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Role of Honey Bees in Horticultural Crops

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Introduction

Pollination transfers pollen grains from a blossom's male anther to its female stigma. The process of Pollination incorporates all events from maturation to zygote division. Camerarius, in 1964, discovered that Pollination is necessary for seed production (Sharma, 2006). Cross-pollination of insect-pollinated crops by a honey bee is one of the most successful and cheapest methods to improve horticultural crop yields. Flowering species of plants provide nectar and pollen to honeybees, while honeybees fulfil their responsibility by pollinating flowers, maintaining genetic variety, and ensuring the survival of that plant species. However, honeybees are still more important to farmers because of their pollination service, which increases crop yields qualitatively and quantitatively (Sharma *et al.,* 2015). Honeybee pollinators directly or indirectly provide 30 per cent of the world's food supply (Greenleaf and Kremen, 2006). The value of extra yields obtained by honeybee pollination services is 15-20 times more than all hive products combined.

Honeybees' species in India

In India, generally, four species of honey bees of commercial importance are found, i.e**.,** little bee *(Apis florae)***,** Rock bee **(***Apis dorsata)***,** Indian bee *(Apis cerana indica)***,** Italian bee *(Apis mellifera)*. Among these first three are indigenous to India, but *Apis mellifera* was introduced to India in the 19th century, which is highly suitable for domestication in India (Chadha, 2001). *Apis cerana indica* takes flight only up to 1-2 km, so it is not effective for pollination, while *Apis mellifera* and *Apis dorsata* take flight or visit flowers up to 5-6km. Still, *Apis dorsata* is difficult to be domesticated. At the same time, the Italian bee has been used extensively to enhance the yield because it is easy to rear and highly suitable for pollination in India. It is estimated that pollination by this bee increases yield by up to 25% compared to the other crop pollinated through other means of pollination or other bee species

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(Sharma, 2006). Recently identified bee species *Apis karinjodian* also play an essential role in pollinating many crops.

Effect of Pollination in improving horticultural crop productivity:

Honey bees may be more effective pollinators due to their colony size (up to 60,000 honey bee workers in the summer). However, native bees are also important pollinators and, in some cases, are more efficient than honey bees at the individual level. Bee pollination not only results in a higher number of fruits, berries or seeds, but it may also give a better quality of produce, and the efficient pollination of flowers may also protect the crops against pests. The better weight due to sufficient pollination arises from the development of all seeds in a fruit. It has been estimated that the benefit of using honeybees for enhancing crop yields through cross-pollination is much higher than their role as producers of honey and beeswax.

Many horticultural crops are self-sterile and require cross-pollination to produce seeds and fruit (McGregor, 1976; Free, 1993). However, self-sterile varieties benefit from cross-pollination, and self-fertile varieties also produce better-quality seeds and fruits if they are cross-pollinated (Free, 1993). Logically, the increase in the cultivation of cross-pollinated horticultural crops will also increase the need for managed pollination. There are two well-known methods for improving crop productivity. The first method uses agricultural inputs such as quality seeds or planting material and good cultural practices like timely irrigation, organic and inorganic fertilizers and chemical pesticides to increase yield.

The second method includes biotechnological techniques, such as manipulating the rate of photosynthesis and biological nitrogen fixation, etc. These conventional techniques ensure the healthy growth of crop plants but work up to a limit. At some stage, crop productivity becomes stagnant, or declines with additional inputs for the known agronomic potentials of the crop will have been harnessed (Partap and Partap, 1997). Nearly 70 per cent of the cultivated crops worldwide are cross-fertile and depend on insects like honeybees for pollination. Insects are the most commonly occurring pollinators of many agricultural and horticultural crops.

Visitation rate:

It is the mean number of flowers a pollinator specimen visited per minute. It is another crucial behavioural parameter because it determines the number of flowers a particular species can pollinate per unit of time. Visitation rate has been studied in many crop

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systems, and the parameter is variable between honey bees and non-*Apis* bees. Also, among non-*Apis* bees, there are apparent differences.

Increase in total yield due to bee pollination:

Crops	Crop Increase yield (%)
Apple	15-20
Cherry	5-15
Citrus	5-15
Mango	3-5
Plum	10-15
Almond	15-20
Cashew	5-15
Coconut	3-5
Grapes	10-20
Guava	5-10
Litchi	20-25
Papaya	5-10
Pear	10-15

Vegetable crops

- **Pumpkins** - Bees are the important pollinator of vine crops (pumpkins, squashes, cucumbers, zucchini), and fruit weight increases proportionally to the amount of pollen transferred to each flower.
- **Carrots** - Honeybees are essential for carrot seed production.
- **Broccoli** - Honeybees are the primary pollinator of broccoli flowers. The bees ensure cross-pollination and high seed quality.

Fruit crops

- **Guava** - In guava, 20-40% of pollination is due to honey bees.
- **Banana -** Honeybees were the dominant visitors in the banana inflorescence; the major species of honey bee *A. cerana, A. mellifera* and *A. dorsata* were visiting with 77.50, followed by a wasp (15.53%). *A. mellifera* forages derived from feral, Africanized colonies. On plant species *A. mellifera* has attain high visitation rate.
- **Apple** - Increase fruit set and a decreased level of apple fruit loss.

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- **Litchi** - Fruit production can be increased 2 to 3 times with the introduction of managed hives to the orchards. Many other tropical fruits including rambutan and longan, also depend heavily on honeybee pollination.
- **Watermelon** - A watermelon flower must receive 1000 pollen grains to produce a marketable fruit.
- **Strawberries** - In strawberries, insect pollination increases fruit yield and quality. Bee pollination increases strawberry weight shape and quality improved through bee pollination
- **Macadamia Nuts** - Fruit set can increase up to 10 fold if bees are abundant in the orchard.

Plantation crops:

- **Coffee** - Coffee fruit set and fruit weight can increase up to 25 % through honeybee pollination.
- **Asparagus** - The production of seeds for asparagus involves pollination by bees. Honeybees visit the asparagus flowers to collect the bright orange pollen and inadvertently help pollinate the plant.

Herbs:

- The flowers of basil, mint, lavender, and thyme, are extremely attractive to honeybees and the bee visitation contributes greatly to the production of seed stock for these valuable herb species.

Conclusion:

The declining horticultural productivity can be attributed to several factors, but pollination is crucial. Promoting the use of beekeeping to pollinate horticultural crops will benefit both the beekeeper and the farmer; Appreciation by the production agriculture sector of pollinators' ecological and economic benefits. The dramatic decline in pollinator populations is a critical issue for production agriculture, but it still needs to be added to the top priority list for many agricultural organizations. Many growers are not aware of how significant the contribution of native pollinators is to the production of their crops and farm profitability. Other challenges include the active participation of researchers and extension specialists, which will help expand the use of honey bee rearing for crop pollination.

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