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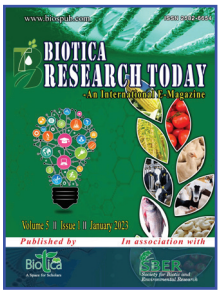

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Hoverfly: A Prominent Predator and Pollinator in the World

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Abstract

Hoverfly is a prominent insect, work as both predator and pollinator in the eco-system of the world. Its larvae initially attack on aphid colonies and certain other insect-pests. The larvae of hoverflies are crucial natural enemy of pests, such as aphids, scales, thrips and some caterpillars. Aphid populations may be reduced by 70% to 100% when hoverfly larvae populations are enormous. Hoverflies that feed on aphids are recognized as promising agents for use in biocontrol agent because aphids alone cause tens of millions of dollars in damage to crops in the world each year. Several species of hoverflies resemble bees or wasps in appearance. The world's 2.5 million types of blooming plants are pollinated by 1,00,000-2,00,000 different animal species. Around 1,500 species of birds and mammals visit flowers and may disseminate pollen between them. However, insects are majority of these pollinators.

Introduction

Hoverfly belongs to the order Diptera of Syrphidae family. It is also known by other common names such as syrphidfly or flowerfly due to they visit flowers to feed or suck on nectar and pollen. Hoverflies are ubiquitous present throughout the world except Antarctica. Globally, hoverfly is considered as prominent predator and pollinator. Pollination through syrphidflies, butterflies, beetles, honey bees, carrion flies, small moths and hawk moths scientifically known as myophily, psychophily, cantharophily, melittophily, saprophily, phaleophily, sphingophily, respectively. Hoverflies are harmless to most of the mammals, many species of hoverflies mimics of stinging wasps and bees, a mimicry by which hoverflies ward off predators. On the basis of research more than 6200 species of Syrphidae in 200 genera are found in world. Syrphidfly larvae may results in drastic reduction of aphid infestations, as it can destroy hundreds of aphids during its whole development period. Syrphid fly becomes the dominant predator in the absence of ladybird beetles. They differ from other flies by a false (spurious) vein that closely parallels the fourth longitudinal wing vein. As aphids destroy crops these predaceous species of hoverfly (maggots) are commonly used in biological control. Most common widespread hoverfly species are *Episyrphus balteatus*, *Syrphus americanus, Eupeodes frequens* and *Allograpta obligae* whose larvae feed on aphids. Adults play a crucial role in pollination too *viz.,* narcissus bulb fly and the lesser bulb fly tunnels in flower bulbs, onions and flower corms. Microdon larvae live in ant and termite nests, volucella larvae in bumblebee nests and others in decomposing vegetation. The rat-tailed maggots (larvae) of the drone fly works as bio-indicator due to its larvae live in drains and polluted water bodies or stagnant water, such as sewage and lagoons, syrphid fly named because as it has telescopic breathing tube. Its adults are not in predaceous nature, but the larvae prey on scales, thrips and

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aphids. In India syrphid fly larvae are important predators of the mustard aphid. They can survive extreme temperatures so it is considered most successful predator than others. Current conservation ecology faces a significant problem in dealing with the impacts of reduction of pollinator diversity and abundance on crops and floral biodiversity (Jauker and Wolters, 2008).

Hoverfly or Syrphid Fly

Scientific name: *Episyrphus balteatus*

Systemic Position

Kingdom : Animalia

Phylum : Arthropoda

Class : Insecta

Order : Diptera

Family : Syrphidae

Genus : *Episyrphus*

Species : *balteatus*

Hosts Range

Larvae of hoverfly primarily feed on various species of aphids, thrips, scales and other soft-bodied insects (Figure 1).

Figure 1: Larvae of hoverfly feeding on (A) mustard aphid (*Lipaphis erysimi*) and (B) legume aphid (*Aphis craccivora*)

Evolution of Hoverfly

The oldest known fossils of crown group Syrphidae are from the Eocene aged Florissant formation, Green River Formation and Baltic amber. However, the genus Prosyrphus from the Late Cretaceous (Cenomanian) aged Burmese amber appears to represent a stem group to the family (Grimaldi, 2018).

Distribution and Habitat

Hoverflies are cosmopolitan in nature found in most of the ecosphere, except extreme deserts, tundra at extremely high latitudes including Antarctica. The American hoverfly, *Eupeodes americanus*, is common in the Nearctic monarchyand the common hoverfly, *Melangyna viridiceps*, is common in the Australasian monarchy. About 6,000 species and 200 genera are present in the family. While some hoverflies larvae are aquatic nature that found in stagnant water, the species that prey upon aphids and other plant parasites are usually terrestrial, living on leaves. Adults are often found near flowers. Some species are found in most unusual locations for example, members of the genus Volucella found in bumblebee nests, while members of Microdon found in nests of ant or termites. Others can also be found in decomposing vegetation.

Predatory Potential

There are more than 4,700 species of syrphid flies over worldwide with 312 species under 71 genera known from the Indian subcontinent. Among of these syrphid flies, *Episyrphus balteatus* and *Eupeodes frequens* are the most common aphidophagous species in the various agricultural field crops. *E. balteatus* can consume 375-407 aphids in their entire life span; while, *E. frequens* feeds about 251-292 aphids.

As Prominent Pollinator

Insect pollinators have a significant impact on quality and quantity of agricultural yields worldwide (Mallinger *et al.*, 2021). Globally, hoverflies are essential pollinators of flowering plants in many ecosystems. Syrphid flies widely visits to aflower of agricultural crops as well as wild plants too (Figure 2). Syrphid fly are second-most important group of pollinators after wild bees. Like many pollinator groups, syrphid flies range from species that approach to foraging by visiting a wide range of plant species. Although hoverflies are often considered as non-selective pollinators, some 'Hoverflies' species are highly selective and carry pollen from one plant species. *Cheilosia albitarsis* is thought to visit only *Ranunculus repens*.

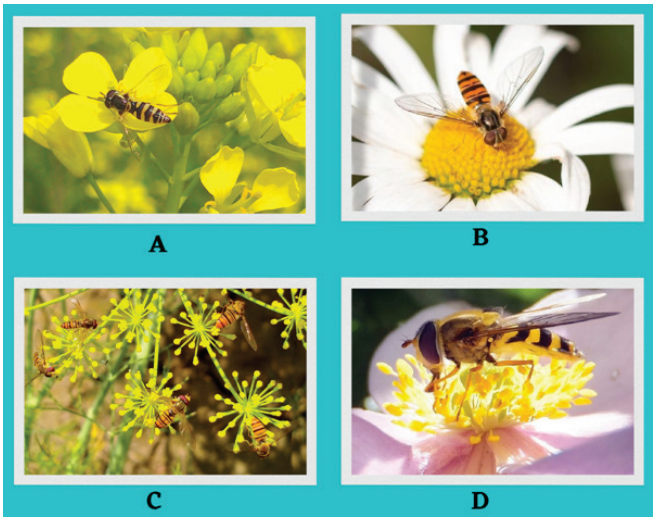

Figure 2: Adult of hoverfly feeding nectar from (A) mustard crop plant; (B) daisy ornamental plant; (C) coriander crop plant; (D) camellia ornamental plant

Preferred Plants for Visiting

Adults of hoverflies prefers to visit on various flowering plants such as aster, coriander, cosmos, dill, daisies, fennel, lavender, mint, marigolds, sunflowers, wild mustard, zinnia and other various aromatic, spices, cereals, pulses and oilseed crops *etc*.

Pollination Ecology

i) Allotrophous Insects: They are also known as visitors. These insects visit on flowers but do not play any important role in pollination, *e.g.,* Thrips, beetles and ants *etc.*

ii) Hemitrophous Insects: These insects visit on flowers and participate in pollination to some extent, *e.g.,* Syrphid flies.

iii) Eutrophous Insects: They are also known as pollinators. These insects visit on flowers and play important role in pollination, *e.g.,* Honey bees and sphingids *etc*.

Life Cycle (Bionomics)

Hoverfly is a major and regular predator of various insects at different regions of the world. Its life cycle completed in four stages *viz.,* egg, larva, pupa and adult (Figure 3). Its egg incubation, larval and pupal period completed in 3-6, 15-25 and 10-15 days, respectively with 3 larval instars. Its egg creamy white in colour resembles as a small grain of rice shape is about 1 mm in size. It lay eggs singly on surface of leaves, near or inside of an aphid colony. Its larvae are yellowish, blind and legless. Its larva is about 5-20 mm long. It has a typical maggot shape, tapering to a point at the head end and broadly rounded at the rear. Its mouth has a triple-pointed dart by which it catches and pierces its prey before sucking it. It has dark coloured breathing tubes on the tail end. While, the adults resemble as a bee or wasp but has a more flattened body and, like other flies, it has only one pair of wings. It's wing expanse ranging between 18-20 mm. It is stingless. It is usually yellow and black colour, in some species; the black parts have a greenish metallic sheen. It is 1/8 to 1inch (4-25) mm long. It is very fast and agile flier, often seen hovering over plants. Its adult longevity period is ranged from 16-19 days in females and 13-17 days in males. Usually they are multivoltine while, some are univoltine in nature. It is complete their entire life cycle within 30-40 days. There are usually 3-7 generations year^{-1}.

Table 1: Predatory potential of different species of hoverflies (Source: Singh *et al*., 2020)

		Episyrphus balteatus		*Eupeodes frequens*	
Stage		Duration (Life span)	Predatory potential (Mean aphid consumption)	Duration (Life span)	Predatory potential (Mean aphid consumption)
Larva	1st instar	4-6 days	29-47	3-5 days	27-46
	2nd instar	3-4 days	103-124	3-4 days	52-85
	3rd instar	4-7 days	220-251	4-6 days	164-221
	Total	12-16 days	375-407	11-14 days	251-292

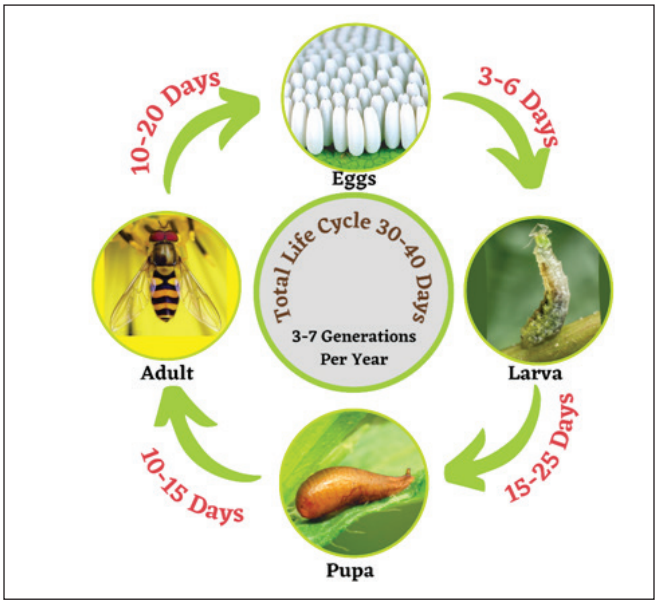

Figure 3: Life cycle (bionomics) of hoverfly (*Episyrphus balteatus*)

Conclusion

Insect pollination also known as entomophily; it is a crucial ecological process in terrestrial ecosystems. Hoverfly adults pollinate majority of the cultivated and wild crops and its larvae manage the harmful insect population by predation. Over 80% of the flowering plants in the world depend on insect pollinators. The great majority of the more than 2,00,000 species of animal pollinators is insects. Moths, butterflies, bees, beetles, flies, ants and wasps are some of the insects that pollinate plants. It benefits human society in terms of both economic and aesthetic value as well as cultural worth. Insect pollinators manage to rapidly changing surroundings.

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