



Characterisation of the mango (*Mangifera indica* L.) fruit and fruit pulp of some indigenous mango varieties of Murshidabad district of West Bengal

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Abstract

India has one of the richest collections of mango (*Mangifera indica* L.) cultivars in the world. Mango is grown in all the states of the country. Different mango varieties have unique taste, flavour, texture and size. Characterization and documentation of indigenous mango varieties is important for identifying potential candidates for improved utilization of the genetic resource. Murshidabad, district of West Bengal, the land of the Nawabs, is famous for its traditional mango varieties. Even after massive genetic erosion there still exists a rich collection of indigenous mango varieties in this district. This paper is on the characterisation of the mango fruit and fruit pulp using DUS Testing based on PPV & FRA, 2008 among some indigenous mango varieties of Murshidabad district of West Bengal.

Keywords: Mango fruit, pulp analysis, DUS testing, PPV & FRA, 2008, Murshidabad

Introduction

Mango (*Mangifera indica* L.) often called the “king of fruits”, is one the most popular fruit of the tropical and subtropical regions of the world. India is the Vavilov centre of origin for cultivated mango and from India mango was distributed to other tropical and subtropical regions. Mango has been cultivated in India for more than 4000 years. Each agro-climatic region India has different traditional mango varieties. Different varieties have unique taste, flavour, texture and size. Mango has rich intra-specific diversity and there are about 1600 cultivars in the world. India has the richest collection of mango cultivars with mango being grown in all the states of the country. Mango is an important fruit crop of West Bengal occupying about 97.93 thousand hectares

which is more than 60% of total area under fruits.

Characterisation of mango germplasm

Mango (*Mangifera indica* L.), which belongs to the family Anacardiaceae, order Rutales, is one of the most important tropical fruits marketed in the world. India accounts for approximately 40 percent of total global mango production (FAO, 2016). It is grown naturally or cultivated mainly in tropical and subtropical regions. Morphological characterization is the simplest of the formal, standardized, repeatable method of identifying and presenting mango's genetic diversity. The International Plant Genetic Resources Institute (IPGRI, 2006) descriptors allow for the use of

visual assessment tools of morphological traits to characterize mango germplasm. Complex plant characters such as yield are quantitatively inherited and are influenced by genetic effect as well as genotype/environmental interaction. This poses the need to identify and use highly correlated characters. Detailed and well documented information about the available mango genetic material together with a broad, well maintained varietal diversity are essential for breeding efforts.

Characterization and documentation of indigenous mango varieties is important for identifying potential candidates for improved utilization of the genetic resource and future breeding programmes (Ramessur & Ranghoo-Sanmukhiya, 2011). Equally important for identifying location-specific most suitable local mango landraces and developing high yielding disease/pest resistant hybrids, and for developing 'conservation through use' strategies to reduce genetic erosion (Sennhenn *et al.* 2013). While geneticists and plant breeders are particularly interested with diversity at the molecular level, farmers are more concerned with how visible morphological and agronomic variations can be used for sustainable farming. In addition to using morphological descriptors for variety characterization (IPGRI, 2006), molecular marker and isozyme analysis techniques are increasingly used for describing the genetic diversity of mango cultivar

However in India, the mango gene pool has not been explored fully with regard to extent of variability, identification, collection and conservation of mango germplasm which are pre requisites for crop improvement. Custodian farmers have been maintaining, promoting and adapting a number of indigenous mango varieties on their farms. These custodian farmers protect, nurture and propagate the rich mango legacy of India (De, 2015).

The physical and chemical parameters of fruits are important indicators of their maturation and internal and external quality. Physical characteristics like size, shape, weight, volume etc. act as an important tool to properly relate the nutritional, chemical and bioactive

compounds in the fruits (Cavalcante *et al.* 2012). The maintenance of fruit quality demands postharvest handlings, such as: preventing mechanical injury, water loss and disease development, limiting unwanted physiological changes and preventing chemical and microbial contamination (Cook, 1999).

Mango diversity in West Bengal

Murshidabad, district of west Bengal, the land of the Nawabs is famous for its traditional mango varieties. There still exists a rich collection of traditional mango varieties in Murshidabad and remain confined only to the orchards of a few individuals and, as a result, these lack popularity. Some varieties are having excellent taste and unrivalled flavour with golden yellow colour. More than 200 indigenous mango varieties were recorded during the time of the royals of Murshidabad district. After independence with rapid industrialization this germplasm is under threat (Mukherjee, 1953). Generally, old mango cultivars are maintained in either homes or village gardens, personal orchards, within the precincts of temples and on public sites such as schools. PI has already initiated collection and documentation of the rich mango legacy of Murshidabad district (De *et al.* 2014). The survey and documentation of the traditional mango varieties will aid in varietal registration under the PPV & FR Act if any unregistered variety is found. Some researchers have used the DUS Morphological characterization old varieties (Bhamini *et al.* 2018)

(PPV& FR) Act, 2001

The Government of India enacted "The Protection of Plant Varieties and Farmers' Rights (PPV &FR) Act, 2001" adopting *sui generis* system. Indian legislation is not only in conformity with International Union for the Protection of New Varieties of Plants (UPOV), 1978, but also have sufficient provisions to protect the interests of public sector breeding institutions and the farmers.

The legislation recognizes the contributions of both commercial plant breeders and farmers in plant breeding activity and also provides to implement TRIPs in a way that supports the specific socio-economic interests of all the

stakeholders including private, public sectors and research institutions, as well as resource-constrained farmers. The Act is the first of its kind in granting intellectual property rights not only to plant breeders but also to the farmers by protecting new, extant and farmers' varieties. It emphasizes farmers' Rights as positive rights capturing the spirit of FAO International Treaty on Plant Genetic Resources for Food and Agriculture and UN Convention on Biological Diversity. At present the PPV&FR Authority has notified 156 crop species and has opened the registration for these crops. The office of the registry initiated the registration process and started receiving applications for registration and protection of eligible varieties of notified genera and species of the crops from 21 May 2007. Morphological Characterization of Mango (*Mangifera indica* L.) Germplasm Using DUS Testing or other standard descriptors have been undertaken by many researchers (Singh Pleguezuelo *et al*, 2012; Singh *et al*. 2012; Simi and Rajmohan, 2013; Kanchan *et al*, 2018).

Materials and Methods

Study area:

Murshidabad is a district of West Bengal in eastern India. Situated on the left bank of the river Ganges, the district is very fertile. The district comprises two distinct regions separated by the Bhagirathi River.



Collection and documentation of indigenous Mango varieties from Murshidabad district was made.

4 (Four) indigenous mango varieties were selected for this study, of which two were rare, one moderate and one available in terms of

availability in the local market. The list of mango varieties, their place of origin and availability is given in Table 1.

Table 1. List of mango varieties with place of origin and availability

Sl. No.	Variety name	Place of origin	Availability
1	Bhabani	Murshidabad	Rare
2	Champa	Murshidabad	Moderate
3	Dilswad	Murshidabad	Rare
4	Molamjam	Murshidabad	Available

Based on the Distinctness, Uniformity and Stability test (DUS) guidelines, morphological characterization of the mango fruit was carried out per PPV& FR Scale of Mango varieties. For the chemical Parameters of the fruit pulp, the fruits were macerated and the fruit pulp was used for noting the chemical parameters. The pulp texture, juiciness and percentage quantity was noted. The pH of mango pulp was noted with the help of pocket pH meter. Pictures of the fruit of these 4 (four) varieties are given viz. Fig. 1 – Fig. 4.



Fig. 1. Bhabani



Fig. 2. Champa



Fig. 3. Dilswad



Fig. 4. Molamjam

Objectives of the study:

Morphological characterization is the simplest of the formal, standardized, repeatable method of identifying and presenting mango's genetic diversity. The International Plant Genetic Resources Institute (IPGRI) descriptors allow for the use of visual assessment tools of morphological traits to characterize mango

Table 2. Morphological parameters of the fruit

Mango variety	BHABANI	CHAMPA	DILSWAD	MOLAMJAM
Morphological parameters				
Mature fruit Length	7	5	5	5
Mature fruit Width	5	5	3	7
Mature fruit ratio L/W	7	5	7	3
Mature fruit shape	2	2	3	1
Mature fruit Color of Skin (S)	7	3	1	2
Predominant colour of Ripe Fruit	3	2	4	4
Speckling of skin	1	1	1	9
Thickness of skin	3	3	7	5
Adherence of skin/flesh	3	3	3	5
Main colour of flesh	5	3	2	3
Firmness of flesh	3	3	5	5
Juiciness	7	7	3	5
Texture of flesh	3	3	5	5

germplasm. Complex plant characters such as yield are quantitatively inherited and are influenced by genetic effect as well as genotype/environmental interaction. This poses the need to identify and use highly correlated characters.

The requirement of Distinctiveness, uniformity and stability were assessed on the basis of descriptors. Descriptors were developed based on the guidelines that are envisaged in (PPV & FR Act, 2008). Detailed and well documented information about the available mango genetic material together with a broad, well maintained varietal diversity are essential for breeding efforts. In this study just 4 (four) varieties were used as a pilot project to see whether there was any variation among the indigenous mango varieties of a single district viz. Murshidabad.

Results

Morphological Characterization of the mango fruit using DUS Testing was carried out. The quantitative morphological parameters were scored as per the PPV& FR Scale of Mango varieties. The results are given in Table 2. The pulp texture, juiciness, pH of mango pulp and percentage quantity was noted. The results are given in Table 3.

Table 3. Pulp characteristic of the mango varieties

Sl. No.	Variety name	Pulp colour	Pulp juciness	Pulp quantity (%)	PH ⁿ
1	Bhabani	Yellow orange	High	56.29	4.38
2	Champa	Light yellow	Intermediate	41.23	4.87
3	Dilswad	Light yellow	Intermediate	47.6	6.04
4	Molamjam	Yellow orange	Intermediate	47.3	5.01

In order to provide for the establishment of an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants it has been considered necessary to recognize and protect the rights of the farmers and plant breeders

Discussion

Detailed and well documented information about the available genetic material together with a broad, well maintained varietal diversity are essential for breeding efforts. This should also include local varieties (Subedi *et al.*, 2003), which may have a low market, but high breeding value. Among just these 4 (four) indigenous varieties it is observed that there is considerable variation both at the morphological parameters of the fruit as well as in the chemical characteristics of the fruit pulp. In fact not one single parameter shows uniform score. Visual comparison of the morphological nature of the mango fruit of these 4 (four) show considerable variation.

The pulp colour ranged from Light yellow to Yellow orange. The mango pulp juciness also ranged from intermediate to high. The variety Bhabani showed high pulp juciness along with the highest pulp quantity of 56.29%. The pH of these pulp of these 4 (four) varieties ranged from 4.38 to 6.04. Bhabani recorded the lowest pH viz. 4.38. The basic pulp characteristics are given in Table 3.

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Conclusion:

In this investigation we have taken only 4 (four) varieties, Characterisation reveals that there is considerable variation. As this is a pilot project it seems that future research should be on the assessment of fruit morphological and chemical parameters of the mango fruit pulp among the other traditional mango varieties. If possible then the detailed morphological characterisation of the other plant parts if undertaken would create important documentation for posterity. The mango germplasm diversity data generated will be valuable to communities, scientists and policy managers to formulate and implement conservation strategies of *in situ*, *on-farm* as well as *ex situ* conservation and management of these genetic resources.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this work.

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