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Short communication

Reproductive phenology, flower biology and pollination in *jamun* (*Syzygium cuminii* L.)

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ABSTRACT

Studies on reproductive biology in *jamun* (*Syzygium cuminii* L.) revealed that period of flowering ranged from 3rd week of February and continued till 2nd week of March under sub-tropical conditions. The tree canopy had 5-13 panicles per shoot, the number of buds panicle^{-1} ranged from 19 to 73 in different directions of canopy, panicle size had clear relation with number of flowering buds. The total flowering phase culminating in fruit set and later ripening lasted for 119 to 126 days with long phase of flower bud initiation, lasting for 45-50 days. Natural pollen transfer in the species was efficient and fruit set following open-pollination was quite high. Inspite of synchronous nature of anther dehiscence and stigmatic receptivity, selfing in a flower was found to coexist in nature with cross-pollination due to pollinator efficiency and pollen grain size. Selfing was promoted by geitonogamous mode and the species was suited to insect and wind pollination. It was found that reproductive phenology in *jamun* under Lucknow conditions was largely governed by seasonal climatic variables.

Key words: *Syzygium cuminii* L., flower biology, pollination, sub-tropics.

Jamun is a common, large, evergreen and important fruit tree of Indian subcontinent. It falls in the broad basket of 'minor crops'. It is a one of the important but under exploited indigenous fruit crop of India. It is originated from Indonesia and India; now grows abundantly in Southern Asia (Bajpai, 1). There are about 400 to 500 species of which a few provide edible fruits. In India, *jamun* trees are found scattered throughout the tropical and subtropical regions, mainly as roadside avenues. It is valuable for reforestation programmes in arid and semiarid areas due to its ability to adapt to highly alkaline soils (pH 10.5). The information gathered on phenology, pollination mechanism and breeding system of wild and cultivated trees can be utilized for future breeding programmes. Studies on reproductive biology which included phenology, pollination and breeding system is essential in *jamun*, which is of considerable socio-economic importance. Hence, the present study was undertaken.

Phenological events floral bud break, flowering, fruiting, fruit maturation) over a period of for five years (2006-2010) was recorded on trees from two sites in Lucknow. The plants located near Rehmankhera, Lucknow were taken for pollen sterility and pollination studies. Observations on phenological events were recorded every day during the flowering and fruiting phases. Average number of flowers in an inflorescence was counted from the tagged flowering branches. The developmental stages of flowers were recognized on the basis of size and morphology, time of anthesis and anther dehiscence, and relative position of anther and stigma in a flower. Time of anthesis, anther dehiscence and stigmatic receptivity were determined by observing the marked flowers in panicles during peak blooming at hourly intervals. Healthy and glistening white stigmas with moist and shining surface were taken as receptive, while dull, brownish and shrivelled ones were assumed as non-receptive.

For pollen studies flower buds of appropriate sizes are taken from early bloom to full bloom period during early morning (9:30-1:00 am). Appropriate size of buds/flowers were taken. Pollen fertility was evaluated by acetocarmine staining method (Shivanna and Rangaswamy, 3). Pollen germination was recorded in modified Brewbaker and Kwack's medium (Brewbaker and Kwack, 2) by hanging drop technique. *In vivo* pollination studies needed hand pollination and subsequent pollen tube study by aniline blue staining. To confirm the type of breeding system operating in *jamun*, hand pollination and bagging of emasculated, non-emasculated flowers, and panicles in the wild as well as cultivated trees were used. Flowers were bagged prior to anthesis to determine the extent of selfing in a flower (autogamy). Manual crosses were made to confirm the geitonogamous and xenogamous mode.

Knowledge of the phenology of a particular crop is important for its correct management. The period for panicle emergence was recorded from 3rd week of February and continued till 2nd week of March The tree canopy had 5-13 panicles per shoot having relation

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with the direction of the shoot (Fig. 1). The number of buds panicle^{-1} ranged from 19 to 73 from different directions of canopy, panicle size having clear relation with number of flowering buds (Fig. 2). The total flowering phase culminating in fruit set and ripening lasted for 119 to 126 days with long phase of flower bud initiation, lasted 45-50 days. However, flower and initial fruit drop was serious hindrance to high fruit set (data now shown). The fruit set in *jamun* was initiated subsequent to anthesis and pollination, the anthesis of individual flowers taking 55-60 days for completion (Fig. 3). The flowering period lasted for 14-19 days, full bloom occurring 5-8 days after initial anthesis in individual plants. Further fruit ripening period lasted for 67-70 days. Overall, reproductive phenology of *jamun* under Lucknow conditions was largely governed by seasonal climatic variables, but ecological variables also need to be considered to account for the observed patterns of flowering and fruiting in this crop. Duration of flowering and fruiting and the peak of flowering were best correlated with canopy forging responses.

The terminal and axillary inflorescence, having hermaphrodite (bisexual) flowers were borne from February to April in different accessions (Fig. 4A). Flowering in all tree populations extended over a month and was synchronous within populations. The number of flowers opening each day is initially small, but increases rapidly, with a peak mass flowering

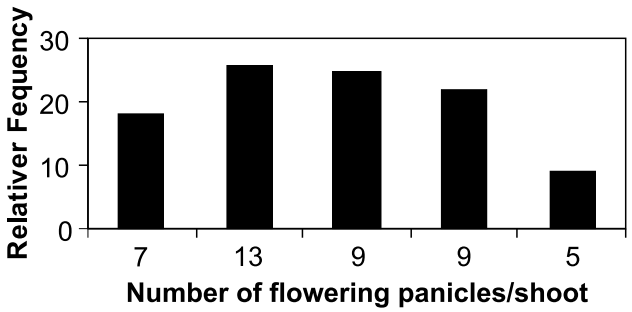

Fig. 1. Frequency for number of panicles per shoot in *jamun*.

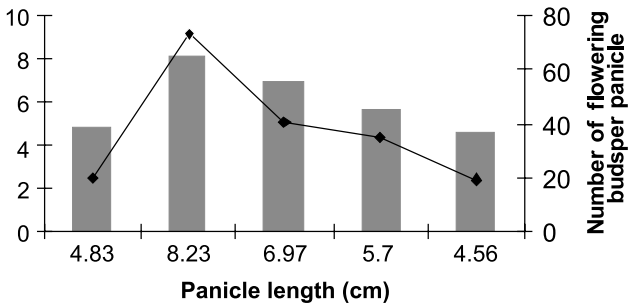

Fig. 2. Panicle statistics influencing fruiting in *jamun*.

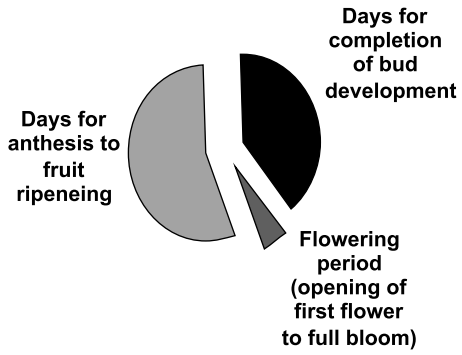

Fig. 3. Flowering phenology and fruit development in *jamun*.

for a fortnight, declining rapidly. Each inflorescence was initially 2.8 mm in size and grew upto 4-10 cm, having 20-50 flowers, which are initially club shaped. The *jamun* flowers were small and confirmed with the Myrtoideae type flowers, usually present, small, epigynous, 4-5-merous, polystemonous that last one day (Lughadha and Proenca, 6). This is the first report of the floral and reproductive biology of *jamun* under subtropics. The petals and sepals are joined to form a cap over the bud, which falls open upon anthesis (Fig. 4B & C). Stamens are conspicuous and numerous as in family Myrtaceae. Anthesis was recorded in early morning and dusk (Table 1). Average number of anthers ranged from 60-65 per flower (Fig. 4D). Stigma receptivity was found maximum on day prior to anthesis and remained receptive up to 2 to 4 days after anthesis. The minimum days taken for bud development to complete flower was noticed in east direction. Maximum anthesis was observed at 4.00 to 5.00 pm in all four directions of the canopy.

In *jamun* flowering panicles, large amount of pollen grains are released from numerous anthers. Pollens are tricolporate (triangular pattern in centre of grain), fertile and 15-20 µm in size, creamish-white in colour. Pollen is typically oblate and triangular in polar view (Fig. 4E). The apertures appear as short furrows in a thickened portion of the wall. The distinctive pattern typically seen in polar view is formed by thinning of the exine, resembling a syncolpium as in other Myrtoids. This thin region often has a triangular island of thick tectum at the pole of the grain. *In vitro* pollen germination in artificial medium was recorded between 35-50%. Pollen germination assessed by pollen tube growth in crossed and selfed stigmas and styles was observed, and there was no difference in attachment and germination of the pollen grains among the two classes (data not shown). Observations on isolated trees for flowering and fruit setting in the field suggest that *jamun* to be

Table 1. Description of flower morphology in *jamun*.

Character	Range
Breeding type	Bisexual
Flower colour	Creamish-pale yellow
Inflorescence	Terminal and axillary
No. of flowers per inflorescence	18-50
Flower dia. (mm)	4-5
Length of stamen (mm)	5.83-7.88
No. of stamens	59-65
Anther size (mm)	0.6-0.7
Pollen grain	Tricolporate
Pollen shape	Triangular in dry, while circular when hydrated.
Pollen size	15-20 µm (dry), 20 µm (hydrated)
Pollen viability	90-94%
Length of style (mm)	8.2-8.37 mm
Width of gynoecium (mm)	3.1-3.5 mm
Anthesis	5.30-7.30 a.m. & 4.00-7.00 p.m.
Anther dehiscence	5.30 a.m. - 9.30 a.m.
Stigma receptivity	One day prior to anthesis and remained receptive upto 2 to 4 days after anthesis

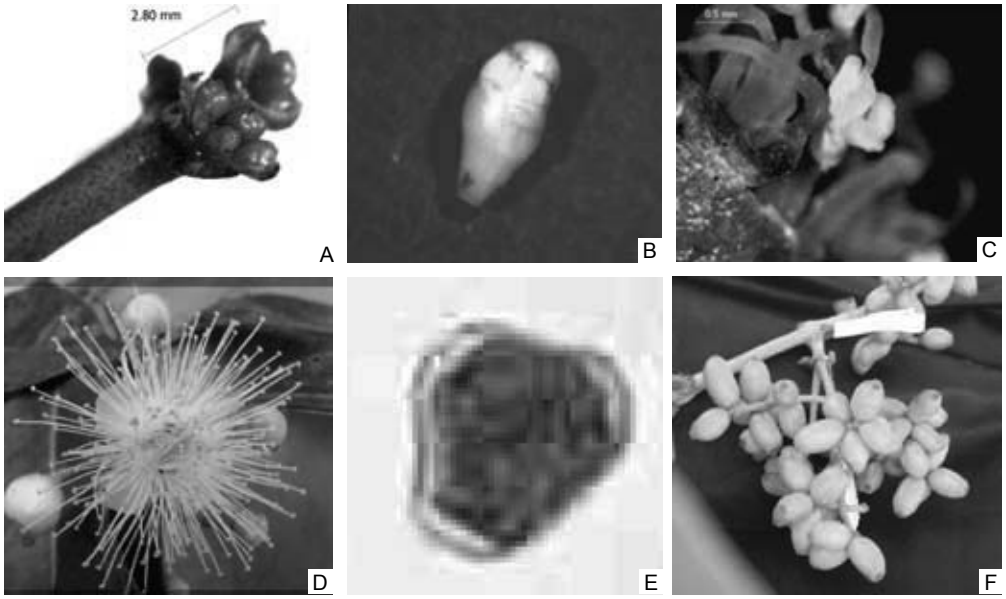

Fig. 4. Flower and pollen biology in jamun. A : Close up of flower bud initiation, B : Anthesis in isolated flower bud with cap like structure formed by fused calyx and corolla; C : Initiation of anthesis, D : Flowering panicle showing expanded flower, E : Tricolporate pollen (size 15-20 µm) F : Initial fruit set in a panicle.

self-compatible. Selfing by bagging of entire flower cluster resulted in good fruit set (Fig. 4F), while single flower bagging resulted in no fruit set probably due to flower abscission. Selfing, using pollen from same tree resulted in 30-40% fruit set, which was 40-50% by cross-pollination. Thus, it can be concluded that geintonogamy is preferred mode of pollination for isolated trees, coexisting with insect and wind mediated cross pollination. Fruit set started from 12th April to 10th May.

Erdtman (4), and Srivastava (10) opined that number of pollen grains produced and morphological characteristics of pollen affect the type and mode of pollination. Singhal *et al*. (8), while analyzing the pollen grains of more than 200 tree species had suggested that small to medium sized pollen grains falling in the size range of 12-58 µm suited for wind pollination. In comparison, very small and large sized pollen grains suited for insect mode of pollination. Pollen grains in *jamun* are non-sticky, medium sized (15-20 µm) and tricolporate. Although flowers are dull coloured, insect visitors were attracted due to the presence of fragrance. As such the species possessed broad pollination spectrum, adopted to both insect and wind mode and the natural pollen transfer was quite efficient as reported in other species of *Syzygium* (Djonwangwe, 3).

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