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Flower–Visitor Interaction and Fruit production of *Grewia asiatica* L.

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A B S T R A C T

The present paper deals with the flower–visitor interaction and fruit production of *Grewia asiatica* L. (phalsa) (Tiliaceae) which has great economic importance for the production of juice. It flowers from March to May and yield fruit from May to June. Flowers are yellow, bisexual, regular, nectariferous and with many anthers. Flowers generally open in the early morning (7:00 hrs – 8:30 hrs). Anther dehiscence takes places before flower opening. In average each flower produces 27,900 pollen grains. Different members of Hymenoptera, Lepidoptera, Diptera, Coleopter (Beetles), Mammals and Birds etc. were found to visit for their forage. During their visit their body parts get dusted with pollen grains and subsequently transferred to the con-specific plants resulting in successful pollination. 70% fruits formation wear observed in natural open condition and 20% fruits formation were found in netted condition. But in bagged condition no fruits formation were observed in this plant.

Introduction

In order to set fruits and seeds the male and female reproductive units must come together that's why pollination is prerequisite for the formation of fruits and seeds in plant. Pollination biology is a recently developed branch in the biological sciences and has attracted the attention of the scientists throughout the world, because of its importance in understanding plant breeding system, floral evolution, foraging theory and animal behaviour. The ultimate fruit production depends upon a number of aspects, such as floral morphology, pollen productivity, stigma receptivity, flower visitor diversity and their foraging behaviour. Changes in any of these events may seriously hamper fruits production. Thus lack of pollinators or bad weather may make pollen transfer difficult. So, the relationship between the flowers – visitors is one of the most critical parts of plant reproduction for the production of quantitatively and qualitatively improved fruits and seeds. Successful reproductive process leads to fruits setting through successful pollination. For this pollen grains

have to be adequately transported to the respective stigmas and pollen tubes have to be accomplished growth in pistil and fertilize the ovules. The pollen grains are transported by different abiotic and biotic agents. Flowering plants are pollinated by animals, mainly by insects. Among these bees and butterflies are dominant. During their visit they carry large quantity of pollen grains which in turn are deposited on the exposed stigmas of flower and thus help in pollination. The production and the dispersal of pollen grains have both biological and genetic implications for the quantity and genetic values of the fruits and seeds.

In conjunction with the efforts to observe the pollinator community of crops and the dominant pollinators of crop production experiments were performed to study the floral morphology, pollen productivity, flower visitor interaction and their foraging behaviour in relation to pollination mechanism of *Grewia asiatica* L. belonging to family Tiliaceae popularly known as phalsa, one of the most important crop with high economic returns.

Materials and Method

The study was conducted flowing the process of Mathur and Mohan Ram (1986), Reddi et al. (1980) to observe different phenological events with the plants growing in and around university campus at Santiniketan, Birbhum, West Bengal ($87^{o}41'$ and $87^{o}42'$ east longitude and between $23^{o}40'$ and $23^{o}42'$ north latitude).

Pollen production was performed following the procedure of Mandal and Chanda (1981).

Netting by nylon mesh and bagging by butter paper are done for determination of fruits set.

Results and Discussion

As soon as flowers open different flower visitors like *Apis dorsata, Apis cerena indica, Trigona* sp., *Ceratina* sp., *Amegilla* sp., *Megachile* sp., *Halictus* sp., *Xylocopa* sp., *Eumenes* sp, ants, members of Lepidoptera and Diptera, Squirrel and Bird etc were found to visit flower for collecting their food materials. The large group of Hymenoptera comprises some of the most interesting, highly evolved, and economically most important pollinating insects. The role of bees has been recognized in pollination since early time (Free, 1970). Social bees like *Apis* sp., *Trigona* sp., *Ceratina* sp., and solitary bees like *Xylocopa* sp., *Amegilla* sp., are more important ones. *Apis* spp. visit flower to collect nectar and pollen. They are attracted to flowers and recognize them by their colour, shape and odour. Bees are able to distinguish only four qualities of colour, yellow, blue-green, blue and ultra violet and when they are working flowers of one colour only they become conditioned to it and do not visit flowers of a different colour, although the petals are the most conspicuous feature of an entomophilies flower (Free, 1970). *Apis* spp. condensed their visit to the yellow colour of *Grewia* flower. They forage the flowers throughout expose surface of anthers and stigma. Stigma becomes sticky during this time. They pay continuous visit and play a major and vital role in pollination. The duration of forage is much more in the morning than noon and afternoon. Petals expansion, nectar secretion and scent production reach their maximum to coincide with anther dehiscence so the nectar foragers pick up mature pollen on their bodies. The petals wither and scent and nectar production cease soon after a flower is fertilized. In unpollinated flowers nectar secretion persists for longer than usual (Free, 1970). The nectarines, or

nectariferous tissue, which secretes nectar, may occur in many parts of the flower including the receptacle, petals and sepals and the bases of the filament and pistil. The nectar secretion by some species is of very limited duration. Nectar secretion is influenced by the maturation of the stigma and stamens, and also often by the age of the flower and is usually greater on the first day, or first few days, a flower is open than later (Shuel, 1961).Different pollinators are attracted by the nectar and collect as food materials. Honeybees possess special modifications for packing pollen which is transported back to their colonies as pollen pellets in the pollen baskets, or corbiculae, on their rear legs. The two pollen pellets collected by a bee during its foraging trip are referred to as pollen load. *Xylocopa* sp. May be considered as effective pollinator to this plant. They use buzz pollination techniques for collecting pollen from the anther. The bees grab onto the flower and move their flight muscles rapidly, causing the flower and anthers to vibrate, dislodging pollen. This resonant vibration is called buzz pollination. They need greater energy for their existence because they are large sized insect. *Xylocopa* sp. suddenly comes and lands on flower in upright position and contact anthers and stigma with their sternum, foreleg and backside of body. Stigmas are about the anther level and capitates. So the viable pollen grains transported by these bees can easily be dropped over stigma of other flowers and eventually help in pollination. *Trigona* sp, *Ceratina* sp. visit the flower for both pollen and nectar. They probe the flowers in the upright position; collect floral rewards efficiently in mess and soil manner and carry pollen on the body. *Amegilla* sp. handles the flower in upright position and collect floral rewards sternotribically and carries huge amount of pollen on its ventral side. These bees are very efficient pollinator because usually they move very quickly from flower to flower. Therefore, the foraging activity of *Amegilla* sp. is important for pollination in this plant species.

Different members of Lepidoptera push their proboscis up to the base of ovary and ultimately pollen grains are attached to their proboscis surface and transported to pollinate the same flower as well as other flowers. Ants collect both pollen and nectar but their bodies are hard and apparently not adapted for pollen transport. Ants crawling around throughout day and night in flowers and inflorescences and may cause autogamy or geitonogamy. Different members of Diptera are found to visit flowers for their food material and help in pollination of the plant. Many small vegetarian vertebrates especially mammals like squirrels roam in the crown of trees and eat blossoms or parts of blossoms or suck nectar. In many, perhaps the majority of these cases the effect is destructive, though even a destructive feeder may more or less accidentally leave some pollinated pistils. During their movement their body get dusted with pollen grains and help pollen transfer and pollination to the con-specific plants resulting in successful pollination. As flying animals with a rough surface, birds possess good external prerequisites for becoming pollinators. Whereas everybody apparently takes for granted the fact that various insects find their food in blossoms, the corresponding habit of birds seems to have caused a great deal of astonishment and speculation about how birds got the idea of utilizing the nectar of blossoms. Thus the bird (*Nectarinia* sp.) also helps in pollination of plant. Different flower visitors visit flower and play a major and important role in pollen transfer and pollination of G*ewia asiatica* L.

Table.1 Fruits Production of *Grewia asiatica* L.

Name of plant	Bagging condition	Netting condition	Open condition
Grewia asiatica	Nil	20%	70%

Table.2 List of Flower Visitors of *Grewia asiatica* L.

Name of the flower visitor	Visiting time	Forage matter
Hymenoptera		
Apis dorsata	Day	Pollen and nectar
Apis cerena indica	Day	Pollen and nectar
Trigona sp.	Day	Pollen and nectar
Amegilla sp.	Day	Pollen and nectar
Megachile sp.	Day	Pollen and nectar
Halictus sp	Day	Pollen and nectar
Eumenes sp	Day	Pollen and nectar
Xylocopa sp.	Day	Pollen and nectar
Camponotus compressus (Ant)	Day and night	Pollen and nectar
Lepidoptera		
Butterflies	Day	Nectar
Borbo sp.	Day	Nectar
Diptera		
Musca sp.	Day	Pollen and nectar
Mammals		
Squirrel (Funambulus sp.*)*	Day	Pollen and nectar
Bird *(Nectarinia* sp.*)*	Day	Pollen and nectar

Fig.1 Flowering Twig

Fig.2 *Apis* sp. Visiting Flower

Fig.3 *Xylocopa* sp. Visiting Flowers

Fig.4 Bird Visiting the Flowers

Fig.5 Squirrel Visiting the Flowers

Fig.6 Fruits

Different insects (members of Hymenoptera, Lepdoptera and Diptera) were found to visit phalsa flowers for their forage which is quite similar with the observation of Parmar(1976) and Manzoor-ul-haq *et* al. (1979) . Inspite of insects birds and squirrels are also found to visit flowers whether Parmar, (1976); Manzoor-ul-haq et al. (1979) found only insect visitors in the taxa. Among the visitors *Apis dorsata*,*Trigona* sp,and *Megachile* sp, are the frequent visitors and pollinate the flowers while collecting nectar as well as pollen and can be considered the potential pollinators of phalsa flowers, whether according to Manzoor-ul-haq et al. (1979), *Apis florea* and several species of *Halictus* (Halictidae) and *Andrena* (Andrenidae) were the most common visitors and according to Parmar (1976), Africanised honey bees were the most abundant visitors of the species.

70% fruits wear observed in natural open condition and 20% fruits formation were found in netted condition. But in bagged condition no fruits formation was observed in this plant. Fruits formations were always better in natural open condition than netted and bagged condition. From the results of netting and bagging experiment it can be predicted that plants require some external agents, indicating their cross-pollination nature. Thus it indicates that some visitors play vital role in fruit formation in *Grewia asiatica* L**.** This mutualism is a good example of diversity and dynamic of plant-animal interaction.

In conclusion, Pollination is a most important ecosystem service provided by insects, resulting in sustainability and the community life. Pollinators, particularly bees, pollinate about majority of the world's crop species and are directly or indirectly essential for an estimated food production. The availability of natural insect pollinators is decreasing rapidly due to continuous use of pesticides and herbicides and decline of necessary habitat. Pollinators provide an essential ecosystem service that contributes to the maintenance of biodiversity and ensures the survival of plant species including crop plants. Insect pollination is necessary for many crop pollinated crops especially in the case of *Grewia asiatica*.

Consequently, native pollinator should be assessed for their pollination potential, so as to conserve and manage the most efficient native pollinator to produce maximum crop yield. In conclusion bees play very important role in cross pollination of *Grewia asiatica* by increasing fruits production of this plant. This study indicates a base line for future researches on conservation of native pollinators which should include exploring the biology of native pollinators and divising some pollinator-friendly practices for sustainable development.

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