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Research Note

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

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Abstract
Sixty different varieties of brinjal (*Solanum melongena* L.) were evaluated for character association. The findings showed that the genotypic correlation was higher than the phenotypic correlation coefficient for most traits. Strong positive correlation was observed between the number of fruits per plant, branches per plant, and fruit yield per plant. Positive correlation was observed between moisture content and fruit characteristics, such as fruit volume and average fruit weight. The path coefficient analysis revealed that high positive direct effect on fruit yield was exerted by fruits per plant, followed by moisture content.

Keywords: Correlation coefficient, Eggplant, Path analysis, Total Soluble Solids

Brinjal, also known as eggplant (*Solanum melongena* L), holds significant importance as a vegetable crop in India. The term “brinjal” originates from Arabic and Sanskrit and is commonly used in the Indian subcontinent. Conversely, the term “eggplant” is derived from the fruit’s shape, resembling white chicken eggs in certain varieties. Brinjal varieties can be categorized into three groups: *var esculentum* for big, round or egg shaped fruits, *var sorpentium* for cylindrical and long types, and *var depicesum* for dwarf brinjal plants. Due to higher outcrossing percentage it is classified as cross pollinated crop with a 12 pair of chromosome. Brinjal retains its vital status as a vegetable crop in India and other regions due to its rich cultural heritage, extensive variety selection, and genetic potential. Its capacity to adapt to various climates and its versatility in culinary uses have contributed to its widespread cultivation and consumption.

India holds a prominent position as a leading global producer of brinjal, with a vast expanse of cultivated land, approximately 0.728 million hectares, dedicated to its cultivation (Anon, 2020). This substantial land allocation contributes to an estimated annual production of 12.66 million tonnes, with an impressive productivity rate of 17.39 million tonnes per hectare (Anon, 2020). In the state of Gujarat, brinjal cultivation covers an expansive area of 71370 hectares. This agricultural endeavor yields an annual production of 14.71 metric tonnes, accompanied by a commendable productivity rate of 20.15 metric tonnes per hectare (Anon, 2020).However, despite these significant production figures, the current levels fall short of meeting the demands of the rapidly growing population. The expanding consumer base and increasing consumption patterns necessitate a substantial improvement in fruit yield within brinjal cultivation. Hence, there is a pressing need to focus on enhancing the productivity and efficiency of brinjal farming practices. Efforts must focus on improving productivity and efficiency in brinjal farming practices. This can involve adopting advanced agricultural techniques, implementing effective crop management strategies, and utilizing high-yielding brinjal varieties. By implementing these measures, farmers can bridge the gap between supply and demand, ensuring a sustainable and sufficient supply of brinjal to cater to the population's needs. Enhancing brinjal fruit yield is not only economically significant but also addresses food security concerns. Increased productivity and optimized farming practices contribute to meeting the nutritional requirements of a growing population, promoting food accessibility, and positively impacting the agricultural sector.

Correlation studies provide an opportunity to examine the relationships between yield and its components, as well as among different components, shedding light on their strength and direction. Path analysis, on the other hand, explores the direct and indirect relationships between independent and dependent variables. This analytical approach allows to gain insights into the complex dynamics of brinjal yield and the factors influencing it. By exploring these aspects of brinjal's nutritional composition, industrial potential, and analytical methodologies, we can deepen our understanding of the versatile nature of this vegetable.

The present research study was conducted at Main Vegetable Research Station, Anand Agricultural University, Anand during *kharif-rabi* (2020-21). It is located in Agro-Climatic Zone III (Middle Gujarat) of Gujarat state and situated at 22° 35' North latitude, 72°55' East longitude and an altitude of 45.01 meters above mean sea level. The experimental material for present investigation comprised of 60 diverse accession that were grown in a randomized complete block design with three replications. Each plot had two line of single genotype which were transplanted with spacing of 90 cm x 60 cm. The genotypes were randomly allotted to the plots in each replication. Five random plants of each genotype were used for recording of data on different quantitative and biochemical traits.

The genotypic and phenotypic correlation coefficients were initially calculated using the formula introduced by Johnson *et al.* (1955), based on the average values of the traits. Path analysis, which involves standardized partial regression coefficients and it measures the direct and indirect effects of traits on yield. The path coefficient analysis followed the methodology proposed by Wright (1921) and previously utilized in plant research by Dewey and Lu (1959).

Correlation analysis: The genotypic and phenotypic correlation coefficients (**Table 1 & Table 2**) were estimated for 14 characters including fruit yield. The fruit yield per plant (r_g=0.854 and r_p=0.794) showed positive and highly significant correlation with the fruits per plant, branches per plant (r_g=0.595 and r_p=0.480) and moisture content (r_g=0.575 and r_p=0.339). The results align with the discoveries of Banerjee *et al.* (2018), Saha *et al.* (2019) and Kustagi *et al.* (2019). Fruit girth showed highly significant correlation with average fruit weight in positive direction. The result is in agreement with Saha *et al.* (2019) and Banerjee *et al.* (2018). On the other hand, total soluble solids and fruit volume manifested

Table 1. Genotypic correlation coefficients between fruit yield per plant and other attributes in eggplant

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1 **	-0.194	-0.208	0.084	0.156	0.854 **	-0.190	0.012	0.595 **	0.201	0.575 **	0.124	0.245	-0.058
2		1 **	0.277 *	0.106	0.010	-0.292 *	-0.095	-0.013	0.191	0.252	0.034	0.033	-0.195	0.041
3			1 **	-0.538 **	-0.119	-0.073	0.526 **	0.051	-0.016	-0.073	-0.249	-0.097	-0.082	0.038
4				1 **	0.587 **	-0.218	-0.246*	0.147	-0.058	0.538 **	0.378 **	0.114	0.098	0.227
5					1 **	-0.372 **	-0.184	0.121	0.154	0.642 **	0.478 **	0.211	0.034	0.410**
6						1 **	-0.075	-0.010	0.481 **	-0.085	0.320 **	0.040	0.173	-0.148
7							1 **	0.063	-0.172	-0.071	-0.098	-0.177	0.025	0.313 *
8								1 **	0.051	0.128	0.117	0.303 **	-0.029	0.304 **
9									1 **	0.029	0.186	0.157	-0.027	-0.113
10										1 **	0.654 **	0.269 **	0.004	0.205
11											1 **	0.086	0.064	-0.029
12												1 **	-0.206	0.182
13													1 **	0.010
14														1 **

Note: * and ** indicate significant at 5% and 1% levels, respectively

1. Fruit yield per plant (kg)
2. Days to 50 % flowering
3. Fruit length (cm)
4. Fruit girth (cm)
5. Average fruit weight (g)
6. Fruits per plant
7. Peduncle length (cm)
8. Plant height (cm)
9. Branches per plant
10. Fruit volume (cc)
11. Moisture content (%)
12. Total phenols (mg/100)
13. Total soluble sugars (%)
14. Total soluble solids (Brix)

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Table 2. Phenotypic correlation coefficients between fruit yield per plant and other attributes in eggplant

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1 **	-0.129	-0.164 *	0.081	0.049	0.794 **	-0.149 *	0.047	0.480 **	0.162 *	0.339 **	0.101	0.208 **	-0.013
2		1 **	0.194 **	0.076	0.158 *	-0.240 **	-0.065	-0.009	0.077	0.187 *	-0.046	0.015	-0.144	0.025
3			1 **	-0.473 **	-0.099	-0.061	0.446 **	0.061	-0.007	-0.071	-0.162 *	-0.093	-0.082	0.015
4				1 **	0.470 **	-0.198 **	-0.195 **	0.113	-0.020	0.440 **	0.238 **	0.097	0.094	0.130
5					1 **	-0.375 **	-0.124	0.116	0.102	0.524 **	0.286 **	0.164 *	0.033	0.237 **
6						1 **	-0.065	0.008	0.420 **	-0.082	0.216 **	0.037	0.162 *	-0.100
7							1 **	0.043	-0.161 *	-0.037	-0.090	-0.148 *	0.025	0.184 *
8								1 **	0.034	0.110	0.078	0.273 **	-0.020	0.198 **
9									1 **	0.028	0.168 *	0.145	-0.022	-0.013
10										1 **	0.416 **	0.242 **	-0.009	0.158
11											1 **	0.072	0.042	-0.010
12												1 **	-0.198 **	0.138
13													1 **	0.002
14														1 **

Note: * and ** indicate significant at 5% and 1% levels, respectively

positive association with average fruit weight at both phenotypic and genotypic levels. It is in consonance with the results of Saha *et al.* (2019), Konyak *et al.* (2020) and Nikitha *et al.* (2020).

Path analysis: The path analysis revealed the relationship between the studied traits and fruit yield, either through their direct impact on yield or through indirect effects *via* other component traits (**Table 3**). The path coefficient analysis unveiled that the most significant and positive direct effect on fruit yield was observed for fruits per plant, followed by moisture content. These traits emerged as crucial contributors to fruit yield, aligning with previous studies by Ravali *et al.* (2017) and Banerjee *et al.* (2018). Therefore, when breeding for high fruit yield, emphasis should be placed on these traits as they play a vital role.

Table 3 Genotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects of different characters on fruit yield per plant in brinjal

	1	2	3	4	5	6	7	8	9	10	11	12	13	Genotypic correlation with FYPP
1	-0.039	0.008	0.011	0.012	-0.212	0.005	0.001	0.037	-0.009	0.008	0.001	-0.019	0.002	-0.194
2	-0.011	0.029	-0.056	-0.015	-0.054	-0.030	-0.003	-0.003	0.002	-0.058	-0.004	-0.008	0.002	-0.208
3	-0.004	-0.016	0.104	0.072	-0.158	0.014	-0.009	-0.011	-0.018	0.088	0.005	0.010	0.009	0.084
4	-0.004	-0.003	0.061	0.122	-0.270	0.010	-0.008	0.030	-0.022	0.112	0.009	0.003	0.016	0.156
5	0.011	-0.002	-0.023	-0.046	0.726	0.004	0.001	0.092	0.003	0.075	0.002	0.017	-0.006	0.854**
6	0.004	0.015	-0.025	-0.023	-0.055	-0.057	-0.004	-0.033	0.002	-0.023	-0.008	0.002	0.013	-0.190
7	0.001	0.002	0.015	0.015	-0.008	-0.004	-0.064	0.010	-0.004	0.027	0.013	-0.003	0.012	0.012
8	-0.007	0.004	-0.006	0.019	0.349	0.010	-0.003	0.192	-0.001	0.044	0.007	-0.003	-0.005	0.595**
9	-0.010	-0.002	0.056	0.079	-0.062	0.004	-0.008	0.006	-0.034	0.153	0.012	0.004	0.008	0.201
10	-0.001	-0.007	0.039	0.059	0.233	0.006	-0.008	0.036	-0.022	0.234	0.004	0.006	-0.001	0.575**
11	-0.001	-0.003	0.012	0.026	0.029	0.010	-0.019	0.030	-0.009	0.020	0.043	-0.020	0.007	0.124
12	0.008	-0.002	0.010	0.004	0.126	-0.001	0.002	-0.005	0.001	0.015	-0.009	0.098	0.001	0.245
13	-0.002	0.001	0.024	0.050	-0.108	-0.018	-0.020	-0.022	-0.007	-0.007	0.008	0.001	0.040	-0.058

Note: * and ** indicate significant at 5% and 1% levels, respectively
Residual effect = 0.0834

1. Days to 50 % flowering
2. Fruit length (cm)
3. Fruit girth (cm)
4. Average fruit weight (g)
5. Fruits per plant
6. Peduncle length (cm)
7. Plant height (cm)
8. Branches per plant
9. Fruit volume (cc)
10. Moisture content (%)
11. Total phenols (mg/100g)
12. Total soluble sugars (%)
13. Total soluble solid (°Brix)

The residual effect, with a positive value of 0.0834 in this study, suggests that the examined traits alone do not fully explain the associations between individual characteristics in brinjal. This indicates the presence of other unaccounted factors that influence fruit yield. To gain a comprehensive understanding of the relationships and factors contributing to fruit yield in brinjal, further investigations and consideration of additional variables are warranted.

Fruit yield per plant exhibited a highly significant association with fruits per plant, branches per plant and moisture content in positive direction at both the genetic and observable levels. At the phenotypic level, there was a significant positive correlation between total soluble sugars, fruit volume, and fruit yield. However, this correlation was not observed at the genotypic level. The path coefficient analysis further elucidated the direct effects of various traits on fruit yield per plant. Traits such as fruit length, fruit girth, average fruit weight, fruits per plant, branches per plant, moisture content, total phenols, total soluble sugars, and total soluble solids all demonstrated a positive influence on fruit yield.

These findings emphasize the crucial role of fruits per plant, branches per plant, and moisture content in determining fruit yield. Additionally, traits such as fruit length, fruit girth, average fruit weight, and the presence of total phenols, total soluble sugars, and total soluble solids directly contribute to enhancing fruit yield per plant. Understanding these relationships and the direct effects of different traits on fruit yield is essential for optimizing breeding strategies and cultivation practices. By leveraging this knowledge, breeders can enhance fruit production and improve overall crop productivity.

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