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Mango (*Mangifera indica* L.) field gene bank (FGB) in Gurudas College, Kolkata-54

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Abstract:

Many important varieties of field, horticultural and forestry species are conserved as Field Gene Banks (FGB). FGBs provide easy and ready access to conserved material for research as well as for use. Plant breeders are in need of a continuous supply of diverse and novel genetic diversity to produce new crop varieties able to cope with the impacts of changing cultivation conditions and climate change. FGB is one of the options of a complementary strategy for the conservation of germplasm of many plant species. Murshidabad and Malda, the once famous districts for Mango (*Mangifera indica* L.) diversity, districts of West Bengal are now facing tremendous genetic erosion of the mango germplasm. The Field gene bank will be an *ex situ* conservation approach. 25 (Twenty five) mango varieties were collected from Malda and Murshidabad districts and cuttings transferred to Gurudas College, Kolkata 700054 for conservation as Field Gene Bank. The mango germplasm accessions were collected with the assistance of the West Bengal Biodiversity Board (WBBB). Some of the valuable mango varieties viz. Bimli, Churmur, Dobani, Do Phala, Golap Bhog, Golap Khash, Molam Jam, collected from orchards of Malda and Murshidabad districts. As a field Gene Bank these varieties are readily accessible and useable for characterization and evaluation. These field gene banks will aid in documentation of the rich mango legacy of West Bengal and help in mango crop improvement.

Keywords: Field Gene Bank (FGB), mango diversity, conservation, custodian farmer.

Introduction

The Field Gene Bank is useful for characterization and evaluation of plants and makes utilization of the germplasms easy. Field Gene Banks have been commonly used for such species as cocoa, rubber, coconut, coffee, sugarcane, banana, tuber crops, tropical and temperate fruits, Field Gene Bank has traditionally been used for perennial plants (Dar *et al,* 2015). In Field Gene Banks, germplasm is maintained in the form of plants as a permanent living collection. Field gene banks are often established to maintain working collections of living plants for experimental purposes. The conservation of germplasm as field gene bank involves the collecting of materials and planting in the orchard or field in another location. Conservation in field gene bank is necessary because some species have short-lived seeds (recalcitrant), for example cocoa, coconut, oil palm, rubber and many tropical fruits like mango, mangosteen, jackfruit, durian and rambutan. In India the germplasm of major commercial fruits and ornamental trees in India are mainly being maintained in field gene banks by the horticultural and related research institutes. National Bureau of Plant Genetic Resources (NBPGR) has a broad germplasm collection of various horticultural species and accessions drawn from different parts of the world, ranging from sweet orange, mandarins, tangelo, grape fruit, lemon, lime, sour orange etc.

Well-managed Field Gene Banks help to preserve genetic diversity and make it available to breeders and other scientists, who can then use it to develop and share improved varieties, including those adapted to particular agro-ecological conditions. Field Gene Banks help bridge the past and the future by ensuring the continued availability of plant genetic resources for research and for breeding new varieties that meet the consumer needs.

Mango diversity in West Bengal

The mango diversity of the districts of Murshidabad and Malda, once famous for top class mango, are now facing tremendous genetic erosion of the mango germplasm. More than 200 mango varieties were recorded during the time of the royals of Murshidabad and Malda districts. After independence with rapid industrialization this germplasm is under threat (Mukherjee, 1953). Generally, old mango cultivars are maintained in home or village gardens, personal orchards, within the precincts of temples and on public sites such as schools. This system continues due to the mango's religious and cultural importance.

In recent years farmers are abandoning the indigenous varieties in favour of more lucrative commercial cultivars. The habitats of local mangoes (such as village orchards, sacred groves, village community land, along pilgrim trails or in temple courtyards) have been affected by various factors, and their existence is threatened by genetic erosion. Farmers are keen to maintain commercial mango cultivars for fresh consumption and income generation. Local mango genetic resources have been found to be community assets for fulfilling the nutritional and other local requirement, such as fuel-wood and shade. Maintenance of local mango orchards is a relatively cost-effective strategy since many of the cultivars are adapted to marginal conditions. Moreover the original habitats of local mango have been rapidly changing in response to biotic, economic and other pressures in recent years (Subedi et al*.,* 2005b).

The genetic erosion of the mango germplasm in Murshidabad and Malda is mainly due to the rampant cultivation of improved varieties. These traditional varieties are also facing extinction because of the aggressive cultivation of Amrapali, Chatterjee, Mallika varieties of mango. Fortunately, despite the pressure of the modern agriculture, which favours uniformity and profit, at least a small percentage of farmers are still actively engaged in maintaining locally important varieties. These 'Custodian farmers' apart from playing a critical role in conserving the rare varieties, act as local guides to disseminate the good practices and also as providers of scions of local varieties and traditional knowledge associated with tropical fruit tree.

Need for conservation and documentation of traditional mango varieties

Farmers are faced with the challenge of identifying cultivars that are productive for their agro-ecological zones because they are unfamiliar with the characteristics of the many different cultivars of mango that are now grown and available in the country, resulting in lower productivity (Wahdan et al., 2011). Characterization and documentation of local mangoes is important for identifying potential candidates for improved utilization of the genetic resource and future breeding programmes (Ramessur & Ranghoo-Sanmukhiya, 2011), 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.

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., 2005a), which may have a low market, but high breeding value. Njuguna et al., (2009) suggested in the absence of fruits, traits such as the color of young leaf, leaf margin type, leaf fragrance strength, tree height and stem circumference can be used to distinguish between cultivars particularly between the indigenous and exotic varieties. Each of the clusters generated by the dendogram possessed varieties that can be used as parents in breeding efforts. 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 cultivars (Karihaloo et al*.,* 2003; Schnell et al., 2006; Díaz-Matallana et al., 2009, Pal et al*.,* 2017).

In West Bengal complete documentation of the mango varieties at the morphological and genetic diversity level is at a nascent stage. Usually for assessment, the quality characters of Mango are very much important (Dash and Hota, 1997; Majumder, 2013), because the quality characters are parameters of selection of proper plants for propagation. The marketable quality characters are only considered when assessing the indigenous varieties. In spite of many valuable morphological traits, genetic diversity conserved in local mango cultivars and in its exotic germplasm has not been assessed fully in Murshidabad and Malda districts either by using morphological characters or DNA-based genetic markers. The preliminary survey has resulted in documenting some rare varieties

Table 1. List of Mango varieties conserved in Gurudas College, Kol-54 as Field Gene Bank.

Sl. No.	Name of the Mango variety	Sl. No.	Name of the Mango variety
1	Bara Sahi	**14**	Himsagar
2	Begam Fuli	**15**	Kishen Bhog
3	Bel kusum	**16**	Lakhna
4	Bimli	**17**	Langra
5	Biswanath	**18**	Mallika
6	Bombai	**19**	Molam Jam
7	Champa	**20**	Motichur
8	Chousa	**21**	Rani Pasand
9	Churmur	**22**	Sadullah
10	Dobani	**23**	Sahi
11	Do Phala	**24**	Saranga
12	Golap Bhog	**25**	Surma Fazli
13	Golap Khas		

Fig. 1. A portion of the Mango Field Gene Bank in 2016 at Gurudas College, Kolkata 700054.

Fig. 2. A portion of the Mango Field Gene Bank in 2019 at Gurudas College, Kolkata 700054.

Fig. 3. A portion of the Mango Field Gene Bank in 2016 at Gurudas College, Kolkata 700054.

Fig. 4. A portion of the Mango Field Gene Bank in 2019 at Gurudas College, Kolkata 700054.

from Malda and Murshidabad (De et al*.,* 2014). Initial DNA fingerprinting of the mango varieties have started with germplasm collected from their place of origin (Pal et al., 2017). This recent documentation of the mango diversity from these areas show that the traditional mango varieties which are in general are low yielding are being replaced by new high yielding hybrids. These mango varieties must be conserved preferably by *in situ* conservation strategy or by on –farm conservation method. If these methods cannot be implemented then *ex situ* conservation methods may be used.

***Ex situ* conservation of mango**

Previous studies indicate that *ex situ* conservation of mango is difficult because of the recalcitrant nature of mango seed, so that it cannot be stored in conventional gene banks (Bompard, 1995). At best, mango seeds of can be stored for about 100 days (Chin and Roberts, 1980). Therefore, conservation needs to focus on the establishment of field gene banks. A field gene bank can complement with *in situ* conservation method effectively. A field gene bank is readily accessible and useable for characterization, evaluation and crop improvement. There are several varieties of mango, which need to be identified and given a geographical identity. Efforts to locate the places linked with a particular variety of mango and there after attempt for registration of geographical identity of such local varieties. Brand development of mango is needed in such a way that it would lead to integrated growth of that crop (Banerjee, 2011).

Materials and methods

25 (Twenty five) mango varieties were collected from Malda and Murshidabad

districts with the help of co authors in Murshidabad. In the year 2016 the cuttings were transferred to Gurudas College, Kolkata-700054 for conservation as Field Gene Bank. The names of the varieties are provided in Table 1 alphabetically. The varieties included mostly traditional mango varieties and few cultivated extensively commercially.

Result and Discussion

Many important varieties of field, horticultural and forestry species are conserved in field gene banks (FGB). FGBs provide easy and ready access to conserved material for research as well as for use. It is one of the options of a complementary strategy for the conservation of germplasm of many plant species. The conservation of germplasm in field gene bank involves the collecting of materials and planting in the orchard or field in another location. Field gene bank has traditionally been used for perennial plants (Dar et al*.,* 2015).

An urgent need is to salvage the mango diversity from the old village orchards and conserve them in field gene banks to maximize the use of diversity on-farm (Subedi et al., 2005b). For sustainability, the field gene bank should be made self-sustaining by integrating with commercial fruit sapling nurseries, so that income can be generated to meet the cost of its maintenance.

The mango plants of the traditional varieties are age old and low yielding and are replaced by new high yielding varieties. Amrapali, Chatterjee, Mallika varieties of mango are cultivated aggressively. Moreover open pollination, continuous grafting, and use of seeds for propagation among factors such as mutations and changing environmental conditions may all contribute to the development of new traits in mango germplasm. Hence, conservation and documentation of Mango (*Mangifera indica* L.) germplasm is of utmost importance.

Conclusion

Unless the mango germplasm is conserved it will be futile to study about the genetic diversity of extinct mango varieties. After efforts have been on the conservation area then genetic diversity study will be meaningful. Selected indigenous mango varieties if conserved as field genebanks in areas other than their native place will provide easy and ready access to conserved material for research as well as for use. Field gene banks of mango should focus on core germplasm maintenance, and conduct research and development work such as stock-scion relations, use local cultivars in mango breeding programmes, and produce planting materials of local cultivars. The mango germplasm diversity data then 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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