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Studies on genetic variability, character association and path analysis in snake gourd (*Trichosanthes anguina* L.) genotypes

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ABSTRACT

Genetic variability, character association and path analysis were studied in 21 genotypes of snake gourd. The genotypic coefficient of variation was high for days to seedling emergence, length of fruit, total number of male flowers, total number of seeds per fruit, total number of fruits per plant and yield of fruit. High to moderate heritability as well as genetic advances were estimated for days to seedling emergence, number of seeds per fruit, days to 50% female flower opening, days to first fruit setting, days to first female flower opening, days to 50% fruit setting and total number of male flowers. Correlation studies revealed that fruit yield had significant positive correlation with total number of fruits, total number of primary branches and total number of nodes. The highest direct positive effects were recorded for days to first female flower opening. For selecting high yielding genotypes,along with the above traits special emphasis should be given on days to seedling emergence, days to 50% female flower opening, days to first fruit setting and days to first female flower opening. Then you are arguing for selection of late genotypes. What about selecting for total number of fruits/plant, total number of primary branches and total number of nodes which you have concluded in middle of above para?-

Key words: Character association, , genetic variability, path analysis

Snake gourd (*Trichosanthes anguina* L.) is a common cucurbitaceous vegetable consumed and relished by most of the people in India. It is a good source of minerals, fibres and other nutrients to make the food wholesome and healthy. . A large number of local lines are cultivated in the country but there is hardly any 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 varieties, 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 simply inherited. The correlation and path coefficient analysis provide information about the association between any two traits and the partitioning of relationship into each of the casual factors. It also provides an indication of effective selection of desirable traits towards the improvement of varieties. The present study was undertaken to find out genetic variability, interrelationship among different characters and the direct and indirect contribution of these characters towards yield.

MATERIALS AND METHODS

The experimental materials consisted of 21 genotypes of snake gourd, collected from different parts of India (Table-4). Please mention the locations/region of collection. The study was conducted at the Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya during February to June,each year in 2009 and 2010.The crop span is a dry to humid hot season. The experimental station is situated in the Gangetic alluvial plain and the soil is of sandy loam type with mild acidic nature (pH 6.5) Detail out the experimental area and condition. The genotypes were grown in RBD with three replications. The spacing adopted was 2.5 × 2.5 m^2. The cultural practices, plant protection measures and fertilizers applications were adopted according to the package of practices recommended by Bose and Som (1986). Days to seedling emergence, node number of first male flower opening, node number of first female flower opening, total number of male flowers, days to first male flower opening, days to 50% male flower opening, days to first female flower opening, days to 50% female flower opening, days to first fruit setting, days to 50% fruit setting, total number of primary branches, average petiole length(cm), average width of fruits(cm), average fruit weight(g),total number of fruits per plant, number of seeds per fruit, total length of vine(cm), days to first harvest, average yield per plant(kg $plant^{-1}$) were collected from four plants per plot and were analyzed statistically.

Variability that existed in the population for various characters was estimated by the method suggested by Burton (1952). Heritability in broad sense was estimated by the formula of Hanson et al (1956). The genetic advance of the genotypes at 5% selection pressure was calculated using the formula suggested by Johnson et al (1955). Path coefficient analysis was also done following the methods of Dewey and Lu (1959).

RESULTS AND DISCUSSION

The snake gourd genotypes exhibited significant differences for all the 21 characters under study (Table 1). Variability of character is measured by range and genotypic coefficient of variation

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(GCV). In most of the cases much more difference between genotypic and phenotypic coefficient of variations was observed indicating that strong influence of environment. on the expression of most of the characters. In general, the GCV were lower ranging from 5.12 to 24.12 per cent while PCV ranged from 11.83 to 35.24. High PCV and GCV were observed for length of fruit, yield of fruit, total number of fruits per plant, total number of first male flower opening, which are in conformity with the finding of Varghese and Rajan (1993).

Table 1: Genetic variability parameters for different characters of snake gourd

Characters	G.M	Range	Variances			GCV (%)	PCV (%)	h^2	GA (%) Mean
			GV	PV	EV				
Days to seedling emergence (X1)	10.77	7.00 -14.16	6.74	8.60	1.85	24.12	27.22	78.47	44.01
Node no. of first male flower opening (X2)	14.91	7.16 -19.50	4.27	20.39	16.11	13.86	30.28	20.96	13.07
Node no. of first female flower opening (X3)	25.43	21.00 -30.66	6.15	19.70	13.54	9.75	17.45	31.25	11.23
Total no. of male flowers (X4)	497.72	306.66 -36.33	12949.5	24223.38	1127.88	22.86	31.27	53.46	34.43
Total no.of primary branches (X5)	4.50	4.00 -6.00	0.08	1.40	1.32	6.40	26.31	6.00	3.21
Days to first male flower opening (X6)	56.75	49.50 -66.66	15.76	62.83	47.06	6.99	13.96	25.10	7.22
Days to 50%t male flower opening (X7)	61.54	53.66 -70.50	16.42	66.61	50.18	6.58	13.26	24.66	6.73
Days to first female flower opening (X8)	67.23	55.66 -79.33	51.41	91.99	40.58	10.66	14.26	55.88	16.42
Days to50% female flower opening (X9)	75.96	65.50 -87.66	46.29	80.83	34.54	8.95	11.83	57.27	13.96
Days to first fruit setting (X10)	70.43	59.66 -82.33	53.52	94.45	40.93	10.38	13.79	56.66	16.10
Days to 50% fruit setting (X11)	76.61	66.00 -87.50	49.70	89.55	39.85	9.20	12.35	55.50	14.12
Petiole length(cm) (X12)	6.86	4.53 -8.47	0.49	2.53	2.04	10.25	23.20	19.53	9.33
Total no. of nodes (X13)	50.84	45.00 -56.66	6.79	36.20	29.40	5.12	11.83	18.78	4.57
Length of fruit(cm) (X14)	40.51	24.29 -73.30	92.76	203.93	111.16	23.77	35.24	45.49	33.02
Width of fruit (cm) (X15)	5.02	3.71 -6.18	0.23	1.13	0.89	9.67	21.20	20.83	9.09
Avg. Fruit weight (g) (X16)	370.24	291.36 -516.83	1773.56	5096.05	3322.48	11.37	19.28	34.80	13.82
Total no. of fruit/pl (X17)	4.41	3.00 -6.66	0.48	1.939	1.451	15.82	31.55	25.15	16.34
No. of seeds per fruit (X18)	50.57	34.50 -75.66	95.73	163.95	68.22	19.34	25.31	58.39	30.45
Length of vine (m) (X19)	5.04	4.28 -5.75	0.09	0.46	0.36	6.10	13.50	20.40	5.67
Days to first harvest (X20)	94.25	80.33 -109.66	67.34	133.57	66.23	8.70	12.26	50.41	12.73
Yield of fruit (kg/plant) (Y)	1.61	1.10 -2.24	0.04	0.28	0.23	13.33	32.76	16.56	11.17

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

Characters	(X1)	(X2)	(X3)	(X4)	(X5)	(X6)	(X7)	(X8)	(X9)	(X10)	(X11)	(X12)	(X13)	(X14)	(X15)	(X16)	(X17)	(X18)	(X19)	(X20)	(Y)
(X1)		-0.28	0.185	-0.114	-0.003	0.723	0.748	0.935	0.934	0.951	0.933	-0.726	0.169	0.3	-0.179	0.252	-0.272	0.378	-0.252	0.906	-0.148
(X2)	-0.113		0.685	-0.09	-0.376	0.393	0.328	-0.092	-0.105	-0.089	-0.051	0.931	0.436	-0.003	0.413	0.053	0.143	-0.449	-0.01	0.087	0.266
(X3)	0.172	0.17		0.328	-0.970	0.384	0.346	0.229	0.284	0.228	0.23	0.646	0.828	0.008	-0.433	-0.375	0.506	-0.295	0.556	0.353	0.265
(X4)	-0.069	-0.007	0.133		-0.495	-0.329	-0.321	-0.07	-0.04	-0.069	-0.079	0.134	0.233	-0.352	-0.152	-0.575	0.599	0.019	0.498	-0.106	0.273
(X5)	0.021	0.039	-0.101	-0.185		0.283	0.332	0.258	0.185	0.235	0.261	-0.042	-0.866	0.064	0.601	0.990	-0.385	0.475	-1.94	0.32	0.66
(X6)	0.458	0.297	0.181	-0.111	0.15		0.982	0.730	0.738	0.750	0.796	0.233	0.200	0.381	0.061	0.343	-0.475	0.189	-0.461	0.760	-0.343
(X7)	0.464	0.27	0.145	-0.135	0.128	0.979		0.760	0.773	0.778	0.828	0.14	0.195	0.425	0.027	0.389	-0.567	0.153	-0.429	0.771	-0.42
(X8)	0.753	-0.116	0.195	-0.061	0.082	0.535	0.550		0.981	0.997	0.991	-0.478	0.154	0.317	-0.11	0.401	-0.282	0.466	-0.171	0.940	-0.031
(X9)	0.749	-0.089	0.207	-0.025	0.101	0.524	0.542	0.966		0.980	0.984	-0.485	0.23	0.305	-0.14	0.345	-0.288	0.402	-0.031	0.962	-0.073
(X10)	0.766	-0.117	0.201	-0.062	0.069	0.536	0.546	0.989	0.964		0.981	-0.493	0.146	0.32	-0.123	0.398	-0.278	0.465	-0.169	0.942	-0.02
(X11)	0.752	-0.105	0.212	-0.026	0.104	0.528	0.535	0.977	0.959	0.978		-0.434	0.118	0.289	-0.064	0.395	-0.296	0.421	-0.226	0.951	-0.041
(X12)	-0.275	0.297	0.038	0.03	-0.087	-0.046	-0.03	-0.318	-0.313	-0.326	-0.319		0.674	0.165	-0.103	0.087	0.491	0.636	-0.132	-0.32	0.419
(X13)	0.081	0.091	0.305	0.121	0.078	0.063	0.078	0.06	0.13	0.07	0.095	0.106		0.681	-0.859	0.178	0.326	0.034	0.595	0.254	0.493
(X14)	0.213	0.065	0.067	-0.145	0.026	0.093	0.113	0.239	0.264	0.261	0.255	0.002	0.339		-0.973	0.402	0.057	0.103	0.081	0.293	0.34
(X15)	-0.159	0.001	-0.115	-0.052	0.07	0.034	0.029	-0.103	-0.131	-0.101	-0.093	0.099	-0.31	-0.409		0.009	-0.454	0.127	-0.619	-0.167	0.491
(X16)	0.128	0.042	-0.126	-0.252	0.171	0.203	0.173	0.172	0.117	0.191	0.151	-0.123	0.012	0.275	0.127		-0.536	0.510	-0.347	0.22	0.162
(X17)	-0.121	0.042	0.134	0.212	-0.135	-0.13	-0.13	-0.065	-0.045	-0.077	-0.079	0.164	0.066	0.002	-0.113	-0.216		0.257	0.336	-0.156	0.741
(X18)	0.275	-0.021	-0.103	-0.013	0.157	-0.084	-0.052	0.26	0.237	0.272	0.234	-0.184	-0.005	0.097	0.124	0.308	-0.096		0.109	0.004	0.099
(X19)	-0.054	0.158	0.084	0.222	-0.048	-0.097	-0.106	-0.124	-0.071	-0.104	-0.123	0.148	0.331	0.026	-0.034	0.013	0.12	0.09		-0.329	0.005
(X20)	0.708	-0.099	0.266	0.015	0.06	0.495	0.489	0.789	0.797	0.790	0.822	-0.248	0.135	0.178	-0.045	0.087	-0.036	0.031	-0.148		0.278
Y	-0.04	0.061	0.064	0.064	-0.06	-0.013	-0.031	0.037	0.02	0.037	0.012	0.086	0.041	0.152	-0.033	0.364	0.807	0.106	0.057	0.179	

Upper diagonal correlations are genotypic correlations and lower diagonal correlations are phenotypic correlation. Correlation coefficient r>0.433 and r>0.531 are significant at 5% and 1% level of significance respectively

Table 3 Phenotypic path coefficient analysis showing direct and indirect effects of component traits in snake gourd genotypes

Characters	(X1)	(X2)	(X3)	(X4)	(X5)	(X6)	(X7)	(X8)	(X9)	(X10)	(X11)	(X12)	(X13)	(X14)	(X15)	(X16)	(X17)	(X18)	(X19)	(X20)
(X1)	**0.003**	0.092	0.153	0.002	0.001	-2.114	1.917	3.957	-3.144	-2.799	1.722	0.244	-0.002	-0.198	0.129	-0.226	0.703	0.205	0.029	-0.295
(X2)	0.001	**-0.33**	0.566	0.001	-0.026	-1.148	0.84	-0.389	0.354	0.26	-0.094	-0.312	-0.005	0.002	-0.299	-0.048	-0.369	0.019	0.001	0.531
(X3)	0.002	-0.23	**0.827**	-0.001	-0.076	-1.122	0.887	0.968	-0.955	-0.672	0.423	-0.217	-0.01	-0.005	0.314	0.033	-1.31	0.079	-0.064	0.529
(X4)	0.001	0.029	0.271	**-0.005**	-0.034	0.961	-0.823	-0.294	0.134	0.202	-0.145	-0.045	-0.003	0.233	0.11	0.516	-1.55	-0.024	-0.057	0.543
(X5)	0.0001	0.124	-0.897	0.002	**0.07**	-0.828	0.852	1.093	-0.621	-0.69	0.48	0.013	0.011	-0.042	-0.435	-1.174	0.997	0.072	0.121	1.323
(X6)	0.002	-0.13	0.317	0.001	0.019	**-2.923**	2.568	3.091	-2.482	-2.207	1.468	-0.078	-0.002	-0.252	-0.043	-0.308	1.228	0.172	0.053	-0.683
(X7)	0.002	-0.11	0.286	0.001	0.023	-2.929	**2.563**	3.216	-2.601	-2.289	1.528	-0.046	-0.002	-0.281	-0.019	-0.349	1.466	0.174	0.049	-0.838
(X8)	0.002	0.03	0.189	0.001	0.018	-2.135	1.948	**4.232**	-3.3	-2.936	1.847	0.16	-0.002	-0.21	0.079	-0.36	0.73	0.213	0.019	-0.062
(X9)	0.002	0.034	0.234	0.001	0.013	-2.157	1.982	4.152	**-3.364**	-2.884	1.815	0.163	-0.003	-0.202	0.101	-0.309	0.746	0.218	0.003	-0.145
(X10)	0.002	0.029	0.188	0.001	0.016	-2.191	1.993	4.221	-3.296	**-2.944**	1.848	0.165	-0.001	-0.212	0.088	-0.357	0.719	0.213	0.019	-0.039
(X11)	0.002	0.016	0.189	0.001	0.018	-2.326	2.123	4.237	-3.309	-2.948	**1.845**	0.145	-0.001	-0.191	0.046	-0.354	0.766	0.215	0.026	-0.081
(X12)	-0.002	-0.31	0.534	0.001	-0.002	-0.681	0.357	-2.024	1.633	1.452	-0.8	**-0.336**	-0.008	-0.109	0.074	0.078	-1.271	-0.072	0.015	0.835
(X13)	0.001	-0.14	0.684	-0.001	-0.061	-0.583	0.501	0.653	-0.774	-0.429	0.218	-0.226	**-0.013**	-0.451	0.623	-0.159	-0.842	0.057	-0.068	0.982
(X14)	0.001	0.001	0.006	0.001	0.004	-1.113	1.09	1.341	-1.026	-0.943	0.534	-0.055	-0.008	**-0.662**	0.706	-0.361	-0.147	0.066	-0.009	0.677
(X15)	0.001	-0.14	-0.358	0.001	0.042	-0.176	0.069	-0.466	0.471	0.36	-0.118	0.034	0.011	0.644	**-0.725**	-0.008	1.173	-0.037	0.071	-0.978
(X16)	0.001	-0.02	-0.31	0.003	0.092	-1.003	0.997	1.698	-1.159	-1.172	0.728	0.029	-0.002	-0.266	-0.006	**-0.898**	1.386	0.049	0.04	0.322
(X17)	0.001	-0.05	0.418	-0.003	-0.027	1.387	-1.453	-1.194	0.97	0.819	-0.546	-0.165	-0.004	-0.037	0.329	0.481	**-2.587**	-0.035	-0.038	1.479
(X18)	0.001	-0.09	0.219	-0.001	0.046	1.002	-1.077	-0.133	0.245	0.057	-0.075	-0.14	-0.006	-0.225	0.355	-0.145	-1.918	**0.002**	-0.012	1.995
(X19)	0.001	0.003	0.459	-0.002	-0.073	1.348	-1.1	-0.722	0.102	0.499	-0.417	0.044	-0.007	-0.053	0.448	0.311	-0.87	-0.074	**-0.115**	0.217
(X20)	0.002	-0.03	0.291	0.001	0.022	-2.222	1.976	3.98	-3.238	-2.772	1.755	0.107	-0.003	-0.194	0.121	-0.197	0.403	0.226	0.037	**0.007**

Residual effect =0 .40, Direct effect are in Bold diagonals

Table 4: Source of Snake Gourd Genotypes

Serial Number	Genotypes	Areas of collection
1.	BCSG-14	Paddapukuria, Dakshin Dinajpur, West Bengal
2.	BCSG-15	Alwal Local, Tamil Nadu
3.	BCSG-16	Medak Local, Tamil Nadu
4.	BCSG-17	Aliyabad Local, Tamil Nadu
5.	BCSG-20	Ukadam, Tamil Nadu
6.	BCSG-21	KAU, College of Horticulture
7.	BCSG-24	Allepy, Kerala
8.	BCSG-25	PKM-1,Tamil nadu
9.	BCSG-26	Malappuram, Kerala
10.	BCSG-28	Pollachhi, Tamil Nadu
11.	BCSG-29	Contai Local, Purba Midnapore,W.B.
12.	BCSG-30	Barasat,W.B.
13.	BCSG-31	Bongaon, North 24 paraganas,W.B.
14.	BCSG-32	Bongaon, North 24 paraganas,W.B.
15.	BCSG-33	Bongaon, North 24 paraganas,W.B.
16.	BCSG-34	Harba, North 24 paraganas.W.B.
17.	BCSG-35	Kalyani, Nadia,W.B.
18.	BCSG-36	Lalbagh, Mursidabad,W.B.
19.	BCSG-37	Barasat, North 24 paraganas,W.B.
20.	BCSG-38	Sonannukhi,Bankura,W.B.
21.	BCSG-39	Bongaon, North 24 paraganas,W.B

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 moderate to high for days to seedling emergence(78.40) followed by number of seeds per fruit(58.30) and days to 50% female flower opening(57.20) indicating that the presence of additive gene action. This is in conformity with the findings of Mathew and Abdulkhader (1999). Total number of primary branches showed low estimates (6.00) of genetic advance as percentage of mean was the maximum for days to seedling emergence (44.01) and total number of male flowers (34.43), while it was the minimum for total number of primary branches (3.21).

Correlation:

In general, genotypic correlation coefficients were higher than phenotypic correlation coefficients, which indicated the masking efficient of the environment which modified the expression of a character thereby reducing the phenotypic expression (Saha et al, 1992 and Islam, 1993). Fruit yield had significant positive genotypic and phenotypic correlation with total number of fruits while primary branches and total number of nodes showed significant and positive genotypic correlation but width of fruits showed significant negative genotypic correlation (Table 2). Significant positive genotypic and phenotypic correlations were observed for days to seedling emergence with days to first male flower opening, days to 50% male flowering, days to first female flower opening, days to 50% female flower opening, days to first fruit setting, days to 50% fruit setting and days to first harvest. Days to first female flower opening had significant positive genotypic and phenotypic correlation with days to 50% female flower opening, days to first fruit setting, days to 50% fruit setting and days to first harvest while days to 50% female flower opening with days to first fruit setting, days to 50% fruit setting and days to first harvest. Rahman et al (2002) found significant positive genotypic and phenotypic correlation of number of fruits per plant and fruit length with fruit yield.

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 coefficient analysis (Table 3) showed that days to first female flower opening had maximum direct effects (4.232) followed by days to 50% male flower opening (2.563) and days to 50% fruit setting (1.845). Saikia *et al.* (1995) found that days to first female flower opening had direct correlation with yield of cucumber. On the other hand days to 50% female

flower opening had the maximum indirect effect followed by days to first fruit setting, days to first male flower opening and number of fruits per plant. The residual effect was 0.40 indicating that about 60 percent of the variability in yield was contributed by twenty one characters studied in path analysis. Results from the present findings indicated that days to seedling emergence, number of seeds per fruit, days to 50% female flower opening, days to first fruit setting and days to first female flower opening had moderate to high heritability and genetic advance. These characters also exert 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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