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SB Varshitha
College of Horticulture, Bengaluru, Karnataka, India

JS Aravinda Kumar
College of Horticulture, Mysuru, Karnataka, India

CN Hanchinamani
College of Horticulture, Bengaluru, Karnataka, India

Jayashree Ugalat
College of Horticulture, Bengaluru, Karnataka, India

CJ Yogesh Babu
College of Horticulture, Bengaluru, Karnataka, India

HM Pallavi
University of Horticultural Sciences, Bagalkot, Karnataka, India

G Manjunath
College of Horticulture, Mysuru, Karnataka, India

Corresponding Author:
CJ Yogesh Babu
College of Horticulture, Bengaluru, Karnataka, India

Genetic variability and character association studies in Brinjal (*Solanum melongena* L.)

SB Varshitha, JS Aravinda Kumar, CN Hanchinamani, Jayashree Ugalat, CJ Yogesh Babu, HM Pallavi and G Manjunath

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Abstract
The investigation was conducted at the vegetable block in the Department of Vegetable Science, College of Horticulture, Mysuru. 29 genotypes of Brinjal collected from different sources were evaluated in Randomized Complete Block Design (RCBD) with 2 replications during kharif 2023. The analysis of variance revealed significant differences among the genotypes for all the characters studied and this indicates the presence of wide range of variability in the genotypes. Among the 23 characters studied plant height, fruit pedicel length, fruit length, fruit breadth, average fruit weight, number of fruits per infructescence, fruit yield per plant, number of fruits per plant, number of seeds per fruit, seed weight, fruit to seed ratio and soluble sugars were recorded high GCV, PCV, heritability and GAM. Hence, these characters had high variability with additive gene actions direct selection would be more effective in improving these traits. The correlation and path analysis studies revealed that fruit yield per plant positively and significantly associated with average fruit weight, fruit length, fruit breadth, number of fruits per plant, number of seeds per fruit, seed weight, fruit dry matter and fruit protein content. These characters have to be considered while selecting the genotypes for fruit yield per plant.

Keywords: Brinjal, GCV, PCV, heritability, variability

Introduction
Brinjal (*Solanum melongena* L.) is one of the most important vegetables, has chromosomal number 2n=2x=24 and belongs to the Solanaceae family. It is known by various names, including Badanekai in Kannada, Baingan in Hindi, Eggplant in the United States, Aubergine in France, Vangi in Marathi, Vankai in Telugu, Katharikai in Tamil and Peethabhala in Sanskrit. Despite being a perennial, it is raised for profit as an annual crop in both temperate and warm climates. In terms of acreage and output, India is second next to China.

The immature fruits are widely utilized in a wide range of culinary preparations, such as packed curries, berthas, sliced bhaji, chutneys, vangibath, pickles, etc. Fiber (1.30 g), protein (1.40 g), vitamin A (124 IU), carbohydrates (4.40 g) and potassium (200 mg/100 g) are all key nutrients found in it. Patients with diabetes, asthma, cholera and bronchitis are advised to consume it. Additionally, it has been recommended as an excellent remedy for people with liver issues. The long-fruited cultivars have a larger concentration of free reducing sugars, anthocyanin, phenols, glycoalkaloids (such solasodine) and dry matter than the oblong-fruited cultivars on average, according to research (Bajaj *et al.*, 1981) [2]. In India, many brinjal hybridization work had been carried out, but local cultivars (land races) are unexplored ones. Local cultivars of brinjal exhibit desirable performance compared to other hybridized cultivar by showing greater adaptability to their local area respectively. These genotypes could be better utilized for commercial use and even for breeding programmes. These local brinjal land races/genotypes can show variable phenology and moderate to high yield but are often highly nutritious.

Present work is very useful in identifying important brinjal genotype for crop breeding owing to their high potential to adapt specific environmental condition and also comparison of different land races of brinjal genotypes.

Materials and Methods

The experiment was conducted at the Department of Vegetable Science, College of Horticulture, Yelachenahalli, Mysuru district, Karnataka. The present study was carried out with 29 genotypes collected from different sources (Table 1). The experiment was laid out in a Randomized Complete Block Design (RCBD) with two replications. Each genotype in a replication was represented by a plot of with 5 plants. The results from the analysis of variance for 23 characters including vegetative, flowering, yield and yield attributing parameters along with quality parameters. Genetic variability components included range, mean, Coefficient of variation (CVe), Phenotypic Coefficient of Variability (PCV), Genotypic coefficient of variability (GCV), heritability in broad sense and genetic advance. The correlation coefficients were calculated to determine the degree of association of character with yield, quality and its components. Phenotypic and genotypic correlation coefficients were estimates employing formula (Al-Jibouri *et al.*, 1958) [1].

Table 1: The experiment was laid out in a Randomized Complete Block Design (RCBD) with two replications

SL. No.	Code	Genotypes	Source
1.	BR-1	Hebbettu Badane	Desi Seeds Producer Co. Ltd. Sahaja Seeds
2.	BR-2	Green Long-1	Desi Seeds Producer Co. Ltd. Sahaja Seeds
3.	BR-3	Purple Light	Desi Seeds Producer Co. Ltd. Sahaja Seeds
4.	BR-4	White Brinjal	Desi Seeds Producer Co. Ltd. Sahaja Seeds
5.	BR-5	White Flower Mudde Badane	Desi Seeds Producer Co. Ltd. Sahaja Seeds
6.	BR-6	Green Stripe Long Brinjal	Desi Seeds Producer Co. Ltd. Sahaja Seeds
7.	BR-7	Musuku	Desi Seeds Producer Co. Ltd. Sahaja Seeds
8.	BR-8	White Flower Green Long	Desi Seeds Producer Co. Ltd. Sahaja Seeds
9.	BR-9	Green Long Cluster	Desi Seeds Producer Co. Ltd. Sahaja Seeds
10.	BR-10	Purple Round	Desi Seeds Producer Co. Ltd. Sahaja Seeds
11.	BR-11	Green Long-2	Desi Seeds Producer Co. Ltd. Sahaja Seeds
12.	BR-12	Green Stripe Short	Desi Seeds Producer Co. Ltd. Sahaja Seeds
13.	BR-13	Green Shape Round	Desi Seeds Producer Co. Ltd. Sahaja Seeds
14.	BR-14	Gomuka	Desi Seeds Producer Co. Ltd. Sahaja Seeds
15.	BR-15	Green Stripe	Desi Seeds Producer Co. Ltd. Sahaja Seeds
16.	BR-16	Green Shape Long	Desi Seeds Producer Co. Ltd. Sahaja Seeds
17.	BR-17	Yellow Musted	Desi Seeds Producer Co. Ltd. Sahaja Seeds
18.	BR-18	No - 14	Desi Seeds Producer Co. Ltd. Sahaja Seeds
19.	BR-19	No - 21	Desi Seeds Producer Co. Ltd. Sahaja Seeds
20.	BR-20	Dinka Local	Dinka village, Mandya
21.	BR-21	Udupi Gulla	Puttur
22.	BR-22	Hussainpura Local	Hussainpura, Mysuru
23.	BR-23	Dharwad Local - 2	Dharwad
24.	BR-24	Dharwad Local - 3	Dharwad
25.	Annamalai	Annamalai	TNAU, Tamil Nadu
26.	Arka Harshita	Arka Harshita	IIHR, Bengaluru
27.	Arka Neelanchal Shyma	Arka Neelanchal Shyma	IIHR, Bengaluru
28.	Arka Keshav	Arka Keshav	IIHR, Bengaluru
29.	Arka Neelanchal Yodha	Arka Neelanchal Yodha	IIHR, Bengaluru

Results and Discussion

The results from the analysis of variance for characters are presented in Table 2 indicated that there are highly significant differences among 29 genotypes of brinjal. It is indicated that, sufficient variability existed for the characters studied and considerable improvement could be achieved. However, the analysis of variance by itself is not enough and conclusive to explain all the inherent genotypic variances in the genotypes. The estimates of genetic parameters *viz*., phenotypic and genotypic co-efficient of variation (PCV and GCV), heritability in broad sense, genetic advance and genetic advance as per cent of mean (GAM) were computed for 23 characters and were presented in Table-3.

Table 2: Analysis of variance (mean sum of squares) for growth, yield and quality parameters in brinjal

SL. No.	Characters	Replication	Treatments	Error	S.E.M±	CD (5%)	CD (1%)
	Degrees of freedom	1	28	28			
A	Growth and earliness parameters						
1	Plant height (cm)	73.94	1933.73**	106.94	7.31	21.18	28.58
2	Number of primary branches per plant	0.02	0.77**	0.11	0.23	0.67	0.90
3	Days to first flowering	5.89	118.34**	17.08	2.92	8.47	11.42
4	Days to 50% flowering	61.51	110.80**	23.87	3.45	10.01	13.50
5	Fruit pedicel length (cm)	0.00	2.91**	0.16	0.29	0.83	1.11
6	Days to first harvest	22.04	5.91**	3.69	1.36	3.94	5.31
B	Yield parameters						
7	Fruit length (cm)	1.92	55.41**	1.18	0.77	2.23	3.00
8	Fruit breadth (cm)	1.28	8.51**	0.20	0.32	0.92	1.25
9	Average fruit weight (g)	83.85	4582.51**	47.27	4.86	14.08	19.00
10	Number of locules per fruit	0.00	0.64**	0.13	0.26	0.75	1.01

11	Number of fruits per infructescence	0.02	1.24**	0.03	0.12	0.36	0.48
12	Number of fruits per plant	4.75	238.98**	5.31	1.63	4.72	6.37
13	Fruit yield per plant (g)	0.01	0.71**	0.02	0.09	0.27	0.37

Table 2. Contd.....

SL. No.	Characters Degrees of freedom	Replication 1	Treatments 28	Error 28	S.E.M±	CD (5%)	CD (1%)
C	**Seed parameters**						
14	Number of seeds per fruit	15703.67	1291644.78**	12466.11	78.95	228.71	308.52
15	Seed weight (g)	0.01	0.75**	0.07	0.18	0.53	0.72
16	Fruit to seed ratio	0.00	0.10**	0.00	0.03	0.09	0.12
D	**Quality parameters**						
17	Fruit dry matter (%)	0.61	1.18**	0.70	0.59	1.72	2.32
18	Fruit protein content (%)	0.07	0.09**	0.01	0.08	0.22	0.30
19	Ascorbic acid content (mg/100g)	0.10	3.19**	0.69	0.59	1.70	2.29
20	Total phenol content (mg/100g) (Free phenols and bound phenols)	0.04	4.32**	1.93	0.98	2.84	3.84
21	Fruit alkaloids content (mg/100g)	0.00	0.00**	0.00	0.00	0.01	0.01
22	Soluble sugars (mg/100g)	0.14	1.04**	0.06	0.17	0.50	0.68
23	Polyphenol oxidase (unit/g fresh wt)	42.55	0.92**	0.89	0.67	1.93	2.61

* Significant at 5% ** Significant at 1%

Table 3: Estimates of mean, range, components of variance, heritability, genetic advance and genetic advance over per cent of mean for growth, earliness, yield and quality parameters in brinjal

SL. No.	Character	Mean	Range	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
A. Growth and earliness parameters								
1.	Plant height (cm)	113.25	70.40-190.90	26.69	28.21	89.52	58.91	52.01
2.	Number of primary branches per plant	4.22	2.90-5.40	13.69	15.71	75.96	1.04	24.58
3.	Days to first flowering	55.69	45.00-74.50	12.78	14.78	74.78	12.67	22.76
4.	Days to 50% flowering	58.29	48.50-76.00	11.31	14.08	64.55	10.91	18.72
5.	Fruit pedicel length (cm)	4.83	1.76-7.15	24.26	25.65	89.41	2.28	47.25
6.	Days to first harvest	75.19	73.50-81.00	1.40	2.91	23.09	1.04	1.39
B. Yield parameters								
7.	Fruit length (cm)	11.12	3.09-27.31	46.83	47.84	95.82	10.50	94.44
8.	Fruit breadth (cm)	4.63	2.16-12.32	44.01	45.08	95.34	4.10	88.53
9.	Average fruit weight (g)	65.06	18.48-277.87	73.20	73.96	97.96	97.09	149.24
10.	Number of locules per fruit	3.97	3.00-6.00	12.69	15.69	65.43	0.84	21.15
11.	Number of fruits per infructescence	1.69	1.00-4.20	46.06	47.20	95.23	1.56	92.60
12.	Number of fruits per plant	24.40	7.70-50.00	44.29	45.29	95.65	21.78	89.24
13.	Fruit yield per plant (kg)	1.35	0.41-2.50	43.65	44.75	95.17	1.18	87.73

Table 3. Contd.....

SL. No.	Character	Mean	Range	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
A. Seed parameters								
14.	Number of seeds per fruit	1124.92	132.30-2965.60	71.09	71.78	98.09	1631.65	145.05
15.	Seed weight (g)	2.66	1.64-4.09	21.91	24.00	83.38	1.10	41.22
16.	Fruit to seed ratio	0.37	0.16-1.15	59.76	60.87	96.41	0.45	120.88
B. Quality parameters								
17.	Fruit dry matter (%)	9.35	8.13-10.80	5.23	10.39	25.39	0.51	5.43
18.	Fruit protein content (%)	1.16	0.80-1.44	16.61	19.07	75.82	0.35	29.79
19.	Ascorbic acid content (mg/100g)	8.52	6.44-12.10	13.12	16.33	64.59	1.85	21.73
20.	Total phenol content (mg/100g) (Free phenols and bound phenols)	14.45	12.03-17.00	7.57	12.24	38.32	1.40	9.66
21.	Fruit alkaloids content (mg/100g)	0.03	0.02-0.04	18.59	20.65	80.99	0.01	34.46
22.	Soluble sugars (mg/100g)	2.37	1.42-4.07	29.51	31.28	89.00	1.36	57.35
23.	Polyphenol oxidase (unit/g fresh wt)	17.26	16.02-18.53	0.71	5.51	1.65	0.03	0.19

GCV- Genotypic co-efficient of variation
PCV- Phenotypic co-efficient of variation
h^2 – Broad sense heritability
GA- Genetic advance
GAM- Genetic advance as per cent of mean

The estimates of genetic parameters *viz*., phenotypic and genotypic co-efficient of variation (PCV and GCV), heritability in broad sense, genetic advance and genetic advance as per cent of mean (GAM) were computed for 23 characters and were presented in Table 3. The phenotypic variance was higher than genotypic variance for all the characters studied. PCV ranged from 2.91 per cent (days to first harvest) to 73.96 per cent (average fruit weight). GCV ranged from 0.71 per cent (polyphenol oxidase) to 73.20 per cent (average fruit weight). The estimates of heritability

ranged from 1.65 per cent (polyphenol oxidase) to 98.09 per cent (number of seeds per fruit). GAM ranged from 0.19 per cent (polyphenol oxidase) to 149.24 per cent (average fruit weight). Means of genotypes varied greatly for several traits, indicating the higher magnitude of variability. The range in the values reflects the amount of phenotypic variability. In the present study, wide range of variability was observed for all the characters High phenotypic coefficient of variation (>20%) with high genotypic coefficient of variation (>20%) was noticed in plant height, fruit pedicel length, fruit length, fruit breadth, average fruit weight, number of fruits per infructescence, number of fruits per plant, fruit yield per plant, number of seeds per fruit, seed weight, fruit to seed ratio and soluble sugars. It indicates existence of broad genetic base which would be amenable for further selection. High phenotypic coefficient of variation with high environmental influence from the total variability. Nevertheless, its use would be limited as this is prone to change with environments, material *etc*. The estimation of heritability has a greater role to play in determining the effectiveness of selection for a character provided as it is considered in conjunction with the predicted genetic advance as suggested by Panse and Sukhatme (1985) [12] and Johnson *et al.* (1955) [8]. In the present study, very high heritability (>80%) was noticed in plant height, fruit pedicel length, fruit length, fruit breadth, average fruit weight, number of genotypic coefficient of variation was noted by Mili *et al.* (2014) [9], Naroui *et al.* (2015) [11], Tripathy *et al.* (2017) [19]. The moderate (10-20%) PCV and GCV was noticed in number of primary branches, days to first flowering, days to 50 per cent flowering, number of locules per fruit, fruit protein content and ascorbic acid content. It indicated that these traits are governed by non-additive genes. Hence, there is a little scope for improvement of these traits through selection. Hence, selection for improvement of such characters will not be rewarding. These results are in accordance with Reshmika *et al.* (2015) [15], Banerjee *et al.* (2018) [3]. The low (0-10%) GCV and PCV were observed in days to first harvest and polyphenol oxidase. Similar results are also observed for days to first harvest by Naik *et al.* (2005) [10], Sao and Mehta (2009) [16], Dahatonde *et al.* (2010) [4]. This indicates the narrow genetic base and hence variability has to be generated for these characters either through introduction or hybridizing divergent genotypes to recover transgressive segregants or by mutation breeding in soybean). The estimates of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) indicated the extent of variability existing for various traits irrespective of their units of measurements. However, even these do not give a correct picture about the extent of inheritance of the characters.

Fruits per infructescence, number of fruits per plant, fruit yield per plant, number of seeds per fruit, seed weight, fruit to seed ratio, fruit alkaloid content and soluble sugars. The similar results are also observed for plant height by Divya and Sharma (2018) [5]. High heritability (60-80%) was noticed in number of primary branches, days to flowering, days to 50% flowering, number of locules per fruit, fruit protein content and ascorbic acid content. It was reported for number of primary branches by Dutta *et al.* (2018) [6], Verma *et al.* (2018) [20]. Low heritability (<40%) estimates along with low GAM (0-10%) was observed in days to 1st harvest, fruit dry matter, free phenols and bound phenols and polyphenol oxidase. These results are in conformity with days to 1st harvest by Naik (2005) [10]; Mili *et al.* (2014) [9] for fruit dry matter; Jayalakshmi *et al.* (2020) for free phenols and bound phenols and Rani *et al.* (2017) [13] for polyphenol oxidase. High estimates of heritability coupled with high GAM was recorded for plant height, fruit pedicel length, fruit length, fruit breadth, average fruit weight, number of fruits per infructescence, number of fruits per plant, fruit yield per plant, number of seeds per fruit, seed weight, fruit to seed ratio, fruit alkaloid content and soluble sugars indicated the predominance of additive gene component. Thus, there was ample scope for improving these characters with direct selection. The similar results were also observed for plant height by Divya and Sharma (2018) [5], Verma *et al.* (2018) [20]. The similar results were also observed for plant height by Divya and Sharma (2018) [5], Verma *et al.* (2018) [20], Satyaprakash *et al.* (2021) [17] and Sharma *et al.* (2022) [18]; fruit length by Tripathy *et al.* (2017) [19], Divya and Sharma (2018) [5], Dutta *et al.* (2018) [6], Satyaprakash *et al.* (2021) [17] and Sharma *et al.* (2022) [18]; average fruit weight by Divya and Sharma (2018) [5], Dutta *et al.* (2018) [6], Verma *et al.* (2018) [20], Satyaprakash *et al.* (2021) [17] and Sharma *et al.* (2022) [18]; number of fruits per plant by Satyaprakash *et al.* (2021) [17], Sharma *et al.* (2022) [18]; fruit yield per plant Tripathy *et al.* (2017) [19], Divya and Sharma (2018) [5], Dutta *et al.* (2018) [6], Satyaprakash *et al.* (2021) [17], Sharma *et al.* (2022) [18]; number of seeds per fruit by Satyaprakash *et al.* (2021) [17] and Sharma *et al.* (2022) [18]; seed weight by Satyaprakash *et al.* (2021) [17], Sharma *et al.* (2022) [18] and soluble sugars by Rekha (2011) [14] and Rani *et al.* (2017) [13]. This Indicates additive gene action hence, higher degree of genetic improvement for these traits can be achieved through selection using the existing germplasm.

Correlation and path analysis

In the present study, the genotypic and phenotypic correlation coefficients were worked for growth, yield and quality traits in brinjal, it was observed that fruit yield per plant had highly significant (at p=0.01) and positively associated with fruit breadth, average fruit weight, number of seeds per fruit, number of fruits per plant and fruit dry matter at both phenotypic and genotypic levels and it was also significant (at p = 0.05) and positively associated with fruit length, seed weight and fruit protein content at phenotypic and genotypic levels. Days to 1st harvest was highly significant (p=0.01) at genotypic level and it was also significant (p=0.05) at phenotypic level. The Phenotypic and genotypic correlation studies were carried out to know the nature of relationship existing between growth, yield and quality and component characters and are presented in Table 5 and 6 respectively.

Average fruit weight was positively and highly significantly (at p = 0.01) correlated with number of seeds per plant (rP = 0.6654), seed weight (rP = 0.4269) and fruit dry matter (rP = 0.3643). Average fruit weight was negatively and highly significantly (at p=0.01) associated with number of fruits per infructescence (rP = -0.3425) and number of fruits per plant (rP = -0.3732). Fruit breadth showed positive and highly significant (at p = 0.01) association with average fruit weight (rP = 0.8864), number of seeds per fruit (rP = 0.6335) and seed weight (rP = 0.5247) and negative and significantly correlated (at p=0.01) with number of fruits per plant (rP = -0.4829) and number of fruits per infructescence (rP = -0.3494). At phenotypic level, number of fruits per infructescence was found to be highly significant (at p=0.01) and positively associated with number of fruits per plant (rP

= 0.5070) and fruit dry matter (rP = 0.3517) and negatively associated with number of seeds per fruit (rP = -0.3511) at p = 0.01. Number of fruits per plant exhibited significant (at p=0.05) and positive phenotypic association with fruit protein content (rP = 0.3294). Fruit yield per plant had highly significant (at p=0.01) and positively associated with average fruit weight (rP = 0.5447), number of seeds per fruit (rP = 0.4256), number of fruits per plant (rP=0.3983), fruit dry matter (rP = 0.3940), fruit breadth (rP = 0.3580), fruit protein content (rP = 0.3247), seed weight (rP = 0.3179), days to 1st harvest (rP = 0.2814) and fruit length (rP = 0.2782). Fruit length showed highly significant (at p = 0.01) and negative association with seed weight (rG = -0.5439) and it was significant and negatively associated with fruit breadth (rG = -0.2783) at p = 0.05. Fruit breadth showed highly significant (at p = 0.01) and positive association with average fruit weight (rG = 0.9096), number of seeds per fruit (rG = 0.6404) and seed weight (rG = 0.5341) but showed highly significant (at p = 0.01) and negative association with number of fruits per plant (rG = -0.4993) and number of fruits per infructescence (rG = -0.3568). Average fruit weight showed highly significant (at p = 0.01) and positive correlation with number of seeds per fruit (rG = 0.6718), seed weight (rG = 0.4319) and fruit dry matter (rG = 0.3628) and it was highly significant (at p = 0.01) and negative association with number of fruits per plant (rG = -0.3882) and number of fruits per infructescence (rG = -0.3479). Number of fruits per infructescence showed highly significant (at p = 0.01) and positive association with number of fruits per plant (rG = 0.5193), fruit dry matter (rG = 0.3614) and showed highly significant (at p= 0.01) and negative association with number of seeds per fruit (rG = -0.3556). Fruit yield per plant had highly significant (at p = 0.01) and positively associated with average fruit weight (rG = 0.5487), days to 1st harvest (rG = 0.4359), number of seeds per fruit (rG = 0.4310), fruit dry matter (rG = 0.4051), number of fruits per plant (rG = 0.3899) and fruit breadth (rG = 0.3651) but it was positively and significantly associated with fruit protein content (rG = 0.3286), seed weight (rG = 0.3236) and fruit length (rG = 0.2818) at p = 0.05.

Path co-efficient analysis is useful for the partitioning of correlation co-efficient into direct and indirect effects of various characters on fruit yield. It provides an effective means of finding out direct and indirect causes of association and presents a critical examination of the specific forces acting to produce a given correlation and measures the relative importance of each causal factor. The path co-efficient analysis of different characters on fruit yield based on phenotypic and genotypic correlations in 29 genotypes of brinjal are furnished in Table 7 and 8 respectively. The data pertaining to the phenotypic path co-efficient for following characters are presented in Table 7 and illustrated in Fig 1.

Fruit length had low positive direct effect (0.1949) on fruit yield per plant and it had positive indirect effect via plant height (0.0709), number of fruits per plant (0.0488) and number of fruits per infructescence (0.0430) and it had no positive indirect effect on days to flowering (-0.0252), number of seeds per fruit (-0.0196) and days to 1st harvest (-0.0088).

Fruit breadth had negative direct effect (-0.2269) on fruit yield per plant and it had positive indirect effect through number of fruits per plant (0.1095), number of fruits per infructescence (0.0793) and fruit length (0.0623) and had negative effects via days to flowering (-0.0415), number of primary branches per plant (-0.0213) and ascorbic acid content (-0.0173). Average fruit weight had high positive direct effect (0.9282) on fruit yield per plant and recorded high positive indirect effects via fruit breadth (0.8227), days to 1st harvest (0.6374), number of seeds per fruit (0.6176), seed weight (0.3963) and fruit dry matter (0.3382) and had negative effects via number of fruits per plant (-0.3464) and number of fruits per infructescence (-0.3179). Number of fruits per infructescence had positive direct effect (0.0847) on fruit yield per plant and it had positive indirect effect via number of fruits per plant (0.0429) and fruit dry matter (0.0298) and it had negative indirect effect via days to 1st harvest (-0.0087) and seed weight (-0.0085). Number of fruits per plant had high positive direct effect (0.4589) on fruit yield per plant and it had positive indirect effect via number of fruits per infructescence (0.2327) and fruit length (0.1148). Fruit length had high negative direct effect (-0.3956) on fruit yield per plant and it had positive indirect effect via seed weight (0.2152), fruit breadth (0.1101) and number of primary branches per plant (0.0693) and it had no positive indirect effect on fruit protein content (-0.0798), fruit dry matter (-0.0793) and ascorbic acid content (-0.0512). Fruit breadth had no positive direct effect (-1.3024) on fruit yield per plant and it had high positive indirect effect through number of fruits per plant (0.6502), number of fruits per infructescence (0.4646) and fruit length(0.3624) and had negative effects via days to flowering (-0.2600), number of primary branches per plant (-0.1486) and ascorbic acid content (-0.1007). Average fruit weight had very high positive direct effect (1.8347) on fruit yield per plant and recorded positive indirect effects via days to 1st harvest (2.1594), fruit breadth (1.6688), number of seeds per fruit (1.2326), seed weight (0.7924), fruit dry matter (0.6656), days to 50 per cent flowering (0.3483) and days to flowering (0.3204) and had negative effects via number of fruits per plant (-0.7122), number of fruits per infructescence (-0.6383) and fruit protein content (-0.2563). Number of fruits per infructescence had moderate positive direct effect (0.2930) on fruit yield per plant and it had positive indirect effect via number of fruits per plant (0.1522) and fruit dry matter (0.1059) and it had negative indirect effect via days to 1st harvest (-0.0657) and seed weight (-0.0303). Number of fruits per plant had high positive direct effect (0.3235) on fruit yield per plant and it had positive indirect effect via number of fruits per infructescence (0.1680) and fruit protein content (0.1093) and it had negative indirect effect via seed weight (-0.0347) and plant height (-0.0143).

Table 5: Phenotypic correlation co-efficient for growth, yield and quality characters in brinjal

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.0000	0.0988	0.2355	0.2254	0.0080	0.3639**	-0.1388	0.0340	0.0130	-0.0431	0.0208	-0.1591	-0.0219	-0.1815	-0.0050	-0.0069
2		1.0000	-0.0200	-0.0388	0.1650	-0.1637	0.0939	0.0659	-0.2080	-0.0059	-0.1107	0.0017	-0.3275*	0.0992	-0.0326	0.1353
3			1.0000	0.9954**	0.5239**	-0.1292	0.183	0.1634	0.122	-0.2141	0.0362	0.2475	-0.0003	-0.3437**	-0.3652**	-0.2238
4				1.0000	0.5259**	-0.1486	0.1861	0.1578	0.1467	-0.1991	0.0317	0.2774*	0.0112	-0.3355*	-0.3942**	-0.2119
5					1.0000	-0.0453	0.6789**	0.6867**	-0.1027	-0.2577	0.4647**	0.5412**	0.2496	-0.1776	-0.0385	0.2814*
6						1.0000	-0.2747*	0.0609	0.2208	0.2502	-0.1003	-0.5419**	0.1994	0.2005	0.1292	0.2782*
7							1.0000	0.8864**	-0.3494**	-0.4829**	0.6335**	0.5247**	0.2582	-0.0832	0.0762	0.3580**
8								1.0000	-0.3425**	-0.3732**	0.6654**	0.4269**	0.3643**	-0.1404	0.0085	0.5447**
9									1.0000	0.5070**	-0.3511**	-0.1003	0.3517**	0.0688	0.0477	0.0620
10										1.0000	-0.3016	-0.1087	0.0796	0.3294*	-0.188	0.3983**
11											1.0000	0.5901**	0.3867**	-0.0912	0.0777	0.4256**
12												1.0000	0.2346	-0.2155	-0.1412	0.3179*
13													1.0000	0.0047	0.1841	0.3940**
14														1.0000	-0.003	0.3247*
15															1.0000	-0.0499
16																1.0000

* Significant at 5% ** Significant at 1%

1. Plant height (cm)
2. Number of primary branches per plant
3. Days to first flowering
4. Days to 50 per cent flowering
5. Days to first harvest
6. Fruit length (cm)
7. Fruit breadth (cm)
8. Average fruit weight (g)
9. Number of fruits per infructescence
10. Number of fruits per plant
11. Number of seeds per fruit
12. Seed weight (g)
13. Fruit dry matter (%)
14. Fruit protein content (%)
15. Ascorbic acid content (mg/100g)
16. Fruit yield per plant (kg)

Table 6: Genotypic correlation co-efficient for growth, yield and quality characters in brinjal

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.0000	0.1146	0.2521	0.2514	0.0082	0.3641**	-0.1403	0.0345	0.014	-0.0443	0.0208	-0.1602	-0.0225	-0.1823	-0.0050	-0.0069
2		1.0000	-0.0399	-0.0074	0.4334**	-0.1751	0.1141	0.0677	-0.2261	0.0036	-0.1241	0.0059	-0.3681**	0.1118	-0.0357	0.1589
3			1.0000	0.9248**	0.9047**	-0.1431	0.1996	0.1747	0.1337	-0.2474	0.0357	0.2619	0.0069	-0.3829**	-0.3950**	-0.2450
4				1.0000	0.8062**	-0.1623	0.2134	0.1898	0.1546	-0.2358	0.0414	0.3063*	0.0286	-0.3750**	-0.4453**	-0.2613
5					1.0000	-0.0655	0.9079**	0.9177**	-0.2241	-0.4627**	0.7596**	0.8704**	0.4513**	-0.3020	-0.0628	0.4359**
6						1.0000	-0.2783*	0.0606	0.2239	0.2556	-0.1003	-0.5439**	0.2006	0.2016	0.1293	0.2818*
7							1.0000	0.9096**	-0.3568**	-0.4993**	0.6404**	0.5341**	0.2694*	-0.0895	0.0773	0.3651**
8								1.0000	-0.3479**	-0.3882**	0.6718**	0.4319**	0.3628**	-0.1397	0.0086	0.5487**
9									1.0000	0.5193**	-0.3556**	-0.1033	0.3614**	0.0707	0.0481	0.0591
10										1.0000	-0.3081*	-0.1073	0.0862	0.3378*	-0.1922	0.3899**
11											1.0000	0.5924**	0.3933**	-0.0925	0.0779	0.4310**
12												1.0000	0.2389	-0.2170	-0.1416	0.3236*
13													1.0000	0.0086	0.1860	0.4051**
14														1.0000	-0.0029	0.3286*
15															1.0000	-0.0502
16																1.0000

* Significant at 5% ** Significant at 1%

1. Plant height (cm)
2. Number of primary branches per plant
3. Days to first flowering
4. Days to 50 per cent flowering
5. Days to first harvest
6. Fruit length (cm)
7. Fruit breadth (cm)
8. Average fruit weight (g)
9. Number of fruits per infructescence
10. Number of fruits per plant
11. Number of seeds per fruit
12. Seed weight (g)
13. Fruit dry matter (%)
14. Fruit protein content (%)
15. Ascorbic acid content (mg/100g)
16. Fruit yield per plant (kg)

Table 7: Phenotypic path co-efficient analysis for fruit yield per plant and its components in brinjal

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	rP
1	-0.0279	-0.0028	-0.0066	-0.0063	-0.0002	-0.0101	0.0039	-0.0009	-0.0004	0.0012	-0.0006	0.0044	0.0006	0.0051	0.0001	-0.0069
2	0.0192	0.1943	-0.0039	-0.0075	0.0321	-0.0318	0.0182	0.0128	-0.0404	-0.0011	-0.0215	0.0003	-0.0637	0.0193	-0.0063	0.1353
3	-0.1908	0.0162	-0.8101	-0.8064	-0.4244	0.1046	-0.1482	-0.1324	-0.0988	0.1735	-0.0293	-0.2005	0.0003	0.2785	0.2958	-0.2238
4	0.1675	-0.0288	0.7398	0.7432	0.3909	-0.1105	0.1383	0.1173	0.1090	-0.1480	0.0236	0.2062	0.0083	-0.2494	-0.2930	-0.2119
5	-0.0020	-0.0406	-0.1289	-0.1294	-0.2461	0.0111	-0.1671	-0.1690	0.0253	0.0634	-0.1144	-0.1332	-0.0614	0.0437	0.0095	0.2814*
6	0.0709	-0.0319	-0.0252	-0.0290	-0.0088	0.1949	-0.0535	0.0119	0.0430	0.0488	-0.0196	-0.1056	0.0389	0.0391	0.0252	0.2782*
7	0.0315	-0.0213	-0.0415	-0.0422	-0.1540	0.0623	-0.2269	-0.2011	0.0793	0.1095	-0.1437	-0.1190	-0.0586	0.0189	-0.0173	0.3580**
8	0.0315	0.0612	0.1517	0.1465	0.6374	0.0566	0.8227	0.9282	-0.3179	-0.3464	0.6176	0.3963	0.3381	-0.1303	0.0079	0.5447**
9	0.0011	-0.0176	0.0103	0.0124	-0.0087	0.0187	-0.0296	-0.0290	0.0847	0.0429	-0.0297	-0.0085	0.0298	0.0058	0.0040	0.0620
10	-0.0198	-0.0027	-0.0983	-0.0914	-0.1183	0.1148	-0.2216	-0.1713	0.2327	0.4589	-0.1384	-0.0499	0.0365	0.1512	-0.0863	0.3983**
11	0.0023	-0.0125	0.0041	0.0036	0.0523	-0.0113	0.0712	0.0748	-0.0395	-0.0339	0.1125	0.0664	0.0435	-0.0103	0.0087	0.4256**
12	-0.0503	0.0005	0.0782	0.0877	0.1710	-0.1712	0.1658	0.1349	-0.0317	-0.0344	0.1865	0.3160	0.0741	-0.0681	-0.0446	0.3179*
13	0.0000	0.0007	0.0000	0.0000	-0.0006	-0.0004	-0.0006	-0.0008	-0.0008	-0.0002	-0.0009	-0.0005	-0.0022	0.0000	-0.0004	0.3940**
14	-0.0402	0.0220	-0.0761	-0.0743	-0.0393	0.0444	-0.0184	-0.0311	0.0152	0.0729	-0.0202	-0.0477	0.0010	0.2214	-0.0007	0.3247*
15	-0.0002	-0.0015	-0.0173	-0.0187	-0.0018	0.0061	0.0036	0.0004	0.0023	-0.0089	0.0037	-0.0067	0.0087	-0.0001	0.0474	-0.0499

Residual effect = 0.3679 * Significant at 5% ** Significant at 1% rP = Phenotypic correlation with fruit yield per plant,
Direct effect values at diagonal and others are indirect effect on fruit yield per plant

1. Plant height (cm)
2. Number of primary branches per plant
3. Days to first flowering
4. Days to 50 per cent flowering
5. Days to first harvest
6. Fruit length (cm)
7. Fruit breadth (cm)
8. Average fruit weight (g)
9. Number of fruits per infructescence
10. Number of fruits per plant
11. Number of seeds per fruit
12. Seed weight (g)
13. Fruit dry matter (%)
14. Fruit protein content (%)
15. Ascorbic acid content (mg/100g)

Table 8: Genotypic path co-efficient analysis for fruit yield per plant and its components in brinjal

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	rG
1	0.0534	0.0061	0.0135	0.0134	0.0004	0.0194	-0.0075	0.0018	0.0007	-0.0024	0.0011	-0.0085	-0.0012	-0.0097	-0.0003	-0.0069
2	0.0053	0.0460	-0.0018	-0.0003	0.0199	-0.0081	0.0053	0.0031	-0.0104	0.0002	-0.0057	0.0003	-0.0169	0.0051	-0.0016	0.1589
3	-0.0479	0.0076	-0.1898	-0.2369	-0.1987	0.0272	-0.0379	-0.0332	-0.0254	0.0470	-0.0068	-0.0497	-0.0013	0.0727	0.0750	-0.2450
4	-0.0328	0.0010	-0.1629	-0.1305	-0.1052	0.0212	-0.0279	-0.0248	-0.0202	0.0308	-0.0054	-0.0400	-0.0037	0.0489	0.0581	-0.2613
5	0.0012	0.0619	0.1495	0.1151	0.1428	-0.0094	0.1542	0.1681	-0.0320	-0.0661	0.1085	0.1243	0.0645	-0.0431	-0.0090	0.4359**
6	-0.1441	0.0693	0.0566	0.0642	0.0259	-0.3956	0.1101	-0.0240	-0.0886	-0.1011	0.0397	0.2152	-0.0793	-0.0798	-0.0512	0.2818*
7	0.1827	-0.1486	-0.2600	-0.2780	-1.4057	0.3624	-1.3024	-1.1846	0.4646	0.6502	-0.8340	-0.6956	-0.3509	0.1165	-0.1007	0.3651**
8	0.0633	0.1243	0.3204	0.3483	2.1594	0.1112	1.6688	1.8347	-0.6383	-0.7122	1.2326	0.7924	0.6656	-0.2563	0.0157	0.5487**
9	0.0041	-0.0663	0.0392	0.0453	-0.0657	0.0656	-0.1045	-0.1019	0.2930	0.1522	-0.1042	-0.0303	0.1059	0.0207	0.0141	0.0591
10	-0.0143	0.0012	-0.0800	-0.0763	-0.1497	0.0827	-0.1615	-0.1256	0.1680	0.3235	-0.0997	-0.0347	0.0279	0.1093	-0.0622	0.3899**
11	0.0025	-0.0148	0.0042	0.0049	0.0903	-0.0119	0.0762	0.0799	-0.0423	-0.0366	0.1189	0.0705	0.0468	-0.0110	0.0093	0.4310**
12	-0.0136	0.0005	0.0222	0.0260	0.0738	-0.0461	0.0453	0.0366	-0.0088	-0.0091	0.0503	0.0848	0.0203	-0.0184	-0.0120	0.3236*
13	0.0018	0.0299	-0.0006	-0.0023	-0.0367	-0.0163	-0.0219	-0.0295	-0.0294	-0.0070	-0.0320	-0.0194	-0.0813	-0.0007	-0.0151	0.4051**
14	-0.0683	0.0419	-0.1434	-0.1404	-0.1131	0.0755	-0.0335	-0.0523	0.0265	0.1265	-0.0347	-0.0813	0.0032	0.3745	-0.0011	0.3286*
15	-0.0002	-0.0011	-0.0122	-0.0137	-0.0019	0.0040	0.0024	0.0003	0.0015	-0.0059	0.0024	-0.0044	0.0057	-0.0001	0.0308	-0.0502

Residual effect = 0.3460 * Significant at 5% ** Significant at 1% rG = Genotypic correlation with fruit yield per plant
Direct effect values at diagonal and others are indirect effect on fruit yield per plant

1. Plant height (cm)
2. Number of primary branches per plant
3. Days to first flowering
4. Days to 50 per cent flowering
5. Days to first harvest
6. Fruit length (cm)
7. Fruit breadth (cm)
8. Average fruit weight (g)
9. Number of fruits per infructescence
10. Number of fruits per plant
11. Number of seeds per fruit
12. Seed weight (g)
13. Fruit dry matter (%)
14. Fruit protein content (%)
15. Ascorbic acid content (mg/100g)

Conclusion

The characters *viz*., plant height, fruit pedicel length, fruit length, fruit breadth, average fruit weight, number of fruits per infructescence, fruit yield per plant, number of fruits per plant, number of seeds per fruit, seed weight, fruit to seed ratio and soluble sugars were recorded high GCV, PCV, heritability and GAM. Hence, these characters had lot of variability with additive gene actions. Therefore, these traits can be improved by simple selection. Fruit yield per plant was positively and significantly associated with average fruit weight, fruit length, fruit breadth, number of fruits per plant, number of seeds per fruit, seed weight, fruit dry matter and fruit protein content. These characters have to be considered while selecting the genotypes for fruit yield per plant. These characters also recorded high direct effect on fruit yield per plant.

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