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Naveen Kumar Das

Department of Horticulture
(Fruit and Fruit Technology),
Bihar Agricultural University,
Sabour, Bhagalpur, Bihar, India

Samik Sengupta

Department of Horticulture
(Fruit and Fruit Technology),
Bihar Agricultural University,
Sabour, Bhagalpur, Bihar, India

Ravi Shankar Singh

Department of Plant Breeding,
Genetics and Bio-Technology,
Bihar Agricultural University,
Sabour, Bhagalpur, Bihar, India

Santosh Kumar

Department of Horticulture
(Fruit and Fruit Technology),
Bihar Agricultural University,
Sabour, Bhagalpur, Bihar, India

Sanjay Sahay

Department of Horticulture
(Fruit and Fruit Technology),
Bihar Agricultural University,
Sabour, Bhagalpur, Bihar, India

Corresponding Author:

Naveen Kumar Das

Department of Horticulture
(Fruit and Fruit Technology),
Bihar Agricultural University,
Sabour, Bhagalpur, Bihar, India

Effect of pollen viability and germination on Fruit set of different mango cultivars

Naveen Kumar Das, Samik Sengupta, Ravi Shankar Singh, Santosh Kumar and Sanjay Sahay

Abstract

A field experiment was conducted during 2017-18 in the Garden, Department of Horticulture (Fruit and Fruit Technology), Sabour, Bhagalpur. The experiment consisting of seven treatments was set up in randomized block design with four replications. The Seven released mango cultivars viz., 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) were chosen to study the effect of pollen viability and germination in different mango cultivars. The results revealed that the maximum viability percentage was measured in cultivar Prabhashankar (86.5%) followed by Alfazli (85.5%), Sabri (83.5%), Menaka (83.25%), Jawahar (81.75%) and Sunder Langra (80.75%). The cultivar Hybrid 60-1 (76.25%), had the minimum pollen viability percentage. The maximum germination percentage was measured in cultivar Prabhashankar (76.5%), followed by Jawahar (67.5%), Alfazli (65.75%), Menaka (63.25%), Sabri (61%) and Sunder Langra (55.25%). The cultivar Hybrid 60-1 (52.5%), had the minimum pollen germination percentage. The cultivars differed significantly in number of fruit set. Among the cultivars evaluated, earliest period of fruit set was found in cultivar Prabhashankar (26 days).

Keywords: Cultivars, hybrid, pollen viability, germination percentage, fruit set

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. In Bihar, many popular cultivars are grown i.e., Alfazli (Alphonso x Fazli), Hybrid 60-1 (Sunder Prasad x Langra), Jawahar (Gulabkhas x Mohmood bahar), Menaka (Selection from Gulabkhas), Prabhashankar (Bombai x Kalapadi), Sabari (Gulabkhas x Bombai), Sunder Langra (Langra x Sunder Prasad), Bombay Green, Chausa, Dashehari, Fazli, Gulabkhas, KishanBhog, 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]. The minimum time required for pollen grains to germinate is 1.5 hr (Sen *et al.*, 1946, Singh, 1954) [8]. Mango pollen viability is highest soon after anther dehiscence and degrades with time (Spencer and Kennard 1955, Young 1955) [9] 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). 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) [3].

Materials and Methods

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. Bihar Agricultural College, Sabour is situated between 25°15'40" North longitude 87 °2'55" East Latitude with an elevation of 45.72 meters above the mean sea level in the heart of the vast alluvial Gangetic plains of North India, South of River Ganga. The climate of Sabour is semi-arid, subtropical with hot desiccating summer, cold but frost less winter with an average annual rainfall of about 1150 mm precipitating mainly in between middle of June to middle of October. Mainly three seasons influences the agricultural activities of this region. These are as: November to February, March to June, Mid-June to October. The overall distribution regarding various details of meteorological observations was recorded on monthly basis for maximum and minimum temperature, rainfall, relative humidity and wind velocity from December, 2017 to April, 2018 and were collected from agro-meteorological observatory, Bihar Agricultural College, Sabour, Bhagalpur. Soil of the orchard where experimental plants were grown is Indo-Gangetic alluvial in origin. The land was fairly leveled. The soil was fair in texture and medium in fertility level. The experiment consisting of seven treatments was laid out in randomized block design with four replications. The Seven released mango cultivars viz., Alfazli (Alphonso x Fazli), Hybrid 60-1 (Sunder Prasad x Langra), Jawahar (Gulabkhas x Mohmood bahar), Menaka (Selection from Gulabkhas), Prabhashankar (Bombai x Kalapadi), Sabari (Gulabkhas x Bombai), Sunder Langra (Langra x Sunder Prasad), were chosen to study the effect of pollen viability and germination in different mango cultivars. Pollen parent were carried out by acetocarmine crushing (Nassar *et al.*, 2000) [4]. *In vitro* germination test was assessed in an agar solidifying medium containing 150 g l-1 sucrose, 100 mg l-1 H₃BO₃, 300 mg l-1 Ca (NO₃)₂, 200 mg l-1 MgSO₄, 100 mg l-1 KNO₃ and 10 g l-1 agar at pH 5.5 (Sahar and Spiegel-Roy, 1980). *In vitro* germination test in liquid media was done by hanging drop technique (Stanley and Linskens, 1974) [10]. The liquid germination medium containing 150 g l-1 sucrose, 100 mg l-1 H₃BO₃, 1000 mg l-1 Ca (NO₃)₂, 300 mg l-1 MgSO₄ and 100 mg l-1 KNO₃ at pH 5.5 (Cavalcante *et al.*, 2000) [2] was prepared. Fruits were counted on each panicle at different intervals viz., 6, 10, 14, 20, and 26 days after pollination. Fruitlet retention up to marble size (26 days after pollination) was taken as final fruitlet set. Per cent fruit set was then calculated based on initial and final counts. The observations were subjected to statistical analysis by using Randomized Block Design (RBD) with four replications. Mean difference were tested by f test at five percent level of significance (LOS). Critical difference (CD) at 5 percent level of significance was used for comparison among treatment.

Results and Discussion

The cultivars differed significantly in pollen viability percentage. The maximum viability percentage was measured in cultivar Prabhashankar (86.5%) followed by Alfazli

(85.5%), Sabri (83.5%), Menaka (83.25%), Jawahar (81.75%) and Sunder Langra (80.75%). While, the cultivar Hybrid 60-1 (76.25%), had the minimum pollen viability percentage (Table 1). There exists a direct relationship between temperature and pollen viability. The cultivars differed significantly in pollen germination percentage. The maximum germination percentage was measured in cultivar Prabhashankar (76.5%), followed by Jawahar (67.5%), Alfazli (65.75%), Menaka (63.25%), Sabri (61%) and Sunder Langra (55.25%). While, the cultivar Hybrid 60-1 (52.5%), had the minimum pollen germination percentage (Table 1). The maximum Pollar diameter was measured in cultivar Sunder Langra (98.8 µm) followed by Alfazli (98.2 µm), Prabhashankar (96.2 µm), Menaka (93.6 µm), Hybrid 60-1 (85.8 µm) and Sabri (78.2 µm). While, the cultivar Jawahar (78.0 µm) had the minimum Pollar diameter (Table 2). The initial fruit set is directly related to the proportion of perfect flowers though the final fruit set doesn't depend on it. The cultivars differed significantly in the number of fruit set. Until 26 days after hybridization one fruit of hybrids of Amarpali with Prabhashankar and Amarpali with Jawahar were retained (Table 3).

Table 1: Pollen characteristics of different mango cultivars

Cultivar	Pollen viability (%)	Pollen germination (%)
Alfazli	85.5	65.75
Hybrid 60-1	76.25	52.5
Jawahar	81.75	67.5
Menaka	83.25	63.25
Prabhashankar	86.5	76.5
Sabri	83.5	61
Sunder Langra	80.75	55.25
SEM (±)	0.63	0.65
CD (P = 0.05)	1.91	1.96
CV (%)	1.54	2.07

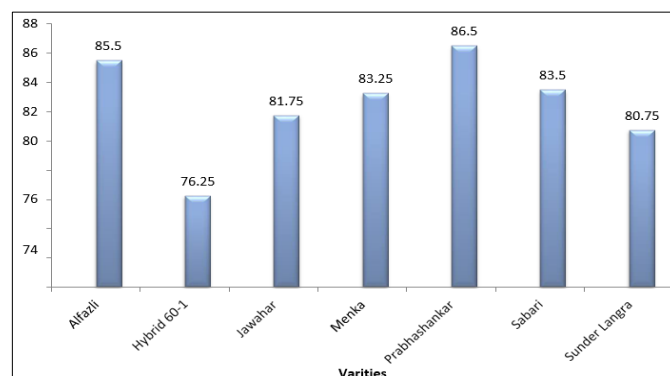


Fig 1: Pollen viability percentage of Mango cultivars

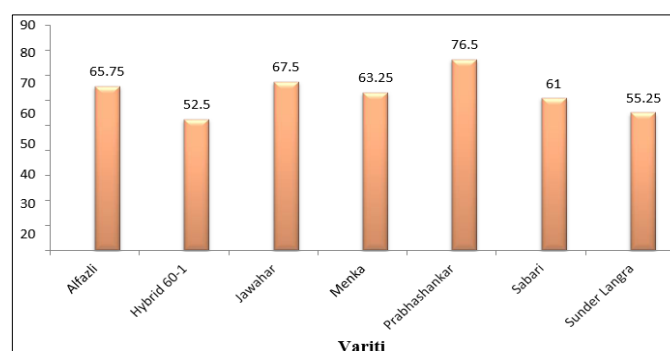


Fig 2: Pollen germination percentage of Mango cultivars

Table 2: Pollen morphological characteristics of different mango cultivars

Cultivar	Equatorial length (μm)	Pollar diameter (μm)
Alfazli	62.8	98.2
Hybrid 60-1	62.4	85.8
Jawahar	72.8	78.0
Menaka	65.0	93.6
Prabhashankar	59.9	96.3
Sabri	72.7	78.2
Sunder Langra	59.8	98.8

Table 3: Effect of cross-pollination on fruit set (26 Days)

Cultivars	No. of flowers crossed	Fruit retention (days)				
		6 day	10 day	14 day	20 day	26 day
Amarpali x Prabhashankar	22	10	8	5	4	1
Mallika x Prabhashankar	23	7	3	2	1	0
Amarpali x Jawahar	30	11	9	4	3	1
Mallika x Jawahar	38	9	6	2	1	0
Amarpali x Sundar langra	26	9	7	3	2	0
Mallika x Sundar langra	27	8	5	1	0	0
Amarpali x Sabri	26	6	3	1	0	0
Mallika x Sabri	24	8	6	3	1	0
Amarpali x Alfazali	23	8	5	2	0	0
Mallika x Alfazali	25	10	8	5	1	0
Amarpali x Menaka	30	7	5	3	0	0
Mallika x Menaka	25	7	3	1	0	0
Amarpali x Hybrid-60-1	27	11	5	2	1	0
Mallika x Hybrid-60-1	24	8	5	2	0	0

Conclusion

There were distinct variations among the mango hybrids for characteristics of panicles, flowers and pollen characters. Hence, it is concluded that the cultivar Prabhashankar performed better in most of the characters. The information pertaining to parameters such as pollen viability, germination and their effect on fruit set etc can have significant implication on successful breeding programme in the future.

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