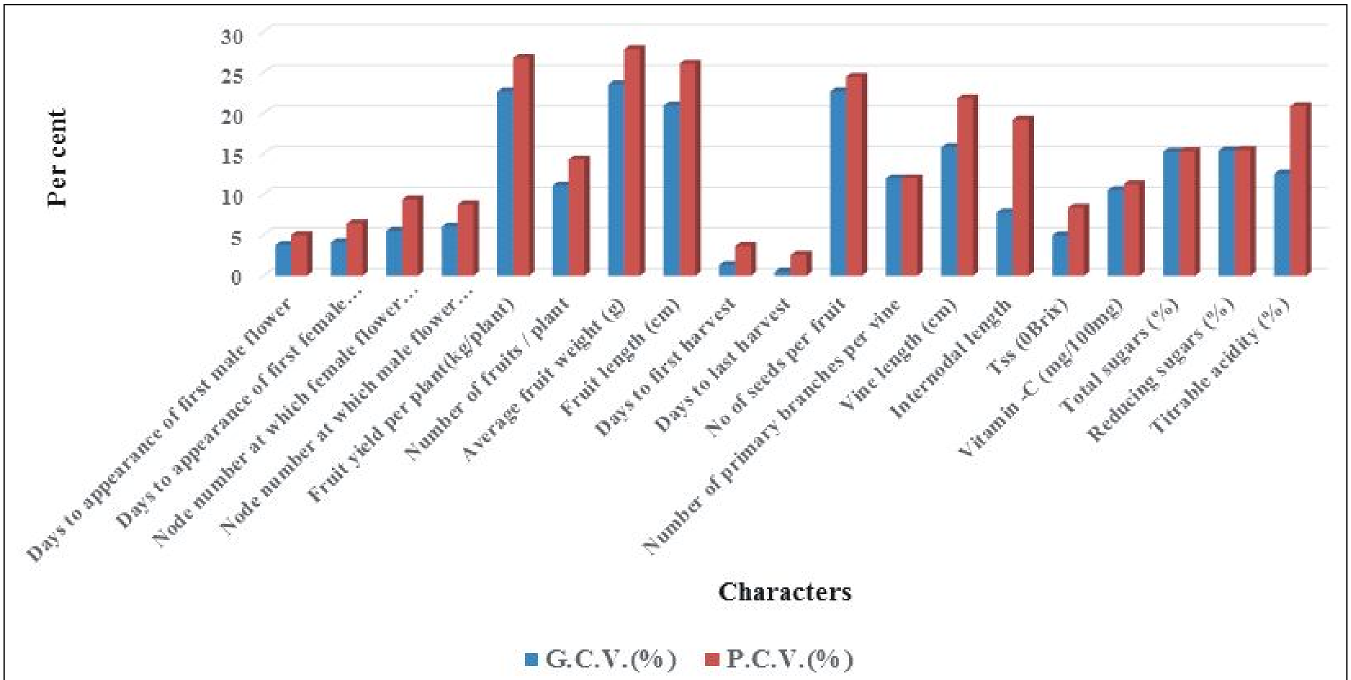

Fig. 1 : GCV and PCV for yeild and quality characters of the bitter gourd germplasm lines.

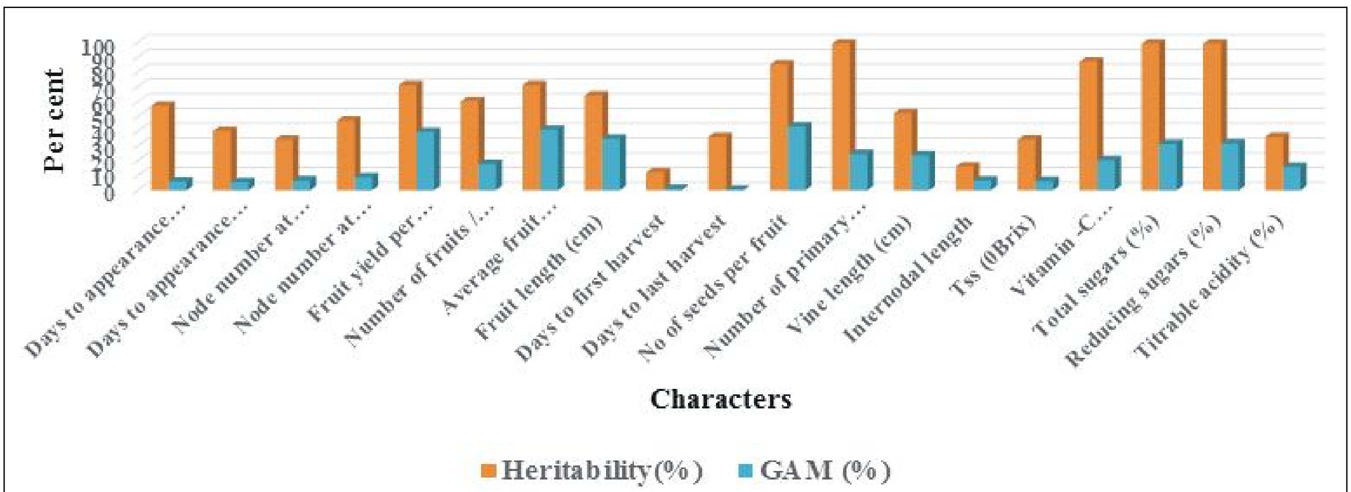

Fig. 2 : Heritability and genetic advance as percent of mean for yield and quality characters of bitter gourd germplasm lines.

days to appearance of first female flower (6.42), days to appearance of first male flower (4.99), days to first harvest (3.64) showed lower value for this parameter. However, lowest value of (2.54) was recorded for days to last harvest among the characters evaluated.

PCV was higher than GCV for all the characters but the degree of variation between the values of PCV and GCV was not much (except for average fruit weight (g) (27.87) and fruit yield per plant (kg) (2.78) indicating the role of environment and also the genetic makeup in the expression of characters. Slightly higher PCV indicates slight dominance of environment in the expression as compared to genetic contribution. Similar results for average fruit weight (g) (33.96) and fruit yield per plant (kg) (2.95) were reported by Kumar *et al.* (2017).

The GCV ranged from (0.48) to (23.54) (data presented in Table 2.). More or less similar trend was observed in the estimates of GCV for all the traits with average fruit weight (g) having the highest value (23.54) followed by number of seeds per fruit (22.66). Moderate values were obtained for total sugars (%) (12.57), number of fruits per plant (11.08) and number of primary branches per vine (11.93). Days to appearance of first male flower exhibited the lowest value (3.77), which was closely followed by days to first harvest (1.29) and in days to last harvest (0.48) in ascending order for this parameter.

Higher values of GCV and PCV were recorded for average fruit weight (g), fruit yield per plant (kg) and number of seeds per fruit, fruit length (cm)

Table 2 : Mean, range, genotypic and phenotypic coefficients of variation, heritability and genetic advance for different traits in bitter gourd.

S. no.	Character	Mean	Range	G.C.V. (%)	P.C.V. (%)	Heritability (%)	Genetic advance	GAM (%)
1	Days to appearance of first male flower	36.04	32.50-41.50	3.77	4.99	57	2.11	5.87
2	Days to appearance of first female flower	41.86	37.62-47.66	4.09	6.42	40	2.25	5.38
4	Node number at which male flower appeared	7.53	6.00-8.75	5.49	9.37	34	0.50	6.63
3	Node number at which female flower appeared	18.30	15.25-21.20	6.04	8.76	47	1.57	8.59
5	Fruit yield per plant(kg/plant)	2.04	1.17-2.97	22.62	26.78	71	0.80	39.35
6	Number of fruits / plant	19.37	16.93-30.00	11.08	14.30	60	3.42	17.62
7	Average fruit weight (g)	47.25	32.25-87.25	23.54	27.87	71	19.35	40.96
8	Fruit length (cm)	11.07	6.70-17.62	20.93	26.08	64	3.83	34.61
9	Days to first harvest	48.56	45.75-51.50	1.29	3.64	12	0.45	0.94
10	Days to last harvest	85.64	82.50-89.00	0.48	2.54	36	0.16	0.19
11	No of seeds per fruit	11.36	5.75-15.75	22.66	24.47	85	4.91	43.21
12	Number of primary branches per vine	9.11	7.01-12.17	11.93	11.96	99	2.23	24.51
13	Vine length (cm)	251.09	185.00-397.00	15.78	21.79	52	59.22	23.58
14	Internodal length	6.98	5.500-10.25	7.80	19.19	16	0.45	6.53
15	Tss (^{0}Brix)	3.76	3.35-4.60	4.95	8.39	34	0.22	6.03
16	Vitamin -C (mg/100mg)	90.40	71.50-114.50	10.52	11.26	87	18.29	20.23
17	Total sugars (%)	3.07	2.34-3.77	15.24	15.29	99	0.96	31.31
18	Reducing sugars (%)	2.63	2.15-3.55	15.39	15.46	99	0.83	31.57
19	Titrable acidity (%)	0.03	0.02-0.05	12.57	20.83	36	0.006	15.64

indicated the wider diversity among the characters. While, moderate GCV and PCV recorded for number of fruits per plant, reducing sugars (%), titrable acidity (%), number of primary branches per vine, days to appearance of first male flower and rest of the characters indicated the less diversity among the genotypes for these characters. Prasanth *et al*. (2020) in bitter gourd reported similar trend of variation for genotypic coefficient of variation and phenotypic coefficient of variation of various characters like days to appearance of first male flower, number of primary branches per vine and days to last harvest, which is in conformity with the present findings.

High value of heritability suggests that selection based on phenotypic expression could be considered as playing a major role in genetic constitution for the expression of horticulture characters. High estimates of heritability for characters indicating that they were least affected by environment and selection based on phenotypic performance would be reliable. Heritability (broad sense) estimates (data presented in Table 2) ranged from 12.0% for (number of primary branches per plant) to 99.0% for average fruit weight (g). High heritability of above 85 % was observed in four characters such as number of primary branches per vine (99.0%), titrable acidity (%) (99.0%), reducing sugars (%) (99.0%) and vitamin -C (mg/100 mg) (87.0%). Moderate to high heritability (60-85%) was observed in five characters such as number of seeds per fruit (85.0%), fruit yield per plant (kg) (71.0%), average fruit weight (g) (71.0%), fruit length (cm) (64.9%), number of fruits per plant (60.1%), while number of days to first harvest has the lowest heritability (12.0%).

It may be noted here that high broad sense heritability estimates were found between 87.0% (vitamin-C mg/100 mg) and 99.0 per cent (number of primary branches per vine, titrable acidity (%), reducing sugars (%). These higher values indicate that there is additive gene effect for these characters. High values of heritability for all the characters except the number of days to first harvest (12.0%) indicated that they were least influenced by environmental changes and signified that the phenotypes were the true representative of their genotypes and selection based on phenotypic performance would be reliable. Similar findings of heritability in broad sense (h^2_{bs}) ranged from 31.21 percent (vine length) to 92.41 per cent (fruit length) reported by Tyagi *et al.* (2018).

High heritability accompanied by high genetic advance is more useful than heritability alone and considerable importance could be made in these characters by predicting the result and selecting the best individual. The genetic advance varied from 0.006 (titrable acidity (%) to 59.22 (vine length (cm)). Other characters showing high genetic advance were average fruit weight (g) (19.35) and vitamin C (mg/ 100mg) (18.29). However, number of seeds per fruit (4.91), fruit length (cm) (3.83) and number of fruits per plant (3.42) have shown moderate genetic advance. On the other hand, lower genetic advance ranging from 0.22 Tss (^{0}Brix) to number of primary branches per vine (2.23) were also observed for rest of the characters under study.

Fruit length (cm), node number to anthesis of first staminate flower, average fruit weight (g) and fruit yield per plant (kg) had high estimates of heritability coupled with high genetic advance. Hence, these characters need to be given more emphasis in selection as these are expected to be controlled by additive genes. Similar results was reported by Tyagi *et al.* (2018) in bitter gourd.

High GCV accompanied by high estimates of heritability and genetic advance recorded for average fruit weight (g), number of seeds per fruit, number of primary branches per vine, titrable acidity (%), reducing sugars (%) and vitamin-C (mg/100mg) indicated additive gene effects controlling the inheritance of these traits and simple selection scheme would be sufficient for the improvement of such traits. These findings were in consonance with Sidhu *et al.* (2013) in bitter gourd.

Moderate GCV associated with high heritability and high genetic advance were observed for total sugars (%), number of fruits per plant, number of primary branches per vine, vitamin-C (mg/100mg), which might be ascribed to additive gene effects governing the expression of these traits and phenotypic selection for their amelioration can be brought. Similar to the present finding's high heritability along with high genetic advance was reported in bitter gourd by Alekar *et al*. (2019) for number of fruits per plant and number of primary branches, Sidhu *et al*. (2015) for total sugars (%).

Conclusion

Closeness of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for most of Expression of high to moderate GCV in characters like average fruit weight (g) (23.54), number of seeds per fruit (22.66), total sugars (%) (15.24), number of primary branches per vine (11.93) and number of fruits per plant (11.08), indicated good amount of genetic variability among the test genotypes. So, selection based on these characters will be useful. Characters with high heritability and genetic advance as percent of mean shows additive gene action breeder will go for direct selection of these traits mostly important for selection. The characters studied indicated that phenotype represents true to the genotypes.

Acknowledgement

We would like to express our gratitude to the Department of Vegetable Science, Dr Y.S.R. Horticulture University Venkataramannagudem, Andhra Pradesh for providing the research facilities.

References

Alekar, A., Shinde K.G. and Khamkar M.B. (2015). Studies on genetic variability, heritability, genetic advance and correlation in bitter gourd (*Momordica charantia* L.). *Int. J. Chem. Stud*., **7**, 1155-59.

Burton, G.W. and DeVane E.M. (1952). Estimating heritability in fall fescue (*Festuca circunclinaceae)* from replicated clonal material. *Agron. J*., **45**, 478-481.

Hanson, C.H., H.F. Robinson and R.E. Comstock (1956). Biometrical studies on yield in segregating population of Korean lespedesa. *Agron. J.,* **48,** 268-272.

Johnson, H.W., Hanson H.F. and Comstock R.I. (1956). Estimates of Genetic and environmental variability in soy bean. *Agron. J.*, **47**, 314-318.

Kumar, K.H., Dubey R.B. and Pareek S. (2018). Genetic variability, correlation and path analysis in sponge gourd (*Luffa cylindrica* Roem.). *Afr. J. Biotech.*, **12**, 539-543.

Lush, J. and Johnson M. (1940). Heritability of quantitative characters in farm animals. *Heriditas*, **35(suppl.)**, 256-261.

Prasanth, K., Sadashiva A.T., Pitchaimuthu M. and Varalakshmi B. (2020). Genetic Diversity, Variability and Correlation studies in Bitter Gourd (*Momordica charantia* L.). *Indian J. Plant Genet. Resour.*, **33**, 179-186.

Sidhu, K. and Mamta, P. (2020). Genetic Diversity Analysis in Bitter Gourd (*Momordica charantia* L.) using Morphological Traits. *Int. J. Agricult. Innov. Res.*, **9**, 2319-73.

Tyagi, N.B. and M. Praveen (2018). Studies on genetic variability, heritability and genetic advance in bitter gourd (*Momordica charantia* L.) for yield and yield contributing traits. *International Journal of Current Microbiology and Applied Science*,**11(3),** 2319-26.