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A Brief Review on Biodiversity of Pollinators

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SUMMARY

Pollinators play a very important role in setting of fruits as well as enhancing their quality and yield in cross pollinated plants and also in the plants where the self-incompatibility is common. The various biotic pollinators are birds, bats, snails and insects. Among these, insects are dominant pollinators and among insects, bees are a fascinating group of insects which contribute to 80% of biotic pollination. Most people are familiar with the non-native European honey bee, Apis mellifera and Indian honey bee, Apis cerana indica. The European honey bee was introduced to India in 1964. They are one of the few truly social species of bees in world that are known as eusocial bees. Most native species of bees are solitary and build nests underground or in cavities. Some bee species are primitively eusocial meaning they share characteristics of eusocial and solitary bees. All bees are important pollinators and not just honey bees! They provide ecosystems services or benefits to humans. Pollinators benefit humans by providing 1/3rd of our food including fruits, vegetables, and nuts- the most nutritious part of our diet.

INTRODUCTION

Pollinators are important in agriculture production. Approximately 30 per cent of the food and fibre crops grown throughout the world depend upon pollinators for reproduction. The fruits and seeds from these crop provides 15 to 30 per cent of the foods consumed by humans. Roughly 25 per cent of food and drink that we consume are produced from pollination services provided by pollinators. >95% fruit production loss occurs under pollinators' absence. Through insect pollination the yield in cucurbitaceous crops can be increased from 100 to 150 per cent. The highest per cent pod set in mustard was found in open pollinated (83.42%) plots followed by bee pollinated (75.41%) and caged pollinated (62.80%). Coriander seed yield significantly higher (14.57 q/ha) was recorded in the bee pollination treatment with the *A. cerana*. Niger seed yield significantly higher (536.25 kg/ha) was recorded in the bee pollination treatment with the *A. mellifera* as compared to treatment of without insect pollination. Insects pollinate an estimated 70 per cent of flowering plants, among them the bee community (family: Apidae) is the most important and efficient pollinators (Danforth *et al*., 2006). Fungicides are useful for protecting crops against many serious plant pathogen. The higher use of fungicides, can have serious health effect for honey bees and pollinators. Fungicides are not labeled as "toxic to pollinators" does not mean the product is safe for bees.

Benefits of insect pollination

- Stimulates germination of pollen on stigma of flower
- More nutritive and aromatic fruits are formed
- Increases vegetative mass and stimulates faster growth of plants
- Increases numbers of fruits and yield of crops
- Increases fruit set and reduces fruit drop
- Increase the quality of fruit like; size, shape, test, colour etc.
- Increases nectar production in the nectaries of flowers

Bee Pollinators

Solitary Bees

Of all the diverse bee species, about 90% of them are solitary. Of those bees, about 70% live underground and the other 30% are cavity nesters. During the life cycle, a female bee builds a nest underground or in a cavity. She will collect pollen and nectar to bring back to the nest. All the collected pollen and nectar is made into a ball called "bee bread" which will be all the food needed for one growing bee. The female lays an egg on the bee bread and seals up the nest. After the egg hatches, the larva will go through full metamorphosis from a larva, then a pupa to an adult before emerging from the nest. Solitary bees live for one season and do not

interact with any other bees of the same species except briefly for mating. Some solitary bees share a communal colony and are known as parasocial bees. Many females of the same generation use the same nest, but individuals create their own cell within the communal nest. They practice mutual tolerance; they do not interact with each other or share social bee behaviours. Green metallic sweat bees (*Agapostemon spp.)* are an example of a bee that share communal nests.

Fig 1 and 2. Solitary bee in the Colletidae family

Fig 3. A human-made bee home for cavity nesting bees

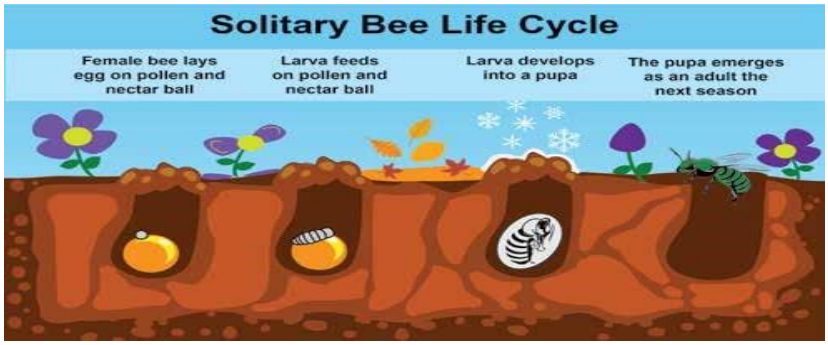

Fig 4. Solitary bee life cycle.

Eusocial Bees

Eusocial bees, such as the European honey bee, *Apis mellifera* live together in groups with one queen, female worker bees, and seasonally produced male drone bees. Honey bees live in manmade hives. Feral honey bee colonies occur in the wild inside natural hollow spaces such as tree trunks. Unlike solitary bees that live only one season, honey bees live through the winter. A colony may have 20,000 to 80,000 worker bees and hundreds of drones.The three main characteristics of eusocial insects are: (1) overlapping generations, (2) cooperative brood care, and (3) reproductive division of labour, (4) worker caste assists their parents in the care of young ones. Overlapping generations occur when younger and older generations work in a colony at the same time. Honey bees are often tasked to do different jobs depending on their age, known as age polyethism. For example, a young bee up to 11 days old will secrete brood food. A middle-aged bee from 11 - 21 days old will secrete bees wax. An older bee over 21 days can have a variety of jobs including forager, storer, or undertaker. Brood care is a task allocation given to younger bees. Queens are the only ones who reproduce in the colony, establishing the reproductive division of labour. Workers are responsible for feeding the larvae, constructing and cleaning the nest, foraging for food, and defending the nest.

Fig 5 and 6. The honey bee, eusocial bee

Primitively Eusocial Bees

Some bees such as bumble bees (*Bombus spp*.) have both eusocial and solitary characteristics and are known as primitively eusocial bees. Bumble bees live underground or in cavities and have a one-year life cycle like a solitary bee. Within the season, a colony will develop. A queen will find a place to nest and hibernate over the winter. When spring arrives, she will emerge, begin to forage, build a new nest, and lay eggs. The eggs will mostly be female worker bees. The queen will continue to lay eggs throughout the season. In late summer, a few new queens and male bumble bees will hatch and leave the colony. The new queens will mate with male bumble bees and then hibernate through the winter. Queen bumble bees are more aggressive and capable of living alone, unlike honey bee queens. Most primitively eusocial bees store food in the brood cell for the larva to feed on. Bumble bees are an exception and store food outside brood cells, a characteristic of eusocial bees.

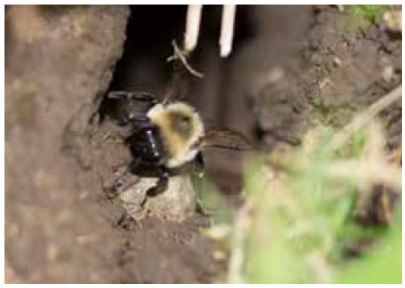

Fig 7. A bumble bee emerging from her)

Fig 8. A commercial bumble bee nest)

Types of Bees

Fig 9. Honey bees

Fig 10. Bumble bees

Fig 11. Green metallic sweat bees

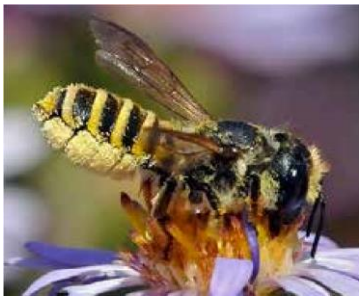

Fig 12. Hairy belly bees

Fig 13. Striped sweat bees

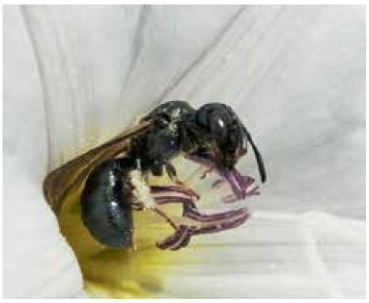

Fig 14. Tiny dark bees

Fig 15. Hairy leg bees

Fig 16. Cuckoo bees

Non-Bee Pollinators, Common Flower Visitors

Fig 17. Ants (e.g. - *Formica* sp.)

Fig 18. Beetles (e.g. - Red or longhorn beetle)

Fig 19. Birds (e.g. - milkweed Humming bird)

Fig 20. Butterflies (e.g. - Two- tailed swallowtail)

Fig 21. Flies (e.g. - Syrphid or flower flies)

Fig 22. Army cutworm moth

Fig 23. Wasps (e.g. - European paper wasp)

Fig 24. Bats (e.g. - Townsend's big-eared bat)

CONCLUSION

Pollinators in general, either insects or other animal species are of utmost importance for their continuous support to most of the cross pollinated plant species for their reproduction. The honey bees, which are considered the most important among all the pollinators, are responsible for achieving global food production demand every year. Bees and other beneficial insects can be exposed to fungicides directly or through contaminated nectar and pollen in urban and agricultural land. Fungicides can harm bees in a variety of ways, affecting bee development, behaviour, immune health and reproduction. Propiconazole, Captan, Boscalid, Pyraclostrobin, Iprodione + Azoxystrobin and Iprodione + Pristine cause mortality of various pollinators. Twenty five different fungicides residues were detected in wax, pollen, bee and honey. Higher uses of fungicides for disease management adversely affect pollinators, animal and human health, it also affects foreign trade of bee products due to its residue. Systemic Neonicotinoids, as well as Synthetic Pyrethroids combined with fungicides, may synergize its high toxicity to honey bees, therefore avoid applying combinations of insecticides and fungicides that together may increase risk to pollinators.

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