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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN SOME STRAINS OF BITTER GOURD (*MOMORDICA CHARANTIA* L.) UNDER SUBTROPICAL CONDITIONS OF GARHWAL HIMALAYA

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Abstract

The present research work was conducted at the Horticultural Research Centre, H. N. B University, Srinagar Garhwal, Uttarakhand (India) during 2014 in summer season and evaluated twenty strains. The main focus of this field trail was to estimate the component of variance, phenotypic and genotypic coefficient, heritability and genetic advance over mean for different growth, yield and quality parameters. The maximum difference between PCV and GCV was reported for fruit yield per vine, while the other traits showed moderate to low PCV and GVC with very less difference between them. This indicated the influence of environmental factors on these parameters is very negligible. The maximum traits showed high to moderate heritability coupled with high to moderate genetic advance over mean except total soluble solids. This indicated these traits are suitable for direct selection and improvement.

Key words : Bitter gourd, genetic stock, genetic advance, yield and quality parameters.

Introduction

Bitter gourd (*Momordica charantia* L.) is one of the most important cucurbitaceous crop belongs to the family cucurbitaceae with 2n= 2x=22. It is a large genus with many species of annul and perennial climber. Bitter gourd is a highly cross pollinated due to their moniceous nature. Bitter gourd uses as boiled, curried, stuffed or sliced and fried and can also be pickled, canned and dehydrated and also rich in medicinal properties like, purgative, carminative and anti-diabetic etc. (Singh *et al.,* 2016). The fruit acts as an anthelmintic, stomachic, antibilious and laxative. In fact, it is a tonic fruit, used in rheumatism, gout and also for diabetes. A decoction of the root extract is helpful in abortion, hemorrhoids and also in biliaesness (Khulakpam *et al*., 2015). The fruit yield is the main factor for determining improvement of a crop. Similarly yield in bitter gourd, is a quantitative trait that highly influenced by other yield related parameters. The selection of desirable types should be based on yield as well as on other yield attributing traits. The information on mutual association between yield and yield related attributing traits is very vital for efficient utilization of available genetic stock in crop improvement programme of bitter gourd. Yield in bitter gourd is a complex trait which influenced by several traits like, number of primary branches per vine, number of nodes per vine, sex ratio, number of fruits per vine and average fruit weight is a main factors. Heritability indicates how much of phenotypic variability has a genetic origin and gives objective information for the genetic selection process. For any planned breeding programme aimed to improve yield potentials of crops, so it is necessary to obtain adequate information on the magnitude and type of genetic variability and their corresponding heritability. The role of genetic variability in a crop is of paramount importance in selecting the best genotypes for making rapid improvement in yield and related characters as well as to select most potential parents for making the hybridization programme successful (Naseeruddin *et al*., 2011 and Singh *et al.,* 2014). This is because selection of superior genotypes is proportional to the amount of genetic variability present and extent to which the traits are heritable. The selection efficiency is increases, if the traits are selected the basis of high heritability with coupled to high genetic advance over mean. The magnitudes of such estimates also suggests to extent to which improvement

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is possible through selection. This present study was undertaken to estimates the component of variance, heritability and genetic advance over mean.

Materials and Methods

The present investigation was conducted at Horticultural Research Centre, Department of Horticulture, H.N.B. University Srinagar, Garhwal, Uttarakhand (India). The experimental materials comprised of 20 strains of bitter gourd *viz.,* GP-1, HP-1, HP-2, JP-1, KVS-7, MN-1, MP-1, PDM, PSPB-14, RAJ-1, RAJ-2, VRBTG-1, VRBTG-2, VRBTG-3, VRBTG-4, VRBTG-5, VRBTG-6, VRBTG-7, VRBTG-8 and VRBTG-9 collected from different parts of India. The experiment was laid out in a Randomized Block Design with three replications. The seeds were sown in the nursery bed on February 15th and transplanting was done in 28 March 2014. All the recommended agronomic package of practices was followed. The observation were recorded on five randomly selected plants per treatment from each replication for 19 quantitative and qualitative traits, *viz.,* days to first seed germination, germination rate, length of vine, number of primary branches per vine, leaf area (cm^2), days to opening of first male and female flower, number of nodes bearing first male and female flower, percent of fruit setting, number of fruit per vine, fruit length (cm), fruit diameter (cm), average fruit weight (g), fruit yield per vine, days to first fruit harvest, duration of harvesting, ascorbic acid and total soluble solids (^{o}Brix). Analysis of variance was done by method suggested by Panse and Sukhatme (1985). The genotypic and phenotypic coefficients of variation were calculated using the formulae of Burton and De Vane (1953). The heritability and genetic advance were calculated according to Allard (1960) and genetic advance as per cent of mean was estimated using the method of Johnson *et al.* (1955).

Results and Discussion

Variability parameters

Analysis of variance as shown in table 1 revealed significant differences among the strains for almost all the characters except total soluble solids studies indicating presence of significant variability in the materials which can be exploited through selection. The extent of variability with respect to growth, yield and quality parameters were estimates in term of mean performance of phenotypic coefficient variation (PCV) genotypic coefficient of variation (GCV), heritability, genetic advance and genetic advance over mean are given in table 2. The success of breeding programme depends upon quantum of variability present in available strains. In present investigation, highest genotypic and phenotypic variance, respectively were recorded for vine length (2422.70 and 2423.83) followed by fruit weight (387.79 and 387.88), harvesting duration (66.92 and 68.68) and leaf area (159.92 and 159.97), whereas the lowest for germination rate (0.15 and 0.25). All the traits recorded high phenotypic variances compression to genotypic variances, which is indication of strong influences of environmental factors for their expression. These findings are in accordance with the findings of Sahni *et al*. (1987), Dahiya *et al*. (1989), Prasad and Singh (1992) and Choudhary *et al*. (2008).

A better idea can be gained by comparing the relative amount of coefficient of phenotypic and genotypic variance for the actual strength of variability. The magnitude of phenotypic coefficient variation (PCV) were higher than genotypic coefficient of variation (GCV) for almost all the traits studies which is an indicator of additive gene effects on the expression of the trait. The difference between phenotypic and genotypic coefficient of variations were very less. This indicates the low impact of environment on the expression of traits and hence, they could be improve by following different phenotypic selections like, directional, disruptive and stabilized selections. The fruit yield per vine (33.95 and 33.96) reported higher magnitude of GCV and PCV respectively, indicating higher variability for this trait. The moderate GCV and PCV were recorded for vine length (17.31 and 17.32), number of primary branches per vine (15.90 and 16.30), fruit length (25.82 and 25.84), fruit weight (26.85 and 26.85) and fruit diameter (23.74 and 23.81). Similar findings have also been reported by Singh and Kumar (2002), Kutty and Dharmatti (2004) and Afangideh and Uyoh (2007).

The low GCV and PCV were observed for days taken to opening of first male flower (9.76 and 9.81), days taken to opening of first female flower (9.65 and 9.70), number of nodes bearing first male flower (11.73 and12.95), number of nodes bearing first female flower (11.30 and 11.79), percent of fruit setting (5.82 and 5.88), days to first fruit harvest (10.99 and 11.01), number of fruit per vine (11.74 and 11.75), ascorbic acid (10.56 and 10.68) and total soluble solid (5.72 and 8.94). Similar results were reported by Reshmi (2006), Arunkumar *et al.* (2011) and Veena *et al.* (2012).

Heritability and genetic advance

Heritability and genetic advance according to Johnson *et al.* (1955) and Panse (1957) with the help of GCV and PCV alone, it is not possible to determine the amount of variation, which is heritable. The heritability

Table 1 : Analysis of variance for 19 different characters in bitter gourd genotypes.

S. no.	Source of variance	Mean sum of square		
		Replication	Treatment	Error
	Degree of freedom	**2**	**19**	**38**
1.	**Days to first seed germination.**	4.116	9.757**	1.555
2.	**Germination rate**	0.005	0.555**	0.103
3.	**Length vine (cm)**	1.597	7269.234**	1.211
4.	**Number of primary branches per vine**	0.0644	5.821**	0.097
5.	**Leaf area (cm^2)**	0.029	479.812**	0.0562
6.	**Days taken to opening of first male flower**	1.248	111.142**	0.401
7.	**No. nodes bearing first male flower**	0.076	3.366**	0.227
8.	**Days taken to opening of first female flower**	1.009	124.822**	0.400
9.	**No. of nodes bearing first female flower**	0.047	7.194**	0.206
10.	**Percent of fruit setting**	0.028	73.911**	0.488
11.	**Days to first fruit harvest**	0.320	235.924**	0.266
12.	**No. of fruits per vine**	0.048	67.143**	0.018
13.	**Fruit length (cm)**	0.009	59.852	0.029
14.	**Fruit diameter (cm)**	0.016	2.880**	0.005
15.	**Fruit weight (g)**	0.0752	1163.461**	0.092
16.	**Fruit yield per vine (kg)**	0.0003	2.295**	0.0002
17.	**Duration of harvesting**	5.049	202.522**	1.751
18.	**Vitamin C (mg/ 100g)**	3.097	253.695**	1.982
19.	**T.S.S. (^{0}Brix)**	0.025	0.421**	0.136

** Significant at 1% level.

along with genetic advance is more meaningful and helps in predicating the resultant effect of selection on phenotypic expression. In present research work, almost all traits showed high heritability, the frequency of heritability ranged from 82% to 100% indicating that these traits are controlled by additive gene action. The high magnitude of heritability estimates in broad sense indicated that sustainable improvement can be made using standard selection procedure. The traits like, days to first seed germination and germination rate showed moderate heritability, while total soluble solid recorded low heritability. Similar results were reported by Dhiman and Prakash (2005), Kumar *et al.* (2008), Singh *et al.* (2012) and Kumar *et al.* (2013).

In the present research work, the resemblance in the magnitude of heritability and genetic advance over mean in almost all the traits. Similar results were also obtained by Hanchinamani *et al.* (2011) and Mandal *et al.* (2015) for number of primary branch per vine, number of nodes bearing first male and female flower, days to first fruit harvest, fruit length, fruit diameter, average fruit weight, number of fruit per vine and total fruit yield per vine indicating that simple selection based on phenotypic performance of these traits may be effective to improve.

However, the estimates of high heritability accompanied with moderate genetic advance over mean were recorded for days taken to opening of first female flower, percent of fruit setting and harvesting duration reported that the existing variability among the strains with respect of these traits is mainly due to additive type of gene action, so there is an ample scope for direct selection for these traits and also can be improve through mass selection. The results are in line with the findings of Kumar *et al.* (2011) and Arunkumar *et al.* (2011).

The moderate heritability accompanied with high genetic advance over mean were observed for days to first seed germination and germination rate which revealed the additive gene effects coupled with high environmental impact on these traits, so selected wound not be effective. The low heritability with low expected genetic advance as percent of mean was reported for T.S.S, which is highly influenced by environmental factors and controlled by non-additive gene thus, limits the chances of improvement of this trait through direct selection. Hence, heterosis breeding would be rewarding.

Table 2 : Estimation of genotypic and phenotypic variance, genotypic and phenotypic coefficient of variability, heritability, genetic advance and genetic advance over mean for twenty traits in bitter gourd.

S. no.	Characters	Mean	Variance		Coefficient of variance (%)		Heritability H^2 (%)	Genetic advance (GA)	Genetic advance over mean GAM (%)
			GV	PV	GCV	PCV			
1.	Days to first seed germination	11.77	2.73	4.29	14.05	17.60	0.64	2.72	23.11
2.	Germination rate	2.77	0.15	0.25	14.02	18.21	0.59	0.62	22.23
3.	Length vine (cm)	284.29	2422.70	2423.83	17.31	17.32	1.00	101.37	35.66
4.	Number of primary branches per vine	8.69	1.91	2.01	15.90	16.30	0.95	2.78	31.96
5.	Leaf area (cm^2)	109.64	159.92	159.97	11.53	11.54	1.00	26.05	23.76
6.	Days Taken to opening of first male flower	62.24	36.91	37.31	9.76	9.81	0.99	12.45	20.00
7.	No. nodes bearing first male flower	8.72	1.05	1.27	11.73	12.95	0.82	1.91	21.90
8.	Days taken to opening of first female flower	66.73	41.47	41.78	9.65	9.70	0.99	13.20	19.79
9.	No. nodes bearing first female flower	13.51	2.33	2.54	11.30	11.79	0.92	3.01	22.30
10.	Percent of fruit setting	84.94	24.47	24.96	5.82	5.88	0.98	10.09	11.88
11.	Days to first fruit harvest	80.64	78.55	78.82	10.99	11.01	1.00	18.23	22.60
12.	Number of fruits per vine	40.28	22.37	22.39	11.74	11.75	1.00	9.74	24.18
13.	Fruit length (cm)	17.29	19.94	19.97	25.82	25.84	1.00	9.19	53.15
14.	Fruit diameter (cm)	4.12	0.96	0.96	23.74	23.81	0.99	2.01	48.77
15.	Fruit weight (g)	73.34	387.79	387.88	26.85	26.85	1.00	40.56	55.30
16.	Fruit yield per vine (kg)	2.58	0.76	0.77	33.95	33.96	1.00	1.80	69.93
17.	Duration of harvesting	86.06	66.92	68.68	9.51	9.63	0.97	16.64	19.33
18.	Vitamin C (mg/ 100g)	86.73	83.90	85.89	10.56	10.68	0.98	18.65	21.50
19.	T.S.S.	5.39	0.09	0.23	5.72	8.94	0.41	0.41	7.54

Conclusion

From the above results obtained under the present investigation, it can be concluded that the strains had high amount of genetic variability that indicated good scope for selection in order to develop superior strains through direct selection for most of the traits. Heritability and genetic advance over mean showed that vine length, number of primary branches per vine, number of nodes bearing first male and female flower, days taken to opening of male and female flower, days taken to first fruit harvest, number of fruit per vine, fruit length, fruit diameter, fruit weight, fruit yield per vine, vitamin C and TSS are important characters that could be improved through direct selection.

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