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Short Communication

Correlation and path coefficient analysis for growth, yield and its associated traits in sponge gourd [*Luffa cylindrica* (Roem) L.]

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Sponge gourd is one of the most important cucurbit, both as rainy and summer season vegetable which is grown throughout the country and world. It is an annual and monoeceous cucurbit plant and it has a gelatinous compound luffien. Luffa is domesticated species and commonly called as sponge gourd, loofah, vegetable sponge or dish cloth. It originated in subtropical Asian region particularly India (Kalloo 1993). It belongs to the family Cucurbitaceae with diploid chromosome number 2n = 2x = 26 which includes about 118 genera and 825 species. The nutritive value of sponge gourd fruits per 100 g edible portion (tough skin removed, edible portion 80%) is: water 93.2 g, energy 18 kcal, protein 1.2 g, fat 0.2 g, carbohydrate 2.9 g, fibre 2.0 g, Ca 36 mg, P 19 mg, Fe 1.1 mg, carotene 120 µg, thiamine 0.02 mg, riboflavin 0.06 mg, niacin 0.4 mg and the composition of young leaves per 100 g edible portion is: water 89 g, protein 5.1 g, carbohydrate 4.0 g, fibre 1.5 g, Ca 56 mg, Fe 11.5 mg, carotene 9.2 mg, ascorbic acid 95 mg. It used for scrubbing of body skin as a bath sponge increase blood circulation and also used for utensils purposes. It has certain medicinal uses and recommended to the patients suffering from malaria or other seasonal fevers. Among vegetables, cucurbits are associated with the origin of agriculture and dawn of human civilization. In food crops, cucurbits are largest producer of biological water and easily digestive and recommended even to sick and frail patients. Its flowers are yellow in colour and showy having five petals. It produces fruits containing a fibrous vascular system having vigorous vines with cylindrical ten angle fruits (Whitaker and Davis 1962). To develop a new variety there is need of high magnitude of genetic variability in the base material and the vast of variability for desired characters. Variability in cucurbitaceous crop occurs in the form of land races, traditional cultivars, wild relatives and related non edible wild weedy species. In India little attention has been given for the genetic improvement of sponge gourd by collecting diverse germplasm, their morphological characterization and assessing the variability parameters like coefficient of variation, coefficient of correlation and path analysis (Badade et al. 2001, Islam 2004). Little attention has been given for the genetic improvement of sponge gourd in India.

The experimental materials consisted of 14 promising parental lines of sponge gourd and their F_1 progenies. Out of these advanced breeding parental lines (10 lines and 4 testers) were crossed to get 40 F_1's under Randomized Complete Block Design (RBD) with three replications at main Experiment Station, Department of Vegetable Science, NDUAT, Kumarganj, Faizabad, UP. The treatments were sown in rows spaced 2.50 meters apart with a plant to plant spacing of 0.5 meter. The experiment was sown on 23th February, 2014 (Y_1) and 27th February, 2015 (Y_2). All the recommended agronomic package of practices and protection measures were followed to raise a good crop. Fertilizers and manures were applied as per recommended dose. Observations were recorded on all the five plants maintained carefully in each plot for fourteen quantitative characters *viz.*, node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, node number of first fruit harvest, days to first fruit harvest, no. of primary branches per plant, inter nodal length (cm), vine length (m), fruit length (cm), fruit circumference (cm), average fruit weight (g), number of fruits per plant and average fruits yield per plant (kg). The simple correlations at genotypic (g) and phenotypic (p) levels

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Table 1: Estimates of genotypic correlation coefficient among 14 characters for yield and yield traits in sponge gourd during Y_1 and Y_2 (Y_1= 2014 and Y_2= 2015)

S.N	Characters		Node no.to anthesis of first staminate flower	Node no.to anthesis of first pistillate flower	Days to anthesis of first staminate flower	Days to anthesis of first pistillate flower	Days to first fruit harvest	Node no. of first fruit harvest	No. of fruits per plant	Average fruit weight (g)	Vine length (m)	Fruit length (cm)	Fruit circumference (cm)	No.of primary branches per plant	Inter nodal length (cm)	Average fruits yield per plant (kg)
1.	Node no.to anthesis of first staminate flower	Y_1	1.000	0.632	0.586	0.439	0.403	0.602	-0.029	-0.155	-0.046	0.333	0.066	-0.064	-0.228	-0.103
		Y_2	1.000	0.745	0.646	0.422	0.332	0.731	-0.075	-0.071	-0.018	0.283	0.097	-0.083	-0.200	-0.023
2.	Node no.to anthesis of first pistillate flower	Y_1		1.000	0.753	0.551	0.441	0.988	-0.074	-0.041	0.043	-0.100	-0.162	-0.151	0.022	-0.052
		Y_2		1.000	0.719	0.435	0.352	0.968	-0.085	-0.084	0.013	-0.069	-0.034	-0.134	-0.078	-0.061
3.	Days to anthesis of first staminate flower	Y_1			1.000	0.855	0.661	0.747	-0.108	0.108	0.005	-0.044	-0.185	-0.442	0.015	0.089
		Y_2			1.000	0.790	0.661	0.721	-0.103	0.130	0.027	-0.020	-0.022	-0.367	-0.022	0.078
4.	Days to anthesis of first pistillate flower	Y_1				1.000	0.858	0.544	0.030	-0.012	0.055	0.027	0.053	-0.474	-0.182	0.154
		Y_2				1.000	0.791	0.478	-0.003	0.056	0.044	-0.090	0.153	-0.248	-0.074	0.135
5.	Days to first fruit harvest	Y_1					1.000	0.467	-0.016	0.048	0.224	0.161	-0.115	-0.309	-0.520	0.159
		Y_2					1.000	0.411	-0.052	0.144	0.173	0.023	-0.162	-0.105	-0.416	0.120
6.	Node no. of first fruit harvest	Y_1						1.000	-0.125	-0.035	0.061	-0.141	-0.217	-0.191	0.019	-0.108
		Y_2						1.000	-0.128	-0.022	0.063	-0.103	0.040	-0.138	-0.072	-0.063
7.	No. of fruits per plant	Y_1							1.000	-0.635	-0.008	-0.017	0.154	0.154	0.007	0.760**
		Y_2							1.000	-0.482	0.077	0.068	0.181	0.213	-0.010	0.788**
8.	Average fruit weight (g)	Y_1								1.000	-0.178	-0.091	-0.223	-0.139	0.086	0.007
		Y_2								1.000	-0.292	-0.143	-0.173	-0.098	0.182	0.152
9.	Vine length (m)	Y_1									1.000	-0.095	0.183	0.186	-0.100	-0.081
		Y_2									1.000	-0.007	0.160	0.190	-0.080	-0.064
10.	Fruit length (cm)	Y_1										1.000	0.185	0.034	-0.579	-0.022
		Y_2										1.000	-0.004	-0.038	-0.482	0.037
11.	Fruit circumference (cm)	Y_1											1.000	-0.030	-0.041	0.041
		Y_2											1.000	-0.225	-0.034	-0.001
12.	No.of primary branches per plant	Y_1												1.000	0.038	0.056
		Y_2												1.000	0.036	0.163
13.	Inter nodal length (cm)	Y_1													1.000	0.014
		Y_2													1.000	0.052
14.	Average fruits yield per plant (kg)	Y_1														1.000
		Y_2														1.000

Table 2: Direct and indirect effects of various yield characters on yield in sponge gourd at genotypic level during Y_1 and Y_2 (Y_1= 2014 and Y_2= 2015)

Residual effect=SQRT(1- 1.0766) (Y_1) and SQRT(1- 1.0210) (Y_2) Bold values, indicated direct effect

S.N	Characters		Node no.to anthesis of first staminate flower	Days to anthesis of first staminate flower	Days to first fruit harvest	Node no. of first fruit harvest	No. of fruits per plant	Average fruit weight (g)	Vine length (m)	Fruit length (cm)	Fruit circumference (cm)	No.of primary branches per plant	Inter nodal length (cm)	Average fruits yield per plant (kg)
1.	Node no.to anthesis of first staminate flower	Y_1	**-0.132**	0.145	0.005	0.004	-0.037	-0.127	-0.002	0.035	0.004	-0.004	0.006	-0.103
		Y_2	**0.133**	-0.072	-0.264	0.441	-0.096	-0.062	-0.004	-0.010	-0.044	0.007	0.072	-0.023
2.	Days to anthesis of first staminate flower	Y_1	-0.077	**0.247**	0.008	0.005	-0.139	0.089	0.000	-0.005	-0.010	-0.030	0.000	0.089
		Y_2	0.086	**-0.111**	-0.524	0.435	-0.131	0.114	0.006	0.001	0.010	0.031	0.008	0.078
3.	Days to first fruit harvest	Y_1	-0.053	0.163	**0.012**	0.003	-0.021	0.039	0.011	0.017	-0.006	-0.021	0.014	0.159
		Y_2	0.044	-0.073	**-0.793**	0.248	-0.066	0.126	0.040	-0.001	0.073	0.009	0.149	0.120
4.	Node no. of first fruit harvest	Y_1	-0.079	0.185	0.006	**0.007**	-0.161	-0.028	0.003	-0.015	-0.012	-0.013	-0.001	-0.108
		Y_2	0.097	-0.080	-0.326	**0.603**	-0.163	-0.019	0.015	0.004	-0.018	0.012	0.026	-0063
5.	No. of fruits per plant	Y_1	0.004	-0.007	0.000	-0.001	**1.288**	-0.521	0.000	-0.002	0.008	0.010	0.000	0.760
		Y_2	-0.010	0.011	0.041	-0.077	**1.276**	-0.421	0.018	-0.002	-0.081	-0.018	0.004	0.788
6.	Average fruit weight (g)	Y_1	0.020	0.027	0.001	0.000	-0.818	**0.820**	-0.009	-0.010	-0.012	-0.009	-0.002	0.007
		Y_2	-0.009	-0.014	-0.114	-0.013	-0.615	**0.873**	-0.068	0.005	0.077	0.008	-0.065	0.152
7.	Vine length (m)	Y_1	0.006	0.001	0.003	0.000	-0.011	-0.146	**0.051**	-0.010	0.010	0.013	0.003	-0.081
		Y_2	-0.002	-0.003	-0.137	0.038	0.099	-0.255	**0.232**	0.000	-0.072	-0.016	0.028	-0.064
8.	Fruit length (cm)	Y_1	-0.044	-0.011	0.002	-0.001	-0.002	-0.075	-0.005	**0.106**	0.010	0.002	0.016	-0.022
		Y_2	0.038	0.002	-0.018	-0.062	0.087	-0.125	-0.002	**-0.034**	0.002	0.003	0.172	0.037
9.	Fruit circumference (cm)	Y_1	-0.009	-0.046	-0.001	-0.002	0.198	-0.183	0.009	0.020	**0.054**	-0.002	0.001	0.041
		Y_2	0.013	0.002	0.129	0.024	0.231	-0.151	0.037	0.000	**-0.447**	0.019	0.012	-0.001
10.	No.of primary branches per plant	Y_1	0.008	-0.109	-0.004	-0.001	0.198	-.0114	0.009	0.004	-0.002	**0.068**	-0.001	0.056
		Y_2	-0.011	0.041	0.083	-0.083	0.271	-0.086	0.044	0.001	0.100	**-0.084**	-0.013	0.163
11.	Inter nodal length (cm)	Y_1	0.030	0.004	-0.006	0.000	0.009	0.071	-0.005	-0.061	-0.002	0.003	**-0.027**	0.014
		Y_2	-0.027	0.002	0.330	-0.043	-0.013	0.159	-0.018	0.016	0.015	-0.003	**-0.358**	0.052

were estimated according to Searle (1961). For the Path coefficient analysis, Dewey and Lu (1959) method was followed. Fruits yield is not independent variable; it is influenced by all the other independent variables and characters, directly as well as indirectly.

Genotypic correlation coefficients between yield and its components traits: The analysis of correlation coefficient revealed that average fruits yield per plant (kg) *exhibited* highly *significant and positive correlation at genotypic level with* number of fruits per plant (0.760 and 0.788) whereas, days to anthesis of first pistillate flower (0.154 and 0.135) and days to first fruit harvest (0.159 and 0.120) *exhibited significant and positive correlation at genotypic level* in both the years *(Table-1)*. Among other traits, maximum traits showed positive correlation with other traits whereas negative and significant correlation also exhibited with some traits. The present findings are supported by Rajput et al. (1995) in bitter gourd and Shah and Kale (2002) in ridge gourd.

Genotypic *path coefficient analysis: The genotypic path coefficient analysis revealed that the highest positive direct effect towards* average fruits yield per plant (kg) *was observed by* number of fruits per plant (1.228 and 1.276), average fruit weight (g) (0.820 and 0.873) in both the years (table-2), node number of first fruit harvest (0.603) in$Y_{2,}$ days to anthesis of first staminate flower (0.247) in$Y_{1,}$ vine length (m) (0.0232) in$Y_{2,}$ node number to anthesis of first staminate flower (0.133) in$Y_{2,}$ number of primary branches per plant (0.068), fruit circumference (cm) (0.054), days to first fruit harvest (0.012) and node number of first fruit harvest (0.007) in$Y_{1.}$ Almost similar conclusions were drawn by Kumar (2007) and Dey *et al.* (2005). *However* days to first fruit harvest (-0.793), fruit circumference (cm) (-0.447) in$Y_{2,}$ inter nodal length (cm) (-0.027 and -0.358) in both the years, node number to anthesis of first staminate flower (-0.132) in$Y_{1,}$ days to anthesis of first staminate flower (-0.111), primary branches per plant (-0.084) and fruit length (cm) (-0.034) inY_2 had exerted maximum negative direct effects on average fruits yield per plant (kg). In $Y_{1,}$ node number to anthesis of first staminate flower via days to anthesis of first staminate flower and in $Y_{2,}$ node number to anthesis of first staminate flower via node number of first fruit harvest, days to anthesis of first staminate flower via node number of first fruit harvest, days to first fruit harvest via node number of first fruit harvest, fruit length (cm) via inter nodal length (cm), days to first fruit harvest via inter nodal length (cm), days to first fruit harvest via average fruit weight (g) and days to anthesis of first staminate flower via average fruit weight (g) showed maximum positive indirect effects on average fruits yield per plant (kg) and also in $Y_{1,}$ node number to anthesis of first staminate flower via average fruit weight (g) and in $Y_{2,}$ days to anthesis of first staminate flower via days to first fruit harvest and node number to anthesis of first staminate flower via days to first fruit harvest whereas, number of fruits per plant via average fruit weight (g), node number of first fruit harvest via number of fruits per plant and days to anthesis of first staminate flower via number of fruits per plant had exerted maximum negative indirect effects on average fruits yield per plant (kg). Same result found by Singh et al. (2013).

The correlation coefficients studies revealed that in general an estimate of genotypic correlation coefficient was higher than corresponding phenotypic correlation coefficient, which indicated a strong inherent association among different traits under study. The lower phenotypic values might be due to environmental interactions. Similar observations were noticed in ridge gourd earlier (Karuppaiah et al. 2005). It is concluded that sufficient genetic variability is present for all traits studied. Therefore, crop improvement could be made on the basis of this genetic variability. In view of character association and path coefficients for yield and its contributing characters, it can also be concluded that breeders should give attention on characters like average fruits yield per plant (kg), average fruit weight (g), number of fruits per plant, days to anthesis of first pistillate flower and days to first fruit harvest for high yielding genotypes in sponge gourd.

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