

## A Novel Report on Precocious Flowering in Buttercup Tree (*Cochlospermum religiosum* (L) Alston.)

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### ABSTRACT

*Cochlospermum religiosum* or yellow silk cotton is a rare and endangered tree species found in dry deciduous forest of India. This tree species is known for its valuable product called 'Gum katira' and floss. In perennials, first flowering time, usually varies between 3-10 years or more in natural population. We are reporting first incidence of precocious flowering in 'four month' old seed originated plants. Early flowering, whether natural or induced, is an advantageous trait to tree breeders which offers curtailment in long breeding cycles to manipulate the trait of interest.

**Keywords** *Cochlospermum*, Yellow silk cotton, Precocious flowering, Early flowering.

### INTRODUCTION

Flowering in angiosperms is the phenomenon, which is characterized by phase transition from juvenility to reproductive maturity. Generally, reproductive system of woody perennials is advances in such a way that usually shows delayed age of first flowering in natural habitat, varying from species to species (Gerhold 1966). The length of the juvenile phase in any species is determined by time taken in attainment of minimal size or height which is further reliant on genetic and environmental stimulus (Chalupka and Cecich 1997). Most woody angiosperms of seed origin are known to have longer juvenile period with regard to floral initiation, often ranging from 3 to 10 years or more in natural ecosystem (Callahan *et al.* 2016).

*Cochlospermum religiosum* or yellow silk cotton is native to tropical region of South East Asia and Indian Subcontinent. It is a small to medium sized (8-12 m height) tree, usually found in dry deciduous forests of Orissa, Bihar, Uttar Pradesh, Rajasthan, Madhya Pradesh, Chhattisgarh, Maharashtra and throughout Southern India (Singh and Singh 2013). Despite the wide distribution ranges in major regions of India, occurrence of *C. religiosum* is rare and has recently been assessed as 'vulnerable' in MP & Chhattisgarh and 'critically endangered' in Rajasthan as per IUCN norms (Ved *et al.* 2016). *C. religiosum* is known for its commercial non timber forest products like gum and floss. The exudates obtained from the bark commonly called 'Gum Katira' find its wider uses in

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pharmaceutical, confectionary and paste industries (Prashith Kekuda *et al.* 2019). Floss obtained from capsules is used as filling material in mattress, pillows and life belts (Anonymous 2010). Besides, the tree holds an aesthetic value due to its magnificent golden yellow colour flowers and thus used mainly for plantations in the gardens, near temples and avenue plantations. Flowers are 4-5 inch in diameter, blooms in the month of February to April on terminal panicles, when tree remains in leafless condition.

As far as literature on phenology and floral biology of this species is concerned, there are ample reports on flowering time and pattern but lacking much information about the first flowering time which indicates that 'precocity' is not common but 'rare' phenomenon in buttercup tree. However, at a single instance, authors encountered with a piece of information mentioning that tree flowers at two years of age, even when it is size of a shrub (Swaminathan and Kochhar 2019). Early flowering in perennials, whether natural or induced, is advantageous from the tree breeding prospective which offers the strong tools in tree breeder's hand by the way of reduction in long breeding cycles to manipulate the trait of interest (Zhang *et al.* 2016)

Though uncommon, natural precocious flowering behaviour across the perennials is documented in some of temperate and tropical tree species like pines (Heimbürger and Fowler 1969), eucalyptus (Pyror, 1966), Ailanthus (Feret 1973), poplar (Melian *et al.* 2004), *Terminallia chebula* (Sharma *et al.* 2012) and *Cordia myxa* (Guleriya 2020). Here, we are reporting early flowering incidence in 'four month' old seedlings, coincided with the natural flowering period of the species, a novel report of precocity in *C. religiosum*.

## MATERIALS AND METHODS

Early flowering was noticed in Experiential Learning Unit on Quality Planting Material, College of Forestry, Navsari Agricultural University, Navsari, Gujarat state, India. Geographically, site is situated at 20°54'33.50" N and 72°54'25.34" E, 10 m above mean sea level. Navsari experiences hot and humid tropical climate with average annual temperature 27.0

°C (Max. 31°C - Min. 22°C) and rainfall of 1555 mm. Highest temperature (Max. 36°C - Min. 28°C) of the year usually prevails during March-May with average 360 sun hours and humidity of 186 % (www.world weather on line. com). As a part of regular activity of plant propagation, capsules of *C. religiosum* were collected from the nearby trees, available within periphery of 100 m from the experimental site, in the month of May-June 2019 and 2020. Seeds were defloxed manually and stored in plastic containers for nearly 4 months. In the fourth week of October, seeds were sown in sand beds (without any pre-treatment) under shade net house. Regular watering was done daily with the help of rose can. Germination started in most of the seeds after 15 days of sowing. Subsequently, when seedling attained four leaf stages, were transferred to polybags (18 × 12 cm), soil mixture containing soil, sand and vermi-compost (2:1:1 v/v). After transplantation, seedlings were kept inside the shade net house (50 % shade factor) than transferred to open condition in the month of January. Usually, watering was done once in two days period with the help of garden pipe.

## RESULTS AND DISCUSSION

Out of nearly two hundred plants, kept together in similar growing conditions, three plants drew attention due to the presence of a terminal bud that turned in to a flower later (Fig.1). Further closed observations revealed that induction of floral buds were initiated in more seedlings, but in asynchronized manner. This unusual phenomenon was noted in total nine seedlings (4.5 % of the population) altogether in March- April 2019. In the month of May all the seedlings reverted back to vegetative phase again without setting of fruits and afterwards no seedling continued to show the transitional traits from vegetative to maturity. The same phenomenon was noticed in the month of March-April- 2020 but in higher magnitude (12 % of the population). Survey of literature revealed that phase transition from juvenile to reproductive, which is characterized by shift of physiological functioning of leaf bud tissues in to flower bud tissues, is the net result of some biochemical changes occurring at molecular and cellular levels (Guleriya 2020). Moreover, scientific understanding of flowering mechanism through Arabidopsis thaliana model has



**Fig. 1.** (A) General view to setting of flower buds and flowers in 4 month old seedlings of *C. religiosum*, (B) Focused view of flower bud, (C) Focussed view of fully open flower.

indicated the role of environmental stimulus, autonomous initiation and chemicals regulation (Mouradov 2002). Environmental precursors (photoperiod, temperature, light intensity and moisture stress), phyto-hormones (Gibberelins, cytokines, auxins) and nutrients (sucrose, reduced nitrogenous compounds) are known to activate the floral signal called 'florigen' (Corbesier and Coupland 2006). These molecular messengers translocates from leaves to shoot apical meristem via phloem sap and cause gene expressions that ultimately switch on the floral transition (Turck *et al.* 2008). In our case, primarily role of environmental stimuli was suspected in flower initiation because no chemicals (phyto-hormone and nutrients) were applied externally to the plants. Further, since, flowering was synchronous with the flowering period in wild, there are indications of adaptive response to perception of photoperiodic stimulus and ambient temperature, matching with the natural requirement of species, that probably been released endogenous signals for the floral transition in some plants. There are also supporting reports of induction of early flowering through physiological stimulus like photoperiodism and temperature (Capovilla *et al.* 2015, Hoenicka *et al.* 2016, Singh *et al.* 2017) available in scientific domain. Although floral initiation is believed to be a complex and multifactor controlled mechanism, in

which all the stimuli do not act, or not all of equal importance to all the plant species. Therefore, further systematic investigation is needed in this regard and the authors are in view to design a well thought experiment to dig out the exact cause of precocity in *C. religiosum*. If consistent results were obtained, early flowering would shorten the breeding cycle that could help tree breeders to carry out improvement work without waiting for long time to end juvenility.

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