

# Species

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## Floral biology and pollination in *Maerua oblongifolia* Forssk. (A. Rich.) (Capparaceae), a dry season blooming woody climbing shrub

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### ABSTRACT

*Maerua oblongifolia* is a woody climbing bushy dry season blooming shrub. Its flowers are hermaphroditic, nectariferous, aromatic and bee-pollinated. Fruit set rate is very low indicating pollination limitation, pollinator limitation and self-incompatibility. Fruits are pulpy and indehiscent; exposure of seeds occurs only when they fall to the ground. Seed germination and new recruitment occur during wet season only.

**Keywords:** *Maerua oblongifolia*, hermaphroditism, bee-pollination, indehiscent pulpy fruits

### 1. INTRODUCTION

*Maerua* is a large polymorphous genus comprising of 90 species distributed chiefly in Africa but a few species also occur in tropical regions of Asia, India and Madagascar (De Wolf 1962; Chayamarit 1991; Nobsathian et al. 2018). In this genus, *M. crassifolia* and *M. subcordata* are used as food in Africa (Spittler 1983; Miller and Cope 1996; Cook et al. 1998; Kers 2000; Hiben et al. 2019). *M. crassifolia* is used as nectar source by migrant birds in Ouadane in the Western Sahara, Mauritania (Salewski et al. 2006) and as a major pollen source by honey bees (Sajwani et al. 2014; Abou-Shhaara 2019). In India, three *Maerua* species, *M. arenaria*, *M. oblongifolia* and *M. apetala* have been reported (Mishra et al. 2015; Pullaiah and Muralidhara Rao 2002). Of these species, *M. apetala* has been investigated for its pollination ecology by Shravan Kumar and Solomon Raju (2021); these authors reported that this species is pollinated by bees and birds in India. *M. oblongifolia* has tuberous root which is sold as a quick street food in many places in India. The root is used in Siddha medicine and eaten raw to quench thirst during dry season. It is mostly used to treat fever, diabetes, epilepsy, piles, typhoid, sterility, stomach ache, snake bites, scorpion stings and skin diseases (Madhavan et al. 2012; authors personal information). Despite the importance of *M. oblongifolia* as food and in

traditional medicine, its floral biology and pollination has not been studied to understand its sexual reproduction through which seed is produced. Therefore, the present study was aimed at providing certain details of floral and pollination of *M. oblongifolia* to understand its sexual reproduction and enable other workers to carry out detailed studies for its conservation and management for its continued use as food as well as in traditional medicine.

## 2. MATERIALS AND METHODS

*Maerua oblongifolia* growing in the wild habitat near Talakona area in Chittoor District, Andhra Pradesh, was used for the study during February-June 2019. The aspects studied included phenology, flowering season, flower morphology, floral biology, foraging activity, pollinators and fruiting. All these aspects were studied following the methods detailed in Solomon Raju et al. (2021). Nectar volume and sugar concentration, and stigma receptivity were evaluated using the protocol described in Dafni et al. (2005). Fifty flowers were tagged on the inflorescences of different plants and followed for six weeks to record fruit development period and fruit dispersal. Flowers visitors were recorded by making observations at the plants from morning to evening. The forage sought and forage collection behavior were carefully observed to evaluate the pollination role of individual species of flower visitors.

## 3. OBSERVATIONS

*Maerua oblongifolia* is a woody climbing bushy shrub with a thick tuberous root stock and unarmed glabrous branches and branchlets equipped with pale brown or ash-colored smooth bark (Figure 1a). Leaves are petiolate, thick, arranged alternately in two opposite vertical rows, simple, elliptic-oblong with obtuse base and obtuse-mucronate apex (Figure 1b). The flowering occurs during dry season from March to May and it is slightly asynchronous at population level within this season. Individual plants bloom for about 4 to 5 weeks only. Flowers are borne in terminal pedunculate corymbose racemes; each raceme produces a few flowers and solitary flowers are also produced here and there at the terminal portion of branchlets (Figure 1c). The flowers are pedicellate, greenish-white, aromatic and appear pretty because the stamens radiate out and placed far above the corolla. They are actinomorphic and hermaphroditic. Mature buds open around sunrise time. The calyx is slightly cup-shaped at base lined by a truncate receptacle and tipped with 4 lobes which are ovate-elliptic, tapering, 15-17 mm long and greenish-light yellow. The corolla with 4 greenish-white petals arise from the cup-shaped receptacle and inserted at the rim of the tubular part of the calyx; the petals are ovate to lanceolate and smaller than sepals. The stamens are approximately 30 and the filaments vary from 1.2 to 3.5 cm in length, connate basally with gynophore, white and tipped with green basifixed 2-3 mm long oblong anthers, all of which dehisce just after anthesis almost synchronously by longitudinal slits. The pollen grains are monads, tricolporate and powdery during day time. The filaments gradually slip their strength showing the signs of fading and withering by the evening of the day of anthesis and fall off either singly or in small groups on the 3<sup>rd</sup> day. The ovary is at the end of 2.5 cm long linear gynophore which slightly exceeded the length of longest stamens; it is cylindrical, 3-4 mm long, 1-2 celled with many ovules arranged on parietal placentation and terminated with sessile capitate stigma. Further, the gynophore together the pistil becomes prominent on the 2<sup>nd</sup> day due to withering and downward position of stamens, corolla and calyx (Figure 1d). The stigma is receptive from the 2<sup>nd</sup> day of anthesis and continues receptivity until late evening of the 3<sup>rd</sup> day. Nectar secretion occurs in the calyx cup around the basal portion of gynophore from anthesis onwards and its production continues until the evening of the day of anthesis; it amounts to  $3.8 \pm 0.34$   $\mu$ l of nectar with 25-31% sugar concentration. The flowers were occasionally foraged by honey bees (*Apis dorsata* and *A. cerana*) and carpenter bees (*Xylocopa latipes* and *X. pubescens*), the former category for both pollen and nectar and the latter category for nectar only. The foraging behavior showed that honey bees had contact with the stigma while collecting pollen from the longest stamens and they had contact with the stamens of lowest length while collecting nectar. The carpenter bees had contact with the stamens of lowest length while collecting nectar. Both categories of bees, however had contact with the pistil portion occasionally while approaching the flowers for forage collection. These foraging behaviors displayed by these bees were considered to be resulting in pollination according to the contact between bee body and the pistil portion of the flowers.

Fruits mature within two months. Fruit set is 5-7% in open-pollinations. Fruit is an indehiscent cylindrical, irregularly twisted and knotted glabrous many-seeded berry hanging on a drooping elongated gynophore; it is deeply constricted between seeds resembling a string of beads. Each twisted or knotted part is 1-seeded. The seeds are globose, 6.5-7 x 5.5-5.8 mm, minutely echinate to tuberculate and embedded in fruit pulp. Mature fruits fall to the ground at parental plants, decompose and expose seeds which subsequently germinate during wet season.



**Figure 1.** *Maerua oblongifolia*: a. Tree in flowering phase, b. Leaves, c. Flowers, d. Flowers showing gynophore with pistil and shriveling corolla and calyx.

#### 4. DISCUSSION

*Maerua oblongifolia* is a woody climbing bushy shrub which flowers during dry season from March to May at the study site. But, Laxmichand and Modi (2019) reported that that *M. oblongifolia* blooms during February-March. Further, Prabhakar et al. (2020) noted that this species displays flowering and fruiting during January to June. These reports indicate that the blooming season in this species varies according to the habitat conditions. In this species, the leaves are large, broad and thick, and provide food for the larvae of different pierid butterflies species, *Belenois aurota*, *Cepora nerissa*, *Ixias marianne*, *Colotis danae* and *C. etrida* (Churi 2021) indicating that *M. oblongifolia* is an important larval host for several pierid butterflies.

Shravan Kumar and Solomon Raju (2021) reported that *M. apetala* is hermaphroditic and pollinated by bees and birds. In this study, *M. oblongifolia* is hermaphroditic with attractive flowers displayed in corymbose racemose at the terminal portion of branches. The flowers with high nectar sugar concentration and abundant pollen produced collectively by many anthers attract only honey bees and carpenter bees, and even these bees visit them occasionally but not consistently indicating that *M. oblongifolia* is not a preferred floral source for them and this situation could be attributable to the presence of other floral sources available simultaneously in the vicinity of this plant species. These bees with their flower to flower visits on the same and different conspecific plants effect both self- and cross-pollination. But, the strong protandry precludes self-pollination within the same flowers but facilitates its occurrence between flowers of the same plant because of the simultaneous presence of male and female phase flowers. Further, the flowers with well exposed stamens presenting powdery pollen could get pollinated by wind but the thick foliage during flowering period hinders free circulation of air and hence there is little possibility for the occurrence of anemophily. Pollination limitation and pollinator limitation collectively contribute to low fruit set rate which is evidenced in this study. Therefore, *M. oblongifolia* is constrained to set high fruit set rate due to limited pollination rate but this constraint is somewhat compensated by the production of several seeds per fruit. Mature fruits despite being pulpy are not consumed by frugivores, especially birds and in effect, they fall to the ground and expose seeds for germination during wet season at parental sites only.

## 5. CONCLUSION

*Maerua oblongifolia* is a woody climbing bushy dry season blooming shrub. Its flowers are hermaphroditic, nectariferous, aromatic and displayed at the terminal portion of the branches. The plant is bee-pollinated but bees visit the flowers only occasionally. Low fruit set rate is an indication of pollination limitation, pollinator limitation and also self-incompatibility; it is compensated partly by the production of several seeds in each fruit. Fruits are indehiscent and pulpy but frugivorous birds never utilized these fruits. Mature fruits fall to the ground and expose seeds upon decomposition of pulp portion to enable the latter to germinate and produce new plants which occurs at parental plants only. Therefore, *M. oblongifolia* is not successful in sexual reproduction to populate itself in the existing habitats or elsewhere.

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### Conflict of Interest

The authors declare that there are no conflicts of interests.

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### Data and materials availability

All data associated with this study are present in the paper.

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