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Genetic diversity evaluation of brinjal germplasms for varietal improvement

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Abstract

A field experiment was conducted with 72 brinjal (*Solanum melongena* L.) germplasms at the Plant Genetic Resources Centre (PGRC) of BARI, Joydebpur, Gazipur, to assess the variability among the germplasms. A wide variation in genetic diversity was observed in both qualitative and quantitative characters studied. Qualitatively all the germplasms showed distinct variation except leaf hairs, corolla colour, fruit cross section and fruit position. The maximum variation observed in overall leaf prickles, fruit calyx prickles, fruit colour at ripening and fruit flesh density. The variability was maximum in leaf prickles. Five categories of leaf prickles were found such as very few (4.17%), few (51.39%), intermediate (26.39%), many (8.33%) and very many (9.72%) in the studied germplasms. Quantitatively the highest variation was observed in 100 seed weight (CV- 67.91%) which was followed by yield per plant (CV-62.40) and number of fruits per plant (CV-59.93%). Based on yield and yield-contributing parameters, the germplasms K 21 (1116.67 g), K 24 (1221.67 g), and RAI 230 (1680.83 g) were identified as the top performers in terms of yield.

Keywords: *Solanum melangena*, characterization, germplasms, improvement

Introduction

Brinjal (*Solanum melongena* L.) is one of the most common, popular and principal vegetable crops grown in Bangladesh as well as other parts of the world. It is highly productive and usually referred as the poor man's crop. Brinjal is usually self-pollinated crop but the extent of cross pollination has been reported as high as 29% due to heterostyle condition and hence it is classified as 'often' cross pollinated crop or facultative cross-pollinated crop (Yadav *et al.* 2018). Bangladesh, being the Indian sub-continent, and the primary centre of origin has accumulated wide range of variation of this crop (Shingh *et al.* 2006, Choudhary *et al.* 2009). Bringal has a great genetic variation with regard to colour, maturity, fruit shape, and other morphological characters (Islam *et al*. 2009). The success of breeding programme for better yield and quality depends on the nature and magnitude of variation available in the genotype (Roychowdhury *et al.* 2011).

All germplasms does not respond similarly in all agroclimatic regions. The consumer preference varies from region to region (Tirfessa *et al.* 2020). The regional preferences differ greatly with shape, colour and even presence of prickles on calyx. However, yield of any crop plant is the result of interaction of several genetic factors and environmental factors. These are actually qualitative and quantitative characters which is associated with component characters. These component characters including yield are influenced by environmental fluctuations. Thus, the improvement in yield is possible only through selection of the desired component characters.

The knowledge of association between yield and its component characters as well as their direct and indirect contribution towards yield is essential for crop improvement in brinjal (Roychowdhury *et al.* 2011). Hence the characterization needs to be done with reference to the morphological characterization and evaluation in both qualitatively and quantitatively. Morphological characterization and evaluation help the breeder to select an appropriate genotype for crop improvement based on the knowledge of genetics of various characters (Baswana *et al.* 2002). The germplasms performing well can be released as a variety or it can be put to further use in the

breeding programme as breeding line by the breeder. Keeping in view the above aspects an investigation was carried out to evaluate indigenous brinjal germplasms through qualitative and quantitative characters to identify the promising germplasms and provide genetic diversity for the crop improvement program.

Materials and methods

The experiment was conducted in the field of Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur October 2023 to march 2024. Seventy-two germplasms (Table 1) were used in this experiment as treatments**.** The experiment was laid out in augmented design with standard check variety. Direct seeding was done in the well-prepared seed beds. Thirty-five days aged seedlings were transplanted in the prepared pits of main experimental field. The plot size was 3 x 2.1 m^2. Seedlings of each germplasms was planted in a plot of three rows having four pits. Row to row and plant to plant distance was 70 × 60 cm. Cowdung, urea, TSP, MoP and borax were applied at the 10 t/ha, 210 kg/ha, 33 kg/ ha, 200 kg /ha and 5 kg/ ha, respectively (Mondal *et al*. 2011). The full doses of cowdung, TSP and borax were applied during land preparation before one week of transplanting. Urea and MP were applied in the three equal splits at 15, 35 and 50 days after transplanting. Weeding and mulching were done four times at 20 days' interval starting from mid-December. Individual net was used per plot to avoid the cross pollination. Sevin 75 WP @ 0.1 g/pit, Sumithion 60 EC @ 2.5 ml/L and Vertimac 18 EC @ 1.2 ml/L were sprayed for controlling insect and mite, respectively. The data was recorded as per the descriptor developed by IBPGR (1990).

Soil and Climate: The soil type of the experimental field belongs to the shallow light brown terrace type under Joydebpur series of Madhupur Tract of Agro Ecological zone (AEZ) 28 which is characterized by silty clay with pH value of 6.5.The experimental site is under the sub-tropical climatic zone .In the experiment period it was characterized by less rainfall, almost clear sun shine and low temperature at earlier part and moderate to high temperature in later part. The heavy rainfall occurred during the month of May to July.

Passport information and data recording: collector's number: Original number assigned by collector of the sample normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates in different collections.

Data recording: Qualitative data were recorded at respective stage of plant on growth habit, leaf blade lobing, leaf blade tip angle, leaf prickles, leaf hairs, corolla colour, fruit calyx prickles, fruit colour distribution, fruit curvature, fruit apex shape, fruit cross section, fruit colour at ripening, fruit flesh density, fruit position, seed colour, and seed size. Quantitative data were also recorded at mature stage of plant growth on leaf blade length (cm), eaf blade width (cm), Fruit length (cm), Fruit width (cm), 100 seed weight, Plant height (cm), Days to 50% flowering, Average number of fruits per plant and Yeild per plant (g)

Statistical analysis: Data were collected, coded, analyzed, and tabulated using the Statistix 10 and Microsoft Excel 2019 program.

Results and discussion

Qualitative characters: A total of 16 qualitative characters were evaluated to know the variability of the studied germplasms (Table 2). All the characters showed distinct variation among the germplasms except leaf hairs, corolla colour, fruit cross section and fruit position. The maximum variation observed in overall leaf prickles, fruit calyx prickles, fruit colour at ripening and fruit flesh density.

Variability in growth and foliage: All the characters studied related to plant growth habit and foliage showed distinct variation among the germplasms except leaf hairs and corolla colour (Table 2). Plant growth habit were observed in upright (5.56%), intermediate (93.06%) and prostrate only (1.39%). Leaf prickles and hairiness in brinjal germplasms are more pronounced in wild types and indicated pest resistance and medicinal value

Table 1. Lists of germplasms used in this experiment

Sl no.	Germplasms	Collected area	Sl no.	Germplasms	Collected area
1.	K-10	Pabna	37.	RAI-219	Chattogram
2.	K-11	Pabna	38.	RAI-230	Sherpur
3.	K-12	Pabna	39.	AMA-294	Sherpur
4.	K-13	Pabna	40.	AMA-302	Sherpur
5.	K-15	Pabna	41.	AMA-312	Sherpur
6.	K-16	Pabna	42.	AMA-368	Jamalpur
7.	K-17	Pabna	43.	AMA-410	Sherpur
8.	K-18	Pabna	44.	AHI-101	Jashore
9.	K20-	Pabna	45.	AHI-102	Jashore
10.	K-21	Pabna	46.	AHI-124	Jhenaidah
11.	K-22	Pabna	47.	AR-216	Dinajpur
12.	K-23	Pabna	48.	IAH-39	Dhaka
13.	K-24	Pabna	49.	ART-12	Kishoregonj
14.	K-25	Natore	50.	AH-41	Gazipur
15.	K-26	Pabna	51.	AC-47	Dhaka
16.	K-27	Pabna	52.	AC-172	Narshingdi
17.	K-28	Pabna	53.	AC-212	Manikgonj
18.	K-29	Pabna	54.	AC-222	Manikgonj
19.	K-30	Pabna	55.	AC-240	Manikgonj
20.	K-32	Pabna	56.	AC-285	Dhaka
21.	K-33	Pabna	57.	AC-396	Dhaka
22.	K-34	Pabna	58.	AC-434	Narsingdi
23.	K-35	Pabna	59.	TT-27	Mymensingh
24.	K-36	Natore	60.	TT-56	Mymensingh
25.	K-37	Natore	61.	TT-58	Mymensingh
26.	K-38	Chuadanga	62.	TT-64	Mymensingh
27.	K-39	Pabna	63.	TT-78	Mymensingh
28.	K-40	Pabna	64.	TT-102	Netrokona
29.	K-41	Chapainawabgonj	65.	TT-103	Netrokona
30.	K-42	Chapainawabgonj	66.	TT-105	Netrokona
31.	K-44	Chapainawabgonj	67.	TT-136	Mymensingh
32.	K-45	Chapainawabgonj	68.	TT-169	Mymensingh
33.	RAI-81	Chattogram	69.	TT-176	Mymensingh
34.	RAI-99	Chattogram	70.	TT-200	Mymensingh
35.	RAI-216	Chattogram	71.	TRMR-102	Cumilla
36.	RAI-150	Chattogram	72.	B-13	Patuakhali

(Naujeer, 2009).

Leaf prickles (Fig. 1) were found in maximum variation such as very few (4.17%), few (51.39%), intermediate (26.39%), many (8.33%) and very many (9.72%) in studied germplasms. The Leaf blade tip angle were also exhibited as four categories such as very acute (4.17%), acute (27.78%), intermediate (48.61%) and obtuse (19.44%). Leaf hairs and corolla colour showed no variation. All leaf hairs were observed as 'very many' type and corolla colour as 'light violate'.

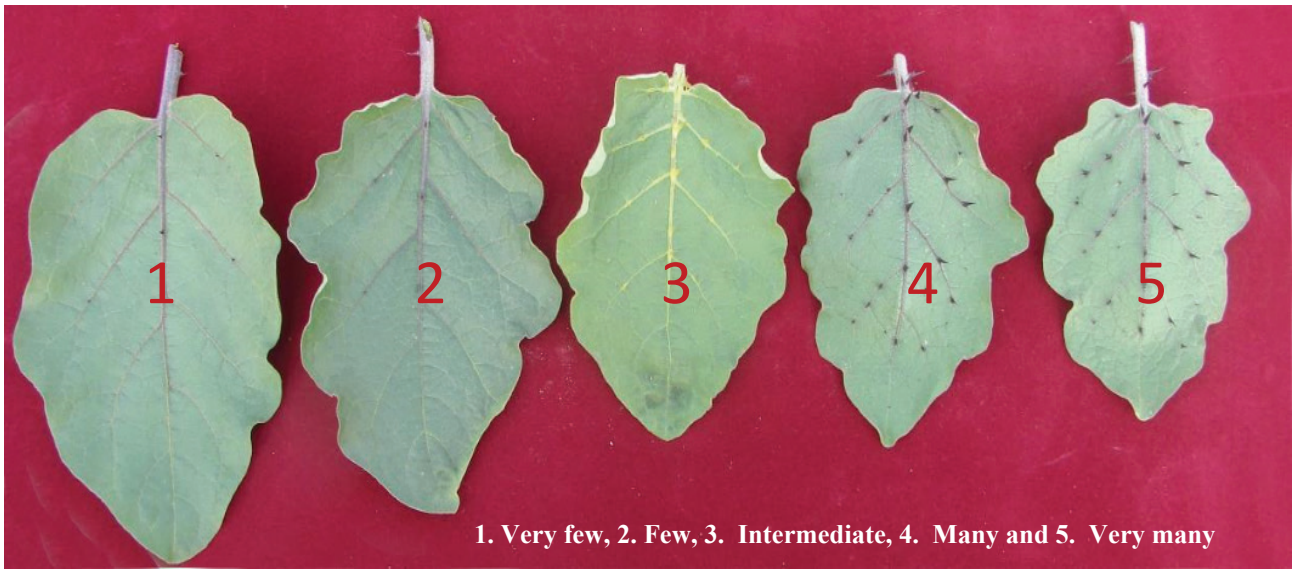

Figure 1. Different types of leaf prickles found in the studied germplasms.

Four categories of leaf blade lobing (Table 2, Fig. 2) were found such as weak (33.33%), intermediate (50.00%), strong (15.28 %) and very strong (1.39 %).

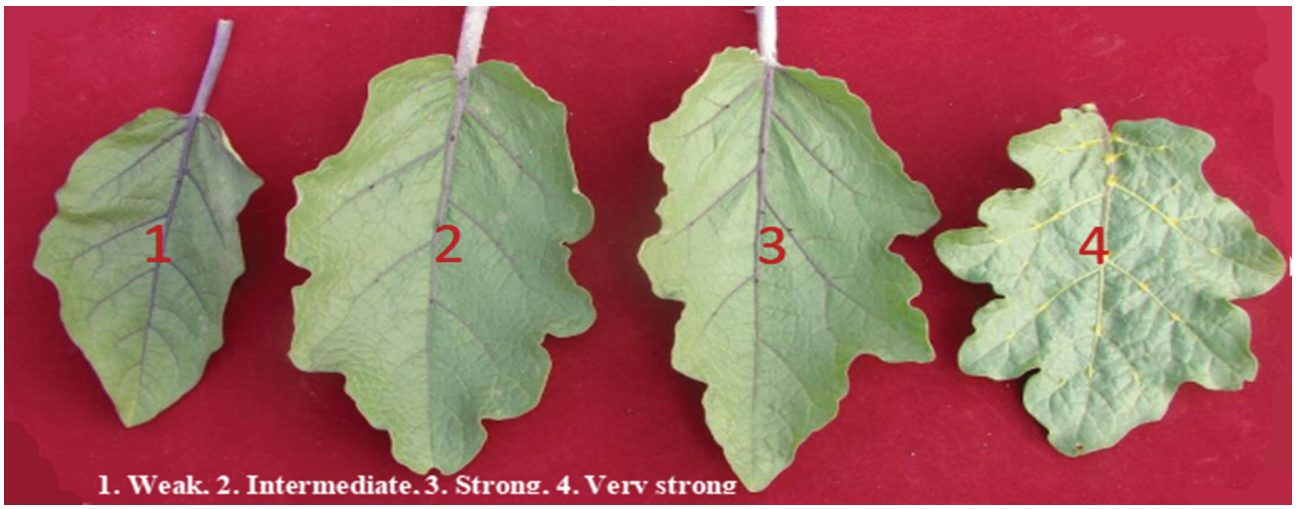

Figure 2. Different kinds of leaf lobing found in the studied germplasms.

Leaf blade lobbing is an important trait to choose a brinjal genotypes for future breeding programme. Leaf blade lobbing can help to a breeder to know the information on photosynthesis rate. Strong leaves can have a greater opportunity to get maximum sunlight than the weaker leaves (Akther, 2015).

Variability in fruit characters: All the characters studied related to fruit of brinjal showed distinct variation among the germplasms except fruit cross section and fruit position (Table 3). The maximum variation was found in 'fruit colour at ripening stage'. Six categories fruit colour at ripening such as milky white (1.39%), lilac grey (4.17%), purple (22.22%), green with mottled at the distal end (25.00%), and green with yellowish stripe (34.72%) and purple with light green at the distal end (12.50%) were observed (Table 3 and Fig. 3.). Fruit color is one of the important traits for consumer preference in brinjal marketing. This variation offered a good scope for breeding consumer preference attributes (Akther, 2015). The next higher variation was found in 'fruit flesh density'. Very loose (spongy), loose (crumbly), average density, dense and very dense type of fruit flesh density was found. Brinjal fruit flesh density is a good storage indicator for culinary purpose as a vegetable (Jha & Matsuoka, 2002). Brinjal germplasms with density type flesh are long lasting germplasms in kitchen storage. However, the majority of the studied germplasms exhibited as average density type (40.28%).

Table 2. Variability in growth and foliage characters in brinjal germplasms

Name of descriptor	Descriptor state	No. of germplasms	% of germplasms
Plant growth habit	Upright	4	5.56
	Intermediate	67	93.06
	Prostrate	1	1.39
Leaf blade lobing	Weak	24	33.33
	Intermediate	36	50.00
	Strong	11	15.28
	Very strong	1	1.39
Leaf blade tip angle	Very acute	3	4.17
	Acute	20	27.78
	Intermediate	35	48.61
	Obtuse	14	19.44
Leaf prickles	Very few	3	4.17
	Few	37	51.39
	Intermediate	19	26.39
	Many	6	8.33
	Very many	7	9.72
Leaf hairs	Very many	72	100.00
Corolla colour	Light violate	72	100.00

[1. Milky white, 2. Lailac grey, 3. Purple, 4. Green with mottled at the distal end, 5. Green with yellowish striped, 6. Purple with light green at the distal end]

Figure 3. Different fruit color at ripening stage of bringal.

On the other hand, fruit calyx prickles were found as very few (1.39%), few (2.78%), intermediate (22.22%), many (41.67%) and very many (31.94%). Fruit colour distribution (Table 3, Fig. 4.) was exhibited as Uniform (23.61%), molttled (16.67%), netted (13.89%) and striped (45.83%). No fruits were found curved in 80.56% of the germplasms. Only 8.33 % germplasms showed curved and 11.11%

Figure 4. Different fruit colour distribution in brinjal germplasms.

showed slightly curved. Fruit apex were exhibited as two categories such as rounded (40.28%) and depressed (59.72%).

Variability in seed characters : Only seed colour and seed size were studied (Table 4). Both parameters varied in three categories. Fifty percent of the germplasms exhibited brown seed colour and rest were grey yellow (8.33%) and brownish yellow (41.67%) (Fig. 5.). Seed size exhibited as small (38.89%), intermediate (54.17%) and large 6.94%).

Quantitative-characters: Range, mean, standard deviation and CV% of the quantitative data of brinjal is presented in Table 4 and Table 5. The highest quantitative variation was observed in 100 seed weight (CV- 67.91%) which was followed by yield per plant (CV-62.40) and number of fruits per plant (CV-59.93%). Leaf blade length ranged from 13.62 cm to 46.50 cm with an average of 19.90 cm. leaf blade width ranged from 8.94 cm to 15.08 cm with an average of 14.20 cm. The fruit length was measured from 6.73cm to 29.40 cm with an average of 15.08 cm and Fruit width from 1.00 to 12.00 cm with an average of 7.03 cm. The longer fruit was observed in TRMR-102 (29.40 cm), TT-105 (24.83 cm), and AH-41 (23.63 cm). The 100-seed weight was ranged from 0.07 g to 4.00 g with an average of 0.82 g. Plant height was measured from 25.20 cm to 115.57 cm with an average of 81.90 cm. The taller plant exhibited in the germplasms of AH-41 (112.50 cm), TT-105 (113.33 cm) and K-13 (115.57 cm). This plant height of studied brinjal germplasms was more or less consistent with the findings of Kishorbhai, 2021 in India.

Based on 50% flowering data, it was evident that the early flowering germplasms were RAI-216 (67.0 days), RAI-219 (68.0 days), AR 216 (77.0 days) and TT 56 (77.0 days). The average time required from transplanting to flowering (98.78 days). Yield of fruits showed highly significant and positive association with number of fruits per plant and individual fruit weight, which indicate the importance of these characters during selection for high yielding genotypes in brinjal (Islam & Uddin 2009). The maximum fruiting was observed in the germplasms of RAI-230 (8.25) which was followed by RAI-216 (4.17) and RAI-150 (4.25). The highest yield per plant found in the germplasms of RAI 230 (1.68 Kg) and it was followed by K 24 (1.32K g) and K-21 (1.12 k g). In India, Kumar *et al.* (2016) found highest brinjal fruit yield per plant was produced by MR/04-26 (1.30 kg) followed by PSR-11883(1.08 kg).

Table 3. Variability in fruit characters in brinjal germplasms

Name of descriptor	Descriptor state	No. of germplasms	% of germplasms
Fruit calyx prickles	Very few	1	1.39
	Few	2	2.78
	Intermediate	16	22.22
	Many	30	41.67
	Very many	23	31.94
Fruit colour distribution	Uniform	17	23.61
	Mottled	12	16.67
	Netted	10	13.89
	Striped	33	45.83
Fruit curvature	None (fruit straight)	58	80.56
	Slightly curved	8	11.11
	Curved	6	8.33
Fruit apex shape	Rounded	29	40.28
	Depressed	43	59.72
Fruit cross section	Circular (no groovs)	72	100.00
Fruit colour at ripening	Milky white	1	1.39
	Lilac grey	3	4.17
	Purple	16	22.22
	Green with mottled at the distal end	18	25.00
	Green with yellowish stripe	25	34.72
	Purple with light green at the distal end	9	12.50
Fruit flesh density	Very loose (spongy)	57	79.17
	Loose (Crumbly)	25	34.72
	Average density	29	40.28
	Dense	14	19.44
	Very dense	3	4.17
Fruit position	Pendant	72	100.00

Brown seeds Yellow seeds Brownish yellow seeds

Figure 5. Different seed colour of brinjal germplasms.

Table 4. Variability in seed characters in brinjal germplasms

Name of descriptor	Descriptor state	No. of germplasms	% of germplasms
Seed colour	Grey yellow	6	8.33
	Brownish yellow	30	41.67
	Brown	36	50.00
Seed size	Small	28	38.89
	Intermediate	39	54.17
	Large	5	6.94

Table 5: Quantitative variation of different characters in brinjal

Parameters	Min	Max	Mean	Std	CV (%)
Leaf blade length (cm)	13.62	46.50	19.90	4.00	20.12
Leaf blade width (cm)	8.94	19.58	14.20	1.94	13.66
Fruit length (cm)	6.73	29.40	15.08	4.27	28.30
Fruit width (cm)	1.00	12.00	7.03	2.18	31.02
100 seed wt. (g)	0.07	4.00	0.82	0.56	67.91
Plant height (cm)	25.20	115.57	81.90	18.90	23.08
Days to 50% flowering	67.00	109.00	98.78	9.17	9.29
Number of fruits per plant	0.83	8.25	1.92	1.15	59.93
Yield per plant (g)	94.33	1680.83	509.62	317.98	62.40

Conclusion

A wide variation was observed in the collected brinjal germplasms. Most of the qualitative characters showed distinct variation among the germplasms. Qualitatively the maximum variation was observed in leaf prickles, fruit calyx prickles, fruit colour at ripening and fruit flesh density. Quantitatively highest variation was observed in fruit length which was followed by 100 seed weight and yield per plant. The germplasms K 21 (1.22kg), K 24 (1.32 kg) and RAI 230 (1.68 kg) could be considered as the best yielder among the studied germplasms as per individual fruit yield per plant. The present findings have a great genetic variability of the studied germplasms. Therefore, the promising germplasms identified in the present study might be used in future breeding programs for crop improvement program.

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