

# Apiculture Training Manual

## 1. Introduction

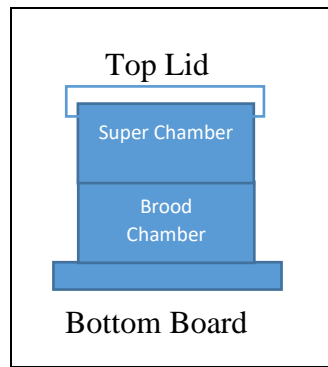
- The species of bees that are indigenous to India is *Apis cerana indica* which are generally cultured in a box within a controlled environment for honey production. Their habitat is normally in a dark place creating multiple hives in nature which is why they are cultured in boxes taking advantage of their affinity for dark places. Before the boxes for apiculture were invented, multiple hives of *Apis cerana indica* were usually found in dark cracks and corners of houses, in earthen pots, on trees that do not receive sunlight and provide abundant shade, and within hay stacks kept away from sunlight.
- In a box or colony, there are 3 types of bees – 1) Queen (only one queen/colony or box) 2) Worker or female bees from fertilized eggs (30,000 – 40,000 nos. in a colony), and Drone or male bees from unfertilized eggs (200 – 300 or 400 – 500 nos. in a colony). **(Pictorial representation has to be acquired)**
- From a colony or box of *Apis cerana indica* species, 20 to 30 kgs of honey used to be regularly procured 30 years ago. The boxes of this species are usually not moved and the bees can be cultured in one place (Static Bee Farming).
- During the period spanning 1970 to 1971, due to a virus attack the entire species of *Apis cerana indica* in India was destroyed. Before this event, a non-indigenous larger species of bees named *Apis mellifera* was brought from Italy to Punjab, India during the year of 1964/1965 and these particular species were cultured by bee farmers all over India as an alternative to *Apis cerana indica*. This species was more commercially viable as up to 200 kg of honey production from a single colony was recorded in the year 1980 but presently the amount of honey production from a single *Apis mellifera* colony or box has reduced to 30 to 40 kg. This species is bigger in size with a huge appetite (generally a concentrated sugar solution is fed to the bees) resulting in greater production of honey.

### I. *Apis dorsata* (Bengali – Dansh Moumachi or Pahari Moumachi)

- Most common worldwide with the best production honey when it comes to quantity. This species is only found in the Sundarbans in West Bengal.
- This species does not stay in one place for more than 6 months. They move to plains or flat terrain when the nectar from the mangroves of Sundarbans are exhausted during the month of April & May.
- They are migratory in nature and therefore cannot be cultured or farmed in boxes. They normally create huge hives in open places in nature. They are fierce and they tend to attack and even have caused human deaths due to the potency of the venom in their sting.
- Normally, honey is extracted from the hives by squeezing the honey out and the collection can be done 3 times from each hive resulting in a minimum quantity of 30 to 40 kg of honey produced every time.
- The process involves smoking the bees out of the hive and then cutting the hive and extracting the honey. Protective gear is a must during the extraction process for this species of bee.

### II. *Apis mellifera* (Commercial Apiculture)

- Most common adaptive species in the world and in India. This species is predominantly used for commercial honey production.
- Illustration of a common box used for rearing of bees.



- The brood chamber is where the Queen Bees lays her eggs and subsequent transformation of pupa and larva takes place. Super chamber is where honey is produced. Depending on the health and population of the colony, multiple super chambers (up to 9 max.) can be installed on top of each other to collect more honey.
- For *Apis cerana indica*, the size of super chamber is half the size of brood chamber while in the case of *Apis mellifera*, the size of both chambers is the same and the chambers can be interchanged and used accordingly.
- *Apis mellifera* produces honey from various sources of nectar from Oct/Nov to April/May of next year. The sources and schedule of availability of the same is illustrated below.

Sr. No.	Source of Nectar (Major Flora)	Duration of Availability
1.	Eucalyptus	October/November
2.	Mustard	December
3.	Coriander (Dhone)	↓
4.	Black Cumin (Kalo Jeera)	↓
5.	Litchi	↓
6.	Mangroves (Sundarbans)	April/ May
7.	Minor Flora such as Sesame (Til), Hog Plum (Amra),Olives (Jalpai) etc. after Mangroves	Due to migration of bees (Boxes) in the saline environment of Sundarban, the bee population reduces and so to sustain and increase the population these sources of nectar are chosen after mangroves, and migration of bees in boxes is done accordingly.

- Honey produced from Eucalyptus is exported to various countries as the quality of honey produced is of high quality. Another factor is that no insecticide is applied to eucalyptus trees.
- Honey produced from Mangroves has high water content in the honey (23 – 24 %) and is not exported outside India even though the benefits and taste of Sundarban Honey are among the best.
- Honey produced from Litchi has the best colour (golden) and is rich in taste.
- Floral nectar has about 80% water content and 20% sugar and it is converted to Honey which has about 20% water content and 80% sugar by each individual bee weighing less than 1 gram. Honey is only made by the worker bees to sustain the population in the brood chamber and the excess is collected by humans for consumption.
- To collect 1 drop of nectar, one bee has to go to the source (flora) almost 400 times.

- Apis cerana indica bees travel to a maximum distance of 1 km in radius from their colony to collect nectar and pollen while Apis mellifera covers a distance of 2 km in radius from its colony or box.
- When nectar is brought into the colony by a bee, the same is consumed, digested, and excreted by multiple bees and enzymatic reactions within the digestive tract of the bees convert the nectar into honey.
- A Queen belonging to the Apis cerana indica can lay about 200 to 800 eggs daily while a Apis mellifera queen can lay about 1200 to 2000 eggs. In her lifetime, a Queen Bee can lay about 25 to 30 lakh eggs.

### III. Apis florea

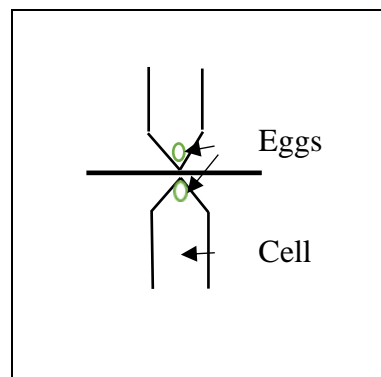
- Another species in India found in bushes and open spaces, normally in a single hive.
- The size of the bees is small and cannot be farmed in boxes.
- Honey from Apis florea is of high medicinal value.
- Honey production is low – from about 500 gm to 1 kg per year.

### IV. Trigona (Dummer bee)

- Stingless Bee (small in size)
- Small Hive made out of wax and soil.
- A spoonful of honey is produced per year.

#### 2. Life – Cycle of Bees

- Illustration of a typical cell within a colony or hive with eggs



- When the Queen first lays an egg, it stays in that same form for 3 days only. On the first day, the egg stays at 90 degrees vertical, the next day it lays at a 45-degree angle, and finally, on the third day, it lays flat (Horizontally). After 3 days, a larva comes out of the egg. The larvae are fed by the worker bees and it gradually transforms into a pupa and finally into a bee.
- **Queen – from egg to bee – 14 to 15 days. Lifespan – 4 years.**
- **Worker (female) bee – from egg to bee – 21 days. Lifespan – 6 months.**
- **Drone (male) bee – from egg to bee – 24 days. Lifespan – 6 months.**
- Worker (female) bees do not lay eggs. In exceptional situations, when the Queen Bee is killed by an enemy attack or killed by human contact while handling the colony or box, the worker bees try to save and sustain the colony and will lay eggs. In the initial

10 -12 days after the death of the Queen, the worker bees attempt to make a Queen from the already laid eggs. If they fail, then a few worker bees lay eggs in the cells and those worker bees are named **Laying Worker Bees**. At the same time, this event which results in presence of Laying Worker Bees, it becomes extremely difficult to save the colony or box. So it is vital and imperative to always check on the health of the Queen Bee in a colony or box at regular intervals.

- The main function of drones or male bees is to copulate with the Queen Bee. When the Queen starts to lay eggs, the worker bees keep the food reserved for the colony in such a way that the drones are unable to get to the stored food and they subsequently die of starvation or are driven out of the colony. The colony almost became free of drones at that time.
- A worker bee has no childhood and it performs duties right after its transformation into a full-fledged bee.

Days	Duties
<b>1-3 days</b>	<ul style="list-style-type: none"> <li>▪ First duty is to clean and repair its own birth cell with wax.</li> <li>▪ Regulate the temperature of the colony. The ideal temperature of a healthy colony should be around 20 to 35 degrees centigrade or 70 to 95 degrees Fahrenheit. In the summer months, a worker bee cools the colony by bringing water and fanning by moving around. In the winter months, a worker bee raises its body temperature with the intake of honey thus increasing the overall temperature of the colony.</li> </ul>
<b>3-6 days</b>	<ul style="list-style-type: none"> <li>▪ Creates “ Bee Bread” by mixing honey, pollen &amp; water.</li> <li>▪ Feeds the “ Bee Bread” to the larvae of worker and drone bees</li> </ul>
<b>6-14 days</b>	<ul style="list-style-type: none"> <li>▪ During this period, a gland is formed on the head of the worker bee named the <b>Hypopharyngeal Gland</b>, which dries up after 14 days.</li> <li>▪ Milk-like secretion from this gland in high protein content called the “Royal Jelly”.</li> <li>▪ The Queen Bee, from its larval stage till death, eats only this particular “ Royal Jelly”.</li> <li>▪ Apis Mellifera species produces a lot of “ Royal Jelly” and is of high commercial value @ Rs 20000/Kg.</li> <li>▪ <b>“Royal Jelly” has to be stored at -4 degrees Celsius right after collection from the colony.</b></li> </ul>
<b>14-18 days</b>	<ul style="list-style-type: none"> <li>▪ A worker bee has 10 chambers in the abdomen including a separate honey chamber. The 4<sup>th</sup> to 7<sup>th</sup> chamber produces wax at this age which solidifies in contact with air. This wax is used to build the colony or hive.</li> <li>▪ The commercial value of bee wax is very high @ Rs 500/kg.</li> <li>▪ A group of worker bees takes up about 35 kg of food to produce 1 kg of wax.</li> </ul>
<b>18-21 days</b>	<ul style="list-style-type: none"> <li>▪ Works as guard in front of the colony or box by staying on the bottom board.</li> <li>▪ Queen Bee has a unique smell or pheromone which designates the colony and makes each colony unique.</li> <li>▪ Every half an hour, the worker bee takes up the pheromone from the Queen to identify itself with the colony.</li> </ul>

**After 21 days till death**      ▪ Collects nectar.

### 3. Miscellaneous Information on how to extract the Queen from a natural hive to a new box

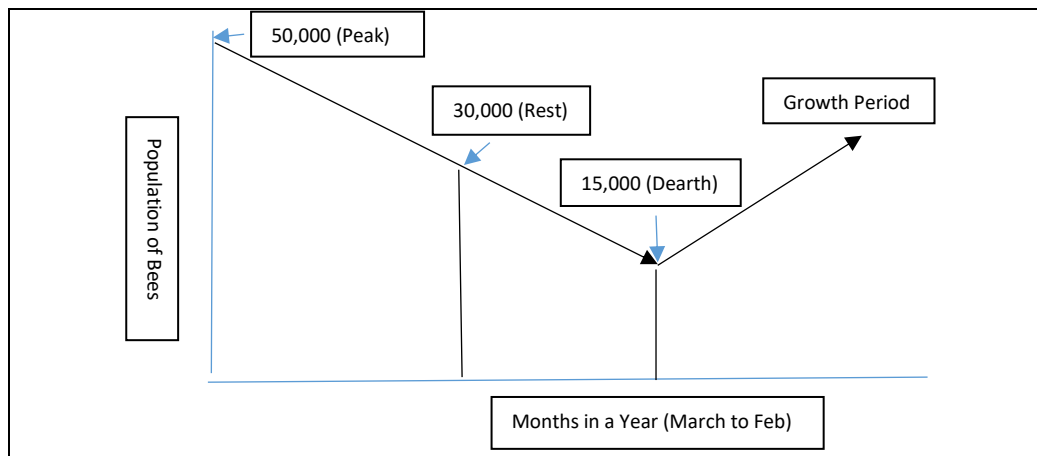
- Protective gear must include a face veil to protect from stings. Venoms of bees are equally potent as those of snakes and other poisonous insects but since each sting has a minute quantity of venom it is less lethal to humans. It is to be noted if one bee stings a person, other bees will follow the smell of the venom and try to sting the person. A person who is attending the colony or box should never use any artificial perfume as it will attract more stings from bees.
- Second protective gear will be the “ Smoker” where the coconut coir or dried cow dung cakes are burnt to create limited smoke. No other fuels should be used.
- With the application of limited smoke, the bees in the front of the hive will retract.
- If the Queen is seen, extract the Queen with some worker bees in a small box carefully (e.g. matchbox) and place them into the new box.
- The original hive without its Queen, is cut from its natural environment with the help of a knife.
- The cut edge of the hive will be placed in the frame within the box. If required, this process is repeated to include multiple cut pieces of the original hive within the separate frames of the box. The cut pieces are tied to the frames. **(Pictorial representation has to be collected)**
- Collect the extra bees with a wet cloth (gamcha) and move them to the frames.
- Once the Queen is placed in the box, all the other bees will naturally come into the box.
- The box is then moved 1 km away from the source hive. From that day onwards for 3 days the bees are fed concentrated sugar syrup which will help the bees settle into the new colony or box.
- Generally, in a box, 8 frames within the brood chamber contain the eggs, larvae & pupae and the super chamber holds the honey or food. When all 8 brood frames have a healthy population after a year, certain parts of a brood frame become black due to repeated use of its cells by the bees. Those blackened parts are cut off and the cleaned brood chamber is moved within the super chamber. Another new frame is added to the brood chamber to bring the number back to 8.
- In a box within a year, 50 % of the frames are replaced with new ones.
- During monsoons, bees have multiple predatory enemies such as lizards, wasps, hornets, cockroaches, frogs etc. which attack the hives, kills the bees, and take up the honey. Replacing old frames with new ones prevents these attacks.
- *Apis cerana indica* has a particular enemy in Wax Moth in the monsoons which lay eggs in the bottom board. If the box has old brood frames the attacks of Wax Moth will be more as the larvae take up the elevated quantities of nitrogen present in the old frames for their growth. The increase in the population of Wax Moth in the box will result in the desertion of bees from that box. The bottom board infested with Wax Moth will be covered with a cobweb-like formation. **Wax Moth is not an enemy of *Apis mellifera*.** To prevent such infestation, the bottom board should be cleaned once a week

and put under direct sunlight for a while. It should be noted that Wax Moth doesn't infest new or fresh brood frames as they have less quantity of nithemogen in it.

- Care should be taken that the box is not placed in a damp environment, smoky environment, or in a thickly populated area. The box must be kept in a North-South orientation with the sunlight hitting the box from the East. During monsoon, the box should be kept on elevated platforms.
- Bees belonging to the *Apis cerana indica* species are active from 4 degrees Celsius but bees from *Apis mellifera* need atleast 8 degrees Celsius temperature.

#### 4. Procedure to increase the number of colonies or boxes from an existing healthy colony or box

- A year is divided into 4 periods relevant to Apiculture
  - Peak Period ( March, April, May, & June)
  - Rest Period (July, August, & September)
  - Dearth Period (Oct, Nov, & December)
  - Growth Period ( Jan & Feb)
- Peak Period – Blooming period of all flora resulting in collection of nectar and high production of honey. Colonies or boxes are augmented during this period. as this the beak breeding time
- Rest Period – During monsoon, honey production and activity in the colony is greatly reduced or even stopped.
- Dearth Period – Population of bees starts reducing in the colonies or boxes.
- Growth Period- This is the breeding time where Queen starts laying eggs.
- In a healthy box with 50,000 bees, the relevance of the above-mentioned period with reference of the population of bees within the box is illustrated in the graph below.



- During the summer or growth or breeding period, the bees display an intent of colony division. In the external side of the colony or hive, queen cells are created where the existing/old queen lays eggs and the worker bees keep on feeding “Royal Jelly” to the queen larvae and the mouths of the cells are sealed.
- During this period, on a sunny day, the existing old queen along with some workers and drones leaves the colony to give space for the new queen. This phenomenon is called **Swarming**. They generally settle in a medium-height tree near the old colony

- After 14 to 15 days, when the new queen emerges from the cell, the other cells with queen larvae are cut off and destroyed by the worker bees. The new queen takes over the old colony and starts copulating with drones.
- The swarm of the old queen along with workers and drones is located and they are collected with a wet cloth and placed in a fresh box or colony, thus creating a new colony for the old queen.
- **Ideally, swarming should be avoided and the process of replication or augmentation of colonies should be started before the phenomenon of swarming.**
- Generally, two types of Swarm are noticed –
  - a) Prime swarm where the old queen leaves with workers and drones.
  - b) Cast swarm where subsequent newer queens leave the colony with workers and drones and there could be instances of many as 9 cast swarms occurring in a colony.
- Swarming also occurs when the queen takes a break from laying eggs and the workers have no larvae to feed with “Royal Jelly”, then the workers leave the colony. Another instance is when the population of worker bees increases to an extent where the majority of the worker bees can't find space to stay and work, then swarming occurs. Lastly due to overpopulation, the workers can't reach the queen to take up the pheromones from the queen and they believe that the queen has died and it is time for them to leave the colony.
- During the breeding season, there are patches of new drone cells created on the exterior of the colony as drones take 25 days to transform/mature into fully grown bees. After the drone cells, the queen cells are created in the colony. This is when the division of the colony is done.
- For example, 8 brood frames have a healthy population with the emergence of drone cells and subsequent queen cells. When the mouths of the queen cells are sealed off, 3 to 4 frames along with the old queen are taken out of the box and placed in a new fresh box. The fresh box is taken away to a distance of 1 km from the old box. Since the population in the old box is reduced, this prevents the phenomenon of swarming and at the same time, augmentation of colonies is also achieved. The new queen takes over the old colony or box.
- When a person (Beneficiary) has achieved thorough expertise in beekeeping, 2 newer colonies or boxes can be replicated or augmented from a single old colony or box, keeping the boxes at 1.5 feet apart from each other rather than taking the new boxes 1 km away.

##### **5. Prevention of Swarming in the old existing colony without replication or augmentation of new colonies (Steps below).**

- During peak summer, to keep the box cool a wet jute cloth must be placed on the box in the evening. This process must be repeated every day to help the bees regulate the temperature which they do by fanning. The cooler temperature in the colonies reduces the tendency of the bees to swarm.
- A source of water (bucket, pot, etc.) is placed near the boxes as the bees need large quantities of water during the summer.
- Whenever there is the emergence of drone cells on the colony, they should be cut off just to reduce their population hence reducing the breeding process, effectively reducing the urge of the queen bee to swarm without drones. The queen gate in the

colony is kept open and the worker bees drag the drone larvae out of the cells thus resulting in their deaths.

- Another step that is difficult and should be done with extreme care where the wings of the Queen bee is detached preventing her to leave the colony.

#### **6. Desertion (The entire colony or box is abandoned by the bees)**

- Starvation is one of the prime reasons. The bees in the colony are either not getting food from nature or from the beekeeper (beneficiary).
- Extreme temperature (Too much cold or hot weather).
- After the drone cells are detached, the worker bees are unable to extract the drone larvae out of the cells as the Queen gate is closed in the colony. This causes the drone larvae to decompose and emit a putrid odour which results in desertion.
- Enemy attack on the colony.

#### **7. Reasons for the creation of a new Queen in a colony**

- Swarm Impulse – The old queen moves away to make way for the new queen. It is to be noted that even the new queen has an impulse to swarm away due to genetic lineage.
- Supersedure impulse – A natural way of replacing the old queen with a new queen by the bees without the beekeeper's intervention.
- Emergency impulse – when the old queen dies due to an accident. The workers create emergency queen cells from larvae present in the colony after 3 days but due to scarcity of “Royal Jelly” within the worker bees results in the development of a fragile and weaker Queen.

#### **8. Laying Worker Bees**

- They lay eggs when the Queen has died in the colony as a part of their attempt to sustain the colony. The larvae from the eggs laid by worker bees feed on “Royal Jelly” and they grow into large-sized worker bees pretending to be queens and they stop carrying out the duties of a normal worker bee. They even kill the new Queen Bee introduced into the colony.
- Steps should be taken to get rid of these laying worker bees. For that exercise, the box should be taken 100 yards away in the evening, and shake all the bees out of the colony. The laying worker bees will not be able to return to the colony and the rest of the workers and drones will return to the original colony. Then a rearing frame is introduced to the colony to create a new Queen for the colony.

#### **9. Uniting colonies**

- Every single colony shows different characteristics of bees with different rates of growth and honey production. Generally, an unhealthy colony is merged with a healthy colony. Every day, the weaker colony is brought closer to the healthy colony by 1 foot till both colonies are placed side by side. Then the queen is extracted from the weaker colony. Then the brood chambers of the weaker colony which is without the queen are placed on top of the brood chamber of the healthy colony separated by a piece of paper or newspaper with multiple holes. The affinity of honey in the healthier colony will tempt the bees of the weaker colony to move towards the healthy colony thus uniting



them. This process should be done gradually to homogenize the smells of both the colonies or boxes for the benefit of the bees.