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Genetic variability in snakegourd (*Tricosanthes cucurminata*)

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An experiment was conducted at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur to study the genetic variability and hybrid performance of snake gourd using seven parents and their twelve F_1 hybrids. The analysis of variance showed significant difference among the parents and hybrids for most of the characters except days to first female flower, days to first fruit setting and node number of first fruit setting. The difference between phenotypic and genotypic variance were minimum in most of the characters except days to first male and female flowering, days to first fruit setting. Node number of first male and female flower, node number of first fruit setting, number of primary branches per plant, length of vine, fruit diameter and fruit yield per plant showed high heritability along with low genetic advance. Again days to first male and female flower, first fruit setting showed low broad sense heritability and low genetic advance. Total number of fruits per plant, average fruit weight and fruit length shows high broad sense heritability along with high genetic advance. The hybrid SG-18× SG-01 produced the highest number of fruits per plant and fruit yield per plant followed by SG-04 × SG-26. The hybrid SG-04× SG-26 took minimum days to produce female flower. The hybrids SG-18× SG-01, SG-04× SG-26, SG-06× SG-18, SG-06× SG-25 and SG-18× SG-25 could be identified as promising combination for commercial cultivation.

Keywords: Snake gourd (*Triconsanthes cucurminata*), hybrid, underutilized crop, GCV, PCV, heritability, summer vegetables

Introduction

Snake gourd is a day neutral type of vegetable which can be grown in any time of the year except acute winter. Snake gourd grows more or less in every part of Bangladesh. Usually it is grown well from March to October both in the field and homestead garden. As a result, it can meet up the vegetable demand during early kharif when there exists an acute shortage of vegetable in

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Bangladesh (BBS, 2007). In addition it has got tremendous export potentiality because of its excellent keeping quality. The yield of snake gourd is very poor and its production is also restricted to only to 3-4 months in Bangladesh. There are number of cultivars with wide range of variability in size, shape and color of fruits available in this country and for this we can easily fulfill the gap by producing more snake gourd in the lean period by hybrid variety (Rashid, 1993; Kamaluddin, 1996). Genetic variability is a prerequisite for a successful breeding program of any crop species and a critical survey of genetic variability is essential before initiating an improvement program aiming to develop high yielding varieties (Rao *et al*., 1997; Haussmann *et al.*, 2004). Very little attention has been given to develop high yielding variety of snake gourd being monoecious. There is bright scope to study the heterosis, which is the prerequisite for developing high yielding snake gourd variety or hybrid variety in Bangladesh (Ahmed *et al.*, 2000). Therefore, the present investigation was undertaken with the objective to determine the magnitude of genetic variability as well as hybrid performance for some desirable yield contributing characters.

Materials and methods

The experiment was conducted at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur, Bangladesh during the months from March to June, 2007. Seven parents (P_1=SG-01. P_2=SG-04, P_3=SG-06, P_4=SG-10, P_5=SG-18, P_6=SG-25 and P_7=SG-26) and their twelve F_1s were used as an experimental materials. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Recommended doses of manure and fertilizers were applied in the experimental field according to BARI (1991). Data were collected on each of the seven parents and their F_1s for the characters such as days to first male flower, days to first female flower, node number of first male flower, node number of first female flower, days to first fruit setting, node number of first fruit setting, number of primary branches per plant, length of vine in each plant (cm), total number of fruits plant, fruit weight (g), fruit diameter (cm), fruit length (cm), fruit yield/plant (g). For univariate analysis, analysis of variance was done individually by a statistical package SAS, version 9.01 (2008) and test of significance was done by F-test (Pense and Shukhatme, 1978; Steel and Torrie, 1980; Singh and Chaudhary, 2006). Genotypic and phenotypic coefficients of variation were calculated by the formula suggested by Burton (1952) and Al-Jibouri *et al.* (1958). The broad sense heritability and genetic advance in percentage of mean were calculated following Hanson (1961) and Johnson *et al*. (1955).

Results and discussions

Analysis of variance, mean performance and genetic parameters for different characters of snake gourd are presented in the Table 1 to 4/3. The analysis of variance showed significant difference among the parents and hybrids for most of the characters except days to first female flower, days to first fruit setting and node number of first fruit setting.

Days to first male and female flowering: First male and female flower bloomed at 74.66 and 81.66 days after sowing, respectively in the parent SG-26 and maximum days for male flower were recorded to be 82.00 in SG-18 and SG-25 and female flower in SG-25 (Table 2). Male flower first bloomed at 71.66 days after sowing in hybrid combinations SG-06 × G-18 and SG-10 × G-18 and maximum days recorded to be 81.66 in SG-18 × SG-1 (Table 3). In case of hybrid, first female flowers bloomed at 74.66 days after sowing in SG-4 × SG-26 and maximum (86.00) in SG-1 × SG-10 (Table 3). Flowering characters showed minimum difference between the genotypic and phenotypic variance. Low estimates of broad sense heritability along with low genetic advanced revealed that the environment played important role in the expression of days to first flowering (Table 1). Ahmed (1998) and Banik (2003) in snake gourd and Srivastaba and Nath (1983) reported similar results days to flowering in bitter gourd.

Node number of first male and female flower: The lowest number of node of first male flower was found in SG-01 (4.33) and the highest (16.00) in SG-18 (Table 2). The genotype SG-10 produced first female flower at the node number 18.33 and genotype SG-06 in the highest (22.66) number of node. Hybrids showed significant differences among them for this character (Table 1). The lowest number of node for first male flower was found in SG-01 × SG-18 (6.33) and the highest (16.00) in SG-06 × SG-25 (Table 3). In case of female flower the lowest number of node was observed in SG-10 × SG-06 (15.66) and the highest (23.66) in SG-01 × SG-26 (Table 3).

The difference between phenotypic variance and genotypic variance for this trait was very low (Table 1) indicating less influence in environment. Podder (2006) in snake gourd and Sonalika and Seth (1980) in ash gourd also reported similar information in the genetic control of fruit yield per plant. The characters showed high heritability coupled with low genetic advanced revealed non-additive gene action for the expression of node number of first male and female flowering. High heritability is exhibit due to influence of favorable environments rather than genotypes and selection for such trait may not be rewarding.

Days to first fruit setting: Mean days to first fruit setting ranged for ranged from 83.66 to 87.33 among the parents and 78.66 to 88.33 days among the hybrids (Table 2). The lowest days for first fruit setting were observed in the genotype SG-26 and the highest in SG-01. In hybrids the lowest number of days observed for first fruit setting in SG-01 × SG-26 and the highest in SG-01 × SG-10 followed by SG-10 × SG-18 (Table 3). Sonalika and Seth (1980) in ash gourd observed same results for days to first fruit setting. Minimum difference between genotypic and phenotypic variance for days to first fruit setting indicates little influence of environment on the expression of this character. Low heritability associated with low genetic advance suggested that improvement of this character would not be effective through phenotypic selection.

Node number of first fruit setting: The analysis of variance for this character showed significant differences among the parents (Table 1). The lowest number of node for first fruit was observed in SG-10 (13.66) and the highest (23.33) in SG-06 (Table 2). The lowest number of node for first fruit was found in the hybrid combination SG-10 × SG-25 (14.66) and the highest (23.00) in SG-01 × SG-26 (Table 3). The difference between phenotypic and genotypic variance for this trait was very low indicating less influence of environment in the expression of this character. Node number of first fruit setting showed high heritability along with lower genetic advanced indicate non-additive gene action. High heritability is exhibit due to influence of favorable environments rather than genotypes and selection for this trait may not be rewarding.

Number of primary branches per plant: Number of primary branches per plant showed significant differences among the parents and hybrids (Table 1). The highest number of primary branches was recorded in SG-25 (11.66) and lowest (8.33) in SG-01 (Table 2). The highest number of primary branches was recorded in SG-06 × SG-25 and SG-18 × SG-01 (11.33) and lowest (7.33) in SG-10 × SG-06 (Table 3). The difference between the genotypic and phenotypic variance for this character was high indicating maximum influence of environment for the expression of this trait. The trait also showed high heritability along with low genetic advanced.

Length of vine: The highest vine length was recorded in parental genotype SG-18 (6.17) and in the hybrid SG-04 × SG-26 (6.36) (Table 3). Snake gourd hybrid produce longer vine length compared to its parent (Latif, 1993; Rahman, 2004). The character showed very minimum differences between the genotypic and phenotypic variance indicating less influence of environment for the expression of this trait. High broad sense heritability along low genetic advanced was observed for this character indicating selection for this character would not be effective.

Total number of fruits per plant: Significant differences among the parents and hybrids were observed for total number of fruits per plant (Table 1). The highest number of fruits was found in SG-10 (30.00) and the lowest (13.00) in SG-26 (Table 2). In case of hybrids the highest number of fruits per plant was found in the combination SG-18 × SG-01 (51.66) and the lowest (14.66) in SG-01 × SG-10 (Table 3). The character showed minimum difference between the genotypic and phenotypic variance indicating less influence of environment for the expression of this trait. High heritability in broad sense along with low genetic advanced for this trait indicated that the selection for this character may not be effective.

Fruit weight: The highest fruit weight was recorded in SG-10 (158.82) and the lowest (101.89) in SG-06 (Table 3). The highest number of fruit was found in hybrid combination SG-04 × SG-26 (210.32) and the lowest (110.26) in SG-10 × SG-25 (Table 3). The character showed minimum difference between the genotypic and phenotypic variance indicating less influence of environment for the expression of this trait (Table 1). High heritability along with high genetic advanced was also observed for this character. It indicates that the heritability is due to additive gene effects and selection for this trait may be effective. Kitroongruang *et al*. (1992) in Thai melon reported similar result for individual fruit weight.

Fruit diameter: The highest fruit diameter was recorded in SG-18 (50.85) and the lowest (26.18) in SG-26 (Table 2). The highest fruit diameter was recorded in SG-18 × SG-01 (50.58) and the lowest (35.14) in SG-10 × SG-25 (Table 3). The character showed less difference between the genotypic and phenotypic variance indicating less influence of environment for the expression of this trait (Table 1). It showed high heritability but low genetic advanced.

Fruit length: Highly significant difference among the parents and hybrids for fruit length showed significant differences among the genotypes in case of parents (Table 1). The highest fruit length was recorded in SG-26 (52.79) and the lowest (17.73) in SG-18 (Table 2). The hybrid combination SG-01 × SG-26 (31.58), SG-04 × SG-26 (33.95) and SG-06 × SG-25 (30.87) produced the longest fruit than grand mean (27.26). The highest fruit length was recorded in SG-04 × SG-26 (33.75) and the lowest (21.85) in SG-10 × SG-18 (Table 3). Maximum difference between the genotypic and phenotypic variance indicating less influence of environment for the expression of fruit length (Table 1). High heritability associated with high genetic advanced indicated that the heritability is due to additive gene effects and considerable potential for developing of high yielding varieties through selection of desirable genotypes.

Fruit yield per plant: The analysis of variance revealed highly significant difference among the parents and hybrids for fruit yield per plant (Table 1, Figure 1). Mean performance of parents and hybrids indicated worth of genetic variability for the improvement of fruit yield in snakegourd (Table 2). The highest fruit yield was recorded in parent SG-10 (4.76) and hybrid SG-10 × SG-25 (9.77).

Fig. 1. Different fruit morphotypes of parents (a) and their hybrids (b)

On the other hand the lowest (1.60) yield in parental genotype SG-01 (Table 2) and in hybrid the lowest (2.26) in SG-01 × SG-10 (Table 3). The hybrid SG-10 × SG-25 (9.77) and SG-04 × SG-26 (8.83) were significantly higher than their grand mean and may be rated as desirable hybrids for improvement of fruit yield. The character showed very low difference between the genotypic and phenotypic variance indicating less influence of environment for the expression of this trait (Table 1). Hybrid produced higher fruit yield compared to their parents (Podder, 2006 in snake gourd; Dhaliwal and Lal, 1996 in mask melon and Vahab, 1989 in bitter gourd). High estimates of broad sense heritability for the character revealed that the variations were transmitted to the progeny. Expected genetic advanced was low for this character. The high value of heritability and genetic advance show that variation is attributable to a high degree of additive effect and the character can be improved by selection (Panse, 1957).

Conclusion

Node number of first male and female flower, node number of first fruit setting, number of primary branches per plant, length of vine, fruit diameter and fruit yield per plant showed high heritability along with low genetic advance revealed non-additive gene action. High heritability is exhibit due to influence of favorable environment rather than genotypes and selection for this traits may be rewarding. Again days to first male and female flower, first fruit setting showed low broad sense heritability and low genetic advance which suggest that the character is highly influenced by environmental effects and selection for this character will not be effective and improvement for this character would not be effective through phenotypic selection. Total number of fruit per plant, average fruit weight and fruit length shows high broad sense heritability along with high genetic advance indicated that the heritability is due to additive gene effects and considerable potential for developing of high yielding varieties through selection of desirable genotypes. Low heritability coupled with high genetic advance for days to first female flower indicates that the character is governed by additive gene effects and the low heritability is due to high environmental effects. The characters with high values of heritability accompanied by high genetic advance indicating that might be transmitted to their hybrid progenies. This result suggests that improvement of these would be effective through phenotypic selection. High heritability is considered to be helpful in making selection of superior genotypes on the basis of phenotypic performance. The high value of heritability and genetic advance show that variation is attributable to a high degree of additive effect and the character can be improved by selection.

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Table 1. Analysis of variance for yield and yield related characters in snake gourd

Source of variation	**df**	**Days to first male flower**	**Days to first female flower**	**Node no. of first male flower**	**Node no. of first female flower**	**Days to first fruit setting**	**Node no. of first fruit setting**	**No. of primary branches per plant**
Genotype	18	8.86**	5.52**	26.09**	20.21**	6.05**	129.433**	17.93**
Error	36	6.17	5.63	1.20	1.08	6.40	1.44	1.11
Parents	6	3.80*	0.44 NS	70.72**	17.43**	2.33 NS	3.13*	12.43**
Error	12	8.84	4.57	0.72	0.53	6.53	9.81	0.29
Hybrid	11	12.35**	7.98**	11.34**	20.85**	6.78**	2.13 NS	24.02**
Error	22	3.19	4.76	1.24	0.83	4.18	11.85	0.29
P Vs H	1	155.5**	50.56*	11.43 NS	4.21 NS	126.92 **	115.47**	2.57 NS
$\sigma^2 g$		7.30	13.00	8.42	4.40	8.18	9.27	1.79
$\sigma^2 p$		12.14	17.96	9.42	5.09	13.04	9.49	2.11
$\sigma^2 e$		4.83	4.96	1.00	0.68	4.86	0.21	0.31
h^2_b		0.60	0.72	0.89	0.86	0.62	0.97	0.84
GA		4.31	6.31	5.65	4.02	4.66	6.19	2.53
Source of variation	df	Length of vine(m)	Total no. of fruits per plant	Fruit weight (g)	Fruit diameter (mm)	Fruit length (cm)	Fruit yield per plant (kg)	Source of variation
Genotype	18	57.32**	808.42**	3427**	580.65**	920.49**	1.31**	Genotype
Error	36	1.40	1.20	0.91	0.44	0.57	11.29	Error
Parents	6	108.86**	578.00**	2055.88**	694.27**	1703.69**	1137.13**	Parents
Error	12	.01	0.33	0.75	0.31	0.25	0.005	Error
Hybrids	11	46.63**	838.10**	4482.42**	500.19**	233.37**	1.29**	Hybrids
Error	22	0.02	0.40	0.50	0.23	0.15	1.50	Error
P Vs H	1	0.395 NS	455.62**	1403.33**	107.78**	6.71 NS	0.70 NS	P Vs H
$\sigma^2 g$		0.4	114.63	660.81	50.17	54.98	14.85	$\sigma^2 g$
$\sigma^2 p$		0.42	115.05	661.39	50.43	55.16	14.865	$\sigma^2 p$
$\sigma^2 e$		0.02	0.42	0.57	0.26	0.17	0.011	$\sigma^2 e$
h^2_b		0.95	0.99	0.99	0.99	0.99	0.99	h^2_b
GA		1.27	22.01	52.93	14.55	48.32	7.93	GA

NS= non significant, *, ** significant at 5% and 1% level of significance, respectively.

Table 2. Performance of seven parental genotypes of snake gourd for yield and yield related characters

Parents	Days to first male flower	Days to first female flower	Node no. of first male flower	Node no. of first female flower	Days to first fruit setting	Node no. of first fruit setting	No. of primary branches per plant
SG-01	81.33	83.00	4.33	19.00	89.66	19.33	8.33
SG-04	76.33	83.0	12.66	22.00	85.00	21.66	10.33
SG-06	76.66	82.33	14.00	22.66	87.00	23.33	11.00
SG-10	75.00	83.00	8.33	18.33	88.00	13.66	10.00
SG-18	82.00	83.33	16.00	20.66	89.00	16.00	10.66
SG-25	82.00	84.33	10.66	18.33	89.00	18.33	11.66
SG-26	74.66	81.667	7.00	21.00	83.66	21.33	9.33
$\overline{X}$	78.28	82.95	10.42	20.28	87.33	19.190	10.190
CV%	3.80	2.52	8.15	3.59	2.93	16.32	5.32
SE	1.71	1.23	0.49	0.42	1.47	1.80	0.31
CD (0.05)	5.28	3.80	1.50	1.29	4.54	5.57	0.95

Parents	Length of vine (m)	Total no. of fruits per plant	Fruit weight (g)	Fruit diameter (mm)	Fruit length (cm)	Fruit yield per plant (kg)
SG-01	4.83	14.33	111.82	34.45	27.31	1.60
SG-04	4.97	32.33	144.37	37.61	22.14	4.66
SG-06	5.59	20.33	101.89	29.89	24.12	2.07
SG-10	4.64	30.00	158.82	44.13	21.28	4.76
SG-18	6.17	28.00	151.55	50.85	17.73	4.24
SG-25	5.54	16.00	136.80	41.05	20.50	2.18
SG-26	4.63	13.00	159.45	26.18	52.79	2.07
$\overline{X}$	5.19	22.00	137.81	37.74	26.55	3.08
CV%	1.87	2.62	0.63	1.47	1.89	2.33
SE	0.05	0.33	0.50	0.32	0.28	0.04
CD (0.05)	0.16	1.02	1.54	0.99	0.88	4.03

Table 3. Performance of twelve hybrids of snake gourd for yield and yield related characters

Hybrids	**Days to first male flower**	**Days to first female flower**	**Node no. of first male flower**	**Node no. of first female flower**	**Days to first fruit setting**	**Node no. of first fruit setting**	**No. of primary branches per plant**
SG-01×SG-10	76.33	86.00	7.66	21.00	88.33	17.50	10.66
SG-01×SG-18	77.00	84.00	6.33	20.66	87.00	21.50	10.33
SG-01×SG-26	73.33	75.33	12.66	23.66	78.66	23.00	7.66
SG-04×SG-26	72.33	74.667	8.33	21.00	79.00	20.33	10.66
SG-06×SG-10	72.00	82.66	11.00	21.00	86.00	18.00	10.66
SG-06×SG-18	71.66	82.33	9.00	19.33	85.00	20.00	7.33
SG-06×SG-25	81.33	84.33	13.33	20.00	87.66	20.00	11.33
SG-10×SG-06	72.66	78.33	10.66	15.66	84.66	18.66	7.33
SG-10×SG-18	71.66	79.00	9.00	22.33	83.00	26.00	9.66
SG-10×SG-25	72.33	82.66	6.66	17.66	84.66	14.66	11.00
SG-18×SG-01	81.66	82.66	9.66	18.00	84.66	17.66	9.00
SG-18×SG-25	76.00	80.00	9.66	16.33	82.33	17.33	11.33
$\overline{X}$	74.86	81	9.50	19.722	84.250	19.417	9.750
CV%	2.39	2.69	11.73	4.62	2.43	17.73	5.57
SE	1.03	1.26	0.64	0.52	1.18	1.98	0.31
CD (0.05)	3.02	3.69	1.88	1.54	3.46	5.82	0.91

Hybrids	Length of vine (m)	Total no. of fruits per plant	Fruit weight (g)	Fruit diameter (mm)	Fruit length (cm)	Fruit yield per plant
SG-01×SG-10	4.92	14.66	154.58	39.94	25.91	2.26
SG-01×SG-18	5.15	28.00	124.13	40.49	24.17	3.47
SG-01×SG-26	4.79	9.00	145.16	42.82	31.58	1.30
SG-04×SG-26	6.36	42.00	210.32	46.42	33.75	8.83
SG-06×SG-10	5.91	23.33	137.85	35.71	24.53	3.21
SG-06×SG-18	4.49	35.33	131.17	36.10	28. 00	4.63
SG-06×SG-25	6.33	22.33	133.95	31.30	30.87	2.99

SG-10×SG-06	5.85	25.33	150.65	34.22	27.77	3.81
SG-10×SG-18	5.02	18.66	140.85	49.66	21.85	2.62
SG-10×SG-25	5.07	32.33	110.26	35.14	25.60	3.56
SG-18×SG-01	4.74	51.66	189.24	50.58	28.25	9.77
SG-18×SG-25	5.78	31.66	152.81	44.69	24.89	4.83
$\overline{X}$	5.37	27.86	148.41	40.59	27.26	4.27
CV%	3.04	2.53	0.48	1.20	1.44	2.86
SE	0.09	0.40	0.41	0.28	0.22	0.07
CD (0.05)	0.23	1.07	1.19	0.81	0.65	2.07