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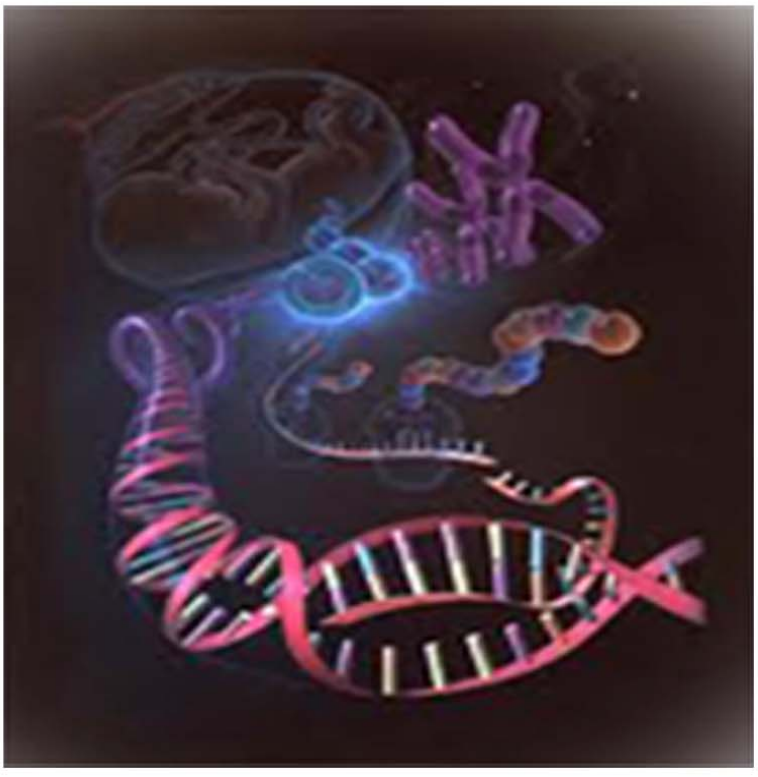

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Research Paper

AN INVESTIGATION ON THE POLLINATING INSECTS OF MEDICINALLY IMPORTANT PLANTS

Pollobi Duara[1*] and Jatin Kalita[1]

Corresponding Author: **Pollobi Duara, ✉ pallu111.111@gmail.com*

The act of pollination is the most important phenomena of plant by which sexual reproduction is possible. Medicinal plants are highly valuable. Therefore, it is important to study the pollination effects on medicinal plants. Scan sampling methods were carried out to explore the insect pollinator diversity from 7.00 h upto 15.00h. Visiting frequency of pollinator insects were observed by using focal sampling. The information together with flowering periods; environmental factors were used as the basic data to determine the effectiveness of insect pollination. Results showed that every species of insect pollination were from order Hymenoptera, Lepidoptera and coleoptera. Three species of Lepidoptera (*Pieris canidia*, *Eurema hecabe simulata* and *Catopsila pomona*) showed highest abundance. The highest abundance and species richness of pollinators occurred at 8.00-12.00 h. Total 43 species were observed during the study. Apidae and Lepidoptera are more abundant as insect pollinators due to high visited frequency. Therefore, this type of study can suggest strategies for attracting pollinator insect.

Keywords: Pollinator insects, diversity, frequencies, medicinally important plants,pollination syndrome

INTRODUCTION

The Greatest service rendered to mankind by insects is the pollination of flowers which otherwise will not set fruits or seeds. Plants and animals have a close inter relationship for their survival, propagation and control. The act of pollination is the most important and essential phenomena of plant by which sexual reproduction is possible. A complete flower bears stamens, which produce pollen, the male particle and the ovary, which contain the ovules, the female counterpart. As both those organs are separate and non motile, hence the flower need some means by which the pollen is carried to stigma of ovary for fertilization which may lead to formation of seed and fruit. The process of transportation of pollens from stamens to the ovary in the same flower or from one flower to another in the same species is called pollination. The process of pollination of flowers by its own pollen is called self pollination, while pollination involving transportation of pollen in between two flowers is called cross pollination. The cross pollination is mostly preferred by plants because it reduces

[1] Department of Zoology, Gauhati University,Guwahati 14.

the genetic deformity and produce more resistant variety of off spring in the next generation (Berenhaum 1995). Pollination in a vast majority of cases involves certain agents wind, animal and water. A great majority of the flowers that we see today are insect pollinated or Entomophilous. In Pollination insect contribute 85%, (Reddi & Reddi 1984) self pollination 5% and air and water contribute only 10%. The various insects help in pollination are – bees, butterflies, ants, flies (Wilson 1999). There may be herbivores and nectar thieves that visit flowers to acquire rewards, but do not disperse pollen (Irwin and Brody 1999, Maloof and Inouye 2000).

To attract insects the following qualities are- bright colour of its petals, attractive scent, presence of nectar gland, edible pollens (Wilson 1999). The numerous peculiarities of structure and physiology of flowers are obviously related to certain morphological and physiology of insect that pollinate them (Dutta 1970). The nectar flowers are mainly pollinated by insects. The insects that visit flower belongs to the groups Hymenoptera, Lepidoptera, Diptera, Coleoptera, Thysanoptera and Hemiptera. The reciprocal relationship between flowers and visitors had been pointed out earlier by Konrad and Spreagel (1973). This type of study have got definite economic value because of the pollination of medicinally important plants depends upon the insect pollinators. It was observed that some economically important food plants facing some problems of pollination e.g. the apple plant is a self incompatible plant which requires cross pollination by bees (Verma and Chauhan, 1985). The pollination of mustard oil seed depend upon *Apis dorsata*. Bees have recognized as pollinators as early as 1761.

MATERIALS AND METHODS

Study Sites

Study was conducted at Nambor Doigrung Wild life sanctuary which is situated in the Golaghat district of Assam. This sanctuary shares its boundaries with the Nambor Reserve Forest and Garampani wild life sanctuary. It covers an entire area of 97.15 sq. km. Study was conducted from March 2011 to March 2012. Nambor Doigrung Wildlife sanctuary is geographically located between 92° 52'to 92° 53'east longitude and 26° 22' to 26° 24' North latitude.

The area is in tropical basin of India and as a result of that the temperature is never too high or low with a very heavy monsoon. The maximum/ minimum temperature is 8 to 30°C. Annual rainfall is 2500 mm.

Flower Phenology

The anatomies of flowers were observed to understand the position of the nectar glands. Flower phenology was observed at both plant and inflorescence level with reference to day to day flowering pattern. Flower phenology is determined by observations made atleast 3 times per week, flowering time, time of opening and closing of flowers (Mark and Francoise, 2005)

Pollination Syndrome

Pollination syndrome study includes the colour, form, shape, size, pollen tract, odour or scent study of the flowers to attract different pollinators.

Collection and Identification of Medicinal Plants

Herbarium sheet of the collected specimens were made with the flowers and then identification is done with reference to books and literatures (Britton and Brown, 1970).

Insect Pollinators Diversity

Diversity of insect pollinators was observed using line transect and point transect method. Several insect visitors were collected for species identification purpose. Environmental factors were measured in every insect observation.

Insect Pollinator visiting Frequency

Observations of insect flower visiting frequency were conducted by scan sampling methods (Martin and Bateson, 1993). The observations included foraging rate (number of flowers/minute), flower handling time (seconds/flower) and plant handling time (seconds/plant) (Dafni, 1992).

Data Analysis

Diversity of insect pollinators were analyzed based on Shannon diversity index (H), Shannon evenness (E), Margalev species richness (d) for difference insect visiting behavior.

RESULTS

Flower Diversity

Plants that are reported in Nambor Doigrung Wild life sanctuary from March 2011 to March 2012 are –

1. *Catharanthus roseus*
2. *Lantana camara*
3. *Verbena* sp
4. *Pisum sativum*
5. *Ixora cocinea*
6. *Eupatorium odoratum*
7. *Spilanthes oleracea*
8. *Oxalis corniculata*
9. *Centella asiatica*
10. *Leucas longifolia*
11. *Asclepias* sp *cordifolia*
12. *Oldenlandia corymobosa*
13. *Cannabis sativa*
14. *Cassia fistula*
15. *Ageratum conyzoides*
16. *Butea monosperma*
17. *Lagerstroemia flos-reginae*
18. *Erythrina indica*
19. *Mesua ferrea*
20. *Citrus longifolia*
21. *Hibiscus rosa chinensis*
22. *Dysoxylum procerum*
23. *Citrus orantifolia*
24. *Tagetes patula*
25. *Lucas lavendulafolia*
26. *Sesamum indicum*
27. *Mimusops elengi*
28. *Chenopodium album*
29. *Feronia elephanta*
30. *Marsilea quadrifolia*
31. *Poecinia regia*
32. *Ficus hispida*
33. *Duranta* sp
34. *Tectona grandis.*
35. *Kurfia*
36. *Nyctanthes arbor-tristis*
37. *Ziziphus mauretiana*

Insects that are reported during the study are:

1. *Pieris canidia*

2. *Appias lyncida*
3. *Ypthima huebneri*
4. *Neptis hylas*
5. *Melantis leda*
6. *Catposilia Pomona*
7. *Danaus plexippus*
8. *Papilio poytes*
9. *Eurema hecabe*
10. *Anaphaeis aurota*
11. *Cirracchoa tyche rotundata*
12. *Hebomoia glaucippe*
13. *Leptosia nina*
14. *Graphium sarpedon*
15. *Zeltus etolus*
16. *Papilio nephelus*
17. *Junonia lemonias*
18. *Euploea radamanthus*
19. *Euploea mulciber*
20. *Atrophaneura varuna*
21. *Neptis hordonia*
22. *Papilio demoleus*
23. *Danaus genutia*
24. *Parantica aglea*
25. *Moduza procris*
26. *Tanaecia lepidea*
27. *Euploea core*
28. *Castalius rosimon*
29. *Ixias Marianne*
30. *Lycanidae* sp
31. *Catopsilia pyranthe*
32. *Papilio helenus*
33. *Ixias pyrene*
34. *Hasperidae- Gangara thyrsis*
35. *Paplio clytia*
36. *Cathosia cyane*
37. *Apis dorsata*
38. *Apis florea*
39. *Fig wasps* (Agaonidae family)
40. *Apis cerana*
41. *Flower flies*
42. *Thrips*

The flowers were brightly coloured and fragrant which is a key feature that attracts insect pollinators. The abundance of insects was positively correlated with number of flowers.

Insect Pollinator Diversity

From the observation, 43 species of insect visitors were seen.

Table 1 : Number of Species and Percentage of Insect Pollinator for 12 Month Observation

Taxon	Species	Percentage
Hymenoptera	4	9.30%
Lepidoptera	36	83.72%
Others	3	6.97%
Total	43	100

Lepidoptera were found in every observation and has the highest abundance found at 8.00-12.00 h. Otherwise Hymenoptera were seen from 7.00-13.00h. The diversity of insect visitor was higher in the morning and noon compare to afternoon (Table 2).

Table 2: Total Species of Insect Visitor in Time Blocks for 12 Month Observation

Time block (h)	Hymenoptera	Lepidoptera	Others
7.00-8.00	2	18	1
8.00-9.00	2	26	0
9.00-10.00	1	25	3
10.00-11.00	1	25	1
11.00-12.00	1	22	0
12.00-13.00	1	18	0
13.00-14.00	0	17	2
14.00-15.00	0	14	1

Table 3: Number of Insect Pollinator from 9.00 to 15.00 h

Time block	Species(S)	Individuals(N)	E	H
07.00-08.00	21	513	0.17	0.52
08.00-09.00	28	870	0.07	0.25
09.00-10.00	29	1059	0.30	*1.0*
10.00-11.00	27	1240	0.08	0.27
11.00-12.00	23	1302	0.05	0.16
12.00-13.00	19	1206	0.06	0.19
13.00-14.00	19	931	0.11	0.32
14.00-15.00	15	806	0.08	0.22

Note: E=Evenness index, H=Shannon weiner index.

DISCUSSION

According to our observations it can be said that some conditions are there for an insect to contribute in the process of pollination. They are-the visited activities have to be in the flower,the insect morphology has to fit with their flower phenology (ecoevolution) (Raju and Ezredanam, 2002), the visited duration frequency has to keep them movable from one flower to another in different plantation, visited frequencies related to food sources (foraging behavior) and environments factors (Faheem *et al*., 2004). In our observation, it was also seen that the insects become active as the day warms up (Table 2).

Out of 43 species of insect that collected in this study, not all of them were effective, ants and flies were also reported but as ants take a long duration in moving from one flower to another and flies visit flowers infrequently. However Ants and flies can pollinate flowering plants like *J. curcus* (Raju and Ezredanam, 2002). Other insects like butterflies cannot fit to small flowers because of their large body size. There is possibility that butterflies performed as pollinators, when they

visited flowers to collect nectar, pollen were patched in their proboscis and legs when they visit another flower, the pollen usually removes from their proboscis or legs and drop into pistil. Butterflies frequently visited the flowers that were observed in the study site, hence they were effective as pollinators.

Bees generally have a heavy body hair, a long or short proboscis and pollen baskets (Michener 2000). Observations showed that honey bee (*Apis indica*) generally visited small sized flowers like Litchee flower as their body fits to it and they had to do less work in collecting food from composite flowers as small flowers remain as composite flower. So our finding is similar to the findings of the above worker. Apis has unique body structure to collect pollen called pollen basket in the hind tibia.

Besides nesting areas, flower phenology and nectar volume also attaract insect to visit flower. The amount of flowers, sizes, shapes, colors, nectar volume, and number of pollens influenced the abundance of insect pollinators (Faheem *et al*., 2004). In our findings it was found that coloured flowers attract more insects.Barth (1991), reported bloomed flowers with inflorescences blue-yellow colour attracted Hymenoptera and Diptera. But our findings revealed that blue yellow colour not only attract Hymenoptera and Diptera but Lepidoptera also.From the data it is found that *Catopsilia crocale*, *Catopsilia pyranthe minna* and *Eurema hecabe simulata* which belongs to Lepidoptera visit yellow flower of *Lantna camara,,Cassia fistula* and *Spilanthes oleracea.*

Hardwicke (2003) and fahem *et al*. (2004) reported the effectiveness of environment factors of insect pollinator. But from the study work it was found that the number and diversity of pollinator insect was not directly affected by temperature. The contrary result may be due to anthropogenic impacts that also change insect number visiting flowers. From the study diverse insects were found and among them highest individuals number were from Hymenoptera and highest species number were from the Lepidoptera (Table 2). Among Lepidoptera highest number of butterflies were of nymphalidae family and lowest lycaenidae family.

From the datas obtained highest insect number visiting flowers were reported in the time block 8.00-12.00hr. and lowest 7.00-8.00 and 14.00-15.00 h. As a remark of the study gives important information about the pollinator insect diversity of Nambor Reserve Forest visiting medicinally important plants. The medicinal plants have their economic importance as well. So, the study no doubt helped to understand the insect-flower relationship.

CONCLUSION

From the above study it can be concluded that Lepidopterans were effective as pollinators due to their high visited frequency. Results showed that highest abundance and species richness of pollinators occurred at 8.00-12.00 h and total 43 species were observed. So this type of study can help to know about the diversity of pollinating insects of medicinally important plants.

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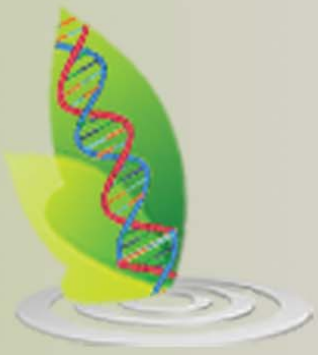

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