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Variability Analysis for Physiological Traits in Different Bottle Gourd (*Lagenaria siceraria* Mol. Standl) Genotypes and their F1 Progenies

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ABSTRACT

In crop plant, collection of germ plasm and assessment of genetic variability is basic step in any crop improvement program which acts as a building block for generation of genetic variability. Evaluation and cataloguing of this variability is of paramount importance of its efficient utilization. In the present investigation, a similar analysis of parameters of variability (PCV and GCV), heritability and genetic advance was carried out for 13 physiological traits in eight parental lines and twenty eight crosses derived from these parental lines. The phenotypic coefficient of variation was significantly higher in magnitude than that of genotypic coefficient of variation for all the characters under study and dry matter Production and Partitioning (Reproductive Parts) recorded the highest PCV & GCV While, high heritability coupled with high genetic advance as % of mean was recorded for all the physiological traits under study.

Keywords: Genetic variability, Heritability, Genetic Advance, Physiological traits.

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INTRODUCTION

Bottle gourd is botanically known as *Lagenaria siceraria* (Mol.) Stand. (*Synonyms L. vulgaris* scr. *L. leucantha* (Duch) Rusby.) and its chromosome No. is 2n = 24. Bottle gourd belongs to the genus Lagenaria that is derived from word lagena, meaning the bottle. In the older literature it is often referred to as *Lagenaria vulgaris* (common) or *Lagenaria leucantha* (white flowered gourd), but now it is known as Lagenaria siceraria. Crop productivity is dependent on its inherent capacity for photosynthesis, photosynthetic area and availability of PAR within the canopy. Thus the genotypic variation in productivity of a crop may be related to physiological parameters by the canopy and partitioning to total photosynthates into economic and non-economic sink. The productivity in crops is limited by genotypic, environmental and physiological interactions. It is essential to investigate the constraints of productivity in soybean in relation to various morpho-physiological parameters and structural yield components. In order to delimit the constraints an analysis of eco physiological complex is a prerequisite and it is necessary to investigate the extent to which macro and micro fluctuations that change the physiological processes and affect the productivity of plant. It is also essential to determine the transfer and sink utilization of assimilates in crop community. Photosynthetic efficiency and its relationship with various environmental parameters enable determination as well as prediction of the productivity potential of the genotypes. Higher WUE are often found to maintain lower leaf internal CO_2 concentration (ci), as estimated by carbon isotope discrimination. However, lower ci may result from reduced stomatal conductance, increased mesophyll (nonstomatal) conductance, or a combination of both. When genotypic variation for WUE is found, it may be important for plant breeding purposes to define whether such variation arises from differences in stomatal or non-stomatal restrictions to CO_2 uptake (Earl 2002). Reduction in transpiration rate and stomatal conductance and concomitant increase in intercellular CO_2 concentration suggests that both stomatal factors were involved in the reduction of photosynthesis (Zhao *et al*. 2003).

Therefore the present study comprises of study of PCV, GCV, Heritability and genetic advance that are important selection parameters for its proper utilization in selection of genotypes based on physiological parameters. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. The estimate of heritability can be utilized for the prediction of genetic gain, which indicates the genetic improvement that would result from the selection of best individuals. Hence, estimate of heritability is an essential pre-requisite for formation of an effective selection method for genetic improvement. Genetic advance is the improvement in the mean genotypic value of selected individual over the parental population. High heritability accompanied with high genetic advance indicates that the heritability is due to additive gene effect and selection may be effective, while high heritability coupled with low genetic advance indicates predominance of non- additive gene action, while low heritability is exhibited due to influence of environmental interaction rather than genotypes. Selection for such characters may not be rewarding.

MATERIALS AND METHODS

The experimental materials for the present study comprised of eight promising and diverse genotypes of bottle gourd selected on the basis of genetic variability. The selected parental lines i.e. (P1) Arka Bahar, (P2) Kashi Ganga, (P3) Narendra Dharidar, (P4) Samrat, (P5) Pusa Naveen, (P6) Pusa Santushti, (P7) Punjab Komal, (P8) Pusa Summer Prolific Long were crossed in the all possible combinations in diallel technique, excluding reciprocals to get 28 F1 hybrids for the study of various physiological parameters. The experimental material was sown in Randomized Block Design with two replications and spacing of 1.80 m x 0.90 m at horticultural farm JNKVV, Jabalpur.

Estimation of phenotypic and genotypic coefficients of variation

The phenotypic and genotypic coefficients of variation in per cent were computed by the following formulae given by Burton (1952).

$$\text{PCV (\%)} = \frac{\text{Phenotypic standard deviation}}{\text{Mean}} \times 100$$

$$\left[\text{GCV (\%)} = \frac{\text{Genotypic standard deviation}}{\text{Mean}} \times 100 \right]$$

Where,

PCV= Phenotypic Coefficient of variation
GCV= Genotypic Coefficient of variation

The estimates of PCV and GCV were classified as low (< 10%), moderate (10%- 20%) and high (>20%) according to Sivasubramanian and Menon (1973).

Heritability

It is the ratio of genotypic variance to the total phenotypic variance. Heritability for the present study was calculated in broad sense by adopting the formula as suggested by Hanson *et al.* (1956).

$$\text{Heritability } (h^2\,b\,\%) = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

Where,
h^2 (b) = Heritability in broad sense
σ^2 g = Genotypic variance
σ^2 p = Phenotypic variance

Heritability per cent in broad sense was calculated for each character and classified into three groups as low (< 50%), moderate (50%-70%) and high (>70%) by (Allard 1960).

Genetic advance

Improvement in the mean genotypic value of selected plants over the parental population is known as genetic advance. Expected genetic advance was calculated by the method suggested by Johnson *et al.* (1955).

$$G\,A = K.\ \sigma\,p.\ h^2\,(b)$$

Where,

GA = Genetic Advance
K = Constant (Standard selection differential) having the value of 2.06 at 5% level of selection intensity

h2 = Heritability of the character
σp= Phenotypic standard deviation

Genetic advance as percentage of mean

It was calculated by the following formula:

$$\text{GA as percentage of mean} = \frac{\text{Genetic advance}}{\text{General mean}} \times 100$$

GA was categorized as low (< 10%), moderate (10%-20%) and high (>20%).

RESULTS AND DISCUSSION

Genotypic and phenotypic coefficient of variation

Genotypic and phenotypic coefficient of variation for yield and yield contributing characters are summarized in Table 1. The phenotypic coefficient of variation was significantly higher in magnitude than that of genotypic coefficient of variation for all the characters under study. Dry matter production and partitioning (Reproductive Parts) recorded the highest PCV and GCV (85.19% and 85.03%) followed by Carboxylation efficiency (73.26% and 71.61%), Water use efficiency (63.24% and 62.25%), Ci (55.65% and 55.45%), dry matter production and partitioning (Branches) (50.29% and 50.01%), Stomatal conductance (48.59% and 43.25%), Photosynthetic rate (47.68% and 47.38%), dry matter production and partitioning (Total) (45.60% and 45.51%), dry matter production and partitioning (Leaf) (37.59% and 37.40%), dry matter production and partitioning (Stem) (33.13% and 32.53%) and transpiration rate

Table 1. PCV & GCV, heritability and genetic advance for 13 physiological traits in bottle gouard.

Sl. No.	Characters	PCV	GCV	Heritability	GA as % of mean
1	Photosynthetic rate	47.68	47.38	98.76	97.00
2	Stomatal conductance	48.59	43.25	79.23	79.31
3	Ci	55.66	55.46	99.28	113.83
4	Transpiration rate	20.10	19.45	93.58	38.75
5	PARi	11.52	11.30	96.22	22.83
6	Water use efficiency	63.25	62.25	96.88	126.22
7	Carboxylation efficiency	73.26	71.62	95.56	144.22
8	Chlorophyll content Index	15.72	15.59	98.29	31.83
9	Matter production and partitioning (Leaf)	37.60	37.40	98.97	76.65
10	Dry matter production and partitioning (Stem)	33.13	32.53	96.40	65.80
11	Dry matter production and partitioning (Branches)	50.30	50.02	98.88	102.46
12	Dry matter production and artitioning (Rep.Parts)	85.19	85.04	99.64	174.86
13	Dry matter production and partitioning (Total)	45.61	45.51	99.59	93.56

(20.10% and19.44%), While moderate PCV and GCV was recorded for Chlorophyll Content Index (15.72% and 15.58%) and PARi (11.51% and 11.29%), respectively. Similar results have been obtained in different and related crops by Sirohi *et al.* (2007), Saeidi *et al.* (2008), Mahbub *et al*. (2015) and Yadav and Kumar (2011).

Heritability (%) (bs)

Heritability was estimated for all the characters under study. The heritability estimates varied for different physiological traits (Table 1). Most of the characters expressed high estimates of broad sense heritability. The highest heritability was obtained (99.64%) for dry matter production and partitioning (Reproductive Parts) followed by dry matter production and partitioning (total) (99.59%), Ci (99.28%), dry matter production and partitioning (Leaf) (98.97%), dry matter production and partitioning (Branches) (98.88%), Photosynthetic rate (98.76%), Chlorophyll Content Index (98.29%), Water use efficiency (96.88%), dry matter production and partitioning (stem) (96.40%), PARi (96.22%), Carboxylation efficiency (95.56%), Transpiration rate (93.58%) and Stomatal conductance (79.23%).

Genetic advance as percentage of mean

The highest genetic advance as percentage of mean (at 5% selection intensity) were recorded for dry matter production and partitioning(Reproductive Parts) (174.86%) followed by Carboxylation efficiency (144.21%), Water use efficiency (126.22%), Ci (113.82%), dry matter production and partitioning, Branches (102.45%), Photosynthetic rate (97.00%), dry matter production and partitioning(total) (93.56%), Stomatal conductance (79.31%), dry matter production and partitioning (Leaf) (76.64%), dry matter production and partitioning (Stem) (65.80%), Transpiration rate (38.75%), Chlorophyll Content Index (31.83%) and PARi (22.82%).Similar findings i.e. high heritability coupled with high genetic advance in several crops was reported by Ramteke *et al.* (2010), Ghodrati (2013), Osekita and Ajayi (2013),Wani *et al.* (2009), Corre (1983), Rao and Mitra (1998) and Kumar *et al.* (2007).

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