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A Study on Correlation and Path Coefficient Analysis of Brinjal (*Solanum melongena* L.) for Yield and Yield Contributing Traits

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Correlation and path analysis was studied for 43 lines and F_1s of brinjal (*Solanum melongena* L.) for seventeen qualitative and quantitative characters. The studies revealed that total fruit yield plant^{-1} which is the most important trait had highly significant and positive association with fruit weight, number of fruits plant^{-1}, fruit length, fruit diameter and number of pickings plant^{-1} at both phenotypic and genotypic level. A significant but negative correlation of fruit yield was recorded with days to first flowering, days to first fruit set and days to first fruit picking. Path coefficient analysis revealed that the highest magnitude of positive direct effect on yield was exerted by number of fruits plant^{-1} (1.865) followed by fruit weight (0.848), fruit length (0.259), plant spread (0.188), plant height (0.142), number of pickings (0.109) whereas, lowest positive direct effect on fruit yield was observed for fruit diameter (0.088). For negative direct effects, days to first flowering (-0.868) showed highest negative direct effect on total fruit yield plant^{-1} followed by number of branches plant^{-1} (-0.099), days to first fruit picking (-0.078), and days to first fruit set (-0.044). Therefore, during selection, these characters should also be taken into consideration. Direct selection may be carried out. Considering these traits as the main selection criteria, direct selection can be done. This will also cut down the indirect effect of other characters for developing high yielding brinjal varieties.

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Keywords: Correlation; path coefficient; brinjal; variability.

1. INTRODUCTION

"Brinjal or eggplant (*Solanum melongena* L.) is an important Solanaceous vegetable crops with diploid chromosome no 2n=2x=24". (Gupta RA et. Al. 2017). As per Vavilo [1] the crop is being of Indian origin. Keeping in view the nutritional and medicinal importance of brinjal and keeping the land limitation in mind it is important to improve the yield of brinjal by developing high yielding varieties.For developing high yielding varieties of this crop it is essential to know the genetics of yield of brinjal and its component correlation and path coefficient analysis.All this will furnish information regarding the nature and magnitude of various correlations and help to find direct and indirect effects of the components studied on the yield.

2. MATERIALS AND METHODS

The study was conducted using 43 collections of eggplant germplasms (10 lines, 3 testers and 30 F_1s).These were evaluated in Randomized Block Design, having three replications .The trails were set at three different elevations at a spacing of 60 × 45 . For raising a healthy crop, recommended package of practices was adopted. Five random plants per replication were selected to record observation on each genotype for 17different yield and quality characters. The Observations were recorded on some earliness and yield traits viz; days to first flowering, days to first fruit set, days to first fruit picking, plant height (cm), plant spread (cm), number of branches plant^{-1}, fruit length (cm), fruit diameter (cm), number of fruits plant^{-1}, No of pickings plant^{-1}, average fruit weight (g), fruit yield plant^{-1} (kg), fruit yield ha^{-1} (q). Some quality parameters were also studied like dry matter (%), Total soluble solids ^{o}Brix, Vitamin C (mg 100^{-1}g) and total Phenols (mg100^{-1}g).Phenotypic and genotypic correlation was computed by formulae suggested by Aljibouri et al. [2]. Path coefficient analysis was carried out to partition the total correlation into direct and indirect effects as suggested by Dewey and Lu [3].

3. RESULTS AND DISCUSSION

3.1 Correlation

"For proper selection in advanced generations, estimation of nature and magnitude of the association between yield and its component traits are necessary. Due to linkage of genes or pleiotropy of genes, there is correlations between character pairs. Hence, selection of one trait influences the other pleiotropically affected or linked traits. Considerable importance has been attached to correlation studies are very important as they have a role in the plant improvement and are helpful in making an effective selection" [4]. "In the present study, correlations between seventeen characters of brinjal was worked out in all possible combinations at phenotypic and genotypic level (Table 1). It was seen that the magnitude of genotypic correlation coefficient was higher than the corresponding values of the phenotypic correlation coefficient. This indicated a strong genetic association between the traits and the phenotypic expression which was suppressed due to environmental influence" [4]. In the current study both genotypic and phenotypic correlation were similar in direction hence proving the authenticity of results. Days to first flowering showed highly significant and positive correlation with days to first fruit set and days to first fruit picking at genotypic and phenotypic levels. All the three maturity traits i.e., days to first flowering, days to first fruit set and days to first fruit picking revealed significant positive correlation with plant spread, number of fruits per plant and total soluble solids at genotypic and phenotypic levels, however it had a significant but negative correlation with dry matter at both levels. Highly significant and positive correlation was shown by plant height with fruit length and total soluble solids while it had a negative significant correlation with fruit weight, fruit diameter and total phenols at both the levels. Plant spread expressed a significant positive correlation with maturity traits, fruit diameter, fruit weight and total phenols at genotypic as well as phenotypic levels. Number of branches per plant exhibited highly significant and positive correlation with fruit diameter and number of pickings at both levels while it expressed a negative but significant correlation with fruit length (Table 1). Fruit length showed significant direct correlation with fruit yield and indirect significant correlation with total phenols. Fruit diameter had highly significant and direct correlation with fruit weight and total phenols at genotypic as well as phenotypic levels. At genotypic and phenotypic levels number of fruits per plant had a positive correlation with number of pickings and vitamin C and significant but negative association with fruit weight.

Table 1. Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficient among different traits in Brinjal

S. No.	Character	Days to first flowering	Days to first fruit set	Days to first fruit picking	Plant height (cm)	Plant spread (cm)	No. of branches plant^{-1}	Fruit length (cm)	Fruit diameter (cm)	No of fruits plant^{-1}	No. of pickings plant^{-1}	Fruit weight (g)	Fruit yield plant^{-1} (kg)	Fruit yield ha^{-1} (q)	Dry matter (%)	Total soluble solids (^{o}brix)	Vitamin C (mg 100^{-1} g)	Total phenols (mg 100^{-1} g)
1	Days to first flowering		0.903**	0.966**	0.265	0.508*	-0.018	-0.214	0.139	0.424**	0.156	-0.114	-0.417**	-0.417**	-0.387**	0.612**	0.228	-0.236
2	Days to first fruit set	0.900		0.883**	0.260	0.395*	-0.231	0.043	0.046	0.317*	0.300*	-0.109	-0.303*	-0.303*	-0.290	0.417**	0.109	-0.186
3	Days to first fruit picking	0.906	0.805		0.242	0.516*	0.009	-0.172	0.098	0.397*	0.074	-0.147	-0.376*	-0.376*	-0.200	0.507*	0.256	-0.266
4	Plant height (cm)	0.235	0.202	0.203		-0.273	-0.087	0.399*	-0.639**	-0.074	0.186	-0.37*	-0.24	-0.24	-0.146	0.397*	-0.014	-0.498**
5	Plant spread (cm)	0.501	0.375	0.499	-0.270		0.262	-0.64**	0.60**	-0.24	-0.22	0.465**	-0.006	-0.006	-0.165	0.210	0.176	0.462**
6	No. of branches plant^{-1}	-0.01	-0.178	0.004	-0.080	0.260		-0.84**	0.33*	0.120	-0.326*	-0.218	-0.007	-0.007	0.284	-0.112	-0.08	0.335*
7	Fruit length (cm)	-0.198	0.038	-0.160	0.387	-0.610	-0.78		-0.48**	0.01	0.228	-0.063	0.384**	0.384**	0.06	-0.163	-0.189	-0.426**
8	Fruit diameter (cm)	0.100	0.039	0.091	-0.630	0.600	0.30	-0.39		-0.170	-0.147	0.716**	0.376**	0.376**	-0.259	0.072	-0.299	0.539*
9	No of fruits plant^{-1}	0.394	0.304	0.368	-0.060	-0.220	0.11	0.008	-0.15		0.302*	-0.414**	0.878**	0.878**	-0.127	0.293	0.423**	-0.549*
10	Number of pickings plant^{-1}	0.115	0.298	0.070	0.180	-0.200	-0.32	0.201	-0.140	0.27		-0.007	0.331*	0.331*	-0.482**	0.353*	-0.091	-0.521**
11	Fruit weight (g)	-0.112	-0.100	-0.144	-0.36	0.445	-0.20	-0.060	0.700	-0.40	-0.005		0.382**	0.382**	-0.234	-0.100	-0.391**	0.307*
12	Fruit yield plant^{-1} (kg)	-0.402	0.292	0.360	-0.23	-0.004	-0.004	0.344	0.360	0.86	0.310	0.37			-0.264	0.261	0.249	-0.46**
13	Fruit yield ha^{-1} (q)	-0.402	0.301	0.361	-0.21	-0.004	-0.004	0.344	0.370	0.86	0.320	0.37	0.98**	0.98**	-0.271	0.269	0.24	-0.46**
14	Dry matter %	-0.33	0.185	-0.200	-0.140	0.145	0.234	-0.04	-0.249	-0.117	-0.448	-0.231	-0.224	-0.240		0.02	-0.04	0.01
15	Total soluble solids (^{o}Brix)	0.608	0.404	0.501	0.376	0.200	-0.110	-0.160	0.061	0.277	0.341	-0.100	0.216	0.261	0.01		-0.06	-0.311**
16	Vitamin C (mg 100^{-1} g)	0.201	0.108	0.244	-0.011	0.134	-0.06	-0.178	-0.267	0.412	-0.087	-0.354	0.240	0.213	-0.03	-0.023		0.633**
17	Total phenols (mg 100^{-1} g)	-0.214	0.172	-0.254	-0.394	0.400	0.331	-0.415	0.519	-0.528	-0.413	0.296	-0.42	-0.40	0.01	-0.266	0.54	

, significant at 5% and 1% levels respectively*

Table 2. Path coefficient analysis in Brinjal (Data Pooled over locations)

S. No.	Character	Days to first flowering	Days to first fruit set	Days to first fruit picking	Plant height (cm)	Plant spread (cm)	No. of branches plant^{-1}	Fruit length (cm)	Fruit diameter (cm)	No of fruits plant^{-1}	No. of pickings plant^{-1}	Fruit weight (g)	Fruit yield plant^{-1} (kg)	Fruit yield ha^{-1} (q)	Dry matter (%)	Total soluble solids (^{o}brix)	Vitamin C (mg 100^{-1} g)	Total phenols (mg 100^{-1} g)
1	Days to first flowering	-0.868	-0.019	-0.029	-0.019	-0.067	0.981	0.195	-0.004	-1.020	0.910	0.732	-0.004	-0.179	-0.986	0.018	0.001	-0.003
2	Days to first fruit set	0.369	-0.044	0.016	0.03	0.093	-0.569	0.017	0.042	0.718	-0.502	0.373	-0.001	0.095	0.250	0.008	-.002	-0.001
3	Days to first fruit picking	0.318	0.009	-0.078	0.04	0.034	0.502	0.119	0.018	0.434	0.555	0.475	0.044	0.144	-0.144	0.674	-0.146	-0.003
4	Plant height (cm)	0.116	0.009	0.022	0.142	0.047	0.883	0.104	-0.012	-0.914	0.818	0.219	0.110	0.021	0.434	0.574	-0.002	-0.001
5	Plant spread (cm)	0.307	0.022	0.014	0.035	0.188	0.300	0.007	0.026	0.381	-0.507	-0.313	-0.025	0.852	0.025	0.039	0.030	0.056
6	No. of branches plant^{-1}	-0.718	-0.02	0.04	0.05	-0.87	-0.999	0.133	0.023	1.128	-0.911	-0.750	0.022	-0.173		0.828	0.035	-0.014
7	Fruit length (cm)	0.655	0.003	0.036	0.017	0.005	-0.513	0.259	0.010	-0.207	-0.240	-0.339	0.026	-0.056	0.882	-0.033	-0.017	-0.321
8	Fruit diameter (cm)	0.044	0.021	0.016	0.034	0.056	-0.264	-0.031	0.088	0.569	-0.200	-0.112	0.028	0.001	-0.086	0.126	0.062	-0.12
9	No of fruits plant^{-1}	0.475	0.017	0.018	0.041	0.038	-0.604	0.029	0.027	1.865	-0.902	-0.416	0.042	-0.152	-0.139	0.339	0.021	-0.012
10	Number of pickings plant^{-1}	-0.481	-0.013	-0.035	-0.009	0.054	0.828	0.057	-0.016	1.53	1.099	0.632	-0.085	0.169	-0.358	-0.119	0.023	-0.011
11	Fruit weight (g)	-0.749	-0.019	-0.044	-0.037	0.069	0.033	0.234	0.896	0.185	0.056	0.848	-0.024	0.217	1.116	0.113	0.112	-0.220
12	Fruit yield plant^{-1} (kg)	0.016	0.001	0.015	0.068	0.02	-0.094	0.029	0.011	0.341	-0.407	-0.087	0.230	0.036	-0.013	-0.189	0.010	0.023
13	Fruit yield ha^{-1} (q)	-0.093	-0.041	0.262	0.003	-0.143	0.537	0.045	-0.001	0.881	0.577	0.571	0.026	0.323	-0.806	-0.202	0.043	-0.034
14	Dry matter %	0.555	0.007	0.034	0.04	0.005	-0.536	-0.148	0.005	-0.168	-0.255	-0.615	-0.028	-0.169	-1.54	0.017	0.011	-0.013
15	Total soluble solids (^{o}Brix)	0.128	-1.53	0.019	0.03	0.004	0.012	0.217	0.167	0.0233	0.033	0.87	0.023	0.019	0.043	-0.044	0.123	0.34
16	Vitamin C (mg 100^{-1} g)	0.78	0.78	0.47	0.066	0.076	0.650	0.225	0.228	-0.009	0.005	0.012	0.112	0.056	0.441	0.036	-0.541	0.060
17	Total phenols (mg 100^{-1} g)	0.076	0.023	0.45	0.133	0.056	0.054	0.188	0.564	0.156	0.044	0.04	0.502	0.119	0.018	0.116	0.009	0.099

Residual effect: 0.024

Dry matter and number of pickings had significant negative correlation with each other at both genotypic and phenotypic levels while total soluble solids expressed a positive significant correlation with number of pickings per plant at both levels. At both levels vitamin C recorded a negative significant correlation with fruit weight while total phenols had a positive significant correlation with fruit weight. Negative significant correlation was recorded by total phenols with number of pickings per plant.

A study of data (Tables 1) revealed that most important traits total fruit yield per plant had highly significant and positive association with fruit weight, number of fruits per plant, fruit length, fruit diameter and number of pickings plant^{-1} at both phenotypic and genotypic level. Thus all these characters can be considered as most important associates of fruit yield in brinjal. The available literature has also indicated correlation between total fruit yield per plant and character mentioned above in brinjal which confirms the findings of Ansari et al*.* [5], Nesgea et al*.* [6], Chung et al*.* [7] Nainaret al*.* [8], Sharma and Swaroop [9], Singh et al*.* [10], Pratibha et al*.* [11] and Patel and Sarnaik [12].

3.2 Path Coefficient Analysis

"Path coefficient is simply standardized partial regression coefficient which splits the correlation coefficient into the measures of the direct and indirect effects of a set of independent variables on the dependent variable. This analysis provides a method for separating out the direct and indirect effect of causal factors which affect the yield" [4]**.** The genotypic correlation coefficient of fruit yield and its components along with morphological and quality traits were partitioned into direct and indirect effect taking total fruit yield per plant as dependent variable. Direct and indirect effect of different characters on total fruit yield per plant are presented in Table 2. The present study on path coefficient analysis revealed that the highest magnitude of positive direct effect on yield per plant was exerted by number of fruits per plant (1.865) followed by fruit weight (0.848), fruit length (0.259), plant spread (0.188), plant height (0.142), number of pickings (0.109) whereas, lowest positive direct effect on total fruit yield per plant was observed for fruit diameter (0.088). Among the negative direct effects, days to first flowering (-0.868) showed highest negative direct effect on total fruit yield per plant followed by number of branches per plant (-0.099), days to first fruit picking (-0.078), and days to first fruit set (-0.044). Therefore, during selection, these characters should also be taken into consideration. Similar results had also been reported by [13,14,15,16,17].

4. CONCLUSION

The overall perusal of the results revealed that most important traits i.e., total fruit yield per plant had high significant and positive association with fruit weight, number of fruits per plant, fruit length, fruit diameter and number of pickings plant^{-1} at both phenotypic and genotypic level. Thus, these characters emerged as most important associates of fruit yield in brinjal and can be selected for improving the brinjal yield.

The estimation of correlation indicates only the degree of association between yield and its components but does not show the direct and indirect effects of different yield attributes on yield per se. Fruit yield is dependent on several characters which are mutually associated; these will in turn affect the true association existing between a component and fruit yield. A change in any one component is likely to change the whole network of effect and cause . Thus, each component has two paths of action viz., the direct influence on fruit yield, indirect effect through components which are not revealed by path coefficient analysis.

The present study on path coefficient analysis revealed that the highest magnitude of positive direct affect on yield per plant was exerted by number of fruits per plant (1.865) followed by fruit weight (0.848), fruit length (0.259), plant spread (0.188), plant height (0.142), number of pickings (0.109) thus improvement of these traits will directly improve the yield of brinjal. Among the negative direct effects, days to first flowering (-0.868) showed highest negative direct effect on total fruit yield per plant followed by number of branches per plant (-0.099), days to first fruit picking (-0.078), and days to first fruit set (-0.044). So the most early lines, means high yield and can be selected directly.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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