

Pollination biology of pomegranate (*Punica granatum* L.) with special reference to entomophily

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Abstract

The pomegranate (*Punica granatum* L.) of Punicaceae family is the earliest and most significant outgrowth crop of arid and semi-arid environments all over the world. Pollination is the one phenomenon, which influences fruit set in many horticulture crops. From the several studies, pomegranate is found to have all three types of pollination modes (Self, cross and often-cross pollination). Fruit production for agricultural yield necessitates the synchronisation of several critical reproductive processes. Understanding the juvenile period, flowering behaviour, duration and flowering seasons in different parts of the country is most crucial in modern crop improvement programmes. So, in depth knowledge of floral biology is an inevitable pre-requisite for development of new cultivars. With this perspective, it is necessary to review the current state of knowledge on floral biology of pomegranate.

Key words: Entomophily, Floral biology, Fruit set, Pollination, Pomegranate

Introduction

The pomegranate (*Punica granatum* L.), which belongs to the Punicaceae family, is an old and important tropical and subtropical fruit. It is thought to have originated in the regions of Iran and northern India (Soriano *et al.*, 2011). Many countries have recorded wild pomegranate bushes being planted in gardens for their fruits or even for their aesthetic appeal (Xhuveli, 2012). Pomegranates is reportedly grown all over the world between the latitudes of 41° N and 42° S. It is grown on around 1.20 lakh ha in India, with a yearly yield of 28.45 lakh tonnes and a productivity of about 6.60

tonnes per ha (Kumar *et al.*, 2020). Maharashtra is the largest producer of this fruit crop in India. For the past decade, it has become an important export crop in India (Chandra and Jadhav, 2008).

Flowering period

In north India, there are two flowering seasons, but Nalawadi *et al.* (1973) recorded three blooming seasons in western India. There are three different blossoming seasons in subtropical central and western India *viz.*, ambe bahar (January-February), mrig bahar (June-July), and hasth bahar (September-

October). Growers choose ambe bahar because of its great yield due to profuse blossoming when compared to other flowering seasons (Prasannakumar, 1998). Flowering was recorded in Karnataka for 80-87 days between June and August (Nalawadi *et al.*, 1973). Only one flowering season was seen in Punjab, from April to June (Josan *et al.*, 1979a).

Pollination

Pollination is a regular phenomenon in flowering plants, particularly horticulture crops, and it influences fruit set intensity and yield. Through varietal compatibility, synchronised blooming and ideal environmental conditions, it entails effective pollinator and pollinizer integration. A pollinator is a biotic agent that delivers pollen from the anther to the stigma of a flower, causing fruits or seeds to develop through fertilisation. Bees, flies, bats, moths and birds are examples of such pollinators. A pollinizer, on the other hand, is a plant that serves as a pollen source for related plants in order for effective pollination to occur. Many horticultural crops are self-sterile and require cross pollination in order to develop seeds and fruit (Free, 1993).

Both self and cross pollination noticed in pomegranate, however cross pollination is favoured for increased fruit yield. Hand pollination yielded a higher proportion of fruit set than pollination under natural circumstances (Josan *et al.*, 1979a, Bavale, 1978).

Role of insects in pomegranate pollination

A greater number of insects, including black ants, honey bees, beetles and lemon butterflies visit the pomegranate blooms. Meanwhile, all flower visitors may necessarily not be pollinators. They may visit flowers by mistake, landing on flower/ substrata for taking rest after long flight or there may be possibility of accidentally, they caught on particular plant in surveyor eyes while looking for the pollinators. Even though, they are aiding in pollination service, their efficiency is not quantifiable or infrequent.

In comparison with self-pollination, bee pollination might greatly enhance the fruit set and weight of pomegranate fruit (Tao *et al.*, 2010). Fruit set is boosted by 68 percent with cross pollination and fruit quality (number of seeds per fruit, fruit size) is also improved (Anonymous, 2006). Three insects *viz.*, *Camponotus* spp., *Apis* spp., and *Papilio demoleus* were responsible for increased yield (67.9 % fruit set) in pomegranate as compared with induced self-pollination by emasculation (46 %) as reported by Nath and Randhawa (1959a). According to research Western Australia's Department of Agriculture and Food (DAF, 2005), stated that honey bees are responsible for 10 per cent increase in pomegranate pollination. One of the projects initiated by crop life India Pvt. Ltd in Maharashtra that aims in creating awareness about the importance of honey bees in crop yield enhanced the pomegranate yield by 35 percent and provided 42 percent additional

income, not only due to increase in yield, but also by improved fruit quality (Anonymous, 2018). With the elaborative work on cross pollination, still there is a scarcity of quantitative data on the role and pollination efficacy of honey bees in pomegranate pollination. In the earlier study, Knuth (1908) enumerated that the beetles of the genus *Trichodes* and *Cetonia* can influence both self and cross-pollination while they devouring the flowers of pomegranate tree.

While some research studies suggests that insect pollinators such as honey bees are beneficial in enhancing fruit set and quality of pomegranate yields, many scientific reports have shown that significant yields can still be obtained from self-pollination. In this perspective, less research has been conducted on pomegranate cross pollination and role of pollinating agents like insects (Entomophily). Meanwhile, there is a huge scope with respect to evaluation and quantification of role of insect fauna in cross pollination of pomegranate in future.

Conclusion

Pomegranate sex appearance varies depending on blooming season and timing. Studies aimed at determining when male and bisexual flowers are required would give insight on what ecological and physiological variables may play a role in pomegranate sex determination. Still there is need to explore more information regarding extent of cross pollination involving biotic and abiotic agents,

meanwhile fruit set due to crossing of pollen from male, intermediate and bisexual flowers.

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