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Research Article

# Variation in flowering and fruit set among indigenous mango varieties from Malda and Murshidabad conserved as Field Gene Bank in Gurudas College, Kolkata, India

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#### **Abstract**

The flowering phenomenon in mango is a complex one. Normally, it crops heavily in one year (on year) and bears less or no crop the following year (off year). Again, it yields heavily the next year. These alternate bearer fruit cultivars present a serious economic problem to fruit growers in West Bengal. Fruit set in Mango is a varietal character, depending upon several factors such as time of flowering, sex ratio, efficient cross-pollination and intensity of flower drop. Varieties differ from one another in these respects and this leads to varying fruit set in different varieties. Understanding the cellular and molecular mechanisms involved in regular and irregular bearing fruit varieties will assist in the development of flowering, identification of regulatory regions and factors implicated for regularity in bearing in mango. Transcriptomic data could be utilized for the synthesis of SSR and SNPs markers. Varieties both alternate and regular bearing need to be identified before the transcription profiling. In this investigation the variation among the 25 mango varieties conserved as field gene bank in the college campus of Gurudas College was assessed.

Keywords: Alternate bearer, Traditional mango variety, Flowering, Field gene bank.

#### Introduction

Mango (Mangifera indica L.) flowering is greatly influenced by the weather conditions and varietal genotypes. Flowering is an important trait as it directly affects the yield. However the flowering phenomenon in mango is a complex one. Normally, it crops heavily in one year (on year) and bears less or no crop the following year (off year). Again, it yields heavily the next year. The rhythm of bearing in mango is not strictly 'alternate' but 'irregular' or

'erratic'. These alternate bearer fruit cultivars present a serious economic problem to fruit growers in West Bengal. Alternate bearing is the processes in fruit trees by which cycles of heavy yield (ON crop) one year are followed by a light yield (OFF crop) the next. The ON' years characterized by significant production are followed by 'OFF' years, characterized by low production. The low production in 'OFF' years usually results from a lack of flower

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formation rather than а poor fruit-Goldschmidt, set (Monselise and 1982). Research findings have clearly indicated that this phenomenon is mostly due to varietal as well as environmental factors in addition to the orchard management practices including pruning, nutrition, irrigation protection.

The major problem associated with alternate bearing habit in mango is the loss of the fruits and yield, which affects the overall crop production. Various research workers throughout the world have studied the phenomenon of alternate bearing in different fruit crops like citrus fruits, mandarin and olives and associated several horticultural traits with this complex phenomenon (Mun~oz-Fambuena et al 2011; Shalom et al, 2012; Turktas et al, 2013.

# Understanding flowering in Mango: Recent trends

A fundamental understanding of flowering is essential to efficiently utilize cropping management systems, which would extend both the flowering and crop production seasons (Chacko, 1991, Ramirez Davenport, 2010). In spite of profuse flowering years, pollination failure during 'on' premature fruit drop results in poor fruit set and low fruit retention respectively in mango (Litz, 1997). Therefore, investigation on floral biology of mango is a pre-requisite for any future line of work in mango crop for increasing productivity. (Geetha et al, 2016).

In recent times genome resources developed by the way of segmental and whole transcriptome data may be utilized for better understanding of genetics of regular bearing habit in fruit crops. The information generated will be utilized for identification of potential parents, desired hybrids in early nursery stage, thus would assist breeders by bringing precision breeding and also make available fruits during off years (Sharma et al, 2015). Development of RNA sequencing (RNA-seq) methodology has facilitated the analysis of transcriptomes of a number of crop and medicinal plants (Duangjit et al., 2013; Xu et al., 2013). Transcriptome analysis resulted in numerous differentially expressed genes (DEGs), allowing the partial identification of

mechanisms that convert 'on' into 'off' buds Flowering involves the sequential action of two groups of genes, i.e. those that switch the fate of the meristem from vegetative to floral (floral meristem identity genes), and those that direct the formation of the various flower parts (organ identity genes). A thorough understanding of the floral transition with complex genetic network, regulated multiple environmental and endogenous clues is a primary requirement. Development of genomic and transcriptomic tools contributed to a better understanding of the metabolic and molecular processes involved in floral biology. Even the regular- bearing types, if they carry a heavy load of crop in 1 year, show a tendency towards reduced yield in the following year. Hence the basic tendency of bienniality exists even in the so-called regularbearing varieties of mango. Understanding the cellular and molecular mechanisms involved in regular and irregular bearing fruit varieties will assist in the development of flowering, identification of regulatory regions and factors implicated for regularity in bearing in mango. Transcriptomic data could be utilized for the synthesis of SSR and SNPs markers. Seauencina of expressed aenes (transcriptomes) using Next Generation Sequencing (NGS) technologies has been used for gene discovery and allele mining (Barabaschi et al.,, 2012; Egan et al., 2012). Recently, the transcriptome of mango cvs. Langra and Zill have been reported (Azim et al., 2014; Xia et al., 2014). However there is no report of the transcriptome profile of indigenous mango cultivars of West Bengal.

# Pre requisite for understanding of the enigma of Mango flowering

Fruit set in Mango is a varietal character, depending upon several factors such as time of flowering, sex ratio, efficient cross-pollination and intensity of flower drop. Varieties differ from one another in these respects and this leads to varying fruit set in different varieties. Understanding the cellular and molecular mechanisms involved in regular and irregular/alternate bearing mango varieties will assist in the development of flowering, identification of regularity regions and factors implicated for regularity in bearing in mango.

Detailed and well documented information about the available genetic material together with a broad, well maintained varietal diversity are essential for breeding efforts. Apart from good soil management, the only other means of reducing losses from alternate bearing in mango seems to be by breeding varieties that tend to bear annually. This should also include local varieties (Subedi et al., 2005), which may have a low market, but high breeding value. So the identification of regular and alternate bearing varieties among the indigenous mango varieties is required so that they may be used as parents in any future hybrid development programs. Varieties both alternate and regular bearing need to be identified before the transcription profiling.

#### **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 (De *et al*, 2019). The varieties included mostly traditional mango varieties and few cultivated extensively commercially. The list of varieties conserved as Field gene banks are given in Table I.

Table I. List of Mango varieties conserved in Gurudas College, Kolkata as Field Gene Bank (FGB)

| SI. | Name of the   | SI. | Name of the   |
|-----|---------------|-----|---------------|
| No. | Mango variety | No. | 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    |     |               |

#### Results

In 2019, of the 25 varieties in Gurudas Mango field gene bank only 10 varieties flowered as shown in Table II. The flowering was scanty in 3 varieties viz. Bimli, Molamjam, Motichur which are traditional varieties of Murshidabad. It was seen that the traditional varieties Sarenga, Surma-Fazli, Churmur and Sahi had low flowering and fruit set. The checks Himsagar and Bombai showed moderate flowering. Only Rani Pasand had profuse flowering and later fruit set.

In 2018 flowering did not occur in these varieties except Golap Khas and Chousa as shown in Table III. This could probably be due to acclimatization process.

Table II. Variation in flowering and fruit set among the Mango varieties during 2019.

| SI<br>No | Name of the variety | Flowering<br>in Feb | Fruiting in<br>April 2019 |
|----------|---------------------|---------------------|---------------------------|
|          |                     | 2019                |                           |
| 1        | Bimli               | Low                 | Scanty fruit              |
|          |                     | flowering           | set, only one             |
|          |                     |                     | fruit                     |
| 2        | Churmur             | Low                 | Scanty fruit              |
|          |                     | flowering           | set                       |
| 3        | Molam Jam           | Low                 | Scanty fruit              |
|          |                     | flowering           | set, only two             |
|          |                     |                     | fruits                    |
| 4        | Sahi                | Low                 | Scanty fruit              |
|          |                     | flowering           |                           |
| 5        | Surma               | Low                 | Scanty fruit              |
|          | Fazli               | flowering           | set                       |
| 6        | Bombai              | Moderate            | Low fruit set             |
|          |                     | flowering           |                           |
| 7        | Himsagar            | Moderate            | Low fruit set             |
|          |                     | flowering           |                           |
| 8        | Sarenga             | Moderate            | Low fruit set             |
|          | _                   | flowering           |                           |
| 9        | Motichur            | Low                 | Scanty fruit              |
|          |                     | flowering           | set                       |
| 10       | Rani                | Profuse             | Good fruit set            |
|          | Pasand              | flowering           |                           |

Table III. Variation in flowering and fruit set among the Mango varieties during 2018.

| SI<br>No | Name of the variety | Flowering in Feb 2018 | Fruiting in April 2018 |
|----------|---------------------|-----------------------|------------------------|
| 1        | Golap Khas          | Low                   | No fruit set           |
|          |                     | flowering             |                        |
| 2        | Chousa              | Scanty                | No fruit set           |
|          |                     | flowering             |                        |



Mango variety, Rani Pasand showing profuse flowering in 2019.



Mango variety, Rani Pasand showing good fruit set in 2019.



Mango variety, Rani Pasand with good fruit set in 2019



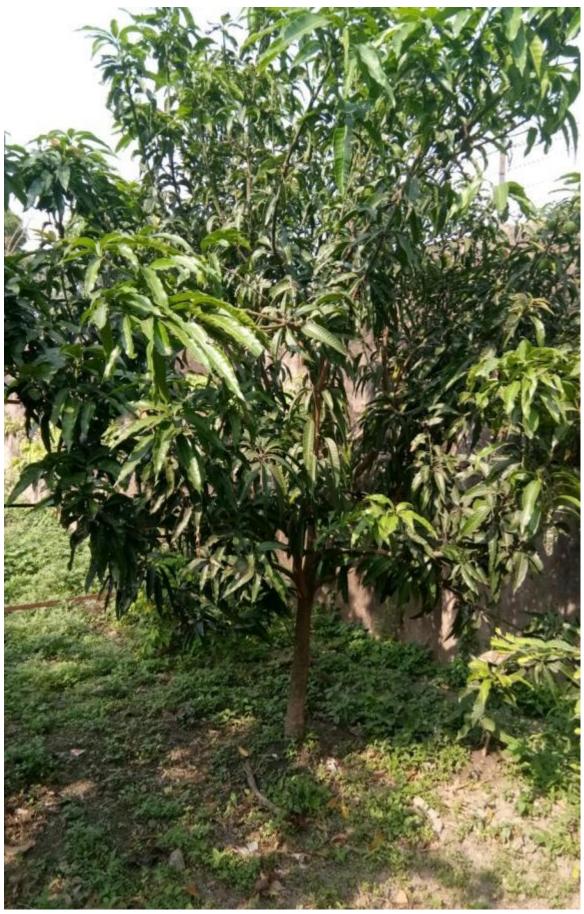
Mango variety, Sarenga with moderate flowering in 2019.



Mango variety, Sarenga with low fruit set in 2019.



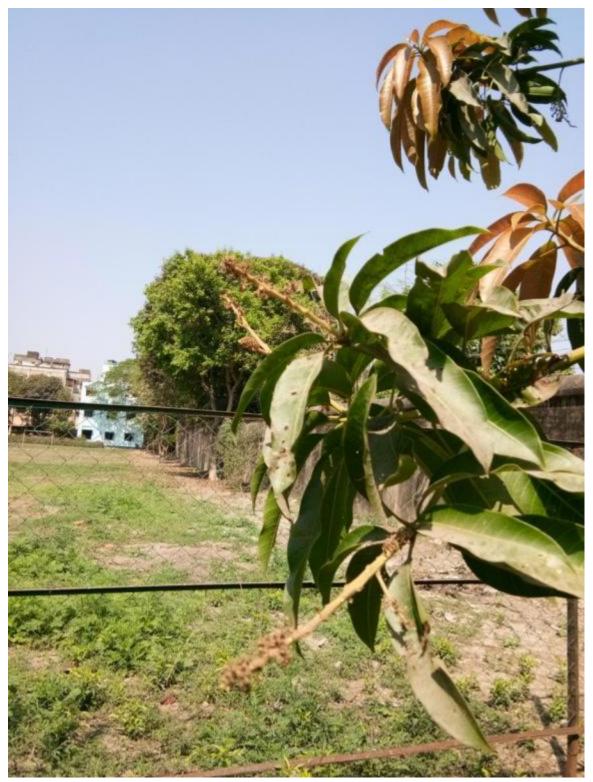
Mango variety, Surma Fazli with low flowering in 2019.



Mango variety, Surma Fazli with very scanty fruit set in 2019.



Mango variety, Golap Khas in flowering condition in 2018 but with no fruit set.



Mango variety, Chousa with scanty flowering in 2018 with no fruit set

## **Discussion**

Transcriptome profiling is needed to study the regular and alternate bearing behavior of mango the indigenous mango germplasm. Transcriptomic data could be utilized for the synthesis of SSR and SNPs markers.

Sequencing of expressed genes (transcriptomes) using Next Generation Sequencing (NGS) technologies could be used for gene discovery and allele mining. The transcriptome information generated can be utilized for identification of potential parents, desired hybrids in early nursery stage and

would assist breeders by achieving precision breeding and also make available mango fruit during the 'off' years. Genetic diversity data both morphological and molecular are needed to understand the enigma of mango flowering. However it is imperative that conservation of the indigenous mango varieties is also implemented. If any mango variety is lost, its unique genetic constitution is lost forever for posterity

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. A preliminary survey by the Principal investigator (PI) has resulted in documenting some rare varieties from Malda and Murshidabad (De et al, 2014). 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. Unless the mango germplasm is conserved it will be futile to study about the genetic diversity of extinct mango varieties. These mango varieties must conserved preferably by in strategy or by on -farm conservation conservation method. If these methods cannot be implemented then ex situ conservation methods may be used. PI has initiated the conservation of some traditional mango varieties of Malda and Murshibad as Field Gene Bank (FGB) in Kolkata (De et al. 2019) with the financial assistance of the West Bengal Biodiversity Board (WBBB). After efforts have been on the conservation area then genetic diversity study will be meaningful.

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#### Conclusion

Murshidabad and Malda Districts of West Bengal is very rich in Mango legacy since the time of Nawabs. These two districts alone harbour near about 200 traditional Mango varieties. The mango plants of the traditional varieties are age old and low yielding and are replaced by new high yielding varieties. Conservation and documentation of Mango (Mangifera indica L.) germplasm is of utmost importance. The mango germplasm diversity will be data generated valuable 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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