



Research Article

STUDY OF FLOWERING BEHAVIOR OF MALFORMED VS NORMAL MANGO VARIETIES IN SUBTROPICAL REGION OF INDIA

VISHWAKARMA M.K.^{*1,3}, BAJPAI A.² AND KOLE C.¹

¹Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, 211007, Uttar Pradesh, India

²Division of Crop Improvement and Biotechnology, ICAR-Central Institute for Sub-tropical Horticulture, Lucknow, 226101, Uttar Pradesh, India

³Borlaug Institute for South Asia, Jabalpur, Madhya Pradesh, 482005, India

*Corresponding Author: Email - manishvis@gmail.com

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Abstract: Flowering is a crucial component with the view for mango production. Four mango varieties were studied for the flowering behavior at Central Institute for Subtropical Horticulture, Lucknow, and Uttar Pradesh. The data on Varietal response of Normal and Malformed cultivars at prebloom stage revealed that the flowers were more in malformed panicles. The blossom bud initiation and panicle length elongation study of Amrapali (Normal Vs. Malformed) showed a high number of flowers emergence in mid of march in normal and malformed panicles. Albeit, in malformed panicles, similar bursts of flower opening were recorded two more times. Similarly, a study of pattern on panicle length revealed that the growth of normal panicles was very fast initially and attained up to 16 cm length. During the corresponding time, panicle development (increase in length) in malformed samples was slow. The total number of flowers was more in malformed panicles in comparison to normal. Likewise, significantly large variations were recorded in number of male: hermaphrodite flowers, 3.5:1 in normal while in malformation ratio was 14:1. The results concluded that in a subtropical region, flowering pattern of mango cultivars response differently. Due to discontinuous bursts of flower opening, sex ratio differences were high in malformed panicle.

Keywords: Flower opening, Sex ratio differences, Normal and Malformed cultivars

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Introduction

Mango (*Mangifera indica* L.), belongs to Anacardiaceae family having 73 genera and 830 species and regarded as favorite fruits of tropics and subtropics [1]. Amongst all the other fruits, mango is most traded commodities in the world market due to its delicious taste and health benefits for consumers. This is the reason; it is called as 'king of the fruits' in the tropical region [2]. Due to its versatile diversity and adaptability, mango is grown in tropical and subtropical region of India. Among the total world production, 56.6% of the mangos produce in India. The Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Orissa, Uttar Pradesh, and West Bengal are major producers of mango. Flowering behavior, sex distribution, and yield contributing traits of mango varieties are main causal factor determining its production performance. In addition to this, productivity of mango mainly determined by flowering, which apparently influence by varietal characters and weather conditions. The flowering pattern of mango cultivars response differentially in tropical and subtropical region [3]. Along with this, mango malformation malady is also a big challenge for proper fruit setting during flowering as out of two types: vegetative and floral, floral malformation is more dominant. Usually, no fruit setting due to abortion at early stages flowering stage [4]. Time to time several responsible factors were claimed by the different researcher as the causes of this malady [5, 6]. In this study with the view to see the effect of malformation on the pattern of flowering and sex distribution in subtropical regions. We studied the flowering behavior and sex distribution in normal and malformed mango plants in the field condition.

Material and Methods

Four varieties viz. Dasehari, Amrapali, Elaichi and Beauty McLean were taken for the study. Two representative trees of each varieties Dasehari, Amrapali, Elaichi

and Beauty McLean were chosen in the orchard at Block II and III, CISH, Rehmankhara, Lucknow, Uttar Pradesh. Twenty normal panicles and twenty malformed ones were tagged in Dasehari and Amrapali varieties at each side of tree respectively. Similarly, twenty panicles were tagged from Elaichi Var. comprised of normal ones only, whereas, twenty tagged panicles of Beauty McLean consisted of all malformed panicles. These twenty panicles were tagged soon after the emergence of blossom buds of rudimentary panicles. The data on floral characters viz. Length of Panicle, Number of Primary Peduncle, Mean Inter Peduncle (Cm.), Number of flowers/ panicle and Length of Primary Peduncle (Cm.) from these twenty panicles in each class of Var. (Malformed and /or Normal) were taken at prebloom stage (just when flowers begin to open) in the first week of March. Growth pattern in Normal and malformed panicles in var. Amrapali was recorded during the full period of flowering. Eighteen shoots showing flowers and formation were tagged on selected trees. Data was recorded for morphological characters like blossom bud emergence and panicle elongation, actually started opening on each panicle till the flowering was over. Eighteen panicles identified as normal and malformed ones were used in order to ascertain the total male and hermaphrodite flowers. A daily count was made from the time of the flowers actually started opening on each panicle till opening was over. Care was taken to remove the opened flowers, each time, so that the actual number may not vary. Counting was done once a day. (10 AM to 1 PM).

Results and discussion

Varietal Response at Prebloom stage

The blossom buds of the four cultivars/varieties started to emerge from the start of February to end of the month.

Table-1 Pattern of growth and flowers at emergence of prebloom stage in different varieties [*N=Normal, M=Malformed]

SN	Varieties/Types	Avg. length of Panicle	No. of Primary Peduncle	Mean Inter Peduncle (Cm.)	No. of flowers/ panicle	Length of Primary Peduncle (Cm.)
1	Dasehari (N)	12.4±0.24	25±0.61	0.98±0.04	305±21.4	6.6±0.15
2	Dasehari (M)	12.2±0.78	22.3±1.61	1±0.11	382±19	6.3±0.20
3	Amrapali (N)	12.1±0.58	20.0±0.89	0.96±0.09	198±11.53	5.9±0.28
4	Amrapali (M)	10.0±0.78	19.1±0.91	0.7±0.1	364±33	6.4±0.23
5	Elaichi (N)	7.79±0.02	24.56±1.6	0.74±0.23	364±19	7.3±0.23
6	Beauty McLean (M)	16.3±0.94	27.60±0.70	0.4±0.05	968±25.2	6.8±0.14
	Critical difference	7.28	5.71	1.81	508.4	0.85

Table-2 Pattern of Sex distribution and number of flowers in Normal V/s Malformed Panicle in Variety Amrapali [*N=Normal, M=Malformed]

Variety	Number of Male Flower	Number of Hermaphrodite flower	Total no. of flower	Percent of Hermaphrodite flower	Sex ratio M:H
Amrapali (N)	446	129	575	22.4	3.5:1
Amrapali (M)	648	46	694	6.6	14:01

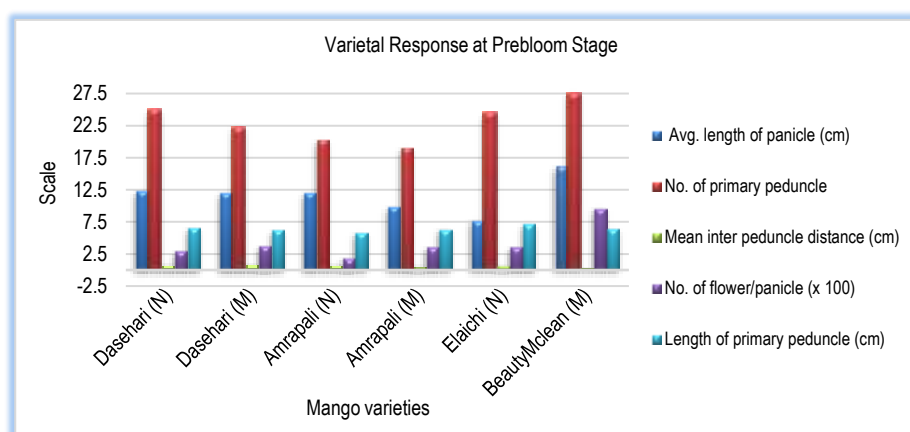


Fig-1 Varietal response of Normal and Malformed cultivars at prebloom stage

The data on morphological characters was taken in the first week of March, just when flowering had initiated at the bottom of panicles appropriately termed prebloom stage. Recorded data [Table-1], [Fig-1] revealed that the average length of panicle was fairly uniform in both commercial varieties Dasehari and Amrapali of normal panicles. Whereas, that of Amrapali malformed was shorter in length (10 cm vs 12.2cm in normal).

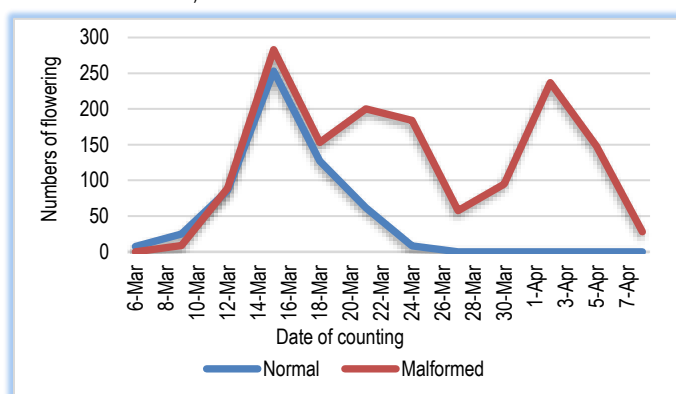


Fig-2 Comparison of blossom bud emergence in Normal vs Malformation in Var. Amrapali

Elaichi (Var.), which is malformation resistant [7], had the least panicle length (7.79). While, Beauty McLean (highly susceptible variety) (16.3) had long panicles. Thus, a lot of variation was recorded for the character panicle length (CD 7.28). However, not much variations were recorded for characters like number of primary peduncles, length of primary peduncles, mean inter-peduncle distance, maximum variations were observed for number of flowers, where the malformed panicles of ways possessed a greater number of flowers/ panicles. Whereas, Amrapali normal panicles had least number of flowers. Mango malformation, occurring across the globe, continues to restrict the overall productivity returns from Mango Cultivation.

The Varietal response to the disease manifestation is variable, varying not only due to genotype, but also influenced in different seasons. The four varieties studied in the present work. Dasehari, Amrapali, Elaichi and Beauty McLean, represent, a diverse germplasm on which expression of morpho-metric characters were measured. Number of flowers and panicle length were two of panicle characters displaying lots of variation corresponding to the disease reaction. Interestingly, within the varieties (i.e. Dasehari Normal and Malformed; Amrapali Normal and Malformed), the variation recorded for panicle length was not significant.

Blossom bud emergence and panicle development

A Comparison was made on the pattern of blossom bud emergence and development of full panicle in malformed and normal panicles of Amrapali Var. The development of panicle and flowering was found to be continuous process, which lasted for approximately a fortnight (1st week to March to 3rd week of March) [Fig-2]. Whereas, flowering was slightly delayed in malformed panicles and lasted for a month (9th March to 8th April) Maximum number of flowers emerging on a single day coincided in both the samples (normal/malformed), however in malformed panicles, similar bursts of flower opening were recorded two more times. Similarly, study of pattern of extension of panicles revealed that the growth of normal panicles was very rapid initially and grew from 12.2 cm to 16 cm [Fig-3]. During the corresponding time, panicle development (increase in length) in malformed samples was slow (10-14 cm). Thereafter the growth curve in both samples showed a similar trend. Similarly studies were done by Singh, (1954) in variety Dasehari and Langra, revealed that emergence of blossom buds initiated in January end and developed of panicle extended up to 3rd week March. Highest extended in panicle length was recorded in the period 23rd February to 1st March and 1st to 7th March. The two varieties (Dasehari and Langra) behaved similarly for their panicle development [8]. Even though, the blossom bud emergence was initiated at the start of February in both normal and malformed panicles the flowering (opening of floral buds) initiated in March 1st week in normal and slightly later in malformed tissues.

The growth curve of panicle length showed similar shapes, however due to initial sharp burst of panicle development [Fig-3] in normal tissues [Fig-3], the final panicle length of malformed tissues was much less (21.0 cm. Vs. 35.3 cm.). The opening of flower buds was similar initially in both the panicles however; the malformed panicles, recorded continuous flowering and more bursts of flowers bud opening (anthesis) were displayed.

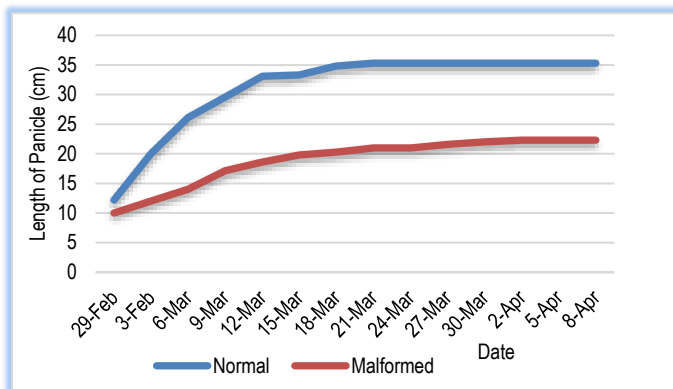


Fig-3 Comparison of panicle length elongation in Normal vs Malformation in Var. Amrapali

Sex distribution and flower in normal Vs malformed panicles in Var. Amrapali

The total number of flowers was more in malformed panicles (694) in comparison to normal (575). Similarly, significantly large variations were recorded in number of male:hermaphrodite flowers, 446:129 in normal while in malformation ratio was 648:46. Thus a high M: H ratio, (14:1) was recorded in malformed panicles in comparison to normal (3.5:1) in normal [Table-2]. The decreases in sex ratio of malformed panicles have been reported by several workers [9]. However, the detailed observations on the unopened bud, flower structure etc. were not made in Var. Amrapali. As high as 77.9% of hermaphrodite flowers was reported in Dasehari and 66.8% in Langra [10]. Naik and Rao (1943) reported 16.41% in Neelum to 3.47% Allumpur Beneshan. Whereas, in our present investigation in the Var. Amrapali the hermaphrodite flower percentage was 22.4 for normal and as low as 6.6% for malformed panicles. Therefore, low hermaphrodite percentage; adequately explains, low (no fruit set) in malformed panicles.

Conclusion

Based on the results, it can be concluded that the flowering pattern of mango cultivars response differentially in subtropical region. Flowers emergence in normal panicle was continue in same pattern while in malformed panicle bursts of flower opening were discontinuous that affect the differences in sex ratio and may be cause of low fruit setting in malformed panicle.

Application of research: Study of impact of malformation malady on flowering pattern and sex ration and its role in fruit setting and productivity.

Research Category: Flowering, Mango malformation

Abbreviations:

AM: Anti Meridiem, PM: Post Meridiem, Avg.: Average, %: Percentage
Cm: Centimetre, Vs.: versus, Var.: Variety, N: Normal, M: Malformed

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*Research Guide or Chairperson of research: Prof. C. Kole

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Study area / Sample Collection: Flowering behavior/ sample collected from Block II and III. CISH, Rehmankhera, Lucknow, Uttar Pradesh.

Cultivar / Variety name: Dasehari, Amrapali, Elaichi and Beauty McLean

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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