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Research Paper

AN EVALUATION OF POLLINATORS OF THE MEDICINAL PLANT - *Helicteres isora* L. (STERCULIACEAE)

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Abstract

Pollination ecology is one of the important aspects of recent origin and the topic is of much relevance for the sustenance of different plant and animal species. The knowledge is important to throw light on the intricate interactions between plants and animals which is the keystone of ecological balance. A study was conducted to analyse various pollinators of the medicinal plant, *Helicteres isora* belonging to family Sterculiaceae. The inflorescence was observed for a continuous period of three weeks to assess the visit of the pollinators, frequency of the visit and mode of foraging. It was observed that insects, birds and mammals were the important pollinators. Stingless bee (*Trigona iridipennis*), Thrips (*Aleurothrips fasciapennis*), Red Ant (*Solenopsis invicta*), Red Crazy Ant (*Nylanderia fulva*), Black Ant (*Lasius niger*) etc. were the prominent insect pollinators. Bulbul (*Pycnonotus barbatus*), Sun Bird (*Cinnyris asiaticus*), Blue winged leaf bird (*Chloropsis cochinchinensis*), Babbler (*Strophocincla fairbanki*) etc. were the important bird pollinators. Squirrel (*Sciurus carolinensis*) was the only mammalian pollinator. Serial dilution study on insect pollinators revealed that Red Crazy Ants was the most potent carrier of the pollen grains of *Helicteres isora*. Shannon-Wiener diversity index was calculated for morning and post-morning session and it indicated that richness and evenness of pollinators were maximum during morning session.

INTRODUCTION

Pollination ecology deals with the intricate interaction between plants and animals where the mutual relationship reaches its zenith and both partners are benefitted for their survival. Plants get pollinated by the animals and in return animals receive food, shelter and elbow room in most of the cases. Their survival is interdependent and hence a detailed study about the types of pollinators of economically important plants warrants much importance. Mahe, a part of the Pondicherry Union Territory, is an abode of large number of medicinal plants and *Helicteres isora* is an important medicinal plant of the locality which is used for treatment of type-2 Diabetes and also as wormicide to control stomach ailments. Biochemically the plant contains tannins, flavanoids, helicterin, diosgenin, saponin etc. of which the flavanoids play an important part in its medicinal properties. Hence this study was conducted.

The plant, *Helicteres isora* is a large shrub with more or less stellately pubescent hairs all over the plant. Root is tap-root system, highly branched. Stem is cylindrical, stiff and shows profuse branching. Leaves are simple, entire and serrate. Flowers are axillary, solitary or fascicled. Calyx is tubular, 5-toothed at the apex, and teeth often unequal. Petals are 5 in number, equal or unequal with long, sometimes with divided claws. The flowers are zygomorphic. Staminal column is elongated, adnate to the gynophore, 5-toothed or lobed; anthers 5-10, in groups at the top of the column between the teeth; cells divergent, superposed, sometimes confluent. Ovary is 5-lobed, 5-celled and placed at the top of the column; ovules many in each cell; styles 5, subulate, more or less united. Follicles are spirally twisted or straight. Seeds tubercled; albumen scanty; cotyledons folded round the radicle. A reference through similar studies could throw more light on pollinators of various crop plants. Zhang Yuan *et al*. (2010) have studied reproductive characteristics in *Ficus altissima*. Shrishail *et al*. (2011) have studied nectar dynamics and pollination in the species of Lamiaceae. Heinrich (1976) has studied the foraging specialization of individual bumble bee. Solomon Raju (2005) has studied the pollination ecology of the genus *Leonotis* (Lamiaceae). Dafni (1992) has mentioned various practical approaches on pollination ecology. Jagadish *et al*. (2002) have studied the foraging behaviour of honey bee and other insect visitors on the bloom of two medicinal herbs, *Hygrophila auriculata* and *Leucas aspera*. Anandhi *et al*. (2012) have studied the reproductive biology of *Gloriosa superba*.

MATERIALS AND METHODS

The plant of the context was selected from Mahatma Gandhi Goverment Arts College, Mahe, campus and an inflorescence bearing nearly 15 flowers of various stages (immature, young and mature) was marked out. The inflorescence was kept under observation for a period of 7 days, i.e. every alternating third day for a period of continuous three weeks. The time of observation was from 6 am to 2 pm for a period of 8 hours per day. Thus 56 hours of observation was possible. During the observation; type of pollinators, number of visits of pollinators, time spent on the inflorescence, type of foraging and any other specific behavioural patterns etc were noted. The insect pollinators were randomly collected using nets and they were sacrificed by keeping in air-tight plastic bottles which contained cotton balls soaked with formaldehyde. They were used for serial dilution study to ascertain the number of pollen grains gathered by them to decipher the most efficient insect pollinator of the area. A wind pollination trap was placed near the inflorescence to check the possibility of wind pollination by the plant. The frequency of pollinators is assessed to measure the richness and evenness for comparison between two time slots; i.e., morning session (duration between 6 am to 10 am) and post morning session (duration between 10 am to 2 pm) by calculating Shannon-Wiener diversity index.

RESULTS AND DISCUSSION

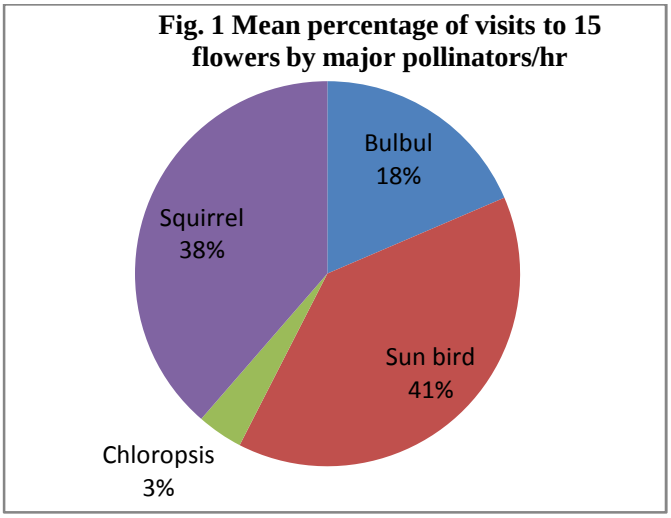
The study showed that insects, birds and mammals were the important pollinators of *Helicteres*. Stingless bee (*Trigona iridipennis*), Thrips (*Aleurothrips fasciapennis*), Red Ant (*Solenopsis invicta*), Red Crazy Ant (*Nylanderia fulva*), Black Ant (*Lasius niger*) etc. were the prominent insect pollinators. Bulbul (*Pycnonotus barbatus*), Sun Bird (*Cinnyris asiaticus*), Blue winged leaf bird (*Chloropsis cochinchinensis*), Babbler (*Strophocincla fairbanki*) etc. were the important bird pollinators. Squirrel (*Sciurus carolinensis*) was the only mammalian pollinator.

Bulbuls (*Pycnonotus barbatus*) were foraging in the early morning (around 6:00 am) onwards and sought nectar till 10:30 am. Indian Sun bird (*Cinnyris asiaticus*) was found frequently visiting the flowers for nectar and the time range of visit was wide. Squirrels (*Sciurus carolinensis*) were also found foraging voraciously, sucking and licking immature, young, mature and older flowers. The Squirrels were munching the apical region of young flowers and thus caused premature fall of flowers. They were mainly meddling with the essential organs of the flower. So they may be a pollinator; but whether they consume nectar or not is to be studied further. Even if Stingless bee (*Trigona iridipennis*), Crazy ants (*Nylanderia fulva*), Black ants (*Lasius niger*) and Thrips (*Aleurothrips fasciapennis*) were present, they were not carrying much pollen except Crazy ants. This may be due to their small size because of which they can directly enter the corolla tube through the wide throat without disturbing the androecium and gynoecium. Hence they could be cheaters.

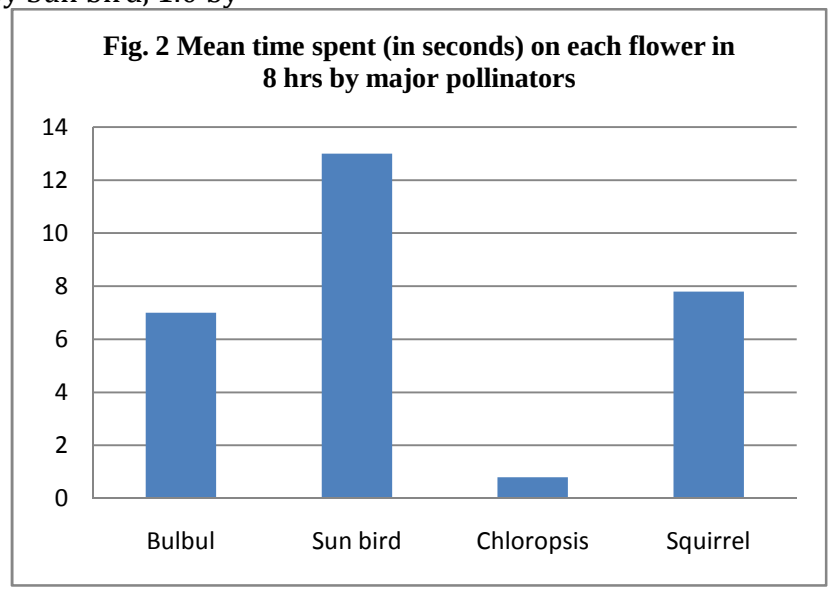
In most of the unopened, mature flowers, the anther were in dehisced condition and the technical term used for anthers showing this phenomenon is cleisto-dehiscence. This may be due to the munching by Squirrels who specifically prefer to eat the upper part of the flower buds as such vitally injuring the essential parts of the flower. Hence it is assumed that the potential pollinators of the *Helicteres isora* could be Bulbul, Sun birds and also Squirrel to some extent.The corolla of some of the young flowers were dull bluish and non-attractive but had more nectar within it. But some older flowers were brightly red coloured and had less amount of nectar. So it is hypothesised that insects are attracted to the flower initially for nectar and later by the colour of the corolla. A well developed honey-guide was seen at the inner basal side of the calyx tube which is a distinguishing feature of this flower.

The plant was supporting large number of *Loranthus longiflorus*, a frequently found semi-parasitic angiosperm and this indicated that birds were the frequent visitors for pollination and not for the dispersal of the fruits as it is a dry, twisted follicle. The presence of gynophore has brought the gynoecium outside the corolla tube and has made it protrude upward above the level of androecium. The staminal tube was found covering the style and stamens were placed below the stigmatic level. The flower was found to be protandrous in nature on the basis of stigmatic receptivity study and analysis.

Serial dilution method was employed to analyse the quantum of pollen borne by the insect pollinators. For this, insects were collected in random and dipped and washed with camel brush in sterilized glucose solution of known volume. One drop of glycerine is added to prevent the clumping of pollen grains. The resultant solution was serially diluted and the pollen grains of *Helicteres isora* were counted based on its morphological features and the total number of pollen grains was enumerated. It is found that Red Crazy Ant (*Nylanderia fulva*) is the major insect pollinator which carried maximum number of pollens than the other 4 insect species. The wind pollination trap showed scanty pollens which was statistically insignificant.



Based on the data collected, it is concluded that total number of average visits per day to 15 flowers of the selected branch of the inflorescence was as follows. 29 visits by Bulbul, 65 by Sun birds, 6 by Chloropsis and 60 by Squirrels. Hence it can be assumed that number of mean visit per hour to the selected 15 flowers was 4.8 by Bulbul, 10.1 by Sun bird, 1.0 by



Chloropsis and 10 by Squirrel (Fig. 1). Total time spent on 15 flowers in 7 hours in seconds was 105 by bulbuls, 195 by Sun birds 12 by Chloropsis and 118 by Squirrels. Hence the mean time spent on each flower was 7 seconds by Bulbul, 13 seconds by Sun bird, 0.8 seconds by Chloropsis and 7.8 seconds by Squirrel (Fig. 2).

Table-I: **Shannon-Wiener diversity index-Morning session (6 am to 10 am)**

Pollinator	No. of visits	pi=sample/sum	ln(pi)	pi*ln(pi)
Bulbul	18	0.173	-1.754	-0.303
Sun bird	41	0.394	-0.931	-0.367
Chloropsis	5	0.048	-3.036	-0.145
Squirrel	40	0.385	-0.954	-0.367
	sum=104			SUM = -1.182

Table-II: **Shannon-Wiener diversity index-Post morning session (10 am to 2 pm)**

Pollinator	No. of visits	pi=sample/sum	ln(pi)	pi*ln(pi)
Bulbul	11	0.197	-1.624	-0.320
Sun bird	24	0.429	-0.846	-0.363
Chloropsis	1	0.018	-4.017	-0.072
Squirrel	20	0.357	-1.030	-0.368
	sum=56			SUM = -1.123

To assess the richness and evenness of the visit of pollinators in two different time schedules, Shannon-Wiener diversity index was calculated for morning session (6 am to 10 am) and post morning session (10 am to 2 pm)-(Table-I&II). The index values showed that morning session is prolific in richness and evenness of pollinators (Shannon-Wiener diversity index = -1.182) than the post morning session (Shannon-Wiener diversity index= -1.123)

The diversity in pollinators of different phyla reinforces the adaptability of the plant to the changing environmental conditions of climate change. This study stresses the importance of conservation of floral and faunal biodiversity whose coexistence is the ultimate force on which our biosphere thrives.

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