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GENETIC VARIABILITY STUDIES FOR YIELD AND YIELD ATTRIBUTING TRAITS IN F_2 GENERATION OF BITTER GOURD (*MOMORDICA CHARANTIA* L)

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ABSTRACT

The present investigation was carried out to estimate phenotypic and genotypic coefficient of variation, heritability in broad sense and genetic advance as per cent of the mean in F_2 generation for fifteen characters in two crosses of bitter gourd. The two crosses are HUB-1 × CO-1 and HUB-1× Mysore Local. In the F_2 population of the cross HUB-1 × CO-1, high (> 20 %) genotypic coefficient of variation (GCV) and phenotypic coefficient variation (PCV) was detected for node at which first female flower appeared, sex ratio, average fruit weight, number of fruits per vine and fruit yield per vine. In the F_2 population of the cross HUB-1 × Mysore Local, high (> 20 %) genotypic coefficient of variation (GCV) and phenotypic coefficient variation (PCV) was observed for node at which first female flower appeared, sex ratio, average fruit weight and fruit yield per vine and number of seeds per fruit and it suggests that all of the traits that were noted had greater variability and that there was lots of opportunity for these characters to be improved through selection. High heritability (> 60 %) along with high genetic advance as per cent over mean (> 20 %) was reported in F_2 population of the cross HUB-1 × CO-1 for node at which first female flower appeared, sex ratio, average fruit weight, number of fruits per vine, fruit yield per vine and number of seeds per fruit. High heritability (>60%) and high genetic advance as per cent over mean (>20%) was observed in F_2 population of the cross HUB-1 × Mysore Local for fruit yield per vine, number of seeds, sex ratio and node at which first female flower appeared. This indicating high heritability was mainly due to additive gene effect and hence selection was highly effective for these characters and indicate a favourable genetic basis for these traits in bitter gourd.
Keywords: Variability, GCV, PCV, genetic advance as per cent of mean, heritability and bitter gourd.

Introduction

Bitter gourd (*Momordica charantia* L.) is an important nutritive and commercial cucurbit belongs to the family Cucurbitaceae. The crops comes under this family is commonly known as gourd, melon or pumpkin. (Singh *et al.*, 2018). The genus *Momordica* has 7 species reported in Indian and 60 species in other part of the world. It is a diploid having chromosome number of 2n=22. Bitter gourd is an old-world origin and is native of Tropical Asia, particularly in Indo-Burma region. The alkaloid 'momordicin', which is distinct from the cucurbitacin found in other cucurbits, is responsible for the bitter principle in bitter gourds (Jeffery, 1967). In the present study the variability observed in F_2 population is due to segregation and recombination of genes. This might be helpful for the breeder to get a desirable traits combination for improving the yield. Hence, the present study was conducted to know the extent of variability in segregating population and it can be estimated through the different genetic parameters viz., PCV, GCV, heritability and genetic advance as per cent of mean.

Material and Methods

The study was carried out at Kittur Rani Channamma College of Horticulture, Arabhavi, Belagavi district, Karnataka, India during June 2024. The experiment was carried out in Augmented block design. In this experiment two hybrids HUB-1 × CO-1 and HUB-1 × Mysore Local were used. There were 10 blocks for each hybrid, contains three check plants (Check-1- US33, Check-2–Nitika, Check-3–Ankur Shreya), two parent plants, one F_1 plant and ten F_2 population plant. A total of 20 blocks and three checks were used in this experiment. Vine length at final harvest (m), number of primary branches at final, node at which first female flower appeared, sex ratio, fruit length (cm), fruit diameter (cm), L:D ratio, days to first fruit harvest, days to last fruit harvest, average fruit weight (g), number of fruits per vine, fruit yield per vine (Kg), number of seeds per fruit , ascorbic acid (mg/100g) and antioxidant activity (%).The data recorded were statistically analysed for genotypic coefficient of variation and phenotypic coefficient of variation according to Burton and Devane (1953). Heritability in broad sense was estimated as per the formulae suggested by Lush (1940) and genetic advance was estimated as per the formula proposed by Johnson *et al*. (1955).

Results and Discussion

The extent of variability present in the two crosses of bitter gourd in F_2 generation were measured in terms of phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense and genetic advance as per cent of the mean are given in Table 1 and Table 2. Considerable amount of variability was observed for all the characters under study and this proves that there is ample scope for selection in the subsequent generations. Segregation and recombination are found maximum in the F_2 generation; therefore, it is the ideal generation for imposing selection. The outcomes of variability and genetic components of variation are studied below with regard to growth, yield and quality parameters in F_2 population of cross HUB-1 × CO-1 (Table 1).

For vine length at final harvest high PCV and moderate GCV values were observed in observed in F_2 population of the cross HUB-1 × CO-1. The difference between GCV and PCV was less indicating the considerable amount of genetic variability and less influence of non-genetic factors. The results obtained are in conformity with the findings of Devmore *et al.* (2010) in bitter gourd. Moderate heritability coupled with low genetic advance and high genetic advance as per cent over mean was noted for this character revealed the additive gene effects coupled with high environmental impact on these traits, so selected wound not be effective. These findings are in accordance with Tyagi *et al.* (2018) in bitter gourd and Singh *et al.* (2022) in cucumber.

Whereas, for number of primary branches at last harvest showed high PCV and moderate GCV which indicating the considerable amount of genetic variability and less influence of non-genetic factors. Low heritability coupled with low genetic advance and moderate genetic advance as per cent over mean was observed which suggests that the high influence of environmental factors and limited genetic variability for this trait. These results are in confirmatory with the findings of Talukder *et al.* (2018) in bitter gourd and Sravani *et al.* (2021) in ridge gourd

High GCV and high PCV values were recorded for node at which first female flower appeared indicating a considerable influence of environment on their expression. High heritability coupled with low GA and high GAM was noted which showed high degree of genetic variability exhibiting additive gene effects for these traits. Considerable amount of variability was observed for these characters, there is more scope for selection in the subsequent generations. These results are in accordance with the findings of Gowda (2017) in bitter gourd and Gautham and Balamohan (2018) and Sravani *et al.* (2021) in ridge in gourd

It was noted that high values of GCV and PCV for sex ratio were recorded and there is minor difference between them which showed influence of environment for this character was low and that would be effective for selection through phenotype. High heritability coupled with low genetic advance and high genetic advance as per cent over mean in this population showing that this trait was controlled by additive gene action effects and selection on the basis of this character would be more effective for further breeding programme. The genetic variability study results in the present investigation for sex ratio are in conformity with findings of Vitthal (2012), Gautham and Balamohan (2018) in ridge gourd and Gowda (2017) and Pradhan *et al.* (2021) in bitter gourd.

In the of cross (HUB-1 × CO-1) fruit length had showed low GCV and moderate PCV per cent values.

This indicated the low variability for these characters which is the constraint for genetic improvement through selection. Moderate heritability followed by low genetic advance and moderate genetic advance as per cent over mean was documented for this trait, indicate that the heritability of a trait is due to additive gene action and that the trait can be improved through selection in future generations. Alekar *et al*. (2019) in bitter gourd and Vaidya *et al*. (2020) in bottle gourd.

With respect to fruit diameter moderate GCV and high PCV were recorded. This indicating the considerable amount of genetic variability and less influence of non-genetic factors was observed. These results are accordance with findings of Vitthal *et al*. (2012) and Gowda *et al*. (2017) in bitter gourd. Moderate heritability followed by low genetic advance and high genetic advance over per cent mean showed in this trait due to environmental effect and non-additive gene action. Incorporating diverse genetic material may help identify or develop lines with better expression of this trait under varying environmental conditions. Mounica *et al.* (2019) and Mehta *et al.* (2021) in bitter gourd.

The L:D ratio showed moderate GCV and high PCV and disparity among them were minute which indicate that environment influence is meagre. Moderate heritability coupled with low genetic advance and high genetic advance over per cent mean, this indicates the trait is largely influenced by environmental factors rather than genetic factors and suggests that selection and additive gene action can be effective in enhancing the L:D ratio. These are in accordance with the earlier observation made by Munshi *et al.* (2007) *Cucumis sativus* var. *hardwickii* R. (Alef.) and Bannatti *et al.* (2023) in bitter gourd.

Days to first fruit harvest showed low GCV and moderate PCV values which indicate this indicates as the trait more influenced by environment. While it showed moderate heritability coupled with moderate genetic advance and moderate genetic advance over per cent mean indicating non-additive gene action which selection was not satisfactory. These findings are similar to Rajawat *et al.* (2017) in cucumber.

Days to last fruit harvest showed low GCV and PCV values. This indicated the low variability for these characters which is the constraint for genetic improvement through selection. Moderate heritability noticed along with low genetic advance and low genetic advance per cent over mean indicating that environmental effect was more than the genotypic effect and due to non-additive gene action selection, hence further improvement of the trait might not be effective. Similar outcomes were observed by Bhoomika *et al.* (2020) in cucumber and Bahiram *et al.* (2023) in bitter gourd.

High GCV and PCV was noticed for average fruit weight indicating wider variation in the population and less environmental influence on the expression of this trait. High heritability was noticed along with high genetic advance and high genetic advance over per cent mean indicating high heritability was mainly due to additive gene effect and hence selection was highly effective for these characters and indicate a favourable genetic basis for this trait in bitter gourd. Similar results were obtained by Hanchinamani *et al.* (2006) in cucumber, Alekar *et al.* (2019) in bitter gourd.

High assessment of both GCV and PCV displayed for number of fruits per vine and it indicates the existence of high variability which will be amenable for further improvement through selection using existing population. High magnitude of heritability accompanied with high genetic advance and high GAM indicating dominance of additive gene action in genetic control of this trait and selection is enough for improving this trait. Similar results were upheld by the Vitthal (2012), Rani *et al.* (2014), Pradhan *et al.* (2021) in bitter gourd.

With respect to fruit yield per vine high magnitude of both genotypic coefficient variation and phenotypic coefficient variation were recorded, indicating wider variation in the population and less environmental influence on the expression of this trait. High assessment of both heritability and genetic advance as per cent over mean displayed that this trait had less affected by environmental factor and control under dominance of additive gene action and pedigree selection is the best breeding approach for advancement of this trait. Similar outcomes were observed by Dey *et al.* (2005), Vitthal (2012), Gowda (2017) and Pradhan *et al.* (2021) in bitter gourd and also by Bhoomika (2020) in cucumber.

Number of seeds per fruit showed moderate values for both GCV and high PCV and it indicate that a trait is influenced by both genetic and environmental factors. High heritability followed by low genetic advance and high GAM indicated, this trait was control under additive genes and offers scope for selection. Similar results were observed by Kumari *et al.* (2018) in bitter gourd. Bhoomika (2020) in cucumber and Pradhan *et al.* (2021).

Ascorbic acid in fruit observed low GCV and moderate PCV values. This indicated the low variability for these characters which is the constraint for genetic improvement through selection. While, it showed moderate heritability coupled with high genetic advance and low genetic advance over per cent mean denoted as the pre- dominance of non-additive gene action and optimizing these environmental conditions could be a more effective approach to increasing ascorbic acid content than relying solely on selection. Similar findings was recorded by Prakash *et al.* (2021), Bannatti *et al.* (2023), Chaudhary *et al.* (2019) and Nithinkumar *et al.* (2022) in bitter gourd

With respect to antioxidant activity, it showed less GCV and moderate PCV values. The values of genotypic coefficient of variation and phenotypic coefficient of variation were close to each other, this indicates as the trait more influenced by environment. While, it showed moderate heritability coupled with high genetic advance and low genetic advance over per cent mean denoted as the pre-dominance of non-additive gene action and optimizing these environmental conditions could be a more effective approach to increasing antioxidant activity. Similar findings were recorded by Anjum *et al.* (2013) in bitter gourd, Lu *et al.* (2012) in wild bitter gourd (*Momordica charantia* L. var. *abbreviata Seringe*).

The outcomes of variability and genetic components of variation are briefly studied below with regard to growth, yield and quality parameters in F_2 population of cross HUB-1 × Mysore Local (Table 2).

Moderate GCV and high PCV values were noted for vine length at the final harvest shows disparity among them were minute which indicate that environment influence not so much. Low heritability coupled with low genetic advance and moderate genetic advance over per cent mean. The vine length in bitter gourd exhibits non-additive gene interactions, where the phenotypic expression is influenced more by the interaction of multiple alleles and environmental factors than by simple additive effects. Results obtained here in agreement with the findings of Islam *et al.*, (2009), Dalamu and Behera (2013), Chakraborty *et al.* (2013), Tyagi *et al.* (2018), Pathak *et al.* (2014) and Yadagiri *et al.* (2017) in bitter gourd.

Whereas, for number of primary branches at last harvest showed high PCV and moderate GCV which indicates medium variability and moderate influence of environment on the expression of this trait. These results are in conformity with the finding of Islam *et al.* (2009). Low heritability coupled with low genetic advance and high genetic advance as per cent over mean was observed which indicates that bitter gourd shows non-additive gene interactions, indicating that environmental influences and multiple allele interactions have a greater impact on phenotypic expression than by simple additive effects. These results are in confirmatory with the findings of Mulge *et al.* (2014) and Bhoomika *et al.* (2020) in cucumber.

High GCV and high PCV values were recorded for node at which first female flower appeared. It indicates the existence of high variability which will be amenable for further improvement through selection using existing population. High GA was observed While, High heritability as well as high GAM was noted which showed the combination of strong genetic control, low environmental influence, significant genetic variability and additive gene action for this trait and these results are in accordance with the findings of Gowda (2017) in bitter gourd and Sravani *et al.* (2021) in ridge in gourd.

It was noted that high values of GCV and PCV value for sex ratio and there is minor difference between them which showed influence of environment for this character was low and that would be effective for selection through phenotype. High heritability coupled with low genetic advance and high genetic advance as per cent over mean in this F_2 population showing that this trait was controlled by additive gene action effects and selection on the basis of this character would be more effective for further breeding programme. The genetic variability study results in the present investigation for sex ratio are in conformity with findings of Vitthal (2012) in bitter gourd and Gautham and Balamohan (2018) in ridge gourd.

In the F_2 of cross (HUB-1 ×Mysore Local) fruit length had showed moderate GCV and high PCV per cent values. It indicates that a trait is influenced by both genetic and environmental factors. Moderate heritability followed by low genetic advance and high genetic advance as per cent over mean was documented for this trait, indicated that pre-dominance of non-additive gene action and optimizing these environmental conditions could be a more effective approach to increasing. These results are in agreement with the results of Singh *et al.* (2014), Yadava and Yadav (2015) and Pradhan *et al.* (2021) in bitter gourd.

With respect to fruit diameter moderate GCV and high PCV value were noticed. the difference between these values were high which indicated that environmental factors play a significant role in determining fruit diameter. Low heritability followed by low genetic advance and low genetic advance over per cent mean showed in this trait due to environmental effect and non-additive gene action. Incorporating diverse genetic material may help to identify or develop lines with better expression of this trait under varying environmental conditions. Sravani *et al.* (2021) in ridge gourd and Mounica *et al.* (2019).

The L:D ratio showed moderate GCV and high PCV and disparity among them were minute which indicate that environment influence not so much. Moderate heritability coupled with low genetic advance and high genetic advance over per cent mean, this indicates that the trait is largely influenced by environmental factors rather than genetic factors and suggests that selection and additive gene action can be effective in enhancing the L:D ratio. These results are in accordance with the earlier observation made by Bannatti *et al.* (2023) in bitter gourd. Munshi *et al.* (2007) *Cucumis sativus* var. *hardwickii* R. (Alef.).

Days to first fruit harvest showed low GCV and PCV values that the characters' varied performances are greatly influenced by their environment and narrow genetic base. Moderate heritability noticed along with moderate genetic advance and moderate genetic advance per cent over mean indicating the possibility of predominance of additive gene action in the inheritance and genotypic influence on these characters. These results are in agreement with the results of Bhoomika *et al.* (2020) in cucumber and Kanimozhi *et al.* (2015) in bitter gourd. Singh *et al.* (2017) in bitter gourd.

Days to last fruit harvest showed low GCV and PCV values, the characters varied performances are greatly influenced by their environment and narrow genetic base. Moderate heritability noticed along with low genetic advance and low genetic advance per cent over mean indicating low level of variation in days to last fruit harvest this indicate that the predominance of non-additive gene action. Similar outcomes were observed by Kanimozhi *et al.* (2015) and Bahiram *et al.* (2023) in bitter gourd.

High GCV and PCV was noticed in average fruit weight indicating wider variation in the population and less environmental influence on the expression of this trait. Moderate heritability coupled with high genetic advance and high genetic advance as per cent over mean. which revealed the additive gene effects coupled with high environmental impact on these traits, hence, selection wound not be effective. These are in accordance with the earlier observations made by Tiwari *et al.* (2021) and Sagar *et al.* (2024) in bitter gourd.

Moderate assessment of GCV and high PCV values displayed for number of fruits per vine indicates that there is potential for genetic improvement and environmental factors significantly affect fruit production. Moderate heritability coupled with low genetic advance and high genetic advance as per cent over mean. Moderate heritability and low genetic advance suggest that genetic factors are important but limited by significant environmental influences and high genetic advance as a percentage of the mean indicates that even small genetic gains can lead to meaningful productivity increases, emphasizing the need for integrated breeding and cultivation strategies. Mehta *et al.* (2021) and Tyagi *et al.* (2018) in bitter gourd.

With respect to fruit yield per vine, high magnitude of both genotypic coefficient variation and phenotypic coefficient variation were recorded indicating wider variation in the population and less environmental influence on the expression of this trait. High assessment of both heritability and genetic advance as per cent over mean displayed that this trait and low genetic advance had less affected by environmental factor and control under dominance of additive gene action and pedigree selection is the best breeding approach for advancement of this trait. Similar outcomes were observed by Vitthal (2012), Gowda (2017) and Pradhan *et al.* (2021) in bitter gourd and also by Bhoomika *et al.* (2020) in cucumber.

High genotypic variation and phenotypic variation was noticed in number of seeds per fruit indicating wider variation in the population and less environmental influence on the expression of this trait. High assessment of both heritability and genetic advance as per cent over mean displayed that this trait had less affected by environmental factor and control under dominance of additive gene action and pedigree selection is the best breeding approach for advancement of this trait. The similar findings were observed by Sowmya *et al.* (2021) and Kumari *et al.* (2018) in bitter gourd.

Whereas the ascorbic acid content showed low GCV and moderate PCV values and suggests that while there is some variability in ascorbic acid levels influenced by both genetic and environmental factors, it's not extremely high. Low heritability coupled with moderate genetic advance and low genetic advance as per cent over mean shows that poor heritability and genetic diversity of the trait, conventional selection techniques may not produce appreciable changes. Thus, improving these environmental factors rather than depending only on selection may be a better strategy for raising ascorbic acid content. The similar findings was recorded by Prakash *et al.* (2021), Bannatti *et al.* (2023), Chaudhary *et al.* (2019) and Nithinkumar *et al.* (2022) in bitter gourd.

Antioxidant activity showed moderate genotypic coefficient of variation and moderate phenotypic coefficient of variance. It indicates existence of broad genetic base, which would be amenable for further selection. High heritability coupled with moderate genetic advance and moderate genetic advance as per cent over mean indicate that a character is indicated non-additive genes involvement in the expression of the trait and this with limited scope of improvement by direct selection. The similar findings were seen in Rane *et al.* (2023) and Mahapatra *et al.* (2023) in bottle gourd and Karmakar *et al.* (2013) in ridge gourd.

Table 1: Estimates of mean and genetic parameters for growth and flowering parameters in F_2 population of HUB-1 × CO-1 of bitter gourd.

SI. No.	Characters	Mean	Range		GCV (%)	PCV (%)	h^2bs (%)	GA	GAM (%)
			Min	Max					
1	Vine length at final harvest (m)	2.58	1.39	6.44	16.74	24.46	46.85	0.61	23.64
2	Number of primary branches at final harvest	4.45	2.00	7.00	12.65	25.35	24.91	0.58	13.03
3	Node at which first female flower appeared	7.59	4.00	14.00	26.74	30.46	77.10	3.67	48.45
4	Sex ratio (Male: Female)	4.03	0.00	10.50	57.80	60.08	92.58	4.62	114.74
5	Fruit length (cm)	10.92	6.04	14.30	9.89	15.82	39.07	1.39	12.76
6	Fruit diameter (cm)	3.46	1.08	7.00	16.31	23.45	48.37	0.81	23.40
7	L:D ratio	3.26	2.20	4.97	15.34	21.99	48.65	0.72	22.07
8	Days to first fruit harvest	51.90	41.00	60.00	7.57	10.15	6.76	6.05	11.66
9	Days to last fruit harvest	82.91	71.00	90.00	3.36	4.63	52.80	4.18	5.04
10	Average fruit weight (g)	54.36	12.42	78.96	24.77	27.77	79.59	24.79	45.60
11	Number of fruits per vine	9.75	5.00	23.00	46.55	51.10	82.98	8.53	87.48
12	Fruit yield per vine (Kg)	0.54	0.07	1.61	56.27	63.06	79.61	0.56	103.57
13	Number of seeds per fruit	13.90	8.40	20.40	18.32	21.71	71.19	4.43	31.89
14	Ascorbic acid (mg/100g)	104.16	83.18	118.12	6.68	10.65	39.26	8.99	8.63
15	Antioxidant activity (%)	71.42	53.67	84.30	6.80	10.42	42.61	6.54	9.16

PCV - Phenotypic coefficient of variation h^2bs- Heritability (broad sense)
GCV - Genotypic coefficient of variation GA - Genetic advance GAM - Genetic advance as per cent of the mean

Table 2: Estimates of mean, range and genetic parameters for growth and flowering parameters in F_2 population of HUB-1 × Mysore Local of bitter gourd

SI. No.	Characters	Mean	Range		GCV (%)	PCV (%)	h^2bs (%)	GA	GAM (%)
			Min	Max					
1	Vine length at final harvest (m)	2.32	1.10	3.53	12.44	23.26	28.60	0.32	13.72
2	Number of primary branches at final harvest	3.94	2.00	7.00	12.23	27.80	19.35	0.44	11.10
3	Node at which first female flower appeared	9.17	5.00	14.00	27.15	30.32	80.22	4.60	50.17
4	Sex ratio (Male: Female)	4.13	0.00	12.33	58.16	60.85	91.36	4.74	114.68
5	Fruit length (cm)	8.03	3.19	12.6	19.59	28.03	48.85	2.27	28.25
6	Fruit diameter (cm)	3.20	1.28	4.67	10.84	24.48	19.63	0.32	9.91
7	L:D ratio	2.65	0.91	4.98	14.61	42.01	12.10	0.28	10.49
8	Days to first fruit harvest	54.65	45.00	65.00	6.89	8.99	58.71	5.95	10.89
9	Days to last fruit harvest	85.52	79.00	90.00	2.83	4.04	49.26	3.51	4.10
10	Average fruit weight (g)	36.02	9.18	70.26	34.23	48.49	49.82	17.95	49.84
11	Number of fruits per vine	13.03	7.00	20.00	19.97	28.09	50.52	3.81	29.28
12	Fruit yield per vine (Kg)	0.48	0.09	1.47	62.78	69.53	81.53	0.57	116.95
13	Number of seeds per fruit	9.24	3.60	19.60	26.71	33.83	62.36	4.02	43.52
14	Ascorbic acid (mg/100g)	80.85	50.00	121.00	8.30	15.84	27.50	7.26	8.98
15	Antioxidant activity (%)	70.62	51.2	85.1	10.49	12.45	70.98	12.88	18.24

PCV - Phenotypic coefficient of variation h^2bs- Heritability (broad sense)
GCV - Genotypic coefficient of variation GA - Genetic advance GAM - Genetic advance as per cent of the mean

Conclusion

In the F_2 population of the cross HUB-1 × CO-1, high GCV and PCV were detected for node at which first female flower appeared, sex ratio, average fruit weight, number of fruits per vine, fruit yield per vine. In the F_2 population of the cross HUB-1 × Mysore Local, high GCV and PCV were observed for node at which first female flower appeared, sex ratio, average fruit weight, fruit yield per vine and number of seeds per fruit which indicates the existence of more variability among all the traits recorded and ample scope for improvement of these characters through selection. High heritability along with high genetic advance as per cent over mean was reported for node at which first female flower appeared, sex ratio, average fruit weight, number of fruits per vine, fruit yield per vine and number of seeds per fruit in the F_2 population of the cross HUB-1 × CO-1. High heritability and high genetic advance as per cent over mean was observed for fruit yield per vine, number of seeds, sex ratio and node at which first female flower appeared F_2 population of the cross HUB-1 × Mysore Local. High heritability suggests that the observed variation in the traits is due to genetic factors, making the traits more predictable and responsive to selection. High genetic advance indicates that selecting individuals with desirable traits will results in significant improvement in the next generation.it reflects the ability of the trait to show measurable progress under selection.

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References

Alekar, A. N., Shinde, K.G. and Khamkar, M.B (2019) Studies on genetic variability, heritability, genetic advance and correlation in bitter gourd (*Momordica charantia* L.). *Int. J. Chem. Stud* 7(3): 1155-1159.

Anjum, F., Shahid, M., Bukhari, S.A., Anwar, S. and Latif S (2013) Study of quality characteristics and efficacy of extraction solvent/technique on the antioxidant activity of bitter gourd seed. *J. Food Process Technol* 4(2): 205.

Bahiram, V.K., Dhakare, B.B., Khirsagar, D.B. and Joshi, V.R (2023) Genetic studies in F_3 generation of bitter gourd (*Momordica charantia* L.). *J. Pharm. Innov* 12(5): 993-997.

Bannatti, R., Rathod, V., Gasti, V.D., Evoor, S., Chittapur, R.B. and Ryavalad, S. Y (2023) Assessment of genotypic variability, heritability and genetic advance for growth, yield and quality related traits in bitter gourd (*Momordica charantia* L.) genotypes. *BFAIJ* 15(1): 493-498.

Bhoomika, M.R (2020) Studies on genetic variability in F_2 population of cucumber (*Cucumis sativus* L.) for yield and quality attributes. *Genetics* 12(9): 768-770.

Burton, G.W. and Devane E.H (1953) Estimating heritability in tall fiscue (*Festuca srundinaceae*) from replicated clonal material. *Agron. J* 45: 478-81.

Chakraborty, L., Acharyya, P. and Raychaudhuri, S (2013) Diversity analysis of *Momordica charantia* L. accessions from Eastern and North Eastern India based on morphological, yield related traits and molecular marker. *Proceedings of FVHH, Thailand*. 179-193.

Chaudhary, I., Singh, V., Rana, D. and Shah, K. N (2019) Assessment of heritability, genetic advancement and yield of bitter gourd under Garhwal region. *Int. J Sci. Res* 8(2): 205-215.

Dalamu, D. and Behera, T.K (2013) Character association and path coefficient analysis of indigenous and exotic bitter gourd (*Momordica charantia*) germplasm. *Indian J. Agric. Sci* 83(5): 525-528.

Devmore, J.P., Dhonukshe, B.L., Thaware, B.L., Bendale, V.W., Jadhav, B.B. and Thprat, T. N (2010) Genetic variability and heritability studies in bitter gourd (*Momordica charantia* L.). *J. Maharashtra Agric. Univ* 35(1): 163-168.

Dey, S.S., Behera, T.K. and Kaur, C (2005) Genetic variability in ascorbic acid and carotenoids content in Indian bitter gourd (*Momordica charantia* L.) germplasm. *Rep. Cucurbit Genet. Coop* 28: 91-93

Gautham, S.P. and Balamohan T.N (2018) Genetic variability studies in F_2 and F_3 generations of ridge gourd for yield and yield components [*Luffa acutangula* (L.) *Roxb*.]. *Ann. Plant Sci* 7(8): 2385-2390.

Gowda, H.V.K (2017) Studies on genetic variability, divergence and character association in F_2 population of bitter gourd (*Momordica charantia* L.). *M. Sc.* (Agri.) *Thesis*, *Odisha Univ. Agri. Tech*., Bhuvneshwar (India).

Hanchinamani, C.N (2006) Genetic variability, divergence, heterosis and combining ability studies in cucumber (*Cucumis sativus*). *Ph.D. Thesis*, *Univ. Agric. Sci*. Dharwad (India).

Islam, M.R., Hossain, M.S., Bhuiyan, M.S.R., Husna, A. and Syed, M.A (2009) Genetic variability and path-coefficient analysis of bitter gourd (*Momordica charantia* L.). *Int. J. Sustainable Agric* 1(3): 53-57.

Jeffery C (1967) Flora of tropical east Africa*: cucurbitaceae*, London crown agents 43: 120-254.

Johnson, H.W., Robinson, H.F. and Comstock, R.E (1955) Estimation of genetic and environmental variability in soybeans. *Agron. J* 47: 314-318.

Kanimozhi, R., Yassin, G.M., Kumar, S.R., Kanthaswamy, V., Thirumeni, S (2015) Genetic analysis in segregating generation of wax gourd. *Int. J. Veg. Sci* 21(3): 281-96.

Karmakar, P., Munshi, A.D., Behera, T.K., Kumar, R., Sureja, A.K., Kaur, C. and Singh, B.K (2013) Quantification and inheritance of antioxidant properties and mineral content in ridge gourd (*Luffa acutangula*). *Agric. Res. J* 2: 222-228.

Kumari, M., Kumar, J., Kumari, A., Singh, V.K., Rani, N. and Kumar, A (2018) Genetic variability, correlation and path coefficient analysis for yield and yield attributing traits in bitter gourd (*Momordica charantia* L.). *Curr. J. Appl. Sci. Technol* 31(4): 1-8.

Lu, Y.L., Liu, Y.H., Chyuan, J.H., Cheng, K.T., Liang, W.L. and Hou, W.C (2012) Antioxidant activities of different wild bitter gourd (*Momordica charantia* var. *abbreviata* Seringe) cultivars. *Bot. Stud* 53(2): 207.

Lush, J.L (1940) Intra-sire correlations or regressions of offspring on dam as a method of estimating heritability of characteristics. *J. Anim. Sci* 1: 293-301.

Mahapatra, S., Sureja, A.K., Behera, T.K., Bhardwaj, R. and Verma, M (2023) Variability in antioxidant capacity and some mineral nutrients among ninety-one Indian accessions of bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. *South African J. Bot* 152: 50-62.

Mehta, T., Duhan, D.S. and Panghal, V.P.S (2021) Genetic diversity studies for improved horticultural traits in bitter gourd [*Momordica charantia* L.] genotypes. *Veg. Sci* 48(2): 198-202.

Mounica, N., Mohapatra, P.P., Devi, A.P., Triveni, D. and Rani, Y.S (2019) Evaluation studies of bitter gourd (*Momordica charantia* L.) genotypes based on growth, yield and yield attributing characters. *Chem. Rev. Lett* 8(30): 241-244.

Mulge, R., Nagaraja, K.S., Srikanth, L.G., Husainnaik, M. and Kumbar, S (2014) Genetic variability, heritability and genetic advance for growth and earliness parameters in cucumber (*Cucumis sativus* L.). *Biosci. Trends* 7(15): 1968-1970.

Munshi, A.D., Panda, B., Behera, T.K. and Kumar, R (2007) Genetic variability in *Cucumis sativus* var. *hardwickii* R. (Alef.) germplasm. *Cucurbit Genet. Coop. Rep* 30: 5-10.

Nithinkumar, K.R., Kumar, J.A., Ramachandra, R.K., Varalakshmi, B., Mushrif, S.K. and Prashanth, S.J (2022) Genetic variability and character association studies in bitter gourd (*Momordica charantia* L.). *J. Genetic, Genom. Plant Breed* 6(1): 1-9.

Pathak, M., Manpreet, K. and Pahwa, K (2014) Genetic variability, corelation and path coefficient analysis in bitter gourd (*Momordica charan*tia L.). *Int. J. Adv. Res* 2(8): 179-184.

Pradhan, P., Tripathy, P., Sahu, G.S., Tripathy, B. and Sourabh, S (2021) Assessment of genetic variability in F_4 segregating population of bitter gourd (*Momordica charantia* L.). *J. Pharmacogn. Phytochem* 10(2): 1452-1455.

Prakash, S., Verma, R.S., Kumar, V., Pal, H. and Shivran, B.C (2021) Studies on growth, yield and quality parameters in bitter gourd (*Momordica charantia* L.). *Pharma Innov. J* 10: 357-59.

Rajawat, K.S. and Collis, J.P (2017) Genetic variability, heritability and genetic advances analysis for quantitative and qualitative traits in cucumber (*Cucumis sativus* L.). *J. Pharmacogn. Phytochem* 6(4): 882-885.

Rane, S.K., Kaushik, P., Rawat, L., Choudhary, D.R., Bisth, T.S. and Kumar, S (2023) Evaluation of bottle gourd variety Thar Avani under rainfed semi-arid conditions for morphological traits along with antioxidant potentiality and mineral content. *Evaluation* 54(08): 15237- 15256.

Rani, K.R., Reddy, K.R. and Raju, C.S (2014) Association of fruit yield and component traits in segregating population of bitter gourd. *Plant Archives* 14(1): 215-220.

Sagar, K.R., Babu, B.R., Babu, M.R., Rao, M.P. and Sekhar, V (2024) Studies on genetic variability, heritability and genetic advance in bitter gourd (*Momordica charantia* L.) germplasm lines. *Plant Arch* 24(1): 232-236.

Singh, M.K., Bhardwaj, D.R., Upadhyay, D.K (2014) Genetic architecture and association analysis in bitter gourd (*Momordica charantia* L.) landraces. *The Bioscan* 9(2):707-711.

Singh, P.R., Karak, C., Mohapatra, P.P., Kumar, B.A. and Hazra, P (2018) Manifestation of heterosis in bitter gourd. *Int. J. Curr. Microbiol. Appl. Sci* 7(10): 1376-1385.

Singh, S.P., Malik, S., Singh, B., Gangwar, L.K., Singh, M.K., Kumar, M. and Chandra, A (2022) Studies on genetic variability, heritability, and genetic advance for selection of genotypes in Cucumber (*Cucumis sativus* L.). *Pharm. Innov* 11(7): 2535-2537.

Singh, V., Rana, D.K. and Shah, K.N (2017) Genetic variability, heritability and genetic advance in some strains of bitter gourd (*Momordica charantia* L.) under subtropical conditions of Garhwal Himalaya. *Plant Archives* 17(1): 564-568.

Sowmya, H.M., Kolakar, S.S. and Nadukeri, S (2021) Variability and heritability studies for yield and yield component traits in bitter gourd (*Momordica charantia* L.). *Pharm. Innov* 10(11): 652-654.

Sravani, Y., Rekha, G.K., Ramana, C.V., Naidu, L.N. and Suneetha, D.S (2021) Studies on genetic variability, heritability and genetic advance in F_2 generation of ridge gourd. *J. Pharm. Innov* 10(7): 927-930.

Talukder, Z.H., Khan, M.H., Das, A.K. and Uddin, N (2018) Assessment of genetic variability, heritability and genetic advance in bitter gourd (*Momordica charantia* L) for yield and yield contributing traits in Bangladesh. *Sch. J. Appl* 1(6): 9-18.

Tiwari, C., Bagri, A.S., Pandey, A., Ganjeer, B., Bhasker, P. and Singh, S.S (2021) Genetic variability and genetic advance in some cultivars of bitter gourd (*Momordica charantia* L.). *J. Pharmacogn. Phytochem* 10(2): 979-981.

Tyagi, N., Singh, V.B. and Maurya, P.K (2018) Character association and path coefficient analysis of bitter gourd (*Momordica charantia* L.) genotypes. *J. Pharmacogn. Phytochem* 7(2): 2419-2422.

Vaidya, A.V., Bhalekar, M.N. and Damse, D.N (2020) Genetic studies in F_4 progenies of bottle gourd (*Lagenaria siceraria* (Molina) *Standl*.). *Int. J. Curr. Microbiol Appl Sci* 9(8): 2616-2622.

Vitthal, R.L (2012) Assessment of variability studies in F_2 and F_3 generations in bitter gourd (*Momordica charantia* L.). *Ph.D. (Agri.) Thesis*, MPKV, Rahuri (India).

Yadagiri, J., Gupta, N.K., Tembhre, D. and Verma, S (2017) Genetic variability, correlation studies and path coefficient analysis in bitter gourd (*Momordica charantia* L.). *J. Pharmacogn. Phytochem* 6(2): 63-66.

Yadava, P.S. and Yadav, G.C (2015) Genetic variability, correlation and path-coefficient analysis in bitter gourd (*Momordica charantia* L.). *Biosci. Trend* 8(4): 873-878.