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Genetic variability studies for seed quality in eggplant genotypes

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Abstract
The current experiment was conducted at College of Horticulture, Mudigere under lab condition to assess the genetic variability for seed quality traits in nineteen eggplant genotypes. Analysis of variance indicated significant variation for all the characters at $p \geq 5$ *per cent* and $p \geq 1$ *per cent.* All the parameters *viz.*, days taken for germination, germination (%), shoot length (cm), root length (cm), root to shoot ratio, seedling fresh weight (mg), seedling dry weight (mg), seedling vigour index-I and seedling vigour index-II had shown high phenotypic and genotypic coefficient of variation and high broad sense heritability tied with high genetic advance over mean. The results indicated that there is high genetic constitution of seed influence on particular trait exhibition with less environmental factor impact. Hence, selection at seed germination level would be effective for improvement and there is ample scope for isolation of promising eggplant genotypes from the present incurred plant material.

Keywords: heritability, genetic advance, germination, shoot length, vigour index-I

Introduction

Brinjal (*Solanum melongena* L.) is a plant species in the nightshade family *Solanaceae* belongs to the genus *solanum* having a chromosome number of 2n=24. The eggplant is a delicate, tropical perennial plant often cultivated as a tender or half-hardy annual in a temperate climate. Eggplant is originated in India where the major domestication of large fruited cultivars occurred (Vavilov, 1928) [14]. It is a self-pollinated and herbaceous plant. However, it shows cross-pollination to the extent reported as high as forty-eight per cent; hence, it is classified under often cross-pollinated crops (Ravali *et al.*, 2017) [13].

In India, the incredible eggplant is delicious and eaten as a variety of dishes. No wonder it is The King of Vegetables popularly called as baingan. Like tomatoes, potatoes and peppers, brinjal is high in fiber and low in calories (25 calories/100g). Brinjal fruit is good source of minerals and vitamins and is rich in total water soluble sugars, free reducing sugars, fats and amide proteins (Gopalan *et al.*, 2007) [7]. Eggplant is rich in minerals as well as vitamins like thiamin (124IU), niacin, pantothenic acid and polacin as compare to tomato (Chauhan, 1981) [4].

Seeds fundamentally are the means of reproduction, and most seeds are the product of sexual reproduction, which produces a remixing of genetic material and phenotype variability on which natural selection acts. Thus, the seed is a basic material for identifying variation. Low germination percentage, slow rate and lacking in seedling growth are common problems in most horticultural crops. Like other crops, brinjal (*Solanum melongena* L.) also suffers differently due to lack of germination of seeds and delay in germination, which affects the growth and development of crop plants. Good seedling establishment under some stress conditions may ensure good crop growth as well as better yield (Nayak and Patra, 2000) [11]. The present research was planned to investigate genetic variability components of seed quality traits in brinjal genotypes under laboratory conditions for better crop and establishment.

Material and Methods

Present investigation was conducted at Genetics and Plant Breeding laboratory, College of Horticulture, Mudigere. The *in vitro* validation for presence of genetic variability in nineteen eggplant genotypes was carried out in a complete randomized experimental design. Twenty seeds per replication per genotype were sown in petri-plate containing germination paper disc. The seeds were moistened with distilled water in alternative days. *In vitro* experiment was done in tissue culture laboratory with a controlled environmental condition of temperature 25 ± 2^0c and relative humidity of about 95±2 % as well as 320 µmol/m^{2}s of light luminosity. The observations were taken at 15 days after sowing except for number of days for germination.

Laboratory test was conducted as per ISTA rules (*Anon.*, 1999) [2] wherein the germination test was conducted with 60 seeds for three replications for each treatment in germination paper placed in petri-plates. Normal seedlings were counted and expressed as germination percentage. First and final counts of germination were recorded on 4th and 7th day respectively.

The seed quality parameters like germination (%), shoot length (cm), root length (cm), seedling fresh weight (g) and seedling dry weight (g) were recorded at 15 days after sowing. Root to shoot ratio was calculated using formula given below.

$$\text{Root to shoot ratio} = \frac{\text{Length of root (cm)}}{\text{Length of shoot (cm)}}$$

The seedling vigour index I and vigour index II values were calculated as per the method prescribed by Abdul-Baki and Anderson (1972) [1] and expressed in whole number.

$$\text{Seedling vigour index I} = \text{Germination \%} \times \text{Seedling length (cm)}$$

$$\text{Seedling vigour index II} = \text{Germination \%} \times \text{Seedling dry weight (g)}$$

Results and Discussion

The examination of variation (Table 1) of brinjal genotypes for seed quality parameter demonstrated that the mean total sum of squares because of genotypes were profoundly noteworthy for all the observations *viz.*, days taken for germination, germination (%), shoot length (cm), root length (cm), root to shoot ratio, seedling fresh weight (mg), seedling dry weight (mg), seedling vigour index-I and seedling vigour index-II were shown significant at 5 *per cent* and 1 *per cent* level of probability. The *per se* performance of all the genotypes for nine different characters were mentioned in Table 2.

Extent of genetic variability observed for all the attributes (Table 3 and figure 1) demonstrated the nearness of adequate measure of variety among the genotypes for all the characters considered. The range in the qualities mirrors the measure of phenotypic inconstancy which is not entirely solid since it incorporates genotypic, environment and genotypic x environmental association factors and does not uncover as which component is indicating further extent of variation. Further, the phenotype of yield is impacted by additive gene effect (heritable), dominance (non-heritable) and epistatic (non-allelic interaction).

In any case, even these don't give important gauge to the degree of inheritance of the characters. Therefore, heritability of characters can be depended upon as it empowers the plant reproducer to choose the degree of determination strain to be applied under a specific domain, which isolates out the environmental influence from the total variability. Nevertheless, its utilization would be constrained as this is inclined to change with environment and material. The estimation of heritability has a more noteworthy task to carry out in deciding the adequacy of choice for a character, if it is considered related to the anticipated hereditary development as recommended by Panse and Sukhatme (1957) and Johnson *et al.* (1955) [8] as the heritability is impacted by biometrical technique, generation of hybrid, sample size of experimental material and environment.

In the present investigation, GCV ranged from 21.40 to 58.30 *per cent*. High estimate of GCV was observed for seedling vigour index-I (58.30 %) followed by seedling vigour index-II (56.10 %), germination percentage (45.70 %), root to shoot ratio (38.52 %), root length (36.41 %), seedling fresh weight (24.80 %), seedling dry weight (23.23 %), days taken for germination (22.94 %) and shoot length (21.40 %). PCV ranged from 21.74 to 58.61 *per cent*. High estimate of PCV was observed for seedling vigour index-I (58.61 %) followed by seedling vigour index-II (56.26 %), germination percentage (46.07 %), root to shoot ratio (38.93 %), root length (36.62 %), seedling fresh weight (25.39 %), seedling dry weight (23.55 %), days taken for germination (23.24 %) and shoot length (21.74 %).

The high GCV and PCV value is due to presence of high genetic variation among the eggplant genotypes these results suggested that mainly additive gene effects govern the inheritance of such characters and therefore, selection based on phenotypic performance may prove useful. Similar results were also reported by Babu *et al.* (2016) [3], Kumar *et al.* (2017) [10], Gobu *et al.* (2017) [6], Kulkarni and Deshpande (2017) and Gatade (2018) [5] in Okra.

Heritability ranged from 95.42 to 99.42 *per cent*. High estimates of heritability was observed for seedling vigour index-II (99.42 %), seedling vigour index-I (98.93 %) followed by root length (98.85 %), germination percentage (98.43 %), root to shoot ratio (97.90 %), days taken for germination (97.48 %), seedling dry weight (97.28 %), shoot length (96.93 %) and seedling fresh weight (95.42 %). The values for genetic advance as *per cent* mean (GAM) were ranged from 43.40 to 119.45 *per cent*. The height estimates of genetic advances as *per cent* mean (GAM) was found for seedling vigour index-I (119.45 %) followed by seedling vigour index-II (115.23 %), germination percentage (93.40 %), root to shoot ratio (78.51 %), root length (74.57 %), seedling fresh weight (49.90 %), seedling dry weight (47.20 %), days taken for germination (46.67 %) and shoot length (43.40 %). High heritability coupled with high genetic advance over mean was reported for number of days taken for germination, germination (%), shoot length (cm), root length (cm), root to shoot ratio, seedling fresh weight (mg), seedling dry weight (mg), seedling vigour index-I, seedling vigour index-II. The results indicate that the variation in a character is mainly due to additive gene action. Thus, there is ample scope for improving these characters with direct selection. Similar findings reported by Babu *et al.* (2016) [3], Kumar *et al.* (2017) [10], Gobu *et al.* (2017) [6], Kulkarni and Deshpande (2017) and Gatade (2018) [5] in Okra.

Table 1: Analysis of Variance (ANOVA) for seed quality traits in nineteen brinjal genotypes

SL. NO.	Source of Variation/ Characters	Genotypes	Error	S. Em±	CD at 5%	CD at 1%
	Degrees of freedom	**18**	**38**			
1.	Days taken for germination	2.08*	0.02	0.08	0.22	0.30
2.	Germination (%)	1332.54**	7.07	1.54	4.39	5.89
3.	Shoot length (cm)	1.70**	0.02	0.08	0.22	0.30
4.	Root length (cm)	4.01**	0.02	0.07	0.21	0.28
5.	Root to shoot ratio	0.36*	0.003	0.03	0.08	0.11
6.	Seedling fresh weight (mg)	830.08**	13.08	2.09	5.98	8.01
7.	Seedling dry weight (mg)	4.27**	0.04	0.11	0.33	0.44
8.	Seedling vigour index-I	103085.39**	371.54	11.13	31.86	42.68
9.	Seedling vigour index-II	62667.08**	122.17	6.38	18.27	24.47

Where, *****and ****** indicates significance at 5 % and 1 % level respectively.

Table 2: *Per se* performance of eggplant genotypes under *in vitro* for different seed quality attributes

Genotypes	Days taken for germination	Germination (%)	Shoot length (cm)	Root length (cm)	Root to shoot ratio	Seedling fresh weight (mg)	Seedling Dry weight (mg)	Seedling Vigour index-I	Seedling Vigour index-II
Mallapur local	3.33	44.49	3.30	2.23	0.68	86.11	6.67	246.51	311.55
Mattigulla round	3.00	66.73	3.87	2.27	0.59	91.52	4.33	409.66	303.60
JB-15	3.00	19.07	2.47	4.03	1.63	40.04	3.33	123.99	66.70
Arka Shirish	3.00	63.56	4.40	3.07	0.70	62.92	6.67	475.15	445.01
IC-5884	4.33	50.84	3.67	1.97	0.54	58.15	4.33	286.65	231.30
Coorg local	3.33	17.47	3.50	4.97	1.42	72.77	5.67	148.11	103.98
Erangere	3.00	41.31	2.53	2.40	0.95	38.13	3.00	203.90	130.06
Madhurai-2	5.33	9.53	2.33	2.33	1.00	45.28	4.00	44.53	40.03
IC-354597	3.00	30.19	3.97	2.60	0.65	80.08	5.00	198.41	158.47
Mudigere local-1	3.33	27.01	3.10	5.60	1.81	55.93	4.33	235.20	122.88
Bhagyamati	3.67	63.56	3.43	3.10	0.90	72.45	7.33	415.59	489.31
Pusa Kranti	5.00	63.56	3.90	3.23	0.83	64.83	5.67	453.76	378.11
Mandya local	4.33	60.37	3.77	2.70	0.72	75.31	6.33	390.78	401.46
Mudigere Local-2	3.67	65.14	4.70	1.97	0.42	74.05	6.33	434.67	433.15
CARI	5.33	42.90	2.57	2.17	0.84	43.85	5.67	203.23	255.22
Dommeru Vanga	3.00	69.91	4.53	5.20	1.15	78.17	4.33	681.06	318.05
Arka Neelakanta	3.00	36.54	3.60	3.53	0.98	82.30	4.67	260.91	179.04
R-2590	3.00	20.66	2.47	2.33	0.94	55.77	4.47	99.23	96.86
Kudchi local	3.00	81.03	4.37	4.50	1.03	86.75	5.00	719.12	425.37
Hiriyur local	3.33	44.49	3.30	2.23	0.68	86.11	6.67	246.51	311.55
Poluru Vanga 35	3.00	66.73	3.87	2.27	0.59	91.52	4.33	409.66	303.60
JB-64	3.00	19.07	2.47	4.03	1.63	40.04	3.33	123.99	66.70
Pusa Shyamala	3.00	63.56	4.40	3.07	0.70	62.92	6.67	475.15	445.01
S. Em±	0.08	1.54	0.08	0.07	0.03	2.09	0.11	11.13	6.38
CD at 5%	0.22	4.39	0.22	0.21	0.08	5.98	0.33	31.86	18.27
CD at 1%	0.3	5.89	0.3	0.28	0.11	8.01	0.44	42.68	24.47

Table 3: Mean, range, genetic components of variance, heritability and genetic advance for seed quality parameters in Brinjal

Characters	Mean	Range		PCV (%)	GCV (%)	h^2 (%)	GAM (%)
		Min.	Max.				
Days taken for germination	3.61	3.00	5.33	23.24	22.94	97.48	46.67
Germination (%)	45.99	9.53	81.03	46.07	45.70	98.43	93.40
Shoot length (cm)	3.50	2.33	4.70	21.74	21.40	96.93	43.40
Root length (cm)	3.17	1.97	5.60	36.62	36.41	98.85	74.57
Root to shoot ratio	0.94	0.42	1.81	38.93	38.52	97.90	78.51
Seedling fresh weight (mg)	66.55	38.13	91.52	25.39	24.80	95.42	49.90
Seedling dry weight (mg)	5.11	3.00	7.33	23.55	23.23	97.28	47.20
Seedling vigour index-I	317.39	44.53	719.12	58.61	58.30	98.93	119.45
Seedling vigour index-II	257.38	40.03	489.31	56.26	56.10	99.42	115.23

Where, GCV: Genotypic coefficient variation, PCV: Phenotypic coefficient variation, h^2: Heritability in broad see, GA : Genetic advance, GAM : Genetic advance as per cent mean

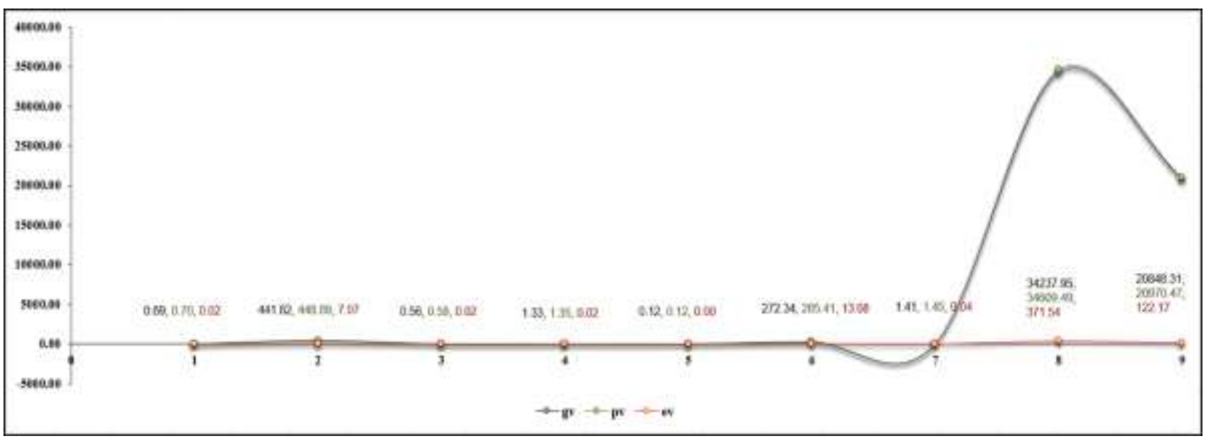

Fig 1: Estimate of genotypic, phenotypic and environmental variance for seed quality parameters in brinjal

Where,
1. Days taken for germination, 2. Germination (%), 3. Shoot length (cm), 4. Root length (cm), 5. Root to shoot ratio, 6. Seedling fresh weight (mg), 7. Seedling dry weight (mg), 8. Seedling vigour index-I, 9. Seedling vigour index-II

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