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Research Note

Correlation studies on yield and yield components in brinjal (*Solanum melongena* L.)

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Abstract
An experiment on correlation analysis involving brinjal (*Solanum melongena* L.) was carried during *rabi* 2018 at college orchard, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. Genotypic correlation coefficient was similar in nature and higher in magnitude than the corresponding phenotypic correlation coefficient for most of the characters. Total yield per plant exhibited highly significant and positive relationship with length of the fruit and the number of fruits per plant is significantly but negatively correlated with shoot borer infestation. Thus, the yield per plant can be enhanced by making selection of these traits during the yield improvement programme.

Keywords
Brinjal, Genotypic Correlation, Phenotypic Correlation.

Brinjal or eggplant (*Solanum melongena* L., 2n=2x=24) is one of the most popular Solanaceous vegetable crop in India. It is probably originated in India and showed a secondary diversity in South East Asia. *Solanum incanum*, a wild species and having a wide distribution in at least 10 habitats in India is the progenitor of the cultivated species, *Solanum melongena*. The first record of brinjal in India was during 300 B.C. to 300 A.D. It is being grown extensively in India, Bangladesh, Pakistan and China and Philippines. India is the second largest producer of brinjal in the world after China. In India, brinjal occupies an area of 0.71 million ha with annual production of 13.55 million tonnes accounting to an average productivity of 19.1 tonnes per hectare (NHB, 2017). The area covered by brinjal crop in Tamil Nadu is 0.015 million ha with a production of 0.196 million tonnes and productivity of 20.0 MT/ha. (NHB, 2017). Due to its highest production potential and availability of the produce to consumers, it is also termed as poor man's vegetable (Kumar *et al*. 2014). Correlation and path co-efficient analysis are important to determine the association between yield and yield components. The characters that are positively correlated with yield are of considerable importance to plant breeder for the selection purpose. Correlation provides a measure of genetic association between the characters and reveals the traits that might be useful as an index of selection. According to Feyzian *et al.* 2009, investigation of the interrelationships between yield and its components will improve the efficiency of a breeding programme with appropriate selection criteria. In the present study, correlation between yield and its components and their inter correlations among the components were estimated in brinjal.

The experiment was carried out during *rabi* 2018 at college orchard, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. The experiment was laid out in a Randomized Block Design with two replications. Each plot consisted of ten plants in a row at 60 x 60 cm inter and intra row spacing. All the recommended package of practices were adopted for raising a healthy crop. Five randomly selected plants, excluding the border ones, from each plot of the two replications were tagged and used for recording the observations and average values were computed. Analysis of covariance for all combinations were done and used for estimation of correlations.

Phenotypic and genotypic correlations were worked out by the formulae recommended by Al-Jibouri *et al.* 1958.

The present investigation revealed that the yield per plant showed a positive and significant association both at genotypic and phenotypic levels, as presented in table 1, with the number of fruits per plant (0.716; 0.575). It showed a positive and significant association at genotypic levels with fruit length (0.836), the number of branches per plant (0.331), calyx length (0.341) and thousand seed weight (0.343). The yield per plant showed a negative and significant association both at genotypic level with ascorbic acid content (-0.440) and total phenol (-0.572).

The interrelationship of different yield components showed that the plant height exhibited a positive and significant association with the number of branches per plant (0.612; 0.331), fruit length (0.333; 0.232) and thousand seed weight (0.361; 0.329) both at genotypic and phenotypic levels. Number of branches per plant registered positive and significant at genotypic levels with fruit length (0.423), fruit girth (0.827), fruit infestation (0.352) and total phenol (0.538). Negative and significant association at genotypic levels were recorded with calyx length (-0.432) and shoot infestation (-0.365).

Days to first flowering was significant and positively correlated at genotypic and phenotypic levels at days to first harvest (0.900; 0.819) and positive and significantly correlated at genotypic levels at fruit length (0.696) and total sugars (0.495). Negative and significant association at genotypic levels with calyx length (-0.561), carbohydrate content (-0.405) and total phenol (-0.543) was also noticed.

Days to first harvest was significant positively associated with carbohydrate content (-0.347), total phenol (-0.543) and solasodine content (-0.375) at genotypic levels. Single fruit weight showed a positive and significant association with calyx length (0.659). Fruit girth was positively correlated with calyx length (0.938), carbohydrate content (0.481), and total phenol (0.932) and negatively significant with solasodine content (-0.592) at genotypic levels. Calyx length recorded a positive and significant correlation with carbohydrate content (0.337), protein content (0.901), total phenol (0.850), polyphenol oxidase (0.549) and solasodine (0.789), whereas, negatively with number of fruits (-0.745), shoot infestation (-0.653), fruit infestation (-0.471) and ascorbic acid content (-0.980) at genotypic level.

Fruit length exerted significant positively correlation with fruit girth (1.098), calyx length (0.508), the number of fruits per plant (0.800), thousand seed weight (0.556), fruit infestation (0.494), ascorbic acid content (0.997), total sugars (0.757), polyphenol oxidase (0.960) and solasodine (0.694), whereas, negatively with single fruit weight (-0.716), protein content (-0.544) and total phenol (-0.896) at genotypic level.

Number of fruits had significant positively correlation with fruit yield per plant (0.716; 0.575) and thousand seed weight (0.451; 0.365) at both levels and negatively significant only at genotypic level with ascorbic acid (-0.557) and total phenol (-0.427). Thousand seed weight showed a negatively and significant association with total phenol (-0.535) at genotypic levels.

Fruit infestation showed a significant negative association with protein content (-0.333) and total phenol (-0.727) at genotypic levels and carbohydrate possessed positively significant correlation at genotypic levels with protein content (0.403), ascorbic acid (0.823) and total phenol (0.733).

Protein content showed a positively significant correlation with solasodine (0.393). It had significant a negative correlation with total phenol (-0.774) at genotypic level. Ascorbic acid registered a significant negative correlation with the total phenol (-0.694) and solasodine content (-0.489) at genotypic level. Total phenol recorded positive association with total sugars (0.527) and polyphenol oxidase (0.658) at phenotypic levels.

Total yield per plant showed a positive correlation with the number of branches, fruit length, the number of fruits per plant, total phenol and polyphenol oxidase. Earlier results obtained also confirm this association in brinjal as reported by Dharwad *et al.* (2011), Muniappan *et al.* (2010), Kranthi and Celine (2013), Vandana *et al.* (2014), (Lakshmi *et al.*, 2014), Ravali *et al.* (2017) and Tiwari *et al*. (2019). A negative association of yield was observed with first flowering, days to first harvest, shoot infestation, fruit infestation and ascorbic acid. High level of infestation in early stage of crop growth would have made a setback on new growth, which prevent the production of new sources and there by dispirited the accessibility of photo assimilates for economic parts. Negative association of yield with shoot and fruit infestation was reported by Vidhya and Kumar (2015) and Tiwari *et al.* (2019).

The inter correlation coefficients of the present investigation on brinjal genotypes revealed that the plant height exhibited a positive and significant relationship with the number of branches per plant, fruits length, fruit girth, thousand seed weight and solasodine. This indicated that the tall plants would have favoured synthesis of growth promoting hormones and thus encouraged production of more number of branches and fruits. Similar results were noticed by Thangamani (2003), Prabhu (2004), Ravali *et al.* (2017) and Tiwari *et al.* (2019).

Number of branches recorded a positively significant association with fruit length, fruit girth, fruit infestation and total phenol. The negative and significant association at both levels was registered with calyx length and shoot infestation. The result of the investigation was in consonance with findings of Prabhu (2004), Ravali *et al.* (2017) and Tiwari *et al.* (2019).

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Table 1. Genotypic and phenotypic correlation coefficients among yield and yield components in brinjal.

		PHT	NBPP	DFF	DFH	FL	FG	IFW	CL	NFPP	TSW	SI	FI	CHC	PC	AAC	TP	TS	PPO	SOS	YPP
PHT	**G**	**1.000**	0.612**	-0.09	-0.076	0.333*	0.279	-0.151	0.091	0.117	0.361*	-0.302	0.190	0.345*	-0.235	-0.50**	-0.101	-0.205	0.293	0.300	0.173
	P	**1.000**	0.331*	-0.08	-0.069	0.232	0.133	-0.109	-0.002	0.118	0.329*	-0.210	0.179	0.119	-0.187	-0.129	-0.067	-0.094	0.274	0.117	0.172
NBPP	**G**		1.000	0.227	0.035	0.423*	0.827**	-0.295	-0.43**	-0.119	-0.292	-0.365*	0.352*	0.168	0.120	0.234	0.538**	0.287	-0.116	0.308	0.204
	P		1.000	0.194	0.105	0.187	0.154	0.028	0.181	-0.175	-0.211	-0.151	0.243	0.027	0.069	-0.120	-0.036	0.092	-0.077	0.035	0.003
DFF	G			1.000	0.900**	0.696**	-0.197	-0.245	-0.56**	0.212	0.111	0.137	0.146	-0.405*	0.163	0.289	-0.54**	0.495	0.209	-0.084	-0.030
	P			1.000	0.819**	0.103	-0.143	-0.044	-0.042	0.124	0.076	0.114	0.133	-0.238	0.102	0.107	0.013	0.299	0.172	-0.085	-0.019
DFH	**G**				1.000	-0.256	-0.034	-0.195	-0.093	0.255	0.207	0.335*	0.274	-0.347*	-0.026	0.429**	-0.64**	0.294	0.273	-0.375*	-0.143
	P				1.000	0.001	-0.029	-0.006	-0.102	0.097	0.133	0.167	0.209	-0.122	-0.069	0.201	0.022	0.250	0.209	-0.153	-0.062
FL	**G**					1.000	1.098**	-0.71**	0.508**	0.800**	0.556**	-0.106	0.494**	-0.093	-0.54**	0.997**	-0.89**	0.757	0.960**	0.694**	0.836**
	P					1.000	-0.078	-0.072	0.066	0.055	0.119	0.101	0.122	-0.032	-0.089	-0.063	0.060	0.111	0.193	0.090	-0.045
FG	G						1.000	0.109	0.938**	-0.185	0.025	-0.099	0.153	0.481**	-0.284	0.012	0.932**	0.086	0.251	-0.59**	-0.205
	P						1.000	-0.015	0.100	-0.164	0.017	-0.030	0.071	-0.009	-0.150	0.008	-0.007	-0.026	0.121	-0.106	-0.054
IFW	**G**							1.000	0.659**	-0.322	-0.246	-0.422*	-0.046	0.017	-0.164	0.060	-0.398*	-0.214	-0.099	-0.333*	0.122
	P							1.000	0.107	-0.200	-0.200	-0.198	-0.028	-0.017	-0.115	0.058	0.083	-0.047	-0.073	-0.273	0.073
CL	**G**								1.000	-0.745**	-0.319	-0.653**	-0.47**	0.337*	0.901**	-0.98**	0.850**	-0.295	0.549**	0.789**	0.314
	P								1.000	-0.161	-0.081	-0.099	-0.073	-0.066	0.133	-0.093	0.121	0.046	0.104	0.126	-0.095
NFPP	**G**									1.000	0.451**	0.264	0.038	-0.007	-0.148	-0.55**	-0.42**	0.224	0.041	-0.190	0.716**
	P									1.000	0.365*	0.151	0.040	-0.009	-0.120	-0.100	-0.079	0.014	0.040	0.025	0.575**
TSW	**G**										1.000	-0.040	0.155	-0.076	-0.047	0.019	-0.53**	-0.010	0.178	-0.065	0.303
	P										1.000	-0.044	0.152	-0.041	-0.035	-0.002	-0.122	-0.004	0.176	-0.037	0.240
SI	G											1.000	-0.025	-0.312	-0.298	-0.224	-0.261	-0.060	0.162	-0.210	-0.209
	P											1.000	-0.009	-0.103	-0.176	-0.140	-0.014	-0.051	0.131	0.123	-0.173
FI	**G**												1.000	-0.181	-0.333*	0.224	-0.72**	-0.166	-0.089	-0.278	0.041
	P												1.000	-0.086	-0.316	0.089	-0.207	-0.096	-0.089	-0.095	0.021
CHC	**G**													1.000	0.403*	0.823**	0.733**	-0.194	-0.018	-0.65**	0.409*
	P													1.000	0.148	-0.020	0.017	-0.147	-0.010	-0.037	0.022
PC	**G**														1.000	0.109	-0.77**	0.036	-0.063	0.393*	-0.090
	P														1.000	0.020	-0.012	-0.022	-0.061	0.133	-0.070
AAC	**G**															1.000	-0.69**	0.302	-0.229	-0.48**	-0.44**
	P															1.000	0.113	0.226	-0.091	0.023	-0.058
TP	**G**																1.000	0.527**	0.658**	-0.104	-0.57**
	P																1.000	0.184	0.121	-0.034	-0.003
TS	**G**																	1.000	-0.039	-0.098	0.072
	P																	1.000	-0.020	0.021	0.105
PPO	G																		1.000	0.072	0.011
	P																		1.000	0.036	0.012
SOS	**G**																			1.000	-0.170
	P																			1.000	0.020

*, **- Significant at 5 % and 1 % probability level, respectively

PHT – Plant Height, NB – Number of Branches Per Plant, DFF – Days to First Flowering, DFH - Days to First Harvest,
FL – Fruit Length, NFPP – Number of Fruits Per Plant, FG – Fruit Girth, IFW – Single Fruit Weight,
CL – Calyx Length, TSW – Thousand Seed Weight, PC – Protein Content, CHC–Carbohydrate Content,
TP – Total Phenol, AAC – Ascorbic Acid Content, TS – Total Sugars, PPO–Polyphenol Oxidase,
SOS - Solasodine YPP – Yield Per Plant.

Days to first flowering was significant and positively correlated with days to first harvest, fruit girth and total sugars and significant negatively associated both at genotypic and phenotypic level with calyx length, carbohydrate content and total phenol. Related results were also reported by Nayak and Nagre (2013), Ravali *et al.* (2017) and Tiwari *et al.* (2019). Days to first harvest had a negatively significant correlation with carbohydrate content, total phenol and solasodine content at both levels.

Fruit length showed a positive association with fruit girth, calyx length, the number of fruits, thousand seed weight, fruit infestation, ascorbic acid, total sugars, polyphenol oxidase and solasodine. Fruit girth was positively correlated with calyx length, carbohydrate content, total phenol and negatively correlated with solasodine at both the levels. Ahmad *et al.* (2009) and Thangamani (2003) also reported the correlation of fruit girth with single fruit weight and Patel *et al.* (2004) for the number of fruits. Calyx length recorded a positively significant association with carbohydrate, protein content, total phenol, polyphenol oxidase and solasodine content at genotypic level.

Number of fruits per plant was significant and positively associated with fruit yield and thousand seed weight at both levels and only genotypic level, respectively. It had a negative and significantly correlation with thousand seed weight, ascorbic acid and total phenol at both levels. Similar results were noticed by Ravali *et al.* (2017) and Tiwari *et al.* (2019).

Fruit infestation exhibited a significantly negative correlation with protein content and total phenol at both levels and only at genotypic level with carbohydrate content. Negative correlation between shoot and fruit borer infestation and polyphenol oxidase has been registered by Doshi (2004) and Khorsheduzzaman *et al.* (2010) It had a positive and significant association with protein content, ascorbic acid and total phenol. Positive correlation between total sugars and shoot and fruit borer infestation has been reported by Doshi (2004), Hazra *et al.* (2004), Shinde *et al.* (2009), Prasad *et al.* (2014) and Ravali *et al.* (2017) and Tiwari *et al.* (2019).

Protein content showed positively a significant correlation with solasodine. It had a negative and significant correlation with total sugars at genotypic level. Positive correlation of protein content with total phenol was noticed by Vidhya and Kumar (2015). Ascorbic acid registered a negative significant association with total phenol and solasodine at genotypic level. Total phenol recorded a positive correlation with total sugars and polyphenol oxidase. Similar result for total phenol was noticed by Vidhya and Kumar (2015). Total sugars had negative and significant association with polyphenol oxidase.

Yield is dependent on various characters which are mutually related; these will in turn impair the true association existing among the component and fruit yield. A change in any one factor is likely to disturb the whole network of cause and effect. Thus, each component has two paths of action *viz.*, direct influence on yield, indirect effect through components which are not revealed from the correlation studies. Number of fruits per plant showed a high positive direct effect at both levels on fruit yield per plant. This trait showed a positive significant correlation and had a high positive direct effect on yield per plant and hence the direct selection through this character would be effective.

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