International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(3): 3208-3210

Received: 13-03-2019
Accepted: 15-04-2019

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Variability, heritability and genetic advance studies in eggplant (*Solanum melongena* L.)

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Abstract
Sixteen genotypes along with four varieties of brinjal were evaluated to estimate variability, heritability and genetic advance as per cent of mean for growth, yield and quality characters at Horticultural College and Research Institute, Periyakulam. The high PCV and GCV were observed for number of flowers per cluster, fruit width (cm), fruit weight (g), percentage of shoot borer incidence, percentage of fruit borer incidence by weight, 1000 seed weight, days to first picking, days to final picking and number of fruits per plant. High heritability coupled with high genetic advance as per cent of mean were observed for fruit width (cm), number of flowers per cluster, percentage of shoot borer infestation, number of fruits per plant exhibiting that the traits are controlled by additive gene action. Therefore, direct selection may be followed for improving brinjal by examining these characters.

Keywords: Brinjal, genetic variability, heritability and genetic advance as per cent of mean

Introduction
Brinjal (*Solanum melongena* L.) or eggplant belongs to the family Solanaceae with basic chromosome number (2n=2x=24). Brinjal is an important year round crop and widely consumed vegetable in tropical and subtropical regions. It is a versatile crop adapted to different agro-climatic regions. It is extensively cultivated in different parts of India and considered to be one of the most remunerative vegetables (Pramasnik *et al*., 2012) [6]. In India it is cultivated over an area of 0.69 m ha with an annual production of 12.40 mt (DAC & FW, 2017). Genetic variability plays an important role in a crop in selecting the best genotypes for making rapid improvement in yield and other desirable characters as well as to select the potential parent for hybridization programmes. Heritability is an index for calculating the relative influence of environment on expression of genotypes. It becomes very much essential to judge how much of variability is heritable and how much is non-heritable. Therefore, information on the extent of variability available in some important economic traits and their heritability along with genetic advance will be helpful to the breeders in exercising the selection effectively and to formulate sound breeding programmes. Therefore, the present investigation was carried out to study the variability, heritability and genetic advance as per cent of mean and the scope of improvement by selection in brinjal genotypes.

Materials and Methods
In this experiment, sixteen genotypes along with four released varieties *viz.,* Annamalai, PLR 1, PLR 2 and CO 2 were used for study. Seeds of the germplasm accessions were collected from the different areas of Tamil Nadu. All the genotypes were planted at a spacing 60 x 60 cm in Randomized Block Design (RBD) with two replications at Horticultural College & Research Institute, Periyakulam during the year 2018-2019.

The observations were recorded on five randomly selected genotype of each plot in all the replications. Nineteen important characters *viz.,* plant height, number of primary branches per plant, number of secondary branches per plant, days to first flowering, days to 50% flowering, number of flowers per cluster, fruit length, fruit width, calyx length, fruit weight, percentage of shoot borer incidence, percentage of fruit borer incidence by weight, percentage of fruit borer incidence by number, number of seeds per fruit, 1000 seed weight, days to first picking, days to final picking, number of fruits per plant and fruit yield per plant were recorded. Phenotypic and genotypic co-efficient of variation (Burton and De-vane, 1953) [1] heritability (Johnson *et al*., 1955) [3] and genetic advance as per cent of mean were calculated.

Results and Discussion

These genotypes exhibited large amount of variation for all the nineteen characters ranging from 58.23 to 94.49 cm for plant height, 4.40 to 8.60 for number of primary branches per plant, 4.60 to 12.30 for number of secondary branches per plant, 43.50 to 55.00 days for first flowering, 51.20 to 61.35 days for 50% flowering, 1.20 to 3.90 for number of flowers per cluster, 8.30 to 17.90 cm for fruit length, 27.95 to 177.05 g for fruit weight, 2.51 to 6.16 cm for fruit width, 2.04 to 5.11 cm for calyx length, 12.27 to 31.83% for percentage of shoot borer incidence, 15.05 to 46.76% for percentage of fruit borer incidence by weight, 17.25 to 47.08% for percentage of fruit borer incidence by number, 474.80 to 2476.70 for number of seeds per fruit, 2.07 to 4.41 g for 1000 seed weight, 62.60 to 72.70 days for first picking,129.10 to 157.60 days for final picking, 16.70 to 38.70 for number of fruits per plant, 1.20 to 1.95 for fruit yield per plant. This wide range of variability for different traits indicates the scope for selection of suitable initial material for breeding and in the improvement programme of brinjal (table 2).

The degree of variability exhibited by different traits can be judged by the magnitude of Phenotypic Co-efficient of Variation and Genotypic Co-efficient of Variation. The Genotypic Co-efficient of Variation values were low in magnitude compared to Phenotypic Co-efficient of Variation values for all the nineteen traits studied (Table 2). This shows that all the characters were influenced by the environment. The Genotypic Co-efficient of Variation for various characters varied from 3.67% (percentage of fruit borer incidence by number) to 56.97% (fruit width). The difference between PCV and GCV was less for the characters viz., plant height, number of secondary branches per plant, days to first flowering, days to 50% flowering, fruit length, fruit width, calyx length, fruit weight, percentage of shoot borer incidence, percentage of fruit borer incidence by weight, percentage of fruit borer incidence by number, number of seeds per fruit, 1000 seed weight, days to first picking, days to final picking, number of fruits per plant, fruit yield per plant. The GCV and PCV values were found to be very distant for the traits *viz*., Number of Primary branches per plant and Number of flowers per cluster as it is influenced by the environment indicating the presences of large amount of variability. High amount of PCV and GCV was observed for fruit width (cm). Traits like fruit width (cm), number of flowers per cluster, fruit weight (g), percentage of shoot borer incidence, percentage of fruit borer incidence by weight, 1000 seed weight, days to first picking, days to final picking, number of fruits per plant shown high amount of phenotypic co-efficient of variation and genotypic co-efficient of variation values. Plant height (cm), fruit yield per plant, calyx length (cm), fruit length (cm), number of secondary branches per plant had shown moderate phenotypic co-efficient of variation and genotypic co-efficient of variation values and rest of all the characters studied were recorded less GCV values than PCV values.

To determine the amount of heritable variation, Estimate of GCV alone is not sufficient. Therefore, heritable variation can be used to find the greater degree of accuracy when heritability is studied along with genetic advance. The value of heritability in broad sense for all the characters ranges from 77.11 (number of primary branches) to 99.97 (fruit width). All the characters exhibited high heritability except the trait number of primary branches per plant which had shown low heritability value.

The study also reported that the trait fruit width (cm) have high genetic advance as percentage of mean. High heritability coupled with high genetic advance as percentage of mean revealed that additive genes are controlling the expression of the characters and this would pave better opportunity for effective and accurate selection of character. These findings were similar with the findings of Rai *et al.* (1988) [7], Mohanty (1999) [4] and Pallavi *et al.* (2014) [5]. Heritability estimates gives a measure of effectiveness with which selection can be utilized for the genetic variability. Further, Burton (1953) [1] has reported that genotypic coefficients of variation along with heritability estimates provides the better picture on the amount of advance to be exploited from selection. It has been reported that the character with high heritability does not mean that it will have high genetic advance. However, in the present findings fruit width (cm), number of flowers per cluster, percentage of shoot borer infestation, number of fruits per plant had higher values of heritability and genetic advance as per cent of mean. Therefore, it is apparent that selection based on phenotypic values of these characters would be useful for selection of parents in breeding programme since these characters are governed by additive gene effect.

Table 1: Place of collection of local genotypes of brinjal

Accession No.	Name of the local genotypes	Place of collection
PKM SM- 2	Gobhi pachai kathiri	Erode
PKM SM-9	Kallivalasu kathiri	Tirupur
PKM SM-11	Karamadai oodha kathiri	Coimbatore
PKM SM-13	Dharmapuri oodha kathiri	Dharmapuri
PKM SM-14	Odavai Pachai kathiri	Dindigul
PKM SM-16	Kothampatti kathiri	Salem
PKM SM-18	Kumbakonam kathiri	Kumbakonam
PKM SM-20	Kallimandhayam vari kathiri	Dindigul
PKM SM-21	Manapparai kathiri	Trichy
PKM SM-26	Nanthavana kathiri	Karur
PKM SM-32	Pachai kathiri	Salem
PKM SM-36	Poiyur purple kathiri	Nagapattinam
PKM SM-46	Villakethi kathiri	Erode
PKM SM-48	Vedasanthur kathiri	Dindigul
PKM SM-53	Sundakudi kathiri	Ariyalur
PKM SM-54	Rayakottai kathiri	Krishnagiri

Table 2: PCV, GCV, heritability and genetic advance per cent of mean for various characters of Brinjal

S.no.	Characters	Mean	S.E. of mean	Range		PCV (%)	GCV (%)	Heritability	GA as % of mean
				Min.	Max.				
1.	Plant height (cm)	83.82	1.19	58.23	94.49	10.81	10.72	98.27	21.89
2.	Number of primary branches per plant	6.58	0.64	4.40	8.60	20.33	17.85	77.11	32.29
3.	Number of secondary branches per plant	10.31	0.66	4.60	12.30	18.97	17.86	88.58	34.63
4.	Days to first flowering	50.09	0.46	43.50	55.00	6.35	6.28	97.91	12.81
5.	Days to 50% flowering	55.12	0.68	51.20	61.35	4.34	4.16	92.01	8.23
6.	Number of flowers per cluster	2.37	0.28	1.20	3.90	36.79	34.78	89.36	67.74
7.	Fruit length (cm)	1345	0.59	8.30	17.90	18.46	17.93	94.34	34.89
8.	Fruit width (cm)	4.11	0.05	2.51	6.16	56.98	56.97	99.97	117.33
9.	Calyx length (cm)	3.68	0.07	2.04	5.11	19.83	19.72	98.88	40.40
10.	Fruit weight (g)	58.35	0.62	27.95	177.05	20.12	20.09	99.68	41.32
11.	Percentage of Shoot borer incidence	20.67	0.37	12.27	31.83	32.80	32.80	99.96	67.56
12.	Percentage of fruit borer incidence by weight	31.31	0.39	15.05	46.76	29.39	29.26	99.09	60.01
13.	Percentage of fruit borer incidence by number	30.57	0.36	17.25	47.08	3.81	3.65	91.85	7.21
14.	Number of seeds per fruit	1515.14	9.59	474.80	2476.70	4.93	4.90	98.80	10.03
15.	1000 seed weight	2.97	0.08	2.07	4.41	23.59	23.53	99.55	48.38
16.	Days to first picking	68.18	0.75	62.60	72.70	21.84	21.76	99.31	44.69
17.	Days to final picking	148.03	0.80	129.10	157.60	31.89	31.87	99.85	65.60
18.	Number of fruits per plant	24.17	0.38	16.70	38.70	31.58	31.56	99.86	64.98
19.	Fruit yield per plant	1.50	0.02	1.20	1.95	13.46	13.38	98.78	27.31

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