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Genome characterization of banana genetic resources of Mizoram, India

P. C. Lalrinfela and Robert Thangjam*

Department of Biotechnology, Mizoram University, Aizawl 796 004, India

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ABSTRACT

Mizoram is located in the region considered as the origin of edible bananas and plantains. Various wild and edible banana and plantains are found in the state that have to be characterized systematically. Fourteen (14) varieties of banana were collected in Mizoram and characterized using morphological parameters. 10 varieties were identified under *Musa paradisiaca*, 1 under *M. acuminata* and 1 under *M. balbisiana*. In addition, 2 other varieties were identified as *Ensete glaucum* and *M. ornata* respectively. Based on the morphological scores, the genome groups of 12 varieties belonging to Eumusa section were established under AB, AAB, ABB, AAA, BB and ABBB groups. The findings of this study will provide useful information on the status of the banana genetic resources of Mizoram and formulation of their conservation strategies.

Key words: Banana; genetic resources; genome; morphological characters.

INTRODUCTION

Banana is regarded as one of the most important food items as it is high in nutrients and commercial value throughout the tropics of the world. It is considered as a major tropical fruit crop distributed in more than 120 countries with an annual production of 102 million tonnes.[1] Banana belongs to the family Musaceae, which consists of two genera *Musa* L. and *Ensete* Bruce. It is highly diversified throughout the world but reported to have originated from Southeast Asia.[2] The genus *Musa* consists of around 50 species while *Ensete* has 9 species.[3,4] On the basis of phenotypic traits and basic chromosome number, *Mus*a has been divided into four sections namely, Eumusa, Rhodochlamys, Australimusa and Callimusa.[4] The Eumusa constitutes the sources of edible bananas derived from the two wild diploid progenitor species *M. acuminata* (designated as AA genome) and *M. balbisiana* (designated as BB genome) which leads to the origin of different ploidy levels of banana varieties (AB, AAB, ABB and ABBB) through intra and inter-specific crosses.[5] India is the largest producer with the annual production of 13.5 mt from an area of 400,000 lakh ha.[6] Northeast India has been

Corresponding author: R. Thangjam
Phone +91-9436151276
E-mail: robertthangjam@gmail.com

considered as the richest sources of banana diversity in which the clones of *M. balbisiana* from Indian subcontinent hybridize with *M. acuminata* from Southeast Asia.[7] Knowledge of the status of genetic resources of plants is a requisite for its proper understanding and implementation of conservation and sustainable utilization. Wild and cultivated bananas are abundantly available in Mizoram, which is one of the states of Northeast Indian region. However, proper survey, documentation and characterization of genetic resources have not been carried out. Thus, the present study was undertaken to evaluate the status of banana genetic resources of Mizoram.

MATERIALS AND METHODS

Survey and collection of the samples

The distribution of banana varieties in different parts of Mizoram was obtained from the consultation of the concerned officials of Agriculture and Horticulture department of Mizoram and the regional farmers. The collection was done based on the agro-climatic condition of Mizoram in 8 places under three districts of tropical, sub-tropical and temperate region to avoid duplication of the samples (Table 1). The collected samples were planted and maintained a germplasm in the department of Biotechnology, Mizoram University, Aizawl, Mizoram. Each sample was provided unique accession numbers and also the passport data were recorded based on the descriptors provided by IPGRI.[8]

Morphological identification and characterization

Identification and classification of the different samples were carried out based on the keys provided by Singh *et al.*[9] Scoring of the 15 morphological characters were carried out using the IPGRI descriptors for banana (Table 2).[8] Genome classification of the samples were carried out based on the identity of A and B genome of *M. acuminata* and *M. balbisiana* respectively by using modified scores of Singh and Uma (1996).[10]

RESULTS AND DISCUSSION

The present study was undertaken to evaluate the status of genetic resources of both cultivated and wild banana clones in Mizoram. A total of 14 varieties were collected from different regions of Mizoram and maintained in the field gene bank of the Department of Biotechnology, Mizoram University, Aizawl (Fig. 1). The passport data of each sample were recorded based on the IPGRI descriptors and unique accession numbers were assigned. Overall a total of 14 different varieties were identified based on the keys provided by Singh *et al.*[9] Details of the samples collected on their identification and the local names were given in Table 3. Majority of the 14 samples collected were identified as *M. paradisiaca* clones, i.e. 10 (changpui, banria, lawngbalhla, changkha, lairawk, banthur, kawlbahla, changpawl, banpawl and balhlasen) while 1 accession under *M. acuminata* (balhlakual) and *M. balbisiana* (changthir).

Based on the modified morphological scores of Singh and Uma (1996)[10] 12 samples were classified into different genome groups and while 2 others were identified as *Ensete glaucum* (saisu) and *M. ornata* (changvandawt). Since *Ensete* belongs to a different genera and *M. ornata* under the Rhodochlamys section, they were not considered for genomic classification as under A or B groups (Table 3). Only 1 sample (changthir) was classified under BB group, 1 under AAA (balhlakual), 4 under AB (changpui, changkha, lairawk and changpawl), 3 under AAB (lawngbalhla, banthur and balhlasen) and two under ABB group (banria and banpawl).

Thus, the present study revealed the occurrence of varied clones of A and B genomes of banana in Mizoram. In addition, the occur-

Figure 1. Banana genetic resources of Mizoram collected for the present study.

Table 1. Information of the different collection sites of Mizoram for banana collection.

Agroclimatic Region	Collection site	District	Longitude	Latitude	Altitude (masl)
Sub-tropical	Aizawl	Aizawl	92°43′3″E	23°43′27″N	1132
Tropical	Tanhril	Aizawl	92°40′16.6″E	23°4′34″N	801
Tropical	Tuivamit	Aizawl	92 °40′51″E	23°44′35″N	801
Tropical	Sesawng	Aizawl	92.8°0′0″E	23.7°0′0″N	803
Tropical	Lungsen	Lunglei	92.5°0′0″E	22.9°0′0″N	394
Tropical	Tlabung	Lunglei	92.4°0′0″E	22.9°0′0″N	21
Temperate	Champhai	Champhai	92°43′3″E	23.5°0′0″N	1678
Sub-tropical	Mualkawi	Champhai	93.6 ° 5′0″E	23.6°0′0″N	1012

Table 2. Characters used in the classification of bananas through a taxonomic scorecard.

Sl. No	Characters	*Musa acuminata*	*Musa balbisiana*
1	Pseudostem color	More or less heavily marked with brown or black blotches	Blotches slight or absent
2	Petiolar canal	Margin erect or spreading, with scarious wings below, not clasping pseudostem	Margin enclosed, not winged below, clasping pseudostem
3	Peduncle	Usually downy or hairy	Glabrous
4	pedicel	Short	long
5	Ovules	Two regular rows in each loculus	Four irregular rows in each loculus
6	Bract shoulder	Usually high (ratio < 0.28)	Usually low (ratio > 0.30)
7	Bract curling	Bract reflex and roll back after opening	Bracts lift but do not roll
8	Bract shape	Lanceolate or narrowly ovate, tapering sharply from the shoulder	Broadly ovate, not tapering sharply
9	Bract apex	acute	obtuse
10	Bract color	Red, dull purple or yellow outside; pink, dull purple or yellow inside	Distinctive brownish-purple outside; bright crimson inside
11	Color fading	fading Inside bract color fades to yellow towards the base	Inside bract color continuous to base
12	Bract scars	Prominent	Scarcely prominent
13	Free tepal of male flower	Variably corrugated below tip	Rarely corrugated
14	Male flower color	Creamy white	Variably flushed with pink
15	Stigma color	Orange or rich yellow	Cream, pale yellow or pale pink

Table 3. List of banana varieties of Mizoram and genome classification based on morphological scores.

Cultivar (Local name)	Accession no	Scientific name	Morphological score (IPGRI, 1996)	Genome group (Singh and Uma, 1996)
Changthir	MZUTRS-01	*Musa balbisiana*	70	BB
Balhlakual	MZUTRS-02	*Musa acuminata*	20	AAA
Changpui	MZUTRS-03	*Musa paradisiaca*	46	AB
Saisu	MZUTRS-04	*Ensete glaucum*	-	-
Banria	MZUTRS-05	*Musa paradisiaca*	62	ABB
Lawngbalhla	MZUTRS-06	*Musa paradisiaca*	33	AAB
Changkha	MZUTRS-07	*Musa paradisiaca*	46	AB
Changvandawt	MZUTRS-08	*Musa ornata*	-	-
Lairawk	MZUTRS-09	*Musa paradisiaca*	46	AB
Banthur	MZUTRS-10	*Musa paradisiaca*	39	AAB
Kawlbalhla	MZUTRS-11	*Musa paradisiaca*	66	ABBB
Changpawl	MZUTRS-12	*Musa paradisiaca*	49	AB
Banpawl	MZUTRS-13	*Musa paradisiaca*	59	ABB
Balhlasen	MZUTRS-14	*Musa paradisiaca*	38	AAB

rence of *M. ornata* (changvandawt) indicates the establishment of Mizoram as one of the native region of its distribution other wild *Musa* types. Rhodochlamys consist of the only *Musa* species adapted to withstanding seasonal droughts, which are common in the monsoonal areas to which they are native.[11] *E. glaucum* (saisu) is distributed over a wide area from Burma to Philippines and Java. Its occurrence in Mizoram can also be correlated to the report on the current pattern of its distribution could not have arisen from the present day sea and land positions, but is due to shorter sea distance between land masses in the geologic past and the presence of land mass of Gondwana.[12]

Mizoram as in other parts of northeast India, the rich occurrence of wild and cultivated bananas enhancing the biological diversity among *Musa* population is also facing the rapid loss of banana genetic resources due to several factors. Therefore there is an urgent need for germplasm evaluation, documentation and interventions for their conservation and utilization. The findings resulted out of this study will provide useful information on the status of the banana genetic resources of Mizoram and formulation of their conservation strategies.

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