

A STUDY ON BEEKEEPING OF INDIA

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ABSTRACT

Both science and art can be found in beekeeping. In India, beekeeping is primarily done as a full-time job and an engaging pastime to generate table honey and a respectable income. A unique gift to humanity, honeybees are used in beekeeping. can be used for their beloved goods like honey, beeswax, propolis, bee venom, etc. as well as their pollination services. These goods are widely used in many Indian small- and large-scale enterprises. The sting of bees is the only unpleasant aspect of beekeeping. When a person first starts beekeeping and becomes accustomed to maintaining bees, they will only taste the sweetness of honey.

Keywords : Beekeeping, *Apis florea*, *Apis cerana*, *Apis mellifera ligustica*, Stingless Bee.

INTRODUCTION

There are currently seven known species of *Apis*; four of these are found only in India: two domesticated species, *Apis cerana* (oriental honeybee) and *A. mellifera* (occidental or European honeybee), and two wild species, *Apis dorsata* (giant/rock honeybee or *dumna*) and *A. florea* (dwarf honeybee). Of the four species, *A. mellifera* was brought to India because it is very well suited for commercial beekeeping and resistant to the Thai sacbrood virus (TSBV). India's many climate zones contribute to a vast diversity of flora, which is beneficial for prospective beekeepers. India's population has a long history of beekeeping and honey consumption. Some documents regarding beekeeping were left by ancient Indians in the form of paintings or rock sculptures. The ancient Indian Ayurvedic texts highlighted honey and its therapeutic properties. Following independence, the Indian government decided to resurrect a number of traditional village industries, and in 1954 the All India Khadi and Village Industries Board (KVIB) was established. In less than 20 years, the beekeeping sector in India rose to prominence among village industries thanks to the coordinated efforts of well-coordinated organizations like KVIC (Khadi Village Industries Commission), State KVIBs, Beekeepers' Cooperatives, and Public Institutions. Given the growing significance of beekeeping, ICAR and Agricultural Universities initiated the All India Coordinated Research Project (AICRP) on Honey bee Research and Training in 1981 (Ramchandra et al. 2012; Sivaram 2012). The Ministry of Agriculture then introduced a Central Sector Scheme called "Development of beekeeping for improving crop productivity" in 1994–1995 as part of the eighth five-year plan.

Honeybee Species in India

Rock Bee (*Apis dorsata*)

These are enormous, vicious bees that build a single, exposed comb that is often three to four feet tall. They are primarily found in woodlands and concrete jungles across the subcontinent. They build their nests as high as 2700 meters in steep areas. Rock bees move about on a regular basis. A single rock bee colony can yield between 50 and 80 kilogram of honey annually (Mishra 1995). They are found in the west from Pakistan (and maybe some areas of southern Afghanistan) to Indonesia and parts of the Philippines in the east, via the Indian subcontinent, Sri Lanka, and Pakistan.

Little Bee (*Apis florea*)

While *Apis florea*, sometimes known as the dwarf honeybee, is a kind of wild honeybee, it is smaller and less aggressive than rock bees. Single vertical combs are constructed by these bees (Hepburn and Radloff 2011; Wongsiri et al. 1996). Additionally, they make palm-sized combs out of shrubs, plants, structures, caverns, open cases, etc. The main distinction between a rock bee and a little bee comb is that the former builds combs around the twigs, while the latter builds combs on the underside of the branch. Compared to rock bees, these bees produce significantly less honey; each hive produces approximately half a kilogram of honey annually. Nonetheless, a lot of honey from *A. florea* is collected in Gujarat's Kutch region (Soman and Chawda 1996). These bees are likewise non-rearable due to their tendency of moving colonies often, yet experiments in India have had some results (Mishra 1995).

Indian Bee (*Apis cerana*)

In India, the Eastern or Indian honeybee is a popular species of bee. This was the only *Apis* bee species that could be raised in India before the Italian bee was introduced. Additionally, Pakistan, Nepal, Burma, Bangladesh, Sri Lanka, and Thailand are home to it after domestication. They rarely change places and are rather non-aggressive. These bees generate 7–9 kg of honey per colony annually and build numerous parallel combs in dark locations like logs, clay pots, walls, tree holes, etc. Based on genetic diversity and living habitats, Ruttner (1988) divided *Apis cerana* into subspecies; of these, *Apis cerana indica* and *Apis cerana cerana* are found in India. Two morphotypes of the *Apis cerana indica* subspecies are known to exist in India: the "hills bee," which is black in color, and the "plains bee," which is yellow in color (Ramchandra et al. 2012). Currently, more than 50,000 beekeepers are engaged in Indian beekeeping, especially in the Kanyakumari area of Tamil Nadu and south India.

European Bee/Italian Bee (*Apis mellifera ligustica*)

The Italian bee, or *Apis mellifera ligustica*, is a subspecies of *A. mellifera* that was brought to India from Europe in the latter half of the 20th century. It is not native to India. The Thai sacbrood virus was the main cause of the invasion, as native Indian bee colonies were going extinct. These days, they are well-established in India, with the most of them found in the north due to the abundance of rich flora, including sunflower, mustard, and sunflower. These bees don't obtain enough food because rice is the main crop in south India. It is rare to see with Italian bees in south India; these bees must be relocated using floral mapping in order to be used for commercial beekeeping. Their habits similarly resemble those of Indian bees,

Stingless Bee

Compared to other bees that produce honey, stingless or dammar bees are smaller (less than 5 mm). They are members of the Meliponinae subfamily and the Apidae family. *Melipona* and *Trigona* are its two genera. Eight genera, fifteen subgenera, and over five hundred species make up the family Meliponinae (Wille 1983). Since dammar is a resin found in dipterocarp trees, these bees are commonly referred to as dammar bees in India (Rasmussen 2013). Other common names used for these bees include "putka" in Sikkim and Nepal (Gurung et al. 2003; Singh et al. 2011; Lepcha et al. 2012); "ngap siwor", "ngap hamang", and "ngap khyndew" in Khasi language (Pugh 1947); and "cherutheneecha" and "arakki" in Kerala (Nair 2003). As its name suggests, these

bees are unable to sting due to a significant reduction in stingers; yet, they attempt to protect their colony from outsiders by utilizing their mandibles (Michener 2000).

Biology and Society

One of nature's most brilliant products is the honeybee. One of the best traits exhibited by honeybees is eusociality, which involves them caring for their young through cooperative brood care as well as other sophisticated defense and communication techniques. In addition to an adult stage, honeybees go through three developmental stages: egg, larval, and pupa. Three classes exist at the adult stage: the lone queen, the hundreds of drones, and the thousands of workers. Because honey bees have a haplodiploid sex determination mechanism, the worker is an unfertilized female capable of generating only males, the drone is male, and the queen is a fertile, functioning female capable of producing both males and females (Tribe and Fletcher 1977; Winston 1979). Their caste is determined by the food they are given during the larval stage; nurse bees feed queen larvae royal jelly at this time. Kamakura (2011) discovered recently that the larvae's development into queens is caused by the 57 kDa protein royalactin, which is found in royal jelly.

The Queen

All other bees in the colony are descended from the queen bee. Its tiny wings and long abdomen help to identify it. The queen's job is to deposit eggs. By means of its pheromones, the queen keeps the colony alive. The quantity of food the workers bring in and the amount of space available for brooding inside the colony determine how productive she is. Over 1500 eggs can be laid by her each day. She will produce up to 2,500 eggs per day if it is honey flow season and there are enough cells available (Winston 1992). The queen emerges from the queen cell, which is located at the base of the comb and resembles a little cup. Because of this structural similarity, the queen cell is also known as the cow's teat in India. Following her emergence, the newly formed queen battles any other queens she comes across and destroys the colony's remaining queen cells

The Worker

A colony has thousands of workers who carry out all tasks within the colony, such as cleaning, guarding, foraging, and raising offspring. Compared to the drones and queen, they are smaller. *A. florea* has between 8,000 and 25,000 workers, *A. mellifera* has between 40,000 and 50,000 workers, *A. cerana* has between 20,000 and 40,000 workers, and *A. dorsata* has between 50,000 and 80,000 workers (Winston 1992; Wongsiri et al. Wongsiri et al. 1991; Wongsiri et al. 1996). Worker bees use their modified ovipositor sting to defend their colonies, and when they sting, they release venom. Under some circumstances, workers may lay eggs that, because they never mate and lack sperm to fertilize their eggs, develop into drones (Anderson 1963; Mackensen 1943). On the other hand, worker regulation and the consumption of eggs produced by other workers are observed in a typical queen right colony (Ratnieks 1993). Unlike *A. mellifera*,

The Drone

Drones are easily recognized by their black color and the way their eyes meet atop their heads. Their sole purpose is to eat the food inside the hive and fertilize the queen. They have no stingers, thus they don't sting. Due to their "haploid" nature, drones only have half the gene pairs that the "diploid" workers and queen have (Anderson 1963; Mackensen 1943; Winston 1992). There are roughly hundreds of drones in a colony; these drone cells are distinguished from worker cells by having larger cappings, and commercial beekeepers in India decap these

drone cells when the drones use up the honey that has been stored. Because they have roughly 75–80% more facets in their complex eyes than the workers or queen, they are better navigators than the other two castes (Gary 1963; Koeniger 1969, 1970; Ruttner 1966; Winston 1992).

Honeybee Foraging

India is a large country with a variety of climate zones that offer rich vegetation to honeybees. Through their foraging activities, honeybees gather pollen and nectar, which together provide them with the protein and carbohydrates they need to meet their nutritional needs (Seeley, 1985 and Winston 1987). Only the forager bees will carry out foraging because honeybees divide their labor (Von Frisch 1967; Suwannapong 2000). Nectar and pollen collectors are the two categories of foraging bees.

The Indian honeybee population is known for its wide variety of flowers, making it challenging to narrow down the available options. These are a few of the crops that provide bees with abundant sources of nectar and pollen. Among the abundant nectar sources are *Anacardium occidentale*, *Nephelium litchi*, *Azadirachta indica*, *Callistemon citrinus*, *Glycine max*, *Cajanus cajan*, *Hevea brasiliensis*, *Acacia catechu*, *Dalbergia sissoo*, *Eucalyptus sp.*, *Syzygium cumini*, and *Nephelium litchi*. Among the abundant sources of pollen are *Zea mays*, *Psidium guajava*, *Sesamum indicum*, *Sorghum bicolor*, and *Helianthus annuus*.

Foraging Distances

A. cerana can be found 200–300 meters from the hive for foraging (Pratap, 2011 and Koetz, 2013). According to certain research, Indian bees may search for food up to 900 meters away (Hyatt 2011). *A. cerana*'s maximum foraging range is between 1500 and 2500 meters (Dhaliwal and Sharma 1974). The range of *Apis mellifera* foraging is excellent; they can reach up to 10 miles (Abrol, 2011). However, the majority of *A. mellifera*'s foraging range is less than 6 km (Visscher and Seeley 1982).

Some of the commercial crops benefitted by honeybee pollination in India

Fruits and nuts	Almond Apples, <i>Prunus dulcis</i> Apricot <i>Malus spp.</i> Peach <i>Prunus armeniaca</i> Strawberry with <i>Prunus persica</i> Citrus <i>Fragaria spp.</i> Plantain species and litchi <i>Litchi chinensis</i>
Vegetable and vegetable seed crops	Broccoli Cauliflower, <i>Brassica oleracea var. capitata</i> Carrot, <i>Brassica oleracea var. botrytis</i> Carota daucus, coriander Cucumber, <i>Coriandrum sativum</i> Melon (<i>Cucumis sativus</i>) <i>Cucumis melo</i> and onion Pumpkin and <i>Allium cepa</i> Radish, <i>Cucurbita spp.</i> Turnip and <i>Rabanus sativus</i> Subspecies Rapa of Brassica
Oilseed crops	Safflower <i>Helianthus annuus</i> , mustard <i>Brassica juncea</i> , rapeseed <i>Brassica napus</i> , niger <i>Guizotia abyssinica</i> , and sunflower <i>Gingely Carthamus tinctorius</i> , <i>Sesamum indicum</i>

Forage seed crops	Clover Trifolium spp. with lucerne Medicago sativa (Ragumoorthi et al.
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Beekeeping Equipment

The tools used in beekeeping have evolved over the years along with the craft itself. Prior to the Langstroth bee space (1851), Johannes comb foundation (1857), and honey extraction techniques by Frang von Hruschka, beekeepers in India practiced beekeeping in baskets, wooden logs, underground hives, clay pots for keeping stingless bees, and other methods. These concepts had a significant impact on beekeeping in India and encouraged beekeepers to transition to movable frames, as movable beekeeping is more user-friendly and modern beekeeping equipment makes work easier for commercial handlers. (Ramchandra et al., 2012; Singh, 2014; Misra, 1995).

Honeybee Hive

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Types of Beehive

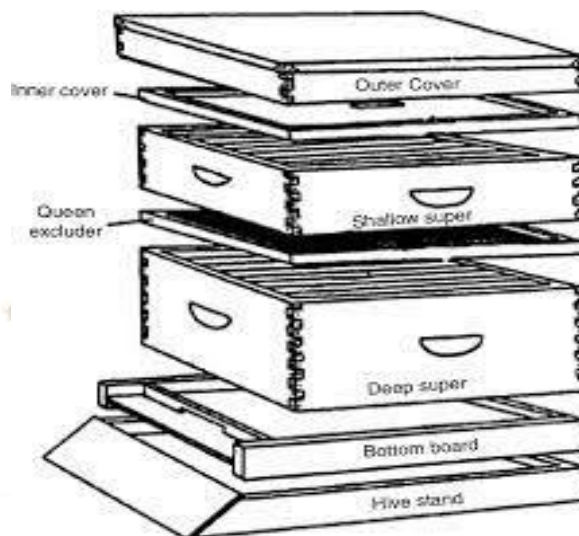
There are different types of hives used in India such as Langstroth hive for *A. mellifera*, BIS hive (Bureau of Indian Standards) for *A. mellifera* and *A. indica* and Newton hive and Marthandam hive for *A. cerana*.

Langstroth Ten-Frame Hive

Stand: Any 15–25 cm tall, four-legged stand will do. Its upper measurements must be such that the bottom board is correctly supported.

Bottom board: It can be created by uniting two wooden boards that have been nailed together using wooden rods, or by taking a piece of wood that is 550 mm long, 406 mm wide, and 22 mm thick. A wooden rod measuring 550 mm in length, 22 mm in width, and 22 mm in thickness is nailed at either end of the longer side, while a second wooden rod measuring 363 mm by 22 mm is nailed at the back. The entry rod on the front measures 363 x 22 x 22 mm and has a center entrance that is 75 mm long and 22 mm deep. Two wooden blocks that will be utilized to reduce the width of the entryway should also be ready when required; each block measures 75 mm by 38 mm by 22 mm.

Brood chamber: It is a rectangular box with a thickness of 22 mm and no top or bottom. Its dimensions are as follows: it is 500 mm long on the outside and 456 mm wide on the inside, 406 mm wide on the outside and 363 mm high, and 238 mm tall. Throughout the whole width of the planks, a rabbet measuring 16 mm in depth and 13 mm in breadth is carved.



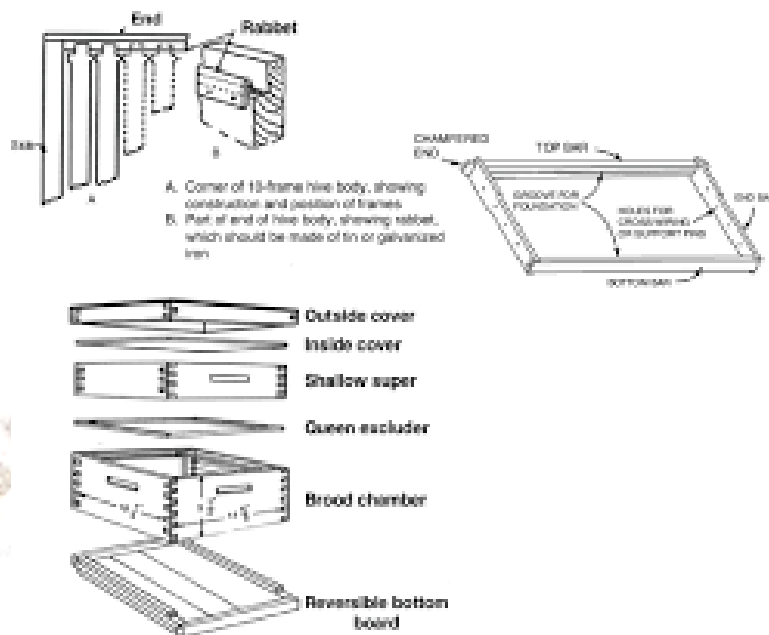
Components of a standard beehive

Frame: Consists of top bar, two side bars and a bottom bar.

- i. Top bar dimensions: 475 mm x 25 mm x 22 mm. It is 25 mm long and carved to a thickness of 9 mm on both sides. Its lower side features a groove in the center where the comb foundation sheet can be fixed.
- ii. Side bars: Each is 226 mm long and 9 mm thick in wood. Each has a base half that is 25 mm broad and an upper part that is 34 mm wide. To make room for the top and bottom bars, respectively, each is carved out from the middle section at each end. Each side bar has four holes for wiring the frame.
- iii. Bottom bar dimensions: 440 mm × 19 mm × 9 mm. The frame's external dimensions are 440 x 228 mm.
- iv. To make the frames stand 34 mm apart, drive two 15 mm staples into the top bar on the opposite side of the bar. All frames ought to be made in either Hoffman or staple-spaced type. The frame should be wired with 28 gauge tinned wire.

Super: The brood chamber and the brood chamber frames' respective dimensions should match those of the super and the super frames.

Inner cover: This wooden board serves as a cover for the super, or brood chamber, depending on the situation. Its dimensions are 406 mm wide, 500 mm long, and 9 mm thick. Its four sides are fastened with a hardwood bar that is 22 mm broad and 9 mm thick.



Langstroth ten-frame hive

Top cover:

To keep rainwater out of it, a metallic sheet is placed over a 9 mm thick hardwood board that is fastened to a rectangular frame that is 50 mm high. Its inside dimensions are 425 x 525 mm. It is loosely positioned above the hive.

Newton Hive

Stand: A roughly 10-cm-diameter wood log that has been well soaked in wood preserver is buried far below the surface of the earth. A 40 x 30 cm board is fastened to the top of the 20–30 cm length that is left above the ground using long nails and screws. This platform is where the hive is situated on the log.

Bottom board: This is a plank that is 25 mm longer and slightly wider than the brood chamber. It has three beadings on three sides, which the hive body snugly fits into. The alighting board is the expansion of the front.

Brood chamber: 278 x 256 x 160 mm in outside dimensions, and 234 x 225 x 160 mm in inside dimensions. It is a box with no top or bottom and is constructed of 22 mm thick planks. A 6 mm deep by 9 mm wide groove is formed along the top of the front and rear planks to rest the frames, and there is a 6 mm gap between the bottom board and the lower extremity of the frames. The lower side of the front board features an opening measuring 88 mm by 9 mm that functions as an entryway.

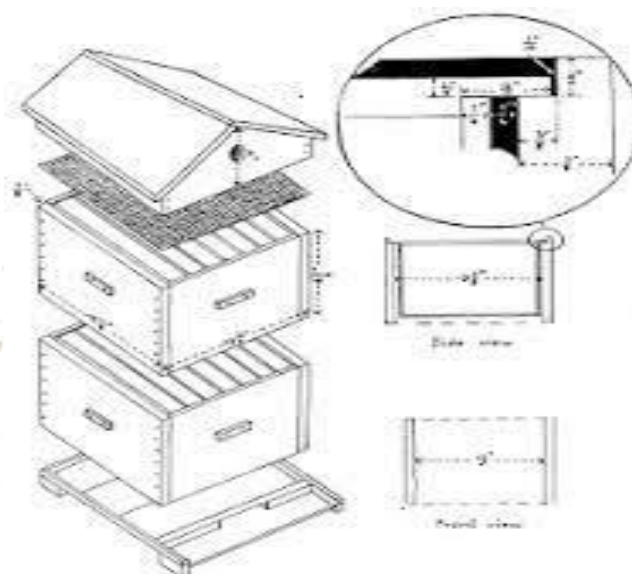
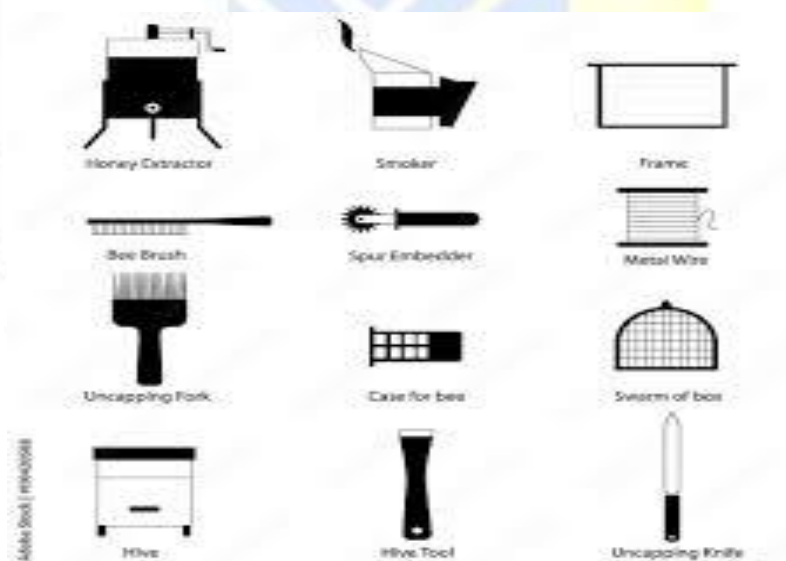


Figure 4. - Nestor hive

Brood frame: The dimensions of the brood frame are as follows: (i) self-spacing; (ii) side bar height of 144 mm, width at top 28 mm and width at bottom 12 mm; (iii) inner length of 206 mm and inner height of 144 mm. When two frames are stored side by side, a 6 mm clearance is guaranteed and an extension of 3 mm is provided on either side of the side bar. A brood chamber contains seven frames.

Super and super frame: Its height is 78 mm, while its length and width are identical to those of the brood chamber. The interior height of the super frame is 62 mm, yet its external measurements are the same as those of the brood frame.



Beekeeping tools

Other Beekeeping Equipments

Smoker: The smoker is a metal cylinder that produces smoke through fire ignition.

Honey Extractor: It is made up of a metal drum with a mechanism that rotates centrifugally to extract honey from the frames.

Comb Foundation Sheet: In the wild, bees use the wax they secrete to construct new, parallel combs that are fastened to the box or cavity's ceiling.

Decapping Knife: A standard plain steel knife or an electric heated knife can be used for decapping.

Tool for Hive: It is a flattened iron tool with hammered edges that is used to scrape extra comb and bee glue from different areas of the hive as well as to pry apart the frames within the hive.

Bee Veil: To protect the face against stings, it is worn over the face. To help us see the image better, it ought to be constructed of black light material like nylon netting.

Gloves: They offer a great deal of protection because handling honeybees usually results in stings on the hands and fingers.

Bee Grass: Before extracting honey from honeycombs, bees are frequently removed with a whisk broom or bee brush.

Feeders: Beekeepers use a variety of feeders to provide sugar syrup to their hives.

Protector of Queen Cells: It is a cone-shaped construction composed of a spirally wound piece of wire. Around a queen cell, it fits.

Division Board or Dummy: The wooden partition functions as a wall that bees may move and reduces the size of the brood chamber, allowing the hive to remain cool and well-protected from weather and other threats.

Embedder: It is a little tool with a circular wheel or spur on top. It is employed to secure the comb foundation sheet to the frame's wires.

Drone Snail: It's a rectangular box with an opening on one side. A queen excluder sheet is attached on the opposite side. There is room for worker bee movement at the bottom of the box.

Pollen Trap: This trap's pollen-trapping screen removes pellets from the foragers' legs as they return.

Apiculture-produced goods

In addition to giving humans the priceless pollination services, honeybees also give valuable goods. As their name suggests, honey is the primary gift that honey bees provide; they also provide beeswax, pollen, royal jelly, propolis, and bee venom.

Honey

When honeybees collect, process, and store plant nectar and sweet deposits in their honeycomb, they create honey (Singh et al. 2012). Honey quality varies according to the kinds of nectar—both floral and extrafloral. There are two types of honey that can be extracted: uni- and multifloral. Even though they are uncommon, honeys can be grouped according to the source of the flowers, such as litchi honey.

Guidelines to Beekeepers

- The best places to keep bee colonies are those with little pesticide use or drift from pesticides.
- If it ever becomes essential to de-infest beehives, the person handling the hives should only use pesticides that are safe for the bees.
- It is always best to keep the bees inside their hives during bloom if nearby crops are being sprayed with insecticides.
- Farmers and apiarists should work closely together to prevent the latter's reckless use of pesticides endangering the beneficial activity of bees.
- Feeding sugar syrup to colonies after pesticide application to minimize foraging by bees may significantly reduce the amount of pesticide exposure for bees.

Guidelines for Farmers

- If using pesticides is an option, then only the substances in the less dangerous categories should be used.
- It is usually ideal to spray in the evening when bee activity is lower and there is a better deposit and distribution.
- Use sprays or granules rather than dusts. During the blooming season, it is best to avoid using baits intended to deter fruit flies.
- Before applying a spray, check fields and field edges to see if bees are feeding on blooming weeds. When possible, tillage or mow the weeds to remove them.
- Pay close attention to how bee colonies are positioned in relation to the direction and speed of the wind. Reducing pressure or switching out the spray nozzles can enhance droplet size and decrease spray drift.

Constraints in Beekeeping in India

As was previously mentioned, honeybees are seriously threatened by the careless use of pesticides (Shinde and Phadke 1995; Kaur 1998; Kumar 2000). Inadequate management of colonies is made possible by a lack of qualified bee workers and honeybee professionals. Numerous commercial beekeepers encounter challenges, such as police and octroi meddling during their colonies' travel. According to a Punjabi poll, 37.5% of beekeepers are dealing with these issues. In migratory beekeeping, the expenses of transportation are likewise substantial (Kaur 1998; Sharma et al. 2014). One of the main issues with beekeeping is the depletion of floral resources due to the expansion of concrete jungles. Bee boxes are placed in fields where round-the-clock maintenance is not possible, and box theft occurs (Bansal et al. 2013). Numerous beekeepers complain that the expense of equipment is prohibitive, which deters prospective business owners from entering this industry. Honey does not have its own market; instead, beekeepers sell their product to nearby markets. Due to their lack of awareness of the international standards, the majority of commercial beekeepers are concerned about exporting honey (Bansal et al. 2013; Sharma et al. 2014). The primary source of honey in southern India comes from rubber plantations, and because of the high moisture content of this honey, local beekeepers are unable to export it. The beekeepers are often irritated by the extremely low producer price for honey and other beekeeping goods when compared to retailer prices (Singh 2000).

CONCLUSION

The world total honey production during 2013 was 2.13 million tons of honey were produced worldwide in 2013. With 466,300 tons produced, China is the world's top producer of honey; India comes in seventh place with 61,000 tonnes. India has a lot of honeybee land. The variety of plants offers additional chances for the beekeeping industry to grow. India is said to have the ability to support over 100 million bee colonies, although the present number is fewer than one million, based on the area under cultivation and bee feed crops. It is imperative that beekeeping be acknowledged as a crucial agricultural endeavor aimed at augmenting the yield of agricultural and horticultural crops. State line departments must to establish a dedicated section dedicated to beekeeping. The forest department ought to take the lead in establishing bee vegetation and grant beekeepers access to it. Beekeepers may stay up to date on the newest developments in beekeeping by attending free training sessions. Establishing efficient collaboration between beekeepers, traders, exporters, extension organizations, and the government is necessary. A lot of work should go into creating consumer goods and culinary items based on honey as well as heavily promoting honey in the media to increase the amount of honey consumed domestically. To dispel the illusions around honey and bees, comprehensive awareness and advertising activities are required.

The government needs to act to support beekeepers' economies by selling honey at the best price. The farmer should be aware of the concept effect of pesticides on honeybees so that the beekeeper is informed before spraying. The government is currently supporting organic farming, which is a beneficial endeavor to preserve bee health and consume organic honey (Bansal et al. 2013; Sharma et al. 2014). Sikkim was recently named the first organic state in India.

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