

STUDIED POLLEN, RECEPTIVITY OF STIGMA, POLLINATING AGENTS AND MODE OF POLLINATION ON IN POMEGRANATE (*PUNICA GRANATUM L*) UNDER VALLEY CONDITIONS OF GARHWAL HIMALAYA

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ABSTRACT

The pollen grains of Ganesh and Kandhari exhibited the largest size (28.14×26.51μ) in acetocarmine and (27.07×22.26μ) in glycerin respectively. The pollen viability in both cultivars was recorded as 92.83% and 95.85% respectively. Sucrose solutions of 10% and 20% showed the highest pollen germination (25.07% and 27.21%) while 20% and 15% sucrose solutions exhibited the largest pollen tube length (28 μ and 49.78 μ) after 24 hours, in both of the cultivars, respectively. The stigma was 80% receptive on the day of anthesis in Ganesh, and one day before anthesis, 100% receptivity was recorded in Kandhari. Honey bees (*Apis mellifera*, *A. indica* and *A. dorsata*), black ants (*Componatus spp.*) and lemon butterfly (*Papilio demoleus*) appeared to be the most important insect for pollination. Hand pollination resulted in the highest fruit set (60% in Ganesh and 80% in Kandhari) followed by bag selfing and open pollination.

KEYWORDS: Pollen, Germination, Receptivity, Ganesh, Kandhari

INTRODUCTION

Pomegranate is very much liked for its refreshing juice and sweet acidic taste and also for its medicinal properties. It is mainly cultivated in tropical and subtropical regions. Because of its great medicinal properties it has great demand in the market. To improve its production and productivity up to the satisfactory level it is necessary to evolve varieties of superior quality, especially the resistant varieties, through the breeding programmes. A precise knowledge of pollen germination, stigma receptivity and mode of pollination is essential pre-requisite for initiating any breeding programme. The present investigation was therefore, carried out to have detailed information on above floral biological aspects of pomegranate cultivar Ganesh and kandhari under valley condition of Srinagar (Garhwal).

MATERIALS AND METHODS

Ten uniform, mature, eight year old healthy trees, grown under similar set of cultural practices were selected for studies at Horticultural Research Centre. H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand during 2010-11. The methods adopted during the course of study have been described under the respective headings of experimental results for the sake of convenience.

RESULT AND DISCUSSIONS

POLLEN STUDIES

Under the present investigation the pollen study include pollen size in different media, viability, artificial pollen

germination and longevity of pollen grains.

Pollen Size

The size of pollen grains (length×width) was measured under different medium (acetocarmine, glycerin, water and dry). The pollen grain of Ganesh attain maximum size (28.14×26.51μ) in acetocarmine after the glycerin (27.88×20.83μ) and minimum (26.82×25.42μ) in water. In dry condition and glycerin the pollen were mostly oblong but few were also observed round in shape, while in water and acetocarmine pollen were almost round in shape. The pollen grains of Kandhari exhibited the maximum size (length×width) of 27.07×22.26μ in glycerin, followed by water (26.76×26.85μ). The minimum size of pollen grains (21.28×21.39μ) was recorded in acetocarmine. Pollen grains of this cultivar looked oblong in glycerin and round in water and acetocarmine.

Pollen Viability

To determine the viability of pollen grains, fresh pollen grains were tested in acetocarmine. The pollen grains stained deeply and looked normal under microscopic field were counted as viable, whereas shriveled and poorly stained were considered as non-viable. Cultivar Ganesh and kandhari exhibited 92.83% and 95.85% pollen viability respectively.

Pollen Germination

The fresh pollen grains of the cultivars under study were planted in artificial sucrose medium (5, 10, 15 and 20%) distilled water served as control "Sitting Drop" culture method (Shivanna and Johri, 1985; Shivana and Rangaswamy, 1992) was employed for pollen germination studies. Slides were examined at 6, 12 and 24 hours, after planting the pollen grains in different sucrose media, and observations on germination of pollen grains and pollen tube length were recorded at least under the five different microscopic fields from each slide for calculating the average value.

Table 1: Ganesh, Pllen Germination and Pollen Tube Length under Sucrose Media

Concentration of Sucrose (%)	Percentage of Pollen Germination			Pollen Tube Length (μ)		
	6 Hours After	12 Hrs After	24 Hours After	6 Hours After	12 Hrs After	24 Hours After
5	27.29	32.22	22.59	19.62	31.98	15.40
10	35.90	34.08	25.07	19.55	29.96	14.93
15	45.48	53.37	33.34	23.58	46.26	23.50
20	33.34	46.68	19.74	23.86	54.16	28.00
Control	18.95	25.97	18.35	14.80	26.66	14.93

Cultivar Ganesh exhibited highest pollen germination (53.37 %) in 15% sucrose solution (Table1 & Figure 1) and longest pollen tube (54.16μ) occurred in 20% sucrose solution, after 12 hours. Among different concentrations tested the minimum pollen germination (18.35%) was recorded in control and smallest pollen tube (14.93μ) was found in control and 10% sucrose solution after 24 hours. Data of table 2 reveal that in Kandhari 20% sucrose solution showed the highest pollen germination (57.10%) and the maximum pollen tube length (67.09μ) occurred in 15% sucrose solution, after 12 hours of planting (Figure 2). The minimum pollen germination (9.51%) recorded in 10% sucrose solution and shortest pollen tube (27.06μ) was found in 5% solution after 24 hours. Results of the present study with regard to pollen germination are very much on line with the findings of Nath and Randhawa (1959C) and Chadha (1983).

Table 2: Kandhari, Pollen Germination and Pollen Tube Length under Sucrose Media

Concentration of Sucrose (%)	Percentage of Pollen Germination			Pollen Tube Length (μ)		
	6 Hrs After	12 Hrs After	24 Hrs After	6 Hrs After	12 Hrs After	24 Hrs After
5	11.80	12.05	29.96	31.33	48.70	27.06
10	7.10	28.31	29.51	30.75	44.45	32.62
15	19.40	47.75	37.79	35.08	67.09	49.78
20	18.41	57.10	27.21	42.93	59.40	43.03
Control	8.14	11.12	14.30	22.21	15.96	34.64

RECEPTIVITY OF STIGMA

Visual Observations

The stigma was observed for total duration of three days before and three days after anthesis for judging the receptivity in these two cultivars of pomegranate under the study. Both of the cultivars show similar characteristics as described below:

- **Three days before anthesis:** The stigma was green, small and less sticky at this stage.
- **Two days after anthesis:** Colour of stigma become whitish green and looked comparatively more sticky and shiny.
- **One day before to one day after anthesis:** From one day before to one day after anthesis, the stigma looked whitish green, very sticky and shiny with more stigmatic secretion. However, the stigma appeared more attractive and plump on the day of anthesis.
- **Two days after anthesis:** The stigma becomes less shiny, slightly sticky with same colour.
- **Three days after anthesis:** Colour of stigma turned light brown, less sticky and slightly dry.

Fruit Set Method

To study the receptivity of stigma by fruit set method, previously emasculated flower buds were pollinated artificially at different stages varying from two and one day before, on the day and one and two days after anthesis. The pollinated buds were covered with paper bags and tagged usually. The fruit set was observed after 21 days of pollination when, ovaries started swelling.

In the cultivar Ganesh the stigma become receptive two before anthesis with 40% fruit-set and remain receptive up to two days after anthesis with 20% fruit-set. However, on the day of anthesis the receptivity was recorded maximum (80%) which was followed by one day after anthesis with 60% fruit-set (Table 3).

Table 3: Ganesh, Stigma Receptivity by Fruit-Set Method

Age of Stigmas	No. of Buds Pollinated	No. of Fruit-Set	Percentage of Fruit-Set
2 days before anthesis	10	4	40
1 day before anthesis	10	4	40
On the day of anthesis	10	8	80
1 day after anthesis	10	6	60
2 days after anthesis	10	2	20

It is evident from Table 4 that the stigma of cultivar Kandhari become receptive two days before anthesis with 20% fruit-set and continues to be receptive even two days after anthesis with 40% fruit-set. The maximum receptivity (100%) was obtained one day before anthesis followed by on the day of anthesis (80%). Findings of Chadha (1983) justify the results of present investigation with respect to receptivity of stigma.

Table 4: Kandhari, Stigma Receptivity by Fruit-Set Method

Age of Stigmas	No. of Buds Pollinated	No. of Fruit-Set	Percentage of Fruit-Set
2 days before anthesis	10	2	20
1 day before anthesis	10	10	100
On the day of anthesis	10	8	80
1 day after anthesis	10	6	60
2 days after anthesis	10	4	40

POLLINATING AGENTS

Honey bees (*Apis mellifera*, *A. indica*, and *A. dorsata*), black ants (*Camponotus spp.*) and Lemon butterfly (*Papilio demoleus*) appeared to be the most important among the insects in transferring pollen grains from one flower to another flower and from one tree to another tree.

MODE OF POLLINATION

- **Natural or open pollination:** Perfect flower buds in each species were tagged before anthesis and allowed to remain on the trees for recording various observations with regards the fruit-set.
- **Bag self-pollination:** The shoots bearing flowers buds were tagged and bagged with all necessary care, a day before anthesis and left for self-pollination and fruit-set inside the bags.
- **Hand self-pollination:** Mature flower buds, ready to open next day, were emasculated and bagged. These flowers were then hand pollinated next day (at anthesis) with the pollen of same plant or same cultivar, collected from freshly dehisced anthers. These pollinated flowers were bagged again and allowed to remain on the trees for fruit set.

Fruit set in each cultivar under study was recorded 21 days after pollination when the ovary had attained a reasonable size. The maximum fruit-set (60% in Ganesh and 80% in Kandhari) has been recorded under hand pollination, followed by open pollination with 40% and 60% fruit-set in Ganesh and Kandhari, respectively. Josan et al. (1979C) and Nath and Randhawa (1959C) recognize the same results in different pomegranate cultivars.

CONCLUSIONS

It is concluded from the present study that Ganesh and Kandhari exhibited the large pollen, with 92.83% and 95.85% viability respectively. Of 10% to 20% Sucrose solutions was recommended best for pollen germination and pollen tube growth. The stigma was found receptive from one day before to one day after anthesis in both of the cultivars. Hand pollination resulted in the highest fruit set followed by bag selfing and open pollination and Honey bees (*Apis mellifera*, *A. indica* and *A. dorsata*), black ants (*Componotus spp.*) and lemon butterfly (*Papilio demoleus*) appeared to be the most important insect for pollination.

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