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

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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

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. The results from the present investigation revealed that on the basis of mean performance for 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 –

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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) was found superior in AVT-I 2020 BIGHYB-3 with 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; fruit yield.

1. 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 [1]. 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 [2-5].

2. MATERIALS 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 trial, 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.

The data were subjected to analysis of variance according to Panse and Sukhatme [6]. The genotypic and phenotypic coefficients of variation were computed according to Burton and Devane [7]. The broad sense heritability was computed according to Falconer and Mackay [8]. Genetic advance over mean was worked out according to Johnson et al. [9]. 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 [10].

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

3. RESULTS AND DISCUSSION

The present investigation entitled “Genetic Variability, Heritability and Correlation Studies on Different Hybrid of Bitter Gourd (Momordica *charantia* L.) in Prayagraj Agroclimatic Condition” was conducted in randomized block design with twenty hybrids of bitter gourd in three replications. The characters studied were viz. days taken to germination, vine length (m) at final stage, emergence of 1st male flower, emergence of 1st female flower, node appearance of male flower, node appearance of female flower, days to 1st picking, days to last picking, fruit length (cm), fruit diameter (mm), fruit weight (g), fruit yield per plant (g/plant), fruit yield per hectare q/ha), Ascorbic acid and Total Soluble Solids (°Brix).

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.

3.1 Days taken to Germinate

The data revealed from Table 1 that the hybrid Sagar (5.33) showed minimum days to followed by hybrid KSP 120 (6.03). The hybrid AVT-II/2019/BIGHYB-6 (12) was observed to show highest days taken to germinate. Similar findings were previously reported by Yadav et al., [11].

3.2 Vine Length (m)

The data revealed from Table 1 that the hybrid AVT-I/2020/BIGHYB-6 (2.67 m) had lowest vine length. The hybrid KSP 120 (4.10 M) had maximum vine length followed by the hybrid AVT-II/2019/BIGHYB-4 (3.98 m). Similar findings were previously reported by Yadav et al. [11].

3.3 Emergence of 1st Male Flower

The data revealed from Table 1 that the hybrid AVT-II/2019/BIGHYB-8 (26.8 days) was earliest in terms of 1st male flower emergence followed by hybrid AVT-I/2020/BIGHYB-6 (27.07 days). The hybrid KSP 120 (37.77 days) was late in terms of 1st male flower emergence. Similar findings were previously reported by Yadav et al., [11].

3.4 Emergence of 1st Female Flower

The data revealed from Table 1 that the hybrid AVT-I/2020/BIGHYB-3 and AVT-I/2019/BIGHYB-1 (31.53 days) was earliest in terms of 1st female flower emergence followed by hybrid AVT-II/2019/BIGHYB-3 and AVT-II/2019/BIGHYB-4 (31.87 days). The hybrid KSP 120 (37.77 days) was late in terms of 1st female flower emergence. Similar findings were previously reported by Yadav et al., [11].

Table 2. Mean performance of different hybrids of bitter gourd

Sl. No.	Name of Genotype	Days Taken to Germination	Vine Length(m)	Emergence of 1st Male Flower	Emergence of 1st Female Flower	Node Appearance of Male Flower
1	AVT-II/2019/BIGHYB-1	9.66	3.217	28.733	31.533	4.133
2	AVT-II/2019/BIGHYB-2	9.00	3.803	30.067	32.6	5.933
3	AVT-II/2019/BIGHYB-3	9.33	3.433	29.333	31.867	6.8
4	AVT-II/2019/BIGHYB-4	11.00	3.977	28.533	31.867	6.2
5	AVT-II/2019/BIGHYB-5	9.00	3.407	28	32.733	6.467
6	AVT-II/2019/BIGHYB-6	12.00	3.04	27.8	33.333	6.333
7	AVT-II/2019/BIGHYB-7	8.66	3.42	27.267	31.6	6.133
8	AVT-II/2019/BIGHYB-8	8.00	3.23	26.8	33.8	6.667
9	AVT-II/2019/BIGHYB-9	7.00	3.407	27.2	31.733	7.2
10	AVT-I/2020/BIGHYB-1	10.00	3.303	29.333	33.667	4.6
11	AVT-I/2020/BIGHYB-2	9.67	3.02	28.467	33.467	5.733
12	AVT-I/2020/BIGHYB-3	9.00	3.27	27.933	31.533	5.4
13	AVT-I/2020/BIGHYB-4	9.33	3.457	27.867	34.133	6.667
14	AVT-I/2020/BIGHYB-5	11.00	3.593	30.533	35.433	5.333
15	AVT-I/2020/BIGHYB-6	9.333	2.667	27.067	32.067	6.067
16	AVT-I/2020/BIGHYB-7	10.333	3.41	28	33.267	5.6
17	AVT-I/2020/BIGHYB-8	8	3.707	27.867	33.733	7.133
18	AVT-I/2020/BIGHYB-9	11.667	3.133	29.533	33.8	8.6
19	SAGAR	5.333	3.767	37.1	37.033	7.133
20	KSP 120	6.033	4.103	37.367	37.767	6.9
Mean		9.17	3.42	29.24	33.35	6.25
CV		6.55	6.02	5.31	5.64	5.72
SEm		0.35	0.12	0.9	1.08	0.21
CD at 5%		0.99	0.34	2.57	3.11	0.59

Table 3. Mean performance of different hybrids of bitter gourd

Sl. No.	Name of Genotype	Node Appearance of Female Flower	Days to 1st Picking	Days to Last Picking	Average Fruit Length(cm)	Average Fruit Weight(g)
1	AVT-II/2019/BIGHYB-1	6.4	40	82.667	9.533	40.787
2	AVT-II/2019/BIGHYB-2	9.2	40.667	83.333	8.467	26.42
3	AVT-II/2019/BIGHYB-3	9.867	42	82.333	7.833	24.6
4	AVT-II/2019/BIGHYB-4	12.2	42.667	82.333	13.867	56.087
5	AVT-II/2019/BIGHYB-5	12.133	47.333	85	11.4	52.727
6	AVT-II/2019/BIGHYB-6	11.6	41.333	84	13.4	43.06
7	AVT-II/2019/BIGHYB-7	8.733	43.333	83.333	12	49.34
8	AVT-II/2019/BIGHYB-8	12	48.333	85	9.267	25.193
9	AVT-II/2019/BIGHYB-9	12.667	43	84	10.533	56.853
10	AVT-I/2020/BIGHYB-1	8.667	41.667	84	12.533	66.68
11	AVT-I/2020/BIGHYB-2	10.2	42.333	85	11	29.053
12	AVT-I/2020/BIGHYB-3	8.8	40	83.667	14.133	74.937
13	AVT-I/2020/BIGHYB-4	13.8	41	83.667	11.667	51.42
14	AVT-I/2020/BIGHYB-5	10.2	48	82.667	8	46.407
15	AVT-I/2020/BIGHYB-6	13.267	42.667	84	9.533	40.637
16	AVT-I/2020/BIGHYB-7	9.267	42.667	82.667	7.9	30.247
17	AVT-I/2020/BIGHYB-8	11.867	43	84.333	8.067	46.503
18	AVT-I/2020/BIGHYB-9	15.867	41	84.333	11.2	52.427
19	SAGAR	9.6	54.967	103	11.167	42.507
20	KSP 120	8.8	58.067	101.2	9.527	46.953
Mean		10.76	44.2	85.53	10.55	45.14
CV		5.6	5.7	5.81	5.87	7.36
SEm		0.35	1.46	2.87	0.36	1.92
CD at 5%		1	4.17	8.21	1.02	5.49

3.5 Node Appearance of First Male Flower

The data revealed from Table 1 that the hybrid AVT-I/2019/BIGHYB-1 (4.13 days) was earliest in terms of node appearance of male flower followed by hybrid AVT-I/2020/BIGHYB-1 (4.6 days). The hybrid AVT-I/2020/BIGHYB-9 (8.60 days) was late in terms of node appearance of male flower. Similar findings were previously reported by Yadav et al., [11].

3.6 Node Appearance of Female Flower

The data revealed from Table 2 that the hybrid AVT-I/2019/BIGHYB-1 (6.40 days) was earliest in terms of node appearance of female flower followed by hybrid AVT-II/2019/BIGHYB-7 (8.74 days). The hybrid AVT-I/2020/BIGHYB-9 (15.86 days) was late in terms of node appearance of female flower. Similar findings were previously reported by Yadav et al., [11].

3.7 Days to First Picking

The data revealed from Table 2 that the hybrid AVT-II/2019/BIGHYB-1 (40 days) was earliest in terms of days to 1st picking followed by hybrid obtained from AVT-II/2019/BIGHYB-1 (40.67 days). The hybrid obtained from KSP 120 (58.07 days) was late in terms of 1st picking. Similar findings were previously reported by Yadav et al., [11].

3.8 Days to Last Picking

The data revealed from Table 2 that the hybrid AVT-II/2019/BIGHYB-2, AVT-II/2019/BIGHYB-3 and AVT-II/2019/BIGHYB-4 (82.33 days) was earliest in terms of days to last picking followed by hybrid genotypes obtained from AVT-I/2020/BIGHYB-3 and AVT-I/2020/BIGHYB-3 (83.67 days). The hybrid obtained from Sagar (103 days) was late in terms of last picking. Similar findings were previously reported by Yadav et al., [11].

3.9 Fruit Length (cm)

The data revealed from Table 2 that the hybrid AVT-I/2020/BIGHYB-3 (14.13 cm) was found to have maximum fruit length followed by hybrid AVT-II/2019/BIGHYB-4 (13.87 cm). The hybrid AVT-II/2019/BIGHYB-4 (7.83 cm) had minimum fruit length.

3.10 Fruit Weight (g)

The data revealed from Table 2 that the hybrid AVT-I/2020/BIGHYB-3 (74.94 g) was found to have maximum fruit weight followed by hybrid AVT-I/2020/BIGHYB-1 (66.68 g). The hybrid AVT-II/2019/BIGHYB-3 (24.60 g) had minimum fruit weight.

3.11 Fruit Diameter (mm)

The data revealed from Table 3 that the hybrid AVT-II/2019/BIGHYB-1 (40.51 mm) was found to have maximum fruit diameter followed by hybrid AVT-I/2020/BIGHYB-3 (39.17 mm). The hybrid AVT-II/2019/BIGHYB-9 (21.28 mm) had minimum fruit diameter.

3.12 Number of Fruits

The data revealed from Table 3 that the hybrid AVT-I/2020/BIGHYB-1 (28.91) was found to have maximum number of fruits per plant followed by hybrid AVT-I/2020/BIGHYB-3 (26.87). The hybrid AVT-II/2019/BIGHYB-4 (20.18) had minimum fruits per plant.

3.13 Fruit Yield per Plant (kg/plant)

The data revealed from Table 3 that the hybrid AVT-I/2020/BIGHYB-1 (28.91) was found to have maximum number of fruits per plant followed by hybrid AVT-I/2020/BIGHYB-3 (26.87). The hybrid AVT-II/2019/BIGHYB-4 (20.18) had minimum fruits per plant.

3.14 Fruit Yield per Hectare (t/ha)

The data revealed from Table 3 that the hybrid AVT-I/2020/BIGHYB-3 (234.44 t/ha) was found to have maximum fruit yield per hectare followed by hybrid AVT-I/2020/BIGHYB-1 (226.88 t/ha). The hybrid AVT-II/2019/BIGHYB-8 (61.18 t/ha) had minimum fruit yield per hectare.

3.15 Ascorbic acid (mg/100g)

The data revealed from Table 3 that the hybrid KSP 120 (84.9 mg/100g) was found to have maximum ascorbic acid content followed by hybrid Sagar (84.4 mg/100g). The hybrid AVT-I/2020/BIGHYB-7 (79.7 mg/100g) had minimum ascorbic acid content.

3.16 Total Soluble Solids (ºBrix)

The data revealed from Table 3 that the hybrid AVT-I/2020/BIGHYB-9 (9 ºBrix) was found to have maximum T.S.S. followed by hybrid AVT-I/2020/BIGHYB-5 (7.33 ºBrix). The hybrid AVT-I/2019/BIGHYB-4, AVT-I/2020/BIGHYB-4 and AVT-I/2020/BIGHYB-7 (6 ºBrix) had minimum T.S.S.

Table 4. Mean performance of different hybrids of bitter gourd

Sl. No.	Name of Genotype	Average Fruit Diameter(mm)	No. of Fruit per Plant	Fruit Yield per Plant(kg)	Average Fruit Yield (t/ha)	Ascorbic Acid(mg/100g)	TSS(°Brix)
1	AVT-II/2019/BIGHYB-1	40.507	24.08	0.981	108.993	84.4	7
2	AVT-II/2019/BIGHYB-2	30.647	22.957	0.606	67.29	81.1	6.667
3	AVT-II/2019/BIGHYB-3	30.987	25.247	0.616	68.437	80.5	6.333
4	AVT-II/2019/BIGHYB-4	30.327	20.183	1.133	125.883	82.033	6
5	AVT-II/2019/BIGHYB-5	33.153	22.443	1.176	130.623	83.533	6.667
6	AVT-II/2019/BIGHYB-6	29.333	22.873	0.985	109.44	81.4	6.333
7	AVT-II/2019/BIGHYB-7	30.74	22.89	1.086	120.883	82.8	6.333
8	AVT-II/2019/BIGHYB-8	24.46	21.85	0.551	61.177	82.2	6.667
9	AVT-II/2019/BIGHYB-9	21.28	21.517	1.225	136.07	82.6	6.333
10	AVT-I/2020/BIGHYB-1	34.707	28.913	1.955	226.883	81.073	6.667
11	AVT-I/2020/BIGHYB-2	25.173	25.353	0.746	82.327	81.703	7
12	AVT-I/2020/BIGHYB-3	39.167	26.873	2.021	234.44	82.057	6.333
13	AVT-I/2020/BIGHYB-4	30.907	25.207	0.985	152.4	81	6
14	AVT-I/2020/BIGHYB-5	30.02	24.16	1.140	130.477	82.7	7.333
15	AVT-I/2020/BIGHYB-6	33.533	22.06	0.899	102.44	83.433	7
16	AVT-I/2020/BIGHYB-7	30.713	22.517	0.688	79.033	79.7	6
17	AVT-I/2020/BIGHYB-8	31.767	23.957	1.119	128.513	80.233	6.333
18	AVT-I/2020/BIGHYB-9	33.8	24.413	1.292	146.15	80	9
19	SAGAR	25.067	26.9	1.118	124.9	84.4	6.3
20	KSP 120	29.333	24.967	1.133	126.7	84.9	7.033
Mean		30.78	23.97	1073.21	111.8	82.09	6.67
CV		5.91	7.96	8.85	10.01	2.05	5.19
Sem		1.05	1.1	54.86	6.46	0.97	0.2
CD at 5%		3	3.15	157.07	18.5	2.78	0.57

Table 5. Phenotypical correlation for different hybrids of bitter gourd

Phenotypical Correlation Matrix																
	Days taken to Germination	Vine length(m) at Final Harves	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 per Plant	Fruit yield per ha (q)	Ascorbic Acid	TSS	Fruit yield per pl
Days taken to Germination	1.0000	-0.349*	-0.471**	-0.260*	-0.2297	0.2171	-0.531**	-0.575**	0.1930	0.0425	0.353*	-0.1385	0.424**	-0.377*	0.1884	0.0092
Vine length(m) at Final Harves		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 Flow						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 pl																1.0000

Table 6. Genotypical correlation for different hybrids of bitter gourd

Genotypical Correlation Matrix																
	Days taken to Germination	Vine length(m) at Final Harves	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 per Plant	Fruit yield per ha (q)	Ascorbic Acid	TSS	Fruit yield per pl
Days taken to Germination	1.0000	-0.449**	-0.567**	-0.550**	-0.2452	0.2348	-0.734**	-0.842**	0.2032	0.0379	0.411*	-0.1912	0.469**	-0.710**	0.321*	0.0259
Vine length(m) at Final Harves		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 Flow						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 pl																1.0000

Genotypic coefficient of variation (GCV) ranged from 50.45% (Average fruit yield) to 1.41% (Ascorbic acid). High GCV (20% and above) was recorded for Average fruit yield (50.45%) followed by Fruit yield per plant (35.3%), Average fruit weight (29.69%) and node appearance of female flower (20.57%). Moderate GCV (10-20%) was observed for Average fruit length (18.79%), Days taken to germination (18.32%), Node appearance of male flower (15.52%), Average fruit diameter (14.56%) and Days to first picking (10.52%). Low GCV (<10%) was recorded for TSS (9.57%), Emergence to 1st male flower (9.47%), Vine length at harvest (9.39%), Number of fruit per plant (7.47%), Days to last picking (5.81%), Emergence to 1st female flower (4.11%) and Ascorbic acid (1.41%).

Phenotypic coefficient of variation (PCV) ranged from 51.43% (Average fruit yield) to 2.49% (Ascorbic acid). High PCV (20% and above) was recorded for Average fruit yield (51.43%) followed by Fruit yield per plant (36.39%), Average fruit weight (30.59%) and node appearance of female flower (21.31%). Moderate PCV (10-20%) was observed for Average fruit length (19.68%), Days taken to germination (19.45%), Node appearance of male flower (16.54%), Average fruit diameter (15.72%), Days to first picking (11.97%), Vine length at harvest (11.14%) Number of fruit per plant (10.92%), TSS (10.88%) and Emergence to 1st male flower (10.85%). Low PCV (<10%) was recorded for Days to last picking (8.21%), Emergence to 1st female flower (6.97%) and Ascorbic acid (2.49%). Similar findings were previously reported by Singh et al. [12], Singh et al. [13,14].

4. 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 yield per 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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Holland JB, WE Nyquist and CT Cervantes-Martinez. Estimating and interpreting he-ritability for plant breeding; A update. plant breed. Rev. 2003;22:109-112.
2. Sharma NK, RD Bhutani. Correlation and path analysis studies in bitter gourd (*Momordica charantia* L.). Haryana J. Hort. Sci. 2001;30(2):84-86.
3. Bhave SG, JL Mehta, VW Bendale, PP Mhatre and UB Pethe. Character association and path co-efficient analysis of bitter gourd *Momordica charantia* L. Orissa J. Hort. 2003;31(1):44-46.
4. Singh HK, VB Singh, R Kumar, DK Baranwal and PK Ray. Assessment of genetic diversity based on cluster and principal component analyses for yield and its contributing; 2014.
5. Islam MR, Hossain MS, Bhuiyan MSR, Hasan GN, Syed A. genetic variability and path-coefficient analysis of bitter gourd *Momodica charantia* L. Int. J. Sustainable Agric. 2009;1(3): 53-57.
6. Panse VG, Sukhatame PV. Statistical methods of agriculture workers, Indian Council of Agricultural Research, New Delhi; 1967.
7. Burton GW, Dewane EM. Estimating heritability in tall fescue (Festuca circuclinaccae) from replicated clonal material. Agron. J. 1953;45:478-481.
8. Falconer DS, TFC Mackay. Introduction to quantitative genetics. 4th ed. Longmans Green, Harlow, Essex, UK; 1996.
9. Johnson HW, HF Robinson, Comstock RE. Estimation of Genetic variability and environmental variability in soybean. J. Agron. 1955;47:314-318.
10. Salahuddin S, Abro M, Kandhro M, Salahuddin L, Laghari S. Correlation and path coefficient analysis of yield components of upland cotton (*Gossypium hirsutum* (L.)) sympodial. World Appl. Sci. J. 2010;8:71-75.
11. Yadav M, Singh DB, Chaudhary R, Singh D. Genetic variability in bitter gourd

(*Momordica charantia* L.) J Hortl. Sci. 2008;3(1):35-38.

12. Singh SP, Kumar S, Singh SP. Genetic variability, correlation studies and path analysis in bitter gourd Momordica charantia L. New Agric. 2008;19(1/2):105-111.
13. Singh V, Rana DK, Shah KN. Evaluation of genetic diversity in bitter gourd (*Momordica charantia* L.) under subtropical conditions of Garhwal, Himalaya. Int. J. of Adv. Sci. Res. and Management. 2018;1.
14. Singh HK, Singh VB, Kumar R, Baranwal DK, Ray PK. Assessment of genetic diversity based on cluster and principal component analyses for yield and its contributing characters in bitter gourd. Indian Journal of Horticulture. 2014;71(1): 55-60.

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