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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN POINTED GOURD (*Trichosanthes dioica* Roxb.)

M. A. Malek, M. A. Bari Miah[1], M. O. Islam, A. M. M. Mosiul Hoque and R. Gomes[2]

Plant Genetic Resources Centre
Bangladesh Agricultural Research Institute
Joydebpur, Gazipur 1701, Bangladesh

ABSTRACT

Genetic variability, heritability in broad sense and expected genetic advance as percent of mean for fruit yield and nine characters were studied in 25 pointed gourd genotypes. Fruits per plant and fruit yield per plant showed maximum variability. Genotypic coefficient of variation was found high for fruit yield and number of fruits per plant. All the characters under study were highly heritable in nature. High heritability coupled with high genetic advance was observed for fruit yield and fruits per plant, which indicated that these characters are more reliable for effective selection.

Key words: Pointed gourd (*Trichosanthes dioica*), genetic variability, heritability, genetic advance

INTRODUCTION

Pointed gourd (*Trichosanthes dioica* Roxb.) locally known as 'patal' is an important summer cucurbit vegetable in Bangladesh. Pointed gourd hold a very coveted position in the vegetable market of our country particularly during summer and rainy seasons. It is a perennial crop and available in the market up to the end of October when there is a scarcity of vegetables. The Bengal and Assam region of India is the primary centre of its origin (Singh *et al*., 1992) of the crop. It is grown almost in every districts of Bangladesh especially in Rajshahi, Bogra, Pabna, Jessore and Kustia (Rashid, 1993).

Pointed gourd is rich in vitamin and minerals. Being rich in protein and vitamin A, it has certain medicinal properties and many reports are available regarding its role in circulatory system especially in lowering total cholesterol and blood sugar (Chandrasekar *et al*., 1988; Sharma and Pant 1988;Sharma *et al.*, 1988). Improvement in any crop depends on the magnitude of its genetic variability. Knowledge of the available variability within the species for the desired characters enables the breeder in determining the most potential genotype. Burton (1952) suggested that genetic variability along with heritability should be considered for effective selection. A study on the variability using genetic parameters like genetic coefficient of variation, heritability and genetic advance is essential for initiating a breeding program.

[1] Professor, Institute of Biological Sciences, University of Rajshahi, Rajshahi 6207 and [2] Research Wing, BARI, Joydebpur, Gazipur 1701

MATERIALS AND METHODS

The study was conducted at the experimental field of Plant Genetic Resources Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur 1701 during October 2002 to August 2003 on twenty five pointed gourd genotypes. The experiment was laid out in a randomized complete block design with three replications. Each block within the replication consisted of 27 genotypes with a distance of 2.0 x 2.0 m. (including two male plants). Recommended cultural practices were followed through the growth period to raise a good crop. Pits of size 30 x 30 x 30 cm^3 were dug and filled with soil, cow dung and sand mixed in equal proportion. Around 30g Urea, 25g Muriate of Potash, 20g Triple Super Phosphate and 4g Zypsum were also added in each pit. The observations were recorded on nodes per vine, vines per plant, vine length (m), fruits per plant, female flower length (cm), fruit length (cm), fruit width (cm), fruit volume (cc), fruit weight (g) and fruit yield per plant (kg). Analysis of variance, variance components, genotypic and phenotypic coefficient of variation, heritability in broad sense and expected genetic advance were estimated by the formulae suggested by Singh and Chaudhary (1985).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed high significant differences among the genotypes for all the characters. Significant differences among the cultivars for the characters like number of nodes, vine length, number of shoots, number of fruits, fruit width, fruit length, fruit weight, fruit diameter, fruit volume and fruit yield per plant in pointed gourd were also reported by Singh *et al*. (1985), Singh and Prasad (1989) and Singh *et al*. (1992). Wide variations were observed for all the characters except female flower length and fruit width (Table 2). These two characters exhibited the minimum range of 1.39-2.44 cm and 2.88-4.06 cm with a general mean of 2.08±0.05 and 3.69±0.06 indicating narrow range of variability. These characters were affected by the environment as genotypic and environmental variances were almost equal. The remaining characters were less influenced by the environment, as they showed less environmental variances. The range of variation was maximum in nodes per vine (49-95), fruits per plant (32-159), fruit yield per plant (1.12-7.24), vines per plant (4-10), vine length (3.53-7.50m), fruit length (7.72-12.17cm), fruit volume (38.02-77.55 cc) and fruit weight (29.06-58.41g), indicating remarkable variations among the genotypes.

The fruit yield per plant exhibited the maximum range of variation (1.12-7.24) with a mean of 3.09±0.30. The general mean value for fruits per plant was 80.00±7.65, but the range varied from 32-159. Characters with`` high range of variation, should be given priority in the selection (Vijay, 1987). While the range of variation was low for the characters indicated narrow range of variability among the genotypes and suggested that selection would not be effective for these traits.

Coefficient of variability is the relative measure of dispersion (Singh *et al*., 1992). Genotypic coefficient of variations was computed to find out the amount of variation caused by genotype and environment (Srivastava and Srivastava, 1976). Sufficient amount of genetic variability is the pre-requisite for starting a breeding program in any crop. The results of this investigation indicated that considerable amount of genetic variability exists in respect of various characters in pointed gourd, and therefore, selection should be effective in improving the yield.

Table 1. Analysis of variance for ten yield and yield contributing characters in pointed gourd

Sources of Variation	d.f.	Nodes per vine	Vines per plant	Vine length (m)	Fruits per plant	Female flower length (cm)	Fruit length (cm)	Fruit width (cm)	Fruit volume (cc)	Fruit weight (g)	Fruit yield per plant (kg)
Block	2	338.440	2.893	0.147	569.053	0.012*	0.085	0.006	0.153	1.192	1.287
Genotype	24	390.61**	6.46**	3.83**	4390.81**	0.22**	3.51**	0.28**	362.11**	206.42**	6.86**
Error	48	44.468	1.435	0.236	103.039	0.034	0.399	0.082	6.514	4.418	0.176
CV%		10.86	13.79	9.50	11.34	8.85	6.22	7.77	4.17	5.66	14.75

** Significant at 1% level

Table 2. Mean, range and phenotypic and genotypic variances for ten characters of pointed gourd

Character	Mean ± SE	Range	σ^2p	σ^2g	σ^2e	F-value
Nodes per vine	64.12 ± 2.28	49-95	159.85	115.38	44.47	**
Vines per plant	7.05 ± 0.29	4-10	3.11	1.68	1.44	**
Vine length (m)	5.16 ± 0.23	3.53-7.50	1.43	1.20	0.24	**
Fruits per plant	80.15 ± 7.65	32-159	1532.30	1429.26	103.04	**
Female flower length (cm)	2.08 ± 0.05	1.39-2.44	0.10	0.06	0.03	**
Fruit length (cm)	10.16 ± 0.22	7.72-12.17	1.44	1.04	0.40	**
Fruit width (cm)	3.69 ± 0.06	2.88-4.06	0.15	0.07	0.08	**
Fruit volume (cc)	61.18 ± 2.19	38.02-77.55	124.29	118.00	6.79	**
Fruit weight (g)	46.35 ± 1.64	29.06-58.41	70.32	66.23	4.10	**
Fruit yield per plant (kg)	3.09 ± 0.30	1.12-7.24	2.45	2.25	0.20	**

σ^2p =Phenotypic variance; σ^2g =Genotypic variance and σ^2e =Environmental variance

Table 3. Phenotypic and genotypic coefficients of variation, heritability in broad-sense and genetic advance for ten characters in pointed gourd

Character	PCV	GCV	Heritability (h^2b)	Genetic advance (GA)	GA as % of mean
Nodes per vine	19.72	16.75	72.18	18.80	29.32
Vines per plant	25.01	18.36	53.87	1.96	27.75
Vine length (cm)	23.23	21.20	83.30	2.06	39.87
Fruits per plant	48.84	47.17	93.28	75.22	93.85
Female flower length (cm)	14.86	11.94	64.51	0.41	19.75
Fruit length (cm)	11.80	10.04	72.31	1.79	17.58
Fruit width (cm)	10.45	6.98	44.60	0.35	9.61
Fruit volume (cc)	18.26	17.75	94.56	21.76	35.56
Fruit weight (g)	18.09	17.56	94.18	16.27	35.10
Fruit yield per plant (kg)	50.45	48.34	91.80	2.96	95.41

PCV= Phenotypic coefficient of variation; GCV= Genotypic coefficient of variation

The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters studied (Table 3). This type of findings are in agreement with those reported by Singh *et al*. (1992) in pointed gourd, Masud *et al*. (1998) in pumpkin, Singh *et al*. (1977) in bitter gourd. The range of phenotypic coefficient of variation was from 10.45-50.45%. Higher values of phenotypic coefficient of variation were observed in fruits per plant (48.84%) and fruit yield per plant (50.45%). Fruits per plant (47.17%) and fruit yield per plant (48.34%) also showed high genotypic coefficient of variation. The fruits per plant, vine length and fruit yield per plant showed higher genotypic coefficient of variation which offered scope for their improvement as these were less affected by the environment. Moreover, the differences in GCV and PCV estimates were narrow, confirming the least environmental influence in attaining the observed variability. These results are in agreement with that of Saha *et al*. (1992) and Masud *et al*. (1998) as they estimated higher levels of variability in pumpkin. Burton and de Vane (1953) and Singh *et*

al. (1985) opined that the higher GCV estimates could be a potential indicator for effective selection. The highest genotypic coefficient of variability was recorded for fruit yield per plant, which indicated the possibilities of utilization of the variation for improvement. Similar results were reported by Singh *et al*. (1992) and Masud *et al*. (1998) in pointed gourd and pumpkin, respectively. Higher magnitude of genetic variance suggested the presence of high genetic variability. These results are in agreement with Singh *et al.* (1977) in bitter gourd and Singh (1983) in pointed gourd. The characters showing low value of genotypic coefficient of variation indicated that they were more influenced by the environment. The GCV values for remaining characters were more or less low, which showed the low genetic variability as they were more influenced by the environment and limited scope for improvement through selection for these characters. Genotypic coefficient of variation was lower than the corresponding phenotypic one, which indicated the larger influence of environment. This finding is in full agreement with Masud *et al*. (1998) in pumpkin.

In the present study, estimates of broad sense heritability were very high for fruit volume (94.56 %) followed by fruit weight (94.18 %), fruits per plant (93.28 %), fruit yield per plant (91.80%), vine length (83.30 %), fruit length (72.31 %) and nodes per vine (72.18 %) which indicated further scope of genetic improvement for these characters. Similar results for fruit weight and fruit yield have been reported by Singh *et al*. (1992), Sachan and Tikka, (1971) and Singh *et al*. (1977) in pointed gourd, water melon and bitter gourd, respectively. Singh and Prasad (1989) and Masud *et al*. (1998) also reported high heritability for number of fruits per plant, fruit weight and fruit yield in pointed gourd and pumpkin, respectively. High estimates of heritability for these traits suggested that the selection based on phenotypic performance would be more effective as reported by Johnson *et al*. (1955) and Singh *et al.* (1992). The remaining characters viz. fruit width (44.60 %), vines per plant (53.87 %) and female flower length (64.51 %) showed low and moderate heritability, respectively. These three characters had also low genotypic coefficient of variation (6.98, 18.36 and 11.94, respectively).

Although estimates of heritability are useful to plant breeder as they provide basis of selection, more reliable conclusion can be made when heritability is considered in conjunction with genetic advance. High heritability value along with high value of genetic advance as percent of mean is most effective condition for selection (Gandhi *et al*., 1964). In the present study, the maximum genetic gain of 95.41% (expressed as % mean) was observed in fruit yield followed by fruits per plant (93.85%). Characters like fruit yield and fruits per plant have showed high heritability value as well as high value of genetic advance as percent of mean. Such condition arises due to action of additive genes (Panse, 1957). This suggested that selection for these two characters would be more fruitful. These characters were less influenced by environment and simply inherited by a few additive genes. It suggests that selection of these characters could be more straight forward and effective (Masud *et al*., 1998). These findings are in full agreement with earlier reports for yield in winter melon (Sachan and Tikka, 1971), number of fruits per plant and yield in bitter gourd (Srivastava and Srivastava, 1976), fruits per plant, yield per plant and fruit weight in pumpkin (Masud *et al*., 1998) and number of fruits per plant and fruit yield in pointed gourd (Singh *et al*., 1992). Additionally, high heritability coupled with high genetic advance in pumpkin was reported for fruits per plant (Mangal *et al*., 1979; Rana *et al*., 1986). These findings were supported by the present study. Further more, patterns of heritability and genetic advance for fruits per plant and fruit yield were corroborated with those of Saha *et*

al. (1992) and Doijode and Sulladmath (1986) in pumpkin. There are other characters like fruit volume, fruit weight, vine length, fruit length and nodes per vine, which showed high value of heritability, but low value of genetic advance as percent of mean. This is because of non-additive gene action, which includes dominance and epistasis (Liang and Walter, 1968). Since higher heritability coupled with high genetic advance indicates the importance of the character, the improvement can be made by repeated selection for these characters. Similar results were obtained by Singh and Prasad (1989) and Singh *et al*. (1985) in pointed gourd. Low heritability along with low genetic advance was observed in fruit width (44.60% and 9.61%), vines per plant (53.87% and 27.75%) and female flower length (64.51% and 19.75%) indicating polygenic inheritance of these traits. Similar results obtained by Masud *et al*. (1998) for fruit diameter (34.15% and 11.63%) in pumpkin. Hence direct selection for these characters would not be beneficial as also reported by Singh *et al*. (1977).

Therefore, it can be concluded that fruits per plant and fruit yield having high heritability associated with high genetic advance and also high GCV confirmed additive gene action suggesting effective selection could be made for these characters in pointed gourd.

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