



## Research article

## Phenological study on *Polyalthia fragrans* (Dalz.) Bedd. - An Endemic Species of Western Ghats, India

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**Abstract:** The phenological observations in *Polyalthia fragrans* were made on various phenophases such as leaf flushing, production of young flowers, maturation of flowers, abscission of flowers, production of young fruits, maturation of fruits and ripening of fruits in Pattighat forest range of Western Ghats, situated in Sampaje, Madikeri district of Karnataka during 2013–15. The flushing in *Polyalthia fragrans* throughout the year confirmed the evergreen character of the species with the flushing peaks during October–December. The floral initiation was during October and continued till December. The fruit maturation was during April to May and the seed dispersal in May to June, during which time the moisture content in the soil was likely to help in good regeneration. The germinated seedlings get established during June to September.

**Keywords:** *Polyalthia fragrans* - Phenology - Phenophases - Pattighat.

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### INTRODUCTION

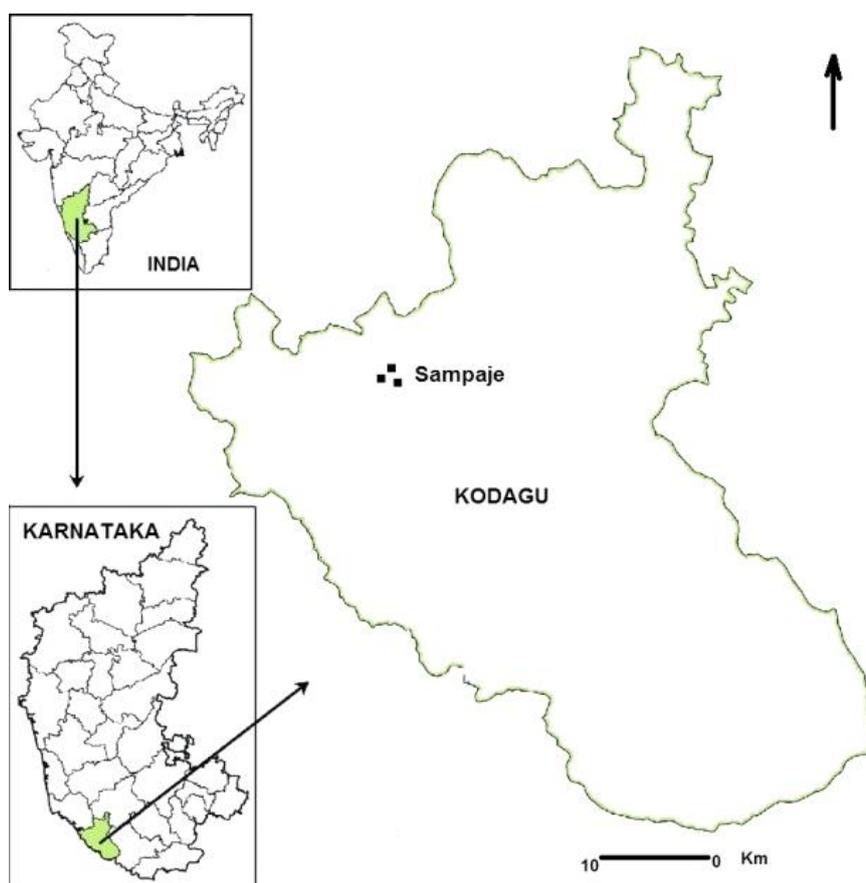
Phenology is the calendar of events in the life history of plants. It is generally described as an art of observing the phase of life cycle through the year. Phenology is also defined as "the study of seasonal timings of life cycle events". Plant phenological study has a great significance because it not only provides knowledge about plant growth pattern but also provides the idea of the effect of the selective pressure of the environment on flowering and fruiting behavior. These studies permit to construct a calendar for the growth activity of the plant especially the period of leaf emergence, the appearance of mature leaves, flowering, fruiting, seed maturity and dispersal. The phenological study is essential, as it has many applications such as in regeneration, afforestation, plant management, floral biology and the estimation of reproductive ability (Mulik & Bhosale 1990, Bajpai *et al.* 2017). Phenological data are of great importance for the correct use and protection of the ecosystems (Machado *et al.* 1997). These data may also contribute to the recuperation of disturbed areas, allowing planning of collection of seeds of species that will be used for restoration projects (Knowles & Parrota 1997). The information on phenological patterns of endemic tree species in tropical forests of the Western Ghats is limited (Bhat 1992).

*Polyalthia fragrans* (Dalz.) Bedd., an endemic species of Western Ghats is commonly known in Karnataka as Chamada, Gowrimara, Nedunar found on the outskirts of semi-evergreen to evergreen forests across the Ghats. The tree is economically important as timber, used in the plywood industries, packing cases and boxes, stumps and racquet frames (Scheffer & Morrell 1998). Bark, leaves and seeds of *Polyalthia fragrans* are used in the treatment of itching and knee pain in the folk medicine (Anilkumar & Shivaraju 2016). The leaves and bark of *Polyalthia fragrans* is having antimicrobial and antioxidant properties (Arunkumar & Chandrashekar 2017). The current study deals with the phenology of *Polyalthia fragrans* growing in Pattighat forest, Sampaje of the Southern Western Ghats region of India.

## METHODOLOGY

### Study area

The study was carried out during 2013–15 at Pattighat forest range of Western Ghats  $75^{\circ} 30'$  to  $75^{\circ} 33'$  E longitude and  $12^{\circ} 30'$  to  $12^{\circ} 32'$  N latitude with the elevation ranging between 140 and 500 m above M.S.L situated in Sampaje, Madikeri district of Karnataka (Fig. 1). The climate of the area is monsoonal and the major rainfall occurs due to south-west monsoon usually from June to September. The north-east monsoon usually occurs during October and some showers during winter and summer. The dry season is comparatively less. The higher temperatures ( $30^{\circ}\text{C}$ ) were reported during April and May while December–January are considered as colder months ( $18^{\circ}\text{C}$ ). Humidity was maximum in June–September (94.5%) and minimum in April (68%). It receives an annual rainfall of about 4,200 mm.



**Figure 1.** Location of study area.

### Phenological study

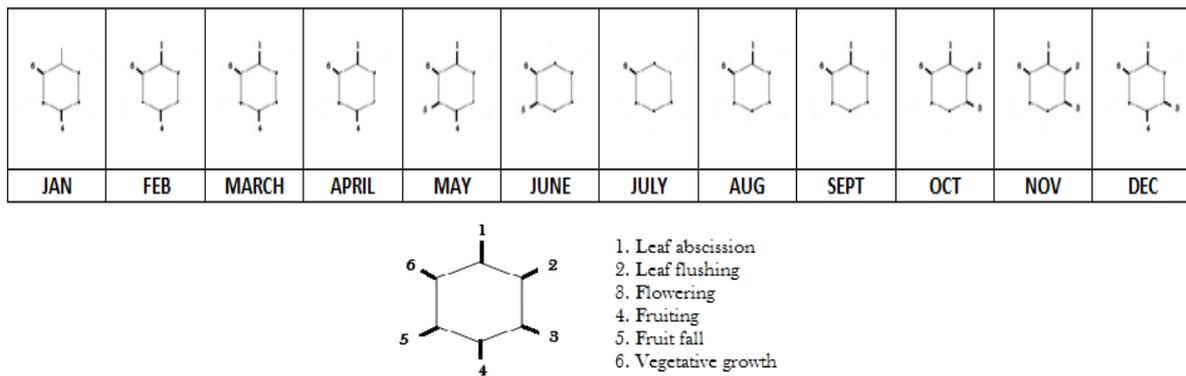
The *Polyalthia fragrans* trees with a girth of 30 cm and above were marked. Each tree was monitored once in a fortnight to record the changes of the following phenological events: the beginning of leaf fall, completion of leaf fall, the commencement of leaf initiation, beginning of flowering, completion of flowering, beginning of fruiting, completion of fruiting and fruit dispersal (Prasad & Hegde 1986). The duration of a phenological event of the species was recorded.

## RESULTS

*Polyalthia fragrans*, being a component of an evergreen forest showed vegetative phases with green leaves throughout the year (Fig. 2). The flushing peaks were observed from October to December. The maximum flushing period ranged for 2–3 months. In contrast, leaf shedding in *P. fragrans* was almost continuous throughout the year. Leaf flushing continued till the opening of flowers and the development of fruits. Shedding of leaves was significantly low during periods of floral bud production. This indicates a lower leaf shedding rate in *P. fragrans* under conditions that are favourable for vegetative growth and reproduction. The leaf shedding ceases once the rainy season is started.

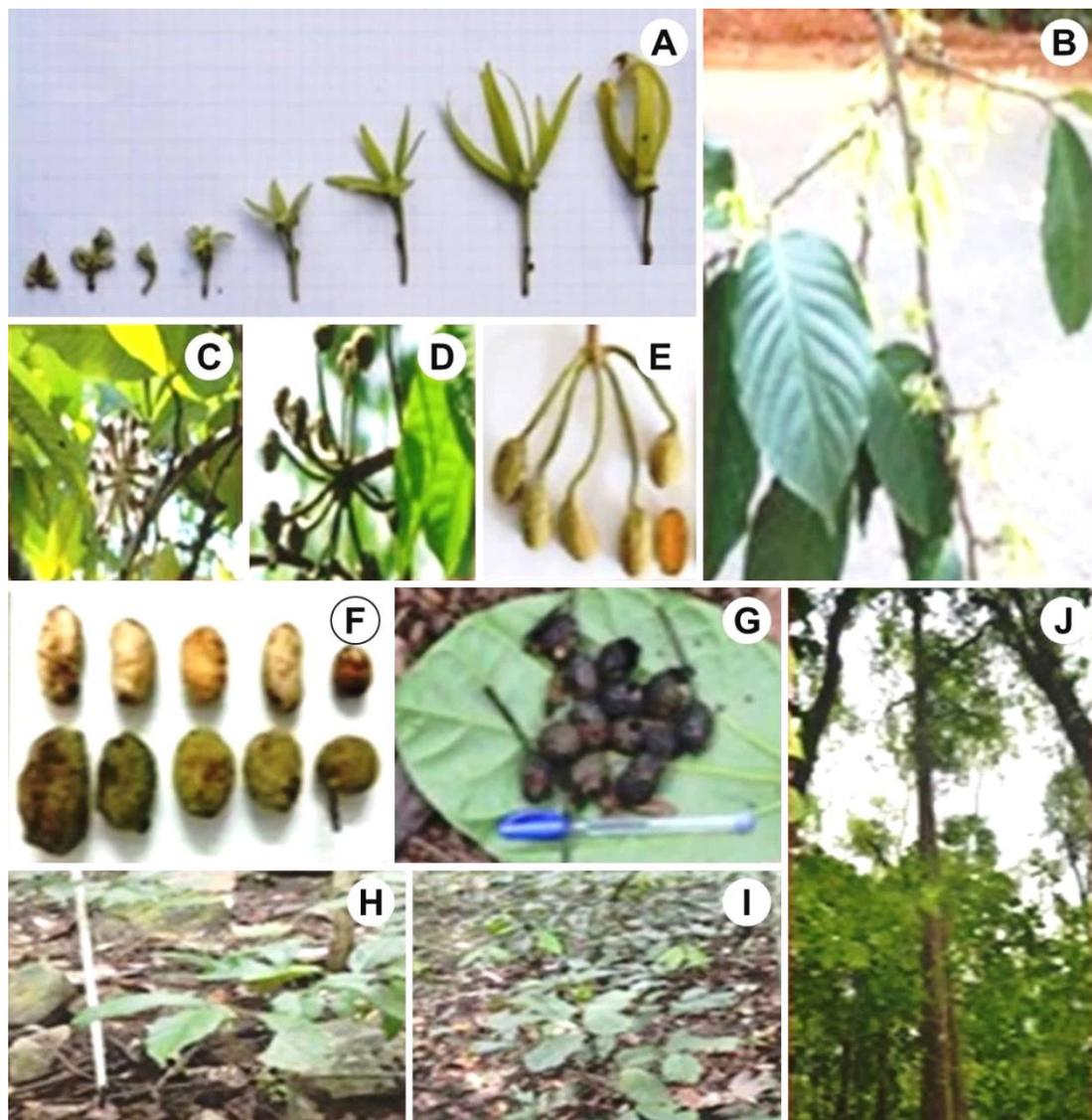
*Polyalthia fragrans* showed the initiation of flower bud development in October which continued till December, with a peak in November. It was observed that the appearance of both flower buds and leaf buds simultaneously. Most of the flower buds reached maturity, with no significant dropping of immature flower

buds. At the time of maturity of fruits, most of the plants had stopped the production of flower buds; which indicated a partitioning of available plant resources for different functions.



**Figure 2.** Phenological events of *Polyalthia fragrans* (Dalz.) Bedd. represented by phenograms.

The fruiting was initiated in December and matured during April–May. It was observed that the number of monocarps in a fruit gradually decreased from more than 8–12 in young fruits to 4–6 in mature fruits. The seed dispersal was during May–June, during which time the high moisture content in the soil was likely to help in good regeneration. The germinated seedlings get established during June–September. Figure 2 shows month-wise phenological observations with phenograms and figure 3 (A–J) shows the phenological events of the species.



**Figure 3.** A, Flower development (bud to mature flower); B, Flowering twig; C–E, Development of seeds; F, Mature fruits and seeds; G, Fallen fruits; H–I, Regeneration and establishment of seedlings; J, Habit.

## DISCUSSION

Among the phenological events, the most important are flowering and fruiting. Since the fruit formation is always preceded by flowering, the periodicity of flowering gives relevant information about the fruiting period and this will help in determining the frequency of seed setting and the proper time of its collection (Ansari 1989). In the current study, *Polyalthia fragrans* showed the flower bud production during October and December, with a peak in November. Bhat (1992) reported the flowering and fruiting duration of *Polyalthia fragrans* during November and June in the tropical moist forest of Uttara Kannada, but in the current study initiation of flowering was recorded during October. Ratnayake *et al* (2006) reported the flowering of *Polyalthia coffeoides* (Thw.) J. Hk & Thoms. during November and June and its peak during March–April, whereas *Polyalthia korinti* (Dunal) Thwaites had two flowering periods *i.e.* September to April and May to June in Sri Lanka. In the case of *Polyalthia longifolia* (Sonn.) Thwaites, flowering and fruiting duration were December to August in Gujarat (Oza & Rajput 2006). In *Polyalthia fragrans* both flower buds and leaf buds appeared during the same period. By the time of maturity of fruits, most of the plants had stopped the production of flower buds. Similar observations were made in *Polyalthia coffeoides* and *Polyalthia korinti* in Sri Lanka (Ratnayake *et al.* 2006).

The fruit setting in *Polyalthia fragrans* started in December and matured till May–June, just before the onset of monsoon rains. The seed dispersal took place during May–June. Similar observations were made by Bhat (1992). Seeds germinated immediately in the presence of moisture without showing any dormancy. It reproduces well under the shade of its numerous associates. Seedling and germination percentages were also very high. The survival and aggressive capacity of the tree was not satisfactory in the study area. The initiation of fruiting in dry season and maturation in late dry season, just before the rains, provides an opportunity for optimum seed germination and seedling establishment on moist soil (Frankie *et al.* 1974, Primack 1987, Singh & Singh 1992, Singh & Kushwaha 2005, 2006, Bajpai *et al.* 2012, Borah & Devi 2014, Bajpai *et al.* 2017, Devi *et al.* 2019). Sometimes, due to high moisture content in the soil as well as in the environment, seedlings may be infected by fungi, thus, reducing the survival rate and establishment of seedlings.

## CONCLUSION

The present study gives an idea about the time span of different life phases in *Polyalthia fragrans*. The present data is useful in the recovery of disturbed areas, allowing planning and collection of seeds of *P. fragrans*, which will be used for restoration projects. The current information can be used as baseline data for further evaluation of phenological variations in response to climate change.

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