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Genetic Investigation of Yield and Related Components in Some Landraces of Brinjal (*Solanum melongena* L.)

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ABSTRACT

An experiment was conducted at Shivapuri, Chidambaram, Tamil Nadu, India for estimation of genetic variability parameters. The genetic investigation studies in 46 brinjal genotypes estimated genetic variability parameters namely Phenotypic (PCV) and Genotypic (GCV) coefficient of variation, range, mean, genetic advance and heritability. The ANOVA due to genotypes is found to be significant indicating the genotypes under study are diverse. The PCV for all characters were slightly higher than GCV, indicating the presence of little environmental influence. The high values of heritability and GAM for yield per plant and yield related traits like fruit weight, fruit length, number of fruits per plant and number of fruits per cluster suggest the inclusivity of these genotypes for yield improvement in brinjal. Further, the genotypes could be studied for genetic and specific combining ability, in-order to include valuable landraces in location specific and objective specific breeding programs.

Keywords Heritability, Genetic advance as % of mean, Brinjal, Genetic Variability.

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INTRODUCTION

Brinjal (*Solanum melongena* L.) has been cultivated primarily in Asia and other parts of the world (Lintu and Namboodiri 2023). This crop is a part of the "Solanaceae" family, which also includes the "Nightshade" plants (Andhale *et al.* 2023). The progenitor of brinjal is believed to be *Solanum incanum,* as the latest sequencing studies revealed the species originated in Eastern Africa. Later, it was introduced to Asian countries, where *Solanum melongena* species evolved in India by repeated domestication events. The earliest cultivation of brinjal dates to 3rd century in Peninsular India (Weese and Bohs 2010). Brinjal is now a crop grown worldwide for its range of culinary dishes, taste, fat less diet and medicinal properties (Susmitha *et al.* 2023). The edible part of eggplant is berry, the fruit. In some places, the leaves are used for traditional medicine preparations. The fruit has been studied recently for its bioactive properties and its richness in phenolic compounds. It is evident that brinjal fruits are one among the top ten vegetables that has high anti-oxidant capacities (Das and Barua 2013). Despite being a functional food, the fruit

extracts were also found to be useful for its anti-cancer properties (Guruvayoorappan *et al.* 2015) and reduction of blood pressure (Papastavropoulou and Proestos 2023).

It is a pre-requisite to categorize the available diverse germplasm before involving them in a breeding program. The next step is to elucidate the variability present in the diverse group. When involved in modern breeding programs for climate resilient crops or nutritional improvement, it is crucial to select parents with rich genetic variability. It is the corner stone of a breeding program as new genetic variation is basic for developing new varieties (Salgotra and Chauhan 2023). New Breeding Techniques or NBT are often involved in crops to induce new genetic variation (Marone *et al.* 2023). India, being the primary centers of origin has abundant genetic variation through several landraces and cultivars of brinjal. Utilization of such germplasm to its full potential is possible only when they are selected for targeted traits which are highly heritable coupled with high genetic advance. Thus, the goals of the current experiment are to determine the genetic parameters for eleven agro-morphological traits in different germplasm of brinjal.

MATERIALS AND METHODS

Experimental layout and study material

The assessment was conducted at Agricultural farm in Sivapuri village located in Cuddalore District, Tamil Nadu, India. In the current study, 46 genotypes, obtained from all over India (Table1), were raised in three replication Randomized Block Design. Seeds were germinated using trays filled with coir pith and soil. Seedlings of good health at five weeks after sowing were transplanted in plots with 60 cm x 60 cm spacing. Intermediate earthing up, weeding, irrigation and all other recommend agronomic and plant protection practices were followed during appropriate periods. For each genotype five plants from each replication were selected in random for observing each trait. The quantitative characters recorded were mentioned in Table 2.

Table 2. List of characters studied for the assessment of variability.

Sl .No.	Name of the character	Unit
1	Plant height	cm
2	Days to first flowering	Days
3	No of branches per plant	Nos
4	No. of flowers per inflorescence	Nos
5	Average fruit length	cm
6	Fruit thickness	mm
7	No. of fruits per cluster	Nos
8	Average fruit weight	g
9	No. of fruits per plant	Nos
10	Days to first harvest	Days
11	Fruit yield / plant	kg

Biometrical analysis

The Analysis of Variance (ANOVA) was calculated for eleven characters by using the method of Panse

Table 1. List of 46 brinjal genotypes.

1	Sevanthampati	17	Manaparai Gundu Kathari	33	Kulamangalam Kathari
2	Karapadi	18	Dindigul Pachai Kathiri	34	White Stripped Thorns
3	Sivapuri Kathari	19	Vellai Kathari	35	Green Small Round
4	Puliyambu	20	White Stripped Green	36	Off White Brinjal
5	Purplelong	21	AU Gold	37	Pachai Vari Kathari
6	Vellaiurundai	22	Cvk Blue	38	Vellai Vari Urundai
7	Keeri Kathari	23	Chitamur Local	39	Vellai Vari Ootha
8	Kannadi Kathari	24	Erode Express	40	Purple Green Brinjal
9	Ottanchathiram Kathari	25	Parampattu Local	41	Vari Kathari
10	Greenlong	26	Myna	42	Dhuruva
11	Half Stripped Brinjal	27	Pachaiurundai Kathari	43	Thirunelveli Vellai Kathari
12	Mulkathari	28	Purple Round	44	Pachai Kathari
13	Kateri Green	29	Pachai Neelam	45	Vellai Ootha Vari Katharai
14	Pale Green Brinjal	30	Stripped Brinjal	46	Vellore Mul Kathari
15	Dindigul Vellai	31	Pudukottai Local 1		
16	Purple beauty	32	Ootha Neelam		

Table 3. ANOVA estimates for MSS (Mean sum of square) for eleven characters in 46 genotypes of brinjal.

Source	Replication	Treatment	Error	SEm	CD (5%)	CV (5%)
Degree of freedom	2	45	90	-	-	-
Days to first flowering	19.75	284.52**	6.11	1.43	4.01	5.13
Plant height (cm)	295.38	676.48**	86.29	5.36	15.07	10.96
No. of branches / plant	6.96	6.98**	0.74	0.50	1.39	12.23
No. of flowers / inflorescence	0.80	3.48**	0.07	0.15	0.44	6.98
Average fruit length (cm)	7.25	13.70**	0.79	0.51	1.44	13.15
Fruit thickness (mm)	278.47	262.07**	20.85	2.64	7.41	11.20
No. of fruits / cluster	4.75	1.59**	0.09	0.17	0.49	13.27
Average fruit weight (gm)	779.80	1092.23**	35.64	3.45	9.68	11.52
No. of fruits / plant	469.39	208.17**	15.84	2.30	6.46	12.98
Days to first harvest	73.49	147.42**	3.54	1.07	3.05	3.78
Fruit yield / plant (kg)	2.88	1.96**	0.10	0.18	0.50	19.81

and Sukhatme (1954). The estimation of Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) as given by Burton and Devane (1953) was followed. The other genetic parameters were found using the formula given by Allard (1960) for heritability, Genetic Advance (GA) and Genetic Advance as percentage over the mean (GAM) were estimated and the genotypes were classified as suggested by Johnson *et al*. (1955). The data were computed using OP-STAT and R software.

RESULTS AND DISCUSSION

The Analysis of Variance between 46 genotypes of brinjal recorded highly significant differences for all the characters studied (Table 3). This indicates the presence of variability between these genotypes and its use in studying the combining ability and gene action. The parents with good performance of mean may be able to transform their superior characters to their hybrids as reported by Chandra *et al.* (1970). The mean value of 46 genotypes for eleven characters are described in Table 4.

Variability parameters like Phenotypic Coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV), heritability and genetic advance are given in Table 4. Generally, phenotypic variance for eleven characters were greater than the genotypic variances (Fig. 1). From the Table 4, PCV was higher than the GCV for all the characters under study. High values of GCV and PCV (greater than 20%) were recorded in all the characters except in plant height, days to first harvest and days to first flowering (Fig.

Table 4. Estimates of mean, range and genetic components of variance for 46 genotypes of brinjal.

Quantitative characters	Range			Variance						GA%
	Min	Max	Mean	Vg	Vp	GCV	PCV	Heritability	GA	mean
Days to first flowering	27.07	67.43	48.19	92.80	98.91	19.99	20.63	93.82	19.22	39.88
Plant height (cm)	64.26	127.70	84.75	196.72	283.01	16.54	19.84	69.51	24.08	28.42
Days to first harvest	39.49	69.86	49.77	47.95	51.49	13.91	14.41	93.13	12.79	25.79
No. of primary branches	3.97	9.77	7.02	2.08	2.81	20.57	23.93	73.86	2.55	36.41
No. of flowers / inflorescence	1.02	5.54	3.85	1.13	1.20	27.72	28.58	94.03	2.12	55.37
Average fruit length (cm)	3.84	13.42	6.75	4.30	5.09	30.72	33.42	84.50	3.92	58.17
Average fruit weight (g)	22.40	112.40	51.80	352.19	387.83	36.22	38.01	90.80	36.84	71.11
Fruit thickness (mm)	23.54	63.11	40.77	80.40	101.26	21.99	24.68	79.40	16.46	40.37
No. of fruits / cluster	1.27	3.91	2.28	0.49	0.58	30.95	33.67	84.46	1.33	58.60
No. of fruits / plant	15.72	58.46	30.67	64.10	79.95	26.01	29.15	80.18	14.76	48.15
Fruit yield / plant (kg)	0.63	5.22	1.57	0.61	0.71	50.29	54.05	86.57	1.50	96.41

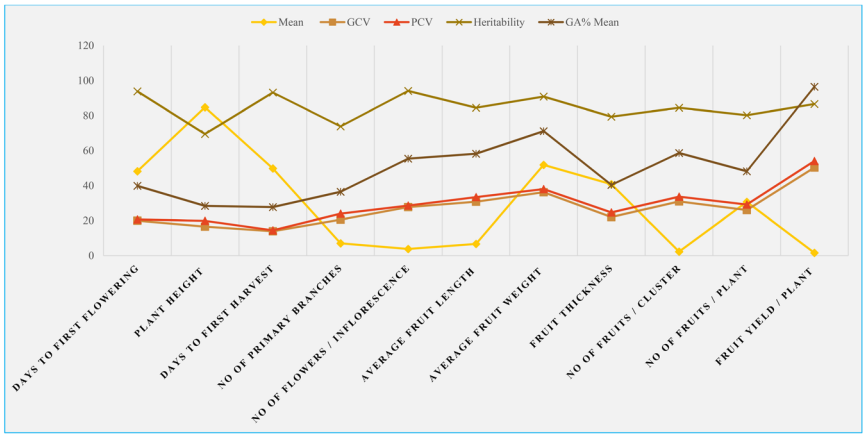

Fig. 1. Line graph showing different genetic variability parameters for eleven characters of brinjal.

1). These results were also reported by Datta *et al.* (2021). The difference between PCV and GCV values are very low (<5) for all the characters. This factor indicates GCV is greater than ECV (Environmental Coefficient of Variation). According to Chithra *et al.* (2021), if the PCV and GCV differences are quite low, it points to greater genetic control over these characters. Phenotypic selection would be beneficial. These findings were consistent with previous observations of the parameters like heritability and genetic advance (as percentage of mean) are measures of additive genetic variance. The higher the values of these parameters, the higher will be the additive genetic variance, which is the pre-requisite for gain under brinjal selection (Singh and Narayanan 2017). Estimated values of broad sense heritability and genetic advance (as percentage of mean) for eleven quantitative traits at 5% selection Intensity were given in Table 3 and Fig. 1.

The characters recorded high heritability (above 60%). Heritability ranging from 69.51% for plant height to 94.03% for number of flowers per inflorescence were observed. The efficiency of selection could be foretold by the values of genetic advance (Rezaeizad *et al*. 2011). The genetic advance as percentage of mean ranged from 25.79% for days to first harvest to 96.41% for fruit yield per plant. However, Broad sense heritability includes both fixable (additive variance, additive x additive epistatic variance) and non-fixable (dominant variance, additive x dominance epistatic and dominance × dominance epistatic variance), even if the characters are least controlled by environment, selection might be ineffective due to non-fixable variances (Singh and Narayanan 2017). So, a selection based on both heritability and genetic advance parameters would be suggested (Johnson *et al*. 1955).

High heritability along with high genetic advance (as percentage of mean) for fruit yield (86.57% and 96.41%) and yield attributing characters like number of fruits per plant (80.18% and 48.15%), average fruit weight (90.80% and 71.11%), number of fruits per cluster (84.46% and 58.60%) suggests that selection for yield improvement among these genotypes would be preferable. This type of selection will be effective when compared to considering one parameter alone. The findings were in concordance with Sonagara *et al.* (2022), Chitra *et al.* (2022) and Reddy *et al.* (2022).

CONCLUSION

The mean sum of squares due to the genotypes, according to ANOVA, had highly significant differences. Thus, the genotypes were found to be diverse from each other. The PCV and GCV values were low for days to first flowering, days to first harvest and plant height. For other characters, the GCV values were lesser than PCV, by little difference indicating the presence of effect of environment on the performance of the genotypes. The assessment of

genetic parameters for 46 genotypes observed high heritability and GAM for all the eleven characters, especially, the high values of heritability and GAM for yield and yield related traits suggest the inclusivity of these genotypes for yield improvement in brinjal. Further, the genotypes could be studied for genetic and specific combining ability, in-order to include valuable landraces in location specific and objective specific breeding programs.

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