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Evaluation of Monoecious and Gynoecious Bitter Gourd Genotypes for Yield Attributing Traits

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ABSTRACT: Analysis of variance revealed significant differences among the 56 germplasm lines for all the 20 characters indicating the presence of adequate variability among the germplasms. Mean values for all the studied characters were differ significantly, for flowering parameters the gynoecious line (ABG-DG-T-5) deviate significantly from other genotypes in a population. Highest number of fruits per vine noticed in ABG-DG-T-1 (27.55 cm) and lowest in ABG-WT-9 (7.02 cm) bitter gourd genotypes. Average fruit weight recorded higher magnitude of variation ranged from 16.79 g (ABG-DG- T-9) to 221.49 g (ABG-DG-T-1). The highest yield per vine observed in ABG-DG-T-1 followed by ABG-WT-1.

Keywords: Variance, Germplasm, Variability, Gynoecious and Bitter gourd.

INTRODUCTION

Bitter gourd is botanically known as *Momordica charantia* L. It's a herbaceous, tendril bearing vine with diploid chromosome number of 2n=2x=22. Bitter gourd is native to tropical and subtropical region of the Asia (Munro and Small 1997). In particularly, East India and south China. Bitter gourd (*Momordica charantia* L.) is a monoecious and cross pollinated crop with lot of variability, the chances of exploiting hybrid vigour are enormous. Information on various quantitative traits, particularly of those that contribute to yield will be most useful in planning and successful implementation of the breeding programme.

MATERIAL AND METHODS

Phenotypic variability is observable and includes both genotypic and environmental variation and therefore, also called total variation. Genotypic variation refers to genetic or inherent variability, which remains unaltered by environmental conditions. Environmental variance is measured in terms of error mean variance. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are derived from standard deviation divided by mean and are used to assess the extent of variation.

Experimental site: The experiment was conducted in the experimental plots of department of vegetable science and molecular characterization was did in central laboratory, Kittur Rani Channamma College of Horticulture (KRCCH) Arabhavi and College of Horticulture, Bagalkot, Karnataka.

Location and climate: Arabhavi is the place situated in northern dry zone of Karnataka. It is located at 74° 45′ E longitude 16° 15′N latitude, and at an altitude of 612.03 meter above mean sea level. Arabhavi, which lies under zone-3 among 10 agro-climatic zones of Karnataka. It has benefitted with both south-west and north-east monsoons. The average rainfall of this area is about 530.00 mm, distributed over a period of five to six months (June to November) with peaks during jully-august. The command area receives water from Ghataprabha River's left bank canal from mid-agust to mid-march. (Supplement data_1)

Variability and divergence studies in bitter gourd genotypes.

Total number of genotypes : 56
Replications : 2
Spacing : 1.2 m × 0.9 m
Design : RBD
Number of plants per row : 10 plants
Net plot size : 10.80 m^2

Maintenance of gynoecious line. The gynoecious lines were treated with two different growth chemicals *i.e.* Gibbrelic acid (GA) (1500 ppm), silver nitrate (250 ppm) at two and four leaf stage of crop for induction of staminate flowers Verma *et al*. (2018). Chemical solutions were prepared with sterilised distilled water and applied about 50 ml per plant with hand compressed spray. The induced staminate flowers were used for selfing with same plant female flower thus the gynoecius lines was maintained.

Observations recorded. Five randomly chosen plants in each replication of each entries were labelled and used for recording the observations. The mean of five plants was taken for analysis. The characters studied and techniques adopted to record the observations are given below.

Growth parameters

Vine length (m): The vine length was measured by using the thread from base to the growing tip of vine. The threads were knotted at one meter distance for convenience to measure using meter scale and expressed in meter. The observations were recorded at the time of final harvest.

Number of primary branches: Number of branches that have emerged from the main vine was counted from five labelled plants. The observations were recorded at 90 DAS.

Number of secondary branches: Number of branches that have emerged from the primary branches was counted from five labelled plants. The observations were recorded at 90 DAS.

Internodal length (cm): The internode length was measured by using small size scale of 15 cm length. The internode length was taken between 15^{th} to 20^{th} nodes of labelled five plants.

Flowering and earliness parameters

Days to first male flower open: The number of days taken from the date of sowing to the date of first male flower opening was counted.

Days to first female flower open: Number of days taken from the date of sowing to the date of first female flower opening was counted.

Nodes at first male flower appear: Number of nodes from base to the node at which first male flower appeared was counted.

Nodes at first female flower appear: Number of nodes from ground to the node at which first female flower appeared was counted.

Days to first harvest: Number of days taken for first harvesting from the date of sowing was counted.

Days from fruit set to maturity: Number of days taken from fruit set to fruit maturity (fully grown but tender) was counted by tagging five female flowers from each of five labelled plants and average was worked out.

Sex ratio: Total number of female and male flowers opened on labelled plants were counted by demarking with the help of black thread and observations recorded at every ten days intervals and cumulative number of male and female flowers worked out. Sex ratio was calculated by using the formula.

$$\text{Sex Ratio} = \frac{\text{Number of female flowers per vine}}{\text{Number of male flowers per vine}}$$

Yield parameters

Number of fruits per vine: Number of fruits per vine was calculated by totalling the number of fruits over all harvests added in all five tagged plants and average was worked out.

Average fruit weight (g): The weight of five randomly selected fruits at marketable stage between third and fourth picking were measured in grams and average was worked out.

Fruit length (cm): Randomly selected five matured fruits from each experimental plot were used for measuring the length of fruits at second picking from the base of stalk to tip of fruit at edible maturity stage.

Fruit girth (mm): Randomly selected five matured fruits from each experimental plot were used to measure the fruit girth at second picking by using the vernier calipers at the middle of the fruit.

Fruit yield per vine (kg): Fruit yield per vine was computed by adding the fruit weight of all the pickings of five tagged plants and mean value per plant was calculated and expressed in kilogram.

Fruit yield per plot (kg): The fruit yield per plot was computed by adding up all the harvested fruits of all the pickings in each treatment and expressed in kilogram.

Quality parameters

Rind thickness (mm): Rind thickness of the fruit was measured at marketable maturity stage from the outer side of the fruit rind to inner green side of the fruit near to the flesh after cutting the fruit at center and measured at five places of each fruit and each of the five fruits average was worked out and expressed in millimeters.

Flesh thickness (mm): The flesh thickness was recorded (mm) after cutting the fruit at the center and each of the five fruits average was worked out and expressed in millimeters.

Statistical and biometrical analysis

Estimation of genetic parameters

Genotypic and phenotypic variances

Genotypic and phenotypic variances were computed based on the expected mean sum of squares from the ANOVA.

Genotypic variance, $\sigma_g^2 = \sigma_p^2 + \sigma_e^2$

Where, σ_g^2 = Genotypic variance

σ_p^2 = Phenotypic variance

σ_e^2 = Environmental variance

Phenotypic variance, $\sigma_p^2 = \sigma_g^2 + \sigma_e^2$

Where, σ_p^2 = Phenotypic variance

σ_g^2 = Genotypic variance

σ_e^2 = Environmental variance

Phenotypic (PCV) and genotypic (GCV) coefficients of variations. Phenotypic and genotypic coefficients of variations were worked out as suggested by Burton and Devane (1953).

$$\text{PCV}\ (\%) = \sqrt{\frac{\text{Phenotypic variance}}{\text{Grand mean}}} \times 100$$

$$\text{GCV}\ (\%) = \sqrt{\frac{\text{Genotypic variance}}{\text{Grand mean}}} \times 100$$

PCV and GCV were classified as suggested by Burton and Devane (1953)

<10%	Low
10-20%	Moderate
>20%	High

Heritability. The broad sense heritability (h^2 bs) was estimated by following the procedure suggested by Weber and Moorthy (1952) as indicated here below

$$\text{Heritability} = \frac{\text{Vg}}{\text{Vp}} \times 100$$

Where, Vp is the phenotypic variance and Vg is the genotypic variance of respective trait.

Heritability percentage was categorized as suggested by Searle (1965) and is given below

<40%	Low
40-80%	Moderate
>80%	High

Genetic advance (GA): It was predicted by using the formula provided by Johnson *et al.* (1955).

$GA = h^2_{bs} \times \sigma p \times k$

Where, h^2_{bs} = Heritability in broad sense

σp = Phenotypic standard deviation of the trait

k = Standardized selection differential which is 2.06 at 5 per cent selection intensity

Genetic advance as per cent over mean (GAM): It is calculated by the formula as given below suggested by Weber and Moorthy (1952) as indicated here below

$$GAM\ (\%) = \frac{\text{Genetic advance}}{\text{General mean of the character}} \times 100$$

The genetic advance as per cent over mean was categorized as suggested by Johnson *et al.* (1955) and is given below

<10%	Low
10-20%	Moderate
>20%	High

RESULTS AND DISCUSSION

The findings of the study of variance for different quantitative characters for 56 bitter gourd genotypes were presented in Table 1. The analysis of variance in the evaluation programme in Randomized Block Design (RBD) and showed significant difference among the treatments for all the characters and results are furnished below. The results indicated that there were highly significant difference among 56 genotypes of bitter gourd.

The analysis of variance (Table 1) documented that extremely significant (both at p = 0.01 and p = 0.05) difference among the genotypes growth, flowering and yield parameters except fruit diameter (p = 0.05) in bitter gourd. It indicated that, enough genetic variability revealed for various characters in bitter gourd genotypes. Whereas, analysis of variance by itself not sufficient and conclusive to explain all the inherent genotypic variance in the genotypes. Variability can be estimated *via* a simple measure of variation (range). The range of variation marked for growth and yield characters in the current investigation indicated a sufficient degree of variations among various characters. The similar results were also documented by Pradhan *et al.* (2021); Adarsh *et al*. (2019); Chaudhary *et al*. (2019).

With a view to understand the extent of observed variation due to genetic factor, range, mean, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2), genetic advance (GA) and genetic advance as per cent of mean (GAM) were worked out and presented in Table 2 and 3. The data revealed the existence of large amount of variability in most of the character studied and also the magnitude of genotypic coefficient variance was smaller than phenotypic coefficient variance. In the current investigation, greater values of PCV and GCV were recognised for fruit length, mesocarp to pericarp ratio, average fruit weight and yield per vine. It indicates the existence of high variability which is amenable for further enhancement by selection. This results agree with earlier research conclusion of Talukder *et al*. (2018); Iqbal *et al*. (2016).

Table 1: Analysis of variance in bitter gourd genotypes (mean sum of squares) for yield and its attributing traits.

Sr. No.	Source of variations/characters	Replications	Treatments	Error	S.Em ±	CD (5%)	CD (1%)
	Degrees of freedom	1	55	55			
I	Growth parameters						
1.	Vine length (m)	0.001	0.53**	0.06	0.18	0.50	0.66
2.	Number of primary branches	3.16	9.06**	0.92	0.68	1.92	2.56
3.	Number of secondary branches	2.83	24.18**	3.63	1.35	3.82	5.08
4.	Internodal length (cm)	0.00	1.03**	0.19	0.31	0.87	1.15
II.	**Flowering and earliness**						
5.	Days to first male flower appear	100.70	88.73**	4.89	1.56	4.43	5.90
6.	Node at first male flower appear	0.57	5.24**	1.13	0.75	2.13	2.83
7.	Days to first female flower appear	240.14	26.08**	6.16	1.75	4.97	6.62
8.	Node at first female flower appear	63.00	4.60**	1.11	0.74	2.11	2.81
9.	Days to 50 per cent plants to flower	87.51	20.24**	3.54	1.33	3.77	5.02
10.	Sex ratio	49.69	29.13**	2.56	1.13	3.20	4.27
11.	Days to first harvest	149.50	25.73**	5.01	1.58	4.49	5.97
III.	**Yield parameters**						
12.	Fruit length (cm)	8.02	30.18**	3.21	1.27	3.59	4.78

13.	Fruit diameter (cm)	2.93	0.92*	0.07	0.19	0.54	0.72
14.	Pericarp thickness (mm)	0.00	0.03**	0.00	0.03	0.09	0.12
15.	Mesocarp weight (g)	555.23	2315.51**	76.69	6.19	17.55	23.37
16.	Pericarp weight (g)	0.10	26.67**	0.92	0.68	1.92	2.56
17.	Mesocarp : Pericarp	6.67	5.83**	1.10	0.74	2.10	2.80
18.	Number of fruits per vine	1.79	32.35**	4.43	1.49	4.22	5.61
19.	Average fruit weight (g)	560.99	2824.12**	86.03	6.56	18.59	24.75
20.	Yield per vine (Kg)	0.02	0.88**	0.04	0.14	0.39	0.52

** significant at 1% * significant at 5%

Table 2: Estimates of mean range, components of variance, heritability and genetic advance for yield and its attributing traits in bitter gourd.

Sr. No.	Characters	Grand mean	Range		Coefficient of variations (%)		h^2	GA	GAM
			Min.	Max.	GCV	PCV			
I.	**Growth parameters**								
1	Vine length	2.53	1.7	3.78	19.15	20.37	88.37	0.94	37.08
2	Internodal length (cm)	7.08	5.21	8.54	9.2	10.16	81.97	1.21	17.15
3	Number of primary branches per vine	12.51	8.7	17.2	16.13	17.02	89.86	3.94	31.5
4	Number of secondary branches per vine	25.45	19.4	34.1	12.6	13.66	85.01	6.09	23.93
II.	**Flowering and earliness**								
5	Days to firs male flower appear	42.22	0	51	15.33	15.77	94.49	12.96	30.71
6	Node at first male flower appear	8.31	0	12	17.26	19.48	78.53	2.62	31.51
7	Days to firs female flower appear	49.41	40.8	57.2	6.39	7.31	76.4	5.68	11.5
8	Node at first female flower appear	12.29	8.7	15.4	10.75	12.34	75.89	2.37	19.3
9	Days to 50 per cent plants to flower	46.03	40.5	53.5	6.28	6.91	82.54	5.41	11.75
10	Sex ratio	22.01	0	27.3	16.56	17.34	91.23	7.17	32.58
11	Days to first harvest	59.21	51.4	67	5.44	6.06	80.51	5.95	10.05
III.	**Yield parameters**								
12	Fruit length (cm)	15.36	7.02	27.55	23.91	25.29	89.37	7.15	46.55
13	Fruit diameter (cm)	3.52	2.21	5.23	18.51	19.29	92.15	1.29	36.61
14	Pericarp thickness (mm)	0.66	0.46	1.17	16.85	17.56	92.04	0.22	33.3
15	Mesocarp weight (g)	60.99	12.42	194.99	54.85	55.79	96.69	67.77	111.11
16	Pericarp weight (g)	8.6	3.67	25.38	41.7	42.44	96.55	7.26	84.42
17	Mesocarp : Pericarp	6.72	3.28	10.71	22.9	25.43	81.09	2.85	42.48
18	Number fo fruits per vine	20.25	11.42	26.8	18.45	19.86	86.32	7.15	35.31
19	Average fruit weight (g)	70.38	16.79	221.49	52.58	53.4	96.95	75.05	106.64
20	Yeild per vine (Kg)	1.33	0.41	3.12	48.9	50.01	95.64	1.31	98.52

GCV- Genotypic Coefficient Variation H2- Broad sense heritability
PCV- Phenotypic Coefficient Variation GA- Genetic Advance GAM- Genetic Advance over per cent mean

Table 3: *Per se* performance of bitter gourd genotypes for yield parameters.

Sr. No.	Treatments	Vine length (m)	Internode length (cm)	Primary branches	Secondary branches	Days to male flower
1	ABG-DG-T-1	3.78	7.43	17.10	34.10	45.30
2	ABG-DG-T-2	3.16	7.93	14.80	29.60	46.00
3	ABG-DG-T-3	2.60	6.63	12.20	26.30	42.80
4	ABG-DG-T-4	3.18	8.06	13.70	27.60	44.60
5	ABG-DG-T-5	2.73	7.57	12.20	22.40	0.00
6	ABG-DG-T-7	2.73	7.41	13.00	23.60	44.70
7	ABG-DG-T-9	1.82	6.40	9.90	19.50	39.00
8	ABG-DG-T-11	2.93	7.59	11.10	22.60	45.80
9	ABG-DG-T-12	1.90	6.70	11.00	19.40	41.80
10	ABG-DG-T-13	2.32	7.71	13.10	20.30	42.90
11	ABG-DG-T-14	2.01	7.29	11.00	24.40	42.50

12	ABG-DG-T-15	2.66	7.85	15.80	28.50	48.00
13	ABG-DG-T-16	2.83	7.55	14.30	28.00	46.00
14	ABG-DG-T-17	2.26	6.62	8.80	26.00	38.30
15	ABG-DG-T-18	2.43	6.96	11.80	20.90	37.80
16	ABG-DG-T-19	1.97	5.94	9.60	23.70	37.70
17	ABG-DG-T-20	2.43	5.72	9.00	20.30	45.70
18	ABG-DG-T-24	2.65	7.47	12.50	27.40	49.00
19	ABG-DG-S-1	3.30	8.54	12.20	28.90	46.90
20	ABG-DG-S-2	2.62	6.90	10.70	24.10	38.70
21	ABG-DG-S-3	3.59	8.29	17.20	30.00	47.40
22	ABG-DG-S-4	2.01	7.06	13.50	26.00	44.40
23	ABG-DG-S-5	1.71	6.58	12.90	20.90	41.20
24	ABG-DG-S-6	3.20	7.65	14.70	23.30	38.80
25	ABG-DG-S-7	2.70	7.70	15.70	28.90	40.00
26	ABG-DG-S-8	3.22	8.16	14.00	32.20	43.90
27	ABG-DG-S-9	2.55	7.13	13.40	27.20	43.60
28	ABG-DG-S-10	2.66	7.31	10.00	25.30	37.80
29	ABG-LG-S-1	2.67	6.51	11.30	22.90	47.50
30	ABG-LG-S-2	2.40	6.50	11.90	22.60	44.50
31	ABG-LG-S-3	2.59	6.94	12.30	25.90	46.70
32	ABG-LG-S-4	2.97	7.05	10.90	24.50	47.50
33	ABG-LG-S-5	3.00	7.45	13.40	26.30	51.00
34	ABG-LG-S-6	3.02	6.16	12.90	29.60	42.00
35	ABG-LG-S-7	1.77	6.70	10.40	22.30	37.20
36	ABG-WT-1	3.09	7.47	14.10	28.70	40.50
37	ABG-WT-2	3.15	6.74	13.60	28.20	41.70
38	ABG-WT-3	2.36	6.85	11.70	25.00	42.20
39	ABG-WT-4	1.70	6.11	10.10	20.60	41.50
40	ABG-WT-5	3.45	7.52	16.90	31.50	42.20
41	ABG-WT-6	2.53	8.25	15.40	30.10	44.00
42	ABG-WT-7	2.44	7.76	14.70	27.40	41.70
43	ABG-WT-8	2.35	6.23	12.00	24.20	39.70
44	ABG-WT-9	2.49	7.08	12.90	26.20	38.10
45	ABG-WT-10	2.08	6.16	8.70	26.00	42.90
46	ABG-WT-11	1.80	6.63	13.40	21.60	41.40
47	ABG-WT-12	1.78	5.21	12.40	21.80	38.70
48	ABG-WT-13	2.24	5.83	10.50	25.30	47.90
49	ABG-WT-14	1.82	5.86	11.90	25.80	40.20
50	ABG-LG-T-1	2.67	7.02	13.80	28.80	41.20
51	ABG-LG-T-2	2.61	7.44	9.90	21.00	43.30
52	ABG-LG-T-3	2.77	7.48	15.80	30.70	41.50
53	ABG-LG-T-4	1.85	7.47	12.80	27.20	46.00
54	ABG-LG-T-5	2.38	7.75	11.90	24.30	44.00
55	ABG-LG-T-6	2.26	7.36	10.20	22.50	48.60
56	ABG-LG-T-7	1.80	6.61	9.40	22.90	40.20
	Mean	**2.53**	**7.08**	**12.51**	**25.45**	**42.22**
	S.Em ±	0.18	0.31	0.68	1.35	1.56
	CD@5%	0.50	0.87	1.92	3.82	4.43
	CV	9.82	6.10	7.66	7.48	5.24

Table 3a: *Per se* performance of bitter gourd genotypes for yield parameters.

Sr. No.	Treatments	Node at male flower	Days to female flower	Node at female flower	Days to 50% flowering	Sex ratio (Male:Female)
1	ABG-DG-T-1	9.50	48.10	13.10	47.50	24.84
2	ABG-DG-T-2	12.00	48.80	15.40	48.50	23.99
3	ABG-DG-T-3	9.80	46.40	12.30	44.70	20.79
4	ABG-DG-T-4	7.60	52.10	11.70	47.25	24.49
5	ABG-DG-T-5	0.00	40.80	8.70	45.50	0.00
6	ABG-DG-T-7	9.20	52.40	14.70	47.85	25.58
7	ABG-DG-T-9	7.80	47.80	10.90	44.00	18.96
8	ABG-DG-T-11	9.70	50.60	11.60	48.50	21.86
9	ABG-DG-T-12	9.00	49.90	12.10	48.50	25.78
10	ABG-DG-T-13	7.60	51.00	13.30	46.10	21.78
11	ABG-DG-T-14	7.70	51.30	13.20	44.90	23.43
12	ABG-DG-T-15	9.10	54.70	14.40	50.50	17.80
13	ABG-DG-T-16	8.30	53.90	13.90	49.00	19.90

14	ABG-DG-T-17	7.90	49.90	10.90	42.20	27.30
15	ABG-DG-T-18	8.40	44.80	10.00	40.85	24.58
16	ABG-DG-T-19	7.70	43.50	10.60	40.50	24.49
17	ABG-DG-T-20	9.50	53.30	14.90	48.60	21.25
18	ABG-DG-T-24	9.50	57.20	12.50	52.50	26.47
19	ABG-DG-S-1	10.10	53.40	12.40	49.10	21.49
20	ABG-DG-S-2	6.90	43.80	10.50	41.20	22.49
21	ABG-DG-S-3	8.70	53.20	13.10	50.25	26.07
22	ABG-DG-S-4	7.90	48.90	15.10	47.25	19.65
23	ABG-DG-S-5	8.30	47.30	13.30	43.40	22.68
24	ABG-DG-S-6	5.90	45.60	11.10	42.25	22.70
25	ABG-DG-S-7	7.30	49.00	10.90	43.20	22.83
26	ABG-DG-S-8	7.80	50.00	13.10	46.50	21.21
27	ABG-DG-S-9	7.20	49.00	12.40	47.25	20.41
28	ABG-DG-S-10	6.00	47.10	10.50	40.60	22.86
29	ABG-LG-S-1	8.90	50.90	11.90	50.30	19.15
30	ABG-LG-S-2	8.30	49.30	11.50	47.00	21.74
31	ABG-LG-S-3	9.90	48.00	12.30	48.00	22.52
32	ABG-LG-S-4	8.70	52.00	11.70	49.80	22.80
33	ABG-LG-S-5	9.70	56.60	12.70	53.50	25.51
34	ABG-LG-S-6	7.70	44.70	10.90	44.10	18.71
35	ABG-LG-S-7	7.30	42.40	10.50	40.50	22.79
36	ABG-WT-1	7.20	47.20	11.80	43.80	18.59
37	ABG-WT-2	8.00	53.00	15.10	45.60	24.29
38	ABG-WT-3	8.70	53.40	12.40	45.40	17.73
39	ABG-WT-4	7.60	48.10	13.30	45.00	21.91
40	ABG-WT-5	9.60	49.60	11.60	45.45	20.88
41	ABG-WT-6	8.60	49.20	12.20	46.75	20.17
42	ABG-WT-7	9.00	51.80	14.60	49.50	19.46
43	ABG-WT-8	7.60	47.50	10.40	43.25	20.28
44	ABG-WT-9	8.80	45.30	10.30	41.90	21.86
45	ABG-WT-10	8.20	51.40	13.50	45.70	22.40
46	ABG-WT-11	7.80	46.90	11.80	44.90	19.49
47	ABG-WT-12	6.70	44.70	10.20	42.00	24.63
48	ABG-WT-13	10.30	55.70	15.10	50.65	22.54
49	ABG-WT-14	8.20	47.40	13.40	43.70	25.24
50	ABG-LG-T-1	7.30	47.30	11.70	43.70	20.10
51	ABG-LG-T-2	8.60	51.00	12.60	46.00	23.15
52	ABG-LG-T-3	8.70	49.30	11.00	44.70	24.27
53	ABG-LG-T-4	11.40	53.70	13.30	48.10	25.28
54	ABG-LG-T-5	9.20	49.50	12.70	46.80	22.72
55	ABG-LG-T-6	8.60	53.10	11.60	50.75	22.66
56	ABG-LG-T-7	8.40	44.20	11.30	42.60	26.40
	Mean	**8.31**	**49.41**	**12.29**	**46.03**	**22.01**
	S.Em ±	0.75	1.75	0.74	1.33	1.13
	CD@5%	2.13	4.97	2.11	3.77	3.20
	CV	12.77	5.02	8.57	4.08	7.26

Table 3b: *Per se* performance of bitter gourd genotypes for yield parameters.

Sr. No.	Treatments	Days to first harvest	Fruit length (cm)	Fruit diameter (cm)	Pericarp thickness (mm)	Mesocarp weight (g)
1	ABG-DG-T-1	58.30	27.55	4.90	1.17	194.99
2	ABG-DG-T-2	57.80	19.12	2.89	0.69	84.54
3	ABG-DG-T-3	56.20	21.39	3.05	0.73	79.69
4	ABG-DG-T-4	61.60	20.47	3.51	0.75	109.24
5	ABG-DG-T-5	51.40	15.19	3.40	0.64	72.40
6	ABG-DG-T-7	62.50	15.87	4.43	0.89	98.28
7	ABG-DG-T-9	58.20	14.71	4.03	0.51	12.45
8	ABG-DG-T-11	59.80	17.39	2.77	0.63	45.52
9	ABG-DG-T-12	59.00	14.89	3.20	0.46	38.20
10	ABG-DG-T-13	60.90	18.16	2.86	0.6	47.02
11	ABG-DG-T-14	62.70	12.39	3.41	0.73	43.66
12	ABG-DG-T-15	65.30	14.53	3.70	0.84	54.74
13	ABG-DG-T-16	65.10	11.96	3.38	0.51	46.39
14	ABG-DG-T-17	59.10	9.76	3.54	0.68	48.89

15	ABG-DG-T-18	53.70	12.45	3.90	0.7	48.97
16	ABG-DG-T-19	53.10	21.19	2.85	0.5	21.41
17	ABG-DG-T-20	61.90	12.92	3.22	0.54	25.60
18	ABG-DG-T-24	66.80	17.45	3.18	0.68	74.95
19	ABG-DG-S-1	63.00	16.58	2.69	0.69	48.45
20	ABG-DG-S-2	53.40	16.49	2.48	0.67	40.68
21	ABG-DG-S-3	61.90	16.93	3.85	0.78	106.24
22	ABG-DG-S-4	57.80	17.11	2.64	0.64	29.76
23	ABG-DG-S-5	56.30	13.28	2.87	0.77	42.62
24	ABG-DG-S-6	55.20	19.95	5.23	0.76	99.42
25	ABG-DG-S-7	58.70	12.64	4.96	0.63	94.73
26	ABG-DG-S-8	59.00	15.88	3.20	0.75	88.97
27	ABG-DG-S-9	60.00	13.47	3.51	0.58	50.73
28	ABG-DG-S-10	56.50	15.66	3.91	0.7	89.81
29	ABG-LG-S-1	60.10	13.01	3.13	0.59	58.80
30	ABG-LG-S-2	58.70	14.06	2.52	0.65	43.48
31	ABG-LG-S-3	57.40	10.87	4.50	0.65	69.93
32	ABG-LG-S-4	61.10	16.84	3.50	0.62	97.29
33	ABG-LG-S-5	67.00	20.55	4.25	0.78	101.15
34	ABG-LG-S-6	53.50	18.20	3.96	0.72	74.73
35	ABG-LG-S-7	53.70	13.75	2.21	0.55	18.62
36	ABG-WT-1	57.20	18.89	4.29	0.89	106.52
37	ABG-WT-2	62.70	12.81	3.68	0.63	56.80
38	ABG-WT-3	63.40	14.47	3.68	0.71	61.78
39	ABG-WT-4	58.20	10.45	4.76	0.55	20.39
40	ABG-WT-5	60.20	15.29	3.90	0.71	81.32
41	ABG-WT-6	58.10	11.56	3.81	0.63	54.02
42	ABG-WT-7	60.50	19.60	4.22	0.61	94.53
43	ABG-WT-8	58.20	12.10	3.10	0.5	12.42
44	ABG-WT-9	55.70	7.02	3.54	0.53	32.63
45	ABG-WT-10	61.90	7.71	3.38	0.5	20.28
46	ABG-WT-11	56.20	17.63	3.01	0.62	16.72
47	ABG-WT-12	54.60	8.77	3.17	0.6	19.94
48	ABG-WT-13	64.50	19.24	4.50	0.67	95.05
49	ABG-WT-14	58.50	11.00	2.71	0.64	29.99
50	ABG-LG-T-1	58.20	17.79	4.27	0.77	86.90
51	ABG-LG-T-2	62.20	16.78	3.46	0.64	43.78
52	ABG-LG-T-3	59.70	17.80	3.19	0.71	74.76
53	ABG-LG-T-4	63.00	21.22	3.47	0.72	96.62
54	ABG-LG-T-5	59.20	13.81	2.59	0.64	35.73
55	ABG-LG-T-6	62.50	10.82	3.70	0.65	30.93
56	ABG-LG-T-7	54.50	12.94	3.10	0.62	42.29
	Mean	**59.21**	**15.36**	**3.52**	**0.66**	**60.99**
	S.Em+	1.58	1.27	0.19	0.03	6.19
	CD@5%	4.49	3.59	0.54	0.09	17.55
	CV	3.78	11.66	7.64	7.01	14.36

Table 3c: *Per se* performance of bitter gourd genotypes for yield parameters.

Sr. No.	Treatments	Pericarp weight (g)	Mesocarp : Pericarp	Number of fruits	Average fruit weight	Yield/ vine (kg)
1	ABG-DG-T-1	25.38	7.74	15.50	221.49	3.12
2	ABG-DG-T-2	12.30	7.00	17.60	97.42	1.72
3	ABG-DG-T-3	10.31	7.72	24.10	90.93	2.06
4	ABG-DG-T-4	13.32	8.23	18.50	123.42	2.24
5	ABG-DG-T-5	8.08	9.05	21.20	81.26	1.41
6	ABG-DG-T-7	13.28	7.39	15.00	112.48	1.93
7	ABG-DG-T-9	3.67	3.36	25.00	16.79	0.50
8	ABG-DG-T-11	6.39	7.10	20.10	52.78	1.05
9	ABG-DG-T-12	6.54	5.83	18.03	45.67	0.60
10	ABG-DG-T-13	8.60	5.46	21.40	56.36	1.15
11	ABG-DG-T-14	7.19	6.07	16.10	51.72	0.79
12	ABG-DG-T-15	8.16	6.70	25.30	63.61	1.55
13	ABG-DG-T-16	7.26	6.36	26.40	54.35	1.44
14	ABG-DG-T-17	8.42	5.86	12.50	57.96	0.73
15	ABG-DG-T-18	7.35	6.58	15.90	57.13	0.80
16	ABG-DG-T-19	4.73	4.50	14.80	26.86	0.41

17	ABG-DG-T-20	5.70	4.45	22.00	31.95	0.74
18	ABG-DG-T-24	9.01	8.32	12.50	84.80	1.03
19	ABG-DG-S-1	6.89	6.99	23.20	56.05	1.28
20	ABG-DG-S-2	6.06	6.68	19.90	47.50	0.93
21	ABG-DG-S-3	16.02	6.63	16.30	123.00	2.01
22	ABG-DG-S-4	7.42	4.05	26.20	37.99	1.00
23	ABG-DG-S-5	7.72	5.49	17.90	50.93	0.83
24	ABG-DG-S-6	12.73	7.82	22.00	113.11	2.20
25	ABG-DG-S-7	11.05	8.56	17.50	106.85	1.79
26	ABG-DG-S-8	9.38	9.58	23.30	98.83	2.10
27	ABG-DG-S-9	8.04	6.28	26.40	59.44	1.53
28	ABG-DG-S-10	11.04	8.17	16.80	101.79	1.75
29	ABG-LG-S-1	8.00	7.43	25.90	67.73	1.75
30	ABG-LG-S-2	7.16	6.05	23.70	51.39	1.17
31	ABG-LG-S-3	8.47	8.27	23.20	78.93	1.48
32	ABG-LG-S-4	12.12	8.02	19.20	110.23	2.07
33	ABG-LG-S-5	12.67	7.98	17.60	114.72	2.04
34	ABG-LG-S-6	9.65	7.73	26.80	85.25	2.12
35	ABG-LG-S-7	5.70	3.28	19.90	24.81	0.54
36	ABG-WT-1	12.88	8.27	26.30	120.17	2.92
37	ABG-WT-2	7.67	7.50	16.80	65.21	1.00
38	ABG-WT-3	9.65	6.55	18.90	72.32	1.32
39	ABG-WT-4	4.02	5.13	22.80	25.00	0.55
40	ABG-WT-5	9.44	8.61	24.80	91.77	2.15
41	ABG-WT-6	7.54	7.21	24.30	62.46	1.55
42	ABG-WT-7	9.45	10.04	11.42	104.55	1.14
43	ABG-WT-8	3.76	3.28	22.40	16.86	0.44
44	ABG-WT-9	5.84	5.61	18.55	39.11	0.74
45	ABG-WT-10	4.39	4.60	20.90	25.43	0.55
46	ABG-WT-11	3.83	4.44	25.90	20.95	0.56
47	ABG-WT-12	4.57	4.33	18.80	25.22	0.55
48	ABG-WT-13	13.24	7.17	22.30	109.13	2.28
49	ABG-WT-14	5.49	5.45	17.30	36.14	0.60
50	ABG-LG-T-1	11.51	7.55	24.30	99.14	2.21
51	ABG-LG-T-2	6.81	6.39	19.40	51.42	0.88
52	ABG-LG-T-3	8.08	9.40	17.10	83.55	1.35
53	ABG-LG-T-4	9.07	10.71	15.90	106.22	1.44
54	ABG-LG-T-5	6.03	5.91	20.20	42.74	0.87
55	ABG-LG-T-6	6.42	4.81	22.00	38.13	0.76
56	ABG-LG-T-7	6.49	6.48	16.00	50.12	0.75
	Mean	**8.60**	**6.72**	**20.25**	**70.38**	**1.33**
	S.Em+	0.68	0.74	1.49	6.56	0.14
	CD@5%	1.92	2.10	4.22	18.59	0.39
	CV	11.14	15.64	10.39	13.18	14.77

Table 3d: *Per se* performance of bitter gourd genotypes for yield parameters.

Sr. No.	Treatments	Pericarp weight (g)	Mesocarp : Pericarp	Number of fruits	Average fruit weight	Yeled/ vine (kg)
1	ABG-DG-T-1	25.38	7.74	15.50	221.49	3.12
2	ABG-DG-T-2	12.30	7.00	17.60	97.42	1.72
3	ABG-DG-T-3	10.31	7.72	24.10	90.93	2.06
4	ABG-DG-T-4	13.32	8.23	18.50	123.42	2.24
5	ABG-DG-T-5	8.08	9.05	21.20	81.26	1.41
6	ABG-DG-T-7	13.28	7.39	15.00	112.48	1.93
7	ABG-DG-T-9	3.67	3.36	25.00	16.79	0.50
8	ABG-DG-T-11	6.39	7.10	20.10	52.78	1.05
9	ABG-DG-T-12	6.54	5.83	18.03	45.67	0.60
10	ABG-DG-T-13	8.60	5.46	21.40	56.36	1.15
11	ABG-DG-T-14	7.19	6.07	16.10	51.72	0.79
12	ABG-DG-T-15	8.16	6.70	25.30	63.61	1.55
13	ABG-DG-T-16	7.26	6.36	26.40	54.35	1.44
14	ABG-DG-T-17	8.42	5.86	12.50	57.96	0.73
15	ABG-DG-T-18	7.35	6.58	15.90	57.13	0.80
16	ABG-DG-T-19	4.73	4.50	14.80	26.86	0.41
17	ABG-DG-T-20	5.70	4.45	22.00	31.95	0.74
18	ABG-DG-T-24	9.01	8.32	12.50	84.80	1.03

19	ABG-DG-S-1	6.89	6.99	23.20	56.05	1.28
20	ABG-DG-S-2	6.06	6.68	19.90	47.50	0.93
21	ABG-DG-S-3	16.02	6.63	16.30	123.00	2.01
22	ABG-DG-S-4	7.42	4.05	26.20	37.99	1.00
23	ABG-DG-S-5	7.72	5.49	17.90	50.93	0.83
24	ABG-DG-S-6	12.73	7.82	22.00	113.11	2.20
25	ABG-DG-S-7	11.05	8.56	17.50	106.85	1.79
26	ABG-DG-S-8	9.38	9.58	23.30	98.83	2.10
27	ABG-DG-S-9	8.04	6.28	26.40	59.44	1.53
28	ABG-DG-S-10	11.04	8.17	16.80	101.79	1.75
29	ABG-LG-S-1	8.00	7.43	25.90	67.73	1.75
30	ABG-LG-S-2	7.16	6.05	23.70	51.39	1.17
31	ABG-LG-S-3	8.47	8.27	23.20	78.93	1.48
32	ABG-LG-S-4	12.12	8.02	19.20	110.23	2.07
33	ABG-LG-S-5	12.67	7.98	17.60	114.72	2.04
34	ABG-LG-S-6	9.65	7.73	26.80	85.25	2.12
35	ABG-LG-S-7	5.70	3.28	19.90	24.81	0.54
36	ABG-WT-1	12.88	8.27	26.30	120.17	2.92
37	ABG-WT-2	7.67	7.50	16.80	65.21	1.00
38	ABG-WT-3	9.65	6.55	18.90	72.32	1.32
39	ABG-WT-4	4.02	5.13	22.80	25.00	0.55
40	ABG-WT-5	9.44	8.61	24.80	91.77	2.15
41	ABG-WT-6	7.54	7.21	24.30	62.46	1.55
42	ABG-WT-7	9.45	10.04	11.42	104.55	1.14
43	ABG-WT-8	3.76	3.28	22.40	16.86	0.44
44	ABG-WT-9	5.84	5.61	18.55	39.11	0.74
45	ABG-WT-10	4.39	4.60	20.90	25.43	0.55
46	ABG-WT-11	3.83	4.44	25.90	20.95	0.56
47	ABG-WT-12	4.57	4.33	18.80	25.22	0.55
48	ABG-WT-13	13.24	7.17	22.30	109.13	2.28
49	ABG-WT-14	5.49	5.45	17.30	36.14	0.60
50	ABG-LG-T-1	11.51	7.55	24.30	99.14	2.21
51	ABG-LG-T-2	6.81	6.39	19.40	51.42	0.88
52	ABG-LG-T-3	8.08	9.40	17.10	83.55	1.35
53	ABG-LG-T-4	9.07	10.71	15.90	106.22	1.44
54	ABG-LG-T-5	6.03	5.91	20.20	42.74	0.87
55	ABG-LG-T-6	6.42	4.81	22.00	38.13	0.76
56	ABG-LG-T-7	6.49	6.48	16.00	50.12	0.75
	Mean	**8.60**	**6.72**	**20.25**	**70.38**	**1.33**
	S.Em+	0.68	0.74	1.49	6.56	0.14
	CD@5%	1.92	2.10	4.22	18.59	0.39
	CV	11.14	15.64	10.39	13.18	14.77

CONCLUSIONS

The characters showing higher additive variance among yard bitter gourd genotypes suggest that the genetic improvement of such traits could be achieved through selection by using the existing genotypes for those traits that exhibits higher variability. ABG-DG-T-5 can be used as gynoecy donor parent in hybridization with high yielding variety for development of high yielding with more number of fruits per vine. The highest yield per vine observed in ABG-DG-T-1 followed by ABG-WT-1. Moreover, this trait is highly influenced by additive gene action and selection could be effective.

FUTURE SCOPE

One or two cycles of biparental mating with a selection of desirable genotypes in advanced segregating generations by evaluating a large number of families and followed by recurrent selection needs to be practiced for dissipating dominance and enhancing the frequency of genes with increasing effects on the expression of gynoecy.

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Conflict of Interest. None.

REFERENCES

Adarsh, A., Kumar, R., Bhardwaj, A. and Chaudhary, H. C. (2019). Correlation matrix study in bitter gourd for qualitative and quantitative traits. *J. pharmacogn. phytochem., 8*(3), 3023-3027.

Burton, G. W. and Devane, D. E. (1953). Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *J. Agron., 45*(10), 478-481.

Chaudhary, I. J., Singh, V., Rana, D. K. and Shah, K. N. (2019). Assessment of Heritability, Genetic Advancement and Yield of Bitter Gourd under Garhwal Region. *Int. J. Sci. Res., 8*(2), 205-213.

Iqbal, M., Munawar, M., Najeebullah, M. and Din, A. (2016) Assessment of genetic diversity in bitter gourd. *Int. J. Veg. Sci., 22*(6), 578-584.

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

Munro, D. B. and Small, E. (1997). *Vegetables of Canada*. NRC Research Press.

Pradhan, P., Tripathy, P., Sahu, G. S., Tripathy, B. and Sourabh, S. (2021). Assessment of genetic variability in F4 segregating population of bitter gourd (*Momordica charantia* L.). *J. pharmacogn. phytochem., 10*(2), 1452-1455.

Searle, S. R. (1965). The value of indirect selection in mass selection. *Biometrics*, *21*, 682-707.

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. Med. Sci.*, *1*(6), 9-18.

Verma, N., Kumar, R. and Kaur, J. (2018). Maintenance of Gynoecious Lines of Cucumber through Modification of Sex Expression using Gibberellic Acid, Silver Nitrate and Silver Thiosulphate in Cucumber (*Cucumis sativus* L.). *Int. J. Curr. Microbiol. App. Sci.*, *7*(8), 320-328.

Weber, C. R. and Moorthy, B. R. (1952). Heritable and non-heritable Relationships and Variability of Oil Content and Agronomic Characters in the F_2 Generation of Soybean Crosses. *J. Agron.*, *44*(4), 202-209.

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