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Genetic Variability, Heritability and Path Analysis in Snake Gourd (*Trichosanthes anguina* L.)

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Abstract: Genetic variability, heritability and path coefficient analysis were studied in 24 genotypes of snake gourd. The genotypic coefficient of variation was high for fruit yield, number of fruits per plant, fruit length, stem length and flesh thickness. High to moderate heritability as well as genetic advances were estimated in fruit yield, number of fruits per plant, fruit length, stem length, flesh thickness and average fruit weight. Correlation studies revealed that fruit yield had significant positive correlation with number of fruits per plant, fruit length and stem length. The highest direct positive effect were recorded for number of fruits per plant. For selecting high yielding genotypes emphasis should be given on number of fruits per plant, stem length, fruit length and average fruit weight.

Key words: Snake gourd, genetic variability, path analysis

Introduction

Snake gourd *(Trichosanthes anguina L.)* is a common cucurbitacous vegetable consumed and relished by most of the people of Bangladesh. It is important as a good source of minerals, fibers and other nutrients to make the food wholesome and healthy (Varghese and Rajan, 1993b). It's medicinal value is also high. It is one of the few vegetables which fetches more yield per unit area but the average yield of the crop is low in Bangladesh. A large number of local lines are cultivated in the country but there is no recommended cultivar. No serious attempts have so far been made to upgrade the productivity and acceptability of this crop. The productivity of the vegetable can be increased to a greater extent through varietal improvement.

For developing superior variety/ies, it is necessary to improve the yield components in snake gourd. Yield is a complex character and is associated with some yield contributing characters which are relatively and simply inherited (Rao *et al.*, 1990). The correlation and path coefficient analysis provide information about the association between any two traits and the partitioning of relationship into direct and indirect effects showing the relative importance of each of the causal factors. It also provides an indication of effective selection of desirable traits towards the improvement of varieties. The characters having high genotypic coefficient of variation indicate high potential for effective selection (Burton, 1952). The present study was undertaken to find out the genetic variability, interrelationship among different characters and the direct and indirect contribution of these characters towards the yield.

Materials and Methods

The experimental materials consisted of 24 genotypes of snake gourd, collected from different parts of southern region of Bangladesh. The study was conducted at the Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Rahmatpur, Barisal during February to August, 1999. The genotypes were grown in RCB design with three replications. There were four pits per unit plot and one plant per pit was retained. The spacing adopted was 2 x 2m^2. The size of the unit plot was 4 x 4m^2. The cultural practices, plant protection measures and fertilizers applications were adopted according to the package of practices recommended by Bose and Som (1986). Data on stem length, days to 1st male and female flower opening, fruit length (cm), fruit breadth (cm), flesh thickness (cm), average fruit weight (g), number of seeds per fruit, number of fruits per plant and fruit yield (kg/plant) were collected from all (four) plants in each plot and analyzed statistically.

Genotypic and phenotypic coefficient of variations and heritability (in broad sense) were estimated as suggested by Singh and Chaudhury (1985). Genetic advance (GA) of the genotypes at 5% selection pressure was calculated according to Johnson *et al.* (1955) and Allard (1960). Genotypic and phenotypic correlation were calculated by the formulae of Singh and Chaudhury (1985). Path coefficient analysis was also done following the methods of Dewey and Lu (1959).

Results and Discussion

Genetic parameters: The snake gourd genotypes exhibited significant differences for all the 10 characters under study (Table 1). Variability of a character is measured by range and genotypic coefficient of variation (GCV). In most of the cases little difference between genotypic and phenotypic coefficient of variations was observed indicating that environment had less influence on the expression of most of the characters. The highest GCV was found for fruit yield per plant (35.52) followed by number of fruits per plant (34.95), fruit length (27.37), stem length (20.70) and flesh thickness (15.38). This high genetic variability can be exploited by selection (Burton, 1952). The above results are in conformation with the results reported by Saha *et al.* (1992) where greater GCV were found for fruit weight, fruit length and fruit yield in pumpkin. These observations also have partial agreement with Varghese and Rajan (1993a).

The highest phenotypic coefficient of variation was found for fruit yield per plant (35.99), closely followed by number of fruits per plant (35.84) and there after fruit length (27.85), stem length (21.28) and flesh thickness (15.68).

A character can be improved only if it is highly heritable. Heritability estimates (broad sense) is used for the determination of the proportion of the total genetic variation. The heritability was high for fruit yield (97.44 %) followed by fruit length (96.52 %) and flesh thickness (96.18 %). Fruit breadth showed less estimates (34.03 %). Miah *et al.* (2000) reported the highest heritability in average fruit weight and the lowest in fruit breadth in bitter gourd.

Genetic advance in percentage of mean was maximum for fruit yield (92.57) and number of fruits per plant (89.98) while it was minimum for days to 1st female flower opening (7.18). The heritability estimates though provide the basis for selection on phenotypic performance, Johnson *et al.* (1955) and Panse (1957) suggested that the estimates of heritability and expected genetic advance should always be considered jointly. The traits which have high to moderate heritability as well as genetic gain are fruit yield, number of fruits per plant, fruit length, stem length and flesh thickness indicating that these are simply inherited traits governed by a few major genes or additive gene effects even if they are under polygenic control and these traits could be improved through selection (Chauhan and Nanda, 1983). Saha *et al.* (1991) reported similar results for fruit yield per plant, number of fruits per plant, fruit weight and days to male flower in teasel gourd. Islam *et al.* (1993) also observed similar results for vine length, weight of average fruit, number of fruits per plant and

Table 1: Estimates of genetic parameters for some economic characters in snake gourd.

Characters	Range	Mean square	Genotypic Coefficient of Variation (%)	Phenotypic Coefficient of Variation (%)	Heritability (broad sense) (%)	Genetic advance (% of mean)
Stem length (cm)	81-196	2125.55**	20.70	21.28	94.64	53.16
Days to 1st male flower	34-46	23.05**	6.46	7.64	71.41	14.41
Days to 1st female flower	41-51	12.57**	3.84	5.41	50.22	7.18
Fruit length (cm)	30.56-73.19	511.06**	27.37	27.85	96.52	70.98
Fruit breadth (cm)	3.24-5.78	0.518**	7.01	12.02	34.03	10.80
Flesh thickness (cm)	0.56-0.99	0.039**	15.38	15.68	96.18	39.82
Number of seeds/fruit	32-56	91.47**	12.18	12.89	89.37	30.40
Average fruit weight (kg)	206.57-280.17	1177.60**	7.55	8.26	83.44	18.20
No. of fruits/plant	17-62	419.69**	34.95	35.84	95.10	89.98
Fruit yield (t/ha)	4.70-15.38	26.81**	35.52	35.99	97.44	92.57

** indicates 1% level of significance.

Table 2: Genotypic (G) and phenotypic (P) correlation among important characters in snake gourd genotypes

Characters		Days to 1st male flower	Days to 1st female flower	Fruit length	Fruit breadth	Flesh thickness	No. of seeds/fruit	Average fruit weight	No. of fruits/ plant	Fruit yield
Stem length	G	-0.617**	-0.310*	0.331*	0.593**	-0.055	-0.241	0.150	0.492**	0.543**
	P	-0.520**	-0.204	0.324*	0.298	-0.062	-0.226	0.139	0.469**	0.525**
Days to 1st	G		0.966**	0.183	-0.805**	-0.369*	-0.093	-0.309*	0.040	-0.008
male flower	P		0.657**	0.133	-0.467	-0.318*	-0.057	-0.221	0.041	-0.010
Days to 1st	G			0.486**	-0.776**	-0.555**	-0.350*	0.008	0.183	0.209
female flower	P			0.340*	-0.394**	-0.387*	-0.262	0.092	0.148	0.145
Fruit length	G				-0.0593**	-0.656**	-0.427**	0.142	0.455**	0.508**
	P				-0.234	-0.608**	-0.375*	0.179	0.406**	0.472**
Fruit breadth	G					0.699**	-0.178	0.348*	-0.223	-0.166
	P					0.491**	0.001	0.403**	-0.245	-0.177
Flesh thickness	G						0.281	0.225	-0.547**	-0.529**
	P						0.284	0.225	-0.557**	-0.536**
No. of seeds/fruit	G							-0.510**	-0.043	-0.146
	P							-0.365*	-0.068	-0.155
Average fruit	G								-0.235	-0.024
weight	P								-0.284	-0.072
No. of	G									0.978**
fruits/ plant	P									0.975**

* and ** indicates 5% and 1% level of significance, respectively.

Table 3: Direct (bold) and indirect effects of different yield attributes on fruit yield of snake gourd.

Characters	Stem length	Days to 1st male flower	Days to 1st female flower	Fruit length	Fruit breadth	Flesh thickness	seeds/ fruit	Ave. fruit weight	No. of fruits/ plant	Genotypic correlation with fruit yield
Stem length	**0.058**	0.010	-0.019	-0.011	-0.008	0.002	-0.010	0.035	0.487	0.543**
Days to 1st male flower	-0.036	**-0.015**	0.062	-0.006	0.011	0.011	-0.004	-0.071	0.040	-0.008
Days to 1st female flower	-0.018	-0.015	**0.063**	-0.016	0.010	0.017	-0.014	0.002	0.181	0.209
Fruit length	0.019	-0.003	0.030	**-0.032**	0.008	0.020	-0.017	0.033	0.450	0.508**
Fruit breadth	0.034	0.012	-0.049	0.019	**-0.013**	-0.021	-0.007	0.083	-0.221	-0.166
Flesh thickness	-0.003	0.006	-0.035	0.021	-0.009	**-0.030**	0.011	0.052	-0.541	-0.529**
No. of seeds/fruit	-0.014	0.001	-0.022	0.014	0.002	-0.009	**0.041**	-0.117	-0.042	-0.146
Average fruit weight	0.009	0.005	0.000	-0.005	-0.005	-0.007	-0.021	**0.231**	-0.232	-0.024
No. of fruits/plant	0.028	-0.001	0.011	-0.015	0.003	0.017	-0.002	-0.054	**0.989**	0.978**

Residual effect = 0.18 ** indicates 1% level of significance.

fruit yield in cucumber.

Correlation: In general, genotypic correlation coefficients were higher than phenotypic correlation coefficients, which indicated the masking effects of the environment which in turn modified the expression of a character thereby reducing the phenotypic expression (Nandpuri *et al.*, 1973; Saha *et al.*, 1992 and Islam *et al.*, 1993). Fruit yield had significant positive genotypic and phenotypic correlation with number of fruits per plant, stem length and fruit length but flesh thickness showed significant negative genotypic and phenotypic correlation (Table 2). Stem length showed significant positive correlation with fruits per plant and fruit length. Significant positive genotypic and phenotypic correlation were observed for days to first male flower opening with days to first female flower opening. Days to first female flower opening had significant positive genotypic and phenotypic correlation with fruit length. Significant positive genotypic and phenotypic correlation were found between fruit length and number of fruits per plant, fruit breadth with flesh thickness and average fruit weight. Islam *et al.* (1993) found significant positive genotypic and phenotypic correlation of number of fruits per plant and average weight with fruit yield in cucumber.

Path coefficient analysis: Association of characters as determined by simple correlation coefficient may not provide an exact picture of the relationship between yield components and yield. Path coefficient analysis, in contrast, permits a critical examination of specific direct and indirect effects of characters and measures the relative importance of each of them in determining final yield. Path co-efficient analysis (Table 3) showed that number of fruits per plant had the maximum direct effect (0.989) followed by average fruit weight (0.231). Rahman *et al.* (1986) reported that number of fruits per plant had the second highest positive direct effect on fruit yield of bottle gourd although the genotypic correlation between them was not significant. Miah *et al.* (2000) found that average fruit weight had maximum direct contribution (1.699) on yield of bitter gourd followed by number of fruits per plant (0.932). On the other hand, Saha *et al.* (1992) found positive direct

effect for number of fruits per plant, fruit weight and fruit length on fruit yield in pumpkin. This direct effect of fruit weight was diluted mainly due to high negative indirect effect on fruit yield via flesh thickness and moderate negative indirect effect on fruit yield via fruit breadth. Consequently, such anomalous situation suggests that restricted simultaneous selection model could be followed to nullify the undesirable indirect effect.

The residual effect was 0.18 indicating that about 82 percent of the variability in yield was contributed by the ten characters studied in path analysis. Results form the present findings indicated that number of fruits per plant, fruit length, stem length, flesh thickness and average fruit weight had high to moderate heritability and genetic advance. These characters also showed moderate to high positive or negative direct effect on fruit yield. Therefore, emphasis should be given on these characters for improvement of fruit yield of snake gourd is aimed at in a breeding program.

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