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Genetic variability and heritability for quantitative characters in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) for rainfed system

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Abstract

The study was carried out on twenty genotypes of bottle gourd collected from diversified areas of the country assessed under rainfed condition for genetic variability, heritability and genetic advance in respect of 16 quantitative characters. The genotype LS-6 recorded the highest fruit yield per plant, highest no of fruits per plant lowest sex ratio and highest fruit set percent, followed by LS-20. The phenotypic and genotypic coefficient of variation for different characters ranged from 6.270-34.045 and 3.749-30.732 respectively. The highest PCV and GCV were observed for fruit yield per plant, fruit length, no. of fruits per plant and sex ratio indicating the extent of variability based in these characters. High heritabilty coupled with higher genetic gain was observed for no. of seed per fruit, fruit length, no. of fruits per plant and yield per plant indicating the additive gene action. Days to first fruit harvest showed moderate to low heritability with low genetic gain expressed non -additive gene action governing these characters.

Keyword: *Heritability, bottle gourd, PCV, GCV*

Introduction

Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) is an important vegetable crop among cucurbitaceous vegetable grown in the country . It is grown in an area of 1.17 lakh ha with a production of 14,28,296 M.T. and productivity of 12.21 t/ha. (Sidhu, 2002). Although the crop is cultivated widely in large part of the country, the productivity varies from season to season and region to region ie. hot arid (Samadia, 2002) to coastal region (Karuppaiah *et al.*, 2002) in cucurbit crops, especially the areas like zero irrigation ie rain fed ecosystem where the crop faces water stress during flowering and late fruit development stages due to inadequate soil moisture leads to higher loss in marketable fruits. Thus there is a need to identify stable varieties for a particular region and location. Rios Labrada *et al.* (1998) studied the role of pumpkin land races for tolerance to marginal condition characterized by drought, high temperature and biotic stress interactions. Such information's are lacking in bottle gourd. Hence, screening of germplasm is essential to select best genotypes for commercial exploitation for zero irrigation areas. As the success of any breeding programme is to pickup desirable genotypes based in the wide genetic base and the larger genetic variability resulting from it, the present study was undertaken to study the extend of variability and heritability with respect to yield and yield components to identify best genotypes adapted to zero irrigation areas.

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Materials and Methods

The present study was conducted at Central Horticultural Experiment Station, Vejalpur, Gujarat comprising twenty diversified genotypes collected from different parts of the country. The genotypes were assessed in the field experiment under randomized block design replicated thrice. Six plants were maintained in each replication spaced at 3.0 x 1.5m between rows and plants, respectively. Cultural practices including need based plant protective measures were followed. The data was recorded from five randomly selected plants from each genotypes in each replication for main vine length (m), no. of primary branches, internode length (cm), days to first female flower anthesis (days) , node of first female flowers appears, sex ratio, days to first fruit harvest (days), Fruit set (%), no. of fruits per plant, yield per plant (kg), fruit weight (kg), fruit length (cm), fruit girth (cm), fruit flesh thickness (cm), 100 seed weight (g), no. of seed per fruit. The mean data were subjected for statistical analysis as per method of analysis of variance (Panse and Sukhatme, 1961), estimation of variance components and coefficient of variation (Johnson *et al.*, 1955) and heritability in broad sense and genetic advance as percent mean (Robinson *et al.*, 1949)

Results and Discussion

The extent of variability present in germplasm was estimated in terms of range, mean, standard error, phenotypic and genotypic coefficient of variation. The analysis of variance (Table 1) showed significant mean sum of square estimates for all the characters under study indicating great wealth of variability among the genotypes selected for all the economic traits. The genotype LS-8 recorded the highest mean value for main vine length (12.15m). The lowest time taken for first female flower anthesis was observed in the genotype LS-14. The genotype LS-6 expressed the lowest sex ratio, highest fruit set, highest no of fruits, higher no of primary branches per plant and higher fruit yield per plant (Table 2). The lowest time taken for first harvest and higher crude protein content were observed in LS-19.

Estimation of quantitative variation like mean, range and standard error etc doesn't indicate the relative amount of variability, the coefficient of variation appears to be a better index when the characters with different units of measurements are to be compared. In the present study, considerable differences between Phenotypic (PCV) and genotypic (GCV) coefficient of variation were observed for the character studied. All character showed higher the PCV than the corresponding GCV due to interaction of the genotypes with the environments and by environmental factors influencing the expression of theses characters. The highest phenotypic coefficient of variation was observed for no. of seeds per fruit (37.329), yield per plant

Table 1. Abstract of analysis of variance for different characters of Bottle gourd genotypes under rainfed condition

Sl. No	Characters	Mean sum of Square values			F values
		Replication (d.f. =2)	Genotypes (d.f. =19)	Error (d.f. =38)	Genotypes
1	Main vine length (m)	2.028	14.97**	1.257	11.901
2	No of primary branches	4.693	4.989**	0.295	16.901
3	Internodal length (cm)	2.47	5.885**	0.51	11.486
4	Days to first female flower anthesis (days)	7.194	54.640**	7.798	7.006
5	Node of first female flower appears	0.087	31.662**	3.575	8.854
6	Sex ratio	1.015	16.825**	1.421	11.837
7	Days to first fruit harvest (Days)	97.539	33.329**	12.483	2.669
8	Fruit set percent (%)	192.63	196.58**	32.15	6.114
9	No of fruits per plant	0.544	15.133**	0.449	33.672
10	Yield per plant (kg)	1.403	17.529**	1.233	14.215
11	Fruit weight (kg)	0.220	0.139**	0.045	3.031
12	Fruit length (cm)	62.208	540.80**	20.23	26.723
13	Fruit girth(cm)	44.27	72.39**	4.697	15.410
14	100 seed weight (g)	6.104	10.975**	1.064	10.305
15	No of seeds per fruit	429.755	44335.5**	549.16	80.732
16	Crude fiber content	7.976	7.338**	1.175	6.240

** Indicates the significant at 1%, * indicates the significant at 5%

Table 2. Range of variability for different morphological characters among Bottle gourd genotypes

Sl.No	Characters	Range	Mean±SE	Standard Deviation	Genotype
1	Main vine length (m)	4.38-12.15	9.316± 0.915	1.121	LS-17-LS-8
2	No of primary branches	4.738-9.446	6.772 ±0.443	0.543	LS-13-LS-6
3	Internodal length (cm)	12.00-16.77	14.687± 0.584	0.715	LS-4-LS-16
4	Days to first female flower anthesis	42.87-56.24	47.231± 2.280	2.792	LS-14-LS-3
5	Node of first female flower appears	10.86-22.04	15.365± 1.543	1.890	LS-12-LS-10
6	Sex ratio	5.36-13.33	8.470± 0.973	1.192	LS-6-LS-5
7	Days to first fruit harvest	61.55-74.94	70.305± 2.884	3.533	LS-5-LS-19
8	Fruit set (%)	15.65-52.58	34.361 ±4.629	5.670	LS-5-LS-6
9	No of fruits per plant	4.13-12.75	7.554 ±1.662	2.036	LS-19-LS-6
10	Yield per plant (kg)	5.00 -13.35	7.583 ±0.906	1.110	LS-1-LS-6
11	Fruit weight (kg)	0.94 -1.88	1.319 ±0.175	0.214	LS-6-LS-8
12	Fruit length (cm)	24.13-67.05	42.428± 3.673	4.498	LS-3-LS-5
13	Fruit girth (cm)	23.26-39.26	30.659± 1.769	2.167	LS-2-LS-12
14	100 Seed weight (g)	11.71-18.74	15.018 ±0.842	1.031	LS-7-LS-3
15	No of seed per Fruit	192.67-616.62	329.66 ±19.133	23.434	LS-6-LS-15
16	Crude fiber content	10.90-16.94	13.028 ±0.885	1.084	LS-13-LS-19

(34.045), fruit length (32.807) and no. of fruits per plant (30.689). Moderate values of PCV was observed for fruit set percent (27.138), main vine length (25.916), node to first female flower appears (23.409), fruit weight (21.054) and no. of primary branches per plant (20.137). The PCV was ranged from 6.270 to 17.030 for the other remaining characters. Rajnarayanan *et al.* (1996) also observed lower values of PCV for days to first female flower anthesis in bottle gourd The genotypic coefficient of variation measures the extent of genetic variation among the genotypes within the particular characters. The highest genotypic coefficient of variation was observed for no. of seeds per fruit (36.646), yield per plant (30.732) and fruit length (31.046). Moderate values of GCV were observed for no. of fruits per plant (27.370), sex ratio (26.751), main vine length (22.949), fruit set percentage (21.545). The lower values of GCV was observed for days to first fruit harvest (3.749), days to first female flower anthesis (8.369), internode length (9.111). Rajnarayanan *et al.* (1996) also observed lower values of GCV for days to first female flower anthesis in bottle gourd. The magnitude of phenotypic coefficient of variation was higher than the genotypic coefficient of variation for all the traits. It is further understood that suitable plant type could be selected where there is minimum difference between phenotypic and genotypic coefficient of variation indicates the least environmental influence. High degree of disparity between PCV and GCV was recorded for fruit weight, fruit set percent showing that these characters were being much susceptible to environmental fluctuation. These findings are in accordance with the findings of Mohanty and Mishra (1999) in pumpkin except for fruit set.

A character can be improved only if it is highly heritable. The magnitude of heritability indicates the effectiveness with which the selection of genotypes can be made a phenotypic performance (Johnson *et al.*, 1955). The success of selection depends on the breeding values of a genotype required from its phenotypic expression. The degree of correspondence between phenotypic and genotypic value and breeding value for a character is measured by heritability, which indicates the reliability of the former as a guide to the latter. In the present study, highest heritability was observed for no. of seeds per fruit (96.3) and no. of fruits per plant (91.5), fruit length (89.5), no. of primary branches per plant (84.1), fruit girth (82.7) and fruit yield per plant (81.4), main vine length, sex ratio, Internode length, 100 seed weight, node to first female flowers, days to first female flower anthesis, crude fiber content, fruit set percent. Joshi *et al.* (1981) and Rastogi and Arya Deep (1990) also observed high heritability for yield per plants, fruit weight and No of fruits per plant in cucumber. The Moderate heritability was observed for days to first fruit harvest and fruit weight in the study, indicated the considerable role of environment. High heritability indicated the large proportion of phenotypic variance was attributable to genotypic variance and the difference for these traits among genotypes was real and these characters are governed by additive gene action. Therefore, such high heritability estimation has been found to be helpful in making selection of superior genotypes on these traits on the basis of phenotypic expression. However, heritability estimates along with genetic advance is more useful than heritability values alone for selecting best individual.

The genetic gain reveals the genetic potential of the characters under selection and effectiveness of the selection. It also emphasizes the quantum of gain obtained under particular selection pressure. If the heritability were mainly due to additive effects, it would be associated with high genetic gain and if it is due to non additive (dominance and epitasis), the genetic gain would be low (Panse, 1957). In the present study, expected genetic gain ranged from 4.618 (days to first fruit harvest) to 74.110 (no. of seeds per fruit) (Table 3). High estimate of genetic gain were observed in the order for no. of seeds per fruit, fruit length,

Table 3. Genotypic and phenotypic variance, Genotypic and phenotypic coefficient variation, Heritability,Genetic advance and Genetic gain of Bottle gourd genotypes

Sl. No	Characters	(GV)	(PV)	Coefficient of variation		(H)	(GA)	Genetic gain
				(GCV)	(PCV)			
1	Main vine length (m)	4.571	5.829	22.949	25.916	78.4	3.900	41.865
2	No. of primary branches	1.564	1.860	18.470	20.137	84.1	2.363	34.890
3	Internodal length (cm)	1.790	2.303	9.111	10.332	77.7	2.430	16.550
4	Days to first female flower anthesis	15.614	23.412	8.369	10.244	66.6	6.647	14.072
5	Node of first female flower appears	9.362	12.937	19.913	23.409	72.3	5.361	34.896
6	Sex ratio	5.134	6.556	26.751	30.228	78.3	4.131	48.770
7	Days to first fruit harvest	6.948	19.431	3.749	6.270	35.7	3.247	4.618
8	Fruit set (%)	54.811	86.961	21.545	27.138	63.0	12.108	35.237
9	No. of fruits per plant	4.894	5.344	27.370	30.689	91.5	4.361	57.903
10	Yield per plant(kg)	5.432	6.665	30.732	34.045	81.4	4.334	57.158
11	Fruit weight (g)	0.031	0.077	13.378	21.054	40.3	0.231	17.513
12	Fruit length (cm)	173.52	193.76	31.046	32.807	89.5	25.67	60.524
13	Fruit girth (cm)	22.564	27.262	15.493	17.030	82.7	8.90	29.037
14	100 Seed weight (g)	3.303	4.368	12.102	13.916	75.6	3.255	21.679
15	No of seed per Fruit	14595.4	15144.6	36.646	37.329	96.3	244.31	74.110
16	Crude fibre content	2.054	3.230	11.001	13.795	63.5	2.354	18.072

(GV- genotypic variance, PV Phenotypic variance, PCV- Phenotypic coefficient of Variation, GCV-Genotypic coefficient of variation, GA- Genetic Advance) no. of fruits per plant, yield per plant, sex ratio, fruit set percent, main vine length, node of first female flower appears and no. of primary branches per plant, fruit girth and 100 seed weight indicates the higher response to these characters to selection. Moderate genetic gain was observed for crude fiber content, fruit weight, internode length, days to first female flower anthesis. The low magnitude of genetic gain was observed for days to first fruit harvest. Raj narayanan *et al.* (1996) also reported low genetic gain for Days to first fruit harvest in bottle gourd.

The characters showing high heritability coupled with high genetic gain possess high selective value and offer ample scope for efficient selection. Rajnarayanan *et al.* (1996) also reported high value of GCV and heritability estimates along with greater genetic gain suggesting of additive gene effect governing the inheritance of such traits. In the present study, high value of GCV, highest heritability coupled with higher genetic gain was observed for no of seeds per fruit, fruit length, fruit yield per plant, sex ratio, main vine length, node of first female flower appears and fruit set percent indicated these character governed by additive gene action. Singh and Rajesh Kumar (2002) also observed high heritability for fruit yield, vine length fruit diameter, fruit length and no. of primary branches per plant indicating the predominance of additive gene action involved in these characters in bottle gourd and contradicting for fruit weight. Raj Narayanan *et al.* (1996) also reported low GCV and lower value of genetic gain for days to fruit harvest and fruit weight in Bottle gourd. The Fruit yield per plant can be raised by 4.334 kg with a selection pressure of 5% intensity and this improvement would 57.158% of mean yield per plant. This is in conformity with the findings Mohanty and Mishra (1999) in pumpkin. Karuppaiah *et al.* (2002) also reported high heritability coupled with higher genetic gain for no. of female flowers per plant, yield per plant, no. of fruits per plant and flesh thickness in ridge gourd. Krishna Prasad *et al.* (2002) also observed additive gene effect for no. of fruits per plant and yield per plot in Watermelon.

Days to first fruit harvest showed low genotypic coefficient of variation and moderate heritability coupled with low genetic gain indicated the non-additive gene action. Dahiya *et al* (2001) also reported moderate to high heritability with low genetic gain for days to first picking, days to 50% female flowering and fruit weight in bottle gourd. Raj Narayanan *et al.* (1996) also reported low GCV and low heritability coupled with low genetic gain for days to fruit harvest and fruit weight in bottle gourd. Karuppaiah *et al.* (2002) also reported non-additive gene action for days to first fruit harvest in ridge gourd. This implies that the selection over several successive generations following hybridization of desirable transgressive segregates. Node to first female flower appears and days to first fruit harvest showed low heritability with low genetic gain indicating marked influence of environment for expression of these characters and they need to be tested under diverse environment s for their effective selection.

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