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Studies on phenological behaviour and malformation incidence in different cultivars of mango (*Mangifera indica* L.)

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Abstract

A field experiment was conducted to study the phenological behaviour and the incidence of malformation in different mango cultivars under western vidarbha region of Maharashtra during the mango season 2017-18 and 2018-19 at the experimental farm of Department of Fruit Science, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS). The results indicated that, the variations were observed in cultivars for the number and time of vegetative flushes, bud bursting and panicle emergence. The maximum number of vegetative flushes (4 flushes) was reported for mango cvs. Pairi and Neelum however the minimum number of flushes (3 flushes) was noted in cvs. Kesar, Amrapali, Mallika, Dashehari and Vanraj. The earliest bud bursting and panicle emergence was recorded in cv. Vanraj followed by cv. Pairi and cv. Amrapali. The least malformation incidence was recorded in cv. Dashehari which was at par with cvs. Mallika, Neelum and Amrapali while it was highest in cv. Pairi.

Keywords: Bud bursting, cultivars, malformation, panicle emergence, vegetative flushes

Introduction

Mango (*Mangifera indica* L.) unarguably is one of the oldest and choicest tropical fruit of the world and is rightly designated as 'King of fruits'. Mango belongs to family Anacardiaceae, which is originated in Indo-Burma region and then gradually spread to the tropical and subtropical regions of the world (Singh *et al.*, 2011) [8, 11, 16, 18-20, 23]. Due to its adaptability, high nutritive value, delicious taste, richness in variety and attractive appearance it enjoys the unique popularity among the masses and classes and occupies the equal position as apple gets in temperate countries and grape in certain regions (Sikhamany, 2005) [17].

Unfortunately, the mango production in India has been badly influenced by number of diseases and other problems like low fruit set, high fruit drop, alternate bearing, recurrent flowering, non-reproductive flushes and malformation incidence caused by extreme weather conditions during the year.

Mango passes through different phenological stages that start with cell division of apical and lateral meristems. Individual stems are dormant most of the time. Periods of dormancy are short in young plants but can last more than 8 months between flushing episodes in mature trees (Davenport, 2000) [4-7]. Growth occurs as intermittent flushes of lateral and apical meristems that can be synchronous or asynchronous in stems throughout the canopy. The number of intercalary units between each branching point indicates the number of vegetative growth episodes or flushes that have occurred between each flowering flush (Davenport, 2007; 2009) [4-7]. Mango trees produce basically three types of shoots as a consequence of cell division. Vegetative shoots bear only leaves. Generative shoots produce inflorescences, and mixed shoots produce both leaves and inflorescences within the same nodes (Davenport, 2007) [4-7].

Like other fruit crops, mango production affected by many physiological and pathological stresses. Malformation is the most threatening malady among several biotic stresses of mango. This century's old problem inflicts enormous losses every year. Malformation is noticed on seedlings, saplings and floral organs. Floral malformation attacks inflorescences on mature plants. The malady is one of the most destructive in nature because the economic losses faced every year vary between 5-30% (Srivastava, 1998) [21].

According to Singh and Jawanda (1961) [8, 11, 16, 18-20, 23], trees between 4 to 8 years age suffer the most (90.9%) from vegetative malformation. As malformed inflorescence fails to produce fruits, the damage of individual tree may vary from 50-80% and in severe cases the loss may be almost total (Summanwar, 1967) [22]. Cultivar susceptibility varies greatly depending upon the variety, age of the tree and prevailing environmental conditions. Malformed inflorescence grow unabatedly beyond the blooming season and sometimes continue growing even until November (Majumdar and Diware, 1989) [13].

The problem is present in almost every orchard in the country but incidence varies from year to year and cultivar to cultivar. The problems associated with low productivity of mango can be overcome by developing full understanding of the plant. Therefore, the present work was envisaged to study the phenological behaviour and extend of malformation incidence in seven mango cultivars under climatic conditions of western vidarbha region of Maharashtra.

Materials and Methods

A field experiment was conducted at experimental farm, Department of Fruit Science, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) during seasons of 2017-18 and 2018-19. Five trees of each cultivar viz., Kesar, Pairi, Neelum, Mallika, Dashehari, Amrapali and Vanraj were randomly selected among vigorous and healthy trees growing under the uniform conditions of soil fertility, irrigation, intercultural and other cultural operations. The

experiment was laid out in randomised block design with five replications. The cultivars were considered as a factor and each tree under study as a replication.

The observations were made at weekly interval to determine the time and number of vegetative flushes emerging on trees during investigation. For date of bud bursting, the date was recorded on which bud bursting was initiated on tree. For percentage of malformed panicles, ten panicles were selected randomly from each tree and out of these malformed were counted and expressed as per cent of malformation incidence.

$$\text{Incidence of malformation (\%)} = \frac{\text{Number of malformed panicles}}{\text{Total number of panicles}} \times 100$$

Results and Discussion

Time and number of vegetative flushes

The number of vegetative flushes was not influenced during the course of investigation among the different mango cultivars (Table 1). The pattern of vegetative flushes was found similar for three years of study, the maximum number of vegetative flushes (4 flushes) was reported for mango cvs. Pairi and Neelum whereas rest of the cultivars showed only 3 flushes. However, the time of vegetative flushing was shown variation among the seven cultivars, all the mango cultivars produced major vegetative flush in April-May followed by two minor flushes (i.e., Aug-Sept and Dec-Jan) in cvs. Kesar, Mallika, Amrapali, Dashehari, Vanraj and three minor flushes (i.e., June, Aug- Sept and Dec-Jan) in only cv. Pairi and cv. Neelum.

Table 1: Time and number of vegetative flushes in different mango cultivars under western Vidarbha region of Maharashtra

Treatments (No. of vegetative flushes)	Time and number of vegetative flushes							
	2017-18				2018-19			
	1 st flush	2 nd flush	3 rd flush	4 th flush	1 st flush	2 nd flush	3 rd flush	4 th flush
Kesar (03)	28 Aug. 2017	05 Jan. 2018	20 May 2018	-	05 Sept. 2018	25 Dec. 2018	24 May 2019	-
Pairi (04)	25 Sept. 2017	25 Jan. 2018	20 Apr. 2018	24 Jun. 2018	28 Aug. 2018	10 Jan. 2019	10 Apr. 2019	15 Jun. 2019
Neelum (04)	15 Sept. 2017	04 Feb. 2018	25 Apr. 2018	17 Jun. 2018	30 Sept. 2018	25 Jan. 2019	30 Apr. 2019	25 Jun. 2019
Mallika (03)	30 Sept. 2017	12 Jan. 2018	25 May 2018	-	05 Oct. 2018	28 Dec. 2018	20 May 2019	-
Amrapali (03)	10 Sept. 2017	15 Jan. 2018	20 May 2018	-	30 Sept. 2018	05 Jan. 2019	10 May 2019	-
Dashehari (03)	05 Sept. 2017	29 Dec. 2017	25 May 2018	-	25 Aug. 2019	25 Jan. 2019	10 May 2019	-
Vanraj (03)	20 Sept. 2017	15 Jan. 2018	05 May 2018	-	30 Sept. 2018	03 Feb. 2019	20 May 2019	-

There is no exact trend was recorded in time of vegetative flushing, the cultivar which showed early vegetative flush during the first year didn't showed the similar trend in subsequent years. The variation in time of emergence of new vegetative flushes in mango cultivars might be attributed to the genotypic nature and its interaction with environmental conditions. Vegetative flushes typically occur one or many times per year depending upon the cultivar, age of the tree, crop load of previous season and growing conditions (Davenport, 2007; Davenport, 2003) [4-7]. However, Chacko and Randhawa (1971) [2, 3] reported that vegetative growth in mango was never continuous but exhibited periodical quiescence. These results were in close agreement with the findings of Abourayya *et al.* (2011) [1], Haldankar *et al.* (2014) [10] and Makhmale *et al.* (2016) [14] in mango.

Time of bud bursting

The data depicted in Table 2 revealed that, the earliest bud

bursting was recorded in cv. Pairi (on 3rd week of November) during 2017 and in cv. Amrapali (on 2nd week of November) in 2018 however the late bud bursting was reported in cv. Kesar and Amrapali (on 2nd week of December) and in cv. Dashehari (on last week November) during the respective years. The variation in time of bud bursting in mango was possibly due to ecophysiological conditions, which varies from place to place and to some extent it also varies with cultivars grown under the same climatic conditions (Davenport *et al.*, 2007) [4-7]. The results obtained in present study coincide with the results of Palanichamy *et al.* (2012) [15] who noted that the bud reached to the 'bud burst' stage on second or third week of January, which was characterized by further loosening of the scales and the elongation of the floral axis with appreciable growth of primary and secondary branches of the panicle.

Table 2: Time of bud bursting and panicle emergence and extend of malformation incidence in different cultivars under western vidarbha region of Maharashtra

Treatments	Time of bud bursting		Time of panicle emergence		Malformation incidence (%)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Kesar	18 Dec	29 Nov	28 Dec	27 Dec	2.17 (8.12)	3.90 (11.36)
Pairi	23 Nov	14 Nov	22 Dec	27 Nov	4.21 (10.70)	5.16 (12.77)
Neelum	12 Dec	27 Nov	27 Dec	06 Dec	2.04 (7.51)	3.13 (10.07)
Mallika	06 Dec	24 Nov	30 Dec	05 Dec	1.60 (5.86)	2.67 (9.24)
Amrapali	18 Dec	11 Nov	25 Dec	03 Dec	2.11 (7.21)	3.31 (10.11)
Dashehari	-	30 Nov	-	12 Dec	-	1.78 (6.82)
Vanraj	26 Nov	24 Nov	11 Dec	23 Nov	2.83 (9.82)	3.96 (11.10)
"F" test	-	-	-	-	Sig	Sig
SE (m) ±	-	-	-	-	0.60	0.51
CD (P=0.05)	-	-	-	-	1.72	1.50

Figures in parenthesis denotes arcsine value

Time of panicle emergence

The earliest panicle emergence was recorded in *cv.* Vanraj *i.e.*, in the 2nd week of December during 2017 and 3rd week of November during 2018 (Table 2). However, the late panicle emergence was noted in *cv.* Mallika *i.e.*, in the 4th week of December during 2017 and in *cv.* Kesar *i.e.*, in the 4th week of December during 2018. The variation in terms of panicle emergence might be due to differences in genetic makeup of cultivars, temperature variations and photo-periodism. The phenology is strongly under environmental control and the flowering in mango is commonly related with dormancy of the terminal growth which is controlled by low temperature in subtropics (Chacko, 1991)^[2, 3]. The results of present research are in close conformity with the finding of Gill *et al.* (2015)^[8], Pandey *et al.* (2016)^[16] and Singh and Pathak (2018)^[8, 11, 16, 18-20, 23] in Mango.

Malformation incidence

During the course of investigation all the cultivars showed significant variation in malformation incidence (Table 2). The least malformation incidence was recorded in *cv.* Mallika (1.60%) during 2017-18 which was at par with *cvs.* Neelum (2.04%), Amrapali (2.11), Kesar (2.17%) and *cv.* Vanraj (2.83%) however the highest malformation incidence was noted in *cv.* Pairi (4.21%). Similarly, during 2018-19, the least malformation incidence was observed in *cv.* Dashehari (1.78%) which at par with *cv.* Mallika (2.67%) however the highest malformation incidence was noted in *cv.* Pairi (5.16%).

Among the seven cultivars the mango *cv.* Dashehari had exhibited late panicle emergence and flowering initiation which might help in escape from the malformation incidence. The incidence of malformation varied among the cultivars and the observed trend was *cv.* Pairi > *cv.* Vanraj > *cv.* Kesar > *cv.* Amrapali > *cv.* Neelum > *cv.* Mallika > *cv.* Dashehari. The variation in malformation incidence might be due to the interaction of the host genotype to the pathogen and several factors like flushing pattern, physiology of plant, rate of transpiration, cellular structure and *mangiferin* content (Kumar *et al.*, 1996)^[12]. The results of present study has been supported by the findings of Hafiz *et al.* (2008)^[9], Kanpure *et al.* (2009)^[11] and Yadav *et al.* (2014)^[14, 19, 23] in mango.

Conclusion

Keeping in view the results of present study, it can be concluded that the variations were observed in cultivars for the number and time of vegetative flushes, bud bursting and panicle emergence. Among the different cultivars of mango, the cultivars Pairi and Neelum recorded 4 vegetative flushes and rest of cultivars gave 3 vegetative flushes. The earliest

bud bursting and panicle emergence was recorded in *cv.* Vanraj followed by *cvs.* Pairi and Amrapali. The least malformation incidence was recorded in *cv.* Dashehari followed by *cv.* Mallika and Neelum due to late panicle emergence and flowering initiation which might help in escape from the malformation incidence and found to be suitable for western vidarbha region against malformation incidence.

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