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STUDIES ON GENETIC VARIABILITY AND INTER-RELATIONSHIP IN BOTTLE GOURD [*Lagenaria siceraria* (Mol.) Standl]

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Received 18 December 2017, Revised 4 June 2018, Accepted 26 June 2018, Published online 30 June 2018

Abstract

The genetic parameters were studied to elucidate the genetic variability, correlation and path co-efficient analysis in thirty-nine genotypes of bottle gourd [*Lagenaria siceraria* (Mol.) Standl] in randomized complete block design with three replications. Observations were recorded for eleven quantitative characters viz., days to first male flower open, days to first female flower open, node number of first female flower, branches plant⁻¹, days to harvest, number of fruits plant⁻¹, fruit weight, fruit length, fruit girth, 100 seed weight and yield ton ha⁻¹. The analysis of variance showed highly significant differences for all the characters studied indicating considerable variability among the genotypes. The highest GCV (35.57%) and PCV (35.62%) were observed for fruit length. The differences between GCV and PCV were high for fruit number plant⁻¹ and days to first male flower open indicating environmental influences. High heritability associates with high estimates of genetic advance in percent of mean were noted for length of fruit, yield, girth of fruit and number of fruits plant⁻¹. It indicated presence of additive gene effect and selection for these traits would be effective. Yield were positively and significantly correlated with fruit weight, 100 seed weight, branch plant⁻¹ and number of fruits plant⁻¹. Negative associations of yield were noted with days to first male and female flower open, days to harvest and length of fruit. Path analysis revealed that fruits plant⁻¹ (0.93) and weight of fruit (0.467) had very high positive effect on fruit yield ton ha⁻¹.

Keywords: Bottle Gourd, Genetic Variability, Genotypic correlation, Path Coefficient

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Introduction

Cucurbitaceous vegetables are under the largest family Cucurbitaceae consisting of maximum number of edible species in vegetable Kingdom. Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is belongs to the family Cucurbitaceae having somatic chromosome number 2n=22. Bottle gourd is gaining popularity as a health food because of its easy digestibility, diuretic and cardiotonic effects (Rahman *et al.*, 2009). Bottle gourd is a cross pollinated crop with large amount of variation for many economically important traits. Bangladesh is one of the Centre's of diversity of bottle gourd endowed with a variety of diverse germplasm. Evaluation of a collection of bottle gourd from different parts of Bangladesh revealed genetic diversity for various quantitative characters. The earliness and yield potentialities of this crop can be improved through an effective breeding program. The available information suggests that modern genotypes often lack additional characters which

farmers consider important. Significant genetic variation may exist among bottle gourd genotypes. Some may be superior in certain traits but lacking in other aspects. Their morphological characteristics may also be different; hence, there is a need for detailed study of genetic variation in bottle gourd genotypes in order to generate data. Studies on variability along with heritability and genetic advance helps in predicting inheritance patterns of various characters. Correlation and path-coefficient studies between yield and its components and their relative contributions to yield will be of great value in planning sound breeding program. Therefore, the present investigation was undertaken with a view to work out phenotypic and genotypic coefficient of variation, heritability, genetic gain, association of important genetic traits and path analysis between yield and components could be used as selection indices for identifications of potentially high yielding bottle gourd genotypes.

Materials and Methods

The experiment was conducted at the Research and Development Farm of Lal Teer Seed Ltd., Gazipur during the period of 2016 - 2017. The 39 genotypes of bottle gourd were sown in randomized complete block design with three replications. The crop was grown in channel and bed system at a distance of 3 m between rows and 1m between plants. Standard package practices were adopted to raise the crop. Observations were recorded from ten randomized selected plants for the characters viz., days to first male flower open (DMFO), days to first female flower open (DFFO), node number of first female flower (NNFFF), number of branches plant⁻¹ (BPP), days to first fruit harvest (DH), fruit weight (FW), fruit length (FL), fruit girth (FG), fruit plant⁻¹ (FPP), 100 seed weight (SW) and yield. Statistical analysis was carried out on 11 quantitative characters (Table 1) by employing SAS (9.2).

Results and Discussion

The mean sums of squares due to genotypes were highly significant for all the characters subjected to analysis of variance (Table 1). This indicated the presence of considerable amount of variation among the genotypes to carry out further genetic analysis. Joydip *et al.* (2015) and Damor *et al.* (2016) also reported similar results. The highest coefficient of variation (17.80%) was recorded for number of fruits plant⁻¹. Therefore, it is possible to select genotype having more number of fruits plant⁻¹ from available germplasm. Among the genotypes, the range of variation was observed from 39.53 to 49.47 with mean value of 45.15 for days to first male flower open, 45.80 to 59.67 for days to first female flower open with mean value of 53.27, for node number 15.47 to 24.50 with mean value 19.60, for branches plant⁻¹ 18.47 to 31.70 with mean value 24.09, for days to first harvest 60.63 to 74.67 with mean value 68.39, for number fruits plant⁻¹ 3.40 to 8.13 with mean value 5.13. 1.26 kg to 1.92 kg with mean value 1.61 kg for fruit weight, 14.33 cm to 49.25 cm with

mean value 30.81 for fruit length, 8.25 cm to 16.37 cm with mean value 11.57 for fruit girth, 16.32 g to 29.22 g with mean value of 21.97 for 100 seed weight and 17.47 ton to 39.76 ton with mean value 27.43 for yield ha⁻¹. In order to obtain a clear understanding of the pattern of variations, the phenotypic variances have been partitioned into genotypic and environmental variance. Considerable genotypic variances were found in number of node at first female flower open. High heritability associated with high estimates of genetic advance in percent of means (GAPM) was noticed for fruit length, yield and fruits plant⁻¹ and fruit girth. It's indicated that presence of additive gene effect and selection of these traits would be effective. The present finding's is supported by Kumar *et al.* (2011) and Singh *et al.* (2012).

The length of edible green fruit exhibited highest value of genotypic and phenotypic coefficient of variation (GCV and PCV). Similar findings observed by Kumar and Syamal (2009) and Pandit *et al.* (2009). High genotypic and phenotypic coefficient of variation was recorded for fruit length, yield, fruits per plant and fruit girth. High heritability coupled with high genetic advance over mean was observed for fruit length, yield, fruits per plant and fruit girth. The individual bottle gourd genotypes, which should desirable mean values in characters like fruit length yield, number of fruits per plant and fruit girth, should be selected, because these characters with high genotypic coefficients of variation, high heritability and high genetic gain are controlled by additive gene action and hence direct selection is effective. Aruah *et al.* (2012), Kumer *et al.* (2013) and Joydip *et al.* (2015) support the present findings. Days to first fruit harvest, days to first male flower open and days to first female flower open registered low genotypic coefficient of variation, high heritability and low genetic gain which indicated the preponderance of non additive gene action and influence of environment.

Table 1. Estimates of Genetic Parameters of 11 characters in 39 bottle gourd genotypes.

Traits	DMFO	DFFO	NNFFF	BPP	DH	FW	FL	FG	FPP	SW	Yield
MSG	24.96**	37.67**	13.93**	24.13**	26.33**	0.07*	360.77**	14.19**	3.35**	26.78**	100.9**
%CV	4.10	3.60	8.20	6.90	2.50	16.80	3.60	8.90	17.80	1.10	4.50
MEAN	45.15	53.27	19.60	24.09	68.39	1.61	30.81	11.57	5.13	21.97	27.43
RANGE	39.53 - 49.47	45.80 - 59.67	15.47 - 24.50	18.47 - 31.70	60.63 - 74.67	1.26 - 1.92	14.33 - 49.25	8.25 - 16.37	3.40 - 8.13	16.32 - 29.22	17.47 - 39.76
GV	8.31	12.54	4.63	8.03	8.77	0.022	120.25	4.73	1.11	8.93	33.63
PV	8.35	12.58	4.66	8.06	8.80	0.023	120.26	4.74	1.12	8.93	33.65
GCV	6.38	6.65	10.97	11.75	4.33	9.32	35.57	18.76	20.47	13.61	21.14
PCV	6.60	6.66	11.02	11.79	4.34	9.32	35.62	18.84	20.66	13.61	21.15
h2b	99.52	99.85	99.54	99.64	99.66	95.65	99.91	99.54	99.06	100.00	99.96
GA	5.92	7.29	4.42	5.83	6.10	0.30	22.60	4.48	2.16	6.16	11.94
GAM	13.12	13.68	22.55	24.20	8.92	18.63	73.34	38.73	42.18	28.05	43.54

Here, * & ** indicates 5% and 1% level of Significance, MSG=Mean sum of squares due to genotypes, CV=Co-efficient of Variation, GV= Genotypic Variance, PV=Phenotypic Variance, GCV=Genotypic co-efficient of variation, PCV=Phenotypic co-efficient of variation, h2b=Heritability in broad sense, GA= Genetic Advance GAM=Genetic Advance in percent of mean.

Correlation indicated the mutual relationship among various plant characters and determines the component characters on which selection can be based for genetic improvement of yield. Correlation coefficients at genotypic level were worked out among different characters keeping fruit yield ton ha⁻¹ as dependable variable (Table 2). Yield was positively and significantly correlated with number of branch plant⁻¹, fruit weight, 100 seed weight and fruits plant⁻¹. Number of fruits plant⁻¹ recorded highest

correlation ($r=0.884$) exhibited highly significant and positive correlation with yield. Similar associations of the characters were observed by Aruah *et al.* (2012), Kumer *et al.* (2013) and Joydip *et al.* (2015). However, first female flower, male flower, node number of first female flower, first harvest and length of fruit had negative non significant correlation with fruit yield. Similar findings were recorded by Deepthi *et al.* (2013), and Janaranjani and Kanthaswamy (2015).

Table 2. Genotypic correlation matrix among different characters in bottle gourd genotypes.

	DFFO	NNFFF	BPP	DH	FW	FL	FG	FPP	SW	YIELD
DMFO	0.743**	0.179	-0.156	0.582**	0.230	-0.464*	0.558**	-0.240	0.147	-0.122
DFFO		0.422*	-0.201	0.792**	0.183	-0.230	0.390*	-0.396*	0.137	-0.290
NNFFF			0.123	0.341*	0.148	-0.135	0.171	0.072	0.169	-0.012
BPP				-0.203	0.056	-0.300	0.176	0.868**	0.419*	0.833**
HD					0.052	-0.209	0.308*	-0.330*	0.133	-0.291
FW						-0.068	0.347*	-0.102	0.189	0.368*
FL							-0.879**	-0.164	-0.423*	-0.182
FG								-0.045	0.358*	0.116
FPP									0.306*	0.884**
SW										0.378*

*Significant at 5% level; ** Significant at 1% level

Table 3. Genotypic path coefficient analysis among different characters in bottle gourd genotypes.

	DMFO	DFFO	NNFFF	BPP	HD	FW	FL	FG	FPP	SW	Yield
DMFO	-0.009	0.008	-0.003	0.001	-0.004	0.108	0.005	-0.006	-0.222	0.001	-0.122
DFFO	-0.007	0.011	-0.006	0.001	-0.006	0.085	0.003	-0.004	-0.368	0.001	-0.290
NNFFF	-0.002	0.005	-0.015	-0.001	-0.002	0.069	0.001	-0.002	-0.067	0.002	-0.012
BPP	0.001	-0.002	-0.002	-0.006	0.001	0.026	0.003	-0.002	0.808	0.004	0.833
HD	-0.005	0.009	-0.005	0.001	-0.007	0.024	0.002	-0.003	-0.307	0.001	-0.291
FW	-0.002	0.002	-0.002	0.001	-0.001	0.467	0.001	-0.004	-0.095	0.002	0.368
FL	0.004	-0.003	0.002	0.002	0.001	-0.032	-0.011	0.010	-0.152	-0.004	-0.182
FG	-0.005	0.004	-0.002	-0.001	-0.002	0.162	0.010	-0.011	-0.042	0.003	0.116
FPP	0.002	-0.004	0.001	-0.005	0.002	-0.047	0.002	0.001	0.930	0.003	0.884
SW	-0.001	0.002	-0.003	-0.002	-0.001	0.088	0.005	-0.004	0.285	0.010	0.378

Residual Effect: 0.067

Association of characters as determined by simple correlation coefficient may not provide an exact picture of the relationship between yield components and yield. The genotypic correlations were portioned into direct and indirect effects through path coefficient analysis to know the relative importance of 12 characters (Table 3). Path coefficient analysis (Table 3) revealed that the highest positive direct effects on yield ha^{-1} were exerted by number of fruits per plant $^{-1}$ (0.93) followed by fruit weight (0.467), first female flower open (0.011) and 100 seed weight (0.01). The contribution of yield components like first female flower open, 100 seed weight, fruit weight and number of fruits plant $^{-1}$ were high in the present study. This is in confirmation with the work of Janaranjani and Kanthaswamy (2015).

Further, node number at first flowering, fruit length, fruit girth and first male flower open, recorded negative low direct effect on fruit yield. In case of indirect effects, number of fruits plant $^{-1}$ has highest indirect effects via number of branch plant $^{-1}$ followed by 100 seed weight. The highest negative indirect effect was recorded by number of fruits plant $^{-1}$ via first female flower open followed by harvest date and first male flower open. The perusal of overall results has impact on yield although simultaneous selection of number of fruits plant $^{-1}$, fruit weight, days to first female flower opening and 100 seed weight were the principle component characters, which exhibited high positive direct effects (Kumer *et al.*, 2013, and Husna *et al.*, 2014). The indirect effects of most of the characters were through number of fruits plant $^{-1}$, number of branches plant $^{-1}$ and 100 seed weight will also be useful in bringing higher yield in bottle gourd. Residual effects 0.067 imply that the total genotypic variability in yield has been explained by the characters associated in the study.

Acknowledgement

We record our sincere thanks to Management of Lal Teer Seed Ltd. for providing us financial assistance during the tenure of the experiment and all those workers in the field who have put in their hard labor and sweat to ensure successful completion of our research program.

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