Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(3): 1106-1109

Received: 13-03-2020
Accepted: 15-04-2020

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Correlation and path coefficient analysis studies on yield and its attributing characters in brinjal (*Solanum melongena* L.)

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Abstract
The present investigation was carried out in the Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during *kharif* 2015 to assess the character association and contribution of quantitative trait towards yield of 110 genotypes of brinjal. The experiment was laid out in randomized block design with three replications. In present investigation, plant height (cm), number of primary branches per plant, number of fruits per cluster, fruit girth (cm), average fruit weight (g), pericarp thickness (mm) and number of fruits per plant per picking showed positive and direct effect had significant positive correlation with fruit yield per plant (kg). It is suggested that the greater emphasis should be given for selection of these characters.

Keywords: Correlation, path coefficient, yield and brinjal

Introduction
Brinjal (*Solanum melongena* L.) also called as eggplant or aubergine is a member of family Solanaceae and one of the most commonly grown vegetables all the year round in the country (Hazra *et al*., 2011) [3]. India ranks second in area and production of brinjal in the world after China. Yield being a complex character, is dependent upon a number of attributes. Before initiating an effective selection programme, it is necessary to know the importance and association of various components with yield and among each other. A simple measure of correlation of characters does not quantify the relative contribution of causal factors to the ultimate yield. Since the component traits themselves are inter-dependant, they often affect their direct relationship with yield and consequently restrict the reliability of selection indices based upon correlation coefficients. The path coefficient analysis permits the separation of direct effects from indirect effects through other related traits by partitioning the genotypic correlation coefficients. Hence, the present study was undertaken to estimate the genotypic correlations and direct and to determine the indirect effects of component characters on yield in brinjals.

Materials and Method
The experimental material of present study comprised of a set of 110 genotypes of brinjal including four checks obtained from AICRP on Vegetable crops, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during *kharif* 2015. The germplasm lines were evaluated in a Randomized Block Design with three replications. Observations were recorded on five plants per genotype per replication for 16 quantitative characters viz., plant height, plant spread, number of primary branches per plant, days to 50% flowering, days to first fruit harvest, number of cluster per plant, number of flower per inflorescence, number of fruits per cluster, total number of fruits per plant, fruit length, fruit girth, average fruit weight, pericarp thickness, number of fruits per plant per picking, fruit yield per plant and fruit yield per hectare. In each replication each genotype was grown in a four rows and five columns plot with a spacing of 75 cm x 60 cm, row-to-row spacing and plant-to-plant spacing respectively. The recommended package of practices was followed to raise a successful crop and necessary prophylactic plant protection measures were carried out to safeguard the crop from pests and diseases.

The data were subjected to analysis of variance as per the procedure described by Panse and Sukhatme (1985) [6]. Correlation and path coefficients were calculated according to method suggested by Miller *et al*., (1958) [4] and Dewey and Lu (1959) [2] respectively.

Results and Discussion

The analysis of variance for fruit yield and its contributing characters of brinjal during *kharif* 2015 is presented in Table 1. The mean sum of squares for genotypes was found to be highly significant for all the traits *i.e.* plant height (cm), plant spread (cm), number of primary branches per plant, days to 50 percent flowering, days to first fruit harvest, number of clusters per plant, number of flowers per inflorescence, number of fruits per cluster, number of fruits per plant, fruit length (cm), fruit girth (cm), average fruit weight (g), pericarp thickness (mm), total number of fruits per plant per picking, fruit yield per plant (kg) and fruit yield per hectare (q). Analysis of variance indicated that the mean sum of squares due to genotypes were highly significant for all the traits indicated the presence of significant variation for most of the characters which are useful for brinjal improvement.

Table 1: Analysis of variance for fruit yield and its component in brinjal during *kharif*, 2015

Sr. No.	Characters	Mean Sum of Square		
		Replication	Genotype	Error
		02	109	218
01	Plant height (cm)	31.8	655.6**	31.9
02	Plant spread (cm)	18.0	925.7**	113.0
03	No. of primary branches per plant	1.50	13.5**	3.4
04	Days to 50 per cent flowering	10.1	86.3**	5.9
05	Days to first fruit harvest	384.2**	157.3**	12.0
06	No. of cluster per plant	36.4**	74.3**	6.09
07	No. of flowers per inflorescence	2.4*	6.2**	0.60
08	No.of fruits per cluster	1.1**	4.2**	0.20
09	No. of fruits per plant	10.38*	60.09**	2.81
10	Fruit length (cm)	4.2	58.2**	3.1
11	Fruit girth (cm)	3.9	45.4**	3.5
12	Average fruit weight (g)	228.7	1510.8**	113.2
13	Pericarp thickness (mm)	0.03	4.17**	0.02
14	No. of fruits per plant per picking	0.05	35.17**	0.83
15	Fruit yield per plant (kg)	0.01	0.57**	0.02
16	Fruit yield per hectare (q)	1170	24084.6**	822.07

The phenotypic (P) and genotypic correlation (G) coefficients were worked out for sixteen characters in brinjal and the results are presented in Table 2. In general, it was observed that genotypic correlation coefficients were higher than that of phenotypic correlation coefficients. This could be interpreted on the basis that there was a strong inherent genotypic relationship between the characters studied, but their phenotypic expression was impeded by the influence of environmental factors.

Fruit yield per plant expressed a highly significant positive correlation with plant height (0.268 and 0.317), number of fruits per cluster (0.202 and 0.216), fruit girth (0.255 and 0.296), average fruit weight (0.255 and 0.295), pericarp thickness (0.298 and 0.320) and number of fruits per plant per picking (0.307 and 0.334) at phenotypic and genotypic level, respectively, where number of primary branches per plant showed positive significant correlation only at genotypic level. The results are in conformity with the results of Prabhu *et al.* (2008) [8], Praneetha *et al.* (2011) [9], Nayak and Nagre (2013) [5] and Chaitnya (2015) [1]. Thus plant height, number of primary branches per plant, number of fruits per cluster, fruit girth, average fruit weight, pericarp thickness and the number of fruits per plant per picking seems to have predominated effect on fruit yield per plant. Hence there is ample scope in the improvement of yield by selecting a genotype having long and higher fruiting duration (for more pickings) since they are highly correlated.

Plant height (cm) showed significant and highly significant correlation for number of primary branches per plant (0.220 and 0.280), number of clusters per plant (0.216 and 0.288), fruit length (0.228 and 0.267) at phenotypic and genotypic level, respectively, while number of fruits per plant per picking showed positively significant correlation at genotypic level. Plant spread exhibited highly significant positive correlation with number of clusters per plant (0.216 and 0.288) and number of fruits per plant per picking (0.292 and 0.326) at both phenotypic and genotypic levels and fruit girth (0.229) showed positive significant correlation only at genotypic level. Number of primary branches per plant exhibited positive and significant correlations with Days to 50 per cent flowering (0.285 and 0.419) and number of fruits per plant per picking (0.207 and 0.306) at both phenotypic and genotypic levels, while, it exhibits significant positive correlation with days to first harvest (0.398), number of fruits per cluster (0.250), number of fruits per plant (0.231) and fruit yield per plant (0.221) only at genotypic level and negative significant correlation with fruit girth (-0.202 and -0.280) at both levels.

Days to 50 per cent flowering showed positive and highly significant correlations with days to first fruit harvest (0.374 and 0.504) at both phenotypic and genotypic level. Number of clusters per plant showed positive and highly significant correlation with number of flowers per inflorescence (0.223 and 0.264), number of fruits per cluster (0.331 and 0.384), number of fruits per plant (0.396 and 0.457) and number of fruits per plant per picking (0.335 and 0.367) at both phenotypic and genotypic level, respectively. Positive and highly significant correlation was shown by number of flowers per inflorescence with number of fruits per cluster (0.394 and 0.464), number of fruits per plant (0.343 and 0.433) and number of fruits per plant per picking (0.391 and 0.471) at both phenotypic and genotypic level, respectively. Number of fruits per cluster exhibited significant and positive correlation with number of fruits per plant (0.591 and 0.677),

number of fruits per plant per picking (0.393 and 0.439), pericarp thickness (0.213 and 0.232) and fruit yield per plant (0.202 and 0.216) at both phenotypic and genotypic level, respectively. Total number of fruits per plant registered significant and positive correlations with number of fruits per plant per picking (0.472 and 0.524) at both phenotypic and genotypic level, respectively, while it exhibits negative significant correlation with average fruit weight (-0.252) at only genotypic level. The findings are in conformity with the reports of Prabhu *et al.* (2008) [8], Praneetha *et al.* (2011) [9] and Thangamani and Jhansirani (2012) for fruit and shoot borer infestation on fruits and Chaitnya (2015) [1] in the number of branches per plant, days to last fruit harvest, number of marketable fruits per plant and total yield per plant. Negative and significant correlations were registered by fruit length with fruit girth (-0.201 and -0.251) at both phenotypic and genotypic level, respectively, whereas positive significant correlations was recorded for plant height (0.228 and 0.267) at both phenotypic and genotypic level, respectively. Fruit girth showed positive significant correlations with average fruit weight (0.396 and 0.518) and fruit yield per plant (0.255 and 0.296) at both levels. Praneetha *et al.* (2011) [9] and Chaitnya (2015) [1] reported parallel character association of fruit width with average fruit weight in brinjal. Prabhu and Natarajan (2008) [7], Prabhu *et al.* (2008) [8] and Praneetha *et al.* (2011) [9] stated similar association of fruit width with marketable yield per plant. The character average fruit weight showed positive and significant correlations with pericarp thickness (0.198 and 0.217) and fruit yield per plant (0.255 and 0.295) at both phenotypic and genotypic level, respectively. Prabhu and Natarajan (2008) [7], Prabhu *et al.* (2008) [8] and Chaitnya (2015) [1] reported similar results with marketable yield per plant in brinjal.

Table 2: Correlation coefficient analysis (Phenotypic and genotypic) among fruit yield and its component in brinjal during *kharif*, 2015

S. No.	Characters/ Parameters		2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Plant height (cm)	P	-0.006	0.220*	-0.115	0.075	0.216*	0.042	0.080	0.002	0.228*	-0.004	0.144	0.149	0.176	0.268**
		G	0.009	0.280**	-0.129	0.112	0.288**	0.049	0.016	0.002	0.267**	-0.031	0.197	0.169	0.219*	0.317**
2	Plant Spread (cm)	P		-0.326**	-0.255**	-0.185	0.207*	0.168	0.184	0.125	0.045	0.170	0.040	0.000	0.292**	0.152
		G		-0.556**	-0.301**	-0.273**	0.264**	0.183	0.204*	0.126	0.074	0.229*	0.007	0.002	0.326**	0.180
3	No. of primary branches per plant	P			0.285**	0.193	-0.082	0.156	0.145	0.128	-0.003	-0.202*	-0.023	0.121	0.207*	0.160
		G			0.419**	0.398**	-0.091	-0.173	0.250*	0.231*	-0.006	-0.280**	-0.029	0.178	0.306**	0.221*
4	Days to 50 per cent flowering	P				0.374**	-0.215*	-0.352**	-0.216*	-0.203*	0.093	-0.090	0.043	0.056	-0.255**	-0.043
		G				0.504**	-0.258**	-0.426**	-0.261**	-0.245*	0.081	-0.098	0.078	0.060	-0.277**	-0.042
5	Days to first harvest	P					-0.119	-0.157	-0.093	-0.165	0.068	0.079	0.129	0.017	-0.154	0.104
		G					-0.204*	-0.267**	-0.150	-0.234*	0.097	0.099	0.175	0.040	-0.201*	0.107
6	No. of cluster per plant	P						0.223*	0.331**	0.396**	0.052	0.010	-0.070	-0.032	0.335**	0.062
		G						0.264**	0.384**	0.457**	0.064	0.030	-0.107	-0.039	0.367**	0.070
7	No. of flowers per inflorescence	P							0.394**	0.343**	0.061	0.084	-0.050	0.062	0.391**	0.137
		G							0.464**	0.433**	0.076	0.089	-0.073	0.068	0.471**	0.166
8	No. of fruits per cluster	P								0.591**	-0.002	0.063	-0.138	0.043	0.393**	0.202*
		G								0.677**	0.027	0.074	-0.165	0.048	0.439**	0.216*
9	No. of fruits per plant	P									-0.031	-0.049	-0.252*	0.034	0.472**	0.092
		G									-0.033	-0.050	-0.316**	0.037	0.524**	0.092
10	Fruit length (cm)	P										-0.201*	0.090	0.039	0.016	0.129
		G										-0.251*	0.083	0.042	0.008	0.144
11	Fruit girth (cm)	P											0.396**	0.108	0.060	0.255**
		G											0.518**	0.117	0.066	0.296**
12	Average fruit weight (g)	P												0.198*	--0.141	0.255**
		G												0.217*	-0.172	0.295**
13	Pericarp thickness (mm)	P													0.036	0.298**
		G													0.036	0.320**
14	No. of fruits per plant per picking	P														0.307**
		G														0.334**

*Significant at 5% and ** significant at 1%

Path coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation into direct and indirect effects. Correlation coefficients along with path coefficients provide more reliable information, which can be effectively predicted in crop improvement programme. If the correlation between yield and a character is due to direct effect of a character, it reveals true relationship between them and direct selection for the trait will be rewarding for yield improvement. However, if the correlation coefficient is mainly due to indirect effect of the character through another component trait, indirect selection through such trait will be effective in yield improvement.

The data on path coefficient analysis at genotypic level showing direct and indirect effects of significant characters over yield (kg) per plant is tabulated in Table 3. The data revealed that no. of primary branches per plant showed the highest positive direct effect (0.51) on fruit yield followed by no. of fruits per plant (0.50), no. of fruits per plant per picking (0.35), fruit girth (cm) (0.28), average fruit weight (g) (0.20), plant spread (cm) (0.21), no. of clusters per plant (0.19), no.

of fruits per cluster (0.19), fruit length (cm) (0.16), plant height (cm) (0.11) and pericarp thickness (mm) (0.10) whereas, days to 50 per cent flowering and days to first fruit harvest showed negative direct effects on fruit yield per plant(kg).

In present investigation, plant height (cm), number of primary branches per plant, number of fruits per cluster, fruit girth (cm), average fruit weight (g), pericarp thickness (mm) and number of fruits per plant per picking showed positive and direct effect had significant positive correlation with fruit yield per plant (kg). The residual factor determines how best the causal factors account for the variability of the dependent factor, the fruit yield per plant in this case. The residual effect was 0.051, which was of low magnitude at genotypic levels. From the foregoing discussion it can be concluded that average fruit weight, total number of fruits per plant, number of marketable fruits per plant and fruit length showed positive correlation and positive direct effect on marketable yield per plant. Hence, these were identified as superior yield components.

Table 3: Genotypic path coefficient analysis for fruit yield and its components in brinjal during *kharif*, 2015

Sr. No.	Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	R
1	Plant height (cm)	0.11	0.01	0.00	0.01	0.00	-0.05	0.00	0.00	0.00	0.04	-0.01	0.04	0.02	0.08	0.317**
2	Plant spread (cm)	0.03	0.21	-0.28	0.02	0.01	-0.05	0.00	0.04	0.01	0.01	0.06	0.00	0.00	0.11	0.180
3	No. of primary branches per plant	0.00	-0.12	0.51	-0.03	-0.01	0.02	0.00	-0.05	-0.01	0.00	0.08	-0.01	0.02	0.11	0.122
4	Days to 50 per cent flowering	-0.01	-0.06	0.20	-0.07	-0.01	0.05	0.00	-0.01	-0.01	0.01	-0.02	0.02	3.00	-0.09	-0.042
5	Days to first fruit harvest	0.01	-0.06	0.20	-0.04	-0.02	0.04	0.00	0.03	-0.01	0.08	0.03	0.04	0.00	0.07	0.107
6	No. of clusters per plant	0.03	0.06	0.41	0.02	0.00	0.19	0.00	0.07	0.02	0.10	0.01	-0.02	0.00	0.13	0.070
7	No. of flowersper inflorescence	0.01	0.04	0.14	0.03	0.01	-0.05	0.01	0.09	0.02	0.01	0.02	-0.02	0.01	0.16	0.166
8	No. of fruits per cluster	0.00	0.04	0.13	0.02	0.00	-0.07	0.00	0.19	0.04	0.09	0.20	0.03	0.01	0.15	0.216*
9	No. of fruits per plant	0.00	0.03	0.12	0.02	0.00	-0.09	0.00	0.13	0.50	0.06	0.01	0.07	0.00	0.18	0.092
10	Fruit length (cm)	0.03	0.02	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00	0.16	0.07	0.02	0.00	0.00	0.144
11	Fruit girth (cm)	0.00	0.00	0.15	0.01	0.00	-0.01	0.00	0.02	0.00	-0.04	0.28	0.11	0.01	0.20	0.296**
12	Average fruit weight (g)	0.02	0.00	0.10	-0.01	0.00	0.02	0.00	0.03	0.02	0.10	0.15	0.20	0.02	0.06	0.295**
13	Pericarp thickness (mm)	0.02	0.00	0.10	-0.01	0.00	0.01	0.00	0.01	0.00	0.08	0.10	0.44	0.10	0.31	0.320**
14	No. of fruits per plant per picking	0.03	0.08	0.16	0.02	0.00	-0.07	0.00	0.07	0.00	0.08	0.21	0.10	0.00	0.35	0.334**

Residual= 0.051 Diagonal and bold underline figures shows direct effect on fruit yield per plant (kg)

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