Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(3): 342-345
Received: 28-03-2017
Accepted: 29-04-2017

Amar Nand Yadav
Department of Vegetable Science, NDUA & T Kumarganj Faizabad, Uttar Pradesh, India

VB Singh
Department of Vegetable Science, NDUA & T Kumarganj Faizabad, Uttar Pradesh, India

GC Yadav
Department of Vegetable Science, NDUA & T Kumarganj Faizabad, Uttar Pradesh, India

Vimlesh Kumar
Department of Vegetable Science, NDUA & T Kumarganj Faizabad, Uttar Pradesh, India

Correspondence
Vimlesh Kumar
Department of Vegetable Science, NDUA & T Kumarganj Faizabad, Uttar Pradesh, India

Determining relationships between different Horticultural and Yield Traits in sponge gourd (*Luffa cylindrica* Roem.) Genotypes with path coefficient analysis

Amar Nand Yadav, VB Singh, GC Yadav and Vimlesh Kumar

Abstract
The aim of experiment was to study the inter-relationship and direct-indirect effect among yield and yield attributes in sponge gourd. The analysis of variance revealed that the mean sum of squares due to genotypes were significant for all the eleven traits. The genotypic correlation in general was greater than the phenotypic correlation. The significant and positive correlation with yield per plant was observed at phenotypic level with average fruit weight (0.462) and number of fruits per plant (0.476). Path coefficient revealed appreciable amount of direct positive effect of number of fruit per plant (0.653) followed by average fruit weight (0.571) and days to anthesis of firs pistillate flower (0.156) on fruit yield per plant. The study concluded that the average fruit weight and number of fruits per plant in due consideration for improvement of genotypes in respect to yield.

Keywords: Luffa (*Luffa cylindrica* Roem.), correlation, path analysis, fruit yield.

1. Introduction
Luffa (*Luffa cylindrica* Roem.) commonly called as sponge gourd, loofah vegetable sponge or dish cloth, having diploid chromosome number 2n = 2x = 26. It is one of the most important cucurbits grown throughout the country and world. It belongs to the family Cucurbitaceae which includes about 118 genera and 825 species. In India, a number of major and minor cucurbits are cultivated which share about 5.6 per cent of the total vegetable production.
The prime objective of the present investigation is to make an improvement in yield, but yield is a complex character and a combined result of a number of component traits. Since yield is controlled polygenically and influenced greatly by the environmental fluctuations. Therefore, the selection of superior genotype based on yield alone would not be effective. One has to put attention on the component characters, which contribute yield in positive direction. 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. The appropriate breeding methodologies may be adopted for genetic improvement of this crop for simultaneously improvement of different characters, information regarding mutual relationship among the characters and direction of correlation analysis provides an effective means of finding out direct and indirect causes of association among causal variables. Keeping in view, of the above facts the present experiment was conducted to determining association of yield and its attributes for yield improvement in sponge gourd.

2. Material and Methods
Thirty genotypes of sponge gourd were evaluated in Randomized Complete Block Design with three replications at Department of Vegetable Science, N.D. University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) India. The crop was planted in 3.0 m. for row length, spaced 3.0 m. apart where, 0.5m. Plant to plant spacing was maintained. The experiment was sown in summer on 2nd April, 2010. All the recommended agronomic package and practices and plant protection measures were followed to raise a good crop. Observations were recorded on five randomly selected plants for eleven characters *viz.,* 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 of first fruit harvest, average fruit weight (g), fruit length (cm), fruit diameter (cm), number of fruits/plant, fruit yield/plant (kg) and vine length (m).

The analysis of variance for the design of experiment was carried out according to the procedure outlined by Panse and Sukhatme (1967) [10]. The simple correlations between different characters at genotypic and phenotypic levels were worked out between characters as suggested by Searle (1961) [12] and path analysis was done the method given by Dewey and Lu (1959) [3].

3. Results and Discussion

The analysis of variance revealed that the genotypes evaluated differed significantly for all the eleven traits. Thus, suggested existence of sufficient variability in the germplasm studied. The average value of the genotypes for different characters and their range indicated that the materials used for estimating genetic and statistical information were suitable for the study.

Genetic correlation between characters could be due to linkage and pleotropic effect of genes. Therefore, selection made for one trait influenced the other linked or pleotropically affected traits. The fruit yield or economic yield, in almost all the crops, is referred as super characters, which result from multiple interactions of several other component characters that are termed as yield components. Thus identification of important yield components and information about their inter relationship with each other will be very useful for developing efficient breeding strategy.

The phenotypic correlation coefficients (Table -1&2) between different characters were generally similar in sign and nature to the corresponding genotypic correlation coefficient in the experiment. However, in general genotypic correlations were larger in magnitude from the corresponding phenotypic values.

Perusal of table no. 1 revealed that the significant and positive correlation with yield per plant was observed at phenotypic level with average fruit weight and number fruit per plant. However, significant negative correlation with yield per plant was observed with vine length and days to anthesis of first staminate flower. Similarly observations were also reported by Singh *et al.* (1977) [15]; Mandal *et al.* (1981) [8]; Singh (2006) [16] in sponge gourd and Kumaran *et al*. (1998) [7] in pumpkin.

Correlation measures only mutual relationship without concern cause and effects of relationship. Path coefficient analysis provides a method for separating out direct and indirect effects and measures the relative importance of casual factor which ultimately affect the yield. Path coefficient is simply a standardized partial regression coefficient and as such measure the direct influenced of one variable upon another into components of direct and indirect effects.

The path coefficient analysis (Table-3) revealed appreciable amount of direct positive effect of number of fruits per plant followed by average fruit weight and node number to anthesis of first pistillate flower on fruit yield per plant. The present findings are supported by Mohanty (2001) [9] in pumpkin.

The high genotypic correlation coefficients between the above traits with fruit yield per plant further strength their reliability in the process of selection for higher yield. The direct effect of remaining component traits may be highly influenced by the environmental factor and may be inconsistent in their expression with the change of environment. The present findings are supported by Chaudhary and Mandal (1987) [2] in cucumber, Rajput *et al.* (1995) [11], Shrama and Bhutani (2001) [14] in bitter gourd and Shah and Kale (2002) [12] in ridge gourd.

Diameter of fruit length, fruit length and days taken for first harvest show week positive correlation with yield, Thus, indicating miner role in improvement of yield per plant. These findings are in agreement of Dora *et al*. (2002) [5] in pointed gourd. High phenotypic correlation of yield per plant with number of fruits per plant, average fruit weight, fruit diameter was observed and it is in agreement of findings of Dey *et al.* (2005) [4] in bitter gourd and Karuppiah *et al.* (2005) [6] in ridge gourd. They also reported that the traits number of fruits per plant, average fruit weight and fruit diameter play vital role to boost the yield per plant. The traits like vine length is significantly negatively associated with yield per plant revealed the direct negative effect on yield per plant. However, slightly negative association of the traits like fruit per plant was negatively correlated with node number of first staminate flower indicating that earlier flowering reduces the fruit yield per plant. Such findings are in agreement of Bhave *et al.* (2003) [1] in bitter gourd.

Table 1: Phenotypic correlation coefficient between 11 characters in sponge gourd germplasm

S. No	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	Fruit length (cm)	Fruit diameter (cm)	Av. fruit weight (g)	No. of fruit/ plant	Vine length (m)	Fruit yield/ plant (kg)
1.	Node no. to anthesis of first staminate flower	1.000	0.153	-0.093	0.154	0.131	-0.149	-0.113	-0.108	-0.003	-0.259*	-0.132
2.	Node no. to anthesis of first pistillate flower		1.000	0.046	0.320**	0.383**	0.059	0.110	-0.061	0.110	0.074	0.180
3.	Days to anthesis of first staminate flower			1.000	0.308**	0.234*	-0.275**	-0.009	0.025	-0.080	-0.072	0.015
4.	Days to anthesis of first pistillate flower				1.000	0.882**	-0.012	0.010	0.059	-0.020	-0.230*	0.091
5.	Days to first fruit harvest					1.000	0.072	0.071	0.002	-0.028	-0.148	0.013
6.	Fruit length (cm)						1.000	0.600**	-0.030	0.316**	0.396**	0.033
7.	Fruit diameter (cm)							1.000	0.141	0.178	0.225*	0.173
8.	Average fruit weight (g)								1.000	-0.264*	-0.238*	0.462**
9.	Number of fruit / plant									1.000	0.068	0.476**
10.	Vine length (m)										1.000	-0.233*

* - Significant at 5 per cent probability level

** - Significant at 1 per cent probability level

Table 2: Genotypic correlation coefficient between 11 characters in sponge gourd germplasm

S. No.	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	Fruit length (cm)	Fruit diameter (cm)	Av. fruit weight (g)	No. of fruit/ plant	Vine length (m)	Fruit yield/ plant (kg)
1.	Node no. to anthesis of first staminate flower	1.000	0.156	0.045	0.410	0.464	-0.260	-0.237	-0.228	-0.321	-0.378	-0.314
2.	Node no. to anthesis of first pistillate flower		1.000	0.023	0.376	0.499	0.054	0.126	0.023	0.080	0.084	0.180
3.	Days to anthesis of first staminate flower			1.000	0.386	0.295	-0.410	-0.029	0.123	-0.427	-0.153	-0.026
4.	Days to anthesis of first pistillate flower				1.000	0.940	-0.032	0.024	0.030	0.072	-0.294	0.109
5.	Days to first fruit harvest					1.000	0.075	0.116	-0.061	0.095	-0.196	0.013
6.	Fruit length (cm)						1.000	0.644	-0.091	0.521	0.426	0.027
7.	Fruit diameter (cm)							1.000	0.160	0.296	0.235	0.224
8.	Average fruit weight (g)								1.000	-0.129	-0.307	0.642
9.	Number of fruit / plant									1.000	0.102	0.471
10.	Vine length (m)										1.000	-0.276

Table 3: Direct and indirect effects of 11 characters of Fruit Yield/ plant (kg) at phenotypic level in sponge gourd

S. No.	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	Fruit length (cm)	Fruit diameter (cm)	Av. fruit weight (g)	No. of fruit/ plant	Vine length (m)	Fruit yield/ plant (kg)
1.	Node no. to anthesis of first staminate flower	-0.157	-0.024	0.014	-0.024	-0.020	0.023	0.017	0.017	0.000	0.040	-0.132
2.	Node no. to anthesis of first pistillate flower	0.029	0.193	0.009	0.062	0.074	0.011	0.021	-0.011	0.021	0.014	0.180
3.	Days to anthesis of first staminate flower	0.003	-0.001	-0.041	-0.012	-0.009	0.011	0.000	-0.001	0.003	0.003	0.015
4.	Days to anthesis of first pistillate flower	0.024	0.050	0.048	0.156	0.138	-0.002	0.001	0.009	-0.003	-0.036	0.091
5.	Days to first fruit harvest	-0.021	-0.063	-0.038	-0.145	-0.164	-0.011	-0.011	-0.000	0.004	0.024	0.013
6.	Fruit length (cm)	0.028	-0.011	0.052	0.002	-0.013	-0.188	-0.113	0.005	-0.059	-0.074	0.033
7.	Fruit diameter (cm)	-0.010	0.009	-0.000	0.000	0.006	0.053	0.089	0.012	0.016	0.020	0.173
8.	Average fruit weight (g)	-0.062	-0.035	0.014	0.033	0.001	-0.017	0.080	0.571	-0.151	-0.136	0.462
9.	Number of fruit / plant	-0.002	0.072	-0.052	-0.013	-0.018	0.206	0.116	-0.172	0.653	0.044	0.476
10.	Vine length (m)	0.035	-0.010	0.009	0.031	0.020	-0.053	-0.030	0.032	-0.009	-0.134	-0.233

Residual effect = 0.5627, bold figures indicate direct effects

4. Conclusion

The significant and positive correlation with yield per plant was observed at phenotypic level with average fruit weight and number of fruits per plant indicating that these traits were most important associates. Path coefficient revealed appreciable amount of direct positive effect of average fruit weight followed by number of fruit per plant and fruit diameter on fruit yield per plant.

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