Original Research Article

"Genetic Variability and Correlation Studies on Different Hybrid of Bitter Gourd (*Momordica charantia* L.) in Prayagraj Agroclimatic Condition"

Abstract

An experiment was conducted on Genetic Variability, Heritability and Correlation Studies on 20 hybrids of bitter gourd (*Momordica charantia* L.) with three replications during Zaid Season of 2022. at the Research Field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. They were evaluated for 16 quantitative characters *viz.*days taken to germination, vine length at final harvest, emergence of 1st male flower, emergence of 1st female flower, node appearance of male flower, node appearance of female flower, days to first picking, days to last picking, average fruit length, average fruit weight, average fruit diameter,number of fruits per plant, fruit yield per plant, average fruit yield, ascorbic acid and total solublesolids. Significant differences among bitter gourd genotypes indicated the presence of wide variation for all the hybrids and AVT-I 2020 BIGHYB-3 found superior in exhibited substantially higher fruit yield per plant and performed better for other desirable traits. This genotype was found superior based on the overall performance of different bitter gourd cultivars for growth and yield in Prayagraj conditions.

***Keywords**:* Genetic variability, correlation studies, Bitter Gourd, Growth and fruit yield

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 English name is Bitter Gourd, Hindi name is Karela, Sanskrit name is Karvellak, karvelli, Katphala, and Gujrati name is Karelo, Kadhwa. Recent biogeographic analyses suggest that M. charantia originated in Africa and probably was domesticated in eastern India and southern China. Bitter gourd is an important plant of the Cucurbitaceae family with high nutritional content. It is also used by people in the treatment of many diseases. It is also known as bitter gourd, African cucumber, balsam apple, balsam pear, papilla, and karela. Bitter melon is a tropical plant that likes moist and warm areas. Its homeland is India. It is grown in open areas in temperate regions of Turkey and greenhouse environments in

cold regions. This plant is used both for treatment and food in many regions where it grows and is grown. The bitter melon plant is grown in Turkey by sowing from its seed in May and the ripe fruits are harvested in August. .

Success in any plant breeding programme solely depends upon the existence of genetic variability present in the population. It is proved that larger the variability, greater is the scope for selection and improvement. It is the genotypic variability and more specifically the additive variances, which is most important for a plant breeder as, it determines the genetic gain through selection. Yield is a complex entity which is associated with a number of component characters. Before aiming at an improvement in yield, it is necessary to have information on genetic variability and heritability, in respect of important characters associated with yield. Genotypic and phenotypic coefficients of variation are useful in detecting the amount of variability present in the available genotypes.

The main purpose of estimating heritability and the genetic parameters that compose the heritability estimate is to compare the expected gains from selection based on alternative selection strategies (Holland *et al.,* 2003). The efficiency of selection depends on the direction and magnitude of association between yield and its component characters. The correlation coefficients indicate association between two characters and form a basis for selecting desirable plant type and path coefficient analysis splits the correlation coefficients into direct and indirect effects to measure the relative importance of each character. Information on character association and direct and indirect effects of component traits on yield would greatly help in formulating the selection criteria and using them effectively in crop improvement programme (Sharma and Bhutani 2001, Bhave 2003, Singh *et al.*, 2008, Islam 2009).

Material and Methods

The experiment was conducted during the Zaid Season of 2022 at the Research Field Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj using randomized block design with three replications. During the period of experimental trail, the maximum temperature of the location reaches up to 45 ºC – 50 ºC and seldom falls as low as 02 ºC – 05 ºC. The relative humidity ranges between 19 to 90 percent. The average rainfalls in this area are around 1013.4 mm annually.

Table 1. Details of Hybrids

Sl. No.	Hybrid Symbol	Name of Genotype/Hybrid	Source
1	H_1	AVT-1 2020 BIGHYB-1	IIVR, Varanasi
2	H_2	AVT-1 2020 BIGHYB-2	IIVR, Varanasi
3	H_3	AVT-1 2020 BIGHYB-3	IIVR, Varanasi
4	H_4	AVT-1 2020 BIGHYB-4	IIVR, Varanasi
5	H_5	AVT-1 2020 BIGHYB-5	IIVR, Varanasi
6	H_6	AVT-1 2020 BIGHYB-6	IIVR, Varanasi
7	H_7	AVT-1 2020 BIGHYB-7	IIVR, Varanasi
8	H_8	AVT-1 2020 BIGHYB-8	IIVR, Varanasi
9	H_9	AVT-1 2020 BIGHYB-9	IIVR, Varanasi
10	H_{10}	AVT-2 2019 BIGHYB-1	IIVR, Varanasi
11	H_{11}	AVT-2 2019 BIGHYB-2	IIVR, Varanasi
12	H_{12}	AVT-2 2019 BIGHYB-3	IIVR, Varanasi
13	H_{13}	AVT-2 2019 BIGHYB-4	IIVR, Varanasi
14	H_{14}	AVT-2 2019 BIGHYB-5	IIVR, Varanasi
15	H_{15}	AVT-2 2019 BIGHYB-6	IIVR, Varanasi
16	H_{16}	AVT-2 2019 BIGHYB-7	IIVR, Varanasi
17	H_{17}	AVT-2 2019 BIGHYB-8	IIVR, Varanasi
18	H_{18}	AVT-2 2019 BIGHYB-9	IIVR, Varanasi
19	H_{19}	SAGAR	VNR Seed
20	H_{20}	KSP 120	Kalash Seed

The data were subjected to analysis of variance according to Panse and Sukhatme (1967). The genotypic and phenotypic coefficients of variation were computed according to Burton and Devane (1953). The broad sense heritability was computed according to Falconer and Mackay (1996). Genetic advance over mean was worked out according to Johnson et al. (1955). Path coefficient analysis provides an effective means of partitioning correlation coefficients into unidirectional and alternative pathways thus permitting a critical examination of specific factors that produce a given correlation, which can be successfully employed in formulating an effective selection programme (Salahuddin *et al.* 2010).

Result and Discussion

The salient results of the study and conclusion drawn from the experiment are summarized below:

Analysis of variance showed significant differences among the hybrids for the sixteen characters studied, Analysis of variance showed significant difference among the hybrids for the different characters at 1% significance.

Out of 20 genotypes of bitter gourd, 3 genotypes namely; AVT I-2020 BIGHYB-3(2.02kg/plant), AVT I-2020 BIGHYB-1(1.95kg/plant), AVT I-2020 BIGHYB-9(1.29 kg/plant) possessed maximum fruit yield per plant**.** Therefore, these genotypes may be promoted for cultivation as well as in future breeding programme to develop superior varieties for eastern plain zones of Uttar Pradesh.

A wide range of variability in bitter gourd (*Momordica charantia* L.) germplasm was observed for different characters viz. days taken to germination (7.00-12.00), Days to 1st Male Flower (26.80 – 30.53 days), Days to 1st Female Flower (31.53 – 35.43 days), Nodes number at which first male flower appears (4.13 – 8.60 nodes), Nodes number at which first female flower appears (6.40 – 15.87 nodes), Days to first fruit picking (40.00 – 48.33 days), Days to last fruit picking (82.33-85.00 days) Fruit Weight (24.60 – 74.94 gm), Number of Fruits per Plant (20.18 – 28.91 fruits), Fruit yield per plant (0.55 – 2.02 kg), Fruit Length (7.83 – 14.13 cm), Fruit diameter (21.28 – 40.51 mm), Yield per Hectare (61.18 – 234.44 q/ha), Vine Length at final Harvest (3.02 – 3.98m), TSS (6.00 – 9.00), Ascorbic acid (79.70 – 84.40 mg/100gm).

Table 2. Mean Performance of Different Hybrids of Bitter gourd in Prayagraj Agro-climatic condition.

Sl. No.	Name of Genotype	Vine Length(m)	Emergence of 1st Male Flower	Emergence of 1st Female Flower	Days to 1st Picking	Av. Fruit Length (cm)	Av. Fruit Weight (g)	Av. Fruit Diameter (mm)	No. of Fruit per Plant	Average Fruit Yield (t/ha)	Ascorbic Acid (mg/100g)	TSS (°Brix)
1	**AVT-II/2019/BIGHYB-1**	3.217	28.733	31.533	40	9.533	40.787	40.507	24.08	108.993	84.4	7
2	**AVT-II/2019/BIGHYB-2**	3.803	30.067	32.6	40.667	8.467	26.42	30.647	22.957	67.29	81.1	6.667
3	**AVT-II/2019/BIGHYB-3**	3.433	29.333	31.867	42	7.833	24.6	30.987	25.247	68.437	80.5	6.333
4	**AVT-II/2019/BIGHYB-4**	3.977	28.533	31.867	42.667	13.867	56.087	30.327	20.183	125.883	82.033	6
5	**AVT-II/2019/BIGHYB-5**	3.407	28	32.733	47.333	11.4	52.727	33.153	22.443	130.623	83.533	6.667
6	**AVT-II/2019/BIGHYB-6**	3.04	27.8	33.333	41.333	13.4	43.06	29.333	22.873	109.44	81.4	6.333
7	**AVT-II/2019/BIGHYB-7**	3.42	27.267	31.6	43.333	12	49.34	30.74	22.89	120.883	82.8	6.333
8	**AVT-II/2019/BIGHYB-8**	3.23	26.8	33.8	48.333	9.267	25.193	24.46	21.85	61.177	82.2	6.667
9	**AVT-II/2019/BIGHYB-9**	3.407	27.2	31.733	43	10.533	56.853	21.28	21.517	136.07	82.6	6.333
10	**AVT-I/2020/BIGHYB-1**	3.303	29.333	33.667	41.667	12.533	66.68	34.707	28.913	226.883	81.073	6.667
11	**AVT-I/2020/BIGHYB-2**	3.02	28.467	33.467	42.333	11	29.053	25.173	25.353	82.327	81.703	7
12	**AVT-I/2020/BIGHYB-3**	3.27	27.933	31.533	40	14.133	74.937	39.167	26.873	234.44	82.057	6.333
13	**AVT-I/2020/BIGHYB-4**	3.457	27.867	34.133	41	11.667	51.42	30.907	25.207	152.4	81	6
14	**AVT-I/2020/BIGHYB-5**	3.593	30.533	35.433	48	8	46.407	30.02	24.16	130.477	82.7	7.333
15	**AVT-I/2020/BIGHYB-6**	2.667	27.067	32.067	42.667	9.533	40.637	33.533	22.06	102.44	83.433	7
16	**AVT-I/2020/BIGHYB-7**	3.41	28	33.267	42.667	7.9	30.247	30.713	22.517	79.033	79.7	6
17	**AVT-I/2020/BIGHYB-8**	3.707	27.867	33.733	43	8.067	46.503	31.767	23.957	128.513	80.233	6.333
18	**AVT-I/2020/BIGHYB-9**	3.133	29.533	33.8	41	11.2	52.427	33.8	24.413	146.15	80	9
19	**SAGAR**	3.767	37.1	37.033	54.967	11.167	42.507	25.067	26.9	124.9	84.4	6.3
20	**KSP 120**	4.103	37.367	37.767	58.067	9.527	46.953	29.333	24.967	126.7	84.9	7.033
Mean		3.42	29.24	33.35	44.2	10.55	45.14	30.78	23.97	111.8	82.09	6.67
CV		6.02	5.31	5.64	5.7	5.87	7.36	5.91	7.96	10.01	2.05	5.19
SEm		0.12	0.9	1.08	1.46	0.36	1.92	1.05	1.1	6.46	0.97	0.2
CD at 5%		0.34	2.57	3.11	4.17	1.02	5.49	3	3.15	18.5	2.78	0.57

The results of present study also revealed that there was a comparative higher degree of genotypic correlation coefficients than their phenotypic counterparts in most of the characters studied. This indicated that there was a higher degree of association between two characters of genotypic association, their phenotypic association was lessened due to the influence of environment. Positive and significant correlation was observed for Average Fruit length, Average Fruit weight, Average fruit diameter, number of fruit per plant and fruit yield per hectare with Fruit yield per plant at both phenotypic and genotypic level. Therefore, these characters emerged as most important attributing associates of seed yield per plant in Bitter gourd. Thus, selection practised for the improvement in one character will automatically result in the improvement of the other character even if direct selection for improvement has not been made for the yield character.

Significant positive association of these above attributes indicated that these attributes were mainly influencing the fruit yield in bitter gourd. Thus, selection practiced for the improvement in one character will automatically result in the improvement of the other character even if direct selection for improvement has not been made for the yield character. The significant correlation at both the levels between above attributing characters can be used for simultaneous improvement in both the characters with selection for one character only while selection for correlated character may not be done. However, significant correlation only at genotypic level reflects the masking effects of the environment.

Conclusion

From the present investigation it is concluded that among 20 hybrids of bitter gourd (*Momordica charantia* L.) AVT-I 2020 BIGHYB-3 exhibited substantially higher fruit yield per plant and performed better for other desirable traits. The analysis of variance for all characters of bitter gourd hybrids revealed presence of good extant of significant differences among the hybrids for all traits. For genotypic correlation fruit yield per plant shows positive significant correlation with fruit yieldper hectare, no. of fruit per plant, average fruit diameter, average fruit weight, average fruit length. For phenotypic correlation fruit yield per plant shows positive significant correlation with fruit yield per hectare, no. of fruit per plant, fruit diameter, fruit weight and fruit length. Henceforth, the data for all characters that showed sufficient amount of significant differences were subjected to further statistical analysis.

Table 3. Genotypical Correlation for Different Hybrids of Bitter gourd

Genotypic Correlation Matrix															
	Vine length (m)	Emergence of 1st Male Flower	Emergence of 1st Female Flower	Node Appearance of Male Flower	Node Appearance of Female Flow	Days to 1st Picking	Days to Last Picking	Average Fruit Length (cm)	Average Fruit Weight(g)	Average Fruit Diameter (mm)	Number of Fruit/ Plant	Fruit yield/ ha (q)	Ascorbic Acid	TSS	Fruit yield/ plant
Vine length(m) at Final Harvest	1.0000	0.696**	0.638**	0.1856	-0.264*	0.584**	0.526**	-0.1228	0.0656	-0.1869	-0.0021	-0.332*	0.2238	-0.305*	0.0146
Emergence of 1st Male Flower		1.0000	0.859**	0.2014	-0.315*	0.872**	0.852**	-0.1053	-0.0308	-0.1845	0.511**	-0.580**	0.670**	0.1510	0.0797
Emergence of 1st Female Flower			1.0000	0.371*	-0.0168	0.750**	0.842**	-0.2093	-0.0871	-0.431**	0.482**	-0.629**	0.329*	0.2291	-0.0158
Node Appearance of Male Flower				1.0000	0.742**	0.280*	0.352*	-0.0481	-0.0713	-0.477**	-0.2249	-0.304*	-0.2454	0.305*	-0.1852
Node Appearance of Female Flower					1.0000	-0.1396	-0.2134	0.1317	0.0929	-0.298*	-0.432**	0.1303	-0.454**	0.328*	-0.0881
Days to 1st Picking						1.0000	0.869**	-0.1984	-0.0941	-0.447**	0.1417	-0.651**	0.895**	0.0537	-0.0653
Days to Last Picking							1.0000	0.0207	-0.0177	-0.395*	0.459**	-0.677**	0.789**	0.0324	0.0678
Average Fruit Length(cm)								1.0000	0.699**	0.1602	0.1751	0.529**	0.1430	-0.1388	0.635**
Average Fruit Weight (g)									1.0000	0.378*	0.322*	0.768**	0.1681	0.0157	0.954**
Average Fruit Diameter(mm)										1.0000	0.370*	0.537**	-0.0309	0.1988	0.455**
Number of Fruit per Plant											1.0000	0.262*	-0.0745	0.0971	0.588**
Fruit yield per ha (q)												1.0000	-0.437**	0.0344	0.756**
Ascorbic Acid													1.0000	0.0886	0.0887
TSS														1.0000	0.0963
Fruit yield per plant															1.0000

Table 4. Phonotypical Correlation for Different Hybrids of Bitter gourd

Phonotypical Correlation Matrix															
	Vine length (m)	Emergence of 1st Male Flower	Emergence of 1st Female Flower	Node Appearance of Male Flower	Node Appearance of Female Flow	Days to1st Picking	Days to Last Picking	Average Fruit Length (cm)	Average Fruit Weight(g)	Average Fruit Diameter (mm)	Number of Fruit/ Plant	Fruit yield/ ha (q)	Ascorbic Acid	TSS	Fruit yield per plant
Vine length(m) at Final Harvest	1.0000	0.439**	0.260*	0.1153	-0.2047	0.393*	0.357*	-0.1162	0.0704	-0.1926	-0.0129	-0.279*	0.0814	-0.2250	0.0108
Emergence of 1st Male Flower		1.0000	0.649**	0.1642	-0.267*	0.671**	0.642**	-0.1290	-0.0264	-0.1246	0.322*	-0.491**	0.308*	0.1400	0.0586
Emergence of 1st Female Flower			1.0000	0.1971	-0.0047	0.643**	0.467**	-0.1828	-0.0786	-0.2516	0.284*	-0.332*	0.2434	0.1700	0.0068
Node Appearance of Male Flower				1.0000	0.686**	0.261*	0.262*	-0.0456	-0.0513	-0.434**	-0.1750	-0.271*	-0.1302	0.2418	-0.1512
Node Appearance of Female Flower					1.0000	-0.1032	-0.1188	0.1074	0.0910	-0.2434	-0.284*	0.1222	-0.2220	0.278*	-0.0794
Days to 1st Picking						1.0000	0.631**	-0.1657	-0.1003	-0.367*	0.0367	-0.572**	0.373*	0.0026	-0.0771
Days to Last Picking							1.0000	-0.0320	0.0134	-0.2063	0.2114	-0.470**	0.408*	0.0277	0.0496
Average Fruit Length(cm)								1.0000	0.662**	0.1359	0.1005	0.486**	0.0554	-0.1218	0.567**
Average Fruit Weight (g)									1.0000	0.349*	0.257*	0.752**	0.0811	-0.0034	0.915**
Average Fruit Diameter(mm)										1.0000	0.1776	0.469**	-0.0179	0.1751	0.383*
Number of Fruit per Plant											1.0000	0.2524	0.0108	0.1459	0.463**
Fruit yield per ha (q)												1.0000	-0.2410	0.0216	0.749**
Ascorbic Acid													1.0000	-0.0721	0.0921
TSS														1.0000	0.0785
Fruit yield per plant															1.0000

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