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Correlation coefficients and path analysis studies for yield and quality traits in brinjal (*Solanum melongena* L.)

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Abstract
Character association and path analysis in 13 parents (10 lines, 3 testers), one check and 30 F_1 hybrids of brinjal were studied at Vegetable Research Farm, Dept. of Horticulture, I.Ag.Sc., B.H.U., Varanasi (U.P.) during season Kharif 2020 and Summer 2021 for twenty-four important characters. The genotypic correlation coefficient in the present investigation was found significantly higher than their corresponding phenotypic correlation for most of the character pairs. The traits like plant height, number of branches per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, percent fruit set, average fruit weight and plant spread both from east-west and north-south direction showed highly significant positive correlation with fruit yield per plant, suggested that selection for these component traits simultaneously will be effective in improving the fruit yield in brinjal. Although these traits exhibited significant association with fruit yield per plant, only number of fruits per plant, average fruit weight and percent fruit set had high direct positive effect on fruit yield per plant, indicating the effectiveness of direct selection for the improvement of these traits. Therefore, more emphasis should be given to traits like number of fruits per plant, average fruit weight and percent fruit set for genetic improvement in brinjal. The high direct effect of these traits appeared to be the main factor for their strong association with fruit yield per plant. Hence, direct selection for these traits will help in development of high yielding varieties of brinjal. Besides direct selection for fruit yield indirect selection through number of branches per plant, plant spread, days to first flowering and days to first fruit picking should be considered for further improvement in fruit yield of brinjal.

Keywords: Character association, path analysis, direct selection, correlation, direct effect

Introduction
Brinjal (*Solanum melongena* L.), a popular vegetable in India and other parts of the world, belongs to the solanaceae family with a diploid chromosome number of 24. It is also known as eggplant in the US and auberzine in France and England. Brinjal is cultivated throughout the year in various parts of India. Brinjal fruit contains fat, carbohydrate, protein, fibre, Vitamin A, Vitamin C, Vitamin B complexes like Thiamin, Riboflavin and Niacin. Additionally, it contains a lot of iron (0.9 mg/100 g) calcium (18 mg/100 g), magnesium (16 mg/100 g) and potassium (2 mg/100 g) (Singh and Bahadur, 2015) [23]. Brinjal is very helpful in controlling the absorption of glucose and in regulating blood sugar levels. Because of its high nutritional quality, it is the most valuable crop for growers and consumers. It is therefore imperative that more production be achieved in order to meet the crop's year-round demand. The improvement in fruit yield in any breeding program can only be achieved through selection for the desired component characters and this crop offers huge genetic diversity for various morphological traits and has lot of potential for its improvement. Knowledge with respect of the nature and extent of association among yield and various component characters is necessary to achieve the improvement in the right direction. The association between different characters is estimated using correlation coefficients, which also identify the component characters that are accounted for selection and yield enhancement (Dhaka and Soni, 2014) [8]. Since yield is a complicated phenomenon influenced by a number of components and selection based solely on correlations without considering cause and effect relationships into account might be deceptive. So, in order to get clear view under this complex situation, the correlation coefficients of fruit yield and its

components along with morphological and quality traits at genotypic and phenotypic level were partitioned into direct and indirect effects through path coefficient analysis by taking total fruit yield per plant as dependent variable. Path coefficient analysis allows the coefficient of correlation to be divided into components of direct and indirect effects and quantifies the direct influence of one variable on another. In light of this, the current study sought to evaluate the relationships between various traits and the direct and indirect impacts of different components on fruit yield per plant among brinjal genotypes.

Materials and Methods

The proposed experiment was undertaken in a randomized block design with 30 F_1 hybrids of brinjal along with thirteen parents and one standard check in three replications at the Vegetable Research Farm, Dept. of Horticulture, I.Ag.Sc., B.H.U., Varanasi (U.P.) during season Kharif 2020 and Summer 2021. All the thirteen parents including ten lines *viz.*, Green Long, Pusa Ankur, JB-9, DMU-1, Kashi Himani, VR-2, JBL-03-06, Utkal Madhuri, SBJH-691, DBR-8, and three testers *viz.*, PLR-1, KS-331, Utkal Keshari and one check Pusa Purple Long were collected from ICAR-IIVR, Varanasi and crossed in Line × Tester mating design to produce 30 F_1 hybrids. Five plants were randomly selected to record the observations of twenty-four growth, yield and quality parameters *viz.*, plant height (cm), number of branches per plant, plant spread in east-west and north-south direction (cm), days to first flowering (DAT), days to 50% flowering (DAT), days to first fruit picking (DAT), number of fruits/cluster, number of flowers/cluster, number of fruits/plant, percent fruit set, fruit length, fruit diameter, average fruit weight, fruit yield per plant (kg), total fruit yield (q/ha), dry matter content (%), total protein content (g/100 g of fruit), seed test weight (g), total soluble solid (°Brix), fruit pH, ascorbic acid content (mg/100 g of fruit), total phenol content (mg/g of fruit) and chlorophyll content of leaf (mg/g). The collected data were subjected to analysis using the methods of Al-Jibouri *et al.* (1958) [1] and Dewey and Lu (1959) [6] to determine genotypic and phenotypic correlations as well as path analysis (Direct and indirect effects).

Results and Discussion

The correlation between fruit yield per plant with different yield attributes and among the attributes themselves are presented in tables 1 and 2. The result clearly showed that all the characters had genotypic correlation coefficient values higher than their corresponding phenotypic correlation coefficient values. Such a high level of genotypic association may be the result of the masking effect of environment. This shows that even though there was a significant degree of genotypic correlation between the two variables, the phenotypic expression was inherent relationship between the two investigated characters, which was also supported by Dhaka and Soni (2014) [8]; Ibaad *et al.* (2016) [10]; Mangi *et al.* (2017) [15]; Singh *et al.* (2020) [24]; Vethamonai *et al.* (2020) [29]; and Rameshkumar *et al.* (2021) [17].

Out of twenty-four characters, number of fruits per cluster, number of fruits per plant, plant spread in north-south direction, percent fruit set, plant height, average fruit weight, plant spread in east-west direction, chlorophyll content of leaf, ascorbic acid content, number of flowers per cluster, number of branches per plant, fruit pH, fruit diameter, dry matter content, test weight of seeds, total protein content and total phenol content exhibited a positive significant correlation at both genotypic and phenotypic levels with fruit yield per plant, respectively. This suggested that selection for these component traits simultaneously will be effective in improving the fruit yield in brinjal. Similar trends of positive and significant correlation were reported by Dhaka and Soni (2014) [8]; Dharwad *et al.* (2009) [7]; Jadhao *et al.* (2009) [11]; Shekar *et al.* (2014) [20]; Kumar *et al.* (2018) [12] and Khan *et al.* (2023) [13]. Fruit yield per plant was negatively correlated with days to first flowering, days to first fruit picking and days to 50% flowering, indicating that the association between these two traits was negative and high. Thomas *et al.* (2022) [28] also found significant negative correlation of fruit yield plant^{-1} both at genotypic and phenotypic levels with the days to 50% flowering and days to first fruit picking.

Correlation between attributes can be caused *via* pleiotropy or linkage among characters. In the current study, correlation observed between any two characters, which were also correlated with fruit yield, led to the conclusion that pleiotropy was primarily responsible for the association between various traits. While, certain correlations between characters and yield were found to be primarily due to linkage rather than pleiotropy, with some characters being correlated with yield and others not. In the present investigation, fruit diameter and average fruit weight expressed a highly significant positive correlation with each other and with fruit yield. This may be due to the effect of pleiotropy. Srivastava *et al.* (2018) [25] in brinjal found that fruit width and average fruit weight showed strong, significant, and positive relationships with fruit yield per plant. Further, fruit length and number of fruits per plant are positively correlated with each other but fruit length was not significantly correlated with fruit yield per plant, although number of fruits per plant was significantly correlated with fruit yield per plant. Association of these characters may be due to linkage and not due to pleiotropy. If genes controlling traits are closely linked, the selection of one trait may automatically favour the other linked traits, leading to a correlated response.

Understanding the interrelationship among yield-contributing variables in a single genotype is crucial for determining the relative significance of individual characters that affect yield. Plant height showed positive and significant correlation with number of branches per plant, number of fruits per cluster, number of fruits per plant, average fruit weight, fruit yield per plant and total fruit yield (q/ha) suggesting that taller plants in brinjal will have more number of branches per plant resulting more number of fruits per plant and more total yield. Similarly, number of branches per plant significantly and positively correlated with number of flowers per cluster, number of fruits per cluster, number of fruits per plant, fruit length, average fruit weight and fruit yield per plant suggesting that increase in number of branches would lead to increase in number of flowers per cluster which leads to produced more number of fruits per plant having higher fruit length resulting higher total yield. These results were in accordance with Mangi *et al.* (2017) [15]; Kumar *et al.* (2018) [12]; Tiwari *et al.* (2019) [27]; Chithra *et al.* (2020) [4] and Dash *et al.* (2020) [5].

Table 1: Estimates of genotypic correlation co-efficient between yield and contributing traits of brinjal

	PH	NBP	PSEW	PSNS	DFF	DF50	DFFP	FLC	FRC	FRP	PFS	FL	FD	AFW	TFY	TWS	DM	TPrC	pH	TSS	AAC	CHL	TPhC	FYPP
PH	1.0000	0.616**	0.573**	0.647**	-0.610**	-0.690**	-0.587**	0.536**	0.699**	0.615**	0.569**	0.0642	0.184*	0.467**	0.694**	0.1361	0.0741	0.413**	0.529**	-0.0036	0.530**	0.414**	0.174*	0.693**
NBP		1.0000	0.845**	0.708**	-0.491**	-0.465**	-0.476**	0.706**	0.696**	0.774**	0.374**	0.232*	0.1582	0.361**	0.675**	0.273*	0.389**	0.290**	0.671**	0.1351	0.694**	0.532**	0.313**	0.592**
PSEW			1.0000	0.858**	-0.480**	-0.509**	-0.453**	0.523**	0.636**	0.674**	0.436**	0.0920	0.388**	0.640**	0.717**	0.183*	0.416**	0.348**	0.607**	0.1204	0.632**	0.692**	0.348**	0.690**
PSNS				1.0000	-0.583**	-0.503**	-0.513**	0.529**	0.752**	0.734**	0.602**	0.1068	0.404**	0.664**	0.810**	0.1254	0.376**	0.277*	0.642**	0.0824	0.620**	0.658**	0.254*	0.803**
DFF					1.0000	0.958**	0.711**	-0.525**	-0.600**	-0.532**	-0.403**	0.0834	-0.322**	-0.433**	-0.605**	-0.1391	-0.190*	-0.180*	-0.456**	0.244*	-0.420**	-0.326**	-0.232*	-0.589**
DF50						1.0000	0.721**	-0.518**	-0.493**	-0.458**	-0.281*	0.1151	-0.273*	-0.373**	-0.511**	-0.1162	-0.1689	-0.242*	-0.484**	0.209*	-0.452**	-0.321**	-0.250*	-0.504**
DFFP							1.0000	-0.449**	-0.555**	-0.535**	-0.412**	-0.0927	-0.1062	-0.280*	-0.581**	-0.310**	-0.220*	-0.1301	-0.443**	0.0298	-0.468**	-0.279*	-0.1072	-0.551**
FLC								1.0000	0.771**	0.764**	0.232*	0.326**	-0.1154	0.0960	0.660**	0.393**	0.270*	0.179*	0.638**	0.192*	0.602**	0.344**	0.362**	0.627**
FRC									1.0000	0.809**	0.807**	0.298**	0.209*	0.520**	0.895**	0.406**	0.327**	0.333**	0.558**	0.0767	0.602**	0.514**	0.221*	0.905**
FRP										1.0000	0.488**	0.343**	0.0151	0.332**	0.863**	0.410**	0.372**	0.236*	0.496**	0.1368	0.561**	0.554**	0.220*	0.841**
PFS											1.0000	0.1466	0.402**	0.679**	0.729**	0.235*	0.207*	0.337**	0.240*	-0.0544	0.344**	0.438**	-0.0589	0.770**
FL												1.0000	-0.616**	-0.244*	0.1427	0.319**	-0.211*	0.377**	-0.1128	0.0834	0.1684	-0.1027	0.1184	0.1107
FD													1.0000	0.826**	0.395**	-0.1098	0.541**	-0.0330	0.418**	-0.0230	0.257*	0.413**	0.1641	0.414**
AFW														1.0000	0.669**	-0.1376	0.492**	0.238*	0.394**	0.0038	0.496**	0.593**	0.176*	0.691**
TFY															1.0000	0.255*	0.459**	0.188*	0.612**	0.190*	0.648**	0.703**	0.237*	0.971**
TWS																1.0000	0.0140	0.1388	0.1640	0.1026	0.0574	0.0019	0.1045	0.292**
DM																	1.0000	-0.0434	0.276*	0.220*	0.337**	0.380**	0.217*	0.412**
TPrC																		1.0000	0.0684	-0.0745	0.313**	0.230*	-0.0481	0.272*
pH																			1.0000	0.0801	0.458**	0.541**	0.364**	0.520**
TSS																				1.0000	0.182*	0.193*	-0.0299	0.0850
AAC																					1.0000	0.460**	0.1600	0.630**
CHL																						1.0000	0.1170	0.651**
TPhC																							1.0000	0.213*
FYPP																								1.0000

PH: Plant height (cm), NBP: Number of branches/plant, PSEW: Plant spread in east to west (cm) direction, PSNS: Plant spread in north to south (cm) direction, DFF: Days to first flowering, DF50: Days to 50% flowering (DAT), DFFP: Days to first fruit picking (DAT), FLC: Number of flowers/cluster, FRC: Number of fruits/cluster, FRP: Number of fruits/plant, PFS: Percent fruit set, FL: Fruit length (cm), FD: Fruit diameter (cm), AFW: Average fruit weight (g), FYPP: Fruit yield per plant (kg), TFY: Total fruit yield (q/ha), TWS: Test weight of seed (g), DM: Dry matter content (%), TPrC: Total protein content (g/100 g of fruit), pH: Fruit pH, TSS: Total soluble solid (°Brix), AAC: Ascorbic acid content (mg/100 g of fruit), CHL: Chlorophyll content of leaf (mg/g), TPhC: Total phenol content (mg/g of fruit).

Table 2: Estimates of phenotypic correlation co-efficient between yield and contributing traits of brinjal

	PH	NBP	PSEW	PSNS	DFF	DF50	DFFP	FLC	FRC	FRP	PFS	FL	FD	AFW	TFY	TWS	DM	TPrC	pH	TSS	AAC	CHL	TPhC	FYPP
PH	1.0000	0.489**	0.537**	0.602**	-0.542**	-0.604**	-0.544**	0.474**	0.632**	0.572**	0.425**	0.0544	0.171*	0.444**	0.656**	0.1251	0.0771	0.390**	0.423**	0.0345	0.497**	0.378**	0.1645	0.656**
NBP		1.0000	0.682**	0.563**	-0.316**	-0.365**	-0.388**	0.474**	0.489**	0.646**	0.223*	0.1642	0.1068	0.307**	0.534**	0.188*	0.212*	0.239*	0.463**	0.0780	0.556**	0.408**	0.269*	0.494**
PSEW			1.0000	0.801**	-0.423**	-0.452**	-0.416**	0.457**	0.563**	0.634**	0.313**	0.0801	0.364**	0.616**	0.673**	0.177*	0.334**	0.323**	0.485**	0.1074	0.591**	0.631**	0.319**	0.652**
PSNS				1.0000	-0.532**	-0.452**	-0.476**	0.468**	0.668**	0.664**	0.447**	0.1066	0.367**	0.636**	0.778**	0.1190	0.303**	0.267*	0.544**	0.0912	0.595**	0.598**	0.244*	0.772**
DFF					1.0000	0.805**	0.623**	-0.447**	-0.493**	-0.462**	-0.297**	0.0628	-0.265*	-0.390**	-0.530**	-0.1227	-0.1045	-0.1533	-0.367**	0.190*	-0.384**	-0.291**	-0.203*	-0.523**
DF50						1.0000	0.647**	-0.432**	-0.417**	-0.394**	-0.186*	0.1208	-0.233*	-0.338**	-0.464**	-0.1176	-0.1238	-0.214*	-0.351**	0.189*	-0.403**	-0.275*	-0.234*	-0.458**
DFFP							1.0000	-0.389**	-0.480**	-0.491**	-0.288**	-0.0615	-0.0977	-0.273*	-0.542**	-0.279*	-0.184*	-0.1241	-0.363**	0.0114	-0.435**	-0.255*	-0.1111	-0.519**
FLC								1.0000	0.624**	0.674**	0.0269	0.282*	-0.0956	0.0871	0.591**	0.361**	0.187*	0.1655	0.504**	0.1637	0.540**	0.310**	0.315**	0.556**
FRC									1.0000	0.703**	0.770**	0.244*	0.218*	0.466**	0.795**	0.352**	0.258*	0.298**	0.402**	0.0680	0.539**	0.438**	0.185*	0.797**
FRP										1.0000	0.365**	0.307**	0.0165	0.318**	0.812**	0.388**	0.278*	0.231*	0.388**	0.1183	0.519**	0.496**	0.204*	0.799**
PFS											1.0000	0.0948	0.321**	0.507**	0.538**	0.1586	0.1456	0.252*	0.1016	-0.0432	0.252*	0.297**	-0.0457	0.556**
FL												1.0000	-0.552**	-0.235*	0.1257	0.301**	-0.172*	0.350**	-0.0533	0.0715	0.1641	-0.0814	0.1004	0.1033
FD													1.0000	0.774**	0.366**	-0.1080	0.431**	-0.0338	0.319**	-0.0149	0.243*	0.369**	0.1477	0.385**
AFW														1.0000	0.642**	-0.1380	0.389**	0.233*	0.346**	-0.0089	0.478**	0.555**	0.1659	0.676**
TFY															1.0000	0.245*	0.354**	0.180*	0.496**	0.1659	0.627**	0.656**	0.221*	0.938**
TWS																1.0000	0.0447	0.1340	0.1297	0.0981	0.0593	0.0010	0.0997	0.279*
DM																	1.0000	-0.0252	0.202*	0.200*	0.272*	0.299**	0.184*	0.315**
TPrC																		1.0000	0.0673	-0.0714	0.302**	0.214*	-0.0383	0.268*
pH																			1.0000	0.0709	0.400**	0.467**	0.304**	0.447**
TSS																				1.0000	0.175*	0.1359	-0.0221	0.0706
AAC																					1.0000	0.430**	0.1501	0.608**
CHL																						1.0000	0.1059	0.613**
TPhC																							1.0000	0.200*
FYPP																								1.0000

PH: Plant height (cm), NBP: Number of branches/plant, PSEW: Plant spread in east to west (cm) direction, PSNS: Plant spread in north to south (cm) direction, DFF: Days to first flowering, DF50: Days to 50% flowering (DAT), DFFP: Days to first fruit picking (DAT), FLC: Number of flowers/cluster, FRC: Number of fruits/cluster, FRP: Number of fruits/plant, PFS: Percent fruit set, FL: Fruit length (cm), FD: Fruit diameter (cm), AFW: Average fruit weight (g), FYPP: Fruit yield per plant (kg), TFY: Total fruit yield (q/ha), TWS: Test weight of seed (g), DM: Dry matter content (%), TPrC: Total protein content (g/100 g of fruit), pH: Fruit pH, TSS: Total soluble solid (°Brix), AAC: Ascorbic acid content (mg/100 g of fruit), CHL: Chlorophyll content of leaf (mg/g), TPhC: Total phenol content (mg/g of fruit).

Table 3: Direct and indirect effects of different traits on the yield of brinjal genotypes at the genotypic level

	PH	NBP	PSEW	PSNS	DFF	DF50	DFFP	FLC	FRC	FRP	PFS	FL	FD	AFW	TFY	TWS	DM	TPrC	pH	TSS	AAC	CHL	TPhC	FYPP
PH	-0.2516	-0.1549	-0.1442	-0.1628	0.1535	0.1735	0.1476	-0.1349	-0.1757	-0.1546	-0.1431	-0.0162	-0.0463	-0.1174	-0.1746	-0.0342	-0.0186	-0.1039	-0.1330	0.0009	-0.1333	-0.1041	-0.0439	0.693**
NBP	-0.2297	0.1696	-0.3151	-0.2641	0.1830	0.1733	0.1773	-0.2634	-0.2596	-0.2887	-0.1394	-0.0865	-0.0590	-0.1347	-0.2517	-0.1018	-0.1451	-0.1081	-0.2504	-0.0504	-0.2589	-0.1985	-0.1166	0.592**
PSEW	0.1088	0.1603	0.1897	0.1627	-0.0911	-0.0966	-0.0859	0.0991	0.1206	0.1279	0.0828	0.0174	0.0737	0.1214	0.1360	0.0347	0.0789	0.0660	0.1152	0.0229	0.1198	0.1313	0.0660	0.690**
PSNS	0.0425	0.0465	0.0563	0.0657	-0.0383	-0.0331	-0.0337	0.0348	0.0494	0.0482	0.0395	0.0070	0.0265	0.0437	0.0532	0.0082	0.0247	0.0182	0.0421	0.0054	0.0407	0.0432	0.0167	0.803**
DFF	-0.1602	-0.1288	-0.1260	-0.1531	0.2625	0.2516	0.1865	-0.1377	-0.1574	-0.1395	-0.1059	0.0219	-0.0844	-0.1137	-0.1589	-0.0365	-0.0500	-0.0473	-0.1198	0.0640	-0.1103	-0.0856	-0.0610	-0.589**
DF50	0.2264	0.1525	0.1671	0.1653	-0.3147	-0.3283	-0.2368	0.1699	0.1618	0.1502	0.0923	-0.0378	0.0897	-0.0664	0.1677	0.0382	0.0554	0.0794	0.1589	-0.0686	0.1484	0.1053	0.0821	-0.504**
DFFP	-0.0979	-0.0794	-0.0756	-0.0856	0.1186	0.1204	0.1670	-0.0749	-0.0926	-0.0893	-0.0687	-0.0155	-0.0177	-0.0468	-0.0971	-0.0517	-0.0367	-0.0217	-0.0740	0.0050	-0.0782	-0.0466	-0.0179	-0.551**
FLC	-0.0196	-0.0258	-0.0191	-0.0193	0.0191	0.0189	0.0164	-0.0365	-0.0281	-0.0279	-0.0085	-0.0119	0.0042	-0.0035	-0.0241	-0.0144	-0.0098	-0.0065	-0.0233	-0.0070	-0.0220	-0.0126	-0.0132	0.627**
FRC	-0.1767	-0.1761	-0.1608	-0.1902	0.1517	0.1246	0.1403	-0.1950	-0.2530	-0.2046	-0.2041	-0.0753	-0.0528	-0.1315	-0.2265	-0.1026	-0.0827	-0.0841	-0.1411	-0.0194	-0.1522	-0.1300	-0.0559	0.905**
FRP	0.1853	0.2333	0.2032	0.2214	-0.1602	-0.1379	-0.1613	0.2303	0.2438	0.3015	0.1470	0.1033	0.0046	0.1000	0.2602	0.1237	0.1122	0.0711	0.1496	0.0413	0.1692	0.1670	0.0663	0.841**
PFS	0.2904	0.1908	0.2227	0.3074	-0.2060	-0.1436	-0.2103	0.1187	0.4119	0.2490	0.5107	0.0749	0.2051	0.1225	0.3722	0.1200	0.1058	0.1720	0.1225	-0.0278	0.1757	0.2235	-0.0301	0.770**
FL	-0.0243	-0.0877	-0.0348	-0.0404	-0.0315	-0.0435	0.0351	-0.1234	-0.1125	-0.1296	-0.0554	-0.3781	0.2330	0.0922	-0.0539	-0.1206	0.0797	-0.1424	0.0426	-0.0315	-0.0637	0.0388	-0.0448	0.1107
FD	-0.0636	-0.0546	-0.1340	-0.1395	0.1109	0.0943	0.0367	0.0398	-0.0720	-0.0052	-0.1386	0.2126	-0.3451	-0.2850	-0.1362	0.0379	-0.1868	0.0114	-0.1444	0.0079	-0.0887	-0.1426	-0.0566	0.414**
AFW	-0.0310	-0.0240	-0.0425	-0.0441	0.0288	0.0248	0.0186	-0.0064	-0.0345	-0.0220	-0.0451	0.0162	-0.0549	0.3467	-0.0444	0.0091	-0.0327	-0.0158	-0.0262	-0.0003	-0.0329	-0.0394	-0.0117	0.691**
TFY	0.6911	0.6721	0.7138	0.8064	-0.6030	-0.5088	-0.5790	0.6570	0.8915	0.8596	0.7259	0.1421	0.3931	0.6661	0.9960	0.2540	0.4568	0.1875	0.6096	0.1894	0.6456	0.7000	0.2362	0.971**
TWS	0.0083	0.0167	0.0112	0.0077	-0.0085	-0.0071	-0.0189	0.0241	0.0248	0.0251	0.0144	0.0195	-0.0067	-0.0084	0.0156	0.0612	0.0009	0.0085	0.0100	0.0063	0.0035	0.0001	0.0064	0.292**
DM	0.0014	0.0073	0.0078	0.0071	-0.0036	-0.0032	-0.0041	0.0051	0.0061	0.0070	0.0039	-0.0040	0.0102	0.0092	0.0086	0.0003	0.0188	-0.0008	0.0052	0.0041	0.0063	0.0071	0.0041	0.412**
TPrC	0.0657	0.0461	0.0553	0.0440	-0.0287	-0.0385	-0.0207	0.0285	0.0529	0.0375	0.0536	0.0599	-0.0052	0.0378	0.0299	0.0221	-0.0069	0.1590	0.0109	-0.0118	0.0497	0.0366	-0.0076	0.272*
pH	0.0729	0.0926	0.0837	0.0885	-0.0629	-0.0667	-0.0611	0.0880	0.0769	0.0684	0.0331	-0.0156	0.0577	0.0543	0.0844	0.0226	0.0380	0.0094	0.1379	0.0110	0.0631	0.0746	0.0502	0.520**
TSS	0.0002	-0.0070	-0.0062	-0.0042	-0.0126	-0.0108	-0.0015	-0.0099	-0.0040	-0.0071	0.0028	-0.0043	0.0012	-0.0002	-0.0098	-0.0053	-0.0113	0.0038	-0.0041	-0.0515	-0.0094	-0.0099	0.0015	0.0850
AAC	0.1295	-0.3730	0.1543	0.1516	-0.1026	-0.1104	-0.1144	0.1471	0.1470	0.1372	0.0841	0.0411	0.0628	0.1212	0.1584	0.0140	0.0823	0.0764	0.1118	0.0446	0.2444	0.1125	0.0391	0.630**
CHL	-0.0975	-0.1254	-0.1631	-0.1550	0.0769	0.0756	0.0657	-0.0811	-0.1210	-0.1306	-0.1031	0.0242	-0.0974	-0.1398	-0.1656	-0.0004	-0.0896	-0.0542	-0.1275	-0.0455	-0.1085	-0.2357	-0.0276	0.651**
TPhC	0.0229	0.0410	0.0456	0.0333	-0.0304	-0.0328	-0.0141	0.0474	0.0290	0.0288	-0.0077	0.0155	0.0215	0.0231	0.0311	0.0137	0.0285	-0.0063	0.0477	-0.0039	0.0210	0.0153	0.1311	0.213*
FYPP	0.693**	0.592**	0.690**	0.803**	-0.589**	-0.504**	-0.551**	0.627**	0.905**	0.841**	0.770**	0.1107	0.414**	0.691**	0.971**	0.292**	0.412**	0.272*	0.520**	0.0850	0.630**	0.651**	0.213*	1.0000
Partial R^2	-0.1744	-0.2209	0.1308	0.0527	-0.1546	0.1656	-0.0919	-0.0229	-0.2290	0.2536	0.3934	-0.0418	-0.1427	-0.0459	0.9667	0.0179	0.0077	0.0432	0.0717	-0.0044	0.1538	-0.1533	0.0279	

PH: Plant height (cm), NBP: Number of branches/plant, PSEW: Plant spread in east to west (cm) direction, PSNS: Plant spread in north to south (cm) direction, DFF: Days to first flowering, DF50: Days to 50% flowering (DAT), DFFP: Days to first fruit picking (DAT), FLC: Number of flowers/cluster, FRC: Number of fruits/cluster, FRP: Number of fruits/plant, PFS: Percent fruit set, FL: Fruit length (cm), FD: Fruit diameter (cm), AFW: Average fruit weight (g), FYPP: Fruit yield per plant (kg), TFY: Total fruit yield (q/ha), TWS: Test weight of seed (g), DM: Dry matter content (%), TPrC: Total protein content (g/100 g of fruit), pH: Fruit pH, TSS: Total soluble solid (°Brix), AAC: Ascorbic acid content (mg/100 g of fruit), CHL: Chlorophyll content of leaf (mg/g), TPhC: Total phenol content (mg/g of fruit).

Number of fruits per cluster was observed to have significant association in positive direction with number of fruits per plant, percent fruit set, fruit length, fruit diameter, average fruit weight, fruit yield per plant and total fruit yield (q/ha). Number of fruits per plant had shown positive and significant correlation with percent fruit set, fruit diameter, fruit length and fruit weight. Similar results were derived from the studies of different scientists like Lakshmi *et al.* (2014) [14]; Shende *et al.* (2014) [26]; Vidhya and Kumar (2015) [30]; Pandey *et al.* (2016) [16]; Gupta *et al.* (2017) [9]; and Srivastava *et al.* (2018) [25]. Moreover, days to first flowering was positively and significantly associated with days to fifty percent flowering and days to first picking at both genotypic and phenotypic level. Positive association of days to fifty percent flowering with days to first flowering is supported by the findings of Senapati *et al.* (2009) [19]. Positive association of days to first flowering with days to picking is in conformity with the findings of Singh and Kumar (2004) [21].

With regards to quality parameters, dry matter of fruit had significant and positive association with average fruit weight; total protein content was found to be positively and significantly associated with number of fruits per plant and fruit length; fruit pH showed positively significant correlation with ascorbic acid content and total phenol content; total soluble solid significantly positive associated with dry matter content and ascorbic acid content. Similar findings were reported by Ravali *et al.* (2017) [18] and Srivastava *et al.* (2018) [25] in brinjal.

The correlation and path coefficients in combination can provide more clarity on the cause-and-effect relationships between various character pairings and are presented in the table 3. The percent fruit set, average fruit weight, number of fruits per plant, number of branches per plant and ascorbic acid content showed high to moderate positive direct effect on fruit yield per plant. This indicates strong association of these characters with fruit yield per plant. Therefore, direct selection for these characters would be beneficial for improvement in fruit yield of brinjal since all these characters also show positive correlation with fruit yield per plant. Further, plant spread in east-west direction, days to first fruit picking, fruit pH, total protein content and total phenol content also produced positive direct effect on fruit yield per plant but of lower magnitude. On the other hand, plant height, days to 50% flowering, number of flowers per cluster, number of fruits per cluster, fruit length, fruit diameter, total soluble solid and chlorophyll content of leaf had negative direct effect on yield per plant being highest in fruit length. The low and negligible positive or negative direct effect resulted due to cancellation by the respective indirect effects *via* total fruit yield (q/ha), percent fruit set, average fruit weight, number of fruits per plant and ascorbic acid content. The results are in conformity with the findings of Bansal and Mehta (2008) [3]; Singh *et al.* (2011) [22]; Lakshmi *et al.* (2014) [14]; Shekar *et al.* (2014) [20]; Vidhya and Kumar (2015) [30]; and Ravali *et al.* (2017) [18]. Negative direct effect of fruit length on yield is in consonance with the findings of Arunkumar *et al.* (2013) [2] and Lakshmi *et al.* (2014) [14].

Conclusion

It can be concluded from the present study that the traits like plant height, number of branches per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, percent fruit set, average fruit weight and plant spread both from east-west and north-south direction showed highly significant positive correlation with fruit yield per plant, suggested that selection for these component traits simultaneously will be effective in improving the fruit yield in brinjal. Although these traits exhibited significant association with fruit yield per plant, only number of fruits per plant, average fruit weight and percent fruit set had high direct positive effect on fruit yield per plant, indicating the effectiveness of direct selection for the improvement of these traits. Therefore, more emphasis should be given to traits like number of fruits per plant, average fruit weight and percent fruit set for genetic improvement in brinjal. Besides direct selection for fruit yield indirect selection through number of branches per plant, plant spread, days to first flowering and days to first fruit picking should be considered for further improvement in fruit yield of brinjal.

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