Research Article

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Studies on genetic parameters and selection indices in eggplant (*Solanum melongena L.*) for growth and yield attributes

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ABSTRACT

The present experiment was carried out to assess the genetic variability for 60 genotypes of eggplant/ brinjal for growth and yield attributes. A degree of variation was observed for all the characters. High PCV and GCV were recorded for the plant height (22.29 and 22.13), number of primary branches (24.96 and 23.74), intra cluster distance (30.75 and 29.80), number of fruits per plant (38.76 and 37.76), length of fruits (32.07 and 31.97), girth of fruits (29.41 and 29.33), fruit weight (29.26 and 29.20), short styled flowers (31.64 and 22.51), fruit yield per plant (40.52 and 40.30), shoot infestation by shoot and fruit borer (24.34 and 23.83) and fruit infestation by shoot and fruit borer (24.92 and 24.35). High heritability (>60%) was noticed for all the characters under study except short styled flowers (50.64). High genetic advance as per cent mean was observed for fruit yield per plant (82.58%), number of fruits per plant (75.77%), length of fruit (65.67%), fruit weight (60.01%), girth of fruit (60.25%), intra cluster distance (59.50%), fruit infestation by shoot and fruit borer (49.03%), shoot infestation by shoot and fruit borer (48.06%), number of primary branches per plant (46.51%), plant height (45.24%), short styled flowers (33.01%) and inter cluster distance (24.11%). The estimates of genetic parameters revealed scope for further improvement of fruit yield by selection. Top index values for five genotypes were recorded. The genotype SM 36 (4724.25), SM 2 (4676.91), SM 9 (4471.43), SM14 (4313.06) and SM21 (4255.83) respectively and these best five high yielding genotypes were further selected for hybridization programme.

Introduction

Eggplant or brinjal (*Solanum melongena* L.) belongs to the family *Solanaceae,* has chromosome number of 2n=24.Itis an important crop in the tropical regions of world and being grown extensively in India, Bangladesh, Pakistan, China and Philippines. It is also popular in Egypt, France, Italy and United States. In India, it is one of the most common, popular and principal vegetable crop grown throughoutthe country. It is a versatile crop adapted to different agro-climatic regions and canbe grown throughout the year. It is a perennial but grown commercially as an annual crop. Brinjal has several ayurvedic medicinal properties and is good for diabetic patients. It has

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also been recommended as an excellent remedy for those suffering from liver complaints (Shukla and Naik, 1993). A number of cultivars are grown in India based on consumer preference for fruit color, size, shape and taste. However, for further improvement evaluation of available genetic variability is prerequisite for planning the crop improvement programme. Knowledge of the nature and magnitude of variation provide rationale choice of character(s) on which selection can be practiced. The observed variability is a combined estimate of genetic and environmental factors, of which the former is heritable and responds to selection. However the estimate of heritability alone does not provide an idea about the expected gain in the next generation, therefore it has to be considered in conjugation with genetic advance. Hence, the present investigation was carried out to analyze variability for growth and yield characters.

Material and Methods

The present study was carried out to assess the variability and character association in 60 diverse genotypes of eggplant at Department of Plant Breeding & Genetics, College of Agriculture (KAU), Vellayani Trivandrum-Kerala during 2016-17. The experimental site was located at 8°5' N latitude and 77°1' E longitude at an altitude of 29 m above mean sea level.

Seedlings were transplanted at a spacing of 60 cm x 70 cm. The crop received timely management practices as per package of practices recommendations of Kerala Agricultural University. The crop was maintained properly till last harvest and observations on growth, yield as well as yield contributing characters was noted on five randomly selected plants in each replication at different stages of the crop. The variance components and coefficients of variation were computed as per Burton (1952). The heritability in broad sense and expected genetic advance were determined by using the formula given by Johnson *et al.* (1955). Observations were taken for all the twenty three characters like plant height, number of primary branches per plant, days to first flower, percentage of medium styled flowers, percentage of long styled flowers, intra cluster distance, inter cluster distance, number of fruits per plant, length of fruit, girth of fruit, fruit weight, days to first harvest, days to last harvest, fruit yield per plant, SFB shoot damage, SFB fruit damage. Percentage of infested shoots and fruits per plant was calculated by number of shoots or fruits showing damage symptoms to the total number of shoots or fruits respectively which is multiply by the 100. The selection index developed by Smith (1937) using discriminate function of Fisher (1936) was used to discriminate the genotypes based on all the characters. Plant height, number of primary branches, number of fruits per plant, girth of fruit, fruit weight together with fruit yield per plant were used for constructing selection index.

Results and Discussion

The analysis of variance revealed significant variation among the 60 accessions for all the characters studied (Table 1). This indicated the presence of high degree of variation within the genotypes. One of the ways by which variability is assessed through a simple approach of examining the range of variations (Phaomei and Pereira, 2016). Range of variation observed for all the traits in the present study (Table 2).

Various genetic parameters like phenotypic and genotypic co-efficient of variability (PCV, GCV), heritability, genetic advance (GA) and genetic advance as per cent of mean (GAM) for the twenty three quantitative characters like plant height, number of primary branches per plant, days to first flower, percentage of medium styled flowers, percentage of long styled flowers, intra cluster distance, inter cluster distance, number of fruits per plant, length of fruit, girth of fruit, fruit weight, days to first harvest, days to last harvest, fruit yield per plant, SFB shoot damage, SFB fruit damage were measured and have been discussed as below (Table 2 and Fig. 1).

High PCV and GCV were recorded for the plant height (22.29 and 22.13), number of primary branches (24.96 and 23.74), intra cluster distance (30.75 and 29.80), number of fruits per plant (38.76 and 37.76), length of fruits (32.07and 31.97), girth of fruits (29.41and 29.33), fruit weight (29.26 and 29.20), short styled flowers(31.64 and 22.51),fruit yield per plant (40.52 and 40.30), shoot infestation by shoot and fruit borer (24.34 and 23.83) and fruit infestation by shoot and fruit borer (24.92 and 24.35) which indicating maximum amount of variability present in the germplasm for these characters. Similar results were reported in brinjal by Patel *et al.* (2004), Rai *et al.* (1998), Shilpa *et al.* (2018), Mohanty *et al. (*2020), Satyaprakash *et al.* (2021). Moderate PCV and GCV were recorded only for inter cluster distance (12.06 and 11.88) whereas, low PCV and GCV was recorded days to first flower (8.73 and 8.55), medium styled flowers (7.18 and 6.56), long styled flowers (5.15 and 4.33), days to first harvest (6.81 and 6.72) and days to last harvest (6.04 and 6.02) indicating the existence of limited variability or low genetic variability in the germplasm evaluated for the trait. This necessitates need for generation of new variability for these characters. The higher estimates of PCV than the GCV indicated towards the environmental influence in the expression of all the characteristics. These results are concurred with the earlier worker in brinjal by Singh and Gopalakrishnan (1999), Sharma and Swaroop (2000), Satyaprakash *et al.* (2021) and Chithra *et al.* (2022).

High heritability in broad sense is useful in identifying appropriate character for selection and enables the breeder to select superior genotypes on the basis of phenotypic expression of quantitative traits. High heritability (>60%) was noticed for all the characters under study except short styled flowers (50.64). The high heritability recorded for the

traits like plant height (98.49%), number of primary branches per plant (90.45%), days to first flower (95.85%), percentage of medium styled flowers (83.48%), percentage of long styled flowers (70.43%), intra cluster distance (93.94%), inter cluster distance (97.03%), number of fruits per plant (94.88%), length of fruit (99.39%), girth of fruit (99.43%), fruit weight (98.80%), days to first harvest (97.43%), days to last harvest (99.24%), fruit yield per plant (98.93%), SFB shoot damage (95.87%) and SFB fruit damage (95.50%). It indicating that these characters are less influenced by environmental factors and are under the control of additive gene effect and selection for improvement of such characters would be rewarding (Sharma and Swaroop, 2000). Burton (1952) suggested that GCV along with heritability estimates would provide a better picture of the amount of advance expected by phenotypic selection. Heritability estimates in conjunction with genetic gains are more effective and dependable in predicting the improvement through selection (Johnson *et al.,* 1955). Since the units of measurements influence the magnitude of genetic advance (GA), the GA as per cent of mean is considered as an essential selection parameter. High genetic advance as per cent mean was observed for fruit yield per plant (82.58%), number of fruits per plant (75.77%), length of fruit (65.67%), fruit weight (60.01%), girth of fruit (60.25%), intra cluster distance (59.50%), fruit infestation by shoot and fruit borer (49.03%), shoot infestation by shoot and fruit borer (48.06%), number of primary branches per plant (46.51%), plant height (45.24%), short styled flowers (33.01%) and inter cluster distance (24.11%) indicating that these characters are controlled by additive gene action. Similar results were reported by Singh and Gopalakrishnan (1999), Sharma and Swaroop (2000). Thus, selection for these characters will improve the yield. Moderate genetic advance as per cent mean was observed for days to first flowering (16.86%), days to first harvest (14.02%) and days to last harvest (12.44%) where as low genetic advance as per cent mean was observed for medium styled flowers (4.52%) and long styled flowers (5.545%) indicating that these characters are governed by non additive gene action, selection for these characters is not useful. More or less similar results were reported by Singh and Gopalakrishnan (1999), Mohanty *et al.* (2020), Satyaprakash *et al.* (2021) and Chithra *et al.* (2022) in eggplant.

Discriminate function technique was adopted for the construction of selection index for yield using fruit yield per plant and the component characters *viz*., plant height, number of primary branches, fruits per plant, girth of fruit and fruit weight. These component characters showed relatively stronger association with yield and could form a valuable selection index for yield in this crop. The index value for each sixty genotypes were determined and they were ranked accordingly (Table 3). Top index values for five genotypes were recorded. The genotype SM 36 (4724.25), SM 2 (4676.91), SM 9 (4471.43), SM14 (4313.06) and SM21 (4255.83) respectively and these best five high yielding genotypes were further selected for hybridization programme.Thus, selection index was formulated to increase the efficiency of selection by taking into account the important characters contributing to yield. Further Hazel, (1943), suggested that selection based on suitable index was more efficient than individual selection for the characters. These results were concurred with earlier works reported by Vadivel and Bapu (1991), Chattopadhyay *et al.* (2011) and Bashar *et al.* (2015).

Table 1. Analysis of variance (mean squares) for growth and yield parameters in eggplant

S. No.	Character	Replication d.f. = 1	Genotypes d.f. = 59	Error d.f. = 59
1	Plant height (cm)	15.02	485.50**	5.99
2	No. of primary branches	0.30	3.72**	0.24
3	Days to first flower	0.14	26.60**	0.49
4	Medium styled flowers (%)	0.01	9.50**	4.94
5	Long styled flowers (%)	2.36	12.49**	4.00
6	Short styled flowers (%)	0.37	3.59**	1.08
7	Intra cluster distance (cm)	0.01	0.34**	0.02
8	Inter cluster distance (cm)	0.12	2.17**	0.03
9	No. of fruits per plant	2.44	95.98**	1.87
10	Length of fruit (cm)	0.00	21.99**	0.17
11	Girth of fruit (cm)	0.01	35.47**	0.28
12	Fruit weight (g)	0.78	2879.43**	23.18
13	Days to first harvest	0.25	39.08**	0.83

14	Days to last harvest	0.00	171.72**	0.77
15	Fruit yield per plant (g)	56325.11	1203696.12**	15162.16
16	FSB shoot damage (%)	0.07	195.92**	1.39
17	FSB fruit damage (%)	3.71	200.90**	3.56

Table 2. Range, mean, estimates of GCV, PCV, heritability and genetic advance for growth and yield parameters in egg-plant

Character	Range		Mean	GCV	PCV	Heritability	Genetic advance at 5%	Genetic advance as % mean
	Min.	Max.						
Plant height (cm)	41.40	119.90	71.80	22.13	22.29	98.49	32.48	45.24
No. of primary branches	3.00	9.30	5.64	23.74	24.96	90.45	2.62	46.51
Days to first flower	32.9000	50.50	42.90	8.55	8.73	95.85	7.40	17.25
Medium styled flowers (%)	33.50	47.85	40.39	6.56	7.18	83.48	4.99	12.34
Long styled flowers (%)	46.05	59.15	53.00	4.33	5.15	70.43	3.96	7.48
Short styled flowers (%)	3.20	11.35	6.59	22.51	31.64	50.64	2.17	33.01
Intra cluster distance (cm)	0.80	2.45	1.46	29.80	30.75	93.94	0.87	59.50
Inter cluster distance (cm)	5.05	10.37	8.44	11.88	12.06	97.03	2.03	24.11
No. of fruits per Plant	10.10	41.75	18.26	37.76	38.76	94.88	13.83	75.77
Length of fruit (cm)	4.90	22.05	10.43	31.97	32.07	99.39	6.85	65.67
Girth of fruit (cm)	8.45	26.65	14.49	29.33	29.41	99.43	8.73	60.25
Fruit weight (g)	47.25	246.50	131.00	29.20	29.26	98.80	78.61	60.01
Days to first harvest	52.70	70.35	62.50	6.72	6.81	97.43	8.54	13.67
Days to last harvest	136.50	174.60	152.56	6.02	6.04	99.24	18.85	12.35
Fruit yield per plant (g)	774.00	4388.50	2024.29	40.30	40.52	98.93	167.67	82.58
FSB shoot damage (%)	6.35	57.50	39.81	23.83	24.34	95.87	19.13	48.06
FSB fruit damage (%)	7.60	51.00	38.03	24.35	24.92	95.50	18.65	49.03

GCV- Genotypic co-efficient of variation

PCV- Phenotypic co-efficient of variation

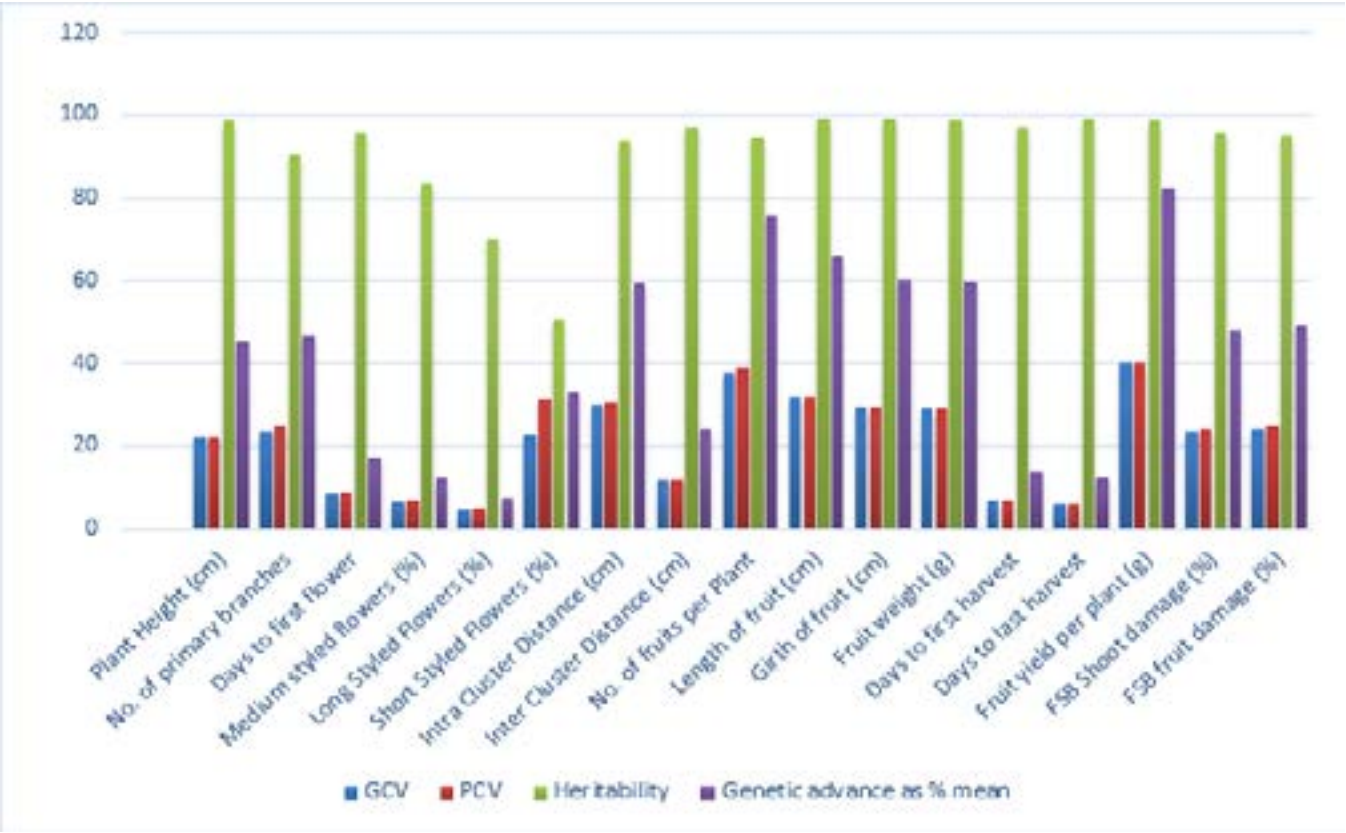

Fig. 1. Estimates of genetic parameters for various characters in eggplant

Table 3. Eggplant accessions ranked according to selection index (based on discriminate function analysis)

S.No.	Genotype	Index	Rank	S.No.	Genotype	Index	Rank
1	SM 36	4724.25	1	31	SM 58	2113.79	1
2	SM 2	4676.91	2	32	SM 52	2111.61	2
3	SM 9	4471.43	3	33	SM 20	2110.63	3
4	SM 14	4313.06	4	34	SM 28	2084.78	4
5	SM 21	4255.83	5	35	SM 51	2070.18	5
6	SM 60	3748.20	6	36	SM 6	2065.42	6
7	SM 1	3714.01	7	37	SM 56	2027.76	7
8	SM 59	3512.11	8	38	SM 42	2026.46	8
9	SM 30	3211.14	9	39	SM 4	2003.13	9
10	SM 35	2720.65	10	40	SM 26	1979.95	10
11	SM 7	2657.05	11	41	SM 5	1977.10	11
12	SM 19	2559.93	12	42	SM 8	1959.33	12
13	SM 31	2514.97	13	43	SM 48	1942.74	13
14	SM 33	2482.48	14	44	SM 53	1914.51	14
15	SM 13	2474.15	15	45	SM 38	1890.95	15

16	SM 15	2458.37	16	46	SM 39	1861.51	16
17	SM 23	2446.83	17	47	SM 24	1831.02	17
18	SM 18	2434.20	18	48	SM 55	1822.30	18
19	SM 43	2336.09	19	49	SM 32	1773.42	19
20	SM 50	2327.30	20	50	SM 46	1771.83	20
21	SM 54	2319.68	21	51	SM 49	1748.27	21
22	SM 25	2309.21	22	52	SM 27	1651.20	22
23	SM 57	2301.97	23	53	SM 10	1636.34	23
24	SM 17	2290.46	24	54	SM 34	1600.28	24
25	SM 45	2281.00	25	55	SM 40	1592.29	25
26	SM 41	2280.56	26	56	SM 11	1373.57	26
27	SM 44	2264.34	27	57	SM 29	1290.56	27
28	SM 37	2186.44	28	58	SM 12	1263.55	28
29	SM 22	2160.14	29	59	SM 3	1051.11	29
30	SM 47	2140.84	30	60	SM 16	994.70	30

Conclusion

The higher PCV and GCV was observed for plant height, number of primary branches per plant, number of fruits per plant, length of fruit, girth of fruit, fruit weight, intra cluster distance, fruit yield per plant, SFB shoot damage and SFB fruit damage indicating that a greater amount of genetic variability was present for these characters which provide greater scope for selection in eggplant. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of primary branches plant, intra cluster distance, inter cluster distance, number of fruits per plant, length of fruit, girth of fruit, fruit weight, fruit yield per plant, SFB shoot damage, SFB fruit damage. It indicated that, these traits were under the strong influence of additive gene action and hence simple selection based on phenotypic performance of these traits would be more effective. The selection index was increases the efficiency of selection by taking into account the important characters contributing to the total yield. The index value for each sixty genotypes were determined and they were ranked accordingly.

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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