Annals of Sri Lanka Department of Agriculture 2017. 19 (2): 138 - 145

GENETIC DIVERSITY ANALYSIS OF BRINJAL (*Solannum melongina* L.) ACCESSIONS GROWN IN UP COUNTRY INTERMEDIATE ZONE OF SRI LANKA USING MORPHOLOGICAL TRAITS

R.M.N.DISSANAYAKE, H.G.B.DARSHANA, W.M.W.S.MARAPANA

Regional Agriculture Research and Development Centre, Bandarawela, Sri Lanka

ABSTRACT

In Sri Lanka, brinjal landraces, wild relatives and farmer varieties are widely available. It is a leading vegetable crop in Sri Lanka in terms of production and extent of cultivation. Badulla district in the Up Country Intermediate zone (UCIZ) is the second largest producer and rich in crop diversity. The aim of the present study was to characterize brinjal germplasm collected from UCIZ using morphological traits and to assess the genetic diversity within germplasm. Thirty eight collected brinjal accessions were used for the study. Morphological characterization of ten plants per accession was studied in an open field using PGRC descriptor as a guideline. Thirteen qualitative and ten quantitative characters were analysed. Cluster analysis was performed using standardized morphological data. Genetic distance of each accession was calculated using Manhattan distance and linkage was computed using complete method. A dendrogram which scale from 0.00 to 68.70 based on similarity coefficient, was constructed and this separated thirty eight accessions into three main clusters. Brinjal accessions did not show any clustering pattern based on the area where they were collected. Accessions in cluster two recorded the highest average fruit weight; however, highest yield was recorded in accessions in cluster one. Accessions in cluster three were recorded lowest yield with intermediate branching habit. There was a high similarity coefficient among accessions, however all the accessions differ from each other. Results proved that morphology based analysis was effective in differentiating brinjal accessions.

Key words: Brinjal, Cluster analysis, Genetic Diversity, Morphological traits, Germplasm

INTRODUCTION

Brinjal (*Solannum melongina* L.) is recognized as one of the most important member of the Solanaceae family which includes economically important species such as potato, tomato, pepper and tobacco. (Donglar *et al*., 2002; Knapp *et al*., 2013). Brinjal is believed to have originated in Asia in the

Indo-Burmese region (Ishiiki *et al*., 1994). Its close relatives *S. aethiopicum* (scarlet brinjal) and *S. macrocarpon* (Gbomabrinjal) are of African origin. Three origins of domestication have been suggested (India, china and Malayasia) and recent views tend to agree on a minimum of two domestication events in favor of India and China (Knapp *et al*., 2013). Although brinjal is not native to Sri Lanka, landraces, farmer varieties and wild relatives are widely available within the country. Brinjal is grown extensively as a cash crop mostly by small scale farmers in the country and it is available in the market throughout the year. Total extend under the cultivation is about 11,635 ha with a total production about 128,595 t at an average yield of 11.05 t/ha (AgStat, 2015).

Badulla district is the second largest brinjal producer of the country in Up Country Intermediate zone (UCIZ) and rich in different brinjal accessions and farmer varieties. Those could be a source of desirable traits for improvement of existing brinjal varieties in the country. In addition, the global interest in development of cultivar has encouraged germplasm collection and preservation. Hence, these resources are of immense importance to plant breeders as a reservoir of genetic variation. Characterization and evaluation of plant germplasm is vital for identification of desirable accessions for utilization in breeding programs (Upadhyaya *et al*., 2008). Hence, the aim of the present study was to characterize brinjal accessions collected from UCIZ of Sri Lanka using morphological traits and to assess the genetic diversity within these germplasm.

MATERIALS AND METHOD

Eighty eight accessions of brinjal, which were collected from UCIZ were used in this study. The preliminary evaluation of germplasm was conducted during 2013/14 *Maha*. The morphological characterization of ten plants per accession was accomplished in an open field and germplasm was narrowed down to thirty eight accessions by removing duplicates. Superior plant of each accession was selected and harvested separately to extract seeds. During 2014/15 *Maha* progeny rows of superior plants were planted and morphological characterization of ten plants per accession was accomplished

in an open field at Regional Agriculture Research and Development Centre, Bandarawela. The Plant Genetic Resource Centre descriptor for brinjal was used to characterize accessions. Thirteen qualitative characters (growth habit, petiole colour, leaf blade colour, leaf blade lobing, intensity of leaf prickels on upper surface of leaf, corolla colour, fruit position, fruit length/diameter ratio, fruit curvature, fruit shape, fruit colour distribution, primary fruit colour, secondary fruit colour) and ten quantitative characters (leaf blade length, leaf blade width, plant height at flowering stage, days to flowering, number of flowers per inflorescence, length of mature fruit, fruit diameter, number of fruits per inflorescence, number of fruits per plant, weight of fruit at table use maturity) were employed in this study.

The quantitative data was subjected to statistical analysis including descriptive statistics, simple correlation coefficients and cluster analysis where as qualitative data was analyzed through frequency distribution. Cluster analysis was performed using Minitab version 17. Genetic distance of each accession was calculated using Manhattan distance and linkage was computed using complete method.

RESULT AND DISCUSSION

Quantitative characters

Descriptive statistics of brinjal accessions displayed variability in different quantitative parameters evaluated (Table 1). Fruit weight remained the highly variable parameter among the 38 accessions of brinjal investigated. Plant height and number of days to flowering displayed a moderate to high variability in Brinjal germplasm. Number of days to flowering varied ranging from 44 days to 85 days where as plant height ranged from 55 cm to 90 cm. Leaf length, leaf width, fruit length and fruit width showed medium to low variation among the accession studied. In a similar type of study parameters such as plant height and leaf size showed same results with the current study (Hazra *et al*., 2003). A low genetic variability was observed for the traits flowers/inflorescences, fruits/inflorescences indicating narrow genetic base of the germplasm for these traits.

Table 1. Descriptive statistics for various traits recorded in brinjal germplasm.

Variable	Mean±SE	SD	Sample Variance	Min	Max
Leaf blade length (cm)	24.98±0.68	4.19	17.55	14.80	30.30
Width of leaf blade (cm)	14.67±0.41	2.55	6.50	6.30	19.60
Plant height (cm)	60.25±2.15	10.28	105.67	55.00	90.00
Days to flowering	63.14±2.79	13.07	170.82	44.00	85.00
Flowers/inflorescences	2.91±0.10	0.64	0.41	2.00	4.00
Fruits/inflorescences	1.10±0.05	0.311	0.09	1.00	2.00
Fruit length (cm)	23.60±0.80	4.98	24.80	14.00	36.00
Fruit diameter (cm)	5.82±0.72	3.59	12.88	3.00	9.00
Mature fruit weight (g)	89.52±12.4	25.83	667.18	55.00	200.00
Fruits per plant	37.58±1.23	6.32	39.94	21.32	57.82

Qualitative characters

The frequency distribution pattern of qualitative characters in brinjal showed diversified results. The predominant growth habit was upright (89%) followed by intermediate (7%) and postrate (2%) growth habit. In the case of petiole colour, the percentage of greenish violet petioles was 89 % and the rest of the accessions had violet petioles while in case of leaf blade colour the percentage of green colour, dark green, light green and violet was 37% ,34 % , 18% and 3%. The leaf blade lobbing was weak (42%) followed by strong (37%) and intermediate (21%). The dominant flower colour was purple (74%) and remaining had light purple (10%), greenish white (8%) and white flowers (7.89). In plant branching, percentage of weak branching habit is very high (84%) than and intermediate branching habit (16%). The fruit shape was mostly ¼ away from base tip (84%) followed by ½ away from base tip (13%)¾ away from base tip (3%) where as the percentage of slightly curved fruits was 47 straight is 29, snake shape is 16 and sickle shape is 8. Percentage purple to dark purple colour fruit was equal 45% followed by pink colour fruits (8%), and green (8%). Majority of fruits has stripped fruit colour distribution (87%) and rest was uniformed (13%). Eighty two percent of fruits that has stripped fruit colours had white colour as secondary fruit colour and remaining had green colour. All the plants were recorded erect fruit positioning.

Trait association

The correlation coefficients displayed significant results for various quantitative traits (Table 2). Leaf length and leaf width revealed positive and highly significant correlation with each other, indicating that an increase/decrease in one parameter will directly influence the increase/decrease of the other parameter. Leaf width and leaf blade length also presented positive correlation with all fruit characters. Plant height significantly exhibited a positive correlation with all leaf parameters and also with fruit diameter, mature fruit weight and number of fruits per plant. Mature fruit weight and diameter of mature fruit also exhibited a highly significant positive correlation with each other. Similar results of correlation between fruit diameter and fruit weight were also observed in a recent study (Chattopadhyay *et al.,* 2011). There was a significant and negative correlation between number of flowers per inflorescence with fruit diameter and fruit weight, which indicating that more number of flowers per axil results in less fruit diameter and low fruit weight and *vise versa*.

Cluster analysis

Cluster analysis categorized 38 brinjal accessions into three main groups (I, II and III) at Manhattan distance of 45.80 (Figure 1). Group-I contained six accessions, group-II contained twenty four accessions whereas group-III comprised of 8 accessions. On the basis of Manhattan distance accessions 023 and 002 showed very close relationship with each other. Besides accessions 006 and 003 were also found closely related with each other and also presented a significant association between both of the accessions because of their mostly similar morphological characters. The accessions denoting high mean values for different traits were grouped into cluster-1 followed by cluster-2. Similarly the accessions with smaller mean values for different parameters were clustered together in cluster-3. Hence the lowest mean for all leaf parameters were found in cluster-3 while cluster-1 has the highest.

Table 2. Comparison of correlation coefficient traits in brinjal Germplasm.

Traits		LL	LW	PH	DF	FWI	FRI	FL	FD	FW
Leaf blade length (cm)	LL									
Width of leaf blade (cm)	LW	0.78**								
Plant height (cm)	PH	0.58**	0.52*							
Days to flowering (No)	DF	0.05	0.01	-0.25						
Flowers/inflorescences (No)	FWI	0.18	0.07	-0.02	0.34					
fruits/inflorescences (No)	FRI	0.16	0.05	-0.01	0.25	0.82**				
Fruit length (cm)	FL	0.47*	0.52*	0.24	-0.25	-0.41*	-0.47*			
Fruit diameter (cm)	FD	0.46*	0.45*	0.46*	-0.24	-0.21	-0.25	0.31		
Mature fruit weight (g)	FW	0.52*	0.48*	0.51*	-0.18	-0.24	-0.48*	0.59**	0.87**	
Fruits per plant (No)	FP	0.54*	0.53*	0.52*	-0.14	0.75**	0.47	0.02	0.03	0.02

Note: *significant at 0.05 probability level and **significant at 0.01 probability level

Similarly, plant height also showed significant variation with maximum values exhibited by cluster 1, followed by cluster 2 and cluster 3. Number of days to flowering in cluster 1 and cluster 3 results are almost same, while cluster 2 shows early flowering as compared to cluster 1 and 3. Maximum flowers per inflorescence were in cluster 1 and minimum in cluster 2. The most economic important parameters of brinjal production is its fruit length, fruit diameter and fruit weight, so accessions in cluster-2 can be used to develop cultivars with maximum fruit size and fruit weight with stripes. Results indicated that brinjal accessions did not show any clustering pattern based on the area where they were collected.

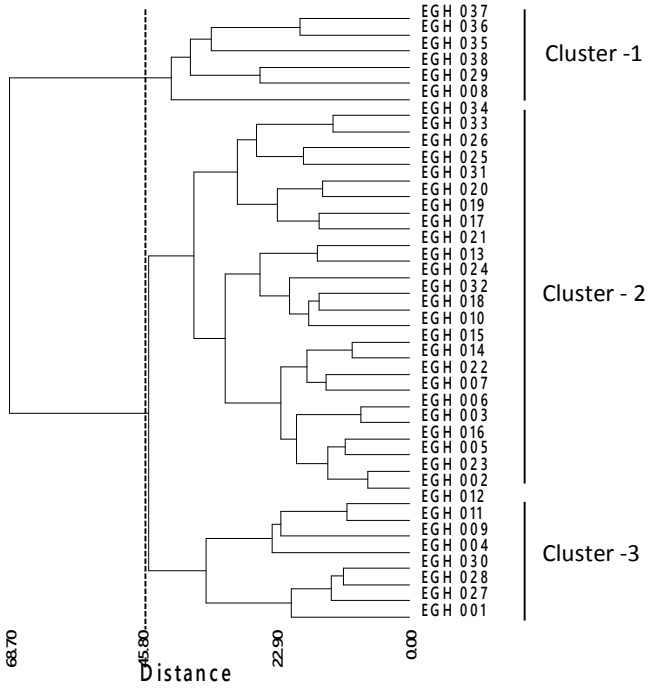

Figure 1. Dendrogram developed according to the Manhattan distance of *S. melongina* accessions based on morphological characters.

CONCLUSION

According to the morphological characterisation significant variations were observed among the tested accessions. Fruit weight showed the highest diversity among the accessions. Cluster analysis divided these accessions into

three groups. Fruit weight and fruit yield were the two main characters responsible to group these accessions into different clusters. Based on these data donor parents can be identified for the bringal breeding program.

ACKNOWLEDGEMENT

Authors wish to express their sincere thanks to the Deputy Director of RARDC, Bandarawela and Former Director, HORDI Dr. Hemal Fonseka for their encouragement given for this study.

REFERENCES

AgStat. 2015. Socio Economic and Planning Centre, Department of Agriculture, Peradeniya.

Chattopadhyay, A., S. Dutta and P. Hazra. 2011. Characterization of genetic resources and identification of selection indices of Brinjal (*Solannum melongena* L.) grown in Eastern India. Veg. Crops Res. Bull., 74: 39-49.

Donglar, S., Frary, A., Daunay, M.C., Lester and R.N., S.D. Tanksley. 2002. Conservation of gene function in the Solanaceaeas revealed by competitive mapping of domestication in eggplant genetics. 161 : 1713-1726.

Hazra, P., A. Rout, U. Roy, S. Nath and T. Roy. 2003. Characterization of brinjal (*Solannum melongena* L.) germplasm. Vegetable Science. 30: 145-149.

Hills, D. M., 1987. Molecular versus morphological approaches to systematics. Annual Review of Ecology, Evolution and Systematics. 18 : 23-42 S. Isshiki, H. Okuba, K. Fujieda (1994b). Genetic control of isozymes in eggplant and its wild relatives. Euphyticaol.80:145-150.

Isshiki, S., H. Okuba, K. Fujieda. 1994. Phylogeny of eggplant and related *Solannum* species constructed by allozyme variation. Scientia Horticulture. 59: 171-176.

Knapp, S., M.S. Vorontsova, J. Prohens. 2013. Wild relative of eggplant (*Solannum melongina* L.: Solanaceae). New understanding of species name in a complex group. *PLoS ONE* 8(2)

Upadhyaya, H.D., C.L.L. Gowda and D.V.S.S.R Sastry. 2008. Plant genetic resources management:Collection, characterization, conservation and utilization. Journal of SAT Agricultural Research. 6: 1-16.