# Chapter 6
# Crop Pollination Using Honeybees and Other Bee Species: Some Examples

Many species of bee, e.g., honeybees, bumble bees, stingless bees, and solitary bees, are managed for pollination of agricultural and horticultural crops in many countries. There are examples of both scientific experimentation and use by farmers.

**How do scientists use honeybees for crop pollination experiments?**

Scientists have conducted experiments on the effect of bee pollination on the yield and quality of agricultural and horticultural crops. Each experiment consists of three sets: (i) a control where part of the crop is covered with cages of nylon or muslin cloth to prevent any pollinating insects visiting flowers; (ii) open pollinated where part of the crop is left open to allow all pollinating insects, including free-ranging honeybees, to visit flowers; and (iii) honeybee pollinated where part of the crop is covered with cages of nylon or muslin cloth and 1-2 colonies of honeybees are placed inside the cages throughout flowering. When the crop is ripe, it is harvested and the yield and quality of each set (experimental plot) is measured. The results of some studies are given below.

- Dr Eva Crane reviewed experimental findings on the increase in fruit and seed production due to *Apis cerana* pollination. She found that fruit production increased 24 times in apple, 15 times in lemon, two times in litchi, two times in peach, 1.2 times in persimmons and six times in plums. She also found that seed set was increased 10 times in large cardamoms, 1.4-1.6 times in mustard, 1.2 times in turnips, 1.3 times in sesame, 1.5 times in sunflower, and 1.7 times in onions.

- Experiments conducted in the former USSR show that bee pollination increased the seed yield of buckwheat by 300 kg/ha.
- Experiments conducted by ICIMOD used *Apis cerana* for pollination of vegetable and fruit crops in the Kathmandu Valley of Nepal. Results showed pod set, seed set, and seed weight of cabbage, cauliflower, Indian mustard, lettuce, and radish increased (Figure 6.1). Fruit set

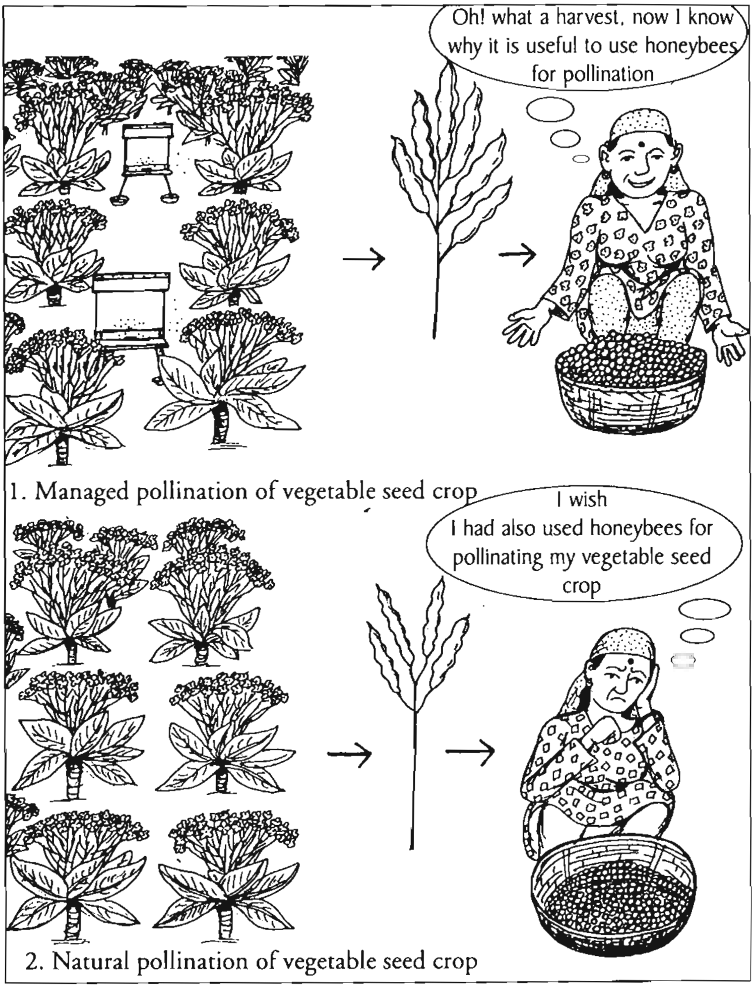


*Figure 6.1: Experiments carried out in the Kathmandu valley showed that managed pollination enhances the yield and size of vegetable seeds.*

increased, fruit drop decreased, and fruit quality was enhanced in peaches, plums, pears, and citrus.

- Experiments conducted in the Shimla hills in India show that bee pollination increased fruit set, decreased fruit drop, and enhanced fruit quality in terms of length, breadth, volume, and weight in apples (Figure 6.2).

**How do farmers use honeybees for crop pollination?**

In the Hindu Kush-Himalayan region, apple farmers in Himachal Pradesh, India, and in the Chinese Himalaya use

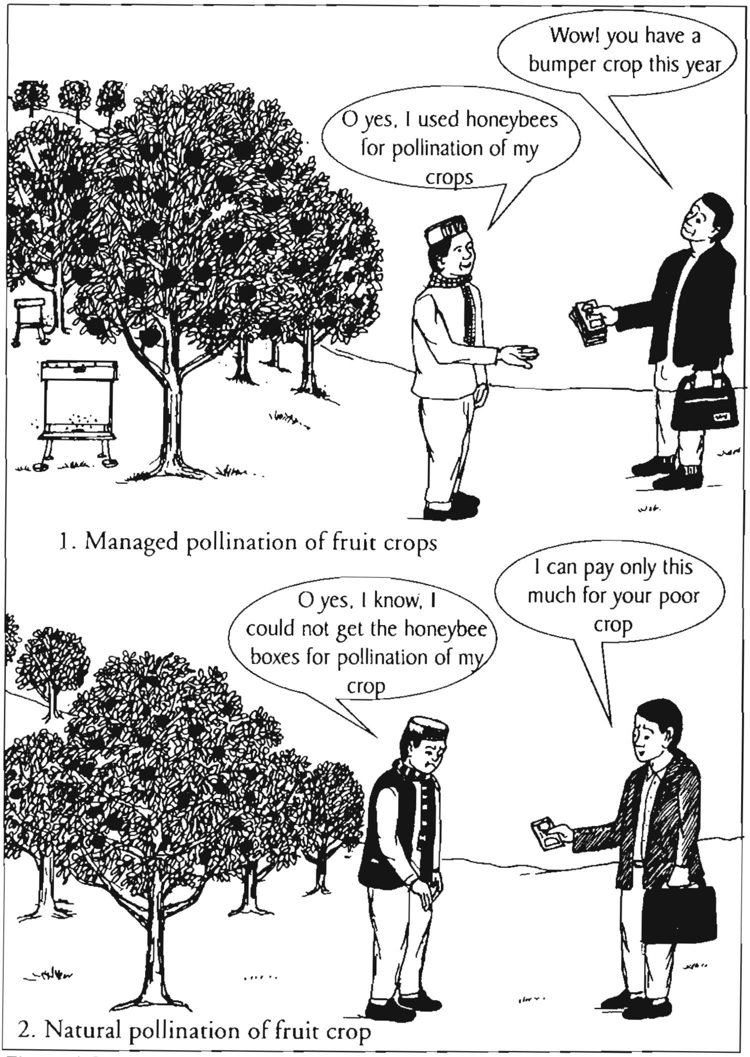


*Figure 6.2: Bee pollination increases the number and size apples.*

honeybees for pollination. In the US, *Apis mellifera* is used for pollination of vegetable and fruit crops such as almond, apple, melon, alfalfa seed, plum, avocado, blueberry, cherry, vegetable seeds, pear, cucumber, sunflower, cranberry, and kiwi fruit. Over 2,035,000 colonies are rented out each year for crop pollination. In Japan, honeybees are used for pollination of strawberries in greenhouses, and for apple and other crops. Honeybees are also used by farmers in Europe for pollination.

**What are the comparable costs of raising apiaries for crop pollination?**

The comparable costs of raising apiaries depend upon the crop to be pollinated. The costs include the labour of the apiarist who prepares the bees, depreciation and mortality of the bees, the expense of feeding sugar to the bees, and so on. It also includes the cost of transporting bee colonies to the crop. In general, it is estimated that the cost of raising apiaries for pollination is 30 per cent of the benefit gained through additional crop yields.

**What is the estimated value of managed crop pollination using honeybees?**

Many economic estimates of the value of managed crop pollination using honeybees have been worked out.

- For example, the value of bee pollination in crop production is estimated to be US$ 20 billion per year in the US; Canadian dollars 1.2 billion (US$ 0.8 billion) in Canada; and US$ 3 billion in the European Community.
- The value of bee pollination for the New Zealand economy has been calculated at around US$ 2.2 billion per year, 113 times greater than the sale of bee products. This also includes the value of nitrogen fixed and added to pastures by honeybee-pollinated legumes.
- In the former USSR, researchers have shown that bee pollination of buckwheat gives an average additional yield of 300 kg/ha. For the whole of East Siberia, this increase would amount to 9,000 tonnes of additional buckwheat grain.

- In the Hindu Kush-Himalayan region, the value of bee pollination is only estimated in China and for a few crops. The value of bee pollination for four major crops—rape, cotton, tea, and sunflower—is more than 6 billion *yuan* (US$ 0.7 billion) per year, which is six to seven times greater than the direct income from bee products.

Although attempts have not been made to estimate the value of bee pollination in other countries of the Hindu Kush-Himalayan region, it is most probably high.

**Can bees other than honeybees be managed for pollination?**

There are about 20,000 bee species worldwide. These include honeybees, bumble bees, stingless bees, and solitary bees. Although honeybees are efficient pollinators of many crops, there are certain crops that are more efficiently pollinated by other bees. Some of these bees can be managed for pollination, e.g., species of bumble bees (*Bombus* spp.), stingless bees (*Melipona* spp and *Trigona* spp), and some species of solitary bees. Although these bees are not being reared and managed for pollination in the Hindu Kush-Himalayan region, they are used in developed countries. A brief account is given below.

***Stingless bees***

Stingless bees include species of *Melipona* and *Trigona*. They are described in Chapter 2. They are important pollinators of many crops, for example, mustard (Figure 6.3).

***Bumble bees***

Many species of bumble bee occur in temperate areas of the Hindu Kush-Himalayan region. These bees are large in size, have hairy bodies, and occur abundantly. Like honeybees, they also live in colonies.

Bumble bees are important pollinators of many crops that honeybees cannot pollinate as efficiently, e.g., tomato and

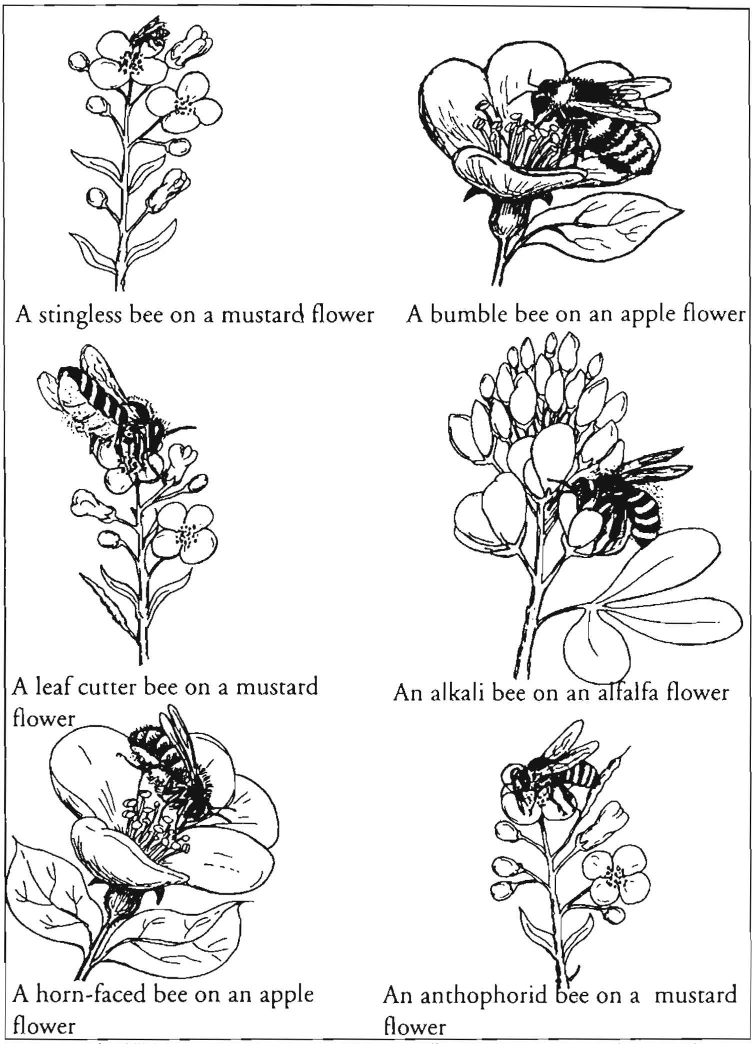


*Figure 6.3: Wild bees are important crop pollinators; some species can be reared in artificial nest sites and managed for crop pollination.*

potato (Figure 6.3). There is a category of crops that requires buzzing of the flowers before pollen can be released. Bumble bees are the most effective at buzzing flowers. Honeybees cannot buzz flowers and visit only to collect pollen released by bumble bee buzzing. The bumble bee species with a long tongue are pollinators of plants that produce nectar deep in their flowers. Bumble bees will fly at lower temperatures than honeybees and are ideal in greenhouses because their colonies are small.

At present, there are 10-15 companies in western Europe, Israel, New Zealand, the US, and Canada that rear bumble bees commercially and sell them to growers for crop pollination. In 1992, these companies sold about 300,000 colonies worth US$ 60 million. In Japan, bumble bee colonies are imported for pollination of potato and tomato.

***Solitary bees***

About 85 per cent of all bee species are solitary. Each female bee mates, constructs a nest with about ten brood cells, stocks each cell with a mixture of pollen and nectar as food for the larva, lays an egg in each cell, and dies before the young emerge. The young adult bees emerge at the time of blooming of their host plant.

Thousands of species of solitary bee occur in the Hindu Kush-Himalayan region. They nest in a variety of places, e.g., in the ground, plant stems, dead branches, etc. Solitary bees do not store honey and beeswax, rarely sting, and cannot be kept in hives. They do not live in colonies but nest gregariously. Most species are active for only a few weeks in the year. The rest of the year, they live in their nests as larvae, pupae, or dormant adults. Their active period coincides with the flowering of their preferred hosts. These bees are therefore excellent pollinators of their hosts (more effective than honeybees), for example, the alkali bee, *Nomia megachile,* and the leaf-cutter bee, *Megachili rotundata,* are excellent pollinators of alfalfa (Figure 6.3). These bees trip the alfalfa flower, which is essential for effective pollination; honeybees collect nectar from the base of the flower without tripping it and therefore do not pollinate it.

Some species can be kept in artificial nest sites (man-made nests), can be mass-reared, and can be managed for crop pollination. For example, the leaf-cutter bee, *Megachile rotundata,* and the alkali bee, *Nomia melanderi,* are managed for pollination of alfalfa in the US and Europe. In Japan, *Osmia cornifrons,* the large horn-faced bee, is the first solitary bee to be used on a commercial scale to pollinate apples (Figure 6.3). Other species of *Osmia—O.*

*coerulescens, O. cornuta, O. fulviventris, O. latreillei, O. lignaria, O. rufa, O. sanrafaelae,* and *O. submicans*—are managed for pollination of tree fruits, cotton, berseem, almond, mustard, and lucerne in countries such as France, Spain, US, Egypt, Denmark and Egypt. In the plains of India, *Andrena ilerda* is managed for the pollination of sarson.

Halictine bee, *Lasioglossum (Evylaeus) metianensis,* is an excellent pollinator of apples at altitudes over 2,600m. Farmers can manage this species by leaving some uncultivated land in or around their orchards as nesting habitat. Other species of solitary bee that can be managed for pollination of orchard crops (apples, almonds, cherries, peaches, pears, plums, and other fruit crops) in the Hindu Kush-Himalayan region include *Amegilla, Andrena, Anthophora, Bombus, Ceratina, Halictus, Megachile, Osmia, Pithis,* and *Xylocopa.* These insects are much more gentle than honeybees and are easily reared and managed for pollination. Although they are already managed for pollination in developed countries, to rear and manage them on a commercial scale for crop pollination in the Hindu Kush-Himalayan region would require a great deal of research.