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Phenological behaviour of mango varieties under South Gujarat conditions

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Abstract

A field experiment was conducted at ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India during the year 2019-20 and 2020-21 to study the phenological development in mango varieties viz., V₁: Sonpari, V₂: Alphonso, V₃: Amrapali, V₄: Kesar, V₅: Dashehari, V₆: Totapuri and V₇: Rajapuri. From this study it was revealed that, in a calendar year, occurrence of different phenophases viz., flower bud differentiation, panicle initiation, initiation of flower opening, attaining grain, pea and marble stages fruits were earlier in Alphonso, Kesar and Rajapuri and these were late in all rest of the cultivars. The major highlighting thing of this investigation was maturity of Sonpari and Dashehari, these cultivars started flowering and its subsequent earlier phenophases comparatively late than early flowering varieties viz., Alphonso, Kesar and Rajapuri. However, these cultivars matches the maturity time with Alphonso. So it can be stated that Alphonso, Sonpari and Dashehari were early maturing than Kesar, Rajapuri, Dashehari, Totapuri and Amrapali. The significant variation in days to attaining different phenophases, among different mango varieties was recorded. Cultivar Sonpari and Dashehari required minimum duration to attained most of the phenophases and in case of Alphonso, Kesar and Rajapuri it was maximum.

Keywords: Mango varieties, phenological stages, duration

Introduction

Mango (*Mangifera indica* L.) is one of the most important tropical and subtropical fruit crops, which is under cultivation throughout the world. Due to its rich nutritive value, taste, attractive fragrance and health nourishing qualities it is also known as the “king of fruits” and also recognised as “National fruit of India”. It is an evergreen tree, can be grown up to 1200 metres from mean sea level, but the fruiting is poor above 600 metres. It can withstand at temperatures between 4.44 to 43.33 °C. However, ideal temperature range is between 23.88 to 26.67 °C (Singh and Saxena, 2008) [10].

It is well known that, flowering and further phenological development of mango is vary considerably as per locality and proximity to sea shore. Hence, it was felt necessary to study the gradual development of different phenophases under South Gujarat conditions.

Materials and Methods

The present investigation was carried out at Regional Horticultural Research Station (RHRS), ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during two consecutive seasons 2019-20 and 2020-21. The experiment was laid out in Completely Randomized Block Design consisting of seven treatments i.e. mango varieties which were repeated three times with two trees repetition⁻¹. Uniform trees of fifteen year old seven mango varieties viz., V₁ - Sonpari V₂ – Alphonso V₃ – Amrapali V₄ - Kesar V₅ - Dashehari V₆ - Totapuri V₇ – Rajapuri were selected for this study. The date of different phenological events were recorded and its respective duration was subjected to analysis of variance as described by Panse and Sukhatme (1985) [7].

Results and Discussions

Earliness in Attaining Different Phenophases

The results during two years of investigation revealed that, in a calendar year, occurrence of different phenophases viz., flower bud differentiation, panicle initiation, initiation of flower opening, attaining grain, pea and marble stages fruits were earlier in Alphonso (V₂), Kesar (V₄) and Rajapuri (V₇) and these were late in all rest of the cultivars.

During both trials, fruit maturity was found earlier in Alphonso (V₂) (15th May, 2020 and 27th

April, 2021) which was closely followed by Sonpari (V₃) (20th May, 2020 and 6th May, 2021) and Dashehari (V₅) (20th May, 2020 and 8th May, 2021), it was mid late in Kesar (V₄) (25th May, 2020 and 10th May, 2021) and Rajapuri (V₇) (27th May, 2020 and 10th May, 2021) and late in Totapuri (V₆) (7th June, 2020 and 1st June, 2021) and Amrapali (V₃) (14th June, 2020 and 5th June, 2021) (Table 4).

The flower bud differentiation and panicle initiation was a varietal character in mango (Singh, 1962)^[9]. The induction of floral bud formation has strong links to prevailing environmental conditions and age of terminal resting shoots (Davenport, 2009)^[11] as under tropical locations, the flower induction occurs in response to age of previous year's shoot. These statements strongly support, earlier occurrence of initial phenophases *viz.*, FBD, panicle initiation, initiation of flowering, attaining grain, pea and marble stage fruits in Alphonso, Kesar, and Rajapuri, as these were harvested early during previous season (May) than other varieties exhibiting late detection of FBD and subsequent phenophases including maturity (Amrapali and Totapuri) which were harvested late (June). In the calendar year, Alphonso (V₂), Sonpari (V₁), and Dashehari (V₅) recorded early maturity than mid late (Kesar and Rajapuri) and late cultivars (Totapuri and Amrapali) these results were might be due to response of respective varietal character in prevailing climatic conditions of costal South Gujarat.

While, comparing years it was revealed that during 2020-21 there was early occurrence of FBD and all subsequent phenophases including maturity than 2019-20. It was due to early withdrawal of monsoon during 2020-21 (Oct., 2020) than that of year 2019-20 (Nov., 2019) these findings are in agreement with Rajatiya (2018)^[8].

The major highlighting thing of this investigation was maturity of Sonpari (V₁) and Dashehari (V₅), these cultivars started flowering and its subsequent earlier phenophases comparatively late than early flowering varieties *viz.*, Alphonso, Kesar and Rajapuri. However, these cultivars matches the maturity time with Alphonso (V₂). So it can be stated that Alphonso (V₂), Sonpari (V₁) and Dashehari (V₅) were early maturing than Kesar (V₄), Rajapuri (V₇), Dashehari (V₅), Totapuri (V₆) and Amrapali (V₃).

Days to Different Phenophases

Flower bud differentiation

The data presented in Table 1 revealed that, mango cv. Alphonso recorded early FBD (177.00, 130.33 and 153.67 days after 1st July) during 2019-20, 2020-21 and in pooled data, respectively, which was at par with Rajapuri (V₇) (177.66, 130.33 and 138.66 days) during 2019-20, 2020-21 and in pooled data, respectively and Kesar (V₄) (178.33 and 161.17 days) during 2019-20 and in pooled data, respectively. Delayed FBD (220.66, 209.66 and 215.16 days after 1st July) was recorded in Amrapali variety (V₃) during both the years and in pooled data, respectively, which was at par with Totapuri (V₆) (199.83 days), Sonpari (V₁) (193.17 days) and Dashehari (V₅) (193.00 days) in pooled results.

Panicle initiation

It is apparent from the data presented in Table 1 that, there were significant differences due to different varieties of mango on days to panicle initiation from flower bud differentiation during both the years, year means and for their interaction with varieties. However, result for pooled analysis was non-significant.

Regarding days required from flower bud differentiation to panicle initiation were minimum (7.33 days) in Sonpari (V₁) which was at par with Amrapali (V₃) (8.00 days), Totapuri (V₆) (8.33 days), Alphonso (V₂) (9.33) and Kesar (V₄) (9.7 days) during the year 2019-20. However, Dashehari (V₅) recorded maximum days for panicle initiation (12.67) which was at par with Rajapuri (V₇) (12.00 days).

In the year 2020-21, Kesar (V₄) recorded minimum days to panicle initiation (9.00) which was at par with Alphonso (V₂) (10.00 days) and Rajapuri (V₇) (12.00 days). Maximum days (14.33) for panicle initiation were recorded in Sonpari (V₁) which was at par with Totapuri (V₆) (14.00 days), Amrapali (V₃) (12.67 days) and Dashehari (V₅) (12.33 days).

Initiation of flowering

It is evident from data presented in Table 2 that, there were significant differences due to different mango varieties on days to initiation of flower opening during both the years, pooled data and for year means. However, their interaction between years with varieties was found non-significant.

Cultivar Amrapali (V₃) recorded minimum days to initiation of flower opening (8.33, 10.33 and 9.33 days) during both the years and in pooled data, respectively. It was at par with Dashehari (9.33, 12.00 and 10.67 days) during both the years and in pooled data, respectively, Totapuri (V₆) (10.67 and 10.50 days) during 2020-21 and in pooled data, and Sonpari (V₁) (12.00 days) during 2020-21. These days were maximum in Kesar (V₄) (14.00) during 2019-20 which was at par with Rajapuri (V₇) (13.33 days) and Alphonso (V₂) (12.67 days). During 2020-21 and in pooled data Alphonso (V₂) recorded maximum days for initiation of flower opening (15.67 and 14.16 days, respectively) which was at par with Kesar (14.00 days each) and Rajapuri (14.00 and 13.67 days, respectively).

Grain stage fruits

The data presented in the Table 2 shows that, different varieties of mango had significant effect on days to attained grain stage fruits during both trials, pooled data and year means. However, year into varieties interaction was found non-significant.

Mango cv. Sonpari (V₁) recorded minimum days to attained grain stage fruits (9.00, 7.67 and 8.33 days) during both trials and in pooled data, respectively, which was at par with Amrapali (V₃) (10.33 days) during 2019-20 and Alphonso (V₂) (8.00 days) during 2020-21.

Cultivar Kesar (V₄) recorded maximum days to attained grain stage fruits (13.67, 13.00 and 13.33 days) during both the years and in pooled data, respectively which was at par with Rajapuri (V₇) (12.67, 12.00 and 12.33 days) during both trials and in pooled data, respectively, Totapuri (V₆) (12.33 days) and Dashehari (V₅) (12.00 days) during 2019-20 and Amrapali (V₃) (11.33 days) during year 2020-21.

Pea stage fruits

The data given in Table 3 indicated that, days required to attained grain stage to pea stage fruits were significantly influenced by different mango varieties for both the years, pool data, year means as well as for their interaction with varieties.

During the year 2019-20, Totapuri (V₆) recorded minimum days (10.67) for attaining pea stage fruits which was at par with Sonpari (V₁) (11.00 days), Dashehari (V₅) (11.33 days), Kesar (V₄) (12.00 days) and Amrapali (V₃) (12.33 days). For the year 2020-21, Sonpari (V₁) and Amrapali (V₃) required

minimum days (7.00 each) to attained pea stage fruits, which were at par with Dashehari (V₅) (7.67 days), Rajapuri (8.33 days) and Totapuri (V₆) (9.00 days). Looking to pool data, Sonpari (V₁) required minimum days (9.00) to attained pea stage fruits, which was at par all cultivars except Alphonso (V₂) (13.66 days).

Maximum days for attaining pea stage fruits (14.67, 12.67 and 13.66 days) were recorded in Alphonso (V₂), during both trials and in pooled data, respectively, which was at par with Amrapali (V₃) (12.33 days) during 2019-20 and Kesar (V₄) (12.00 days) during 2020-21 and in pooled data each.

Marble stage fruits

It is evident from data presented in Table 3 that there were significant differences due to different varieties of mango on days to attained pea stage to marble stage fruits during both the years, pooled data and interactions. However, year means were found non-significant.

During the year 2019-20, Amrapali (V₃) recorded minimum days (14.00) to attained marble stage fruits which was at par with Kesar (V₄) (15.67 days). However, maximum days (19.67) were recorded in Totapuri (V₆) which was at par with Alphonso (V₂) (19.33 days), Sonpari (V₁) (18.67 days) and Dashehari (V₅) (18.33 days).

For the year 2020-21, Totapuri (V₆) required minimum days (9.00) to attained marble stage fruits, which was at par with Dashehari (V₅) (9.33 days). While, Alphonso (V₂) recorded significantly maximum days (27.00) to attained marble stage fruits. Cultivar Amrapali (V₃) recorded minimum days to

attained marble size fruits than Alphonso (V₂).

Maturity stage fruits

The data presented in Table 4 clearly revealed that there were significant differences due to mango varieties on days to fruit maturity during both the years, pooled analysis, year means as well as their interaction with varieties.

During the both years and in pooled data, Sonpari (V₁) recorded minimum days (64.33, 67.00 and 5.67 days, respectively) to attained maturity which was at par with Dashehari (V₅) (68.33, 67.00 and 67.7 days) during both trials and in pooled data, respectively and Amrapali (V₃) (77.50 days) in pooled data.

Maximum days to maturity were recorded in Rajapuri (V₇) (85.33, 104.67 and 95.00 days) during both trials and in pooled data, respectively which was at par with Kesar (V₄) (84.67, 99.67 and 92.1 days) during both trials and in pooled data, respectively, Totapuri (V₆) (78.33 and 82.83 days) during 2019-20 and in pooled data, respectively and Alphonso (V₂) (85.50) in pooled data.

The variation in days to attaining different phenophases, among different mango varieties might be due to respective varietal characteristics. Cultivar Sonpari (V₁) and Dashehari (V₅) required minimum duration to attained most of the phenophases. This was might be due to their varietal response to prevailing climatic conditions. These results are in agreement with Kumar *et al.* (2014) [5], Kishor *et al.* (2015) [4], Kanzaria (2015) [3], Rajatiya (2018) [8], Indian *et al.* (2020) [2] and Mhatre *et al.* (2021) [6].

Table 1: Effect of mango varieties on days to flower bud differentiation and panicle initiation and their dates

Treatments	Days after 1 st July for flower bud differentiation and its date			Days after FBD to panicle initiation and its date		
	2019 - 20	2020 - 21	Pooled	2019 - 20	2020 - 21	Pooled
V ₁ - Sonpari	205.33 (21 st Jan.)	181.00 (29 th Dec.)	193.17	7.33 (28 th Jan.)	14.33 (12 th Jan.)	10.83
V ₂ - Alphonso	177.00 (24 th Dec.)	130.33 (8 th Nov.)	153.67	9.33 (2 nd -Jan.)	10.00 (18 th -Nov.)	9.67
V ₃ - Amrapali	220.66 (6 th Feb.)	209.66 (26 th Jan.)	215.16	8.00 (14 th Feb.)	12.67 (8 th -Feb.)	10.33
V ₄ - Kesar	178.33 (25 th Dec.)	144.00 (22 th Nov.)	161.17	9.67 (4 th Jan.)	9.00 (1 st Dec.)	9.33
V ₅ - Dashehari	192.66 (9 th Jan.)	193.33 (9 th Jan.)	193.00	12.67 (22 th Jan.)	12.33 (21 st Jan.)	12.50
V ₆ - Totapuri	204.00 (20 th Jan.)	195.66 (12 th Jan.)	199.83	8.33 (28 th Jan.)	14.00 (26 th Jan.)	11.17
V ₇ - Rajapuri	177.66 (25 th Dec.)	138.66 (17 th Nov.)	158.16	12.00 (6 th -Jan.)	12.00 (29 th Nov.)	12.00
Year mean	193.66	170.38		9.62	12.05	
S.Em.±	3.77	3.63	8.82	0.78	1.00	1.61
C.D. at 5%	11.44	11.02	30.50	2.35	3.03	NS
C.V. (%)	3.37	3.69	3.52	13.98	14.39	14.32
Pooled	Year		Year x Treatments	Year		Year x Treatments
S.Em.±	4.71		3.70	0.86		0.90
C.D. at 5%	16.31		10.73	2.99		2.59

Table 2: Effect of mango varieties on days to initiation of flower opening and grain stage fruits and their dates

Treatments	Days to initiation of flower opening and its date			Days to grain stage fruits and its date		
	2019 - 20	2020 - 21	Pooled	2019 - 20	2020 - 21	Pooled
V ₁ - Sonpari	10.33 (7 th Feb.)	12.00 (24 th Jan.)	11.17	9.00 (16 th Feb.)	7.67 (1 st Feb.)	8.33
V ₂ - Alphonso	12.67 (15 th -Jan.)	15.67 (4 th Dec.)	14.16	11.33 (26 th Jan.)	8.00 (12 th Dec.)	9.67
V ₃ - Amrapali	8.33 (22 nd Feb.)	10.33 (18 th Feb.)	9.33	10.33 (3 rd Mar.)	11.33 (1 st Mar.)	10.83
V ₄ - Kesar	14.00 (18 th Jan.)	14.00 (15 th Dec.)	14.00	13.67 (1 st Feb.)	13.00 (28 th Dec.)	13.33
V ₅ - Dashehari	9.33 (1 st Feb.)	12.00 (2 nd Feb.)	10.67	12.00 (13 th Feb.)	10.33 (12 th Feb.)	11.17
V ₆ - Totapuri	10.33 (7 th Feb.)	10.67 (6 th Feb.)	10.50	12.33 (19 th Feb.)	10.00 (16 th Feb.)	11.17
V ₇ - Rajapuri	13.33 (19 th Jan.)	14.00 (13 th Dec.)	13.67	12.67 (1 st Feb.)	12.00 (25 th Dec.)	12.33
Year mean	11.19	12.66		11.62	10.33	
S.Em.±	0.58	0.66	0.44	0.71	0.58	0.46
C.D. at 5%	1.77	2.01	1.26	2.15	1.75	1.33
C.V. (%)	8.94	8.95	8.97	10.59	9.67	10.21
Pooled	Year		Year x Treatments	Year		Year x Treatments
S.Em.±	0.23		0.62	0.24		0.65
C.D. at 5%	0.68		NS	0.71		NS

Table 3: Effect of mango varieties on days to pea and marble stage fruits and their dates

Treatments	Days to pea stage fruits and its date			Days to attained marble stage fruits and its date		
	2019 - 20	2020 - 21	Pooled	2019 - 20	2020 - 21	Pooled
V ₁ - Sonpari	11.00 (27 th Feb.)	7.00 (8 th Feb.)	9.00	18.67 (17 th Mar.)	20.33 (28 th Feb.)	19.50
V ₂ - Alphonso	14.67 (10 th Feb.)	12.67 (25 th Dec.)	13.66	19.33 (29 th Feb.)	27.00 (21 st Jan.)	23.17
V ₃ - Amrapali	12.33 (15 th Mar.)	7.00 (8 th Mar.)	9.67	14.00 (29 th Mar.)	11.33 (19 th Mar.)	12.67
V ₄ - Kesar	12.00 (14 th Feb.)	12.00 (9 th Jan.)	12.00	15.67 (1 st Mar.)	21.00 (30 th Jan.)	18.33
V ₅ - Dashehari	11.33 (24 th Feb.)	7.67 (20 th Feb.)	9.50	18.33 (13 th Mar.)	9.67 (2 nd Mar.)	14.00
V ₆ - Totapuri	10.67 (1 st Mar.)	9.00 (25 th Feb.)	9.83	19.67 (21 st Mar.)	9.00 (6 th Mar.)	14.33
V ₇ - Rajapuri	13.33 (15 th Feb.)	8.33 (2 nd Jan.)	10.83	17.00 (3 rd Mar.)	23.00 (25 th Jan.)	20.00
Year mean	12.09	9.09		17.52	17.33	
S.Em.±	0.81	0.82	0.97	0.71	0.62	3.66
C.D. at 5%	2.44	2.48	3.36	2.16	1.87	NS
C.V. (%)	11.16	15.56	13.21	7.05	6.16	6.63
Pooled	Year		Year x Treatments	Year		Year x Treatments
S.Em.±	0.52		0.81	1.96		0.67
C.D. at 5%	1.80		2.35	NS		1.93

Table 4: Effect of mango varieties on days to maturity and its date

Treatments	Days to maturity and its date		
	2019 - 20	2020 - 21	Pooled
V ₁ - Sonpari	64.33 (20 th May)	67.00 (6 th May)	65.67
V ₂ - Alphonso	75.00 (15 th May)	96.00 (27 th Apr.)	85.50
V ₃ - Amrapali	76.67 (14 th Jun.)	78.33 (5 th Jun.)	77.50
V ₄ - Kesar	84.67 (25 th May)	99.67 (10 th May)	92.16
V ₅ - Dashehari	68.33 (20 th May)	67.00 (8 th May)	67.67
V ₆ - Totapuri	78.33 (7 th Jun.)	87.33 (1 st Jun.)	82.83
V ₇ - Rajapuri	85.33 (27 th May)	104.67 (10 th May)	95.00
Year mean	76.09	85.71	
S.Em.±	2.32	2.66	4.49
C.D. at 5%	7.04	8.06	15.55
C.V. (%)	5.28	5.37	5.34
Pooled	Year		Year x Treatments
S.Em.±	2.40		2.49
C.D. at 5%	8.31		7.22

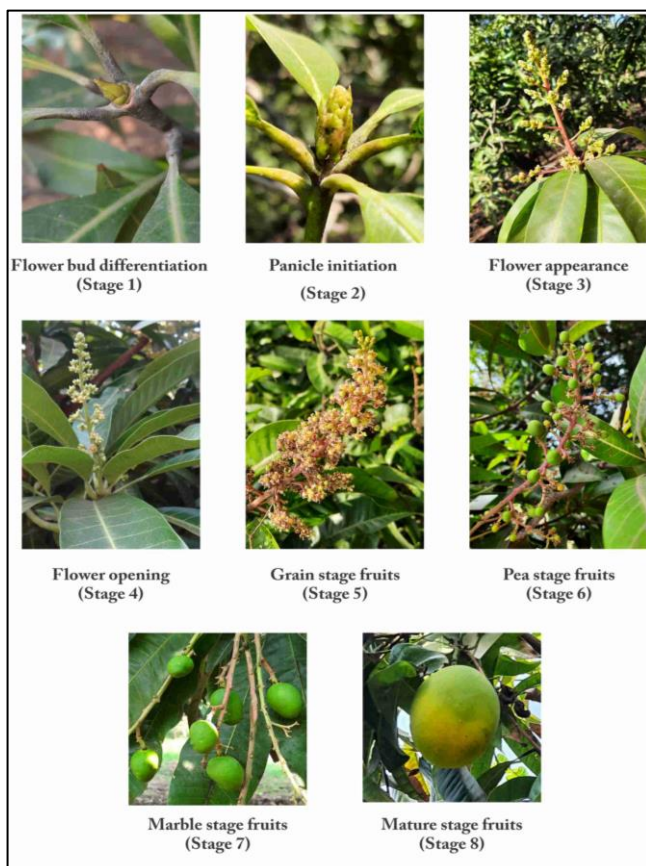


Photo 1: Different Phenological Stages in Mango

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