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An overview on bio-pollinators in present scenario

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Abstract
The study of pollination biology teaches about the various pollinators in different seasons. Tiny pollinators such as ants, alkali bees, beetles, hoverflies, solitary bees, beetles, and bumble bees have been found to have decreased pollination frequency as a result of the heavy and irregular use of pesticides and fertilizers. Three families, Fabaceae, Malvaceae, and Apiaceae have revealed newer and newer types of pollinators engaged in pollination. Pollinators such as *Xylocopa* sp., *Plebejus* sp. (Silver studded Blue), *Lycaena* sp., and *Oplodontha* sp. have been found to be dominant pollinators, and birds are also used to cause pollination from time to time.

Keywords: pollination, bio-pollinators, fertilizers, pesticides, adaptation

Introduction

Recent pollination biological studies show that the trends of different pollinators visiting flowering plants are proximally fixed, but the visiting of pollinators is also diversified due to the use of various types of insecticides and pesticides in crop fields. In many landscapes with a mix of agricultural and natural habitats, crop pollination by bees and other animals is a potentially valuable ecosystem service [1, 2]. It has been discovered that animal pollination benefits 87 of 115 types of globally important crops. It has been discovered that the majority of tiny insect pollinators are dying as a result of the massive addition of poisonous chemicals such as insecticides and pesticides [3].

Over the past decade, scientists have been reporting steady and mysterious declines in the populations of so called pollinator insects. These include the honeybees, wasps, flies, beetles, butterflies and moths.

Bumblebees (*Bombus* sp.) were brought from Europe due to a lack of pollinators for red clover (*Trifolium pretence*) seed production in New Zealand at the same time that the fig pollination issue was resolved in California [4, 5, 6]. Their establishment was successful, although New Zealand has still not solved its on-going problems with regard to the pollination of *Actinidia deliciosa* [7].

Recently, a solution to oil palm pollinator shortages has been found in Malaysia, where labour costs for manual pollination are rising sharply. It was found that pollination of this important crop has a relationship between the pollinating *Elaeidoubius* sp. and the male and female inflorescences of palm trees [8]. After careful screening and quarantine, *Eleidobias* sp. was released in palm oil plantations in Malaysia, where it quickly established and spread [9]. The result is sustainable and adequate plant pollination, with high yields that surpass those previously achieved with hand pollination, saving millions of US dollars annually [10].

In this study, we aim to find out some novel pollinators that visit flowering plants (crops) for pollination. From the point of view of pollination biology, three families were selected, such as Fabaceae, Malvaceae and Apiaceae.

Materials and Methods

Plants of the families like Fabaceae, Malvaceae, and Apiaceae were selected for this study. The study was done in Birbhum district of West bengal, India for two consecutive flowering seasons (2019-2020 & 2020-2021). Various floral phenology and floral biology were studied according to the proposed method [11, 12, and 13]. Insect flower visitor foraging times, feeding types, and pollination syndromes were carefully observed and recorded using standard methods [14].

Result and Discussion

Bee poisoning by pesticides is a major problem affecting bee efficiency not only in honey production, but also in crop pollination. This problem is not unique to the United States [15], but occurs in all other countries with highly developed agriculture. The problem is complex, has many implications, and frequency is intertwined with state. Most of the problems are related to pesticides used on crops such as cotton, fruits, vegetables, grains and legumes. Damage is also caused by the treatment of forests, rangelands and even suburban areas for human and animal management.

Wild bees are also being harmed by pesticides [16]. Poisoning can be caused not only by contaminated food, but also by wood, leaves, soil or other materials that bees use to build their nests. The toxicity of a particular insecticide to honeybees and wild honeybees is not always the same, and even to wild honeybees, some substances are more toxic to one species than another.

The problem of bee poisoning is a long-standing problem. At the beginning of this century, things got unusually serious in relation to the use of arsenic sprays on fruit. This has led several states to pass laws banning the spraying of flowering trees. Pesticides applied to plants can reach the nectar either directly or indirectly by traveling through the plant system from the treated part [17].

For many beekeepers, the severity continued to rise, with a catastrophe in the late 1960s. At this time, legislation in response to public concern severely restricted the use of DDT and other chlorinated hydrocarbons, in most cases replacing them with the more toxic phosphates and carbonates.

Our research and observations revealed that three families, Fabaceae, Malvaceae, and Apiaceae, have different types of pollinators (Table 1; Fig. 1) that contribute to improve pollination and yield.

Numerous insect species, such as bumblebees, solitary bees, thrips, beetles, alkali bees, hoverflies, and hairy-footed flower bees have been discovered as pollinators in the past. Due to the unscientific overuse of pesticides and chemical fertilizers, these pollinators are now scarce. However, new pollinators like butterflies, honey bees, flies, and birds have increasingly replaced it due to evolutionary trends [18, 19].

The fact is that, one plant species per 10,000 or 20,000 species is in danger of going extinct shows how much of problem pollinator food availability is becoming [20]. It was also observed that such changes are currently having an effect on pollinators. Some honey bee colonies were weighed on scales in Baton Rouge, Louisiana, from 1929 to 1963, and the weight change over the course of the season was noted. According to research, the colonists' weight declined with time, going from an average gain of 7 pounds to an average loss of 24 pounds from September to November [21, 22].

This loss was caused by weedicide sprays and urbanization, both of which contribute to low honey production. Across the continent, similar reports from commercial beekeepers are common [20]. It was also discovered that a lack of a sufficient fall honey crop caused the colonies to be less productive the following spring. Reduced pasture became additionally linked to bee losses [22].

Table 1: List of some dominant animal pollinators in Fabaceae, Apiaceae and Malvaceae

Family	Animal pollinators
Fabaceae	Lepidoptera : • *Plebejus argus* ▪ *Lycaena hippothoe* ▪ *Borbo* sp. Hymenoptera: • *Apis mellifera* • *Apis dorsata* • *Xylocopa* sp. *Aves:* • *Cinnyris asiaticus*
Apiaceae	Lepidoptera: • *Lycaena phlaeas* • *Lycaena hippothoe* Diptera: • *Musca* sp. Hymenoptera: • *Apis mellifera* • *Apis dorsata*
Malvaceae	Lepidoptera: • *Plebejus argus* • *Lycaena hippothoe* • *Colias hyale* Diptera: • *Oplodontha* sp.

Negative effects of pesticides on pollinators are well understood, particularly from a toxicological standpoint [22], but less is known about their impact on crop reductions. Several studies have been conducted to investigate the effects of the Organophosphorous pesticide, Fenitrothion insecticide on nontarget habitat and blueberry pollinators in New Brunswick, Canada [23, 24, 25, 26, and 27]. The loss of pollinators resulted severe declines in the affected regions' blueberry crop that provincial yields were significantly lower than those of neighboring Nova Scotia and Maine [25, 26], with an annual harvest loss of about 0.75106kg. Agricultural activity intensity has also been shown to correlate with lower (by about 50%) populations and diversity of pollinators in British Columbia apple orchards [28] and berry production areas [24, 29].

Despite the fact that several studies have attempted to demonstrate the severity of pollinator declines [24, 30, 31, 32], the problem has largely gone unnoticed, which may have serious implications for future agricultural systems and global food production, leaving several questions unanswered.

Conclusion

Finally, we urge the general public and producers to use fertilizers and pesticides in such a way that the above pollinators are not eradicated or eliminated as a result of their infrequent and unscientific use. It is to advise cultivators to use bio fertilizers and bio-pesticides instead of so-called chemical fertilizers, insecticides, and pesticides to increase crop yields.

Pollinators such as, Alkali bee, Hoverflies, Hairy-footed flower bee, Ants, Beetles, Bumble bees, and others are not found in the picture of pollination because they have been abolished or retreat back from the function of pollination over time due to evolution or physico-chemical barriers and have been replaced by newer bio-pollinators such as butterflies, flies and birds.

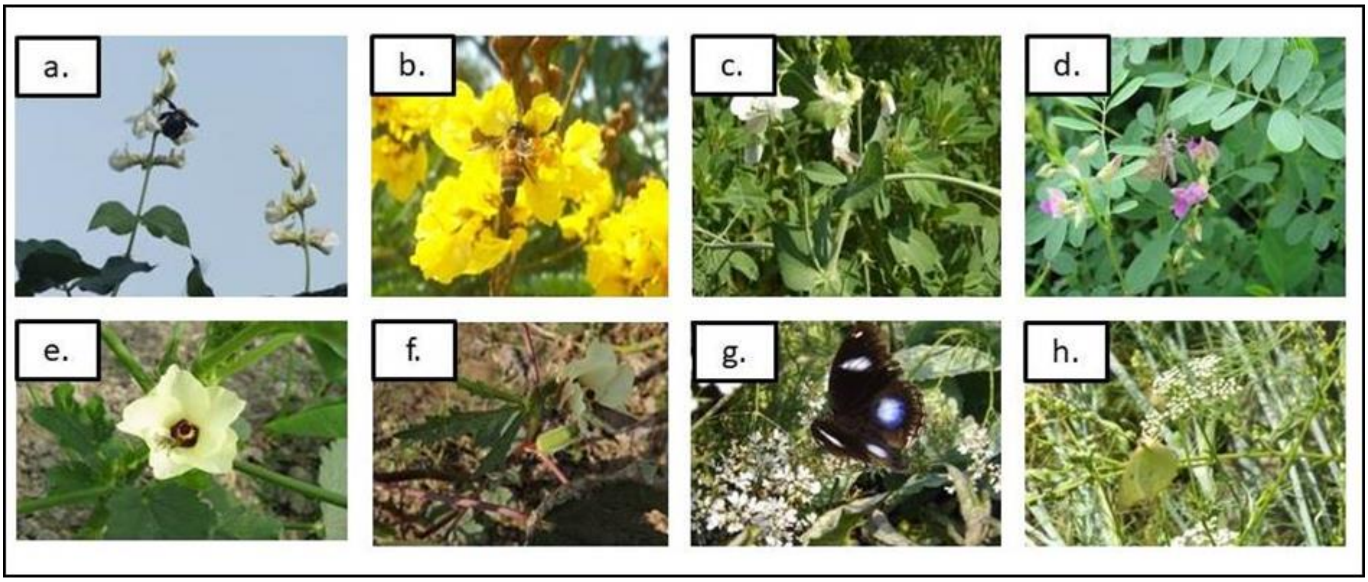

Fig 1: Biopollinators of Fabaceae, Malvaceae and Apiaceae family: a.*Xylocopa* sp. Pollinating Fabaceae plant (*Dolichos lablab*), b. Honey bees pollinating Fabaceae plant, c. *Plebejus argus* (Silver studded Blue) pollinating Leguminous plant (*Pisum sativum*), d. *Borbo* sp. pollinating Fabaceae plant (*Tephrosia purpurea*), e. *Oplodontha* sp. pollinating plant of Malvaceae (*Abelmoschus esculentus*), f. Lepidopteran insect pollinating Fabaceae plant (*Abelmoschus esculentus*), g. Butterfly (Lepidopteran) pollinating plant of Apiaceae (*Coriandrum sativum*) & h. Butterfly (family- Pieridae) pollinating plant of Apiaceae (*Trachyspermum ammi*)

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