Selection of Variety with High Performance Rose Apple (*Syzygium jambos*) Variety can be achieved with Morpho-Taxonomic Characterization

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Rose apple (*Syzygium jambos*) is a popular fruit native to Southeast Asia. The blossoms contain hundreds of stamens and the fruits are crisp, juicy with distinct rose scent. The fruits are palatable with a moderate sweet taste. Rose apple contains low fibre level, appreciable level of vitamin C, some level of acid, protein and ash content. *In-situ* characterization and preliminary evaluation are performed following Biodiversity International Tropical Fruit Descriptor. Total 6 numbers of accessions were taken under the study, the tree age varied from 18yrs to above 20yrs. Height and trunk girth varied from 8m to above 12m and 124.00 cm to 205.00 cm in studied accessions. Leaf characters in rose apple reveals lanceolate leaf blade shape, narrowly acuminate leaf apex, cuneate leaf base, opposite leaf orientation and arcuate leaf venation. Length of the leaf blade ranges from 19.21 cm to 25.04 cm and breadth varies from 4.08 cm to 6.54 cm. Maximum fruit weight (27.36 g), seed weight (12.11 g) in ACC-3 and maximum number of seeds (2.4) in ACC-4 and ACC-3 were recorded. TSS ranged from 5.08° Brix (ACC-4) to 6.08° Brix (ACC-2). Average linkage technique clustering when applied on squared Euclidean distance matrix a total of 4 clusters were formed for plant physical parameters, fruit physical parameters and for fruit biochemical parameters.

Introduction

Syzygium jambos belonging to family Myrtaceae is a tree originated in Southeast Asia. *Syzygium jambos* is a medium sized tree upto 15 metres height with a low branching tendency. The edible fruit is guava shaped with thin, waxy skin which is extremely sensitive and has a pleasant floral aroma. They are eaten fresh or processed into jellies and jams, as they have high levels of pectin.

The tree is rich in tannins that are of some antimicrobial interest. The ash content of rose apple is 0.144%, 0.132% protein, 0.002% fibre, 0.66% fat and 4.10% total soluble solid.

Rose apple is a kind of a fruit that can serve as a raw material in wine and fruit juice production (Bolarin *et al*., 2016).

Tuiwawa *et al.,* (2013) has documented twenty species of *Syzygium* occurring in Vanuatu region and identification keys are provided for flowering and vegetative material. Morphological variation of a crop indicates the genetic diversity and effect from environment. Both environmental and genetic effects contribute to phenotypic variation within and among populations (Andrew *et al*., 2010). Exploration, conservation, utilization and correlation of different traits were studied under the topic genetic diversity of minor fruit in environmental condition of Tirana zones.

The study aimed to evaluate and characterize the available genotypes, to identify the genotypes with better characteristics for further propagation and uniformity plantation (Koka, 2012). Intensive work on germplasm collection, evaluation and improvement has been done on lasora, karonda and khejri which resulted in identification of some high yielding genotypes in these crops (Meghwal, 2018). To safeguard the existing diversity of this fruit and to achieve sustainable development based on use of available genetic wealth, promotion and conservation of this species is of immense importance.

Materials and Methods

Different agroclimatic zones of West Bengal were stratified depending on availability of fruit crop and on convenience of the study. The study has been carried out in Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal during the years 2013-2015.

Data for this study has been generated through key informant survey and individual household survey from respondents by using semi-structured questionnaire. *In-situ* characterization and preliminary evaluation of under-utilised/minor fruit Rose apple (*Syzygium sps.*) are performed following Biodiversity International Tropical Fruit Descriptor.

The general information like age of the plant, behaviour of the plant was documented by making a questionnaire at the time of the survey. The genotypes were selected randomly with their varying age and location, which were further given accession numbers considering each accession as a treatment and replicating it for five times for all the quantitative parameters.

The analysis has been carried in three parts according to the variation in age of the plants and observations to be recorded. Under the observation for characterization, the plant physical parameters has been analyzed and so for preliminary evaluation fruit physical parameters and fruit biochemical parameters has been analyzed.

Multivariate analysis of characterization and evaluation parameters will be done following nearest neighbourhood method of hierarchical clusters analysis of squared Euclidean distance matrix on the basis of characters measured following Dillon and Goldstein (1984).

Results and Discussion

Total 6 numbers of accessions were taken under the study, 5 numbers of accessions belonged from institutional farm and 1 from Fatepur (Nadia district) Table 1. Branching pattern was observed to be irregular, semi circular crown shape and spreading type tree growth habit in all the accessions Table 2. Leaf characters in rose apple revealed lanceolate leaflet blade shape, narrowly acuminate leaflet apex, cuneate leaflet base,

opposite leaf orientation and arcuate leaf venation in all the observed accessions Table 3. Studies on morphology of Rose apple fruits has been documented in which spreading tree growth habit, long oblong-lanceolate leaves and almost spherical fruit characters has been reported (Mazumdar, 2004).

The proximity value of 114.51 between ACC-2 and ACC-6 denoted the maximum similarity followed by 117.29 between ACC-1 and ACC-4. The maximum value 6569.38 between ACC-3 and ACC-5 denoted the maximum dissimilarity for plant physical parameters Table 4.

Average linkage technique clustering when applied on squared Euclidean distance matrix a total of 4 clusters were formed for plant physical parameters. The data presented in the Table 5 and Fig. 1 showed that 1 to 2 clusters comprised of homogeneous types having similarity in characterization attributes. Cluster 3 and cluster 4 comprised of single member namely ACC-5 and ACC-3. ACC-2 and ACC-6 formed the first cluster at the distance of 114.51 followed by 117.29 between ACC-1 and ACC-4 which formed the second cluster.

The value 0.72 between ACC-5 and ACC-6 followed by 1.06 between ACC-4 and ACC-6 denoted maximum similarities for fruit physical parameters. The maximum value 22.40 between ACC-1 and ACC-3 denoted minimum similarity Table 6.

Average linkage technique clustering when applied on squared Euclidean distance matrix a total of 4 clusters were formed for fruit physical parameters. The data presented in the Table 7 and Fig. 2 shows that cluster 1 comprised of homogeneous types having similarity in characterization attributes. On the other hand 2 to 4 cluster comprised single member namely ACC-1, ACC-3 and ACC-2.

The first cluster comprised of ACC-5 and ACC-6 paired at the coefficient distance 0.72 followed by ACC-4 at the coefficient distance 1.34.

ACC-5 and ACC-6 with minimum value 1.43 denoted the maximum similarity followed by 8.37 between ACC-4 and ACC-5. The maximum value 2145.46 between ACC-2 and ACC-3 denoted minimum accessions similarity for fruit bio-chemical parameters Table 8.

Haque *et al.,* (2009) reported a study of five minor and three major fruits for nutritional and physico-chemical properties. The fruits were analyzed to determine the edible portion, pH, titratable acidity, moisture, total soluble solid, reducing sugar, total sugar, crude fibre etc.

Average linkage technique clustering when applied on squared Euclidean distance matrix a total of 4 clusters were formed for fruit biochemical parameters. The data presented in the Table 9 and Fig. 3 shows that cluster 1 comprised of homogeneous types having similarity in characterization attributes.

On the other hand cluster 2 to 4 comprised single member namely ACC-3, ACC-1 and ACC-2. The first two accessions to pair were ACC-5 and ACC-6 at the coefficient distance 1.43 followed by ACC-4 at the coefficient distance 9.91 respectively.

Documentation regarding great variabilities in the physico-chemical composition of Bael, Jack fruit and many other minor fruits has been reported by Singh (2001). Bal (2003) has documented on genetic diversity of some under-utilized fruit crops, namely Dhaeu and Karonda in Punjab to identify and conserve superior genotypes. Physico-chemical characters, maturity period and yield components had wide range of variability.

Table.1 General experimental site details of Rose apple accession

Accession no.	Name of owner	Address	Site of characterization	
ACC-1	Hamida Banu	Fatepur, Jaguli (Nadia)	22°56'17.40"	088°35'16.87"
ACC-2	B.C.K.V.	Mandouri farm (Nadia)	22°56'51.09"	088°31'1.58"
ACC-3	B.C.K.V.	Mandouri farm (Nadia)	22°56'51.09"	088°31'1.58"
ACC-4	B.C.K.V.	Mandouri farm (Nadia)	22°56'51.09"	088°31'1.58"
ACC-5	B.C.K.V.	Mandouri farm (Nadia)	22°56'51.09"	088°31'1.58"
ACC-6	B.C.K.V.	Mandouri farm (Nadia)	22°56'51.09"	088°31'1.58"

Table.2 General tree characteristics of Rose apple accession

Accession no.	Branching pattern	Tree growth habit	Crown shape
ACC-1	Irregular	Spreading	Semi circular
ACC-2	Irregular	Spreading	Semi circular
ACC-3	Irregular	Spreading	Semi circular
ACC-4	Irregular	Spreading	Semi circular
ACC-5	Irregular	Spreading	Semi circular
ACC-6	Irregular	Spreading	Semi circular

Table.3 Leaf characters of Rose apple accession

Accession no.	Leaf blade shape	Leaf apex shape	Leaf base shape	Leaf Orientation	Leaf Venation
ACC-1	Lanceolate	Narrowly Acuminate	Cuneate	Opposite	Arcuate
ACC-2	Lanceolate	Narrowly Acuminate	Cuneate	Opposite	Arcuate
ACC-3	Lanceolate	Narrowly Acuminate	Cuneate	Opposite	Arcuate
ACC-4	Lanceolate	Narrowly Acuminate	Cuneate	Opposite	Arcuate
ACC-5	Lanceolate	Narrowly Acuminate	Cuneate	Opposite	Arcuate
ACC-6	Lanceolate	Narrowly Acuminate	Cuneate	Opposite	Arcuate

Table.4 Proximity Matrix for Rose apple plant physical attributes

	Squared Euclidean Distance				
	1:ACC-1	2:ACC-2	3:ACC-3	4:ACC-4	5:ACC-5
2:ACC-2	504.07				
3:ACC-3	4214.16	1833.53			
4:ACC-4	117.29	150.45	3023.50		
5:ACC-5	283.66	1484.15	6569.38	716.80	
6:ACC-6	1060.79	114.51	1049.45	514.98	2382.18

This is a dissimilarity matrix

Table.5 Details of clusters for characterization variables using average linkage clustering methods on squared Euclidean distance matrix for Rose apple plant physical characters

No. of clusters	Cluster members (Allowed distance co-efficient 117.29)
1	Acc-2, Acc-6
2	Acc-1, Acc-4
3	Acc-5
4	Acc-3

Table.6 Proximity matrix for Rose apple fruit physical attributes

	Squared Eusclidean Distance				
	1:ACC-1	2:ACC-2	3:ACC-3	4:ACC-4	5:ACC-5
2:ACC-2	4.45				
3:ACC-3	22.40	44.00			
4:ACC-4	5.98	20.44	6.32		
5:ACC-5	4.28	15.02	7.72	1.62	
6:ACC-6	2.56	13.06	10.16	1.06	.72

This is a dissimilarity matrix

Table.7 Details of clusters for characterization variables using average linkage clustering methods on squared Euclidean distance matrix for Rose apple fruit physical characters

No. of clusters	Cluster members (Allowed distance co-efficient 1.34)
1	Acc-5, Acc-6, Acc-4
2	Acc-1
3	Acc-3
4	Acc-2

Table.8 Proximity matrix for Rose apple fruit biochemical attributes

	Squared Euclidean Distance				
	1:ACC-1	2:ACC-2	3:ACC-3	4:ACC-4	5:ACC-5
2:ACC-2	15.37				
3:ACC-3	1817.39	2145.46			
4:ACC-4	897.00	1123.01	177.00		
5:ACC-5	891.57	1125.42	164.02	8.37	
6:ACC-6	890.75	1123.87	164.90	11.45	1.43

This is a dissimilarity matrix

Table.9 Details of clusters for characterization variables using average linkage clustering methods on squared Euclidean distance matrix for Rose apple fruit bio-chemical characters

No. of clusters	Cluster members (Allowed distance co-efficient 9.91)
1	Acc-5, Acc-6, Acc-4
2	Acc-3
3	Acc-1
4	Acc-2
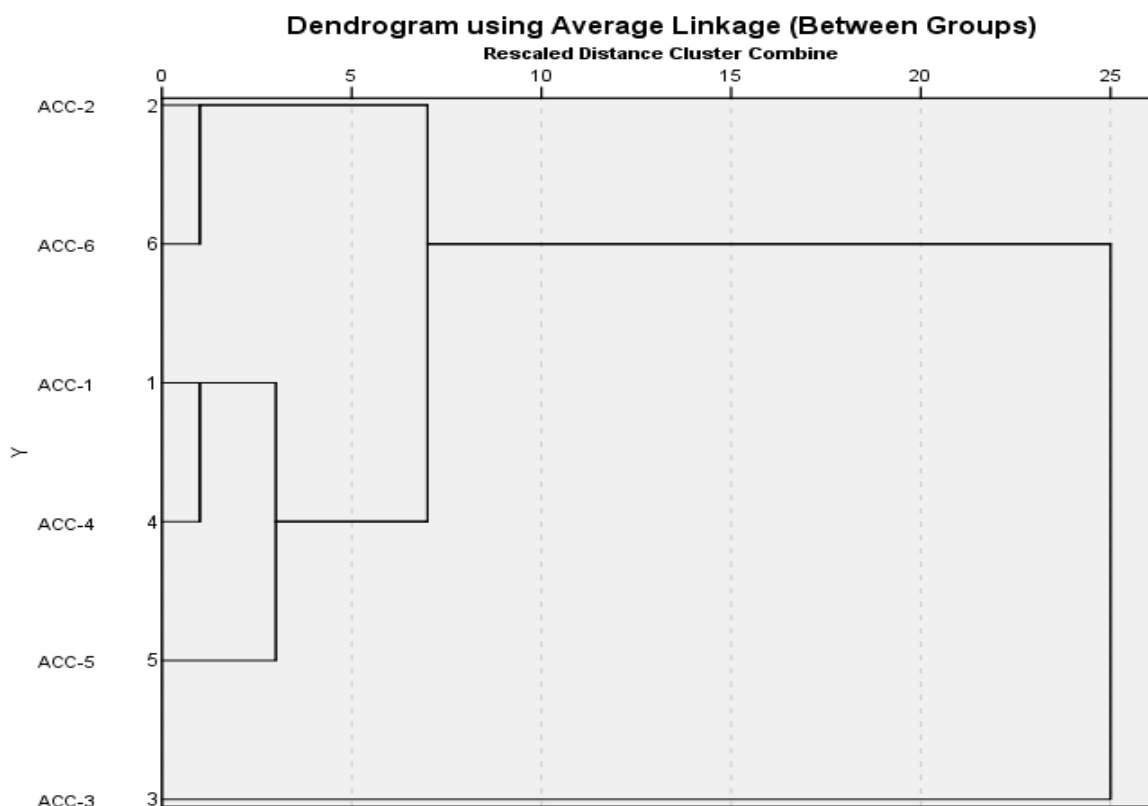
Fig.1 Dendrogram using average linkage hierarchical clustering of squared Euclidean distance matrix for Rose apple plant physical attributes
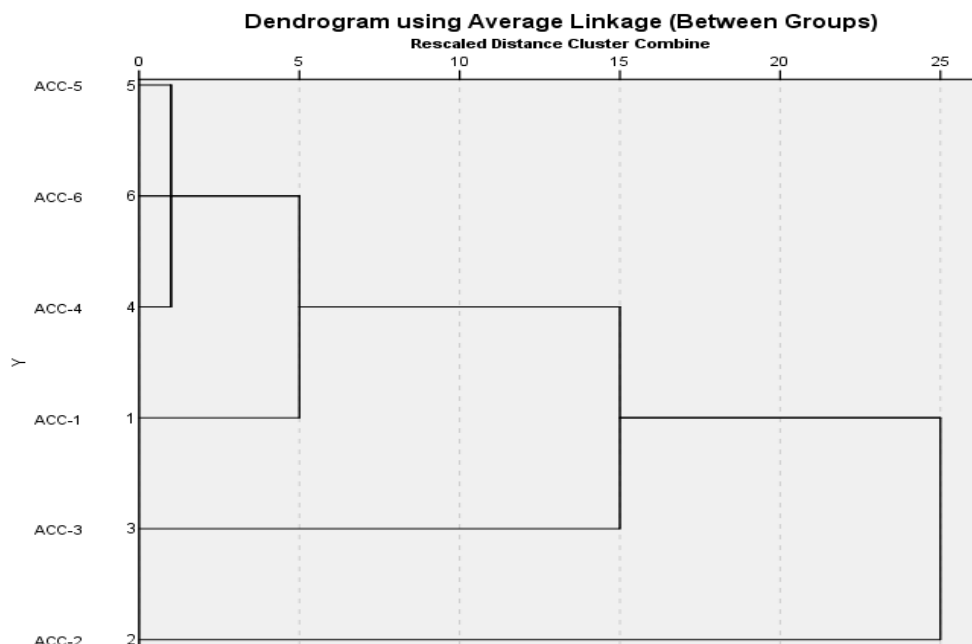
Fig.2 Dendrogram using average linkage hierarchical clustering of squared Euclidean distance matrix for Rose apple fruit physical characters
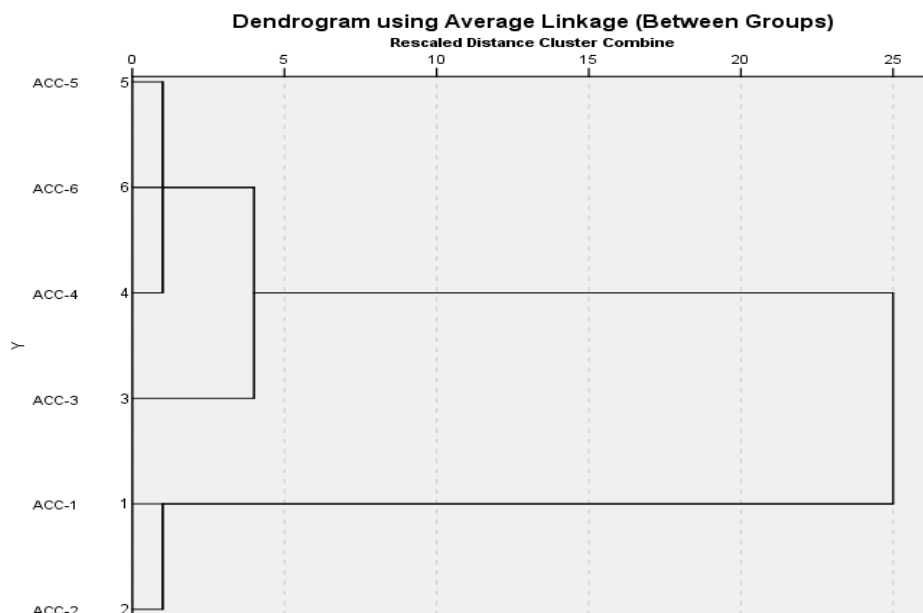

Fig.3 Dendrogram using average linkage hierarchical clustering of squared Euclidean distance matrix for Rose apple fruit bio-chemical characters

During the course of survey total 6 numbers of accessions were taken under the study, the tree age of rose apple accessions varied from 18yrs to above 20yrs in different germplasm. Height and trunk girth varied from 8m to above 12m and 124.00 cm to 205.00 cm girth.

Branching pattern was observed to be irregular, semi-circular crown shape and spreading type tree growth habit in all the accessions. Leaf characters in rose apple reveals lanceolate leaf blade shape, narrowly acuminate leaf apex, cuneate leaf base,

opposite leaf orientation and arcuate leaf venation. Length of the leaf blade ranges from 19.21 cm to 25.04 cm and breadth varies from 4.08 cm to 6.54 cm. Maximum fruit length was recorded in ACC-1 (3.32 cm) and breadth of 3.32 cm in ACC-4. Maximum fruit weight (27.36 g), seed weight (12.11 g) in ACC-3 and maximum number of seeds (2.4) in ACC-4 and ACC-3 were recorded.

TSS ranged from 5.08° Brix (ACC-4) to 6.08° Brix (ACC-2). Maximum total sugar 5.81 mg/100 gm (ACC-6), pulp reducing sugar 17.85 mg/100 gm (ACC-3), acidity 0.581 mg/100 gm (ACC-5) and Vit.C 71.00 mg/100 gm (ACC-3) has been recorded. Average linkage technique clustering when applied on squared Euclidean distance matrix a total of 4 clusters were formed for plant physical parameters, fruit physical parameters and for fruit biochemical parameters.

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