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Correlation Coefficient Analysis for Yield and Yield Attributing Traits in Sponge Gourd (*Luffa cylindrica* (L.) Roem.)

Chithra K.*, Shashikanth Evoor, Allolli T.B., Jagadeesh S.L. and Sarvamangala Cholin
Department of Vegetable Science, College of Horticulture, Bagalkot,
University of Horticultural Sciences, Bagalkot (Karnataka), India.

(Corresponding author: Chithra K.)*
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ABSTRACT: The current investigation was undertaken at the experimental plot of Department of Vegetable Science, College of Horticulture, UHS, Bagalkot (Karnataka) during 2020-2021. Fourty sponge gourd genotypes collected from different places were evaluated to know the character association between them. The correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for improvement in yield. The present study indicated that genotypic correlation co-efficient is higher than the phenotypic correlation co-efficient for all the 17 characters studied. This indicates very little or no influence of environment on genotypes performance and the presence of inherent association between various characters. The trait fruit yield per vine was significantly and positively correlated with vine length, number of branches per vine, fruit length, average fruit weight and number of fruits per vine and sponge yield at both genotypic and phenotypic levels. Therefore, selection based on these characters can be effective for identifying high yielding sponge gourd genotypes.

Keywords: Sponge gourd, fruit yield, phenotypic and genotypic correlation co-efficient.

INTRODUCTION

Luffa cylindrica (L.) Roem., commonly known as sponge gourd, is a minor vegetable crop grown in tropical and subtropical regions of the world. It is a diploid species with chromosome number of 2n=26 belonging to the family cucurbitaceae. This crop is indigenous to Tropical Asia, probably India and South East Asia. It has several other names like, towel gourd, smooth luffa, bath sponge, Chinese luffa. It is also called ghiya tori, nenua and turai in hindi and tuppada hirekayi in Kannada (Nath and Swamy 2016). It has been cultivating extensively in Tropical and sub-tropical climatic conditions of Middle East, India, China, Japan and Malaysia (Porterfield, 1955). In India, the crop is widely cultivated in Uttar Pradesh, Bihar, West Bengal, Orissa, Assam, Andhra Pradesh and Kerala (Arya and Prakash 2002). In Karnataka, it is grown mainly in kitchen gardens during the spring summer and rainy seasons.

Sponge gourd is an annual climber and monoecious vegetable, but different sex form like hermaphrodite, staminate, pistillate, etc. are commonly found in nature (Takahashi, 1980). The tender or immature fruits of sponge gourd are eaten as cooked vegetable, used in the preparation of chutneys and curries. The tender fruits are easily digestible and increase appetite when eaten. The fruits of this vegetable rich in vitamin A, vitamin C and minerals (Mg, Ca, Na, K, Fe, Cu, Zn and Mn). It contains moisture of 93.2 g, protein 1.2 g, fat 0.2 g, carbohydrates 2.9 g and vitamins like, thiamine (0.02 mg), riboflavin (0.06 mg) and fibres (0.20 g) per 100 g of edible portion (More and Shinde 2001). Besides being a vegetable, the mature, dry fruit consists of a hard shell surrounding a stiff, dense network of cellulose fibers (sponge) which is a good source of fiber used in industries for filter and cleaning the motor car, glass wares, kitchen utensil, bath and body bathing accessories (Shah *et al.*, 1980; Oboh and Aluyor 2009).

The yield is a complex character, which is influenced by many other quantitative traits. Variability studies provide information on the extent of improvement possible in different characters, but they do not throw light on the extent and nature of relationship existing between yield and various yield contributory characters. Hence, the knowledge regarding the association of various characters among themselves and with economic characters (correlation studies) is necessary for making direct and indirect selection for improvement of economic characters. Correlation

coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for improvement in yield (Fisher, 1918). Hence, the present investigation was undertaken to study the correlation coefficient analysis for quantitative and qualitative traits in sponge gourd.

MATERIAL AND METHODS

The experiment was carried out at the experimental plot of Department of Vegetable Science, College of Horticulture, UHS, Bagalkot (Karnataka) during rabi 2020-2021. The experiment was laid out in a RCBD design with two replications consisting of fourty sponge gourd genotypes collected from different places. The seeds were sown with a spacing of 2 × 1 m and all the cultural practices followed as per the package of practices. Data was recorded on five randomly selected plants in each of the treatment.

The observations were recorded on vine length at harvest, number of branches per vine, days to first female flower, node at first female flower, days to first harvest, fruit length, fruit diameter, average fruit weight, number of fruits per vine, number of seeds per fruit, sponge yield, TSS, ascorbic acid, potassium content, phenol content, crude fiber and fruit yield per vine. Data was analyzed to estimate correlation coefficients by employing Al-Jibouri *et al.* (1958) formula.

RESULTS AND DISCUSSION

Phenotypic correlation co-efficients. The data pertaining to phenotypic correlation co-efficients for different characters in sponge gourd are presented in Table 1. The fruit yield per vine in the present study had highly significant (at p=0.01) and positive correlation with number of fruits per vine (0.784), vine length (0.532) and fruit length (0.508). While, it is positive and significantly (at p=0.05) correlated with sponge yield (0.484), number of branches per vine (0.453) and average fruit weight (0.434). These could be used as traits of interest for indirect selection to improve fruit yield per vine in sponge gourd. It also had a positive but non-significant correlation with crude fibre content (0.133), TSS (0.097), number of seeds per vine (0.033) and potassium content (0.011). However, the traits such as phenol content (-0.250), days to first fruit harvest (-0.210), days to first female flower (-0.206), node at first female flower (-0.178), ascorbic acid (-0.146) and fruit diameter (-0.096) were negatively and non-significantly associated with fruit yield per vine at phenotypic level. Similar impact of these traits on fruit yield per plant was observed by Sharma *et al.* (2017); Kumar *et al.* (2019); Parveen *et al.* (2019); Annigeri (2020); Som *et al.* (2020); Ray (2021); Purushottama (2022) in sponge gourd. Negative direct effect was observed by days to first female flower, fruit diameter, TSS and potassium content. Similar associations were also noticed between parameters on fruit yield per vine by Kumar *et al.* (2019); Annigeri (2020).

The vine length had highly significant and positive association with number of fruits per vine (0.533) and fruit yield per vine (0.532) at phenotypic level. While, positive significant (at p=0.05) association was observed for fruit length (0.458) and sponge yield (0.449). The trait, number of branches per vine showed highly significant (at p=0.01) and positive association with sponge yield (0.503) while, it exhibited positive significant (at p=0.05) association with fruit yield per vine (0.453), number of fruits per vine (0.407) and fruit length (0.365). The positive and significant outcomes were also seen by Kumar *et al*. (2019); Parveen *et al.* (2019); Annigeri (2020); Som *et al.* (2020); Purushottama (2022) in sponge gourd.

Days to first female flowering had manifested negative and significant correlation with sponge yield (-0.431) and number of fruits per vine (-0.387). But it was exhibited positive and highly significant correlation with days to first harvest (0.738) and it also exhibited significant positive association with average fruit weight (0.370). These results are in accordance with the findings of Singh and Tiwari (2018); Singh *et al*. (2019) in sponge gourd. The trait node at which first female flower appear had shown negative but non-significant association with fruit yield per vine (-0.178), number of seeds per fruit (-0.119), fruit diameter (-0.088), phenol content (-0.080) and TSS (-0.029). These results are in agreement with the findings of Hanumegouda *et al.* (2012); Madhuri (2018) in ridge gourd. Days taken for first fruit harvest had significant and negative association with sponge yield (-0.398) and number of fruits per vine (-0.390). These results are in conformity with the results of Akhila and Singh (2020) in ridge gourd.

Fruit length had recorded positive and highly significant (at p=0.01) correlation with fruit yield per vine (0.508). While, it exhibited significant (at p=0.05) and positive association with sponge yield (0.439) and number of fruits per vine (0.317). These results are in agreement with the reports of Parveen *et al.* (2019); Som *et al.* (2020); Purushottama (2022) in sponge gourd.

The parameter fruit diameter had exhibited positive and non-significant correlation with crude fibre content (0.299), ascorbic acid (0.205), TSS (0.192), potassium content (0.160), number of seeds per fruit (0.148) and number of fruits per vine (0.016). Phenotypic correlation co-efficient for average fruit weight had exhibited significant and positive correlation with fruit yield per vine (0.434). Singh and Tiwari (2018); Kumar *et al*. (2019); Parveen *et al.* (2019); Ray (2021); Purushottama (2022) also observed similar results with sponge gourd.

The character number of fruits per vine had positive and highly significant (p=0.01) correlation with fruit yield per vine (0.784) while, it showed positive and significant association with sponge yield (0.456). These results are in accordance with the findings of Annigeri (2020); Purushottama (2022). The sponge yield had manifested positive and significant correlation with fruit yield per vine (0.484). These results were in agreement with earlier researcher Purushottama (2022).

The TSS had positive association with crude fibre content (0.208), potassium (0.168), fruit yield per vine (0.097) and ascorbic acid content (0.087). The ascorbic acid content in fruit has a positive correlation with phenol (0.244), potassium content (0.160) and crude fibre content (0.030). Whereas, potassium content in fruits had positive association with crude fibre content (0.071) and fruit yield per vine (0.011). These results are similar to those from Annigeri (2020).

Phenol content had exhibited negative association with fruit yield per vine (-0.250) and crude fibre content (-0.160). Whereas, crude fibre content in fruit had exhibited positive association with fruit yield per vine (0.133). These findings are in agreement with the results of Krishnamoorthy (2020) in ridge gourd.

Genotypic correlation co-efficient. The data pertaining to genotypic correlation co-efficients for different characters in sponge gourd are presented in Table 2. At genotypic level fruit yield per vine had highly positive and significant (p=0.01) association with number of fruits per vine (0.914), vine length (0.769), number of branches per vine (0.564), fruit length (0.555) and sponge yield (0.531). While, it had positive and significant correlation with average fruit weight (0.439). However, the trait exhibited negative and significant correlation with node at first female flower (-0.437) and days to first harvest (-0.328) which is desirable. It also similarly exhibited positive but non-significant association with crude fibre content (0.147), TSS (0.130), number of seeds per vine (0.048) and potassium content. Further, negative and non-significant association was noticed with days to first female flower (-0.248), fruit diameter (-0.127), ascorbic acid (-0.213) and phenol (-0.250) content. The findings are in confirmation with the results of Parveen *et al.* (2019); Annigeri (2020); Som *et al.* (2020); Purushottama (2022) in their experiment.

The vine length had showed highly significant (p=0.01) and positive association with number of fruits per vine (0.856), sponge yield (0.773), fruit yield per vine (0.769), number of branches per vine (0.622) and fruit length (0.589). While, it had positive significant correlation with TSS (0.319). However, negative and highly significant association was observed for days to first fruit harvest (-0.525) and negative significant association with days to first female flower (-0.372). Similar results were also reported by Singh and Tiwari (2018); Parveen *et al.* (2019); Som *et al.* (2020); Purushottama (2022) in their studies.

The number of branches per vine had exhibited highly significant (p=0.01) and positive association with node at first female flower (0.745), sponge yield (0.650), fruit yield per vine (0.564), number of fruits per vine (0.555) and fruit length (0.517). Whereas, it exhibited negative and highly significant association (p=0.01) with days to first harvest (-0.529) and negative significant association with days to first female flower (-0.491). The findings of Singh and Tiwari (2018); Som *et al.* (2020); Purushottama (2022) are in conformity with present findings.

Days to first female flower appearance had showed negative and highly significant correlation with number of fruits per vine (-0.586) and sponge yield (-0.539). It had negative and significant association with fruit length (-0.388) and node at first female flower (-0.387). While it had positive and highly significant (p=0.01) correlation with days to first harvest (0.821) and it exhibited significant at p=0.05 and positive association with average fruit weight (0.449). Similar findings were also reported by Singh *et al.* (2019); Purushottama (2022) in sponge gourd.

The parameter, node at first female flower appearance had shown negative and significant association with fruit yield per vine (-0.437). While it exhibited positive and highly significant (p=0.01) association with number of fruits per vine (0.519) and it showed positive and significant association with potassium content (0.429) and sponge yield (0.332). These results are in agreement with the findings of Hanumegouda *et al.* (2012); Madhuri (2018) in ridge gourd.

It was noticed that days to first fruit harvest had exhibited highly significant and negative association with sponge yield (-0.651) and number of fruits per vine (-0.644). Whereas, significant and negative association was observed for TSS (-0.443), fruit length (-0.414) and fruit yield per vine (-0.328). While it exhibited positive and significant association with average fruit weight (0.464). Similar results were also noticed by Som *et al.* (2020) in sponge gourd; Akhila and Singh (2020) in ridge gourd.

Fruit length had positive and highly significant (p=0.01) correlation with fruit yield per vine (0.555) and sponge yield (0.539). While, it exhibited significant and positive association with number of fruits per vine (0.448). Whereas, significant and negative association between fruit length and fruit diameter (-0.363) was seen. The increase in fruit length leads more average fruit weight which ultimately increases the yield of fruit and sponge. These traits can be considered for simultaneously improvement of yield along with these traits. These results are in accordance with the reports of Parveen *et al.* (2019); Annigeri (2020); Purushottama (2022).

Table 1: Estimates of phenotypic correlation coefficients for yield and its attributing traits in sponge gourd genotypes.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}
X_1	**1.000**	0.287	-0.296	0.025	-0.397*	0.458*	-0.192	0.067	0.533**	0.133	0.449*	0.165	-0.095	0.080	-0.123	-0.036	0.532**
X_2		**1.000**	-0.254	0.240	-0.149	0.365*	-0.118	0.043	0.407*	0.067	0.503**	0.056	-0.212	0.093	-0.120	-0.061	0.453*
X_3			**1.000**	-0.181	0.738**	-0.292	0.090	0.370*	-0.387*	-0.157	-0.431*	-0.087	0.075	-0.124	0.147	-0.110	-0.206
X_4				**1.000**	0.022	0.140	-0.088	0.060	0.112	-0.119	0.187	-0.029	0.145	0.184	-0.080	0.077	-0.178
X_5					**1.000**	-0.217	0.035	0.300	-0.390*	-0.184	-0.398*	-0.110	0.130	-0.190	0.169	-0.077	-0.210
X_6						**1.000**	-0.309	0.230	0.317*	0.074	0.439*	-0.084	-0.032	-0.068	0.064	-0.051	0.508**
X_7							**1.000**	-0.108	0.016	0.148	-0.133	0.192	0.205	0.160	-0.169	0.299	-0.096
X_8								**1.000**	-0.090	-0.222	-0.035	-0.216	-0.212	-0.300	0.053	0.021	0.434*
X_9									**1.000**	0.084	0.456*	0.272	-0.005	0.208	-0.296	0.159	0.784**
X_{10}										**1.000**	0.190	0.171	-0.138	0.199	-0.115	0.152	0.033
X_{11}											**1.000**	0.186	-0.220	0.093	-0.281	-0.116	0.484*
X_{12}												**1.000**	0.087	0.168	-0.233	0.208	0.097
X_{13}													**1.000**	0.160	0.244	0.030	-0.146
X_{14}														**1.000**	-0.023	0.071	0.011
X_{15}															**1.000**	-0.160	-0.250
X_{16}																**1.000**	0.133
X_{17}																	**1.000**

Critical r value at 5 %= 0.312, Critical r value at 1 %= 0.500 *Indicates significant at 5 % **Indicates significant at 1 %

X_1= Vine length at harvest X_2= Number of branches per vine X_3= Days to first female flower X_4= Node at first female flower
X_5= Days to first harvest X_6= Fruit length X_7= Fruit diameter X_8= Average fruit weight
X_9= Number of fruits per vine X_{10}= No. of seeds per fruit X_{11}= Sponge yield X_{12}= TSS
X_{13}= Ascorbic acid X_{14}=Potassium content X_{15}= Phenol content X_{16}= Crude fiber
X_{17}= Fruit yield per vine

Table 2: Estimates of genotypic correlation coefficients for yield and its attributing traits in sponge gourd genotypes.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}
X_1	**1.000**	0.622**	-0.372*	-0.099	-0.525**	0.589**	-0.068	0.093	0.856**	0.176	0.773**	0.319*	-0.088	0.097	-0.175	-0.062	0.769**
X_2		**1.000**	-0.491*	0.745**	-0.529**	0.517**	-0.233	0.055	0.555**	0.051	0.650**	-0.010	-0.203	0.085	-0.151	-0.114	0.564**
X_3			**1.000**	-0.387*	0.821**	-0.388*	0.173	0.449*	-0.586**	-0.198	-0.539**	-0.276	0.017	-0.187	0.176	-0.112	-0.248
X_4				**1.000**	-0.095	0.197	-0.251	0.129	0.519**	-0.214	0.332*	0.070	0.260	0.429*	-0.204	0.050	-0.437*
X_5					**1.000**	-0.414*	0.030	0.464*	-0.644**	-0.288	-0.651**	-0.443*	0.174	-0.287	0.262	-0.167	-0.328*
X_6						**1.000**	-0.363*	0.252	0.448*	0.121	0.539**	-0.127	-0.084	-0.111	0.065	-0.055	0.555**
X_7							**1.000**	-0.144	-0.044	0.240	-0.193	0.292	0.237	0.278	-0.214	0.364*	-0.127
X_8								**1.000**	-0.103	-0.231	-0.035	-0.286	-0.264	-0.305	0.054	0.021	0.439*
X_9									**1.000**	0.172	0.626**	0.321*	0.020	0.270	-0.350*	0.173	0.914**
X_{10}										**1.000**	0.218	0.276	-0.149	0.214	-0.120	0.180	0.048
X_{11}											**1.000**	0.260	-0.372*	0.107	-0.298	-0.146	0.531**
X_{12}												**1.000**	0.129	0.196	-0.298	0.226	0.130
X_{13}													**1.000**	0.221	0.320*	0.102	-0.213
X_{14}														**1.000**	-0.024	0.079	0.012
X_{15}															**1.000**	-0.166	-0.250
X_{16}																**1.000**	0.147
X_{17}																	**1.000**

Critical r value at 5 %= 0.312, Critical r value at 1 %= 0.500 *Indicates significant at 5 % **Indicates significant at 1 %

X_1= Vine length at harvest X_2= Number of branches per vine X_3= Days to first female flower X_4= Node at first female flower
X_5= Days to first harvest X_6= Fruit length X_7= Fruit diameter X_8= Average fruit weight
X_9= Number of fruits per vine X_{10}= No. of seeds per fruit X_{11}= Sponge yield X_{12}= TSS
X_{13}= Ascorbic acid X_{14}=Potassium content X_{15}= Phenol content X_{16}= Crude fiber
X_{17}= Fruit yield per vine

The trait fruit diameter had exhibited positive and significant correlation with crude fibre content (0.364). The average fruit weight was recorded significant and positive association with fruit yield per vine (0.439). The individual fruit weight is increases automatically yield is also increases. This is in conformity with the findings of Singh and Tiwari (2018); Annigeri (2020); Ray (2021) in sponge gourd.

The character number of fruits per vine had exhibited positive and highly significant correlation with fruit yield per vine (0.914) and sponge yield (0.626) while, it recorded positive and significant association with TSS content (0.321). It also exhibited significant negative association with phenol content (-0.350). More number of fruits per vine leads to more yield per plant and more sponge yield which indicating that these traits were most important associates for fruit yield. These results are in compliance with the reports of Singh and Tiwari (2018); Parveen *et al.* (2019); Annigeri (2020); Purushottama (2022) in sponge gourd.

Number of seeds per fruit had exhibited positive and non-significant correlation with TSS (0.276), sponge yield (0.218), potassium content (0.214), crude fibre content (0.180) and fruit yield per vine (0.048). The findings are in close proximity with the reports of Purushottama (2022).

The fruit sponge yield had recorded positive and highly significant correlation with fruit yield per vine (0.531). However, it has negative significant correlation with ascorbic acid content (-0.372). The total soluble solids had positive association with crude fibre (0.226), potassium content (0.196), fruit yield per vine (0.130) and ascorbic acid content (0.129).Ascorbic acid content in the fruit has a positive significant correlation with phenol content (0.320). Whereas, potassium content had positive association with crude fibre content (0.079) and fruit yield per vine (0.012). Besides that, crude fibre content had showed positive association with fruit yield per vine (0.147). Annigeri (2020) also made similar reports on sponge gourd.

CONCLUSION

The present investigation revealed that fruit yield per vine was significantly and positively correlated with vine length, number of branches per vine, fruit length, average fruit weight and number of fruits per vine and sponge yield at both genotypic and phenotypic levels. These traits were considered as important component contributing to fruit yield per plant and the selection primarily based on these characters may result in development of high yielding genotypes.

FUTURE SCOPE

Fruit yield per vine was significantly and positively correlated with vine length, number of branches per vine, fruit length, average fruit weight and number of fruits per vine and sponge yield at both genotypic and phenotypic levels. Hence, these characters are considered as important selection criteria to improve fruit yield per vine in sponge gourd.

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Conflict of Interest. None.

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