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Genetic variability, heritability and genetic advance in brinjal (*Solanum melongena* L.)

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Abstract
The present investigation conducted at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Ayodhya, involving 40 diverse genotypes of brinjal (*Solanum melongena* L.) in Randomized Block Design replicated thrice during *kharif-Rabi*-2017 to estimate the genetic variability, heritability (bs) and genetic advance in present of mean for planning the leading strategy in the available germplasm of brinjal. The observations were recorded on twelve quantitative traits *viz.* days to 50% flowering, plant height (cm), primary branches per plant, days to first fruit harvest, crop duration, fruits per plant, fruit length (cm), fruit circumference (cm), average fruit weight (g), marketable fruit yield per plant (kg), unmarketable fruit yield per plant (kg) and total fruit yield per plant (kg) and qualitative traits viz. fruit colour, fruit shape and calyx colour. The analyses of variance revealed that mean sum of squares due to genotypes were highly significant for all the traits indicating ample variation among the genotypes. Whereas, the higher magnitude of coefficient of variation at phenotypic level observed for fruits per plant (53.98%) followed by average fruit weight (43.36%), fruit circumference (34.63%), unmarketable fruit yield per plant (30.73%), marketable fruit yield per plant (26.64%) and total fruit yield per plant (23.99%). However, low variability recorded in the case of crop duration (5.62%). High heritability (>75) coupled with high genetic advance (>30) was observed for most of the traits except days to 50 per cent flowering, plant height, days to first fruit harvest and crop duration which indicated opportunity for selection response in available germplasm of eggplant.

Keywords: brinjal or *Solanum melongena* L. mean performance, PCV, GCV, heritability

Introduction
Brinjal or eggplant (*Solanum melongena* L.) is one of the most important solanaceous vegetable crop having diploid chromosome number 2n=2x=24. It is grown in the tropics and subtropics of India and other parts of the world. It is called brinjal in India and aubergine in Europe.

It is undoubtedly of Indian origin and has been cultivated for long time (Thompson and Kelly, 1957) [16]. Vavilov (1951) suggested China as the centre of origin. Wild brinjal types are available in southern coastal area of Africa.

Brinjal is being cultivated in India over an area of 0.73 million hectares with an average annual production of 12.51 million tonnes and productivity of 17.06 million tonnes/hectares. It is widely distributed in Orissa, Bihar, Karnataka, West Bangal, Andhra Pradesh, Maharashtra and Utter Pradesh. In Uttar Pradesh, brinjal is being cultivated on an area of 4.10 lakh ha with annual production of 136.16 lakh tonnes (Anonymus. 2017) [1].

Brinjal an annual herbaceous plant has inflorescence with a cluster of 2-5 flowers. Both solitary and cluster type flowering are found. Heterostyly is common feature. Four types of flowers have been reported depending upon the length of style, these are long styled with large ovary, medium styled with medium ovary, pseudo-styled with rudimentary ovary and true short styled with very rudimentary ovary. Fruit setting in long styled is 70-85% while medium styled varies from 12-15%. Brinjal is usually self-pollinated but the extent of cross-pollination as high as 29 per cent has been reported. It is consider as often cross pollinated and out crossing takes place with the help of insects. Flower emerges 40-45 days after transplanting. Anthesis occurs at 6-8 am in August-September and usually 9:30-11:15 am in December-January. Stigma receptivity is highest during anthesis *i.e*. flower opening. Anthers usually dehisce 15-20 minutes after the anthesis.

Materials and Methods

The present investigation was carried out at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.), during Kharif/Rabi season 2016-17. The study was comprised of 40 genotypes of two groups (purple round and purple long) including four checks (Pant Rituraj, KS-224, Swarna Mani and Punjab Sadabahar). The experiment was conducted in Randomized Complete Block Design with three replications. Each treatment consisted of 20 plants in two rows, having spacing of 75cm x 60cm with net plot size of 6.0x1.5 m^2. The observations were recorded on twelve quantitative traits *viz*. days to 50% flowering, plant height (cm), primary branches per plant, days to first fruit harvest, crop duration, fruits per plant, fruit length (cm), fruit circumference (cm), average fruit weight (g), marketable fruit yield per plant (kg), unmarketable fruit yield per plant (kg) and total fruit yield per plant (kg) and qualitative traits *viz.* fruit colour, fruit shape and calyx colour. The mean data were subjected to the various statistical and biometrical analyses.

Analysis of variance of the data for the component traits was analyzed as per the following model given by Panse and Sukhatme (1967) [11]. The phenotypic, genotypic, environmental coefficients of variation, heritability in broad sense (h^2bs) and the expected genetic advance (GA) for different characters content were calculated as suggested by-Burton and De Vane (1953) [3] and Johnson *et al.* (1955) [7] respectively.

Table 1: Mean performance of forty genotypes for twelve characters in brinjal

S. No.	Characters Genotypes	Days to 50% flowering	Plant height (cm)	Primary branches per plant	Days to first fruit harvest	Crop duration	Fruits per plant	Fruit length (cm)	Fruit circumference (cm)	Average fruit weight (g)	Marketable yield per plant (kg)	Unmarketable yield per plant (kg)	Total yield per plant (kg)
1.	NDB-51	39.000	94.480	5.833	75.667	173.000	8.190	12.333	25.500	247.333	1.393	0.289	1.682
2.	NDB-52	39.667	74.493	7.433	55.667	161.000	10.667	13.700	19.767	146.667	1.256	0.292	1.548
3.	NDB-53	34.667	77.467	6.433	58.333	159.667	7.103	13.100	22.867	162.000	1.018	0.247	1.265
4.	NDB-54	51.333	94.327	7.467	77.667	162.000	5.527	12.800	23.867	152.333	0.856	0.246	1.102
5.	NDB-55	52.000	96.000	6.300	77.000	174.000	4.680	11.433	20.733	145.667	0.655	0.316	0.971
6.	NDB-56	40.333	101.293	6.400	75.333	161.667	6.517	11.700	22.767	199.333	1.148	0.307	1.456
7.	NDB-57	34.667	87.240	5.333	61.000	176.667	6.243	12.233	25.433	212.667	0.939	0.277	1.216
8.	NDB-58	36.000	93.333	5.500	73.000	163.000	6.163	10.933	22.800	154.667	1.054	0.194	1.248
9.	NDB-59	48.000	94.133	6.533	79.333	159.333	4.637	11.400	25.567	241.333	0.752	0.232	0.984
10.	NDB-60	37.667	104.773	10.433	61.000	172.667	7.087	13.567	20.433	165.667	0.860	0.412	1.271
11.	NDB-61	37.333	94.320	11.400	61.333	180.667	8.110	15.067	23.667	193.333	1.248	0.311	1.558
12.	NDB-62	34.333	75.320	7.367	61.000	176.667	7.660	14.900	23.033	181.667	1.174	0.382	1.557
13.	NDB-63	42.000	96.893	8.533	64.667	161.667	8.310	17.633	23.200	141.667	1.209	0.329	1.538
14.	NDB-64	41.000	94.800	9.767	65.333	188.667	13.600	16.700	21.767	187.667	1.885	0.554	2.439
15.	NDB-65	42.667	109.373	9.133	69.333	176.000	22.023	17.150	25.717	104.333	1.523	0.634	2.157
16.	NDB-66	36.000	95.173	9.467	59.333	160.667	9.187	16.400	20.233	173.667	1.412	0.377	1.789
17.	Pant rituraj (C)	39.333	86.464	7.400	60.667	155.333	6.447	14.967	23.167	166.333	0.784	0.372	1.156
18.	KS-224 (C)	40.333	98.587	7.400	73.667	172.000	6.900	12.667	26.967	189.333	1.180	0.198	1.379
19.	Swarna Mani (C)	46.667	106.453	6.667	74.000	185.667	9.677	13.733	27.467	210.667	1.539	0.387	1.877
20.	NDB-71	30.333	95.147	8.200	57.667	161.333	18.943	17.367	10.000	70.333	1.349	0.305	1.653
21.	NDB-72	38.667	75.320	5.867	53.333	163.333	16.813	19.600	8.033	33.333	0.958	0.357	1.315
22.	NDB-73	38.667	88.893	7.800	57.667	176.000	26.600	18.767	10.600	66.667	0.897	0.409	1.306
23.	NDB-74	30.000	94.690	6.367	51.000	166.333	14.450	18.600	12.000	100.333	0.636	0.332	0.968
24.	NDB-75	33.333	87.240	6.400	67.000	166.000	20.393	21.767	11.933	93.333	1.042	0.443	1.485
25.	NDB-76	36.667	92.347	7.300	56.333	177.667	25.883	19.867	15.567	92.667	1.689	0.404	2.093
26.	NDB-77	35.000	76.040	8.267	54.667	161.333	14.830	23.100	10.300	75.333	0.825	0.298	1.123
27.	NDB-78	35.667	86.520	7.133	54.000	164.000	18.237	19.567	10.033	61.333	0.875	0.281	1.155
28.	NDB-79	35.667	93.493	7.367	53.000	175.000	19.963	19.467	9.700	74.000	1.522	0.348	1.870
29.	NDB-80	34.667	86.600	6.600	55.667	172.333	16.100	19.933	10.567	80.000	1.077	0.288	1.365
30.	NDB-81	46.000	91.800	7.233	67.333	170.000	19.503	23.267	14.667	102.000	1.231	0.506	1.737
31.	NDB-82	38.000	79.960	6.633	61.333	183.333	37.253	18.600	11.567	83.333	1.958	0.498	2.456
32.	NDB-83	37.333	92.520	11.200	61.667	163.000	17.513	22.233	12.067	73.000	1.262	0.422	1.684
33.	NDB-84	37.667	88.080	8.233	66.667	168.000	21.707	23.500	13.600	112.333	1.411	0.397	1.807
34.	NDB-85	34.333	103.013	8.767	75.000	162.000	16.720	24.867	13.067	87.667	1.119	0.336	1.455
35.	NDB-86	33.667	93.800	10.650	64.333	166.667	24.740	21.467	15.100	95.333	1.347	0.459	1.807
36.	NDB-87	35.333	96.520	8.733	60.000	163.000	8.717	13.733	16.433	190.333	1.300	0.339	1.639
37.	NDB-88	33.333	83.907	10.067	59.333	173.000	9.260	18.133	19.567	184.333	1.204	0.428	1.631
38.	NDB-89	32.833	71.640	7.467	52.667	164.667	17.353	17.150	15.033	95.667	1.281	0.399	1.679
39.	NDB-90	36.167	89.000	7.017	56.000	165.000	20.597	22.900	11.050	72.667	1.083	0.293	1.376
40.	Punjab Sadabahar (C)	34.500	102.280	8.000	52.000	164.333	22.423	22.317	10.417	62.000	1.395	0.202	1.597
Mean		38.021	91.093	7.753	63.000	168.667	14.168	17.215	17.656	132.058	1.184	0.353	1.535
C.V.		8.402	9.469	5.475	6.172	3.697	6.748	4.286	3.615	8.387	8.131	17.578	6.085
S.E.		1.844	4.980	0.245	2.245	3.600	0.552	0.426	0.368	6.394	0.056	0.036	0.054
CD 5 %		5.193	14.022	0.690	6.320	10.136	1.554	1.200	1.037	18.003	0.156	0.101	0.152
C.D. 1%		6.887	18.596	0.915	8.382	13.443	2.061	1.591	1.376	23.877	0.207	0.134	0.201
Range lowest		30.000	71.640	5.333	51.000	155.333	4.637	10.933	8.033	33.333	0.636	0.194	0.968
Range Highest		52.000	109.373	11.400	79.333	188.667	37.253	24.867	27.467	247.333	1.958	0.634	2.456

Table 2: Analysis of variance (mean squares) for twelve quantitative characters in brinjal germplasm

S. No	Characters	Source of variation		
		Replication	Treatments	Error
	d.f.	2	39	78
1.	Days to 50% flowering	29.10	77.11**	10.20
2.	Plant height (cm)	53.73	249.64**	74.40
3.	Primary branches per plant	0.19	7.18**	0.18
4.	Days to first fruit harvest	44.10	201.81**	15.11
5.	Crop duration	29.80	191.38**	38.88
6.	Fruits per plant	2.45	173.67**	0.91
7.	Fruit length (cm)	0.26	49.10**	0.54
8.	Fruit circumference (cm)	0.58	111.33**	0.40
9.	Average fruit weight (g)	156.43	9591.38**	122.66
10.	Marketable fruit yield per plant (kg)	0.009	0.27**	0.009
11.	Unmarketable fruit yield per plant (kg)	0.001	0.027**	0.003
12.	Total fruit yield per plant(kg)	0.004	0.38**	0.008

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

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

S. No.	Characters	Range		Grand mean	PCV (%)	GCV (%)	Heritability broad sense (%) (h^2_{bs})	Genetic advance	Genetic advance in per cent of mean (Ga)
		Lowest	Highest						
1.	Days to 50% flowering	30.00	52	38.02	15.00	12.42	68.61	8.06	21.19
2.	Plant height (cm)	71.64	109.37	91.09	12.65	8.39	43.98	10.44	11.46
3.	Primary branches per plant	5.33	11.40	7.75	20.46	19.71	92.84	3.03	39.13
4.	Days to first fruit harvest	51.00	79.33	63.00	13.96	12.52	80.46	14.58	23.14
5.	Crop duration	155.33	188.66	168.66	5.62	4.23	56.66	11.06	6.55
6.	Fruits per plant	4.63	37.25	14.16	53.98	53.56	98.44	15.51	109.47
7.	Fruit length (cm)	10.93	24.86	17.21	23.76	23.37	96.75	8.15	47.35
8.	Fruit circumference (cm)	8.03	27.46	17.65	34.63	34.44	98.91	12.46	70.56
9.	Average fruit weight (g)	33.33	247.33	132.05	43.36	42.54	96.26	113.55	85.98
10.	Marketable fruit yield per plant (kg)	0.63	1.95	1.18	26.64	25.37	90.69	0.59	49.77
11.	Unmarketable fruit yield per plant (kg)	0.19	0.63	0.35	30.73	25.20	67.27	0.15	42.58
12.	Total fruit yield per plant (kg)	0.96	2.45	1.53	23.99	23.20	93.56	0.71	46.23

Results and Discussion

A very wide range of variations in mean performance of genotypes were observed for all the characters has been presented in Table 1. The comparison of mean performance of forty genotypes for twelve traits using critical differences revealed existence of very high level of variability in the used genotypes. The genotypes NDB-82 (2.456 kg) and NDB-76 (2.093 kg) significantly out yielded in respect of all genotypes as well as check in case of long purple and also showed high mean performance for fruits per plant 37.253 and 25.883 respectively. These genotypes also showed high mean performance for some other characters as well. Genotypes NDB-64 (2.439 kg) and NDB-65 (2.157 kg) produced significant higher yield per plant than the check Swarna Mani (1.877 kg) in case of round purple groups, out of which genotypes NDB-64 (2.439 kg) and NDB- 65 (2.157 kg) were the top two performer for fruit yield per plant. Similar result was also reported by Kumar et al. (2012) [9].

The analysis of variance for different characters has been presented in Table 2. 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. Perusal of Table-3 revealed that the phenotypic coefficients of variability were 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. High magnitudes of variability was observed in case of fruits per plant (53.98%) followed by average fruit weight (43.36%), fruit circumference (34.63%), unmarketable fruit yield per plant (30.73%), marketable fruit yield per plant (26.64%), total fruit yield per plant (23.99%), fruits length (23.76%) and primary branches per plant (20.46%).While, low variability was recorded in case of days to 50% flowering (15.00%) followed by days to first fruit harvest (13.96%), plant height (12.65%) and crop duration (5.62%). Jadhav *et al.* (2009) [6], Ansari *et al.* (2011) [2], Thangavel *et al*. (2011) [18], Kumar *et al*. (2014) [10], Rajpoot *et al.* (2015) [13] and Samlindsujin *et al.* (2016) [16] also reported similar results. Moderate PCV and GCV were estimated for primary branches per plant (20.46) and fruit length (23.76). The phenotypic and genotypic coefficients of variations were lower for crop duration (5.62) and it may be due to the fact that the environment influenced the observed variance. Similar result was also reported by Ansari *et al.* (2011) [2] and Chaitanya and Reddy (2017) [4].

The result on heritability and genetic advance in per cent of mean of present investigation has been presented in Table-3. High heritability was observed for all the characters except plant height. Similar finding was also reported by Sharma *et al*. (2000) [17] and Tripathi *et al.* (2009) [20]. High heritability coupled with high genetic advance in per cent of mean were recorded for fruit per plant, average fruit weight, fruit circumference, marketable yield per plant, fruit length, total yield per plant, unmarketable yield per plant and primary branches per plant indicating that these traits were less influenced by environment. Negi *et al*. (2000) [11], Kamani *et al*. (2007) [8], Dhaka and Soni (2012) [5], Kumar *et al.* (2012), Reshmika *et al.* (2015) [15] and Ravali *et al.* (2017) [14] also reported similar results in their studies.

Thus it could be concluded that there exists ample variability in the available germplasm. The inheritance of traits with high heritability and genetic advance revealed that there is great scope in yield improvement in brinjal following selection.

References

1. Anonymous. Data base National Horticulture Board, Gurgaon, Haryana, India, 2017.
2. Ansari SF, Mehta N, Ansari S, Gavel JP. Variability studies in brinjal (*Solanum melongena* L.) in Chhattisgarh plains. Electronic J Pl. Breed. 2011; 2(2):275-281.
3. Burton GW, de Vane EH. Estimated heritability in tall replicated clonal material. Agron. J. 1953; 45:474-478.
4. Chaitanya V, Reddy RK. Genetic variability and correlation studies in brinjal (*Solanum melongena* L.). Hort Flora Research Spectrum. 2017; 6(1):21-25.
5. Dhaka SK, Soni AK. Genetic variability in brinjal (*Solanum melongena* L.). Asian J Hort. 2012; 7(2):537-540.
6. Jadhav ST, Thawane BL, Rathod DR, Navhale VC. Correlation and path analysis studies in brinjal. Ann. Pl. Physiol. 2009; 23(2):177-179.
7. Johnson HW, Robinson HF, Comstock RE. Genotypic and phenotypic correlation in soybean and their implications in selection. Agron. J. 1955; 47:477-483.
8. Kamani JM, Monpara BA. Genetic parameters for the traits associated with fruit yield in brinjal (*Solanum melongena* L.). National J Pl. Sci. 2007; 9(2):119-122.
9. Kumar SR, Arumugam T, Premalakshmi V. Evaluation and variability studies in local types of brinjal for yield and quality (*Solanum melongena* L.). Electronic J Plant Breed. 2012; 3(4):977-982.
10. Kumar A, Kumar B, Kumar SVS, Prakash JC. Genetic variability and divergence studies for morpho-economic characters in brinjal (*Solanum melongena* L.). Int. J agric. Sci. 2014; 10(2):529-533.
11. Negi AC, Baswana KS, Singh A, Sanwal SK, Batra BR. Studies on genetic variability and heritability in brinjal (S*olanum melongena* L.) under high temperature conditions. Haryana J Hort. Sci. 2000; 29(3&4):205-206.
12. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers, ICAR Publication, New Delhi, 1967.
13. Rajpoot BS, Misra SP, Prajapati S, Sharma SK, Verma V. Gentic variability, correlation and path coefficient analysis in brinjal (*Solenum melongena*) genotypes. Ind. J Tropi. Biodiver. 2015; 23(2):174-179.
14. Ravali B, Reddy KR, Saidaiah P, Shivraj N. Variability, Heritability and Genetic Advance in Brinjal (*Solanum melongena* L.). Int. J Curr. Microbiol. App. Sci. 2017; 6(6):42-47.
15. Reshmika PK, Gasti VD, Jayappa SE, Mulge JR. Genetic variability studies for growth, earliness, yield and quality parameters in brinjal (*Solanum melongena* L.). Envir. and Ecol. 2015; 33(2):761-766.
16. Samlindsujin G, Karuppaiah P. Studies of genetic divergence in brinjal (*Solanum melongena* L.) for yield attributes and shoot and fruits borer (*Leucinodes arbonalis)* incidence. Inter. J Pl. Sci. (Muzzaffarnagar). 2016; 11(1):47-50.
17. Sharma TVRS, Kishan S, Swaroop K. Genetic variability and character association in brinjal (*Solanum melongena* L.). Indian. J Hort. 2000; 57(1):59-65.
18. Thangavel P, Kumar T, Baradhan S. Studies on genetic variability, heritability and genetic advance in segregating generations of brinjal (*Solanum melongena* L.). Plant Archives. 2011; 11(1):453-456.
19. Thompson HC, Kelly WC. Vegetable Crops. McGraw-Hill Book Co. Inc., New York, 1957, 500-503.
20. Tripathi MK, Singh AK, Singh BK, Rat VK. Genetic variability, heritability and genetic advance among different quantitative characters of brinjal (*Solanum melongena* L.). Haryana J Hort. Sci. 2009; 38(3/4):334-335.