

## Role of Pollinators in Hybrid Seed Production

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Intensification and diversification are the present pressing needs for the sustenance of Indian agriculture and are likely to be vigorously followed in future in order to support the burgeoning population. Bees are the important components of agro-ecosystem as they provide free ecosystem services in the form of pollination which not only enhance the productivity of agricultural crops but also help in conservation of biological diversity through propagation of wild flora besides, providing honey and other hive products (Abrol, 2012; Dutta & Sheela, 2018).

Apiculture (Beekeeping) as non-land-based income and employment generating activity in fast becoming a prime component of present-day strategies for integrated rural development and off farm employment (Gill & Singh, 2004; National Bee Board [NBB], n.d.).

“Pollination” is a simple process involving transfer of pollen from anthers to the stigma of the same or different flowers. In several cross-pollinated crops, external bio-agents are required to accomplish this process. Cross pollination of entomophilous crops by honeybees is considered as one of the effective and cheapest method for triggering the crop yield both qualitatively and quantitatively. It has been reported that there are more than 25,000 described species of bees in the world and account for 65% pollination of various flowering crops (FAO, n.d.; Dutta & Sheela, 2018).

Primarily two honey bee species viz., *Apis cerana indica* and *Apis mellifera* have been successfully domesticated and practices for their management for pollination of different crops (Gill & Singh, 2004). Being the pollination service provider bees, contribute handsomely in enhancing the productivity and production of cross as well as self-pollinated crops through efficient pollination in an inconspicuous and silent manner (Abrol, 2012).

Among the pollinators, insect mainly belonging to the orders of Hymenoptera, Lepidoptera, Coleoptera, Diptera, Hemiptera etc. and are the most common and dominant pollinators in various regions (Dutta & Sheela, 2018).

### Role of Honey Bees in Open and Cross-Pollinated Crops

#### Digger bees/Mining bees

Many ground nesting bees (*Andrena*, *Colletes* and other species) are known as digger bees, mining bees, or sand bees. They excavate nests in the ground, leaving small mounds of soil aboveground. They often hide their nest entrances beneath leaf litter or in the grass. All digger bees

are solitary but some nest in dense aggregations. These bees pollinate a variety of plants. They are drab, solitary and rarely noticed, yet they may be the most abundant wild pollinators in the field. There are many species of digger bees found throughout North America. Most of these bees are known only by their Latin binomial names, although they are sometimes referred to as polyester bees.

#### Bumble bees (*Bombus* spp.)

Bumble bees are highly social like honeybees, but with smaller, less structured nests, consisting of one to five hundred bees. Bumble bees work harder, faster and at cooler temperatures than honey bees. They prefer to nest underground, in undisturbed meadows, old barns and woodlots. Red clover is an excellent forage crop for bumblebees. Bumble bees pollinate tomatoes, eggplants, peppers, melons, raspberries, blackberries, strawberries, blueberries and cranberries. Bumblebees are the only pollinators of potato flowers worldwide.

#### Sweat bees (*Halictidae* family)

Though most species of this small bee, found throughout the U.S. are black or brownish, some such as *Agapostemon femoratus* are bright metallic green. All species nest in the ground. Halictid bees are common insects and good general pollinators. Sweat bees take their name from their habit of landing on people to lick the salt from their skin. Like most solitary bees, sweat bees are non-aggressive and will sting only if you swat at them. Unlike other mining bees, halictid female's mate before hibernating for the winter, so they can begin nesting earlier in the spring. This allows them to raise only daughters during the growing season, much like bumblebees. Males are raised in late summer or early autumn.

#### Alkali bees (*Nomia melanderi*)

The alkali bee is a solitary ground nesting bee native to western North America. As its name suggests, it can be found nesting in alkali soil. It prefers to nest in bare soil that remains moist but not wet, and dry on top. This occurs naturally in areas where a layer of hard pan exists in alkali soils. The alkali salts seal the top of the soil, holding in the moisture. The alkali bee is an excellent pollinator of alfalfa and onion seed.

#### Squash bees (*Peponapis pruinosa*):

Squash bees, which are related to carpenter bees, collect pollen and nectar only from the flowers of cucurbits (squash, pumpkin, and gourd).

### Leafcutter bees (*Megachile* spp.):

Leafcutter bees are solitary bees, usually grayish in colour native to woodland areas. The females cut pieces of leaves to line their nests. They can be rather particular about the leaves they use. Leafcutter bees prefer legume blossoms, but they will also pollinate the other crops, like carrots. They are most active in summer when temperature rises above 70°F. Leafcutters are efficient; 150 leafcutters can do the work of 3,000 honeybees. They are gentle and ideal for greenhouse work.

### Carpenter bees (*Xylocopa* spp.)

Carpenter bees are some of the largest bees and have a blue-black, green or purple metallic. Carpenter bees can pollinate several crops including passion fruit, blackberry, canola, corn, pepper, pole bean and rhododendron. These bees are excellent pollinator of cotton in India and Egypt. The small carpenter bee of genus *Ceratina* are also known as an important pollinator of several crops including fruit crops like peach.

### Mason bees (*Osmia* spp.)

Mason bees are so called because they construct their nests out of materials like mud and small pebbles. *Osmia lignaria* (commonly called the orchard mason bee, blue orchard bee, mason bee or orchard bee) is a pollinator of many fruit crops including almond, apple, cherry, pear, and plum. A single hornfaced bee can visit 15 flowers a minute, setting 2,450 apples in a day compared to the 50 flowers set in a honeybee's day.

### Stingless bees (*Trigona* spp.)

These bees are found in the holes of tree trunks. Over 130 species of stingless bees world over have been identified as potential pollinators of crop and can be managed for this purpose.

### Shaggy Fuzzyfoot bees (*Anthophora pilipes*)

The shaggy fuzzyfoot bee is a fat, shaggy, fast flying bee that buzz-pollinates blueberries. In this type of pollination, bee creates a vibration that releases the pollen from inside tiny, tube-like anthers. Shaggy fuzzyfoot bees pollinate in the rain. They pollinate blueberries, apples and other crops for about 6 weeks in the spring.

**Other pollinators:** The bees listed above are by no means inclusive of all available pollinators. Other candidates among the native bees include sunflower bees (*Eumegachile pugnata*) and blueberry bees (*Habropoda laboriosa*). Beetles, butterflies and moths can also be good pollinators.

### Some facts about Bee Pollination

- ✓ More than 50% of the existing species of plants propagated by seeds are dependent upon insects for adequate pollination.

- ✓ Only 15% of the 100 or so crops that fed the world are pollinated by domestic honey bees while 80% are pollinated by wild bees and other wild life (Partap, 2011; FAO, n.d.).
- ✓ Value of additional yield obtained due to bee pollination alone is 15-20 times, more than the value of all the hive products put together (NBB, n.d.).
- ✓ The total value of pollination services rendered by all insects globally comes in excess of 100 billion US dollars annually (FAO, n.d.).
- ✓ In India, 50 million hectares of land is under bee dependent (NBB, n.d.).
- ✓ It has been estimated that bees are gainfully tapping only about 1/4<sup>th</sup> of the available floral resources of the country.
- ✓ Of the 90% of flowers which are cross pollinated, 85% depend upon insects for pollination (Gill & Singh, 2004).
- ✓ Being a mega diversity country, there are about 1,000 species of bee forage plants offering rich food to all the four important species of honey bees.
- ✓ Estimated losses in India due to complete absence of bee pollination has been measured to be somewhere between 10,000 to 55,000/ha in some crops (NBB, n.d.).

### Advantages of Bee Pollination

Honey bees are the most efficient pollinators of several agricultural, horticultural, silvicultural, fodder and wild plants because of their following characteristics:

- ✓ Body parts are specially modified to pick up many pollen grains
- ✓ Flower fidelity and constancy
- ✓ Potential for long hours
- ✓ Maintainability of high populations as and when needed
- ✓ Adaptability to different climates and niches

### Qualitative and Quantitative changes in Crop Plants due to Bee Pollination

As a result of cross pollination by bees, somatic, reproductive and adaptive heterosis or hybrid effect occurs in plant progeny. Such hybrid effect brings the following qualitative and quantitative changes in plants:

- ✓ Stimulate germination of pollen on stigma
- ✓ Increase viability of seeds, embryos and plants
- ✓ Fruits become more nutritive and aromatic
- ✓ Stimulate faster growth of plants
- ✓ Increases number and sizes of seeds and yield of crops

- ✓ Increases nectar production in the nectaries
- ✓ Increases fruit set and reduces fruit drop
- ✓ Enhances resistance to diseases and other adverse climatic conditions
- ✓ Increases the oil content in oilseed crops

### Increase in yield due to bee pollination

It has been established through research that installation of 3-5 bee colonies of *Apis cerana indica* per acre of crop increased the seed yield in Sunflower by 79%, Mustard by 55%, Niger by 33%, Sesamum by 15%, Safflower by 64%, Cotton by 18%, Litchi by 20%, Coconut by 40% and Gourd crops by 20%. Ample yield increases in fruit crops have been recorded from honey bee pollination in India (Apple 25-55%, Peach 2.6 times, Plum 2.5-3.7 times, Apricot 48%, Litchi 2-3 times, Citrus 22%). The National Bee Board also reported exponential increases in fruit yields (Apple 180-6950%, Pear 240-6014%, Cherries 56-1000%, Strawberry 17.4-91.9%, Litchi 4538-10246%, Orange 47-900%, Citrus 7-33.3% and Guava 70-140%). At the global level, 33 fruit crops have been identified which need bee pollination for increase in their yields. In India, 12 crops including eight fruit crops (Almond, Apple, Citrus, Coconut, Guava, Grapes, Mango and Papaya) are most dependent on honey bee pollination.

### Protecting the Bees from Pesticide Poisoning

Irrational and indiscriminate application of non-specific broad-spectrum pesticides give devastating set back to the non-target useful fauna mainly pollinators and biocontrol agents. Various ways to reduce bee poisoning are:

- ✓ Persuade the farmers, not to use pesticides or use selective pesticides that are less harmful to bees at recommended concentrations
- ✓ Avoid the use of dust formulation as they are harmful to bees than spray formulation
- ✓ Prior information about spraying would help in reducing poisoning of bees
- ✓ Avoid spraying of pesticides during flowering of the crop and peak foraging time of the bees would help in reduction in the mortality of foraging bees
- ✓ Spraying may be given in the evening hours when bees do not forage
- ✓ Colonies may be temporarily shifted if heavy spraying schedule is fixed
- ✓ If shifting of colonies is not possible, feed the colonies with 200 ml of sugar syrup and close the

entrance gate by using wire screen for the day of spraying

### Different Pollinators in Hybrid Seed Production



Digger bees/mining bees



Bumble bees



Sweat bees



Alkali bees



Squash bees



Leafcutter bees



Carpenter bees



Mason bees



Stingless bees



Shaggy fuzzyfoot bees



Sunflower bees

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