

## FLORAL AND PHENOLOGICAL STUDIES ON *OROXYLUM INDICUM* IN SIKKIM

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### ABSTRACT

Impact of some environmental factors on floral phenology and reproductive biology of *Oroxylum indicum* (Bignoniaceae) growing in Sikkim has been observed in the present study. The species flowers from July to third week of August and later after one month, produces well developed fruits with containing numerous papery, flat, winged light seeds. An average production of flower was observed to be  $524.15 \pm 120.11$  ( $X \pm SD$ ,  $n=13$ ) however, fruit production was only  $11.61 \pm 4.99$  ( $X \pm SD$ ,  $n=13$ ). Profuse fruiting takes place when the average temperature ranges between 18.64-23.29°C and average relative humidity sustains around 70%. The study reveals a direct impact of environmental factors on the efficiency of pollinator too.

**Keywords :** Sikkim, Flower production, *Oroxylum indicum*, and Phenology.

### साराँश

सिक्किम प्रान्त में पाए जाने वाली प्रजाति *ओरोजाइलम इन्डिकम* (बिगनोनिएसी) के पुष्पों की रचना एवं प्रजनन संबंधित प्रक्रियाओं पर वहाँ के वातावरण का क्या प्रभाव पड़ता है इसका अध्ययन किया गया है।

### Introduction

Environment exerts significant influence on flowering and fruiting in plants (Shivanna, 2003). Several abiotic factors like soil type, soil nutrients, atmospheric conditions such as temperature and relative humidity, affect the formation of fruits to a great extent (Shivanna and Johri, 1985).

*Oroxylum indicum* (L.) Benth. ex Kurz is one of the endangered species of India and belonging to the family Bignoniaceae commonly known as Putivriksha, Bhut-vriksha and Totala is found to be growing throughout the India. It is an annual small or semi deciduous tree that has a height of 10-19 meters tall. The flowers stalk is one feet long. The flowers are companulate and bisexual

with purple in colour (Fig. 1). They are born in rainy season and fruit appears in December to March. There are 56-66 flower buds arranged axially on a 1 to 1.5 m per inflorescence. Fruits are 30 to 90 cm long, 5 to 10 cm broad.

*Oroxylum indicum* (L.) Kurz is a (*Eonycteris spelaea*) bat-pollinated tree species native to the Indo-Malayan region and occurs in many parts of India (Start, 1974, Srithongchuay *et al.*, 2008). They are nocturnal blooming, hermaphroditic and bell-shaped (Faegri & van der Pijl 1979 and Corner, 1988) with a cream-colored corolla tube and light purple petal lobes. Flowers open from 08.00-09.00 PM, during which the stigma is receptive. Anthers also dehisce during and considerably after this time transom (07.00-08.40PM) (Vikas *et al.*, 2008, Sritongchuay *et al.*, 2010).

### Taxonomy

*Oroxylum indicum* (L.) Benth. ex Kurz belongs to the family Bignoniaceae. Its taxonomical classification reported in literature (<http://www.ncbi.nlm.nih.gov/Taxonomy/>) is as given below:

Kingdom - Plantae; Division - Magnoliophyta; Class - Magnoliopsida; Order - Lamiales; Family - Bignoniaceae; Genus - *Oroxylum* Species - *indicum*.

### Vernacular Name

There are many vernacular names of *Oroxylum indicum* in different languages according to distribution of India (Ayurvedic Pharmacopoeia of India, Nadkarni, 1982). **English:** Indian trumpet flower, Indian Trumpet Flower., Broken Bones Plant and Tree of Damocles. **Hindi:** Putivriksha, Bhut-vriksha, Son, Shallaka, Manduk, Kutannat, Vatuk, Patrona, Dirghavrinta, Shuran, Sanskrit: Aralu and Shyonaka. **Bengali:** Sona. **Nepali:** Totala. **Kannada:** Patagani, Tigadu., Tattuna, Alangi, Sonepatta, Tattuna and Bunepaale. **Tamil:** Puta puspam, Paiyalarandai, Palaiyudaycci, Peiarlankei and Achi Pana. **Marathi:** Tayitu and Tetu. **Telugu:** Tundilamu, Pampena and Manduka-parnamu (Khare, 2004 and Chauhan, 1999).

### Synonyms

*Arthrophyllum ceylanicum* Miq.; *Arthrophyllum reticulatum* Blume ex Miq.; *Bignonia indica* L.; *Bignonia lugubris* Salisb.; *Bignonia pentandra* Lour.; *Bignonia quadripinnata* Blanco; *Bignonia tripinnata* Noronha; *Bignonia tuberculata* Roxb. ex DC.; *Calosanthus indica* (L.) Blume; *Hippoxylon indica* (L.) Raf.; *Oroxylum flavum* Rehder; *Oroxylum indicum* Vent. nom. inval.; *Spathodea indica* (L.) Pers. (Gamble, 1877).

### Materials and Methods

Sikkim is located between 27°43'40"-28°04'53" N latitude and 88°02'61"-88°97'39" E longitudes and the smallest of the north-eastern states of India, it covered a total area of 7,096 sq. km. The topography of the state is highly variable with mountains, ridges and valleys with the altitude ranging between 250-8598 m above mean sea level. The annual average maximum and minimum temperatures are 19.8 °C and 11.3 °C respectively with December-February being the coldest months and June-September being the warmest month.

Studies of some floral attributes and phenological parameters like leafing, leaf fall, flowering, fruiting and fruit seed dispersal were recorded over a period of flowering season. Flower production per inflorescence and the fruit production were determined from randomly tagged inflorescences and flowering branches (n=10).

### Results and Discussion

#### Phenological studies

Observations of the Phenological events in *Oroxylum indicum* were done throughout the year from 2012-13 in Manglee, South Sikkim were visited as reproductive season and the phenological characteristics, such as leafing, leaf fall, flowering, fruit formation, fruit fall and dehiscence and dispersal of seeds were noted (Table 1).

#### Leafing

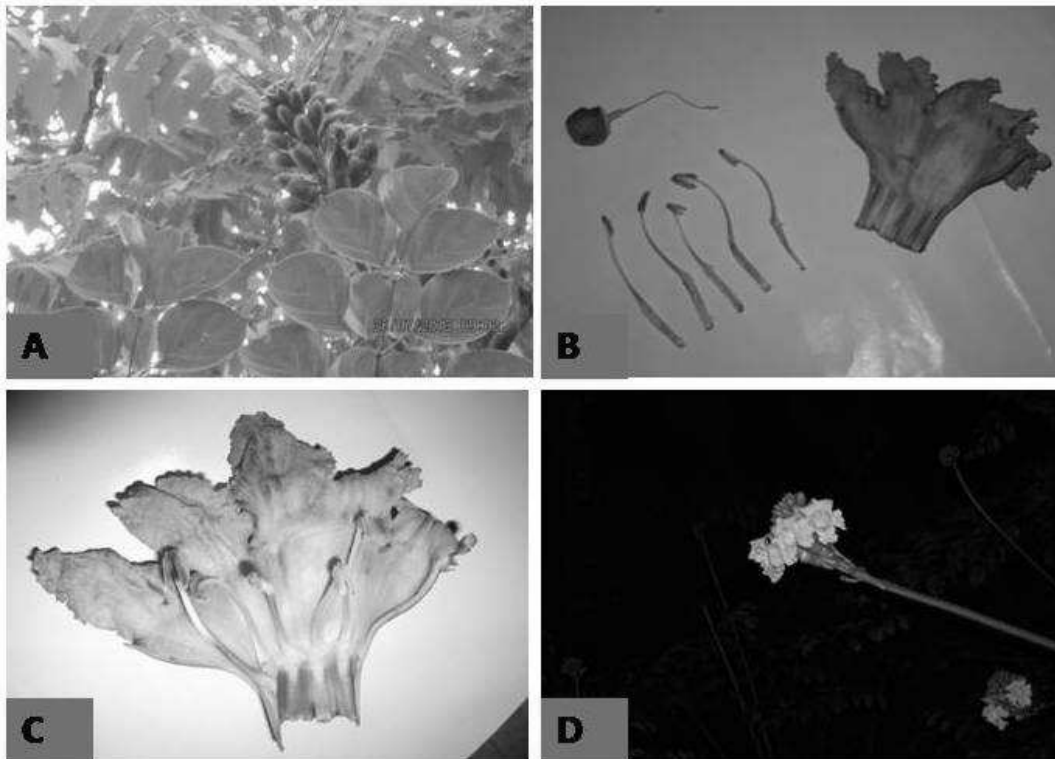
*Oroxylum indicum* of the family Bignoniaceae was observed to bear new foliage in the rainy season. The initiation of new leaves was observed in the end of May and Last First week of September. Leafing period continues onto the months of first week of September and Last week of May (Table 1).

**Leaf fall**

It is been observed that leaf fall in *Oroxylum indicum* commences in the last week of January could be seen to continue till third week of April and the plants remain leafless up to second week of May (Table 1).

**Flowering**

The observations revealed that the *Oroxylum indicum* showed flowering during the early summer and rainy season. The initiation of flower buds has been observed in last week of May and peak flowering was observed in the third week of July (Table 1).



**Fig.1. *Oroxylum indicum* (A) Flowering bud, (B-C) Flower section with stamens, pistil and corolla and (D) Inflorescence with open flower, photo was taken from South Sikkim at night.**

**Fruiting**

Fruit formation started after one month of peak flowering, i.e. third week of August to November. Fully ripened fruits were observed in the first week of September (Table 1).

**Fruit Dehiscence and Seed Dispersal**

Dehiscence of fruits and dispersal of seeds were observed in month of December to February. Thus, all the phenological events there are about one month difference in study sites.

**Table 1. Showing phenological events for *Oroxylum indicum* at the study site; L=Leafing; Lf=Leaf fall; Fl=Flowering; Fr=Fructing; Fr F=Fruit fall; S.D=Seed dispersal.**

Study site	Events	Initiation (Month)	Completion (Month)	Total duration of phenological behavior (in month)
South Sikkim (27°16'11.5"N- 88°25'22.4"E)	L.	Last week of March	Last week of May	2
	Lf.	Last week of January	Third week of March	1.75
	Fl.	Third week of May	Third week of July	2
	Fr.	Third week of August	Third week of Nov.	3
	Fr. F.	December	February	2
	S.D	Second week of March	First week of April	0.75

**Table 2. Floral characters of *Oroxylum indicum* Flower and fruit production**

Floral parameters	Observations
No. of flowers/ inflorescence	33-39
Length of Inflorescence (cm)	15-19.5
Flower Length (cm)	13.5
Stamen Length (cm)	6-7
No. of Stamens	5 (4+1)
No of Pistil	1
Pistil Length (cm)	7
Anthesis time (Hr.)	08.00PM-03.00AM
Flower open time (Hr.)	08.00PM-09.00PM
Flower shading time (Hr.)	03.00AM-04.30AM
Flower visitors time (Hr.)	09.00PM-11.00PM

Flower and fruit production was  $524.15 \pm 120.11$  and  $11.61 \pm 4.99$  ( $X \pm SD$ ,  $n=13$ ) respectively (Table 3). There was low fruit-set due to poor pollination efficiency and declining populations of pollinator i.e. bats species may adversely affect the survival of *O. indicum*. Gould, 1978 and Srithongchuay *et al.* 2008 was reported *O. indicum* is legitimately pollinated by a generalist bat, *Eonycteris spelaea*.

Table 3. Mean number ( $\pm SD$ ) of flowers and fruits produced by *O. indicum* throughout the reproductive period in 2013. Mean values of fruits/ flower and seeds /fruit ratios are shown. Parameters were compared between localities;  $n$ = Sample size;  $t$ =Observed student  $t$ -value for  $P < 0.05$  or  $P < 0.001$  and 20 degree of freedom;  $P$ = Probability of observing the  $t$ -value.

Site	Flower/inflorescence	Flowers/plant	Fruits/plant	Fruits/ flower	Seeds/fruit
Study Area ( $n=13$ )	$35.92 \pm 3.81$	$524.15 \pm 120.11$	$11.61 \pm 4.99$	$1.38 \pm 0.96$	$243.38 \pm 42.59$
t-value	-4.633	45	-6.528	54	45
P-value	<0.001	<0.05	<0.001	<0.05	<0.05

**Table 4. Mean values ( $\pm SD$ ) of phenological parameters (flowering) in *O. indicum* during 2013. Parameters were compared between both sites;  $n$  = sample size;  $t$  = observed Student  $t$ -value for  $P < 0.001$  and 18 degrees of freedom;  $P$  = probability of observing the  $t$ -value.**

Site	Flowering initial (Days)	Optimum (Days)	End of flowering (Days)
Study Area ( $n=10$ )	$145.5 \pm 2.91$	$167.2 \pm 2.78$	$206.2 \pm 2.57$
t-value	21.59	23.26	28.61
P-value	<0.001	<0.001	<0.001

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