



## Insect pollinators and sustainable agriculture

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Pollinators provide an essential ecosystem service, namely pollination. Indeed, One-third of world's agricultural crops depends upon pollination by animals, including birds, bats, lizards and other animals - but the main pollinators are insects. Insect pollinators include bees, (honey bees, solitary species, bumblebees); pollen wasps (Masarinae); ants; a variety of flies including bee flies and hoverflies; lepidopterans, both butterflies and moths; and flower beetles. They play a key role in maintaining plant diversity and increases the production of many commercial crops, like Agricultural, Horticultural and vegetables crops. Pollinators are also important to the reproduction of many wild plants and are to maintain a healthy and bio-diverse environment.

Insect pollinators forage on flowering plants to obtain plant-provided food (nectar, pollen). Flower-visiting insects have the potential to transfer male gametes (contained in pollen) to the female gametes while foraging, resulting in pollination. Insect-mediated pollination is an essential step in reproduction for the majority of the world's plants. Flowering plants, including numerous cultivated plant species *i.e.* Sunflower, Cucurbitaceous vegetables, Alfalfa, Coriander, Cardmom, Gingelly, Apple etc. Many crops depend on pollination for seed production and fruit set to achieve good yield. Globally, an estimated 35 per cent of crop production is a result of insect pollination. The *Apis* sp. (*Apismeliffera*, *Apis dorsata*, *Apis cerana indica*, *Apis florea* and *Melipona irridipennis*) and non-*Apis* are responsible for the pollination services in majority of crops. Non-*Apis* bees especially pollinates those crops, in which honey bees are inefficient pollinators (e.g. alfalfa, squash). A few non-*Apis* species are managed for crop pollination. Examples of managed non-*Apis* species include bumble bees, *Bombus impatiens* Cresson (Hymenoptera: Apidae) managed for cranberry (*Vaccinium* spp.) pollination. Although bees are considered the most effective insect-pollinator of most plant species, other insects have been recognized for their contributions to pollination. Flower visiting flies (Diptera) have been documented as proficient pollinators of several crops including carrot (*Dacus carota*

L.), mustard (*Brassica* spp.), leek, (*Allium ampeloprasum* L.), and almond (*Prunus dulcis*). Weevil *Elaeidobius kamerunicus* (Coleoptera: Curculionidae) plays great role in pollination of Oil palm. Fig wasps are responsible for the pollination in both *Smyra* and Capri Fig Plantation.

Some examples of insects pollinators are given here:

### Bees :

**Honey bees :** Honey bees (*Apis* species like: *Apismeliffera*, *Apis dorsata*, *Apis cerana indica*, *Apis florea* and *Melipona irridipennis*) are good pollinators for many reasons. Their hairy bodies trap pollen and carry it between flowers. The bees require large quantities of nectar and pollen to rear their young, and they visit flowers regularly in large numbers to obtain these foods. In doing so, they concentrate on one species of plant at a time and serve as good pollinators for this reason. Their body size enables them to pollinate flowers of many different shapes and sizes. The pollination potential of the bees is increased because they can be managed to develop high populations. The number of colonies can also be increased as needed and the colonies can be moved to the most desirable location for pollination purposes.



Honey bees are most active at temperatures between 60°F. (16°C.) and 105°F. (41°C.). Winds above 15 miles per hour reduce their activity and stop it completely at about 25 miles per hour. When conditions for flight are not ideal, honey bees work close to their colonies. Although they may fly as far as 5 miles in search of food, they usually go no farther than 1 to 1-1/2 miles in good weather. In unfavorable weather, bees may visit only those plants nearest the hive. They also tend to work closer to the hive in areas where there are large numbers of attractive plants like Alfalfa Apple Apricot, Blackberry, Blueberry, Cherry, Clovers, Cucumber, Muskmelon, Peach, Sweet

clovers, Pear Persimmon, Cranberry, Plum, Pumpkin, Raspberry, Squash, Sunflower and Watermelon etc. in bloom.

**Bumble bees :** Bumble bees (*Bombus impatiens*) are excellent pollinators, especially of berry species. They are important to the ecosystem, as without them seed setting and fruiting will not take place in many plants. India is home to 48 of the 250 known species of bumble bees.



Mostly characterized by black, yellow and reddish body hair, and often striped, bumblebees are generally found on altitudes of 2,000-15,000 feet along the entire Himalayas, from Jammu and Kashmir to Nagaland.

They are generalist foragers that visit a diversity of flowers of vegetables, fruit trees, cash crops and even ornamental and medicinal plants and pollinate them.

**Sweat bees :** Sweat bees belong to the *Hymenoptera* family of insects which is one of the biggest insect families and includes some of the common insects ants, bees, sawflies and wasps in its



group. Evolved from the Halictidae group of family, these bees are commonly found in Australia and Southeast Asia. They are named for their attraction to the salts in human perspiration. Sweat bees

are a group of solitary bee species that live alone in underground nests. Most sweat bees are small to medium in size, 1/8 to 3/8 of an inch long. They are generally black or metallic, and some are brilliant green or brassy yellow. Since the sweat bees are very small, they are almost inconspicuous but at times hundreds of sweat bees swarm over the flowers in meadows and gardens. All types of bees along with the sweat bees are extremely vital to our eco-system. They play a crucial role in the sustenance of myriad plant species by carrying out pollination amongst vegetations scattered over large distances.

**Mining bees :** Mining bees (the correct scientific name for this genus being '*Andrena*') are one of the largest groups of solitary bees. It is believed to consist of over 1,300 known species of bees across the world. They

resemble the typical honey bee in shape and size. Their bodies are dark in colour and covered with fine, light brown or yellow hairs. Andrenid bees have chewing-lapping mouth parts used to manipulate and collect nectar and pollen. The protruding, 'lapping' mouthpart is shorter in mining bees than honeybees, giving them the common name of short-tongued



bees. They seem to prefer to build nests in sandy soil, although some species are apparently less fussy. Evidence of them may be seen if you come

across little mounds of earth in lawns, borders, or even in pots, resembling worm casts. Nests will often consist of one small, main tunnel, with perhaps 5 or so branches, each containing an egg cell. The tunnel will usually be about 20cm – 40cm deep, and the entrance is about the size of a 10p coin. The nests will not cause any damage in soil or in gardens, and indeed, they should be welcomed. They rarely, if ever sting, and provide an excellent pollination service.

**Wasps :** Wasps are very important pollinators. Wasps



are insects, in the same Order, Hymenoptera, as bees and ants. Most familiar wasps belong to a group called the Aculeata. The word "Aculeata" refers to the defining feature of the group, the modification of their ovipositors into

stingers, however not all members of Aculeata sting. In some members, the ovipositor is modified for a different function, such as laying eggs, or was entirely lost. This group is largely predatory or parasitic.

Wasps look like bees, but are generally not covered with fuzzy hairs. As a result, they are much less efficient in pollinating flowers, because pollen is less likely to stick to their bodies and to be moved from flower to flower. Wasps, like bees, have very high-energy needs that must be met for their survival. Wasps need key resources such as pollen and nectar from a variety of flowers. The true wasps have stingers that they use to capture insects or spiders for food for their larvae.

**Syrphid flies :** Hoverflies, sometimes called flower flies, or syrphid flies, make up the insect family Syrphidae. As

their common name suggests, they are often seen hovering or nectaring at flowers; the adults of many species feed mainly on nectar and pollen, while



the larvae (maggots) eat a wide range of foods. In some species, the larvae are saprotrophs, eating decaying plant and animal matter in the soil or in ponds and streams. In other species, the larvae are insectivores and prey on aphids, thrips, and other plant-sucking insects. Aphids alone cause tens of millions of dollars of damage to crops worldwide every year; because of this, aphid-eating hoverflies are being recognized as important natural enemies of pests, and potential agents for use in biological control. Some adult syrphid flies are important pollinators. About 6,000 species in 200 genera have been described. Hoverflies are common throughout the world and can be found on all continents except Antarctica. Hoverflies are harmless to most other animals, despite their mimicry of more dangerous wasps and bees, which wards off predators.

**Butterflies :** Butterflies, as well as moths, can serve as pollinators. Butterflies feeds on nectar from flowers, pollen will be deposited on their appendages and then transferred to the stigma of the next flower that the butterfly visits to feed on. Butterfly-pollinated flowers tend to be pink or lavender coloured, scented and with large petals or leaves for the butterfly to land on. Most British butterflies remain a cause for concern, with three quarters of our native species in decline.



**Beetles :** Beetles are widely believed to have been the first insects to pollinate flowers, a process that started around 150-200 million years ago. In the semi-arid environments of certain parts, beetles still play a major part in plant pollination.



Plants that use beetles to pollinate usually have wide open flowers and well protected carpels, helping to avoid their reproductive organs being damaged by the beetle's mandibles. These flowers can also include traps to ensure that beetles stay on the flowers long enough

to pick up pollen. Some plants commonly pollinated by beetles, such as the Cantharid beetle include, sunflowers, hogweed and magnolias which, due to the evolution of insect pollination, are amongst the oldest flowering plants.

**Flies :** There are over 7000 species of flies are found, many of which as well as drinking nectar and eating pollen visit flowers in order to take shelter from bad weather, find mates or lay eggs. Flies are especially important to flowering plants that grow in damp or dark environments where less bees and other pollinating insects visit. For this reason, many woodland species are pollinated by flies.



One large group of flies, the Hoverfly, of which there are around 250 species play a large role in the pollination of common wildflower such as Buttercups, Daisies, Dandy Lions, Calendula and Fennel.

**Ants :** Although ants certainly collect nectar from flowers, some believe that many species of ant excrete antibiotics that destroy pollen.



There are however examples of ant pollination, such as the spurge, which grows close to the ground and in addition to being

pollinated by small species of bee, are also pollinated by ants. Certain orchids are also pollinated by tree ants.

**Midges :** The term midge refers to a large group of small flies, and like all flies many are pollinators. Perhaps most interestingly the Forcipomyia midge, at a little over 1mm is believed to be the only animal capable of pollinating the cocoa plant. Without which the production of chocolate would be impossible without artificial human pollination.



**Moths :** Over 2400 species of moth have been recorded by far the most common are those that feed using a long narrow straw called a proboscis to draw nectar from flowers. Flowers that have evolved to be particularly attractive to moths such as Wild Honeysuckle, Campions, Evening Primroses and Sweet Williams are usually light

in colour, improving their visibility in low light, they also have long narrow tubes leading to the nectar and usually produce scents that become stronger in the evening. Despite this, moths are able to extract nectar from a wide variety of flowering plants and visit many species.



Under estimation of the pivotal role played by managed and native insect pollinators is a key constraint to the sustainability of contemporary agricultural practices. The economic value of such insects to pollination, seed set, and fruit formation greatly outweighs that suggested by more conventional indices, such as the value of honey and wax produced by honeybees. Although the European honeybee has been widely regarded as the single most important pollinating species, the increasing spread of tracheal and Varroa mites and Africanized bees threatens the distribution and magnitude of traditional honey beekeeping enterprises. A number of other bee and insect pollinators, such as orchard bees, bumblebees, and squash bees, which are not affected by either the mites or the Africanized bees, are considered as likely candidates for management and use in commercial agriculture. An additional role can be played by native or wild pollinators, provided that attention is given to curtailing of population losses caused by both inadvertent insecticide poisoning and habitat destruction. To ensure a reliable source of pollinators, both managed and native, a more comprehensive strategy for management of crop pollination is needed. Elements of this strategy include an increased understanding of the biology and ecology of pollinating insects, as well as providing appropriate nesting habitat, and ensuring the availability of alternative sources of “forage” to sustain populations when the target crops

are not in bloom. Examples are discussed to illustrate how private initiatives and changes to public policy can enhance pollinator habitat, and ultimately, agricultural productivity.

Some point to remember about role of Pollinators in Agriculture

- There are over 25,000 species of different bees in the world.
- 35 per cent of food crop production worldwide depends on animal pollinators, including honey bees.
- Of the 115 crop species that provide 90 per cent of food supplies for 146 countries, 71 are bee-pollinated.
- The total economic value of insect pollination worldwide amounted to 210 billion, which represented 9.5 per cent of the total value of agricultural production used for human consumption.
- Insect pollination is thought to be the main reproductive mechanism in 78 per cent of temperate flowering plants, and is essential to maintaining plant genetic diversity.
- Some crops, including blueberries and cherries, are 90 per cent dependent on honey bee pollination; one crop, almonds, depends entirely on insect pollination at bloom time.

#### Protecting pollinators :

- Good stewardship practices by the crop protection industry, farmers, and beekeepers are necessary for protecting the health of pollinators.
- The crop protection industry is committed to educating farmers on stewardship best practices to limit any risks to pollinators.
- The crop industry relies on our pollinators and wants to keep them safe and healthy.
- Farmers can improve pollinator habitats by planting flower borders around crop areas.
- Beekeepers must be vigilant in monitoring for disease and mite levels in a colony.

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