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Fly as pollinator in *Caralluma umbellata* Haw. (Asclepiadaceae) found in the Pachamalai hills, Eastern Ghats, Tamil Nadu.

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ABSTRACT:

Pollination studies have been done in the *Caralluma umbellata*, a member of Asclepiadaceae found in the Pachamalai hills of Tamil Nadu. The hills lie between latitudes 11°09'00" to 11°27'00" N and longitudes 78°28'00" to 78°49'00" E. The studies were carried out between April 2006 and April 2008. The main scope of the work was to investigate the pollination of the *C. umbellata*. Pollinator captures were carried out by (1) stalking near plants visually searching for arrival of probable pollinators and (2) random captures in the sampling area. The phenology of flowering is starting in the month of February and extended up to April. The fruit set is starting in the month of June onwards. The pollination in the *C. umbellata* is mainly done by house fly. A fleshy odour is produced during the peak flowering season. This odouring attracts the pollinator towards the flowers. The activity of the pollinator is almost peak during 14:15 hrs to 17:30 hrs. The time duration of the fly retaining in the flower is varied from few minutes to 25 minutes. The average time of the fly visiting the flower is 8.29 ± 7.98 minutes.

Keywords:
Caralluma umbellata, house fly, pollination.

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INTRODUCTION

Plant-animal pollination relationships have held the interest of scholars since the late 18th century (Sprengel, 1793) and played an important role in shaping early ideas about natural selection (Darwin, 1880). The dicotyledonous plant *Caralluma umbellata* belongs to the family Asclepiadaceae. It is otherwise known as the 'milkweeds', arguably one of the most highly evolved of all dicotyledon families, rivaling the monocotyledonous Orchidaceae in floral complexity. As in many orchids, asclepiad pollen is usually presented for a pollinator as a coherent mass known as pollinium. Specialized transportation devices called translators have evolved to provide attachment of pollen to the pollinator, whilst pollination is usually brought about by insertion of the pollinium into modified anther organs. From this basic ground plan, a range of floral forms has evolved. An overview of the morphological aspects of asclepiad pollination is given by Kunze (1995) has proposed a model of asclepiad floral evolution. This paper emphasizes the ubiquity of the fly - pollination in *C. umbellata.*

MATERAILAS AND METHODS

Study area

Pachamalai hill is situated in the two districts of Salem and Trichy of Tamil Nadu. The hills lie between latitudes 11°09'00" to 11°27'00" N and longitudes 78°28'00" to 78°49'00" E. The total geographical area is 14,122 sq. km. A Sub - tropical climate prevails with a maximum temperature ranging from 23°C to 31°C, and a minimum temperature ranging from 12°C to 18°C. The annual rainfall varies with years and the maximum rainfall is 1250 mm. The total area of Pachamalai is 14, 121 ha. The forests occupy 3806.92 ha. (26.96%).

Material

Caralluma umbellata is an erect succulent herb. The stem and branches are angles and contain watery latex. Leaves are caducous and leaving spine like scars on the angles. It produces inflorescence in the terminal part of the branches. The peduncle is stout and short (1 cm). Flowers are mostly solitary and sometimes paired. The length of the pedicel is up to 3.5 cm. Calyx is 5 -7 lobed and sub equal. Calyx is lanceolate in shape and thick. Corolla is purplish brown with yellow bands. Pollinial bags are minute. Receptacle found. Ovaries in two number but sometimes three. The shape of the seeds is oblong and obtuse in the ends with silky – white coma.

Methods

Fieldwork was carried out from April 2006 to April 2008. Most of the observations were diurnal, with limited nocturnal surveillance. Since the main scope of the work was to investigate the pollination of the *C. umbellata*. Pollinator captures were carried out by following two techniques: (1) stalking near plants visually searching for arrival of probable pollinators, (2) random captures in the sampling area. Captures were done with an entomological net and specimens were kept separately in plastic test tube with cork shaving imbued with ethyl acetate until they could be drying prepared for identification. The standard deviations were calculated by using Microsoft Excel Program. Photo documentation was done by using Canon Power Shot A 550, with the 7.1 mega pixels and up to 4x optical zoom.

RESULTS AND DISCUSSION:

The average height of *C. umbellata* shoot is 32.68 ± 7.62 cm. A single individual plant can produces 2.91 ± 1.16 branches. Thus the total population of the plant contains 58 ± 10.14 erect branches. Among these branches only 4 ± 2.19 branches are producing the inflorescence. Even though, only 1.37 ± 0.91 branches are getting maturity. From a single inflorescence 59.42 ± 9.10 individual flowers are produced. The opening of the flower is from the base to the centre (**Figure – 3**). Only 1.71 ± 0.75 flowers are producing the pod in an inflorescence after pollination. The fully matured pod reaches the length up to 15 ± 2.44 cm (**Table**).

The phenology of flowering is starting in the month of February and extended up to April. The fruit set is starting in the month of June onwards. The pollination in the *C. umbellata* is mainly done by house fly (**Figure – 4**). A fleshy odour is produced during the peak flowering season. This odouring attracts the pollinator towards the flowers. The complicated structure of the corona and rigid hairs on the corolla enable flies only a limited access to the nectar glands. They fumble with the proboscis near the slots towards the mouth of the flower. Doing this, the hairs or bristles of the head or legs are often stuck in the guide rails and only one way is possible upwards to the end of the stamina lock, which is connected to the jag of the corpusculum of the pollinarium. Only one fly can be accommodated at a time in the flower. But, sometimes another fly comes and struggle with the already existing fly, the dominating fly is retaining in the flower. After getting enough nectar from the

flower, the fly start to go away from the flower and then only the fly comes to feel that their mouth parts are trapped in the receptacle. At this time, the fly tries to escape from the receptacle with their full force; finally it pulls out the pollinal bags and carries to the next flower. If the flies are too weak to remove the pollinarium, they remain trapped in the flower. At this time the weak flies are hunted by the spiders (**Figure – 5**). The pollinator is trapped again and if it is strong enough, it frees itself or tears off the remnant of the pollinarium at the translator arm. It can pollinate another flower with the remaining pollinium. The placed pollinium remains in the receptive area of the style.

The activity of the pollinator is almost peak during 14:15 hrs to 17:30 hrs. The time duration of the fly retaining in the flower is varied from few minutes to 25 minutes. The average time of the fly visiting the flower is 8.29 ± 7.98 minutes.

TABLE: Vegetative and Flowering characteristics of *C. umbellata.*

S. No	Parameter	Observations
1	Height of the Plant (cm)	32.68 ± 7.62
2	Number of Branches in an Individual	2.91 ± 1.16
3	Number of Branches Branch in a Population	58 ± 10.14
4	Number of Branch initiating inflorescence	4 ± 2.19
5	Number of inflorescence Matured	1.37 ± 0.91
6	Number of flowers in inflorescence	59.42 ± 9.10
7	Number of Pod Produced Per Flower	1.71 ± 0.75
8	Pod Length (cm)	15 ± 2.44

Similar results are obtained in some *Bulbophyllum* species have flowers that are pollinated by flies belonging to four dipteran families, Calliphoridae, Lonchaeidae, Milichiidae, as well as Tephritidae (Christensen, 1994). But there is no information as to the actual chemical component(s) responsible for fly attraction. The foral structure of the Asclepiadaceae has lead to highly specialized insect pollination that promotes out breeding (Wyatt and Broyles, 1994).

It is interesting to note that all the Diptera families involved in pollination have a biology linked to decaying organic matters and therefore *Caralluma europaea* falls within the sapromyiophilous pollination syndrome. According to Dobson (Dobson. 2006) a single fly species may visit distinct flowers for different purposes (i.e. food versus oviposition) and therefore pollinate flowers. In particular flies prefer yellow in the presence of sweet scents, which signal food sources, and brownpurple in the presence of odor of excrements, which indicate egg-laying sites. Flowers of *C. europaea* are brown-purple with yellow stripes, they contain compounds with both sweet odors and compounds found in excrements, and in this way they may mimic both food resources and oviposition sites thus augmenting the spectrum of potential pollinators.

Flowers in taxa of the genus *Caralluma* show decaying organic matter odours, like *C. arachnoidea* with scents of rotting fruits and are pollinated by small Drosophilidae or Milichiidae, while the floral odour of *Desmidorchis flava* can be described as reminiscent of decaying urine or pungent and ruinous and Coleoptera (Dermestidae) have been recorded as flower visitors, although it has not been determined whether they really act as pollinators (Jurgens et al., 2006).

CONCLUSION

The flowering of *Caralluma umbellata* is peak during the months February and April. The pollination in the *C. umbellata* is mainly done by house fly. A fleshy odour is produced during the peak flowering season. This odouring attracts the pollinator towards the flowers. After getting enough nectar from the flower, the fly tries to escape from the receptacle with their full force and at the same time it also pulls out the pollinal bags and carries to the next flower. If the flies are too weak to remove the pollinarium, they remain trapped in the flower and hunted by the spiders.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 1: The habit of *C. umbellata.*
Figure 2: Formation of the inflorescence at the apex of the fleshy shoot.
Figure 3: Base to the Centre Opening of the developed flowers.
Figure 4: Fly busy in pollination.
Figure 5: Fly hunted by the spider.
Figure 6: After pollination

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