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Studies on genetic parameters in Brinjal (*Solanum melongena* L.)

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Abstract

The present investigation "Assessment of genetic variability in brinjal (*Solanum melongena* L.)" was carried out during kharif season of 2017-2018 at the farm of AKS University, Satna (M.P.). The experimental material for the present investigation was comprised of 19 genotypes of brinjal. These genotypes were sown in Randomized Complete Block Design with three replications, to observed morphological characters and to estimate the genetic variability. Observations were recorded on the basis of five random competitive plants selected from each genotype separately for morphological characters. The mean performance of the genotypes revealed a wide range of variability for all the traits. The variation was highest for number of leaves plant^{-1} (118.13 to 245.53), followed by fresh fruit weight (63.94 to 170.39), plant height at final harvest (61.90 to 124.17), fruit yield hectare^{-1} (47.26 to 78.97), days to first fruit set (41.80 to 54.93) and days to 50 per cent flowering (31.33 to 42.00). The PCV was higher than the GCV for all the characters. High genotypic coefficient of variation and phenotypic coefficient of variation was noted for fresh fruits weight (31.66, 31.96) followed by number of fruit plant^{-1} (27.50, 28.14), fruit length (27.02, 27.50) and number of leaves plant^{-1} (23.63, 24.76). The high values of GCV suggested greater genotypic variability among the genotypes and responsiveness of the attributes for making further improvement by selection. High heritability coupled with high genetic advance for traits like fresh fruit weight (98.12, 64.61) followed by number of fruits plant^{-1} (95.52, 55.35), fruit length (96.52, 54.67) and number of leaves plant^{-1} (91.07, 46.46). Suggested that the preponderance of additive genes. It also indicated higher response for selection of high yielding genotypes as these characters are governed by additive gene actions.

Keywords: PCV, GCV, heritability, genetic advance, brinjal

Introduction

Brinjal (*Solanum melongena* L.), or eggplant is one of the most common, popular and principle vegetable crops grown in India and other parts of the world. The brinjal is of much importance in the warm areas of far east, being grown extensively in India and other Asian countries like Bangladesh, Pakistan, and Philippines. Other major brinjal producing countries are China, Turkey, Japan, Egypt, Indonesia, Iraq, Italy, Syria and Spain.

The cultivated brinjal is of Indian origin and has been in cultivation for long time (Thompson and Kelly, 1957) [22]. Vavilov (1931) [24] was of the opinion that its center of origin was in the Indo Burma region. Brinjal (*Solanum melongena* L.) belongs to the family *Solanaceae*. Twenty seven out of the 2000 spp of genus *Solanum* are Indian. All the present day cultivars belong to three botanical varieties of equal rank of the spp. They are:

a) *esculentum*, which includes round and egg shaped cultivars.
b) *serpentinum*, has longer and slender types.
c) *depressum* includes all early and dwarf cultivars.

Brinjal is an often cross-pollinated crop. The high percentage of cross-pollination is attributed to pronounced heterostyly, which favors cross-pollination. India contributes 13.56 million tonnes to the global production of brinjal and ranks second to China. Brinjal occupies forth position among vegetable crops in India covers 6.50% of total vegetable area i.e. 669 thousand hectare with a productivity of 18.53 t/ha and produces 7.08% i.e. 12400 thousand metric tonnes in India (Anonymous, 2016-17a) [3]. In Madhya Pradesh the annual production is 918.78 thousand metric tonnes in an area of 50.57 thousand hectare with a productivity of 18.16 t/ha. (Anonymous 2016-17b) [4]. Major brinjal producing states are Orissa, Bihar, Karnataka, West Bangal, Andhra Pradesh, Maharastra and Uttar Pradesh.

It can be grown in wide range of agro-climatic zones which provides a tremendous scope and potential for cultivation of this crop. However, regional preference differs greatly with size, shape, colour of fruits.

This has created the necessity to breed new brinjal varieties, which may fulfill the area specific needs of the growers. Planning and execution of a breeding programme for the improvement of the various quantitative attributes depend, to a great extent, upon the magnitude of genetic variability existing in the population. Hence, studies on genetic variability with the help of suitable biometrical tools such as coefficient of variability, heritability, and genetic advance become indispensable in breeding programmes for tangible results of desired values. Selection cannot be effective without variability. Variability, it is the genetic fraction of the observed variation that provides a measure of transmissibility of the variation under study and responds to selection.

Material and Methods

The present investigation was conducted at farm of AKS University, Satna (M.P.) during *kharif* season of the year 2017-2018. The soil of the experimental field was medium block with good drainage and uniform texture with medium NPK status. The experimental material includes 19 genotypes of brinjal collected from IIVR, Varanasi and KVK, Majhgava of India. The experiment was laid out in Randomized Complete Block Design with three replications and each replication consisted of nineteen genotypes. All the genotypes were randomized separately in each replication.

Mean

The mean of all the observations in each replication was worked out as follows:

$$Mean(\overline{X}) = \frac{\sum_{i-1}^{N} Xi}{N}$$

Where,

$\sum x_i$ = the sum of all the observations

N= Number of observations

Genotypic coefficient of variation (GCV)

Genotypic coefficient of variation was computed as per the method suggested by Burton (1952) [6].

$$GCV = \sqrt{\frac{\sigma_g^2}{\overline{\overline{X}}}} \times 100$$

Phenotypic coefficient of variation (PCV)

Phenotypic coefficient of variation was computed by dividing the square root of phenotypic variance by population mean and multiplying by 100.

$$PCV = \sqrt{\frac{\sigma_p^2}{\overline{\overline{X}}}} \text{ x } 100$$

Heritability (broad sense)

Heritability of a character on the other hand is an index of its transmissibility. In broad sense, it may be defined as the proportion of genotypic variance to phenotypic variance and is calculated by the formula suggested by Hanson *et al.* (1956) [1].

$$h_{bs}^2 = \frac{\sigma_g^2}{\sigma_p^2} \times 100$$

Genetic advance as percent of mean

$$GA(\%) = \frac{\text{Genetic advance}}{\overline{x}} \times 100$$

Results and Discussion

Estimation of components of genetic parameters of variation for yield and its attributes exhibited a wide range of variation for the characters studies (Table 1). Result indicated that the value of phenotypic coefficient of variations were of higher in magnitude than that of genotypic coefficient of variation for all the characters showing that the environment had an important role in influencing the expression of the characters.

The phenotypic coefficient of variation range from 7.93% for days to first fruit set to 31.96% for fresh fruits weight. The phenotypic coefficient of variations was highest for characters viz., fresh fruits weight (31.96%), number of fruit plant^{-1} (28.14%), fruit length (27.50%) and number of leaves plant^{-1} (24.76%). However, it exhibited in low for characters like days to first fruit set (7.93%) followed by days to 50 per cent flowering (8.14%), days to first flowering (9.81%), fruit diameter (14.40%) and number of primary branches plant^{-1} (15.88%). The rest of the characters such as fruit yield plot^{-1} (18.38%), fruit yield hectare^{-1} (18.38%), plant height at final harvest (18.14%) and fruit yield plant^{-1} (16.59%). exhibited moderate phenotypic coefficient of variation.

Results revealed from the Table 1 that genotypic coefficient of variation varied from 5.68% for days to first fruit set to 31.66% for fresh fruits weight. High genotypic coefficient of variation was noted for fresh fruits weight (31.66%) followed by number of fruit plant^{-1} (27.50%), fruit length (27.02%) and number of leaves plant^{-1} (23.63%). Days to first fruit set (5.69%), days to 50 per cent flowering (7.03%), days to first flowering (8.74%), number of primary branches plant^{-1} (12.05%) and fruit diameter (12.67%) showed lowest GCV. While, it was moderate for rest of the characters such as plant height at final harvest (16.30%), fruit yield plant^{-1} (15.53%), fruit yield plot^{-1} (15.52%) and fruit yield hectare^{-1} (15.51%). In the present findings phenotypic coefficient of variation were observed to be higher than the corresponding genotypic coefficient of variation for all the characters studied, however, the differences was narrow which implied their relative resistance to environmental variation. It also described that genetic factors were predominantly responsible for expression of those attributes and selection could be made effective on the basis of phenotypic performance. The finding of Thangavel *et al.* (2011) [21], Patel *et al.* (2015), Abul *et al.* (2015) [1] and Shende *et al.* (2015) [17] were similar to that of the present findings.

Results revealed from the Table 1 that genotypic coefficient of variation and phenotypic coefficient of variation varied from 5.68% and 7.93% for days to first fruit set to 31.66% and 31.96% for fresh fruits weight, respectively. High genotypic coefficient of variation and phenotypic coefficient of variation was noted for fresh fruits weight followed by number of fruit plant^{-1}, fruit length and number of leaves plant^{-1}. The high values of GCV suggested greater genotypic variability among the genotypes and responsiveness of the attributes for making further improvement by selection. The findings are in close harmony with the result of Mili *et al.* (2014) [11], Abul *et al.* (2015) [1], Shende *et al.* (2015) [17], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20] and Chaudhary and Kumar (2017) for fresh fruits weight, Naik *et al.* (2010) [13], Chandra

Shekar *et al.* (2012) [7], Singh *et al.* (2014) [18], Mili *et al.* (2014) [11], Abul *et al.* (2015) [1], Shende *et al.* (2015) [17], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19] and Sujin *et al.* (2017b) [20] for number of fruit plant^{-1}, Chandra Shekar *et al.* (2012) [7], Singh *et al.* (2014) [18], Mili *et al.* (2014) [11], Patel *et al.* (2015), Tripathy *et al.* (2017) [23] and Ravali *et al.* (2017a) [15] for fruit length and Chandra Shekar *et al.* (2012) [7] for number of leaves plant^{-1}.

Days to first fruit set, days to 50 per cent flowering, days to first flowering, number of primary branches plant^{-1} and fruit diameter showed lowest GCV. The finding of Singh *et al.* (2014) [18], Abul *et al.* (2015) [1], Tripathy *et al.* (2017) [23] for number of primary branches plant^{-1} and Chandra Shekar *et al.* (2012) [7], Mili *et al.* (2014) [11], Patel *et al.* (2015), Tripathy *et al.* (2017), Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20] for fruit diameter was similar to the present finding which indicated that there is limited scope for improvement.

While, it was moderate for rest of the characters such as plant height at final harvest, fruit yield plant^{-1}, fruit yield plot^{-1} and fruit yield hectare^{-1}. The finding of Naik *et al.* (2010) [13], Tripathy *et al.* (2017) [23] for plant height at final harvest, Chandra Shekar *et al.* (2012) [7], Mili *et al.* (2014) [11], Shende *et al.* (2015) [17], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20], Chaudhary and Kumar (2017) for fruit yield plant^{-1} and Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7], Mili *et al.* (2014) [11], Chaudhary and Kumar (2017) for fruit yield plot^{-1} Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7], Chaudhary and Kumar (2017) for fruit yield hectare^{-1} was similar to the present finding.

The heritability (BS) was computed for each of the characters by the variance components for estimating their relative magnitudes of genotypic and phenotypic variability contributed through environmental factors. The estimates of heritability (BS) for all the characters have been discussed as fallows (Table 1). It was varied from 51.36% for days to first fruit set to 98.12% for fresh fruits weight and also partitioned as very high (above 90%), high (70 to 90%), medium (50-70%) and low (less than 50%).

Result indicated that the heritability estimates were very high for fresh fruits weight (98.12%), fruit length (96.52%) and number of fruits plant^{-1} (95.52%). However, it was recorded in high for number of leaves plant^{-1} (91.07%), fruit yield plant^{-1} (87.60%), plant height at final harvest (80.73%), days to first flowering (79.43%), fruit diameter (77.48%), days to 50 per cent flowering (74.64%), fruit yield plot^{-1} (71.24%) and fruit yield hectare^{-1} (71.24%). Moderate estimation of heritability was recorded for number of primary branches plant^{-1} (57.56%) and days to first fruit set (51.36%).

Heritability which denotes the proportion of genetically controlled variability expressed by a programme for a particular character or a set of character is very important biometrical tool for guiding plant breeders for adoption of appropriate breeding procedures. High heritability in broad sense in helpful in identifying appropriate character for selection and enables the breeder to select superior genotypes on the basis of phenotypic expression of quantitative characters. The estimated values of heritability in broad sense were classified as very high (more than 90%), high (70- 90%), medium (50-70%) and low (less than 50%).

Result indicated that the heritability estimates were very high for fresh fruits weight, fruit length and number of fruits plant^{-1}. However, it was recorded in high for number of leaves plant^{-1}, fruit yield plant^{-1}, plant height at final harvest, days to first flowering, fruit diameter, days to 50 per cent flowering, fruit yield plot^{-1} and fruit yield hectare^{-1}. High values of broad sense heritability for the above characters expressed that they were least influenced by environmental modification. It reflected that the phenotypes were the true representative of their genotypes and selection based on phenotypic performance would be reliable. The results were in close proximate to that of Ansari *et al.* (2011), Chattopadhyay *et al.* (2011), Singh *et al.* (2014) [18], Mohammad Reza *et al.* (2015), Abul *et al.* (2015) [1], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20], Chaudhary and Kumar (2017) for fresh fruits weight, Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7], Singh *et al.* (2014) [18], Mohammad Reza *et al.* (2015), Shende *et al.* (2015) [17], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15], Chaudhary and Kumar (2017) for fruit length, Naik *et al.* (2010) [13], Ansari *et al.* (2011), Chandra Shekar *et al.* (2012) [7], Mili *et al.* (2014) [11], Shende *et al.* (2015) [17], Akpan *et al.* (2016), Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15] for number of fruits plant^{-1}, Chandra Shekar *et al.* (2012) [7], Chaudhary and Kumar (2017) for number of leaves plant^{-1}, Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7] Mili *et al.* (2014) [11], Ravali *et al.* (2017a) [15] Sujin *et al.* (2017a) [19] Sujin *et al.* (2017b) [19] Chaudhary and Kumar (2017) for fruit yield plant^{-1}, Chattopadhyay *et al.* (2011), Mili *et al.* (2014) [11], Tripathy *et al.* (2017) [21] for plant height at final harvest, Thangavel *et al.* (2011) [21], Shende *et al.* (2015) [17] for days to first flowering, Chandra Shekar *et al.* (2012) [7], Singh *et al.* (2014) [18], Mili *et al.* (2014) [11], Shende *et al.* (2015) [17], Akpan *et al.* (2016), Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15] for fruit diameter, Chattopadhyay *et al.* (2011), Ravali *et al.* (2017a) [15] for days to 50 per cent flowering and Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7] and Chaudhary and Kumar (2017) for fruit yield plot^{-1} Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7], Akpan *et al.* (2016) and Chaudhary and Kumar (2017) for fruit yield hectare^{-1}.

Moderate estimation of heritability was recorded for number of primary branches plant^{-1} and days to first fruit set, which indicated that selection based on phenotypic performance would be rewarding. The results were in close proximate to that of Shende *et al.* (2015) [17] for number of primary branches plant^{-1}.

Based on the estimate of heritability (BS), expected genetic advance was computed on the hypothetical selection at 5 per cent best individual (1<= 2.06). Due to masking influence of environment upon characters concerned, values of genetic advance exhibited high fluctuations. Therefore, to attain relative comparison of the characters in relation to environment genetic advance as percentage of mean was calculated to predict the genetic gain (Table 1).

Genetic advance as percentage of mean ranged between 8.39% for days to first fruit set to 64.61% for fresh fruit weight. The highest estimate of genetic advance as percentage of mean was recorded for fresh fruit weight (64.61%), number of fruits plant^{-1} (55.35%), fruit length (54.67%) and number of leaves plant^{-1} (46.46%). Plant height at final harvest (30.17%), fruit yield plant^{-1} (29.94%), fruit yield plot^{-1} (26.98%) and fruit yield hectare^{-1} (26.98%) showed moderate value of genetic advance as percentage of mean. Whereas, low estimates were observed for days to first fruit set (8.39%), days to 50 per cent flowering (12.51%), days to first flowering (16.05%), number of primary branches plant^{-1} (18.83%) and fruit diameter (22.99%).

Estimates of genetic advance helps to predict the extent of improvement that can be achieved for improving the different characters. The estimated values of genetic advance as percent of mean were classified as high (more than 45%), moderate (25-45%) and low (less than 25%).

Genetic advance as percentage of mean ranged between 8.39% for days to first fruit set to 64.61% for fresh fruit weight. The highest estimate of genetic advance as percentage of mean was recorded for fresh fruit weight, number of fruits plant^{-1}, fruit length and number of leaves plant^{-1}. The results were in consonance with Ansari *et al.* (2011), Chattopadhyay *et al.* (2011), Singh *et al.* (2014) [18], Mili *et al.* (2014) [11], Abul *et al.* (2015) [1], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20], Chaudhary and Kumar (2017) for fresh fruit weight, Naik *et al.* (2010) [13], Ansari *et al.* (2011), Chandra Shekar *et al.* (2012) [7], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15] for number of fruits plant^{-1}, Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15] for fruit length and Chandra Shekar *et al.* (2012) [7], Chaudhary and Kumar (2017) for number of leaves plant^{-1}.

Plant height at final harvest, fruit yield plant^{-1}, fruit yield plot^{-1} and fruit yield hectare^{1} showed moderate value of genetic advance as percentage of mean. The findings were in agreement to the findings of Chandra Shekar *et al.* (2012) [7] for plant height at final harvest, Naik *et al.* (2010) [13], Chandra Shekar *et al.* (2012) [7], Mili *et al.* (2014) [11], Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20], Chaudhary and Kumar (2017) for fruit yield plant^{1} fruit yield plot^{-1} and fruit yield hectare^{-1}.

Low estimates were observed for days to first fruit set, days to 50 per cent flowering, days to first flowering, number of primary branches plant^{-1} and fruit diameter. The findings were in agreement to Chattopadhyay *et al.* (2011), Ravali *et al.* (2017a) [15] for days to 50 per cent flowering, Chandra Shekar *et al.* (2012) [7] for days to first flowering, Thangavel *et al.* (2011) [21], Tripathy *et al.* (2017) [23], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20] for number of primary branches plant^{-1} and Chandra Shekar *et al.* (2012) [7], Mili *et al.* (2014) [11], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15] for fruit diameter.

High heritability coupled with high genetic advance for traits like fresh fruit weight followed by number of fruits plant^{-1}, fruit length and number of leaves plant^{-1}. Suggested that the preponderance of additive genes. It also indicated higher response for selection of high yielding genotypes as these characters are governed by additive gene actions. The findings were in agreement to the findings of Ansari *et al.* (2011), Chattopadhyay *et al.* (2011), Singh *et al.* (2014) [18], Mili *et al.* (2014) [11], Abul *et al.* (2015) [1], Tripathy *et al.* (2017) [23], Ravali *et al.* (2017a) [15], Sujin *et al.* (2017a) [19], Sujin *et al.* (2017b) [20] and Chaudhary and Kumar (2017) for fresh fruit weight, Naik *et al.* (2010) [13], Ansari *et al.* (2011), Mili *et al.* (2014) [11], Tripathy *et al.* (2017) [23] and Ravali *et al.* (2017a) [15] for number of fruits plant^{-1}, Naik *et al.* (2010) [13], Singh *et al.* (2014) [18], Tripathy *et al.* (2017) [23] and Ravali *et al.* (2017a) [15] for fruit length, Patel *et al.* (2015) for number of leaves plant^{1}.

High heritability coupled with low genetic advance as percentage of mean was observed for days to first fruit set, days to 50 per cent flowering, days to first flowering, number of primary branches plant^{-1} and fruit diameter. This revealed the predominance of non-additive gene action in the expression of these characters.

Table 1: Estimates of genetic parameters of variations for various characters in Brinjal

Characters	Grand Mean	Range		Coefficient of variations		Heritability % (BS)	Genetic Advance	GA as % of mean
		Min.	Max.	Phenotypic	Genotypic			
Plant height (cm) at final harvest	96.47	61.90	124.17	18.14	16.30	80.73	29.10	30.17
No. of primary branches plant^{-1}	5.37	4.13	6.80	15.88	12.05	57.56	1.01	18.83
No. of leaves plant^{-1}	169.31	118.13	245.53	24.76	23.63	91.07	78.66	46.46
Days to first flowering	33.27	27.27	37.47	9.81	8.74	79.43	5.34	16.05
Days to 50 % flowering	37.02	31.33	42.00	8.14	7.03	74.64	4.63	12.51
Days to first fruit set	48.92	41.80	54.93	7.93	5.68	51.36	4.11	8.39
Fruit length (cm)	14.08	10.80	21.31	27.50	27.02	96.52	7.70	54.67
Fruit diameter (cm)	5.16	3.97	6.51	14.40	12.67	77.48	1.19	22.99
Fresh fruits weight (g)	93.29	63.94	170.39	31.96	31.66	98.12	60.27	64.61
No. of fruits plant^{-1}	19.67	10.07	31.20	28.14	27.50	95.52	10.89	55.35
Fruit yield plant^{-1} (kg)	1.704	1.287	2.130	16.59	15.53	87.60	0.51	29.94
Fruit yield plot^{-1} (kg)	17.013	12.760	21.320	18.38	15.52	71.24	4.59	26.98
Fruit yield hectare^{-1} (t)	63.02	47.26	78.97	18.38	15.51	71.24	17.00	26.98

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