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Diversity of flower visiting insects on some cultivated and non cultivated plants in Gangulia, West Bengal

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Abstract
Flower visiting insects play a significant role in the pollination of plants, which ultimately determines the survival and reproduction of plant populations. Among the most well known flower visiting insects are bees, butterflies, moths, and flies. Plant-pollinator interactions are crucial for both wild and cultivated plant species. However, they are currently at risk due to several factors. These include indiscriminate use of pesticides, habitat fragmentation, and intensified cultivation practices. The present study aims to develop a comprehensive dataset regarding the diversity of common flower visiting insects on both the cultivated and non cultivated plants in the Gangulia region, West Bengal, India. Three cultivated plants, namely *Solanum melongena*, *Brassica nigra*, *Cucumis sativus* and one cultivated plant, *Ziziphus mauritiana* respectively, were selected for this study to observe flower visiting insects. A total of 7, 5, 3 and 13 species of insects were observed in the flowers of *Solanum melongena*, *Brassica nigra*, *Cucumis sativus* and *Zizyphus mauritiana* respectively. The insects found are belong to the order Diptera, Hymenoptera, Lepidoptera and Coleoptera. This data will be a valuable resource for future studies and aid in the preservation of the local flora and fauna.

Keywords: Pollinator, insect, diversity, flower, agriculture

Introduction

Flower visiting insects are remarkable organisms that play an essential role in the life cycle of flowering plants. These insects, also known as pollinators, engage in complex behaviour with flowers as they seek out nectar or pollen. They travel from one flower to another and indirectly transfer pollen from the anthers to the stigma, allowing fertilisation to occur. This process is vital for the production of seeds, which ultimately determines the survival and reproduction of plant populations [1]. According to Losey and Vaughan (2006) [2], the pollination services provided by flower visiting insects play a crucial role in global crop production**.** Among the most well known flower visiting insects are bees, butterflies, moths, and flies. Matteson *et al*. (2013) [3] have documented the presence of herbaceous flowering plants and flower visiting insects (e.g. Diptera, Coleoptera, Lepidoptera, Hymenoptera) across urban and rural green areas. Each of these species has unique characteristics that enable them to interact with flowers in different ways. In recent years, the importance of pollination. primarily by insects in crop plants has been increasingly recognised [4]. Some of the major crops that depend on pollinators include fruits, vegetables, spices, plantation crops, pulses, and oilseeds. The economic value of crop pollination worldwide is estimated to be around € 153 billion annually **[5]**. According to Klein *et al*. (2007) [4], 87 of the world's leading food crops rely on animal pollination, accounting for 35 percent of global food production. Additionally, the area covered by pollinator-dependent crops has expanded by over 300 percent in the last half-century [6, 7]. Plant-pollinator interactions, which are crucial for both wild and cultivated plant species, are currently at risk due to several factors [8]. These include indiscriminate use of pesticides [9]**,** habitat fragmentation [10, 11], and intensified cultivation practices [12, 13]. Climate change is also projected to be a further cause of concern for pollination services [14, 15, 16]. Although there have been some studies on the effects of climate change on plant-pollinator interactions, empirical research linking these effects is still limited [17]. Furthermore, there is a lack of research on crop pollination in relation to climate change. Therefore, it is essential to protect and conserve these vital creatures and their habitats to guarantee the sustained health and diversity of our ecosystems. The quick expansion of human settlements is having an impact on the natural habitats due to urbanization and other land-use practices. This is causing stress on the ecosystem services provided by wild pollinators. Simultaneously, the need for pollination in agricultural production must continue to grow to maintain food production. To ensure that our environment remains healthy and sustainable, it is important to understand the relationship between plants and insects. Specifically, knowledge of the pollinators in a particular area is crucial for the survival of plant species. In light of this, our study aims to develop a comprehensive dataset regarding the diversity of common flower-visiting insects on both the cultivated and non cultivated plant in the Gangulia region, West Bengal, India. This data will be a valuable resource for future studies and aid in the preservation of the local flora and fauna.

Materials and Methods

This study was conducted at Gangulia, North 24 Parganas, West Bengal. It lies between latitude 22.8^0 N and longitude 88.6^0 E. The average annual rainfall of this region is 1579 mm, with maximum and minimum average temperatures being 30.6^0C and 18^0C respectively. Three cultivated plants namely *Solanum melongena*, *Brassica nigra*, *Cucumis sativus* and one non cultivated plant *Ziziphus mauritiana* respectively were selected for observation of flower visiting insects on them. Field studies were carried out from August 2021 to January 2022 with a one-week interval for

observation of phenological traits such as the appearance of flower buds, flower anthesis, completion of flowering, and duration of flowering. The blossoms in these fields were observed for two hour. Insect visits to the blossom were recorded at each observation. Throughout the study period, some insect species were collected, carefully anesthetized with chloroform, and transported back to the laboratory for further analysis. Regular field trips were conducted every two weeks to survey and collect insects. Several meteorological parameters like rainfall and temperature were also recorded during this study period. To collect insects at random locations within the study sites, both sweep net and hand picking methods were utilized. Once caught, insects were placed in a container with 70% alcohol to facilitate identification. Identification was done with the help of literature, books, and museum specimens to identify insects found on specific flowering species.

Results and Discussion

Solanum melongena, also known as brinjal or eggplant, is a significant crop that is grown in sub-tropical and tropical regions. The name brinjal comes from Arabic and Sanskrit and is popular in the Indian subcontinent. The name eggplant, on the other hand, is derived from the shape of the fruit of some varieties, which is white and resembles chicken eggs. Brinjal flowers are solitary or in clusters of two or more, and they are violet in colour. Brinjal is mostly self-pollinated, but it can also be cross-pollinated, with cross-pollination rates as high as 48%. This is why it is classified as a cross-pollinated crop. The cone-like formation of anthers facilitates self-pollination, but since the stigma ultimately projects beyond the anthers, cross-pollination can occur as well. The natural rate of cross-pollination may vary based on factors such as genotype, location, and insect activity. Reports show that the extent of outcrossing ranges from 3 to 7% in China and from 0 to 8.2% at the Asian Vegetable Research Development Centre [18]. However, Indian researchers have reported outcrossing rates of between 2 to 48% in brinjal varieties grown in India [19]. A total of seven species of insects were studied on the *Solanum melongena* during the survey period of 20 days (Table.1). Among seven species, three belong to Hymenoptera; these are *Apis dorsata, Ropalidia sp.*, and *Rynchium brunneum*. Two species belong to Lepidoptera; these are *Eumera hecabe and Ariadne sp*. Two species belong to Diptera; these are *Chrysops sp.*, and *Sarcophaga sp*. *Solanum melongena* is a cultivated plant. The production of *Solanum melongena* is totally dependent on pollination. But by using pesticides, the number of flowers visiting insects is reduced. Among seven insects on *Solanum melongena*, *Apis dorsata* predominantly plays an important role in pollination. They visit several times on *Solanum melongena* than other insects. *Rynchium brunneum* is very effective because it feeds harmful insects of *Solanum melongena. Brassica nigra* is an annual plant that is grown for the purpose of harvesting its seeds, which are typically used as a spice. Flowers are in clusters, and when fully mature, they range from 0.5-2 ft. long. Summer is the flower-blooming season of *Brassica nigra*. A total number of five species of insects were studied on *Brassica nigra* during 7 days of survey periods (Table.2). Among these, one species belongs to Lepidoptera, this is *Syntomoides imaon*. Three species belong to Diptera, these are *Episyrphus balteatus*, *Lucilia sericata* and *Sarcophaga* sp. And One species *Phyllotreta sp.* belongs to Coleoptera. *Brassica nigra* production completly depend on pollination process. *Syntomoides sp., Episyrphus sp., and Chironomus sp.* are predominantly pollinate the flower of *Brassica nigra*. During study time, it was observed that they visited frequently, and their abundance was more than other pollinator on *Brassica nigra.* The cucumber plant, *Cucumis sativus* is a widely cultivated creeping vine plant in the family Cucurbitaceae. It bears long, green fruit with tapering tips, as well as huge leaves and beautiful yellow flowers. The three species of insects were studied on the blossom of *Cucumis sativus* during 15-day periods in peak flowering times (Table.3). These are *Apis dorsata, Apis melifera* and *Megachile brevis*. They play an important role in pollination, and the production of cucumber is totally dependent on pollination by this pollinator. It was observed that pollination is mostly carried out by *Apis sp. Ziziphus mauritiana* is a spiny evergreen shrub that is not cultivated. The flowers of this plant are greenish-yellow in color and about 5mm wide. Over a period of fifteen days, a total of 13 insect species were recorded visiting the blossoms of *Z. mauritiana* (Table.4). These insects included 4 species of flies, 3 species of wasps, 5 species of butterflies, and 1 species of bee. Thus the insect community predominantly comprised of flies and wasps. The species of insects found were *Eristalinus sp., Lucilia sericata, Sarcophaga sp., Condylostylus sp., Vespa affinis, Ropalidia sp., Eumeninae sp., Junonia atlities, Hapolimnas bolina, Parnara sp., Pseudocoladenia sp., Prosotas nora*, and *Apis dorsata* respectively. These insects are considered to be good pollinators of this plant. The green bottle fly *Lucila Cericata* is a dung visitor and also acts as a pollinator for the other three representatives of the order Diptera that is *Sarcophaga sp, Chondylostylus sp., and Eristalinus sp*. Three out of four species of the order Hymenoptera, such as *Apis dorsata and Ropalidia sp.,* are well-known pollinators. The role of the common tiger wasp *Vespa affinis* as a pollinator is uncertain because of its predatory nature on other insects. However, it may also act as a pollinator because the adults feed on nectar. The four Lepidoptera species are commonly known for their role as pollinators.

Table 1: Flower visiting insects on *Solanum melongena*

Sl no	Order	Family	Common name	Scientific name	Figure
1	Hymenoptera	Apidae	Giant Honeybee	*Apis dorsata*	1(a)
2		Vesoidae	Yellow Paper Waps	*Ropalidia sp.*	1(e)
3			Potter waps	*Rynchium brunneum*	1(f)
4	Lepidoptera	Pieridae	Grass Yellow	*Eumera hecabe*	1(d)
5		Nymphalidae	Ruddy daggerwing	*Ariadne sp*	1(b)
6	Diptera	Sarcophagidae	Flesh fly	*Sarcophaga sp*	1(g)
7		Tabanidae	Deer fly	*Chrysops sp*	1(c)

Table 2: Flower visiting insects on *Brassica nigra*

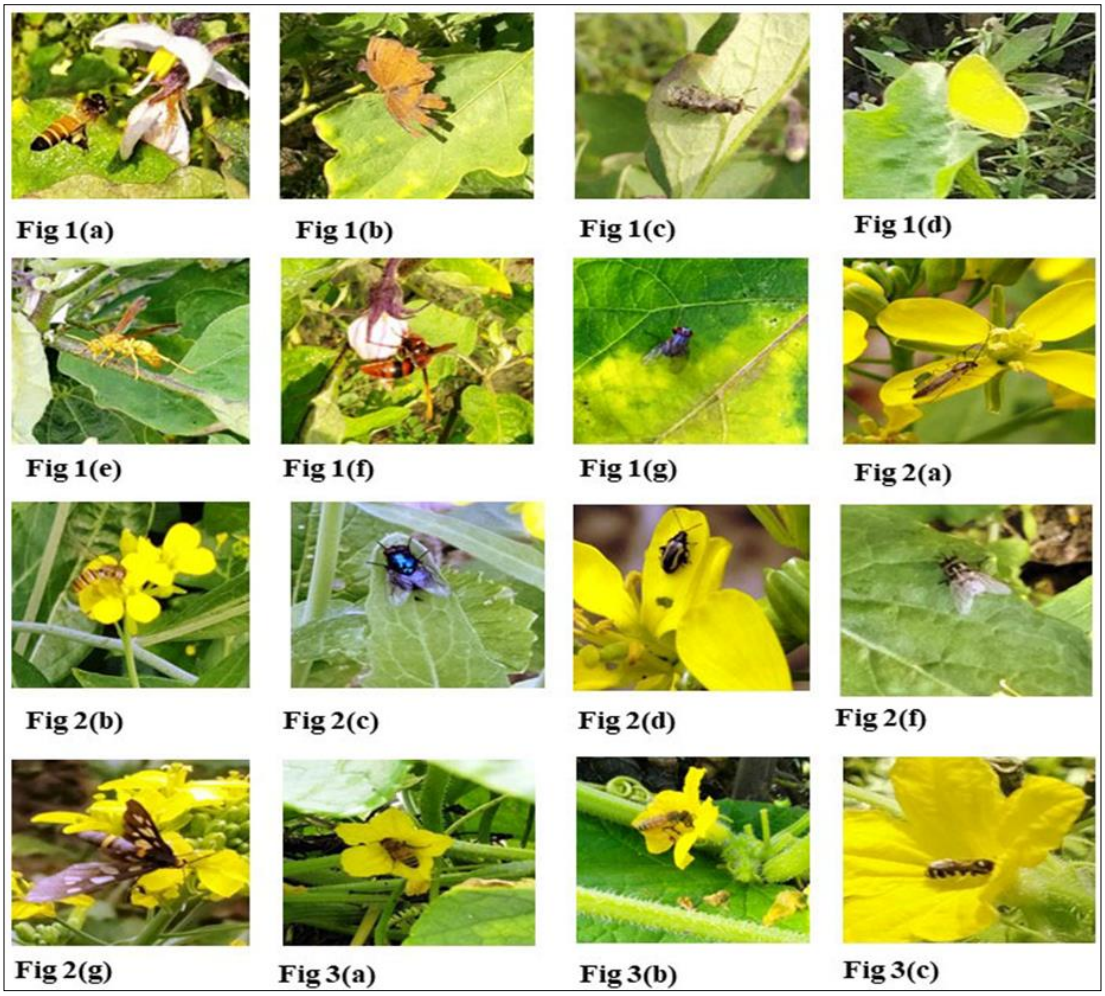
Sl no	Order	Family	Common name	Scientific name	Figure
1	Lepidoptera	Eribidae	Handmaiden moth	*Syntomoides imaon*	2(g)
2	Diptera	Syrphidae	Marmalade hoverfly	*Episyrphus balteatus*	2(b)
3		Calliphoridae	Green bottle fly	*Lucilia sericata*	2(c)
4		Sarcophagidae	Flesh fly	*Sarcophaga sp*	2(f)
5		Chironomidae	Non - biting midge	*Chironomus sp*	2(a)
6	Coleoptera	Chrysomelidae	Flea beetle	*Phyllotreta sp*	2(d)

Table 3: Flower visiting insects on *Cucumis sativus*

Sl no	Order	Family	Common name	Scientific name	Figure
1	Hymenoptera	Apidae	Leafcuter bee	*Megachile brevis*	3(c)
2			Giant honeybee	*Apis dorsata*	3(b)
3			Western honey bee	*Apis melifera*	3(a)

Table 4: Flower visiting insects on *Zizyphus mauritiana*

Sl no	Order	Family	Common name	Scientific name	Figure
1	Lepidoptera	Nymphalidae	Gray Pancy	*Junonia atlities*	4(i)
2			Blue moon butterfly	*Hapolimnas bolina*	4(k)
3		Hesperiidae	Paranas Swift	*Parnara sp.*	4(l)
4			Pied Flat	*Pseudocoladenia sp*	4(j)
5		Lycaenidae	Line Blue	*Prosotas nora*	4(h)
6	Hymenoptera	Vespidae	Common tiger wasp	*Vespa affinis*	4(g)
7			Yellow paper wasp	*Ropalidia sp*	4(e)
8			Potter wasp	*Eumeninae sp*	4(f)
9		Apidae	Giant honeybee	*Apis dorsata*	3(b)
10	Diptera	Syrphidae	Hoverfly	*Eristalinus sp*	4(a)
11		Calliphoridae	Green bottle fly	*Lucilia sericata*	4(b)
12		Sarcophagidae	Flesh fly	*Sarcophaga sp.*	4(c)
13		Dolichopodidae	Long legged fly	*Condylostylus sp*	4(d)



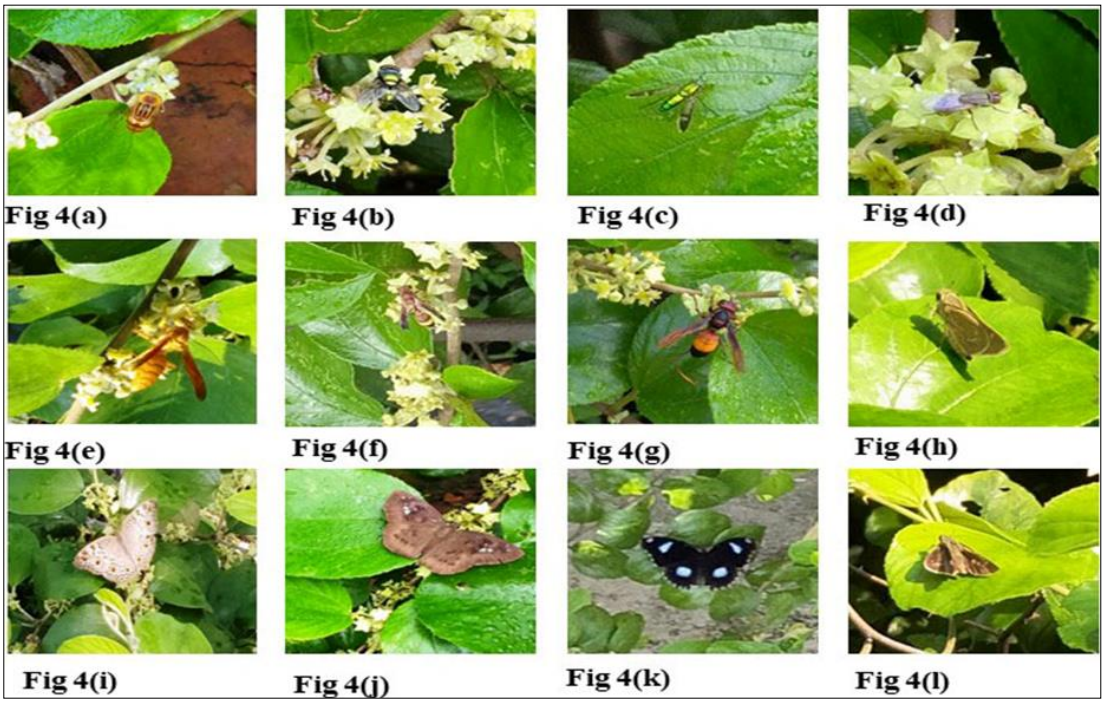


Fig 1(a) to 1(g): Flower visiting insects of *Solanum melongena*.
Fig 2(a) to 2(g): Flower visiting insects of *Brassica nigra.*
Fig 3(a) to 3(c): Flower visiting insects of *Cucumis sativus.*
Fig 4(a) to 4(i): Flower visiting insects of *Zizyphus mauritiana*

Conclusion

In conclusion, flower visiting insects play a significant role in the pollination of plants, which ultimately determines the survival and reproduction of plant populations. The pollination services provided by these insects are also crucial for global crop production. However, habitat loss, pesticide use, and climate change are major factors that endanger their survival. It is, therefore, important to protect and conserve these vital creatures and their habitats to ensure the sustained health and diversity of our ecosystems. The study conducted in the Gangulia region, West Bengal, India, provides valuable insights into the diversity of common flower-visiting insects on both cultivated and non-cultivated plants. This data will aid in the preservation of the local flora and fauna and be a valuable resource for future studies.

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