



Genetic variability in eggplant (*Solanum melongena* L.)

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Abstract: The present investigation was during *Kharif* 2012, with objectives to assess variability, heritability and genetic advance for quantitative characters. Experimental material for the study was consisted of 46 genotypes of eggplant pertaining to four groups including five checks (Arka Nidhi, NDB-2, SM-6-6 Pant Rituraj and KS-224). The experiment was conducted in Randomized Complete Block Design with three replications. Each treatment consisted of 20 plants in two rows, having spacing of 60x45cm with net plot size of 4.5x1.2m². Observations were recorded on 11 quantitative characters *viz.*, days to 50% flowering, primary branches per plant, plant height (cm), fruit weight (g), fruit circumference (cm), flowers per inflorescence, fruit length (cm), fruits per plant, marketable fruit yield per plant (kg), unmarketable fruit yield per plant (kg) and total fruit yield per plant (kg). The analysis of variance for the design of experiment indicated highly significant differences among the genotypes for all the traits. Based on mean performance of genotypes NDB-216 for long purple and NDB-252 for round purple fruit were found as most promising genotypes for total fruit yield per plant. High magnitude of variability (GCV and PCV) was observed in case of unmarketable fruit yield per plant followed by fruit circumference, marketable fruit yield per plant, fruits per plant, total fruit yield per plant and primary branches per plant. Days to 50% flowering exhibited low value of variability. High heritability coupled with high genetic advance in percent of mean were recorded for fruit circumference, fruit length, fruit weight, primary branches per plant, total fruit yield per plant and marketable fruit yield per plant indicating opportunity for selection response.

Key words: Brinjal or egg plant (*Solanum melongena* L.), GCV, PCV, Heritability, Genetic advance

Introduction

Brinjal or egg plant (*Solanum melongena* L.) is one of the most important solanaceous vegetable crop having diploid chromosome number $2n=2x=24$. It is worldwide known as aubergine or guinea squash which is one of the most popular and major vegetable crop in India and other parts of the world. It is probably originated in India and showed secondary diversity in South East Asia. It is being grown extensively in India, Bangladesh, Pakistan, China, Japan, Philippines, France, Italy and U.S.A. In Southern Europe, brinjal is a staple vegetable and it is a favorite dish in South East of France. Brinjal has got much potential as raw material in pickle making and dehydration industries. It is highly productive and usually finds its place as the poor man's vegetable. In India, it is being consumed as a cooked vegetable in many ways and is liked by both poor and rich. Year round availability, easy culture, moderate to high yield and consumption in varieties of ways like salad, bhaji, stuffed brinjal, bharta, chatni, pickles etc., has made brinjal the king of vegetables in India. Further, in recent years brinjal is being exported in the form of products like *baingan bharta*, *chatni*, *pickles* etc. to Middle East countries.

Brinjal contain certain medicinal properties like white brinjal is said to be good for diabetic patients (Choudhary, 1976). It can cure toothache if fried egg plant fruit in til oil is taken (Chen and Li, 1996). It has also been recommended as an excellent remedy for those suffering from liver complaint. One hundred gram edible portion

of brinjal fruit contains 92.7% moisture, 24.0% calories, 4.0% carbohydrates, 1.4 g protein, 0.3 g fats, 1.3 g fibres, 124.0 (I.U.) Vitamin A and 12.0 mg Vitamin C (Chen and Li, 1996). It also contains 52.0 mg chlorine, 47.0 mg Phosphorus, 44.0 mg sulphur and other minerals (Aykroyd, 1963).

Brinjal being most important to growers and consumer, there is pressing need to increase its productivity to fulfill the increasing demands throughout the year. The information usually needed for developing high yielding varieties in a particular species pertains to the extent of genetic variability for desirable traits in the available germplasm. Evaluation of germplasm is the basic tool for identification of important genotypes. The great extent of natural variation present in various characters among the genotypes suggests good scope of improvement in economic traits. Large variability ensures better chance of producing new forms. Variability parameters like genotypic and phenotypic coefficients of variation, heritability and genetic advance are of paramount significance in formulating an appropriate breeding strategy aimed at exploiting the inherent variability of the original population.

Phenotypic variability changes under different environmental conditions while genetic variability remains unchanged and more useful to a plant breeder for exploitation in selection or hybridization. Yield is very complex characteristics controlled by several yield contributing components and it is highly influenced by environmental factors, consequently estimates of heritability and genetic advance

are useful for selection. Keeping in view of the above theme, the present investigation was under taken during autumn - winter season 2012, with the objectives to assess variability, heritability and genetic advance for the quantitative characters.

Material and Methods

The experiment was conducted in Randomized Complete Block Design with three replications at MES, department of Vegetable Science, Narendra Deva University of Agriculture and Technology Kumarganj, Faizabad (UP) India during autumn-winter season in 2012 to assess the performance of 46 genotypes of brinjal. Each treatment consisted of two rows. Ten plants were maintained in each row and replicated thrice. Transplanting was done at a spacing of 60 cm between row to row and 45 cm plant to plant having net plot size of 4.5x1.2 m². The seed were sown in nursery bed on 03-08-2012 and transplanted on 08-09-2012. All the recommended agronomic package of practices and plant protection measures were followed to raise a good crop. The analysis of variances was worked out as per methods suggested by Panse and Sukhatme (1967), genetic variability and heritability as per Burton and de Vane (1953) and genetic advance Johnson *et al.* (1955).

Result and Discussion

The analysis of variance for different characters is presented in Table 1. The mean squares due to genotypes were highly significant for all the characters. In other words, the performances of the genotypes with respect of these characters were statistically different; suggesting that, there exists ample scope for selection in different traits for brinjal improvement. In order to evaluate the listed genotypes the mean of forty six genotypes including check for eleven characters has been presented in Table 2. A very wide range of variations in mean performance of genotypes were observed for all the characters under study. The comparison of mean performance of 46 genotypes for eleven traits using critical differences revealed existence of very high level of variability in the used genotypes. The genotype NDB-216 (2.85 kg) significantly out yielded in respect of all genotypes as well as check in case of long purple and long green groups and also showed high mean performance for fruits per plant. This genotype also showed high

mean performance for some other characters as well. The genotypes NDB-252 (3.36 kg) produced higher yield per plant than the best check Pant Rituraj (2.49 kg) in case of round purple groups. Among green round groups genotype NDB-251 (2.64 kg) was found superior for total fruit yield per plant.

The estimate of genotypic coefficient of variation is of prime importance to breeder because genetic variance alone, does not allow a decision as to which characters were showing the highest degree of variability. Therefore, accurate relative comparison can be made with the help of phenotypic and genotypic coefficients of variation. In general, the phenotypic coefficients of variability was higher than the genotypic coefficients of variability for all the characters under study which indicates that environment played very important role in the expression of the traits. The highest phenotypic and genotypic coefficient of variation was observed for unmarketable fruit yield per plant, marketable fruit yield per plant and total fruit yield per plant (Table 3). Islam and Uddin (2009) Thangavel *et al.* (2011); Kumar *et al.* (2012) and Kumar *et al.* (2013) also reported similar results in their studies. Moderate PCV and GCV were estimated for fruits per plant, yield per plant and primary branches per plant. The phenotypic and genotypic coefficients of variations were lower for days to 50% flowering. It may be due to the fact that the environment influenced the observed variance. Such influences were also evident for genotypic coefficient of variation. Genotypic coefficient of variation ranged from 10.26 (days to 50% flowering) to 68.49 (fruits per plant). Similar result was also reported by Ansari (2011).

Heritability in broad sense of a character is important to the breeder since it indicates the possibility and extent to which improvement is possible through selection. It also indicates direction of selection pressure to be applied for a trait during selection because it measures relationship between parents and their progeny, hence widely used in determining the degree to which a character may be transmitted from parents to offspring. However, high heritability alone is not enough to make efficient selection in advanced generation unless accompanied by substantial amount of genetic advance (Burton, 1952). High estimates of heritability along with high genetic

Table-1: Analysis of variance (mean squares) for eleven quantitative characters in brinjal germplasm

Characters	Source of variation		
	Replication	Treatments	Error
	<i>d.f.</i>	2	45
Days to 50% flowering	2.115	49.169**	4.027
Plant height (cm)	1.411	190.977**	8.144
Primary branches per plant	0.016	3.448**	0.105
Flowers per inflorescence	0.211	3.842**	0.167
Polar length of fruit (cm)	0.408	27.060**	0.607
Fruit circumference (cm)	0.502	89.669**	1.832
Fruits per plant	4.146	21.622**	2.256
Fruit weight (g)	140.760	3678.154**	91.85
Marketable fruit yield per plant(kg)	0.117	0.639**	0.054
Unmarketable fruit yield per Plant(kg)	0.004	0.022**	0.010
Total fruit yield per plant(kg)	0.126	0.677**	0.045

* = Significant at 5 per cent probability level, ** - Significant at 1 per cent probability level.

Table-2: Mean performance of forty six genotypes for eleven characters in brinjal

Group of Genotypes	Sl. No.	Characters Genotypes	Days to 50% flowering	Plant height (cm)	Primary branches per plant	Flowers per inflorescence	Polar length of fruit (cm)	Fruit - circumference (cm)	Fruits per plant	Fruit weight (g)	Marketable fruit yield / plant (kg)	Unmarketable fruit yield / plant (kg)	Total fruit yield per plant (kg)
Long purple	1.	NDB-216	51.67	67.50	4.80	6.13	14.13	10.30	14.67	156.67	2.54	0.31	2.85
	2.	NDB-220	51.67	89.33	7.27	5.87	22.07	18.70	15.52	151.67	2.230	0.19	2.42
	3.	NDB-221	51.67	75.53	4.50	6.33	20.50	17.03	14.63	140.00	2.35	0.15	2.50
	4.	NDB-223	50.33	66.50	6.63	5.50	19.67	15.77	17.00	145.33	2.21	0.26	2.47
	5.	NDB-228	51.67	58.13	4.07	5.00	16.97	18.70	10.92	145.00	1.61	0.12	1.73
	6.	NDB-230	54.00	62.63	4.73	3.67	13.47	17.50	15.79	133.33	2.39	0.11	2.50
	7.	NDB-231	54.00	66.33	3.47	6.90	13.27	12.83	10.67	133.33	1.43	0.15	1.58
	8.	NDB-235	46.00	83.03	6.87	4.73	17.50	11.25	9.43	166.67	1.47	0.22	1.69
	9.	NDB-236	54.00	70.43	4.27	6.83	25.30	14.80	11.20	164.33	1.45	0.11	1.56
	10.	NDB-238	60.33	69.67	3.83	7.17	12.97	16.37	13.34	146.67	2.01	0.10	2.11
	11.	NDB-239	61.33	72.27	3.70	4.93	17.40	10.73	10.97	133.33	1.51	0.12	1.62
	12.	NDB-240	51.00	72.17	4.33	7.43	17.90	12.43	11.75	163.33	1.95	0.11	2.06
	13.	NDB-243	57.00	66.40	5.33	7.87	15.63	9.67	10.00	113.33	1.00	0.18	1.17
	14.	NDB-246	52.67	70.13	4.77	5.83	14.60	14.20	11.33	150.33	2.04	0.12	2.16
	15.	Siliguri	55.00	80.33	4.97	6.93	19.54	21.50	12.67	155.00	1.87	0.13	1.96
	16.	Neelam	48.67	78.77	5.37	5.40	15.67	12.00	14.57	174.00	2.39	0.47	2.57
17.	Arka Nidhi(c)	52.00	76.10	6.20	7.93	20.50	12.80	13.50	135.00	1.67	0.13	1.80	
18.	NDB-2(C)	51.00	65.77	4.70	5.97	20.50	12.83	17.22	131.67	2.11	0.13	2.28	
19.	NDB-215	56.00	83.67	6.77	5.17	18.23	17.57	15.17	153.33	2.26	0.31	2.57	
20.	NDB-218	53.00	66.67	5.67	4.73	13.33	11.77	16.37	141.67	2.41	0.18	2.66	
21.	NDB-222	50.67	67.63	5.03	5.53	18.23	14.37	20.67	95.00	2.02	0.21	2.23	
22.	NDB-224	55.33	88.40	4.27	7.67	15.53	9.70	15.67	140.00	2.22	0.16	2.38	
23.	NDB-225	50.67	90.33	7.33	6.33	18.80	13.80	14.33	106.67	1.52	0.11	1.63	
24.	NDB-232	61.67	62.90	4.40	6.00	14.67	15.24	9.95	115.00	1.14	0.11	1.24	
25.	NDB-233	56.33	65.00	3.33	7.93	17.93	13.50	11.56	128.33	1.84	0.14	1.99	
26.	NDB-241	52.67	83.30	5.07	7.73	14.57	11.43	14.82	165.00	2.43	0.12	2.55	
27.	NDB-242	56.33	65.37	4.40	7.97	10.93	17.33	14.33	166.00	2.42	0.12	2.54	
28.	NDB-244	53.00	70.43	4.63	7.67	12.87	11.40	11.33	121.67	0.88	0.32	1.21	
29.	NDB-245	54.33	71.27	4.77	5.90	15.47	10.67	11.33	131.67	1.30	0.20	1.50	
30.	SM-6(C)	43.67	63.27	3.90	5.70	18.50	13.02	19.67	141.67	2.31	0.43	2.73	
31.	NDB-251	49.67	65.17	6.63	7.67	16.50	23.47	11.61	203.33	2.33	0.17	2.50	
32.	NDB-253	46.67	67.70	4.13	7.80	18.83	23.27	12.67	171.33	2.52	0.11	2.64	
33.	NDB-258	51.67	77.67	4.13	6.67	13.00	21.47	12.24	181.67	2.32	0.14	2.46	
34.	NDB-261	52.00	69.67	4.47	7.60	14.07	22.83	10.89	203.33	2.18	0.13	2.31	
35.	NDB-265	61.00	62.50	4.20	4.70	14.33	26.40	9.92	226.67	2.22	0.13	2.35	
36.	NDB-252	50.67	80.63	6.93	5.93	21.50	23.80	16.30	208.33	3.13	0.23	3.36	
37.	NDB-255	53.33	65.57	4.23	6.87	17.23	22.07	11.67	2.8.333	2.35	0.18	2.52	
38.	NDB-256	51.00	78.33	3.97	6.53	17.17	25.43	11.14	231.00	2.45	0.14	2.59	
39.	NDB-260	58.00	70.67	5.57	7.83	13.37	25.30	10.64	216.67	2.18	0.22	2.40	
40.	NDB-262	52.00	72.00	4.83	7.67	13.87	23.43	11.81	216.67	2.54	0.11	2.65	
41.	NDB-263	53.00	89.33	7.53	7.67	13.13	19.50	10.41	185.00	2.10	0.13	2.23	
42.	NDB-268	47.00	77.00	4.33	4.97	14.30	23.33	10.90	208.33	1.99	0.27	2.25	
43.	Swarnamani Black	61.00	65.00	4.00	5.80	13.33	26.37	11.44	221.67	2.54	0.10	2.36	
44.	Mukta Keshi	51.33	83.17	5.23	6.87	15.17	24.83	12.83	185.00	2.46	0.27	2.62	
45.	KS-224(C)	51.00	72.47	4.83	5.30	14.87	24.83	12.87	183.33	2.14	0.31	2.45	
46.	Pant Rituraj (C)	47.67	81.67	5.27	5.73	15.07	25.00	11.00	203.33	2.27	0.22	2.49	
Mean		52.93	72.34	4.97	6.40	16.36	17.36	13.06	162.98	2.06	0.18	2.23	
C.V.		3.79	3.95	6.51	6.40	4.76	7.80	11.50	5.88	11.39	56.28	9.55	9.55
S.E.		1.16	1.65	0.19	0.24	0.45	0.78	0.87	5.53	0.14	0.06	0.12	0.12
CD 5 %		3.26	4.63	0.53	0.66	1.26	2.20	2.44	15.55	0.38	0.17	0.35	0.35
Range lowest		43.67	58.13	3.33	3.67	10.93	9.67	9.43	95.00	0.88	0.10	1.17	1.17
Range Highest		61.67	90.33	7.53	7.97	25.30	26.40	20.67	231.00	3.13	0.47	0.47	3.36

Table-3: Range, grand mean, phenotypic (PCV), genotypic (GCV), environmental (ECV) coefficient of variation, heritability in broad sense, genetic advance in percent of mean (Ga) for eleven characters in brinjal germplasm

Characters	Range		Grand mean	PCV (%)	GCV (%)	ECV (%)	Heritability broad sense (%) (h^2_{bs})	Genetic advance	Genetic advance in % of mean (Ga)
	Lowest	Highest							
Days to 50% flowering	43.667	61.667	52.93	8.25	7.33	3.79	79.00	9.10	17.19
Plant height (cm)	58.133	90.333	72.34	11.49	10.79	3.94	66.00	19.36	26.76
Primary branches per plant	3.333	7.533	4.97	22.21	21.24	6.51	91.00	2.66	53.61
Flowers per inflorescence	3.667	7.967	6.40	18.44	17.29	6.40	66.00	2.74	42.82
Polar length of fruit (cm)	10.933	25.300	16.36	18.77	18.16	4.76	94.00	7.58	46.36
Fruit circumference (cm)	9.667	26.400	17.36	32.12	31.16	7.80	94.00	13.86	79.81
Fruits per plant	9.433	20.667	13.06	22.60	19.46	11.50	74.00	5.77	44.22
Fruit weight (g)	95.000	231.000	162.98	22.01	21.21	5.88	93.00	87.96	53.97
Marketable fruit yield per plant(kg)	0.883	3.127	2.06	24.31	21.47	11.39	76.00	1.03	50.09
Unmarketable fruit yield per plant (kg)	0.100	0.473	0.18	65.84	34.17	0.01	27.00	0.09	46.81
Total fruit yield per plant (kg)	1.167	3.357	2.23	22.66	20.54	0.05	82.00	1.10	49.18

advance provide good scope for further improvement in advance generations. The result on heritability and genetic advance in per cent of mean of present investigation has been presented in Table 3. The heritability estimates for different characters ranged from 28.00 to 94.10%. High heritability was recorded for all the characters except unmarketable fruit yield per plant. High heritability coupled with high genetic advance in per cent of mean were recorded for fruit circumference, polar length of fruit, fruit weight, primary branches per plant, plant height, flowers per inflorescence, total fruit yield per plant and marketable fruit yield per plant, indicating that these traits were less influenced by environment. Thus, require low selection intensity for improvement. Similar results were also reported by Dudi *et al.* (1983); Negi *et al.* (2000); Naik *et al.* (2009) and Muniappan *et al.* (2010). The days to 50% flowering exhibited high heritability along with low genetic advance as per cent of mean whereas, unmarketable fruit yield per plant showed low heritability and high genetic advance indicating that they were largely influenced by environment and thus require high selection intensity for improving these traits. Sharma *et al.* (2000) observed high heritability coupled with high genetic advance for length of fruit, fruits per plant, fruit weight and yield per plant. Negi *et al.* (2000) found high genetic advance coupled with high heritability for fruits per plant, fruit weight and yield per plants, Shekhar *et al.* (2012) reported highest genetic advance as per cent of mean for almost all the characters except for days to first flowering and days to first picking. Thus, there exists ample scope for improvement in the available germplasm of eggplant.

References

- Aykroyd, W.R.: The nutritive value of Indian foods and planning of satisfactory diet. ICMR Special Rep. Series.No. 42 (1963).
- Ansari, S.F.; Mehta N.; Ansari S. and Gavel, J.P.: Variability studies in Brinjal (*Solanum melongena* L.) in Chhattisgarh plains. *Electronic J. Plant Breeding*, **2**: 275-281 (2011).
- Burton, G.W.: Quantitative inheritance in grasses. *Proc. 6th Int. Grassland. Cong. J.*, **1**: 227-283 (1952).
- Burton, G.W. and de Vane, E.H.: Estimated heritability in tall replicated clonal material. *Agron. J.*, **45**: 474-478 (1953).
- Choudhary, B.: Vegetable, 4thedn.National Book Trust, New Delhi, p. 50-58 (1976).
- Chen, N.C. and Li, H.M.: *Cultivation and Seed Production of Eggplant.AVRDC. Annual Publication*, **203**: 246-261 (1996).
- Dudi, B.S., Dixit, J. and Pratap, P.S.: Components of variability, heritability and genetic advance studies in tomato. *Haryana Agric. Univ. J. Res.*, **13**: 135-139 (1983).
- Islam, M.S. and Uddin, M.S.: Genetic variation and trait relationship in the exotic and local eggplant germplasm. *Bangladesh J. Agric. Res.*, **34**: 91-96 (2009).
- Johnson, H.W.; Robinson, H.F. and Comstock, R.E.: Genotypic and phenotypic correlation in soybean and their implications in selection. *Agron. J.*, **47**: 477-483 (1955).
- Kumar, S.R.; Arumugam, T.; Anandakumar, C. R. and Premalakshmi, V.: Genetic variability for quantitative and qualitative characters in brinjal (*Solanum melongena* L.). *African J. Agric. Res.*, **8**: 4956-4959 (2013).
- Kumar, S.R., Arumugam, T. and Premalakshmi, V.: Evaluation and variability studies in local types of brinjal for yield and quality (*Solanum melongena* L.). *Electronic J. Plant Breed*, **3**: 977-982 (2012).
- Muniappan, S.; Saravan, K. and Ramya, B.: Study on genetic divergence and variability for certain economic characters in egg plant (*Solanum melongena* L.). *Electronic J. Pl. Breed.*, **1**: 462-465 (2010).
- Naik, K; Sreenivasulu, G.B.; Prashanth, S.J.; Jayaprakashnarayan, R. P.; Madalageri, M.B. and Mulge, R.: Studies on genetic variability and its importance in brinjal (*Solanum melongena* L.). *Asian J. Hort.*, **4**: 380-382 (2009).
- Negi, A.C., Baswana, K.S., Singh, A. Sanwal, S.K. and Batra, B.R.: Studies on genetic variability and heritability in brinjal (*Solanum melongena* L.) under high temperature conditions. *Haryana J. Hort. Sci.*, **29**: 205-206 (2000).
- Panse, V.G. and Sukhatme, P.V.: Statistical Methods for Agricultural Workers, ICAR Publication, New Delhi (1967).
- Sharma, T.V.R.S., Kishan, S. and Swaroop, K.: Genetic variability and character association in brinjal (*Solanum melongena* L.). *Ind. J. Hort.*, **57**: 59-65 (2000).
- Shekhar, K.C.; Ashok, P. and Sasikala, K.: Studies on heritability and multivariate analyses in brinjal (*Solanum melongena* L.). *Veg. Crops Res. Bulletin.*, **76**: 79-88 (2012).
- Thangavel, P. Kumar, T. Baradhan, S.: Studies on genetic variability, heritability and genetic advance in segregating generations of brinjal (*Solanum melongena* L.). *Plant Archives*, **11**: 453-456 (2011).