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Research Note

Genetic variability, heritability, correlation and path analysis in snake gourd (*Trichosanthes cucumerina* L.)

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Abstract
The present investigation was conducted to magnitude the genetic variability, heritability and genetic advance in snake gourd for identifying desirable parents. Fifty genotypes were evaluated for eleven characters through RBD during the year 2011–12. The phenotypic coefficient of variance (PCV) was slightly higher than their corresponding genotypic coefficient of variance (GCV) for all characters. Highest GCV and PCV values were observed for characters like fruit length, fruit weight and number of fruits per plant. Moderate phenotypic coefficient of variation and genotypic coefficient of variation for yield, fruit girth and number of seeds per fruit indicated the presence of high genetic variability for these traits in the material. High heritability along with high genetic advance observed for fruit length, yield, fruit girth and number of fruits per plant. Fruit yield had significant positive genotypic and phenotypic correlation with number of fruits per plant, fruit girth and vine length. Path coefficient analysis showed that fruit weight had maximum direct effect followed by number of fruits per plant. For selecting high yielding genotypes emphasis should be given on number of fruits per plant, fruit length, fruit weight, fruit girth and vine length.

Key words
Snake Gourd, *Trichosanthes cucumerina* L., genetic variability, correlation, path analysis

Snake gourd (*Trichosanthes cucumerina* L.) belongs to the family Cucurbitaceae and it's an important summer vegetable but it may grow throughout the year except extreme winter. It is a good source of minerals, fiber and nutrients to make the food wholesome and healthy (Ahmed *et al*., 2000). Its 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. 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 of the snake gourd and it can be increased to a greater extent through varietal improvement. For developing superior varieties, it is necessary to improve the yield and yield contributing components in snake gourd. Yield is a complex character and is associated with some yield contributing characters, which are relatively and simple inherited (Rao *et al*., 1990). The assessment of variability present in any crop species is the essential pre-requite for formulating an effective breeding programme.

The existing variability can be used for further improvement to enhance the yield level of the cultivars following appropriate breeding strategies (Patil *et al.,* 2012). The heritability is also influenced by environment, the information on heritability alone may not help in pin pointing characters for enforcing selection. Nevertheless, the heritability estimates in conjunction with predicted genetic advance will be more reliable (Johnson *et al*., 1955). Heritability gives the information on the magnitude of quantitative characters, while genetic advance will be helpful in calculating suitable selection procedures. The present investigation aims to assess the variability together with the relative contribution of different yield attributes to yield and their interrelationship by estimating phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance, correlation and path analysis in snake gourd. Selection based on these characters may be helpful in planning efficient breeding programme.

The present investigation was conducted in the Department of Horticulture, Agricultural College and Research Institute, Madurai during the period from 2011–'12. Totally 50 genotypes were collected from different geographical location and utilized for study. Among 50 genotypes, 40 genotypes were collected from NBPGR, New Delhi, three varieties were collected from Tamil Nadu Agricultural University viz., PKM1, MDU1 and Co 2 and seven local types were collected from in and around Tamil Nadu *viz*., Kulithalai, Kumbakonam, Palayajeyamkondam, Nagappattinam, Jeyamkondam, Madurai and Coimbatore. The experiment was laid out in Randomized Block Design with three replications. The seeds were sown at a spacing of 2x2m. The plants were supported by trellis and other intercultural operations such as weeding, irrigation, plant protection measures etc. were done as and when needed. Observations were recorded for yield and yield contributing characters, *viz.*, vine length, days to first female flower appearance, days to first male flower appearance, fruit length, fruit girth, fruit weight, number of seeds per fruit, number of fruit per plant and yield were recorded. Standard

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statistical procedures were used for the analysis of variance, genotypic coefficients of variation (Burton and De Vane, 1952), heritability (Lush 1940), correlation (Johnson *et al*., 1955) and path analysis (Dewey and Lu, 1959).

Genotypic and Phenotypic Coefficient of Variation: The snake gourd genotypes exhibited significant differences for all the eleven characters under study presented in Table 1. Variability of a character was measured by range and genotypic coefficient of variation (GCV). In most of the cases, little difference between genotypic and phenotypic coefficient of variations were observed, it indicating that the environment had less influence on the expression of most of the characters. The highest GCV was found for fruit length (47.15) followed by fruit weight (46.23), number of fruits per plant (31.81), yield (29.46) and number of seeds per fruit (22.77). This high genetic variability can be exploited by selection (Burton and De Vane, 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 girth in pumpkin. These observations also have partial agreement with Varghese and Rajan (1993) and Rahman *et al*. (2002).

The highest phenotypic coefficient of variation was found for fruit weight (121.58), Fruit length (47.15), number of fruits per plant (31.86) and yield (29.46). The lowest phenotypic coefficient of variation was observed in days to first female flower appearance (5.82) and days to first male flower appearance (10.20). This result was in conformity with the findings of Rahman *et al*., 2002.

Heritability and Genetic advance: A character can be improved only if it is highly heritable. Heritability estimates (broad sense) is used for determination of proportion of the total genetic variation. The heritability was high for fruit length (99.99%) and fruit yield (99.99%) followed by number of seeds per fruit (99.97%), number of fruits per plant (99.69%), fruit girth (99.94%), vine length (99.82%). The similar result obtained by Rahman *et al*., 2002 and Khan *et al*., 2016 in snake gourd. The fruit weight showed less estimates (14.46%). Miah *et al*. (2000) reported the highest heritability in average fruit weight and the lowest in fruit girth in bitter gourd. Genetic advance in percentage of mean was maximum for fruit length (97.13) followed by number of fruits per plant (65.42), yield (60.69) and fruit girth (50.78). While it was minimum in days to first female flower appearance (9.14).

The heritability estimates provide the basis for selection on phenotypic performance. The traits, *viz*., fruit length, number of fruits per plant, yield, fruit girth recorded moderate heritability and genetic advance. It 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). Khan *et al*., 2016 reported similar results for fruit yield per plant, number of fruits per plant, fruit weight, days to first male flower appearance in teasel gourd. Islam *et al*., 1993 also observed similar results for vine length, fruit weight, number of fruits per plant and fruit yield in cucumber.

Correlation: In general, genotypic correlation coefficient was higher than phenotypic correlation coefficient, which indicated the making effects of the environment, which in turn modified the expression of a character thereby reducing the phenotypic expression (Rahman *et al*., 2002 and Khan *et al*., 2016). Fruit yield had significant positive genotypic and phenotypic correlation with number of fruits per plant, fruit girth and vine length but none of the character showed significant negative phenotypic and genotypic correlation (Table 2). Vine length had significant positive genotypic and phenotypic correlation with yield. Inter nodal length had significant negative genotypic correlation with fruit weight. First female flower appear on node (earliness) and days to first female flower appearance had significant positive genotypic and phenotypic correlation with days to first male flower appearance and number of seeds per fruit. Days to first male flower appearance had significant positive genotypic correlation with number of seeds per fruit. Number of seeds per fruit character showed significant negative phenotypic and genotypic correlation with number of fruits per plant. Fruit length had significant negative phenotypic and genotypic correlation with fruit girth and number of fruits per plant. Fruit girth had significantly positive phenotypic and genotypic correlation with number of fruits per plant and yield. Number of fruits per plant had significantly positive phenotypic and genotypic correlation with yield. Islam *et al*., 1993 found significant positive phenotypic and genotypic correlation of number of fruits per plant and average fruit weight with fruit yield in cucumber and Rahman *et al*. (2002) in snake gourd.

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 character and measures the relative importance of each of them in determining final yield. Path coefficient analysis (Table 3) showed that fruit weight had maximum direct effect (1.7224) followed by number of fruits per plant

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(1.7047). Rahman *et al*., 2002 found that number of fruits per plant (0.989) followed by fruit weight (0.231) had maximum direct contribution on yield of snake gourd. On the other hand, Miah *et al*., 2000 found that average fruit weight had maximum direct contribution (1.699) on yield of bitter gourd and 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 positive indirect effect on fruit yield via fruit girth. Consequently, such anomalous situation suggests nullifying the undesirable indirect effect.

The residual effect of 0.35 indicated the adequacy of the traits chosen for the path analysis. Results from the present finding indicated that, the characters *viz*., number of fruits per plant, fruit length, stem length, fruit breadth and fruit weight had high to moderate heritability and genetic advance. These characters also showed moderate to high positive and negative direct effects and indirect effect on fruit yield. Therefore, emphasis should be given on these characters for improvement of fruit yield of snake gourd through breeding programme.

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

Characters	Mean	Range	GCV (%)	PCV (%)	Heritability %	GA (% of mean)
Vine length (cm)	5.57	3.65-7.30	15.40	15.41	99.82	31.70
Internode length (cm)	17.08	12.40-22.51	12.64	13.38	89.19	24.58
First female flower appear on node	13.38	8.00-19.00	16.47	18.87	76.18	29.62
Days to first female flower appearance	43.38	38.00-49.00	5.08	5.82	76.18	9.14
Days to first male flower appearance	40.07	22.00-46.00	6.89	10.20	45.64	9.59
Number of seeds per fruit	74.95	18.60-112.50	22.77	22.77	99.97	46.89
Fruit length (cm)	59.47	14.97-151.85	47.15	47.15	99.99	97.13
Fruit girth (cm)	17.58	10.49-32.98	24.66	24.67	99.94	50.78
Fruit weight (g)	579.85	29.75-985.00	46.23	121.59	14.46	36.21
Number of fruits per plant	22.46	12.00-42.00	31.81	31.86	99.69	65.42
Yield (tons/ha)	25.72	7.25-41.90	29.46	29.46	99.99	60.69

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

Character		Internode length	1st female flower appear on node	Days to 1st female flower appearance	Days to 1st male flower appearance	No. of seeds per fruit	Fruit length	Fruit girth	Fruit weight	No. of fruits per plant	Yield
Vine length	G	0.151	0.127	0.127	0.12	0.079	0.048	0.082	-0.207	0.058	0.252*
	P	0.141	0.111	0.111	0.083	0.079	0.048	0.082	-0.080	0.058	0.252*
Internode length	G		-0.14	-0.14	-0.224	0.005	-0.047	-0.076	-0.359**	0.131	0.168
	P		-0.115	-0.115	-0.072	0.005	-0.045	-0.071	-0.112	0.121	0.159
1st female flower appear on node	G			1.000	1.027**	0.252*	0.119	0.067	0.084	-0.065	0.051
	P			1.000	0.682**	0.222*	0.104	0.057	-0.035	-0.053	0.044
Days to 1st female flower appearance	G				1.027**	0.252*	0.119	0.067	0.084	-0.065	0.051
	P				0.682**	0.222*	0.104	0.057	-0.035	-0.053	0.044
Days to 1st male flower appearance	G					0.247*	0.171	-0.01	0.119	-0.182	-0.015
	P					0.167	0.115	-0.008	0.006	-0.121	-0.01
No. of seeds per fruit	G						0.157	-0.096	0.027	-0.330*	-0.192
	P						0.157	-0.096	0.014	-0.330*	-0.192
Fruit length	G							-0.466**	0.215	-0.349**	0.137
	P							-0.466**	0.082	-0.349**	0.137
Fruit girth	G								0.135	0.340**	0.322*
	P								0.051	0.340**	0.322*
Fruit weight	G									-0.710**	0.216
	P									-0.269*	0.082
No. of fruits per plant	G										0.398**
	P										0.397**

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

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

Characters	Vine length	Internode length	1st female flower appear on node	Days to 1st female flower appearance	Days to 1st male flower appearance	No. of seeds per fruit	Fruit length	Fruit girth	Fruit weight	No. of fruits per plant	Genotypic correlation with Yield
Vine length	**0.463**	0.055	0.084	0.062	-0.137	0.016	0.007	-0.041	-0.356**	0.099	0.252*
Internode length	0.070	**0.366**	-0.092	-0.068	0.256	0.001	-0.007	0.038	-0.618**	0.223	0.168
1st female flower appear on node	0.059	-0.051	**0.658**	0.484	-1.169	0.052	0.018	-0.034	0.145	-0.111	0.051
Days to 1st female flower appearance	0.059	-0.051	0.658	**0.484**	-1.169	0.052	0.018	-0.034	0.145	-0.111	0.051
Days to 1st male flower appearance	0.056	-0.082	0.675	0.497	**-1.139**	0.051	0.026	0.005	0.206	-0.310	-0.015
No. of seeds per fruit	0.036	0.002	0.166	0.122	-0.281	**0.207**	0.024	0.048	0.047	-0.563	-0.192
Fruit length	0.022	-0.017	0.078	0.058	-0.195	0.033	**0.151**	0.233	0.370	-0.595	-0.137
Fruit girth	0.038	-0.028	0.044	0.033	0.012	-0.020	-0.070	**-0.499****	0.232	0.580	0.322**
Fruit weight	-0.095	-0.131	0.055	0.041	-0.136	0.006	0.032	-0.067	**1.723**	-1.211	0.216
No. of fruits per plant	0.027	0.048	-0.043	-0.032	0.207	-0.068	-0.053	-0.170	-1.223	**1.705**	0.398*

Residual effect = 0.35 *and** indicates 5% and 1% level of significance, respectively.