

Research Article

Genetic variability and correlation analysis in F₂ segregating population in brinjal (*Solanum melongena* L.)

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Abstract

Genetic advance denotes the improvement in the mean genotypic values of selected families over the base population. Thus, it helps the breeder select the progenies in the earlier generation. The objective of the study was to analyse the heritability, genetic advance and genetic variability for ten traits in brinjal contributing to fruit yield were studied in the F₂ population obtained from the cross of Sevathampatti local x Seetipulam local. The study examined the subsistence of a significant extent of genetic variability for the traits considered. The characteristics of brinjal exhibited higher values of genotypic variation (GCV), viz., the height of the plant (20.93), yield per plant (17.42), number of branches (22.73) and shoot infestation (56.39) and phenotypic coefficient of variation (PCV) viz., the height of the plant (21.10), yield per plant (22.32), number of branches (23.42) and shoot infestation (57.24). However, the number of branches (45.44 %), height of the plant (42.76%), number of fruits (38.58%), fruit yield (28.02%) and shoot infestation (114.4%) exhibited high estimates of genetic advance and heritability for plant height (98.36), number of branches per plant (94.19) and shoot infestation (97.06). These characteristics can be effectively improved through selection. Association analysis mentioned that the yield of the fruit was significantly and positively correlated with the number of fruits, number of branches, individual fruits per plant and fruit girth. Direct selection may be executed because of these characteristics as the key choice of criteria to minimize the indirect result of additional traits throughout the improvement of high yielding varieties.

Keywords: F₂ Segregating Population, Variability, Correlation and Brinjal

INTRODUCTION

Brinjal (*Solanum melongena* L.) is an essential solanaceous vegetable crop in subtropical and tropical regions. Cytological studies have indicated that the basic chromosomal number is 2n = 24. Large genetic variability with respect to the size, maturity, shape of the fruit, culinary traits and spyness exists in the original material. The low yield levels in India are due to the lack of sufficient crop genetic improvement and the development of promising genotypes. Therefore, brinjal

needs constant genetic improvement. Better variability present in the initial material should be the chance for evolving desired types. A clear understanding of the variability of various quantitative characteristics of breeding materials is an asset to plant breeders for selecting superior genotypes on the basis of their phenotypic expression. Yield is a complex character influenced by various components that contributes to the genetic potential of the crop. F₂ segregating populations were selfing hybrids (F₁), which provided all potential variations. Therefore, assortment with fastidious

objective (F₂) segregation is extremely efficient, and inbred lines were produced by utilizing the genotypes by selfing generation after generation. Estimates of genotypic and phenotypic coefficients of variation provide an idea of the interplay of the genotype and environment that influences breeding results (Ravali *et al.*, 2017) in brinjal.

High heritability and genetic advance for specified characters denote which is governed by additive gene action and hence the successful stipulation for selection. Association studies involving yield-attributing traits and their comparative parts of fruit yield per plant are assessments in forecasting a programme on breeding. Pathway analysis accelerates the separation of the association coefficient into indirect and direct belongings on yield and other characteristics (Mahmoud *et al.*, 2018). Path analysis is also very helpful in formulating breeding program strategies to develop superior genotypes through selection in advanced generations. Hence, the current study was implemented to analyse the concert of various agronomical traits and to measure the degree of heritability, expected genetic advance, variability, path coefficient and correlation analysis components in *S. melongena*.

MATERIALS AND METHODS

The experiment was conducted at the College Orchard, Department of Vegetable Crops, Horticultural College & Research Institute, Tamil Nadu Agricultural University, Coimbatore. In total, 250 F₂ brinjal plants derived from the cross Sevathampatti local x Seetipulam local were evaluated for high yield and yield contributing characteristics during 2018 – 2019. The F₂ progenies obtained by selfing from the F₁ cross were raised. Each plant in the cross was labelled for fifteen recorded qualitative and quantitative traits, which included the number of fruits per plant, height of the plant (cm), number of branches, days to first flowering, length of the fruit (cm), weight of the fruit (g), fruit girth (cm), fruit borer infestation (%), shoot borer infestation (%) and yield (kg/plant). Singh and Chaudhary (1997) reported that the phenotypic coefficient of variation (PCV), heritability in a broad sense (h²), genotypic coefficient of variation (GCV) and genetic advance as a percentage over the mean and genetic advance (GA) were analysed. The correlation coefficient was estimated according to the formula given by Johnson *et al.* (1955). According to Dewey and Lu (1959), indirect and direct paths were obtained according to the method

$$\text{Heritability in broad sense (h}^2\text{)} = \frac{\sigma_g^2}{\sigma_p^2} \times 100 \quad \dots\dots\text{Eq. 1}$$

The range of heritability
 Low-<30
 Moderate-30 to 60

High->60

$$\text{Genetic advance (GA)} = \frac{\sigma_g^2}{\sigma_p^2} \times k \times \sqrt{\sigma_p^2}$$

Where,

k=Selection differential which is equal to 2.06 at 5 per cent level

σ_g^2 =genetic variance

σ_p^2 =phenotypic variance

Genetic advance was expressed as per cent of mean

GA as per cent of mean = Genetic advance / grand mean x 100

Genetic advance was also categorized by

Low - <10

Medium - 10 to 20

High ->20

$$\text{Genotypic variance } (\sigma^2g) = \frac{M_g - M_e}{r}$$

$$\text{Phenotypic variance } (\sigma^2p) = \sigma^2g + \sigma^2e$$

Where,

r = Number of replications

M_g = Mean sum of squares for genotypes

M_e = Mean sum of squares for error

σ^2e = Environmental variance

$$\text{PCV} = \frac{\sqrt{\text{Phenotypic variance}}}{\text{Grand mean}} \times 100$$

$$\text{GCV} = \frac{\sqrt{\text{Genotypic variance}}}{\text{Grand mean}} \times 100$$

The range of following PCV & GCV values were classified as low, moderate and high.

Range	Scale
Less than 10%	Low
10 - 20%	Moderate
More than 20%	High

Correlation

Genotypic correlation coefficient

$$r_g(xy) = \frac{\text{Cov.g}(xy)}{\sqrt{\sigma^2g_x \times \sigma^2g_y}} \quad \dots\dots\text{Eq.2}$$

Where,

r_{g(xy)} = Genotypic correlation coefficient

Cov.g(xy) = Genotypic covariance between the traits 'x' and 'y'

S²g_x = Genotypic variance of the trait-'x'

σ^2g_y = Genotypic variance of the trait-'y'

Path coefficient analysis

The direct and indirect effects were classified based on the scale

More than 1.0	:	Very high
0.30 to 0.99	:	High
0.20 to 0.29	:	Moderate
0.10 to 0.19	:	Low
0.00 to 0.09	:	Negligible

RESULTS AND DISCUSSION

Variability plays an important role in crop breeding material, ensuring a better chance of producing desirable crop plants. The results of range, mean, GCV, PCV, heritability (h^2), GA % in the F_2 population of cross Sevathampatti local x Seetipulam local are shown in Table 1. The results showed that the genotypic coefficient of variation was highest for shoot infestation (56.39%), followed by the number of branches per plant (22.73%) and plant height (20.93%), while moderate GCV was observed for the number of fruits (19.18%) and yield of individual plants (17.42%). The highest phenotypic coefficient of variation was recorded for shoot infestation (57.24%), followed by no. of branches per plant (23.42%) and yield of the individual plant (22.32%), and moderate GCV were recorded in a number of fruits per plant (19.65%) and fruit infestation (10.95%). Higher GCV and PCV were recorded for characters like shoot infestation followed by no. of branches indicating higher degree of variability for these traits. Genetic variability as the genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in a broad sense (HB), genetic advance (GA) and genetic advance as percent of mean (GAM) for ten studied characters. Close estimates of GCV and PCV indicated that genetic variance contributed to a large portion of phenotypic expression rather than environmental factors of most characters. Therefore, the phenotypic selection is effective and suitable for improvement, as reported by Ravali *et al.* (2018) in brinjal. The highest value of heritability was noticed for plant height (98.36%), followed by shoot infestation (97.06%), number of fruits (95.34%), number of branches (94.19%) and fruit infestation (70.57%). The results confirmed the involvement of additive gene action in these traits with less environmental influence. The lowest value of heritability was recorded by fruit girth (23.19%). Genetic

advance as a percentage of the mean was highest in shoot infestation (114.45%), followed by the number of branches (45.44%), height of the plant (42.76%) and no. of fruits (38.58%). High estimates of high genetic advance and heritability as percentages over the mean were recorded for shoot infestation, followed by the number of branches per plant, number of fruits per plant and plant height. These findings are similar to Mili *et al.* (2014), who revealed that high estimates of genetic advance and heritability might be attributed to the control of additive genes and phenotypic selection for their improvement could be achieved in brinjal by simple breeding methods.

Correlation studies achieved

The correlation between fruit yield per plant and different yield attributes is presented in Table 2. The correlation coefficient between diverse traits that yield was positive and significantly linked with no. of fruits (0.227), individual fruit weight (0.126) and no. of branches (0.105). These consequences are in agreement with the results of Ravali *et al.* (2017) in brinjal and Tiwari *et al.* (2019) in brinjal. Plant height exhibited a significant and positive relationship with the length of the fruit (0.506) and fruit borer infestation (0.341). Tiwari *et al.* (2019) also obtained similar results in brinjal. First flowering had a significant and negative association with the number of branches (-0.09) and shoot infestation (-0.068). Fruit length had a significant and positive association with fruit diameter (0.46) and fruit infestation (0.265). The outcome is in accord with the findings of Tiwari *et al.* (2019) in brinjal. The diameter of the fruit recorded a positive correlation with individual fruit weight (0.066) and fruit infestation (0.065). The individual fruit weight was positively correlated with shoot infestation (0.069). These outcomes confirm the results of Ravali *et al.* (2017) and Tiwari *et al.* (2019) in brinjal, which revealed the existence of sufficient

Table 1. Mean, range and genetic parameters in the F_2 population of the brinjal hybrid Sevathampatti local x Seetipulam local

Characters	Mean	Range		PCV	GCV	h^2	GA as % mean
		Minimum	Maximum				
Plant height	88.91	56.17	146.9	21.10	20.93	98.36	42.76
Days to first flowering	48.01	38.00	56.00	6.93	4.62	44.48	6.35
No. of branches per plant	8.12	4.00	14.00	23.42	22.73	94.19	45.44
No. of fruits per plant	42.94	23.00	73.00	19.65	19.18	95.34	38.58
Fruit length	7.01	4.92	8.86	12.03	8.57	50.80	12.59
Fruit girth	12.68	10.10	15.28	6.55	3.16	23.19	3.13
Single fruit weight	50.31	36.00	59.46	8.02	5.58	48.40	8.00
Shoot infestation	14.90	5.94	52.37	57.24	56.39	97.06	114.45
Fruit infestation	20.00	15.93	25.38	10.95	9.20	70.57	15.91
Yield per plant	2.15	0.67	3.43	22.32	17.42	60.92	28.02

Table 2. Simple correlation coefficient between fruit yield and yield component traits in the F₂ generation of the brinjal hybrid Sevathampatti local x Seetipulam local

Traits	PH	DFF	NBPP	NFPP	FL	FG	IFW	SI	FI	YPP
PH	1.000	0.054	0.085	0.001	0.506	0.179	-0.184	-0.128	0.341	-0.083
DFF		1.000	-0.090	0.074	0.184	-0.008	-0.050	-0.068	0.078	-0.040
NBPP			1.000	-0.026	-0.003	0.034	0.152	-0.097	-0.024	0.105
NFPP				1.000	0.004	0.004	-0.041	-0.075	0.026	0.227
FL					1.000	0.406	-0.066	-0.309	0.265	0.002
FG						1.000	0.066	-0.170	0.065	0.039
IFW							1.000	0.069	-0.194	0.126
SI								1.000	-0.026	0.070
FI									1.000	-0.082

PH – Plant Height, DFF – Days to First Flowering, NBPP – No. of Branches Per Plant, NFPP – No. of Fruits Per Plant, FL - Fruit Length, FG – Fruit Girth, IFW – Individual Fruit Weight, SI – Shoot Infestation, FI – Fruit Infestation, YPP – Yield Per Plant

variability in genetic stock studied and the environmental role is negligible.

Conclusion

The study concluded that concerning fruit yield of the F₂ plant Sevathampatti local x Seetipulam local, the most important characteristic in an improvement programme, high genetic advance fixed with high heritability was recorded. This indicates the chances for a wide range of selection in the F₂ population of the cross Sevathampatti local x Seetipulam local, and the yield was positively related to the number of branches, plant height, individual fruit weight and a number of fruits per plant. Hence, these traits can be further exploited by direct selection for genetic improvement in brinjal to improve yield.

Conflict of interest

The authors declare that they have no conflict of interest.

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