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Review Paper

Role of Insects in Pollination of Mango Trees

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Abstract

The insects are the most dominant and important animals on the earth and affects the human life directly or indirectly. They are beneficiary (pollinators, biocontrollers, as food, in sericulture, in apiculture and in lac culture etc.) as well as harmful (pests of crops, wood, stored grains etc.). Many plants are depends on insects for pollination, mango tree are pollinated most predominantly insects, like numerous insects of the orders Hymenoptera, Diptera, Lepidoptera and Coleoptera. Pollen-grains have been observed adhering to the bodies of many species belonging to these orders. On the basis of different studies, it is concluded that majority of pollinators belong to order Hymenoptera. Among Hymenopterans insects, different species of honey bee are the most efficient flower visiting insect. Some studies have suggested that insects of order Diptera are the dominant pollinators.

Keywords: Taxonomy, Insect, Pollinators, Mango.

Introduction

Insects are the abundant animals on the earth at present. These are the most dominant over all other terrestrial animals in numbers, and occur everywhere. It is an ancient group of animals in the world. They are found throughout the world in all bio geographical regions and ecological zones. They are seen in poles, deserts, caves, rivers, estuaries etc. The role of insects in maintaining the cycle of nutrients, soil regeneration and protection, pollination of phanerogamic plants as well as natural regulation of pests. About 75% of all crop plant species are pollinated by insects, while many flowering plants are capable of self-fertilization, the majority of them depend on pollination of their flowers from those of another plant in order to set fertile seed and maintain genetic diversity. The mutual advantage of this association has evolved many pollination mechanisms (very complicated and highly specific) and has leads to many adaptations in structure, functions and behavior of both insects and plants.

Many workers have affirmed that the mango is largely anemophilous plant. But morphologically or physiological the mango does not shows any adaptations for wind pollination. The single anther produces comparatively few pollen-grains (200 or 300) and the stigma is small and to assist in catching pollen grains. The nectar production for the attraction of insects also indicates entomophilous pollination of mango trees. Observations have shown that the flowers are visited by numerous insects of the orders Diptera, Hymenoptera, Lepidoptera and Coleoptera ranking in the order given as to the number of visits. Pollen-grains have been observed adhering to the bodies of many species belonging to these orders. In spite of numerous insect visits, a large number of the stigmas are never pollinated and it seems probable that very little pollen is transferred from one flower to another. The biology of different kinds of pollinators of mangos have been studied in India and Israel, it is observed that the Dipteran and Hymenopteran insects play major roles in pollination of mango[1-4]. In another many recent studies it was concluded that the honey bees is an important pollinating insect for mango trees. It has been reported that fruit set was poor in both open-pollinated and bagged inflorescences, when honey bees were introduced into South African mango orchards[5]. The several mango flower visiting insects including the European honey bee significantly increased fruit set[6].

Dipteran insects are important, but neglected pollinators. Many species of flies are pests, while fewer workers realized they are beneficiary to human kind because of activities of flies, including biocontrolling, food for another important species such as birds and fish, as decomposers and soil conditioners, indicators of water quality and as pollinators. At least adult of 71 of the 150 Dipteran families include flies, depends for feeding on flowers[7]. Dipteran species are good pollinators of more than 550 species of flowering plants[8]. The fruit trees including mango trees are depends on insects for pollination. Global studies on pollination in mango orchards and other fruits orchards by insects have been carried out by many workers[9-17]. Moreover, known species such as the honey bee, *A. cerana* (Fabr.), bumble bee, *Bombus terristris* (Linn.) or stingless bee, *Melipona beecheii* (Bennet) are beneficial to pollination and economic value for human life[18,19].

It has been reported that not only the Hymenopteran insects but

insects from order Diptera belonging to different families also act as pollinators of various temperate fruit crops[11,16]. A study has been carried out to record pollination of mango (*Mangiferae indica*) (Anacardeaceae) in the neotropic region[20]. The major pollinating insects of mango recorded from the order Diptera, such as *Meliopona* sp. And *Syrphus* sp., *Musca domestica* (Linn.), and reported that the house fly were not much prevalent pollinator[6]. In another study hoverflies reported as good pollinators of mango[21]. Foraging activity of honey bees has also been correlated with environmental factors[22]. A study in the mango orchards in the Letsitele Valley the honey bees reported as the good visitors of the inflorescences throughout the day[23]. The study in fruit orchards like avocados, mangoes and litchis and identified the visitors of and also reported foraging activity of honey bees[5]. The visitation frequency and abundance of *Apis cerana indica* (Fabr.) reported on mango (*Mangifera indica*) trees at Bangalore in India and it has been concluded that the number of *A. cerana* visits increased from 6 am, with activity greatest from 9 am to 11 am (16-20 bees/panicle). From 2 pm to 5 pm there were only 2-5 visits/panicle and none after 6 pm. In early March, bee's activity increased (60-95 bees/panicle)[24]. An entomological survey was conducted to record the relative abundance of insect visitors on flowers and their effect on fruit set of major subtropical fruits in Himachal Pradesh and reported that a total of 34 insect species visited the flowers of many species of citrus, mango and litchi, out of which 15 species belonged to Diptera, 13 to Hymenoptera (ants, bees, wasps and sawflies), 4 to Coleoptera (beetles, weevils) and 1 each to Lepidoptera (butterflies, moths) and Hemiptera (bugs, aphids and cicadas). They found that the honey bees, *Apis mellifera* (Linn.) were the main pollinators on citrus sp., *Apis florae* (Fabr.) and hoverflies, *Episyrphus balteatus* (De Geer) on litchi and flies belonging to the family Calliphoridae (blowflies) on mango[2].

One study revealed that pollination increases with flower number, but fruit set did not, refuting the hypothesis that excess flowers increase fruit set by attracting more pollinators[25]. Dipteran insects like, *Chrysomya*, *Lucilia* and *Musca* sp. were reported as most efficient pollinators in mango orchards because of their visiting frequency and abundance[26]. In a scientific survey in mango orchards of Southern Taiwan, a total of 126 individual insects belonging to 39 species from 23 families and five orders have been reported and it has been concluded that most of the pollinators belonged to the order Diptera (*Chrysomya megacephala* Fabr., *Ch. pinguis*, and *Musca domestica*) and Hymenoptera (*Apis cerana* and *A. mellifera* Linn., *Braunsapis hewitti* Cameron)[27]. Asian honey bees have been reported as the most efficient pollinators of fruit orchards[18].

An entomological survey was made in mango orchards and reported that the flies of the Syrphidae and *M. domestica*, and stingless bees *Trigona* spp., are the dominant flower visitor of mango in India[28]. It has been observed that the hoverflies act as mango pollinators[26]. A study on pollination of mango trees was made and concluded that Dipterans and Hymenopterans are the major pollinators of mango trees in India[1]. Most of pollinator insects belongs to order Diptera, such as *Meliopona* species and *Syrphus* species, and also revealed that house fly (*Musca domestica*), was not good pollinating insects[6]. By an entomological survey in mango orchards it has been recorded that flower visiting frequency and abundance of *Apis cerana indica* (Fabr.) on mango trees increased from 6 am more active from 9 am to 11 am (16-20 bees/panicle)[24]. A scientific study on abundance of insect visitors on flowers in fruit orchards in Himachal Pradesh reported a total 34 insect species on flowers of many species of citrus, mango and litchi, out of which 15 species belonged to Diptera, 13 to Hymenoptera (ants, bees, wasps, sawflies), 4 to Coleoptera (beetles, weevils) and 1 each to Lepidoptera (butterflies, moths) and Hemiptera (bugs, aphids, cicadas). They found that *Apis mellifera* was the main pollinators on citrus plant, while *Apis florea* (honey bee) and *Episyrphus balteatus* (hoverflies) on litchi and flies (family Calliphoridae) on mango[2].

A study shown that pollinator insects and concluded that the frequently flower visiting insects were from the families, Syrphidae, Bombyliidae and Tachinidae. Out of these, the Syrphid flies were the most predominant pollinators[8]. About 80% of the plant species are pollinated by flower flies. The species of flies like *Eristali stenax* or *Helophilus* sp. are capable for transporting the pollens for long distance. This pollen transport is possible by migrating species like *Episyrphus balteatus* in Europe. It also concluded that this species can reproduce rapidly, producing large numbers of eggs and up to five generations per year[29]. An entomological survey was made to study the pollinators and their behaviour in mango orchards of Southern Taiwan and reported 39 species of 23 families and 5 orders as visitor or pollinator on mango flowers. It was found that most of these insects belonged to the Diptera with 15 species and Hymenoptera with 14 species. Major pollinators included honeybees (*Apis cerana* and *A. mellifera*) and an allodapine bee (*Braunsapis hewitti*) of the Apidae and sweat bees (*Halictus* sp. and *Lassioglossum* sp.) of the Halictidae among the Hymenoptera and *Chrysomya megacephala*, *Chrysomya pinguis* and *Musca domestica* of the Diptera, which were considered to be the dominant species due to their frequent appearance. Some other insects were also commonly observed by them such as *Cantharis* sp. and *Menochilus sexmaculatus* of the Coleoptera, and *Idioscopus* spp. of the order Hemiptera[26]. In a study pollinatorinsects were reported from fruit orchards of Iowa, USA reported insects belonging to orders Coleoptera, Diptera, Hemiptera, Hymenoptera, Mecoptera, and Thysanoptera. They did not reported *Rosa multiflora* visiting insect from Apidae (bumble bees and honey bees) but *Bombus* spp. and *Apis mellifera* reported as foraging species[30]. A scientific study made in mango orchards to record the insect pollinators and their behaviors in mango orchards of Southern Taiwan and reported 39 species from 23 families and 5 orders and concluded that most of pollinators belonged to the Diptera (*Chrysomya megacephala*, *Ch. pinguis*, and *Musca domestica*)

and Hymenoptera (*Apis cerana* and *A. mellifera, Braunsapis hewitti*)[27]. A total of 1961 individuals of insect pollinators recorded fruit orchards of district Nainital and Lepidoptera was the most abundant order with 1272 individuals followed by Hymenoptera (445), Coleoptera (137), Diptera (90) and Hemiptera (17) individuals[31]. A study made on diversity of pollinators in apple orchards in Shimla hills of Western Himalayas, India and reported 46 species of insects representing 5 orders and 17 families. Out of these orders, the order Diptera was the most abundant (18 species) followed by Hymenoptera (16 species), Lepidoptera (8 species), Coleoptera (3 species) and Thysanoptera (1 species). Among all species, *Apis cerana* was the most abundant in all orchards[32].

Different species of bees such as honey bees (*Apis cerana*, *A. mellifera*) bumblebee (*Bombus terristris*), stingless bee (*Melipona beecheii*), sweat bees (*Halictus* spp. and *Lassioglossum* spp.), and the Oriental latrine flies (*Chrysomya megacephala*, *C. pinguis* and *Lucilia caesar*) has been reported as pollinators of different fruit orchards by many workers[19,26].

A study was made in mango orchards of district Haridwar and a total of 4227 individuals recorded belonging to 122 species and 31 families of 4 insect orders from five different mango orchards. Among them Lepidoptera was the most abundant order contributing 54.91% in terms of species and 52.50% in terms of number of individuals. A total of 67 species of order Lepidoptera were reported visiting to mango flowers, followed by order Hymenoptera (34), Diptera (19) and Coleoptera (2)[33].

Significance of Study

Importance of insects in pollination and fruits production has been described in this study with the help of different research studies. The present study highlighted the different pollinators and most frequently flower visiting insects in mango orchards. This study has provided the percent contribution of different insects orders in pollination and listing of harmful as well as beneficiary insects can be prepared with the help of this study.

Conclusion

From above maximum studies it is concluded that Hymenopteran and Dipteran insects are major pollinators of fruit orchards including mango orchards. Other insects orders such as Lepidoptera and Coleoptera are also recognized as pollinators but these insects are comparatively less important pollinators. Keeping in mind above importance of such insects, it is necessary to conserving the different species of these pollinator species.

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