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Research Article

# CHARACTER ASSOCIATION AND PATH COEFFICIENTS ANALYSIS FOR VARIOUS YIELD ATTRIBUTES OF BRINJAL (*Solanum melongena* L.)

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**Abstract-** A field experiment including forty genotypes was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during autumn winter season 2015-16. The observations were recorded on qualitative and qualitative traits. The genotypic path coefficient revealed that highest positive direct effect (0.866**) on fruit yield followed by number of flower per cluster (0.355**) and fruit yield per plant (0.610*), whereas length of peduncle showed significant and negative association with number of branches per plant (-0.186*). Simultaneously, significant positive genotypic correlation was observed for number of branches per plant (0.610**), number of fruits per plant (0.565**), number of flowers per cluster (0.394**) and plant height (0.213*) with fruit yield per plant. Path analysis showed that number of branches and fruits per plant had high direct effect and number of flowers per cluster had indirect effect *via*., number of branches per plant with fruit yield per plant, indicating that these traits should be given importance for selection in present material.

**Keywords**- Character association, Correlation, Path analysis, *Solanum melongena* L.

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## Introduction

Brinjal (*Solanum melongena* L.) is one of the most extensively grown vegetable all over the world including India. To increase its productivity the efforts being made to develop superior varieties. Knowledge in respect of the nature and magnitude of associations of yield with various component characters is a pre-requisite to bring improvement in the desired direction. Correlation and path coefficient analysis are helpful tools to ascertain the real components of yield, which is a complex character. Any crop improvement is intended to improve the yield considering all other related components, which directly or indirectly contribute for its improvement. Hence, to illustrate the association between these variables coefficient of correlation is generally adopted, which is of prime importance to select the suitable genotypes for improving the yield.

Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters, on which selection can be based for genetic improvement in yield, whereas, path analysis partitioned the correlation coefficients into direct and indirect effects of a set of dependent variables on independent variable, thereby assists in the isolation of genotype. The all above cited parameters are pre-requisite to plan effective and successful breeding strategy. The aim of the present study was to assess the association between yield and yield contributing characters with their direct and indirect effects on fruit yield and related traits of brinjal.

## Materials and Methods

The present study was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during autumn-winter of 2015-16. The experimental material comprised forty genotypes. The genotypes have been selected from the material and maintained by department based on morphological characters. Recommended agronomic and cultural practices were adopted to obtain good phenotypic expression of the characters. Observations were recorded on number of branches per plant, plant height, length of peduncle, number of fruits per plant, number of flowers per cluster, fruit length, fruit diameter, days to 50% flowering, leaf length, fruit weight, yield per plant, leaf width, fruit length to width ratio from ten randomly selected competitive plants in each genotype of a replication. The experiment was laid out in randomized block design with three replication having 40 genotypes, respectively. The knowledge of correlation between yield and its contributing characters are basic and foremost endeavor to find out guidelines for plant selection. The existing relationships between traits are generally determined by the genotypic and phenotypic correlations. The phenotypic correlation measures the degree of association of two variables and is determined by genetic and environmental factors. On the other hand, the genotypic correlation that represents the genetic portion of phenotypic correlation is of inheritable nature and therefore, it is used to orient breeding programs [3].

## Results and Discussion

The number of branches per plant showed significant and positive correlation [Table-1] with number of fruits per plant (0.866**), number of flower per cluster (0.355**) and fruit yield per plant (0.610*). Similar trends in results were also obtained by [21,1] for number of branches per plant in brinjal. Plant height [Table-1] exhibited significant and positive correlation with number of branches per plant (0.234*). Similar results were found by [24,1, 23]. The length of peduncle [Table-1] showed significant and negative association with number of branches per plant (-0.186*) and non-significant and positive association with plant height (0.161) at genotypic level, respectively. The present results are similar to the findings of [6,4,12]. The number of fruits per plant [Table-1] showed significant and positive correlation with number of branches per plant (0.866**). It also showed non-

significant and negative association with length of peduncle (-0.014) but significant and positive correlation with plant height (0.205*). Similar results were reported by [17,1,10] for number of fruits per plant.

The number of flowers per cluster [Table-1] showed highly significant and positive correlation with number of branches per plant (0.355**) and number of fruits per plant (0.447**) at genotypic level. On the other hand, the trait demonstrated significant and negative correlation with length of peduncle (-0.214*) also showed non-significant and negative association with plant height (-0.008). Similar to the present findings, [10, 11] also showed positive correlation with number of flowers per cluster. Fruit length [Table-1] showed significant and positive relation with length of peduncle (0.184*) and non-significant and positive correlation with number of flowers per cluster (0.103) and number of fruits per plant (0.005) at genotypic level and significant and negative association with number of branches per plant (-0.196*) and non significant and negative correlation with plant height (-0.046). The earlier reports of [18] also reported positive correlation with yield per plant. Similarly, [1,13,15,22] support the present findings.

**Table-1** *Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients among different yield and yield contributing characters of brinjal*

| Genotypic correlation coefficient | NBBP | PH | LP | NFPP | NFPC | FL | FD | D50%F | LL | FW | YPP | LW | FL/WR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NBBP** | **1.00** | 0.169 | -0.099 | 0.545** | 0.170 | -0.136 | -0.061 | -0.059 | -0.011 | -0.168 | 0.441** | -0.153 | -0.097 |
| **PH** | 0.234* | **1.00** | 0.122 | 0.177 | 0.018 | -0.025 | 0.090 | 0.039 | -0.092 | -0.073 | 0.197* | -0.122 | -0.034 |
| **LP** | -0.186* | 0.161 | **1.00** | -0.056 | -0.135 | 0.175 | -0.226* | 0.149 | 0.232* | 0.043 | -0.215* | 0.171 | -0.103 |
| **NFPP** | 0.866** | 0.205* | -0.114 | **1.00** | 0.331** | 0.025 | -0.128 | -0.037 | 0.071 | -0.146 | 0.514** | -0.024 | -0.139 |
| **NFPC** | 0.355** | -0.008 | -0.214* | 0.447** | **1.00** | 0.081 | 0.032 | 0.078 | -0.175 | -0.089 | 0.315** | -0.072 | 0.206* |
| **FL** | -0.196* | -0.046 | 0.184* | 0.005 | 0.103 | **1.00** | -0.116 | 0.236** | -0.024 | 0.048 | -0.087 | 0.205* | 0.207* |
| **FD** | 0.028 | 0.119 | -0.286** | -0.143 | 0.082 | -0.130 | **1.00** | -0.396** | -0.135 | 0.148 | -0.074 | -0.366** | 0.056 |
| **D50%F** | -0.071 | 0.072 | 0.259** | -0.005 | 0.021 | 0.366** | -0.525** | **1.00** | 0.058 | -0.073 | -0.038 | 0.228* | 0.152 |
| **LL** | 0.151 | -0.074 | 0.349** | 0.126 | -0.377** | -0.018 | -0.238** | 0.155 | **1.00** | 0.248** | -0.145 | 0.070 | -0.102 |
| **FW** | -0.238** | -0.069 | 0.055 | -0.162 | -0.122 | 0.061 | 0.161 | -0.088 | 0.387** | **1.00** | 0.312** | -0.163 | -0.022 |
| **YPP** | 0.610** | 0.213* | -0.264** | 0.565** | 0.394** | -0.095 | -0.085 | -0.049 | -0.247** | -0.319** | **1.00** | 0.017 | -0.096 |
| **LW** | -0.245** | -0.135 | 0.171 | -0.028 | -0.089 | 0.217* | -0.430** | 0.325** | 0.089 | -0.167 | 0.019 | **1.00** | -0.392** |
| **FL/WR** | -0.130 | -0.047 | -0.132 | -0.146 | 0.277** | 0.232* | 0.068 | 0.191* | -0.204* | -0.022 | -0.098 | -0.411** | **1.00** |

*, **P ≤ 0.05 and 0.01, respectively

NBBP- number of branches per plant, PH- plant height, LP- length of peduncle, NFPP- number of fruits per plant, NFPC- number of flowers per cluster, FL- fruit length, FD- fruit diameter, D50%F- days to 50% flowering, LL- leaf length, FW- fruit weight, YPP- yield per plant, LW- leaf width, FL/WR- fruit length to width ratio

Fruit diameter [Table-1] exhibited significant and negative correlation (-0.286*) with length of peduncle and non-significant and positive association with plant height (0.119), number of flowers per cluster (0.082) and number of branches per plant (0.028) and non-significant and negative correlation with number of fruits per plant (-0.143) and fruit length (-0.130), respectively. Earlier, [2,13] reported that fruit diameter had positive correlation with yield per plant. Similarly, this study confirms the findings of [22]. Days to 50% flowering showed highly significant and positive relationship with fruit length (0.366**) and length of peduncle (0.259**) and non-significant and positive correlation with plant height (0.072) and number of flowers per cluster (0.021) at genotypic level [Table-1]. It also showed significant and negative correlation with fruit diameter (-0.525**) and non-significant and negative correlation with number of branches per plant (-0.071) and number of fruits per plant (-0.005) at genotypic level. [8,25] also showed similar result but the findings of [21] were contradictory to the present findings.

Leaf length [Table-1] showed highly significant and positive correlation with length of peduncle (0.349**) and highly significant and negative correlation with number of flowers per cluster (-0.377**) and fruit diameter (-0.238**). On the other hand, it showed non-significant and positive association with days to 50% flowering (0.155), number of fruits per plant (0.126) and number of branches per plant (0.151). Similar results exhibiting positive correlation for leaf length were explained by [15,18,22]. Fruit weight showed highly significant and positive correlation with leaf length (0.387**) and non-significant and positive association with fruit length (0.061), length of peduncle (0.055) and fruit diameter (0.161) at genotypic level [Table-1]. The character reflected significant and negative association with number of branches per plant (-0.238**) and non-significant and negative association with plant height (-0.069), number of fruits per plant (-0.162), number of flowers per cluster (-0.122) and days to 50% flowering (-0.088) at genotypic level. Similar trends in findings were also obtained by [1,13,17,18].

Yield per plant showed highly significant and positive relationship with number of branches per plant (0.610**), number of fruits per plant (0.565**) and number of flowers per cluster (0.394**) and significantly positive association with plant height (0.213*) indicates that the traits are governed by same pleiotropic effect of gene and simultaneous improvement would be effective at genotypic level [Table-1]. It also showed highly significant and negative genotypic correlation with fruit weight (-0.319**), length of peduncle (-0.264**) and leaf length (-0.247**). It showed non-significant and negative correlation with days to 50% flowering (-0.049), fruit diameter (-0.085) and fruit length (-0.095) at genotypic level. Close results were found by various workers [1,13,14,17,21], respectively. Leaf width [Table-1] showed highly significant and positive relationship with days to 50% flowering (0.325**) and positive association with fruits length (0.217*) at genotypic level. On the other hand, the trait demonstrated non-significant and positive association with length of peduncle (0.171), leaf length (0.089) and yield per plant (0.019) at genotypic level. It also showed highly significant and negative genotypic correlation with number of branches per plant (-0.245**) and fruit diameter (-0.430**). It showed non-significant and negative correlation with plant height (-0.135), number of fruits per plant (-0.028), number of flowers per cluster (-0.089) and fruit weight (-0.167) at genotypic level. Similar results for leaf width were obtained by [14,22].

Fruit length to width ratio showed highly significant and positive correlation with number of flowers per cluster (0.277**) and highly positive association with fruit length (0.232*) and days to 50% flowering (0.191*) at genotypic level [Table-1]. On the other hand, fruit diameter (0.068) showed positive correlation with fruit length to width ratio. The fruit length to width ratio showed highly significant and negative correlation with leaf width (-0.411**) at genotypic level. It also showed non-significant and negative correlation with number of branches per plant (-0.130), plant height (-0.047), length of peduncle (-0.132), number of fruits per plant (-0.146), fruit weight (-0.022) and yield per plant (-0.098) at genotypic level. Results of present investigation were in quite agreement with the reports of [1], [15] and [22].

**Path coefficient analysis**

The number of branches per plant [Table-2] had positive direct effect (0.930) on yield per plant and positive indirect effect *via* plant height (0.029), number of flowers per cluster (0.025), length of peduncle (0.016) and days to 50% flowering (0.011) and negative indirect effect *via* number of fruits per plant (-0.235), fruit length (-0.010), fruit diameter (-0.007), leaf length (-0.058), fruit weight (-0.024), leaf width (-0.065) and fruit length to width ratio (-0.003). Similar trend of findings was also obtained by [1,16, 21]. Plant height [Table-2] showed positive direct effect (0.125) on yield per plant and indirect positive effect *via* number of branches per plant (0.218) and leaf length (0.028). It also showed negative indirect effect through number of fruits per plant (-0.056), length of peduncle (-0.014), number of flowers per cluster (-0.001), fruit length (-0.002), fruit diameter (-0.031), days to

50% flowering (-0.011), fruit weight (-0.007), leaf width (-0.036) and fruit length to width ratio (-0.001) on yield per plant. [1,7] also obtained similar result with this trait.

Length of peduncle [Table-2] showed negative direct effect (-0.086) on yield per plant and positive indirect effect *via* plant height (0.020), number of fruits per plant (0.031), fruit length (0.009), fruit diameter (0.075), fruit weight (0.005) and leaf width (0.045). It also showed negative indirect effect through number of branches per plant (-0.173), number of flowers per cluster (-0.015), days to 50% flowering (-0.039), leaf length (-0.133) and fruit length to width ratio (-0.004). [1] reported similar results for length of peduncle. The number of fruits per plant [Table-2] showed negative direct effect (-0.272) on yield per plant and positive indirect effect *via* number of branches per plant (0.806), plant height (0.026), length of peduncle (0.010), number of flowers per cluster (0.032), fruit length (0.000), fruit diameter (0.038) and days to 50% flowering (0.001). It also showed negative indirect effect *via* leaf length (-0.048), fruit weight (-0.016), leaf width (-0.007) and fruit length to width ratio (-0.004). [18] also reported negative direct effect on this trait. On the other hand, similar results were reported by [1,16,17,19].

**Table-2** *Direct (diagonal) and indirect genotypic path coefficient values of different characters on yield of brinjal*

| Path Coefficient | NBPP | PH | LP | NFPP | NFPC | FL | FD | D50%F | LL | FW | LW | FL/WR | Genotypic correlation with yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NBPP** | **0.930** | 0.029 | 0.016 | -0.235 | 0.025 | -0.010 | -0.007 | 0.011 | -0.058 | -0.024 | -0.065 | -0.003 | 0.610** |
| **PH** | 0.218 | **0.125** | -0.014 | -0.056 | -0.001 | -0.002 | -0.031 | -0.011 | 0.028 | -0.007 | -0.036 | -0.001 | 0.213** |
| **LP** | -0.173 | 0.020 | **-0.086** | 0.031 | -0.015 | 0.009 | 0.075 | -0.039 | -0.133 | 0.005 | 0.045 | -0.004 | -0.264** |
| **NFPP** | 0.806 | 0.026 | 0.010 | **0.272** | 0.032 | 0.000 | 0.038 | 0.001 | -0.048 | -0.016 | -0.007 | -0.004 | 0.565** |
| **NFPC** | 0.331 | -0.001 | 0.018 | -0.122 | **0.071** | 0.005 | -0.022 | -0.003 | 0.144 | -0.012 | -0.024 | 0.007 | 0.394** |
| **FL** | -0.183 | -0.006 | -0.016 | -0.001 | 0.007 | **0.049** | 0.034 | -0.056 | 0.007 | 0.006 | 0.057 | 0.006 | -0.095** |
| **FD** | 0.026 | 0.015 | 0.025 | 0.039 | 0.006 | -0.006 | **-0.264** | 0.080 | 0.091 | 0.016 | -0.113 | 0.002 | -0.085** |
| **D50%F** | -0.066 | 0.009 | -0.022 | 0.001 | 0.001 | 0.018 | 0.138 | **-0.152** | -0.059 | -0.009 | 0.086 | 0.005 | -0.049** |
| **LL** | 0.141 | -0.009 | -0.030 | -0.034 | -0.027 | -0.001 | 0.063 | -0.024 | **-0.382** | 0.038 | 0.024 | -0.005 | -0.247** |
| **FW** | -0.221 | -0.009 | -0.005 | 0.044 | -0.009 | 0.003 | -0.042 | 0.013 | -0.148 | **0.099** | -0.044 | -0.001 | -0.319** |
| **LW** | -0.228 | -0.017 | -0.015 | 0.008 | -0.006 | 0.011 | 0.113 | -0.049 | -0.034 | -0.017 | **0.264** | -0.011 | 0.019** |
| **FL/WR** | -0.120 | -0.006 | 0.011 | 0.040 | 0.020 | 0.011 | -0.018 | -0.029 | 0.078 | -0.002 | -0.109 | **0.026** | -0.098** |

Residual are 0.4186

NBBP- number of branches per plant, PH- plant height, LP- length of peduncle, NFPP- number of fruits per plant, NFPC- number of flowers per cluster, FL- fruit length, FD- fruit diameter, D50%F- days to 50% flowering, LL- leaf length, FW- fruit weight, LW- leaf width, FL/WR- fruit length to width ratio cluster (-0.015), days to 50% flowering (-0.039), leaf length (-0.133) and fruit length to width ratio (-0.004)

The number of flowers per cluster [Table-2] showed positive direct effect (0.071) on yield per plant and positive indirect effect *via* number of branches per plant (0.331), length of peduncle (0.018), fruit length (0.005), leaf length (0.144) and fruit length to width ratio (0.007). It also showed negative indirect effect through plant height (-0.001), number of fruits per plant (-0.122), fruit diameter (-0.022), days to 50% flowering (-0.003), fruit weight (-0.012) and leaf width (-0.024). The negative direct effect with this trait was mentioned earlier by [10,18] conforming the present results. Fruit length [Table-2] showed positive direct effect (0.049) on yield per plant and positive indirect effect *via* number of flowers per cluster (0.007), fruit diameter (0.034), leaf length (0.007), fruit weight (0.006), leaf width (0.057) and fruit length to width ratio (0.006). It also showed negative indirect effect through number of branches per plant (-0.183), plant height (-0.006), length of peduncle (-0.016), number of fruits per plant (-0.001) and days to 50% flowering (-0.056). Similar to present study, [1,11,13,15,22] reported the positive direct and indirect effects.

Fruit diameter showed negative direct effect (-0.264) on yield per plant and positive indirect effect *via* number of branches per plant (0.026), plant height (0.015), length of peduncle (0.025), number of fruits per plant (0.039), number of flowers per cluster (0.006), days to 50% flowering (0.080), leaf length (0.091), fruit weight (0.016) and fruit length to width ratio (0.002) [Table-2]. It also showed negative indirect effect through fruit length (-0.006) and leaf width (-0.113). The results of present study admit the finding of [13,22,12]. Days to 50% flowering [Table-2] showed negative direct effect (-0.152) on yield per plant and positive indirect effect *via* plant height (0.009), number of fruits per plant (0.001), number of flowers per cluster (0.001), fruit length (0.018), fruit diameter (0.138), leaf width (0.086) and fruit length to width ratio (0.005). It also showed negative indirect effect *via* number of branches per plant (-0.066), length of peduncle (-0.022), leaf length (-0.059) and fruit weight (-0.009). The results are in agreement with the results of [7,9,21,16].

Leaf length [Table-2] showed negative direct effect (-0.382) on yield per plant and positive indirect effect *via* number of branches per plant (0.141), fruit diameter (0.063), fruit weight (0.038) and leaf width (0.024). It also showed negative indirect effect through plant height (-0.009), length of peduncle (-0.030), number of fruits per plant (-0.034), number of flowers per cluster (-0.027), fruit length (-0.001), days to 50% flowering (-0.024) and fruit length to width ratio (-0.005). These results also follow the trend of [1,11,13, 15]. Fruit weight [Table-2] showed positive direct effect (0.099) on yield per plant and positive indirect effect *via* number of fruits per plant (0.044), fruit length (0.003) and days to 50% flowering (0.013). It also showed negative indirect effect through number of branches per plant (-0.221), plant height (-0.009), length of peduncle (-0.005), number of flowers per cluster (-0.009), fruit diameter (-0.042), leaf length (-0.148), leaf width (-0.044) and fruit length to width ratio (-0.001). [11] reported similar observations. Similar results were reported by [1,13,17,14,21].

Leaf width [Table-2] showed positive direct effect (0.264) on yield per plant and positive indirect effect *via* number of fruits per plant (0.008), fruit length (0.011) and fruit diameter (0.113). It also showed negative indirect effect *via* number of branches per plant (-0.228), plant height (-0.017), length of peduncle (-0.015), number of flowers per cluster (-0.006), days to 50% flowering (-0.049), leaf length (-0.034), fruit weight (-0.017) and fruit length to width ratio (-0.011). [18, 22] also reported similar results. Fruit length to width ratio [Table-2] showed positive direct effect (0.026) on yield per plant and positive indirect effect *via* number of length of peduncle (0.011), number of fruits per plant (0.040), number of flowers per cluster (0.020), fruit length (0.011) and leaf length (0.078). It also showed negative indirect effect *via* number of branches per plant (-0.120), plant height (-0.006), fruit diameter (-0.018), days to 50% flowering (-0.029), fruit weight (-0.002) and leaf width (-0.109). On the other hand, positive indirect effect was also found by [1, 15, 11, 22] for the trait fruit length to width ratio.

## Conclusion

It can be concluded that the nature and magnitude of various yield and associated yield related characters is a pre-requisite to improve in the desired direction. The studied yield and related characters showed significantly positive association with yield, which conclude that the these associations will be easily considered in brinjal breeding selection programmes for improvement of genotypes, which can be economically used for further assortment of superior segregants in further breeding programme of the brinjal.

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**Conflict of Interest: None declared**

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