



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(10): 1728-1731
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www.thepharmajournal.com
Received: 26-07-2021
Accepted: 07-09-2021

Naveen Kumar Das
Department of Fruit and Fruit
Technology, BAU Sabour
Bhagalpur, Bihar, India

Karanjeev Kumar
Department of Fruit and Fruit
Technology, BAU Sabour
Bhagalpur, Bihar, India

Samik Sengupta
Department of Fruit and Fruit
Technology, BAU Sabour
Bhagalpur, Bihar, India

Sanjay Sahay
Department of Fruit and Fruit
Technology, BAU Sabour
Bhagalpur, Bihar, India

Kumari Madhumala
Department of Fruit and Fruit
Technology, BAU Sabour
Bhagalpur, Bihar, India

Corresponding Author:
Karanjeev Kumar
Department of Fruit and Fruit
Technology, BAU Sabour
Bhagalpur, Bihar, India

Effect of pollen viability and germination on phenological character of different mango cultivars

Naveen Kumar Das, Karanjeev Kumar, Samik Sengupta, Sanjay Sahay and Kumari Madhumala

Abstract

Mango (*Mangifera indica* L.) is one of the most important fruit crop belongs to the family Anacardiaceae. Bihar has the wider adaptability of mango cultivars rich in bioactive compounds such as ascorbic acid, polyphenols, carotenoids and receives increased attention because of their potential antioxidant activity. Therefore, the present investigation entitled Effect of pollen viability and germination on phenological character of different mango cultivars was carried out during 2017-18 in the Department of Horticulture (Fruit and Fruit Technology), BAC, Sabour. For this experiment seven released mango cultivars viz., Alfazli, Hybrid 60-1 (Sabour Mango-1), Jawahar, Menaka, Prabhashankar, Sabri and Sunder Langra were chosen for the present study. On the basis of data recorded on date of panicle emergence it can be concluded that Jawahar was the earliest and Menaka was the last among all the cultivars evaluated at Sabour condition. Hybrid 60-1(Sabour Mango-1) took the minimum (21 days) and Prabhashankar took the maximum (30 days) period of full bloom. The maximum number of male flower was recorded in Prabhashankar (354.25) While, the cultivar Alfazli (189.75) had the minimum number of male flower in a panicle. Physiological parameters like pollen viability, germination, equatorial length and pollen diameter were recorded in the cultivars. Pollen grain viability were observed under an optical microscope (light microscope at 40X magnification) and subsequently classified as fertile or non-fertile ones. *In vitro* germination test was assessed in an agar solidifying medium as per the medium proposed by Spiegel-Roy (1980). The maximum pollen viability and germination percentage was recorded in Prabhashankar (86.5%, 76.5%) While, the cultivar Hybride 60-1 (Sabour mango-1) (76.25%, 52.5%), had the minimum pollen viability and germination percentage.

Keywords: Mango, pollen, hybrid, microscope, germination

Introduction

Mango (*Mangifera indica* L.) is also known as the king of the fruits. It is the national fruit of India grown in the tropical and sub-tropical parts of the country except hilly regions above 915 m from the mean sea level. It possesses a rich aromatic flavour and delicious blended of sweetness and acidity. Due to its high palatability, sweet fragrance, attractive colour, delicious taste and nutritive value, it occupies a superior position in the world market. From nutritional point of view, ripe mango is rich in sugar, an excellent source of vitamin A and a good source of vitamin C, apart from the usual content of minerals and other vitamins. Sugar constitutes the main bulk of carbohydrates and most of the soluble solids in ripe mango. In India, mango is cultivated in an area of 2267 thousand ha with a production of 20295 thousand MT (NHB 2016-17). Low productivity of mango may be due to poor pollination and fruit drop. Mango is rich source of bioactive compounds such as ascorbic acid, polyphenols and carotenoids etc. In recent years mango is receiving increased attention because of its potential antioxidant activity. Consumption of such antioxidants offers health benefits including protection against cardiovascular diseases and cancer. Beside its table value, the ripe fruit is also a good source of raw material for jam, jelly, juice, squash, nectar, mango leather for canning industry. Unripe mangoes are widely used in chutneys, pickles, side dishes or may be eaten raw with salt.

In Bihar, many popular cultivars are grown *i.e.* Alfazli (Alphonso x Fazli), Hybrid 60-1 (Sunder Prasad x Langra), Jawahar (Gulabkhas x Mohmoodbahar), Menaka (Selection from Gulabkhas), Prabhashankar (Bombai x Kalapadi), Sabari (Gulabkhas x Bombai), Sunder Langra (Langra x Sunder Prasad), Bombay Green, Chausa, Dashehari, Fazli, Gulabkhas, Kishan Bhog, Himsagar, Zardalu and Langra (Malda). These cultivars are gaining popularity due to their attractive colour, pleasant flavour, taste, sugars, fibrelessness and pulpiness.

Though, these cultivars grown all over the country, but Bihar is the leading producer of these cultivars. Growth of flushes occurs in alternate months pattern. Under the subtropical conditions, cool temperature not only triggers bud break but also favours higher ratios of florigenic promoter to vegetative promoter in developing buds resulting in induction of generative shoots. Flowering in mango is an important event as it marks the physiological start of fruit production. Mango plants flower in response to the age of the last vegetative flush. In contrast, cool inductive temperatures induce flowering under subtropical conditions. Mango flowering can be manipulated in order to obtain off season fruits and improve mango productivity (Anwar *et al.*, 2011) [1]. Mango cultivation is concentrated between 27° N and 27° S where the shortest annual photoperiod is 10.5 h and the longest photoperiod is 13.5 hrs. In the upper-latitude tropics and subtropics, mango flowers during the winter when photoperiods are short however, trees in the low-latitude tropics, where a 12 hrs photoperiod is nearly constant, can flower at any time of the year. The Flowering on spring-initiated shoots in the subtropics occurs during summer. Irregular bearing is a major problem of commercially important mango cultivars, affecting the productivity of mango orchards. However information on the relationship of pollen parameters with flowering and fruit development in mango are scarce. Pollen is generated through meiosis and further maturation occurs in the anthers. Anthers are about 1.2 mm long (Issarakraisila and Considine, 1994) [5]. The pollen mother cells or microsporocytes give rise to microspores. Anthers produce 250–650 pollen grains with a mean of 410 grains per anther (Popenoe, 1917). Pollen adhesion to stigmatic surface varies from cultivar to cultivar (Dutta *et al.*, 2013) [3]. Stigma receptivity began about 18 hr prior to anthesis and continued for 72 hr after anthesis and is most receptive during the first 6 hr (Pimentel *et al.*, 1984) The optimum receptivity is within 3 hr from anthesis (Pimentel *et al.*, 1984). The minimum time required for pollen grains to germinate is 1.5 hr (Sen *et al.*, 1946, Singh, 1954). Once pollen germination has occurred, the two generative nuclei and the tube cell nucleus contained in the pollen grain grow carrying the sperm cells through the style to the micropyle. Depending upon ambient temperature, the rate of pollen tube growth varies among cultivars. Mango pollen viability is highest soon after anther dehiscence and degrades with time (Spencer and Kennard 1955, Young 1955) reported that viability of mango pollen begins to decrease about 12 hrs after it is shed. Germination and viability are highly dependent on temperature. Warm temperatures tend to preserve pollen viability but cool temperature conditions can negatively impact pollen development and tube growth to the ovule (Davenport, 2009) [4]. Mango pollen germination does not occur below 16°C (Young, 1955). Sensitivity of pollen development to cool temperatures (<15°C) causes reduced

viability from 30 to 40% (Issarakraisila and Considine, 1994) [5].

Materials and methods

An investigation on “Effect of pollen viability and germination on phenological character of different mango” was carried out in the Department of Horticulture (Fruit & Fruit Technology), Bihar Agricultural College, Sabour, Bhagalpur, Bihar during 2017-18. The field experiment was conducted in the Garden, Department of Horticulture (Fruit and Fruit Technology), Sabour, Bhagalpur. The experimental plot had well drained sandy loam soil of good fertility with leveled surface. All details about materials used, experimental procedure followed and methods adopted for experiment are Randomized block design. The results have been depicted in tabular form and illustrated with tables and figures in order to obtain comprehensive idea of investigation. The data have been analyzed statistically. The results obtained are presented under appropriate heading, which are as follows:

Date of bud break

The data concerning to the date of bud break for different cultivars are provided in Table-1. The analysis of data clearly indicated that the cultivar Jawahar (04 Feb) showed earlier bud break followed by Sabri (05 Feb), Hybrid 60-1 (06 Feb), Sunder Langra (07 Feb), Alfazli (9 Feb), Prabhashankar (09 Feb) and Menaka (10 Feb).

Date of panicle initiation

The data concerning date of panicle initiation for different cultivars are provided in Table-1. The analysis of data clearly indicated that the cultivar Jawahar (06 Feb) showed earlier panicle initiation followed by Sabri (7 Feb), Hybrid 60-1 (8 Feb). Sunder Langra (9 Feb), Alfazli (10 Feb), Prabhashankar (11 Feb) and Menaka (12 Feb).

Length of panicles (cm)

The data related to length of panicles for different cultivars are mentioned in Table-1 and depicted pictorially. The cultivars differed significantly in length of panicles. The maximum length was measured in Prabhashankar (29.75 cm) followed by Jawahar (27.95 cm), Hybrid 60-1 (27.75 cm), Menaka (27.62 cm), Sabri (26.05 cm), Sunder Langra (25.77 cm). While, the cultivar Alfazli (24.1 cm) had the minimum length of panicle.

Width of panicles (cm)

The data related to width of panicles for different cultivars are mentioned in Table- 1 and depicted pictorially. The cultivars differed significantly in width of panicles. The maximum width was measured in Prabhashankar (16.12 cm) followed by Jawahar (15.75), Hybrid 60-1 (14.30 cm), Menaka (13.80 cm), Sunder.

Table 1: Panicles characteristics of different mango cultivars

Cultivars	Date of bud break	Date of panicles initiation	Length of panicles (cm)	Width of panicles (cm)
Alfazli	9/02/18	10/02/18	24.1 cm	12.15 cm
Hybrid 60-1	6/02/18	08/02/18	27.75 cm	14.3 cm
Jawahar	4/02/18	06/02/18	27.95 cm	15.75 cm
Menaka	10/02/18	12/02/18	27.333 cm	13.8 cm
Prabhashankar	9/02/18	11/02/18	29.75 cm	16.12 cm
Sabri	5/02/18	07/02/18	26.05 cm	11.72 cm
Sunder Langra	07/05/18	09/02/18	25.77 cm	12.8 cm
SEM (±)			0.3	0.29
CD (P = 0.05)			0.89	0.87
CV (%)			2.22	4.23

Date of Anthesis

The data concerning to the date of anthesis for different cultivars are provided in Table- 2. Scrutiny of data clearly indicated that the cultivar Jawahar (9 Feb) showed earlier anthesis followed by Prabhashankar (14 Feb), Alfazli (15 Feb), Sabari (15 Feb) Hybrid 60-1 (16 Feb), Sunder Langra (17 Feb) and Menaka (19 Feb).

Date of 50% flowering

The data concerning to the date of 50% flowering for different cultivars are provided in Table- 2. Analysis of data clearly indicated that the cultivar Jawahar (24 Feb) showed earlier

50% flowering followed by Prabhashankar (25 Feb), Alfazli (25 Feb.), Hybrid 60-1 (26 Feb), Sabri (27 Feb), Sunder Langra (27 Feb) and Menaka (02Mar).

Date of 100% flowering

The data concerning to the date of 100% flowering for different cultivars are provided in Table- 2. Scrutiny of data clearly indicated that the cultivar Jawahar (03 Mar) showed earlier 100% flowering followed by, Hybrid 60-1 (08 Mar), Alfazli (11 Mar), Sunder Langra (12 Mar), Sabri (14 Mar), Prabhashankar (15 Mar) and Menaka (16 Mar).

Table 2: Flowering duration of different mango cultivars

Cultivars	Date of Anthesis	Date of 50% flowering	Date of 100% flowering
Alfazli	15/02/18	25/02/18	11/03/18
Hybrid 60-1	16/02/18	26/02/18	08/03/18
Jawahar	09/02/18	24/02/18	03/03/18
Menaka	19/02/18	02/03/18	16/03/18
Prabhashankar	14/02/18	25/02/18	15/03/18
Sabri	15/02/18	27/02/18	14/03/18
Sunder Langra	17/02/18	27/02/18	12/03/18

Flower diameter (mm)

The data related to flower diameter for different cultivars are mentioned in Table- 3. The cultivars differed significantly in flower diameter. The maximum flower diameter was measured in Prabhashankar (8.41 mm) followed by Alfazli (8.32 mm), Jawahar (7.26 mm), Sabri (6.71 mm), Menaka (6.66 mm), and Hybrid 60-1 (5.98 mm), While the cultivar Sunder Langra (5.92 mm) had the minimum flower diameter.

Flower colour

The data related to flower colour for different cultivars are mentioned in Table- 3. Flower colour was found to vary from light yellow in Sunder Langra to yellow in Alfazli, Jawahar, Prabhashankar, Sabri. The flowers of Sabour Mango 1 (Hybrid 60-1) was observed to be Pink in colour where as Menaka produced light pink coloured flowers. The variation observed for flower colour might be due to the genetic constitution of variety and interaction with the agroclimate.

Table 3: Flower morphological characteristics of different mango cultivars

Variety	Flower colour	Flower Diameter (mm)
Alfazli	Yellow	8.32
Hybrid 60-1	Pink	5.98
Jawahar	Yellow	7.26
Menaka	Light pink	6.66
Prabhashankar	Yellow	8.41
Sabri	Yellow	6.71
Sunder Langra	Light yellow	5.92
CD (P = 0.05)		0.153
SE(m) ±		0.051
CV (%)		1.45

Number of male flowers

The data related to the number of male flower in panicles for different cultivars are mentioned in Table- 4. The cultivars differed significantly in number of male flower in a Panicle. The maximum number of male flower was recorded in Prabhashankar (354.25) followed by Menaka (333.25), Jawahar (323.25), Hybrid 60-1 (271.75), Sabri (266), Sunder Langra (192.5). While, the cultivar Alfazli (189.75) had the minimum number of male flower in a panicle.

Percentage of male flowers

The data related to the percentage of male flower in panicles for different cultivars are mentioned in Table- 4. The cultivars differed significantly in Percentage of male flower. The maximum Percentage of male flower was measured in cultivar Jawahar (70.54%) followed by Hybrid 60-1 (69.24%), Sabri (60.45%), Menaka (59.35%), Sunder Langra (55.35%) and Alfazli (53.70%), While, the cultivar Prabhashankar

(52.28%), had the minimum percentage of male flower.

Number of hermaphrodite flowers

The data related to the no. of hermaphrodite flower in panicles for different cultivars are mentioned in Table- 4. The cultivars differed significantly in no. of hermaphrodite flower in a Panicle. The maximum no. of hermaphrodite flower was counted in Prabhashankar (323.25), followed by Menaka (228.25), Sabri (174), Alfazli (163.5), Sunder Langra (155.25), Jawahar (135). While, the cultivar Hybrid 60-1 (120.75) had the minimum number of hermaphrodite flower in a panicle.

Percentage of hermaphrodite flowers

The data related to the percentage of hermaphrodite flower in panicles for different cultivars are mentioned in Table- 4. The cultivars differed significantly in Percentage of hermaphrodite

flower. The maximum percentage of hermaphrodite flower was measured in cultivar Prabhashankar (47.71%) followed by Alfazli (46.29%), Sunder Langra (44.64%), Menaka

(40.64%), Sabri (39.54%), Hybrid 60-1 (30.75%) Jawahar (29.45%) While, the cultivar Jawahar (29.45%) had the minimum percentage of hermaphrodite flower.

Table 4: Male and hermaphrodite flower characters of different mango cultivars

Cultivars	No. of male flowers	Percentage of male flowers (%)	No. of hermaphrodite flowers	Percentage of hermaphrodite flowers (%)
Alfazli	189.75	53.70	163.5	46.29
Hybrid 60-1	271.75	69.24	120.75	30.75
Jawahar	323.25	70.54	135	29.45
Menaka	333.25	59.35	228.25	40.64
Prabhashankar	354.25	52.28	323.25	47.71
Sabri	266	60.45	174	39.54
Sunder Langra	192.5	55.35	155.25	44.64
SEM (\pm)	2.06	0.34	1.55	0.34
CD (P = 0.05)	6.19	1.01	4.66	1.01
CV (%)	1.50	1.13	1.67	1.70

Conclusion

There were distinct variations among the mango hybrids for characteristics of panicles, flowers and pollen characters under study. It is concluded that the cultivar Prabhashankar performed better in most of the characters. The information generated from this study will be useful for breeders who normally face problem of non availability of parental pollen for fertilization of the receptive target female cultivars due to non synchronous flowering time of different cultivars. The information pertaining to parameters like bud break, date of panicle initiation, number of male & hermaphrodite flowers, pollen viability and germination and their effect on fruit set etc can have significant implication on successful breeding programme in the future.

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