Estimate of genotypic and phenotypic correlation and Path coefficients in Brinjal (*Solanum melongena* L)

Abstract

The significant positive correlation among phenotypic and genotypic performance, as well as path correlation of crops, contributes to the selection of superior cultivars. Based on the essential relevance of these estimations, it was used in our research.The current research wascarriedoutduringautumnwinterseason2021-2022 with the aim of to estimate correlation coefficient among the growth and yield attribute and to elucidate the direct and indirect effects of different traits on yield through path coefficient analysis. The experimental material for the study consisted of 40 genotypes including one check (KS-224), laid in Randomized Complete Block Design with three replications. Observations were recorded on twelve quantitative characters. The most important trait, total fruit yield per plant had exhibited highly significant and positive phenotypic correlation with average fruit weight (0.662), number of fruits per plant (0.476), fruit circumference (0.394) and fruit polar length (0.392). Average fruit weight, number of fruits per plant, fruit circumference and fruit polar length were found significantly and positively correlated among themselves. The genotypic direct and indirect effects of most of the traits were similar in nature and higher in magnitude than the phenotypic direct and indirect effect. The higher magnitude of positive direct effect on total fruit yield was exerted by average fruit weight (0.793), number of fruits per plant (0.684) and fruit circumference (0.046). While, negative direct effect on total fruit yield per plant was exerted by days to 50 per cent flowering (-0.093), calyx length (-0.052) and pedicel length (-0.022).Thus, it can be inferred from the data above that selecting for these qualities will effectively enhance the crop for increased production and contributing traits.

Keywords: Brinjal (*Solanum melongena* L.) correlationgenotypic, phenotypic, path coefficient, quantitative trait.

INTRODUCTION

Brinjal (*Solanum melongena* L.) belongs to the family Solanaceae and is considered native to India. It is a commonly grown vegetable in Asian nations. It is an annually growing crop of subtropical and tropical regions grown extensively for its berry-like fruit. The bushy plant has an elevated level of flavonoids, alkaloids, and other beneficial compounds like as arginine and aspartic acids. Brinjal or baingan, commonly known as aubergine and aubergine (French term) in North America and Europe, is a staple vegetable in India. Brinjal is widely grown in India and other Asian nations, including Bangladesh, Pakistan, and the Philippines. China, Turkey, Japan, Egypt, Indonesia, Iraq, Italy, Syria, and Spain are also big producers of brinjal (Patel and Sarnaik, 2003).). India ranks second after China. In India it is well distributed in Orissa, Bihar, Karnataka, West Bengal, Andhra Pradesh, Maharashtra, and Uttar Pradesh. In India, it has a production of 13.154 million tonnes from an area of 0.758 million hactare with a productivity of 17.5 tonnes per hactare (Anonymous, 2021). There are over 2000 species in the Solanaceae family which is divided approximately into 75 genera. According to Daunay and Lester (1988). The remaining species are non-tuberous. Under the species melongena, there are three main botanical varieties: esculentum (round and egg-shaped), serpentinum (long and slender), and depressum (dwarf brinjal) **(**Chaudhary, 1976**)**. The yield is a compare traits, and improving it directly is challenging. Knowledge of the type and size of yield connections with distinct component qualities is required to make progress in the intended direction. A crop breeding programme aimed at boosting plant productivity must take into account not just yield but also the components of yield that have a direct or indirect impact on yield. Path coefficient analysis determines the direct influence of one variable on another and allows the correlation coefficient to be divided into direct and indirect effects components (Ahmed *et al.*, 2013). This gives a clear picture of the direct and indirect effects of the various traits on the fruit yield of the plant.

MATERIALS AND METHODS

The current study was conducted during the fall winter season 2021-2022 at the main experiment site, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.). The experimental material for the study consisted of 40 genotypesincluding one check (KS-224), laid in Randomized Complete BlockDesign with three replications. To produce a successful harvest, all the necessary agronomic practises and plant protection measures were implemented.Each treatment consisted of 12 plants in two rows, havingspacing of 60 x 50 cm with net plot size of 1.2 x 3.0 m^2. Observations were recorded on 12quantitative characters *viz.*, days to 50% flowering, days to first fruit harvest, plant height (cm),number of primary branches per plant, pedicel length (cm), calyx length (cm), fruit polar length (cm), fruit circumference (cm),average fruit weight (g), number offruits per plant, TSS

(^{o}Brix) and totalfruit yield per plant (kg).

The correlations between different characters at genotypic (g) and phenotypic (p) levels were worked out as suggested by **Searle** (1961).

i) Phenotypic correlation coefficient between characters X and Y

$$r_{xy(p)} = \frac{Cov._{xy(p)}}{\sqrt{Var.\ X\ (p).Var.\ Y\ (p)}}$$

ii) Genotypic correlation between characters X and Y

$$r_{xy(g)} = \frac{Cov._{xy(g)}}{\sqrt{Var.\ X\ (g).\ Var.\ Y\ (g)}}$$

Where,

r_{xy} =Correlation coefficients between X and Y.

Covariance XY=Co-variance between characters X andY

Var.X=Variance for X character

Var.Y=Variance for Y character

The significance of phenotypic correlation coefficients was tested against (n-2) degrees of freedom at 5% and 1% probability level. Where, n is the number of germplasm on which the observations were recorded.

Table-1: List of genotypes and their source of origin

S. No.	Genotype	Source of origin
1.	2020/BRRVAR-1	A.N.D.U.A.&T, Ayodhya (U.P.)
2.	2020/BRRVAR-2	A.N.D.U.A.&T, Ayodhya (U.P.)
3.	2020/BRRVAR-3	A.N.D.U.A.&T, Ayodhya (U.P.)
4.	2020/BRRVAR-4	A.N.D.U.A.&T, Ayodhya (U.P.)
5.	2020/BRRVAR-5	A.N.D.U.A.&T, Ayodhya (U.P.)
6.	2020/BRRVAR-6	A.N.D.U.A.&T, Ayodhya (U.P.)
7.	2020/BRRVAR-7	A.N.D.U.A.&T, Ayodhya (U.P.)
8.	2020/BRRVAR-8	A.N.D.U.A.&T, Ayodhya (U.P.)
9.	2020/BRRVAR-9	A.N.D.U.A.&T, Ayodhya (U.P.)

10.	2019/BRRVAR-1	A.N.D.U.A.&T, Ayodhya (U.P.)
11.	2019/BRRVAR-5	A.N.D.U.A.&T, Ayodhya (U.P.)
12.	2019/BRRVAR-6	A.N.D.U.A.&T, Ayodhya (U.P.)
13.	2019/BRRVAR-7	A.N.D.U.A.&T, Ayodhya (U.P.)
14.	2019/BRRVAR-8	A.N.D.U.A.&T, Ayodhya (U.P.)
15.	2019/BRRVAR-9	A.N.D.U.A.&T, Ayodhya (U.P.)
16.	2019/BRRVAR-11	A.N.D.U.A.&T, Ayodhya (U.P.)
17.	2019/BRRVAR-12	A.N.D.U.A.&T, Ayodhya (U.P.)
18.	2019/BRRVAR-14	A.N.D.U.A.&T, Ayodhya (U.P.)
19.	2019/BRRVAR-15	A.N.D.U.A.&T, Ayodhya (U.P.)
20.	2021/BRRVAR-1	A.N.D.U.A.&T, Ayodhya (U.P.)
21.	2021/BRRVAR-2	A.N.D.U.A.&T, Ayodhya (U.P.)
22.	2021/BRRVAR-3	A.N.D.U.A.&T, Ayodhya (U.P.)
23.	2021/BRRVAR-4	A.N.D.U.A.&T, Ayodhya (U.P.)
24.	2021/BRRVAR-5	A.N.D.U.A.&T, Ayodhya (U.P.)
25.	2021/BRRVAR-8	A.N.D.U.A.&T, Ayodhya (U.P.)
26.	2021/BRRVAR-9	A.N.D.U.A.&T, Ayodhya (U.P.)
27.	2021/BRRVAR-10	A.N.D.U.A.&T, Ayodhya (U.P.)
28.	2021/BRRVAR-11	A.N.D.U.A.&T, Ayodhya (U.P.)
29.	2021/BRRVAR-12	A.N.D.U.A.&T, Ayodhya (U.P.)
30.	2021/BRRVAR-13	A.N.D.U.A.&T, Ayodhya (U.P.)
31.	2021/BRRVAR-14	A.N.D.U.A.&T, Ayodhya (U.P.)
32.	2021/BRRVAR-15	A.N.D.U.A.&T, Ayodhya (U.P.)
33.	NDB-11-1	A.N.D.U.A.&T, Ayodhya (U.P.)
34.	NDB-12	A.N.D.U.A.&T, Ayodhya (U.P.)
35.	NDB-12-1	A.N.D.U.A.&T, Ayodhya (U.P.)
36.	NDB-13	A.N.D.U.A.&T, Ayodhya (U.P.)
37.	NDB-15	A.N.D.U.A.&T, Ayodhya (U.P.)
38.	NDB-16	A.N.D.U.A.&T, Ayodhya (U.P.)
39.	NDB-18	A.N.D.U.A.&T, Ayodhya (U.P.)
40.	KS-224 (Check)	C.S.A.U.A.&T, Kanpur (U.P.)

RESULT AND DISCUSSION

Correlation coefficient:

The nature and scope of the relationship between yield and its component traits must be understood for efficient selection in future generations. The individuals observed commonly impact both the kind of the population under consideration and the quantity of the correlation coefficient. Linkage of genes or pleiotropy of genes cause correlations between pairs of characters. As a result, choosing one feature influences the other related or pleiotropically affected attributes. Correlation studies have received a lot of attention in the plant improvement field since they help with effective selection.

Table 2 and 3 shows the results of a study that looked at correlations between twelve traits in all possible combinations at the phenotypic and genotypic levels. In general, the magnitudes of genotypic correlation coefficients were higher than the phenotypic correlation coefficients' comparable values. This revealed a substantial genetic link between characteristics and phenotypic expression, which was inhibited by environmental factors. The current investigation also found that the direction of genotypic and phenotypic connection was comparable. Similar findings had also been reported by Sharma *et al*. 2000.

A perusal of data (Table 2 and 3) revealed that the most important trait, total fruit yield per plant had exhibited highly significant and positive phenotypic correlation with average fruit weight (0.662), number of fruits per plant (0.476), fruit circumference (0.394) and fruit polar length (0.392). Average fruit weight, number of fruits per plant, fruit circumference and fruit polar length were found significantly and positively correlated among themselves. Thus, the selection for average fruit weight, number of fruits per plant and fruit circumference or either of it may automatically improve the total fruit yield per plant. Many earlier research workers have also reported significant and positive association of total fruit yield per plant with average fruit weight, number of fruits per plant and fruit circumference. These finding as similar report (Kumar *et al.* 2011, Pandey *et al.* (2016), Gupta *et al.* (2017) and Koundinya *et al.* (2017), and Mawuli *et al.* (2022).

4.6 Path coefficient analysis:

Correlation measures the mutual relationship between various plant characters and determines the component characters, on which selection can be based for genetic improvement in yield without indicating the cause of relationship, whereas, path analysis splits the correlation coefficients into direct and indirect components, indicating the cause of relationship, assisting in genotype selection and also calculating the relatives.

To resolve direct and indirect impacts of eleven traits on total fruit yield per plant, route coefficient analysis was performed using phenotypic and genotypic correlation coefficients. Tables 6 and .7 showed the direct and indirect effects of several features on total fruit yield at the phenotypic and genotypic levels.

The genotypic direct and indirect effects of most of the traits were similar in nature and higher in magnitude than the phenotypic direct and indirect effect. The higher magnitude of positive direct effect on total fruit yield was exerted by average fruit weight (0.793), number of fruits per plant (0.684) and fruit circumference (0.046). While, negative direct effect on total fruit yield per plant was exerted by days to 50 per cent flowering (-0.093), calyx length (-0.052) and pedicel length (-0.022).

The average fruit weight was not only found to have maximum direct effect on total fruit yield per plant but it also contributed substantial positive indirect effect on total fruit yield *via*; fruit circumference (0.589), fruit polar length (0.342), plant height (0.174), calyx length (0.173), pedicel length (0.102). While, negative indirect effect showed *via*; number of fruits per plant (-0.194), TSS (-0.036) and days to first fruit harvest (-0.009) towards total fruit yield per plant. Therefore, during selection these characters should also be taken into consideration. Similar results had also been reported by many workers Patel *et al.* (2017), Sujin *et al*. (2017), Ramesh Kumar *et al.* (2021), Dhaka *et al.* (2022) and Sakriya*et al.* (2022).

Table-2: Estimates of phenotypic correlation coefficients among twelve characters in brinjal germplasm

Traits	Days to 50% Flowering	Days to first harvest	Plant height	Number of primary branches per plant	Pedicel length	Calyx length	Fruit polar length	Fruit Circumference	Average fruit weight	Number of fruit per plant	TSS	Total fruit yield per plant
Daysto50% flowering	**1**	0.275**	0.020	-0.013	0.080	0.020	0.090	-0.041	0.006	-0.012	-0.030	-0.090
Daystofirst fruit harvest		**1**	-0.072	-0.044	-0.030	0.084	0.100	-0.084	-0.011	0.138	0.036	0.083
Plant height			**1**	0.043	0.289**	0.330**	-0.082	0.290**	0.219*	-0.210*	-0.169	0.031
Number of primary branches per plant				**1**	0.052	-0.077	-0.014	0.109	0.021	-0.275**	0.059	-0.129
Pedicel length (cm)					**1**	0.216*	0.039	0.231*	0.128	-0.267**	-0.074	-0.105
Calyx length						**1**	-0.186*	0.319**	0.218*	-0.047	-0.030	0.095
Fruit polar length							**1**	0.413**	0.431**	-0.006	0.162	0.392**
Fruit circumference								**1**	0.731**	-0.340**	-0.059	0.394**
Average fruit weight									**1**	-0.245**	-0.045	0.662**
Number of fruits per plant										**1**	0.138	0.476**
TSS											**1**	0.071

*- Significant at 5 per cent probability level, **- Significant at 1 per cent probability level

Table-3: Estimates of genotypic correlation coefficients among twelve characters in brinjal germplasm

Traits	**Days to 50% Flowering**	**Days to first harvest**	**Plant height**	**Number of primary branches per plant**	**Pedicel length**	**Calyx length**	**Fruit polar length**	**Fruit Circumference**	**Average fruit weight**	**Number of fruit per plant**	**TSS**	**Total fruit yield per plant**
Daysto50% flowering	**1**	-0.538**	-0.183*	-0.075	0.363**	-0.359**	0.451**	-0.082	-0.043	-0.026	0.088	-0.099
Daystofirst fruit harvest		**1**	-0.354**	-0.230*	-0.323**	0.001	0.344**	-0.084	-0.110	0.271**	0.181*	0.244**
Plant height			**1**	0.145	0.416**	0.395**	-0.175	0.309**	0.236**	-0.266**	-0.302**	0.047
Number of primary branches per plant				**1**	-0.171	-0.111	-0.223*	0.132	-0.013	-0.530**	-0.058	-0.394**
Pedicel length (cm)					**1**	0.263**	-0.082	0.256**	0.165	-0.396**	-0.406**	-0.205*
Calyx length						**1**	-0.292**	0.392**	0.277**	-0.102	-0.172	0.156
Fruit polar length							**1**	0.292**	0.594**	0.081	0.205*	0.605**
Fruit circumference								**1**	0.971**	-0.444**	-0.133	0.551**
Average fruit weight									**1**	-0.305**	-0.118	0.673**
Number of fruits per plant										**1**	0.143	0.470**
TSS											**1**	-0.022

*- Significant at 5 per cent probability level, **- Significant at 1 per cent probability level

Table-4: Direct and indirect effect of eleven characters on fruit yield per plant at phenotypic level in brinjal

Traits	Days to 50% Flowering	Days to first harvest	Plant height	Number of primary branches per plant	Pedicel length	Calyx length	Fruit polar length	Fruit Circumference	Average fruit weight	Number of fruit per plant	TSS	Total fruit yield per plant
Daysto50% flowering	**-0.093**	0.009	0.000	-0.001	-0.002	-0.001	0.003	-0.002	0.005	-0.008	0.000	-0.090
Days to first fruit harvest	-0.026	**0.031**	-0.001	-0.002	0.001	-0.004	0.003	-0.004	-0.009	0.094	0.000	0.083
Plant height	-0.002	-0.002	**0.017**	0.002	-0.006	-0.017	-0.003	0.013	0.174	-0.144	-0.001	0.031
Number of primary branches per plant	0.001	-0.001	0.001	**0.034**	-0.001	0.004	-0.001	0.005	0.016	-0.188	0.000	-0.129
Pedicel length	-0.008	-0.001	0.005	0.002	**-0.022**	-0.011	0.001	0.011	0.102	-0.183	0.000	-0.105
Calyx length	-0.002	0.003	0.006	-0.003	-0.005	**-0.052**	-0.006	0.015	0.173	-0.033	0.000	0.095
Fruit polar length	-0.008	0.003	-0.001	-0.001	-0.001	0.010	**0.033**	0.019	0.342	-0.004	0.001	0.392**
Fruit circumference	0.004	-0.003	0.005	0.004	-0.005	-0.017	0.014	**0.046**	0.579	-0.232	0.000	0.394**
Average fruit weight	-0.001	0.000	0.004	0.001	-0.003	-0.011	0.014	0.033	**0.793**	-0.168	0.000	0.662**
Number of fruit per plant	0.001	0.004	-0.004	-0.009	0.006	0.003	0.000	-0.016	-0.194	**0.684**	0.001	0.476**
TSS	0.003	0.001	-0.003	0.002	0.002	0.002	0.005	-0.003	-0.036	0.094	**0.004**	0.071

*-Significant at 5 percent probability level, **- R^2 = 0.8859, RESIDUAL EFFECT = 0.3378

Table-5: Direct and indirect effect of eleven characters on fruit yield per plant at genotypic level in brinjal

Traits	Days to 50% Flowering	Days to first harvest	Plant height	Number of primary branches per plant	Pedicel length	Calyx length	Fruit polar length	Fruit Circumference	Average fruit weight	Number of fruit per plant	TSS	Total fruit yield per plant
Daysto50% flowering	**0.314**	-0.147	-0.048	0.017	-0.152	0.028	-0.007	-0.068	-0.005	-0.016	-0.016	-0.099
Days to first fruit harvest	-0.169	**0.273**	-0.093	0.052	0.136	0.000	-0.005	-0.069	-0.013	0.165	-0.032	0.244**
Plant height	-0.058	-0.097	**0.263**	-0.033	-0.175	-0.031	0.003	0.255	0.027	-0.162	0.053	0.047
Number of primary branches per plant	-0.024	-0.063	0.038	**-0.225**	0.072	0.009	0.003	0.109	-0.002	-0.322	0.010	-0.394**
Pedicel length	0.114	-0.088	0.109	0.039	**-0.420**	-0.020	0.001	0.211	0.019	-0.241	0.072	-0.205*
Calyx length	-0.113	0.000	0.104	0.025	-0.111	**-0.078**	0.005	0.323	0.032	-0.062	0.030	0.156
Fruit polar length	0.142	0.094	-0.046	0.050	0.035	0.023	**-0.015**	0.241	0.068	0.050	-0.036	0.605**
Fruit circumference	-0.026	-0.023	0.081	-0.030	-0.107	-0.030	-0.004	**0.825**	0.112	-0.270	0.024	0.551**
Average fruit weight	-0.014	-0.030	0.062	0.003	-0.069	-0.022	-0.009	0.801	**0.115**	-0.186	0.021	0.673**
Number of fruit per plant	-0.008	0.074	-0.070	0.119	0.166	0.008	-0.001	-0.366	-0.035	**0.609**	-0.025	0.470**
TSS	0.028	0.049	-0.079	0.013	0.170	0.013	-0.003	-0.110	-0.014	0.087	**-0.177**	-0.022

*-Significant at 5 percent probability level, **- R^2 = 1.0226, RESIDUAL EFFECT =SQRT (1- 1.0226)

CONCLUSION:

Based on the above result of correlation studies it could be concluded that characters like average fruit weight, no. of fruits per plant and fruit circumference showed highly positive significant correlation with the yield. Thus, this finding indicated that these traits could utilize in various breeding as well as improvement programmes. The information may further help the breeders in formulating appropriate strategy aimed at getting higher yield and character improvement in brinjal.

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