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EC MICROBIOLOGY
Research Article

Genetic Diversity of Eggplant Germplasm in Bangladesh Condition

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Received: October 08, 2018; **Published:** January 04, 2019

Abstract

The study was conducted at the experimental field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur during 2017-18 to assess the extent of genetic diversity among 21 eggplant germplasm. The collected germplasm originating from different local and exotic sources were subjected to cluster analysis. The germplasm were constellated into five distinct groups with the range of 3 germplasm in cluster II, cluster III and cluster IV to 7 germplasm in cluster V. The inter-cluster distance in all cases was larger than the intra-cluster distance. Maximum inter-cluster distance (17.053) was observed between germplasm of cluster II and II followed by cluster I and II (14.754) and minimum was found between germplasm of cluster II and III (4.104). The highest intra cluster value (4.438) was observed in cluster V. Mean performance of different clusters revealed that cluster I recorded the highest mean value for number of marketable fruit (32.40), cluster II for average fruit weight (147.33g), fruit weight per plant (3.51 kg), fruit diameter (7.33 cm), fruit yield (38.57 t/ha), Cluster III for fruit length (24.00 cm), Cluster IV for plant height at 1st harvest (74.33 cm), plant height at last harvest (126.67 cm), while some desirable lowest mean value was observed viz., days to 1st harvest (105.00) in cluster I and FSB infested fruit (15.33%), BW infestation (0.00%) cluster II. Therefore, in-breeds belong to cluster I, cluster II and cluster IV would be given higher priority for crossing in future eggplant hybridization programme.

Keywords: *Genetic Diversity; Eggplant Germplasm; Bangladesh*

Introduction

Eggplant is the most important vegetable crop in respect of total acreage (50415 ha) and production (504817 ton) in Bangladesh with an average yield of 10.00 tons per hectare [1], which is very low as compared to that other producing countries. It is available in the country round the year. Improved eggplant varieties have generally higher yield potential than traditional local varieties when grown with sufficient inputs. Although traditional varieties have low yield but locally adapted and suited with better consumption quality.

Genetic diversity is the extent of genetic variation existed among selected cultivars, breeding lines or species. Knowledge of genetic diversity among existing cultivars of any crop is essential for long-term success of breeding programme and maximizes the exploitation of the genetic resources. If the structure of the genetic diversity is known within a large collection of germplasm which may be of great help to make decisions on management procedures and breeding strategies to use in breeding programme. With the development of advanced biometrical techniques such as multivariate analysis, quantification of degree of divergence among the biological population and assessing the relative contribution of different components to the total divergence at intra- and inter-cluster levels have now become possible. Such a study also permits to select the genetically diverse parents to obtain the desirable recombinant in the segregating populations upon crossing. Hybridization is a common practice for combining the desirable characters of two or more lines or varieties into a single variety. In several cases, the progenies become far superior to the parents in vigor i.e. hybrid vigor or heterosis. Inclusion of more diverse parents (within a limit) is believed to increase the chances for obtaining stronger heterosis and gives broad spectrum of variability in segregating generations. Available research also reported that crossing between moderately diverse parents showed maximum heterosis. The present study was, therefore, undertaken to assess the extent of genetic diversity in 21 eggplant germplasm which will help to select prospective parents to develop higher yield and biotic, abiotic stress tolerant OP/ F1 variety.

Materials and Methods

The experiment was conducted at the Olericulture Division of Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI) during 2017-18 with 21 germplasm of eggplant. The experimental field was at 23.9917º N Latitude and 90.4124º E Longitudes having an elevation of 8.2m from sea level. The seeds of these germplasm were sown on the seedbed on 22 September, 2017. Forty five days old seedlings were transplanted in the main field on 07 November, 2017. The experiment was laid out in a RCB design without replication. The unit plot size was 7.0 × 0.7 m and 10 plants were accommodated in a plot with a plant spacing of 70 cm apart in single row maintaining a row to row distance of 120 cm including 50 cm drain. The land was fertilized with cowdung-N-P-K-S-Zn-B @ 10,000-170-50-125-18-4.3-1.70 kg/ha, respectively. One third of the cowdung and half of P and full of S, Zn and B were applied during final land preparation. Rest of cow-dung and P and 1/3 of K were applied as basal in pit. One fifth of urea and K were applied after 20 days of transplanting. After that, rest of urea and K were applied in equal four installments at 20 days interval. The intercultural operations (weeding, irrigation, insecticide spray etc.) were done as and when necessary. Data on days to 1st harvest, number of marketable fruit, average fruit weight (g), fruit weight per plant (kg), fruit length (cm), fruit diameter (cm), plant height at 1st harvest (cm), plant height at last harvest (cm), fruit and shoot borer (FSB) infested fruit (%), Bacterial wilt (BW) infestation (%) and fruit yield (t/ha), were recorded from five randomly selected plants per germplasm. Plot means for 11 quantitative characters were used for the statistical analysis.

Genetic diversity was studied following Mahalanobis's [2] generalized distance (D^2) extended by Rao [3]. Based on the D^2 values, the germplasm were grouped into clusters following the method suggested by Tocher [3]. Genetic diversity was studied following Mahalanobis's [2] generalized distance (D^2) extended by Rao [3]. Statistical analyses were carried out using Genstat 5 software.

Results and Discussion

The analysis of variance showed significant differences between the germplasm for all the characters studied indicated the presence of sufficient variability in the germplasm. Based on the degree of divergence 21 germplasm were grouped into five clusters (Table 1). The distribution pattern revealed that maximum number of germplasm (7) was included in cluster V, while cluster II, cluster III, cluster IV included the minimum (3) germplasm each.

Clusters	Number of germplasm/ cluster	Germplasm	Fruit colour	Fruit shape
I	5	SM319	Purple	Cylindrical
		SM323	Purple	Oblong
		SM345	Deep purple	Cylindrical
		SM347	Purple	Oblong
		SM354	Purple	Cylindrical
II	3	SM328	Purple	Oval
		SM351	Green with white stripe	Oval
		SM357	Green with white stripe	Oval
III	3	SM344	Light purple	Elongate
		SM355	Light purple	Elongate
		SM356	Light purple	Elongate
IV	3	SM346	Purple	Cylindrical
		SM350	Purple	Elongate
		SM353	Light green	Cylindrical
V	7	SM317	Purple	Elongate
		SM318	White	Elongate
		SM335	Deep purple	Cylindrical
		SM338	Purple	Elongate
		SM339	Light purple	Round
		SM340	Purple	Oval
		SM343	Purple	Oblong

Table 1: *Distribution of 21 germplasm of eggplant in different clusters.*

The inter cluster distances in all of the cases were larger than the intra cluster distances indicating wider diversity among the germplasm of the distant group (Table 2). The intra cluster distance was maximum in cluster V (4.438) and minimum in cluster III (0.185) indicating the germplasm in cluster V were more heterogeneous and those in cluster III were closely related. The range of the intra cluster distance values indicated homogeneous nature of the germplasm within the cluster I, cluster IV, cluster V and cluster II, cluster III.

Clusters	I	II	III	IV	V
I	3.946	14.754	4.104	9.676	8.650
II		0.638	17.053	8.593	6.106
III			0.185	10.105	11.125
IV				3.912	5.285
V					4.438

Table 2: *Mean intra (bold) and inter cluster distances (D^2) for the 21 eggplant germplasm obtained on the basis of the 11 morphological characters.*

Regarding inter cluster distance, cluster II showed maximum genetic distance with cluster III (17.053) followed by the genetic distance from cluster I and II (14.754) and cluster III and cluster V (11.125) suggesting wide diversity between them and the minimum distance was found between the germplasm of cluster I and III (4.104) followed by cluster IV and V (5.285). Moderate inter cluster distance was also found between cluster I with IV (9.676) and cluster I with V (8.650). The result was supported by scatter diagram (Figure 1).

Differences in cluster means existed for all the characters. In this discussion minimum value for days to 1st harvest, FSB infested fruit and BW infestation is positive for selection, while maximum value positive for rest characters. Cluster I recorded the highest mean for number of marketable fruit (32.40) and second highest for fruit weight per plant (3.12 kg), fruit yield (34.31 t/ha), while plant height at 1st harvest (57.20 cm). Cluster II was constituted of three germplasm and exhibited highest mean value for average fruit weight (147.33 g), fruit weight per plant (3.51 kg), fruit diameter (7.33 cm), fruit yield (38.57 t/ha) and second highest mean value for days to 1st harvest (109.33), plant height at 1st harvest (65.67 cm), while minimum value for FSB infested fruit (15.33%), BW infestation (0.00%), fruit length (13.67 cm). Cluster III was responsible for several minimum mean value viz., average fruit weight (86.33g), fruit weight per plant (2.07 kg), fruit yield (22.73 t/ha) and maximum mean value for fruit length (24.00 cm), days to 1st harvest (114.33), BW infestation (20.00%). Cluster IV was constituted of three germplasm and exhibited highest mean value for plant height at 1st harvest (74.33 cm), plant height at last harvest (126.67 cm), while second highest mean value for number of marketable fruit (25.33), fruit length (22.67 cm) and second lowest mean value for FSB infested fruit (17.00%), BW infestation (3.33%) and lowest mean value for days to 1st harvest (105.00). Cluster V was constituted of seven germplasm and exhibited lowest mean value for number of marketable fruit (21.29), plant height at last harvest (83.14 cm), FSB infested fruit (19.43%). Jagadev., *et al*. [4] reported that the characters contributing maximum to the divergence should be given greater emphasis for deciding the type of cluster for the purpose of further selection and the choice of parents for hybridization.

Characters	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V
Days to 1st harvest	111.20	109.33	114.33	105.00	112.14
Number of marketable fruit	32.40	24.00	24.00	25.33	21.29
Average fruit weight (g)	95.80	147.33	86.33	103.67	122.14
Fruit weight per plant (kg)	3.12	3.51	2.07	2.64	2.62
Fruit length (cm)	20.60	13.67	24.00	22.67	16.00
Fruit diameter (cm)	3.72	7.33	4.07	3.43	6.40
Plant height at 1st harvest (cm)	57.20	65.67	58.67	74.33	63.86
Plant height at last harvest (cm)	84.20	87.67	104.00	126.67	83.14
FSB infested fruit (%)	18.40	15.33	17.50	17.00	19.43
BW infestation (%)	6.00	0.00	20.00	3.33	4.29
Fruit yield (t/ha)	34.31	38.57	22.73	29.04	28.79

Table 3: *Cluster means for 11 characters in 21 eggplant germplasm.*

Based on principal component axes I and II, a two-dimensional scattered plotting diagram (Z1 and Z2) reflecting the position of germplasm are presented in figure 1. It was revealed that from the diagram there were mainly five clusters. Most distantly located germplasm was within cluster II [SM328, SM351, SM357] and cluster III[SM344, SM355, SM356] and cluster I [SM319, SM323, SM345, SM347, SM354] and cluster II [SM328, SM351, SM357]. Distribution pattern of germplasm in the scattered diagram also revealed that considerable variability exist in the germplasm studied.

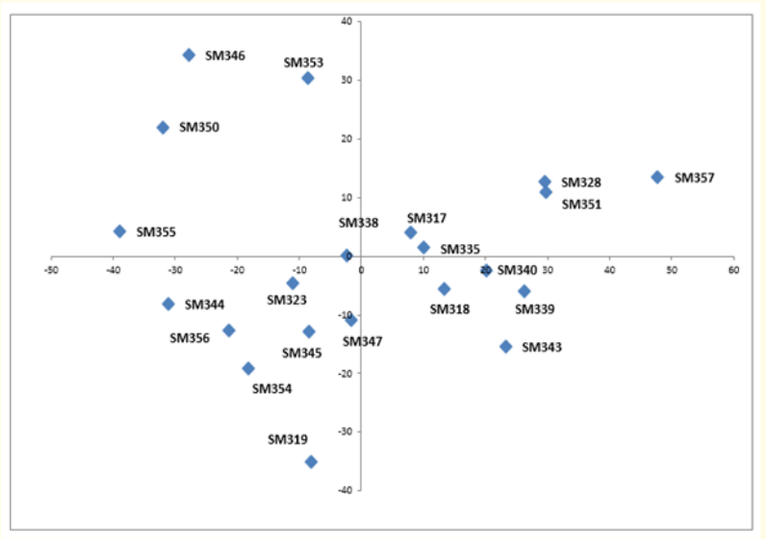

Figure 1: *Distribution of 21 eggplant germplasm in a two-dimensional scatter diagram based on PCA scores superimposed with clusters.*

Contributions of the characters towards divergence are presented in table 4. The canonical analysis revealed that, values in both vectors (Vector I and II) for days to 1st harvest (0.0563, 0.0273), number of marketable fruit (0.0841, 0.6208), fruit weight per plant (0.4303, 0.3791) and fruit yield (0.4305, 0.3787) were positive. Such results indicated that these characters contributed maximum towards divergence of the germplasm. It is interesting to note that the greater divergence among the materials in the present study due to days to 1st harvest, number of marketable fruit, fruit weight per plant and fruit yield will offer a good scope for improvement of yield through rational selection of parents for producing heterotic eggplant hybrids. The major contribution of this character to divergence was well confirmed by their cluster mean; where the ranges varied indicating the major role of this character as differentiate at inter cluster level.

Characteristics	Vector (Z_1)	Vector (Z_2)
Days to 1st harvest	0.0563	0.0273
Number of marketable fruit	0.0841	0.6208
Average fruit weight (g)	0.4313	-0.2256
Fruit weight per plant (kg)	0.4303	0.3791
Fruit length (cm)	-0.4010	0.2807
Fruit diameter (cm)	0.3325	-0.4133
Plant height at 1st harvest (cm)	0.0789	-0.0505
Plant height at last harvest (cm)	-0.2604	0.1019
FSB infested fruit (%)	0.0299	-0.1151
BW infestation (%)	-0.2948	-0.0045
Fruit yield (t/ha)	0.4305	0.3787

Table 4: *Latent vectors for 11 quantitative characters of 21 germplasm of eggplant.*

The cluster means for days to 1st harvest were 105.00 for Cluster IV and 114.33 for Cluster III with a significant difference, which confirmed by the moderate intercluster distance (8.593) between these two clusters. The cluster means for number of marketable fruit were 21.29 for Cluster V and 32.40 for Cluster I with a significant difference, which confirmed by the moderate intercluster distance (8.650) between these two clusters. The cluster means for fruit yield were 22.73 for Cluster III and 38.57 for Cluster II with a significant difference, which confirmed by the moderate intercluster distance (8.650) between these two clusters, while the cluster means for fruit weight per plant were 2.07 for Cluster III and 3.51 for Cluster II with a significant difference. This was also confirmed by the maximum intercluster distance (17.053) between these two clusters.

Conclusion

Considering group distance and other yield contributing performance, the maximum distances existed between cluster II with cluster III and cluster II with cluster III, while cluster II with cluster IV exhibited moderate distances. Cluster I recorded the highest mean values for marketable fruit and second highest for fruit weight per plant, fruit yield, while cluster II recorded the highest mean values for average fruit weight, fruit weight per plant, fruit diameter, fruit yield and second highest mean value for days to 1st harvest, plant height at 1st harvest. Cluster IV exhibited highest mean value for plant height at 1st harvest, plant height at last harvest, while second highest mean value for number of marketable fruit, fruit length and second lowest mean value for FSB infested fruit, BW infestation.

Considering group distance and other agronomic performances, crosses between the germplasm of cluster I with that of cluster II and cluster II with cluster IV would exhibit high heterosis and likely to produce new recombinant with desired traits in eggplant.

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Volume 15 Issue 1 January 2019