

## **Animal production**

### **Level-III**

**Based on May 2023, Version -4 Occupational  
Standard**



**Module Title: Performing apiculture production**

**LG Code: AGR ANP3 M03 LO (1-6) LG (7-12)**

**TTLM Code: AGR ANP3TTLM 0523v1**

**May, 2023**

**Adama, Ethiopia**

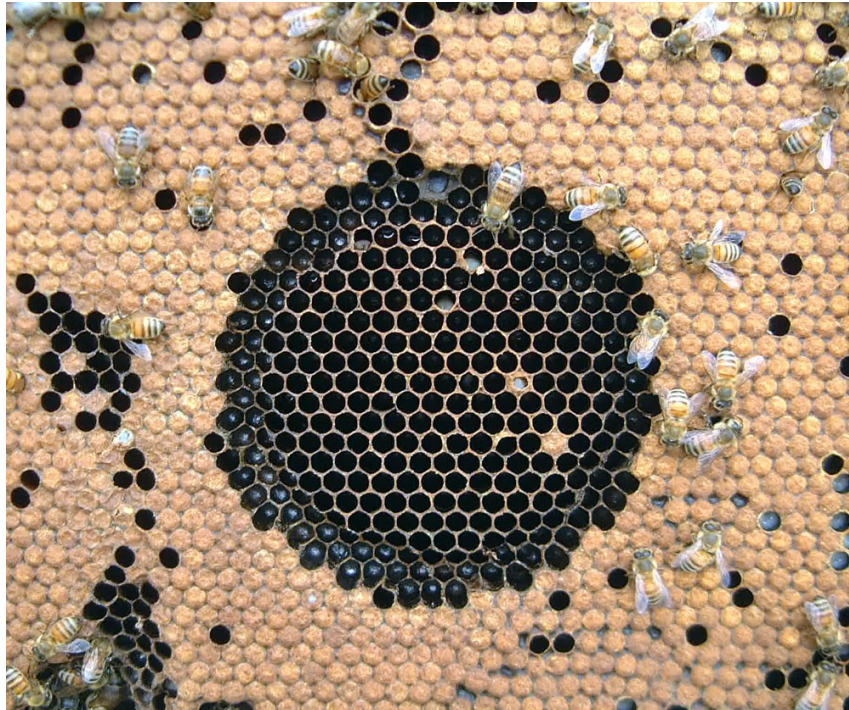
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## Introduction to module

This module covers the knowledge, skills and attitude required to identify species and races of honey bee, perform beekeeping operation to establish and monitor queen rearing and re-queen honey bee, manipulate honey bee brood, manage honey bee swarm, remove and extract honey crops and prevent and control pests and diseases in beekeeping activity.



LG#7

## L01. Identify species and races of honey bee

### **Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content and topics:

- Describing history and advantages honey bees
- Describing races of honey bees
- Describing Duties of honey bee casts

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

following content coverage and topics:

- Describe history and advantages honey bees
- Describe races of honey bees
- Describe Duties of honey bee casts

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

## 1.1. Describing history and advantages honey bees

### 1.1.1. History of honey bee in Ethiopia

- In Ethiopia, beekeeping has been a tradition since long before other farming systems. Even though it is an oldest farming system there is no well documented evidence that indicates when and where beekeeping practice started in Ethiopia. The Hieroglyphs of ancient Egypt refer to Abyssinia (ancient name of Ethiopia), as source of honey and beeswax.
- The country has a high potential for beekeeping as the climate is favorable for growing different vegetation and crops, which are a good source of nectar and pollen for honeybees. The country is the leading honey producer in Africa, and is one of the ten largest honey producing countries in the world.

### Advantages of honey bee

- It used as source of food and other products
- It can be started with limited capital.
- All the necessary inputs required for beekeeping are available locally.
- Any one regardless of age and sex can do it
  - ✓ It doesn't require valuable land used for crop farming and other animal production. It improves the ecology. The honeybee provides **pollination service**. Bees do not over-graze as other animals do.
- The honeybee produces honey, beeswax, pollen and propolis...that can be marketed locally and abroad, thus generate income for the beekeeper.

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- Beekeeping does not involve mass feeding, because bees can collect their own food source
- As source of medicine
- Conservation of natural resources

## 1.2. Describing races of honey bees

There are various types of bees which include the stingless bees, **solitary bees**, **social bees**, social including the bumble bees (*Bombidae*), **stingless bees** (*Meliponidae*) and few species of **social honey bees** (*Apidae*). Bees that produce enough honey to make harvesting valuable belong to two sub- families' honeybees (Apinae) & stingless bees (Meliponinae). The **Bombidae** are found mainly in temperate climates. Their nests are very small, often in the ground and no commercial importance except as pollinators of certain plants. The *Meliponidae*, or stingless bees, occur throughout the tropical regions of the world. In addition, their nesting places are pots in the ground, hollow trees or small cavities in walls and underside of branches and the family *Apidae*, to which the honeybee belongs, is indigenous only to Europe, Africa and Asia.

### 1.2.1. Species and Races of Honey Bees

*Apis reniformis*, *Apis cerana*, *Apis cerana indica*, *Apis dorsata*, *Apis dorsata binghami*, *Apis florea*, *Apis laboriosa*, *Apis mellifera* and *Apis vechtii* are the 9 species of honeybees. Among these, 5 ***Apis cerana/indica***, ***Apis dorsata***(the giant honeybee), ***Apis laboriosa*** (the darker giant honeybee), ***Apis florea***(the dwarf honeybee) and ***Apis mellifera*** are the major honeybee species considered as economic important species. Of these five species of honeybees, *A. mellifera* has greatest economic importance and widely distributed all over the world.

Race in honeybees is a result of natural selection and honeybees have been adapted to different geographical areas of the world for many years without the interference of mankind. there has been an environmental effect on the **anatomy** and **physiology** of honeybees leading to differentiations. the races of honey bees are like:

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- African Honeybee races
  - Ethiopian honeybee races
  - European Honeybee races
- ✓ **African and European honeybees**, even though were from the same species, are differing in behavior, production and on some morphologically importance.

### 1.2.2. Honeybee races of Ethiopian (*A. mellifera* races)

There are 5 honeybee races are found in the country. Those five honeybee races occupying ecologically different areas

Character and distribution of those races are as follows:

#### ***Apis mellifera monticola***

- The biggest and darkest of all other races found in the country
- Found to exist in the northern high mountainous part of the country
- Has low tendency for reproductive swarming and migration
- Less aggressive than other races
- Has longest body hair than other races

#### ***Apis mellifera bandansii***

- The largest honeybees next to monticola
- Found in central highlands of the country
- Dark in colour, but has few yellow members
- Has longest body hair next to monticola
- Has high tendency for reproductive swarming
- Has less migration tendency than *A. m. jemenitica*
- Is less aggressive than *A. m. Jemenitica*
- Give better honey yield than *A. m. jemenitica*

#### ***Apis mellifera scutellata***

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- Occupy the wet tropical forest lands
- It is darker than *A. m. jemenitica* & *A. m. woy-gambella*
- Its population comprises some yellow honeybees
- Has higher tendency for migration
- It exhibits aggressive to highly aggressive behaviour
- Give better yield than *A. m. jemenitica*

#### ***Apismellifera jemenitica***

- Is the yellowiest honeybee but also consists black members
- Smaller than *bandansii*, *monticola* & *scutellata*
- Has less tendency for reproductive swarming
- Has high migration tendency
- Is aggressive than other races

#### ***Apismellifera woyi-Gambella***

- Found in the extreme western and southern semi-arid to sub moist low lands
- Found only in Ethiopia
- It is the smallest of all honeybee races in the world
- It has shortest hair cover
- It is predominantly yellow in colour, but also comprise black members
- Has less tendency for reproductive swarming
- Has intermediate migration behaviour
- It is aggressive to highly aggressive in behaviour



Figure 1.1: Honey bee

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### 1.3. Duties of honey bee casts

#### 1.3.1. Castes in bee colony

Honey Bees are social insects that live in colonies of about 10,000 to 60,000 bees. The honeybee colony consists of three casts (**Queen Worker, and Drone**). The queen and workers are females and developed from fertilized female eggs and drones are male and developed from unfertilized male eggs. Each member of the cast passes complete metamorphosis in its developmental stages. This means that there are four distinct stages in the life cycle of each cast- **egg, larva, pupa**, and **adult**. The first three stages develop in **comb cells** and are collectively referred to as the **brood**. Eggs and larvae are in open cells and are cared by **adult workers**. These stages are called the **open or unsealed brood**. Once the egg hatches, the workers continually feed the developing larva. When the larva nears the end of the larval period, it engorges on food provided by the workers, and the workers seal the cell. This is known as the **capped or sealed brood**. After the cell is sealed, the larvae changes into **pupal stage**. There is no feeding during this period. The pupa develops into the **adult form**, which emerges on its own from the cell.

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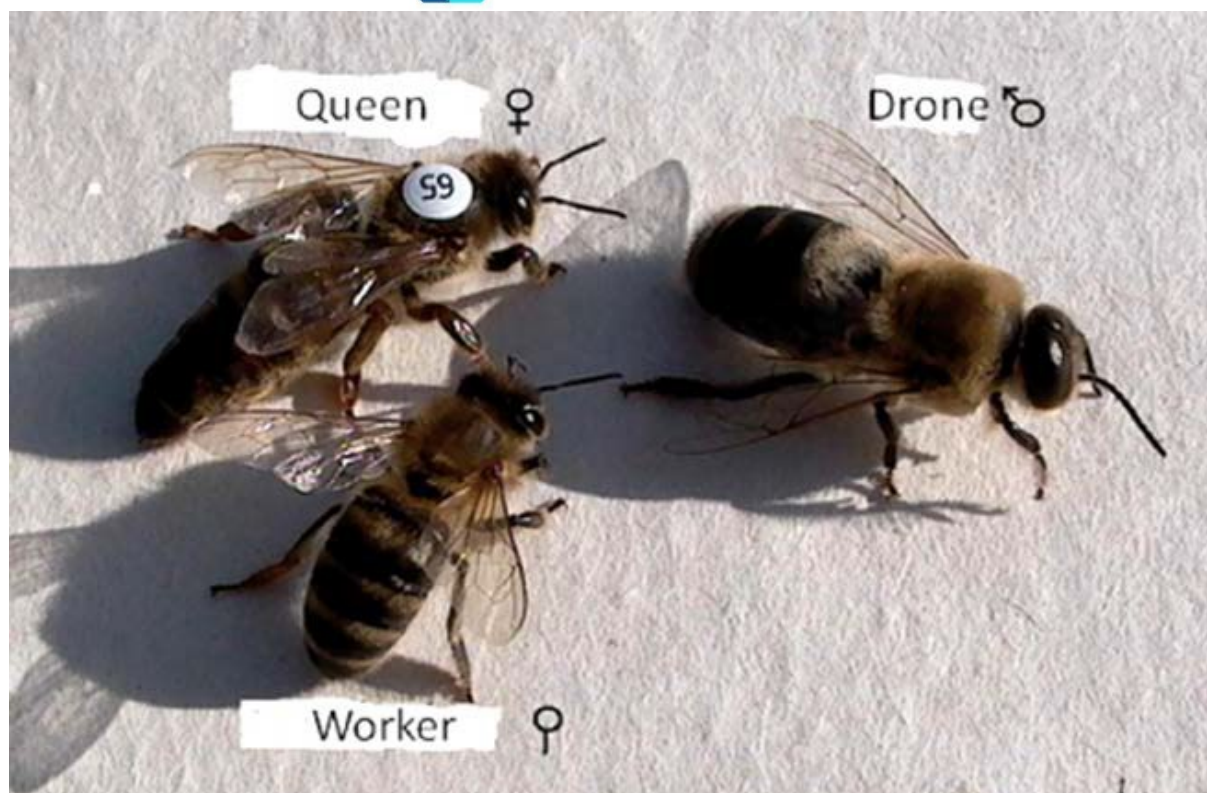


Figure1.2 :cast of bee

### 1.3.2. Duties of honey bee

#### Queen bee

The Queen bee is a reproductive female. There is only one queen in the hive and her job is to **lay eggs** and **produce queen substance** (pheromones). When a new queen starts life, she mates only once with drones outside the hive. A good queen lays between 1,500 - 2,000 eggs per day but after two years she lays fewer eggs. queen lives for three to five years. It is very difficult to find the queen but she can be recognized by her **long** and **slender body** and **short wings**. She is fed by the young workers and is bigger than the other occupants due to massive feeding especially with **royal jelly**. She has a sting that is only used against rival queens. Her pheromones or scents serve to control the other bees and harmonize the colony's behaviour. The Queen bee can be marked on the dorsal surface of the abdomen for easy identification and to avoid being crushed accidentally during hive manipulations. **generally queen bee:-**

- For laying an egg in each honeycomb cell.

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- produce queen substance (pheromones).

## Drones

The Drones are males and are **bigger than the workers**. They develop from unfertilized eggs and their major task is to **mate with the queen**. They are **stingless**, very large eyes which are used to **spot the Queen during mating**. Drones look large and square and make a loud buzzing noise when they fly. Drones are **dependent on the workers** for food because their **proboscis is short and cannot collect food for them**. There can be about 200 to 500 drones in a hive but in time of food shortage, the workers chase the drones out of the hive to die. Their lifespan is usually not more than 2 months.

## The Workers

- Most of the bees in the hive are workers- they are all sterile females. The worker bees' change tasks according to age. Young worker bees:-
  - ✓ clean the hive
  - ✓ feed both young and the Queen
  - ✓ make the beeswax combs
  - ✓ They control the temperature of the hive by flapping their wings and also
  - ✓ guard the hive.
- Older workers scout for food and collect the pollen, nectar, water and propolis. They have a **sting plus special glands and organs** to help them to defend the colony against enemies. The workers are also responsible for the honey formation process. The lifespan of a worker bee is **7-8 weeks** during the main flowering season when they work hard. They can live longer during dormant periods.

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• **As nurse, bees perform activities like:**

- ✓ Feeding larvae, (one larvae requires to be attended 1300 times)
- ✓ Feeding and grooming the queen,
- ✓ Packing of pollen
- ✓ Ripening of honey,
- ✓ Regulating hive temperature,
- ✓ Finally make an orientation flights before becoming field bees (foragers).
- ✓ Wax secretion and comb construction,
- ✓ Guarding their nest

Therefore, many nurse bees are required to do these activities especially during the honey flow season.

Table 1.1: summarizes the duties of worker bees starting from the first day they emerge as adults.

Day after emergence	Task performed
1-2	Clean cells starting by the cell she emerged from and warm the brood nest by forming cluster
3-5	Feed older larvae (larvae of ages 4 days and above) with the mixture of honey and pollen.
6-10	Feed larvae of ages 1-3 days (younger) with products of head glands (Royal jelly)
11-18	Ripen nectar in to honey, produce wax from their wax glands, construct combs
19-21	Guard and ventilate the hive, exercise flying, take orientation flights to familiarize themselves to the location of the hive
22 <sup>+</sup>	Forage for nectar, pollen, water or propolis based on the need of the colony

## Field bees

- After 22+ days workers serve as **field bees**
- During this period, they collect nectar, pollen, water and propolis
- collection is according to nest requirements
- In workers duty there is a flexibility of division of labor according to a colony needs
- Again, an optimum number of field bees are required to collect the available nectar during the honey flow season.

The life span of worker adults varies greatly with the time of year. During inactive (dearth periods), workers may live three months or more, but when the colony is active, few workers live for as long as six weeks.

### 1.3.3. Life cycle of a bee

Each bee in the course of its life passes through 4 stage metamorphosis: Egg→ Larva→Pupa→Adult. During the development stages, the eggs, larvae and pupae are known as brood. The egg laid by the queen looks like a small grain of rice or hair nit. Whether an egg will develop into a queen, drone or worker depends on the type of cell it is laid in (it is very important to learn the difference between **capped brood and capped honey** – capped brood is usually dark brown and capped honey is usually white or creamy in colour).

The egg develops into larva, which looks like a white maggot. All larvae are fed on royal jelly for the first **three days** after which larvae for workers and drones are fed on pollen and honey put into the cell by the nurse bees (younger worker bees). The **queen feeds on royal jelly** throughout the life.

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**Figure1.3: Peanut-shaped queen cell**



**Figure1.4 :queen cell**

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**Figure1.5: Pebbly textured drone cells**

The larvae are sealed with a wax capping in the comb after six days where they turn into pupae and later emerge as adult bees as shown in the table below.

**Table 1.2:** life span of bee

Cast	Egg	Larvae	Pupae	Total day
Worker	3	6	11-12	21
Queen	3	6	6-7	16
Drone	3	8-9	12-13	24

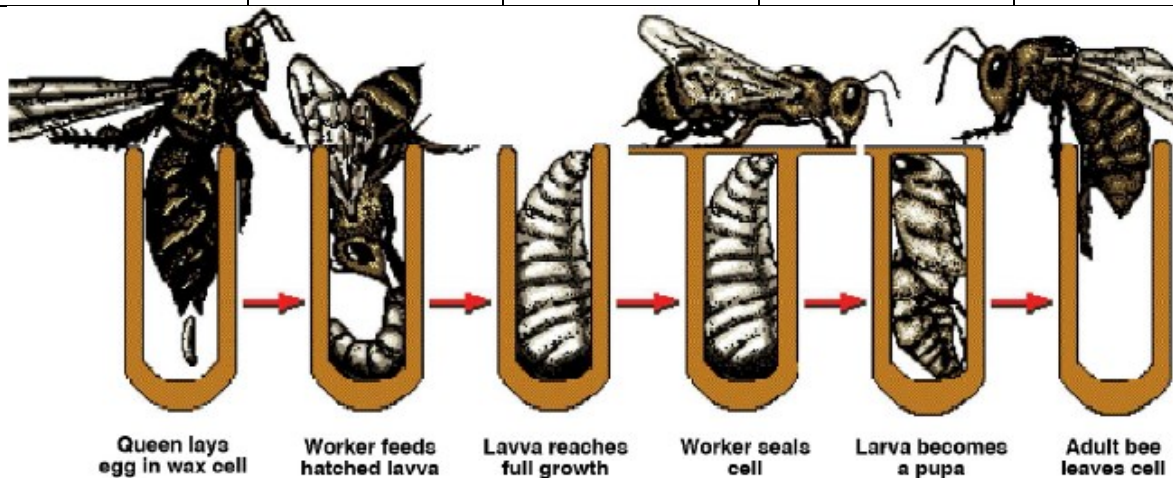


Figure 1.6: Life cycle of honey bee

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<b>Self-check 1</b>	<b>Written test</b>
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Name..... ID..... Date.....

**I. choice the best answer and encircle on it**

- worker bee duties changed depend on
  - size
  - age
  - color
  - A and B
- among one is the shape of queen cell
  - peanut shape
  - febby texture shape
  - round invisible shape
  - all
- which one of the following is **not** the advantage of honey bee
  - pollination
  - source of medicine
  - overgrazing of pasure land
  - conserving natural resource
- among one isfor feeding hatched larvae
  - worker
  - nurse bee
  - field bee
  - all

**II. Directions:** Answer all the questions listed below.

- List five honeybee races that are found in ethiopia
- write caste of honey bee and their function
- write the difference between capped brood and capped honey

## **Operation sheet 1**

### **Identification of honey bee species**

#### **A. Tools/ Equipments/ Materials required**

- Honey bee colonies
- protecting clothings
- smoker
- insect collecting net
- insect killing
- bottle
- insect pins
- insect collection box
- dissection microscope
- glass slides
- cover slips

#### **B. Procedure**

- Visit the habitats of wild honey bees (i.e. forest areas) and apiaries of hive honey bee species.
- Collect a few live bees of each species.
- Put them into the insect killing bottle.
- Pin the bees at the thorax and fix them in an inset collection box.
- Observe the bees of different species for their size, shape and colour.

LAP TEST	PERFORMANCE TEST
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Given necessary template, materials, tools and equipment you are required to perform the following task in **two** hours .The project is expected from all student to do it.

**Task 1:** prepare all materials, tools and equipment to identify species of honey bee in your apiary site.

LG#8

## L02. Identify requirements for queen rearing and re-queen honey bee

### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content and topics:

- Obtaining and confirming beekeeping tools, equipment and PPE
- Selecting productive breeding stock according to *breeding program criteria*
- Selecting Day-old larvae for grafting and transferring
- Confirming adequate numbers of nurse bees in cell raising colonies
- Placing grafted cells into starting colonies and finishing colonies
- Transferring ripe queen cells into nucleus and Confirming drones during mating
- Assessing Vigor of the current queen
- Monitoring signs of replacement queen
- Raising Queen bee from a nucleus colony and re-queen
- Raising Queen bee from a nucleus colony and re-queen
- Monitoring egg laying and level of hatching

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Obtain and confirm beekeeping tools, equipment and PPE
- Select productive breeding stock according to *breeding program criteria*
- Select Day-old larvae for grafting and transferring
- Confirm adequate numbers of nurse bees in cell raising colonies
- Place grafted cells into starting colonies and finishing colonies
- Transfer ripe queen cells into nucleus and Confirming drones during mating
- Assess Vigor of the current queen

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- Monitor signs of replacement queen
- Raise Queen bee from a nucleus colony and re-queen
- Raise Queen bee from a nucleus colony and re-queen
- Monitor egg laying and level of hatching

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
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5. Perform Operation Sheets
6. Do the “LAP test”

## 2.1. Obtaining and confirming beekeeping tools, equipment and PPE

### 2.1.1. Tool and equipment.

The necessary tools and equipment to rear queen bees are the following

- Appropriate lighting
- Bee smoker and fire extinguisher
- cell starting and cell finishing colonies
- First aid kits
- grafting material such as:
- Cell bar holders
- Cell bars
- Plastic cells
- Modified frame and cell bar.
- Grafting tool. This may be fashioned by the beekeeper from a toothpick or a matchstick with the end is flattened and bent.
- Royal jelly. Royal jelly is collected beforehand from uncapped queen cells and is diluted 1:1 with warm water.
- lower brood chamber
- Queen excluder
- Super
- Upper brood chamber
- grafting tools
- hive tools
- Hives
- Nucleus boxes
- Outdoor cooker pots and wax
- Record keeping equipment
- Sugar feeders.
- Artificial plastic queen cups

**NB:** To achieve queen rearing process successfully all above equipment have to be identified, selected and prepared

**Pollen Trap.** As its name implies, the pollen trap is used to scrape pollen pellets from the legs of foragers as they return to the hive. When a pollen trap is set at the hive entrance returning

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foragers have no way of entering the hive but to pass through the trap. As they do so, the pollen pellets attached to their hind legs are scraped off and fall into a receiving tray.



Figure2.1:Polline Collectors

**Queen Excluder.** The purpose of the queen excluder is to confine the queen to the brood box while allowing the workers to have access to the super, in order to ensure that the honey combs contain no brood. It is also used in producing **royal jelly**, in queen-rearing and in forming **multi-queen colonies**. The conventional excluder is designed to be inserted horizontally between the super and the brood box of a multi-storey hive, but vertical models also exist that can be placed between frames of brood and honeycomb in single-storey hives.

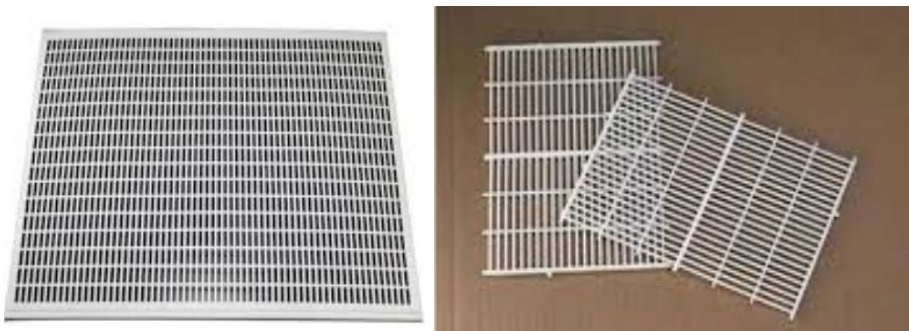


Figure2.2:Queen Bee Excluder

**Feeder.** At certain times of the year the beekeeper may wish to feed his colonies with sugar syrup as a food supplement, or to medicate them using syrup as a carrier. Among various types of feeders existing, two simple models can be recommended: the **division-board feeder** and the **feeding pail or, jar**. In the broad sense, the division-board feeder is a rectangular syrup

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container whose length is the same as that of a frame; it is designed to be placed within the hive in the same manner as a frame. To prevent the bees from drowning, chips of wood or Styrofoam are placed in the feeder as floats. Alternatively, plastic or glass pails or jars holding from 2 to 4 litres of liquid can be used feeders, provided that they have relatively large and tight-fitting lids in which small holes can be pierced. When in use, the pail containing the sugar syrup is turned upside down and placed on the frames, allowing the syrup to seep through the holes. An empty super is installed between the hive cover and the honey chamber, in order to close the hive.



Figure2.3:Division-Board, Jar and Pail Bee Feeder

**Hive Tool.** Honeybees use propolis to seal frames and covers to hive bodies and supers. In order to separate these various pieces (e.g. to open the hive or remove a frame for inspection) the beekeeper prizes them apart with a hive tool, which is also useful in scraping excess propolis or wax from hive parts. It consists basically of a length of iron or steel, flattened at one end. A good commercial hive tool may be made of spring steel, but the sawn-off end of a crowbar can furnish equally satisfactory leverage.



Figure2.4:Bee chisels

**Smoker.** The bee smoker, used to calm bees, consists of two principal units: a metal fire-pot with a funnel-shaped cover, and a bellows. Some good models are equipped with a shield for protection against the heat generated. A smoke-releasing fuel (e.g. dried leaves, grasses,

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wood shavings, rice hulls, etc.) is burned in the fire-pot, and air is injected into the pot by operating the bellows; the smoke is then directed at the bees through the funnel.



Figure 2.5 : Smoker.

**Bee Brush.** A soft camel-hair brush, used to brush the bees off combs and supers being manipulated, is considered one of the most necessary tools for harvesting frames of honey comb, particularly in small-scale beekeeping. In less sophisticated operations, a handful of grass or leaves may be used.



Figure2.6: Bee Brush

**Uncapping frock and Knife.** Worker bees seal honey-storage cells with a thin layer of wax, known as capping, which must be removed from the combs as a first step in honey extraction. Although normal long-bladed kitchen knives can be used for this purpose, the operation can be carried out with greater ease if heated knives are used. The beekeeper may

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use two knives and plunge them alternately in hot (preferably boiling) water, or he may decide to obtain a specially designed electrically heated knife or steam knife.



Figure2.7 :Uncapping frock and Knife

### Water Sprayer

Used to spray water on bees (especially at low land areas like Gamble) to reduce-

- Aggressiveness
- Immediate evacuation from their nest.



Figure2.8:Bee hive

### 2.1.2. Identifying and controlling OHS hazards associated with rearing queen bees

The major OHS hazard while rearing queen bees are the following

- Bee stings
- Fire
- Use of incorrect techniques when manually lifting

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The people who rear queen have to apply the necessary OHS requirements. This may include:

- Using of relevant protective clothing and equipment: such as
  - ✓ bee veil
  - ✓ gloves
  - ✓ Protective suit.,
- use of tooling and equipment,
- workplace environment and safety handling of material,
- use of firefighting equipment, enterprise first aid,
- Hazard control and hazardous materials and substances.
- Using gowns, rubber boots of appropriate size, Goggles, respirators, cap, and head phones , gloves etc,
- Following Occupational health and safety procedures designated for the task
- Checking and fulfilling required safety devices before starting operation

## **2.2. Selecting productive breeding stock**

### **2.2.1. Selecting Breeding stock**

The process of rearing queens begins with the selection of a mother queen of high quality, a selection of the desired stock to breed is very important. Honeybees are not the same, each race and colony has different traits from each other; these traits depend on selective breeding. If we breed from a colony with bad characteristics, we will be perpetuating these bad characteristics, similarly, if we breed from poor colony, the resulting queen will be inferior.

There is a large set of heritable traits in the honeybee colony and the breeder should select for desired traits. Some of the important trait in selecting bees are:

- Gentleness
- High honey production
- Early spring build up in population
- No or low level of swarming tendency
- Disease and varroa mite resistance
- Quite on the comb
- Good comb builders
- Ripens honey rapidly
- Honey comb capping is white
- No or low propolis producers

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- Good wintering quality
- No or low followers (i.e. bees do not follow the beekeeper when leaving the apiary)
- Economical brood rearing when nectar flow is low or stopped.
- Bees that fly out at lower temperatures.

It is impossible in queen rearing to get all these characteristics at the same time, however, 3 or 4 items on this list will be achieved.

### 2.2.2. The desired stock to breed

In order to produce good queens the following is required:

**Breeder queen:** It is very important that the beekeeper should choose a queen mother from the best hive in his apiary that is one that lays well and produces a lot of brood.

**One-day-old larva:** about the same size as an egg, the best queens are raised from 24 hours old larva. A one-day larva has a crescent shape, and older larva is curved into the letter C, and fills the cell all the way. Old larvae are too old for queen rearing and will be rejected by the bees.

**Cell raising colonies:** Bees will not raise a queen if their queen is present in the hive. To induce bees into raising queens, the queen in the raising hive must be removed 1 to 2 days before insertion is made. By so doing, the contact with their own queen is broken and the bees become in an emergency mood (queenlessens). The emergency mood is absolutely necessary for the start of queen raising.

**A queen-raising colony should be vigorous** and have a lot of young bees at age suitable for feeding larvae and constructing queen cells, that is between 5 and 20 day old bees.

**A single hive body** is used when only a small number of queen cells are to be raised, and should have at minimum eight combs thickly covered with bees. Weak colonies produce inferior queens and are unsuitable for queen raising.

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**Sufficient food (nectar and pollen):** A Colony used for queen raising ought to be well supplied with uncapped honey and pollen frames. If there is no nectar and pollen coming in the hive, it should be fed with syrup and pollen to stimulate the production of royal jelly and the secretion of wax, which is needed for feeding and constructing queen cells. The beekeeper must ensure that there is plenty of pollen in the hive, because nurse bees eat pollen to be able to produce royal jelly. In contrast, poorly fed queens will have underdeveloped ovaries and will have a shorter productive life.

**Ample drones to mate with the newly emerged virgin queens.** A virgin queen mates approximately with 10 to 15 drones, it has been estimated that a drone population of approximately 30 drones per queen is needed for excellent mating. A strong hive may have between 300 to 500 drones at peak periods. If there are lots of drones flying in the apiary, the queen can get mated with those local drones.

**Suitable weather for mating of queens and drones:** Both queens and drones are stimulated to fly on a sunny day with a temperature about 21 to 27°C. During a rainy day or unfavorable weather queens will not fly out for mating. In contrast, poorly fed queens will have underdeveloped ovaries and will have a shorter productive life.

### 2.2.3. Time of rearing queen bee

- In general, the best time for producing good quality of queens is when **nectar and pollen are abundant** and there are enough drones available to ensure successful mating.
- Raising queens so late in the season is not recommended as emerged queens may not have a good chance of mating; queens that have not a sufficient amount of sperms at mating time are bad layers and will be superseded by bees.

### 2.2.4. Importance of queen rearing

#### 1. To improve the genetic conditions of a stock

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- The success in beekeeping partly depends on the nature and performance of the queen, that is:

The behavior of a colony like: aggressiveness, swarming and migratory tendencies, hording ability and other party governed by heritable traits that pass from the parent. The productivity of the colony in most cases is proportional to the population size of a colony, which is again depend on the prolific and population build up nature of a queen.

## **2. To requeen the old queen**

The commercial lifespan of the queen is 2 years. When the queen become old, the number of eggs laid becomes less or the queen may run out of stored sperm in the spermatheca and it may only lay unfertilized eggs, which become only drones and that bring the colony totally unproductive.

## **3. To replace a sudden loss of a queen**

During hive operation or some other reasons a queen may die and very strong may be queen less. Having extra queen is very important to rescue such queen less colonies.

## **4. To multiply colony**

- As a source of income
- To increase the existing stock

### **2.2.5. colony with good characteristics**

**We have to requeen colonies that show the following characteristics:-**

- Low bee population for no apparent reason other than a failing queen
- Bees that are particularly susceptible to diseases or mites
- Queen laying more drone than worker eggs
- Unmated or injured queen that is laying drone eggs, or drone and worker larvae scattered over the comb
- Diseased queen, brood or workers
- Defensiveness
- Excessive propolizing

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- Too much debris on hive floor (non-hygienic)
- Poor wintering success (very weak)
- tendency of swarming
- High honey consumption
- Poor honey production
- High ten

#### 2.2.6. Stock mated in an isolated area or select tested

controlled mating in the honeybee appears to be especially hard to achieve. A few days after hatching, the queen leaves the hive to mate with several drones in flight(mid-air) with an average of 12 drones from neighboring hives . Because she must fly some distance from her colony to mate (**nature's way of avoiding inbreeding**), she first circles the hive to orient herself to its location.

The queen leave the hive by herself and is gone approximately 13 minutes. Drones are able to find and recognize the queen by her **chemical odor (pheromone)**. the two most practical control mating of honey bee is **Isolation**, by placing colonies containing the 'breeding individuals (virgin queens and drones) in a location far away from other bees and **artificial insemination**, by taking semen from one or more drones and injecting it into the queen by means of special instruments.

#### 2.2.7. Breeding program criteria

Queen breeder produces new queens with the goal of **maintaining and improving high quality stocks**. Many honey bee behaviors are influenced by heritable genetic traits. As the mother of the entire colony, the qualities of a particular queen are expressed in every one of her offspring. These traits can have profound effects on the behavior and health of the whole colony:-

**Temperament:** The reaction of a colony when it is approached, opened or otherwise disturbed can be a genetic trait. Africanized bees are particularly known for their extremely defensive behavior. Gentle strains are especially important when keeping bees in urban settings.

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**Mite tolerance:** Parasitic mites are among the greatest problems for beekeepers. The effectiveness of current mite treatments is limited, and their use has other detrimental effects on colony health. Breeding bees which are able to remove or resist parasites without the assistance of beekeepers is an important step for improving the health of the beekeeping industry.

**Disease resistance:** Bees that exhibit hygienic behaviors are able to detect and remove diseased brood at a very early stage of infection. This behavior greatly reduces the chance that an entire colony will become infected with a contagious pathogen.

**Colony population growth:** Some colonies will adjust their brood rearing to seasonal conditions. They may increase in size prior to a nectar flow, ensuring more foragers to collect nectar. They may also reduce their population during times of summer dearth or approaching winter, which allows them to use stored food more efficiently. Other colonies maintain a large population and brood area despite conditions.

**Honey production:** Some colonies of bees will be better producers of honey than others in the same apiary. Honey production is dependent on outside conditions as well as colony population, brood production and overall colony health. Typically, strong, healthy colonies are better producers of honey, and therefore, good honey production often indicates good overall colony health

**Status of hive** being re-queened should be checked to make sure it is queenless and availability of Queen candy which is used to plug the opening of the cage

### 2.2.8. Conducting queen rearing

**Queen rearing:** - is a process of producing virgin queen in a colony of honeybee. Good queens are a prerequisite for successful beekeeping for all practical purposes. **Generally the following points indicate the importance of queen rearing:**

- ✓ For requeening the existing queen:- actual life span of queen is 5 years
- ✓ But commercial life span of queen is 2 years for Ethiopia (tropics)

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- ✓ To improve the genetic qualities of the bees
- ✓ To have extra queens so that colony number will be increased
- ✓ To replace for sudden loss as emergency

Therefore, queen rearing is not only one aspect of beekeeping but also important aspect and prospective business as trading and marketing of package bee colonies by queen rearing. Generally, there are two types of queen rearing, Natural queen rearing and artificial. Natural queen rearing is done by the colonies and it occurs during active period depending on weather, strength of the colony and the swarming tendency of the bees. Some beekeepers use swarm cells to requeen colonies or introduce to new colonies when making splits. However, this practice is not recommended in modern beekeeping, since it perpetuates (brings) the tendency of swarming in bee colonies from one generation to the other.

### Methods of queen rearing

- Natural Queen bee Rearing and
- Artificial Queen Bee Rearing

#### 1. Natural Queen bee Rearing

- Queens are naturally reared (raised) in three different circumstances: swarm queens, supersedure queens, and emergency queens.
- Under natural conditions, bee colonies rear queens for one of the following reasons:
  - ✓ To replace a queen which gets old or which dies or disappears suddenly
  - ✓ To Produce Superseder bee Queens
  - ✓ For Reproductive Rearing

#### A. Emergency Queen

When a queen dies suddenly or killed accidentally through colony inspection, the bees discover her absence and begin quickly to raise a new queen from a few **worker cells** contain eggs or larvae by enlarging and extending the worker cells and feeding royal jelly to the selected larvae.

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**Emergency queen cells** are distinguishable from the queen cells of supersedure or swarming by being raised in enlarged **worker cells** on the comb face and are often smaller in size than queen cells raised from **queen cups**. In general, emergency queen cells are built anywhere that there are larvae or eggs, although a central position on the comb is common. They look smaller than queen cells for swarming or supersedure.

### B. Supersedure Queen

When the queen becomes too old or infertile or has a physical mishap or diseased the bees are decide to raise a new queen to replace her with a young one more efficient.

They build only one to three queen cells in the center of the comb in which the original queen lays eggs, these are usually raised on the face of the comb and built as one hatch, all in a period of a few days.

If a few cells are found on the face of a comb, and there are eggs present, these are supersedure cells and indicate a dud queen. When the new queen emerges, the two queens exist together and do not fight with each other. The old queen will disappear from the hive within a few weeks. Queens raised from supersedure impulse are excellent queens and the cells can be utilized for **replacement** or making new colonies when they are sealed and ripe

### C. The Swarm Queen

Swarming is a natural phenomenon and is the bee colony's method of reproduction and ensures the survival of their species. When a colony preparing to swarm, bees build large number of queen cells about 6 to12, but some strains build 20 or more. They are built on the sides or along the bottom of the comb in successive batches and are found in various stages of development, this generally occurs in spring up to midsummer depending on the weather and the strength of the hive and the swarming tendency of the bees.

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## 2. Artificial Queen Bee Rearing

Beekeepers endeavored to induce bees to build queen cells for use when they need to multiply colonies, requeening to improve the genetic potential of honey bees. There are various methods that help to produce a virgin queen honey bees exercised by different beekeepers in the world. Efficient ways of queen rearing method that favor the local bee behavior and applicable to local condition is an urgent needs of the beekeeper, and the response of local honey bees to different artificial queen rearing methods like splitting, Miller, Overcrowding and Grafting.

The following are **aims** of artificial queen rearing:

- To increase colony number,
- To replace aging queens,
- To produce emergency queens.
- To improve quality of species and to replace bee colony with better ones and
- To earn income by selling bee colonies.

### Methods of Artificial Queen Rearing

- These artificial queens rearing methods are divided into two major groups: simple queen rearing and commercial queen rearing.

#### A. Simple methods of queen rearing

This method enables the beekeeper to rear a few number of queens per rearing cycle. It includes the techniques such as Splitting, Miller and overcrowding

#### B. Commercial method of queen rearing

It is used for commercial purpose (high level) of queen rearing. The common commercial method of commercial queen rearing is grafting.

#### Factors to be considered in artificial queen rearing

One has to follow the following series procedures of honeybee breeding programmers and breeder colonies should have the following good traits.

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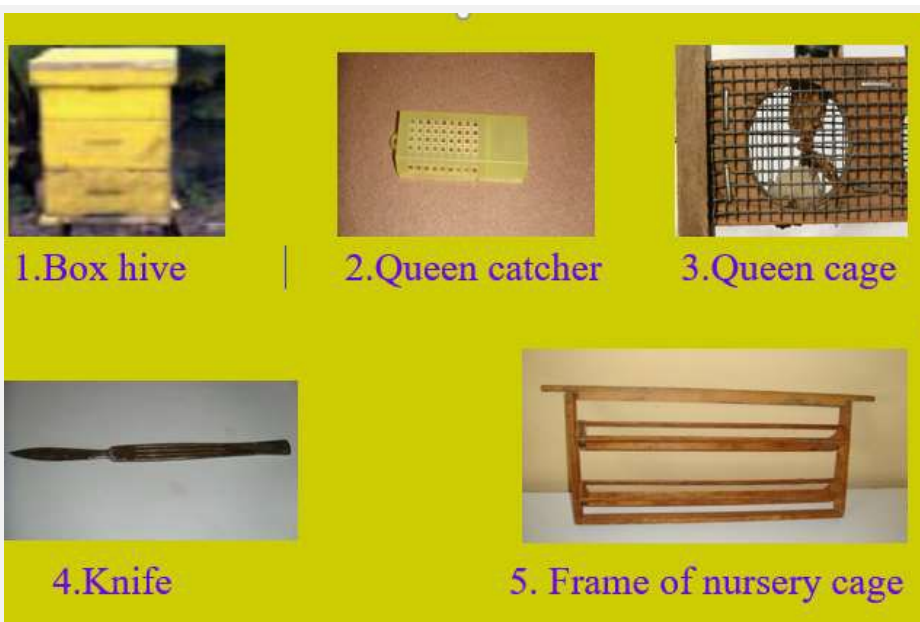
- Good brood pattern should be solid and compact
  - high Disease and pest resistance
  - High honey production history
  - Good temperament
  - Pollen gathering ability should be high
  - Propolis collection shouldn't be too low or too high
  - Early/pre-flow buildup of the colony
  - Less tendency of swarming
  - Absconding tendency should be minimal or none
  - Adaptation to all weather conditions
  - Foraging time should be longer (early and late foraging behavior)
  - Clustering and fanning ability
  - High hive defense and cleaning behavior
  - Queen rearing season should be active to supply enough pollen and nectar.
  - There should be adult drones, which are ready for mating.
  - The working site should be appropriate and it has to be away from public areas.
- Knowledge and skill for rear queens needed

• Queen rearing equipment and facility should be available. The type of equipment required depends on the techniques of rearing which is going to be used. The commercial method of queen rearing requires more of sophisticated equipment than that of simple methods of queen rearing.

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## Queen rearing materials



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Figure 2.9: Queen rearing materials

## Simple methods of queen rearing

### Splitting method

This involves the splitting of strong colony into two or more divisions. The queen right box should be moved 1km away from its original location or there should be a barrier between the splits.

As long as eggs and larvae are present in queenless colony, honeybees can rear their own queen. the methods which involve the division of a strong colony into two parts

- The action of splitting takes place in two ways:
  1. Excluding the queen
  2. Random division of colony

### Excluding the queen:

- It is the process of finding and excluding of the queen with **few worker and brood** from parent colony.
- **Sealed brood, honey, pollen adult bees and large share of open brood from the parent colony** is transferred into empty bee hive and taken far from parent colony, such split is a **queen right colony**.
- While the parent colony remains queenless with high proportion of sealed brood, food stores (honey and pollen), small of open brood, and a very important comb containing from day old eggs to less than two days of larva, such split is said, **queenless split** and stayed in its **original site**.

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### Random division of colony:

- It is the division of colony without finding the queen.
- Both the splits share equal amount of **adult worker bees, sealed brood, open brood, honey and pollen combs**.
- The most important matter is having a **day old eggs to less than two days of larva comb in each split**.
- One of the split by chance is kept far from the **original place**, while the other remain in the **original site**.

**NB:** Both the splits share equal amount of *adult worker bees, sealed brood, open brood, honey and pollen combs*.

### Procedures

- Select a colony based on selection parameters.
- Strengthen the selected colony through feeding extra sugar syrup.
- Rearrangement of the frame, sharing of the brood in two or more chambers equally.
- Split the selected colony in to two or more parts.
- Move the queen right colony to a distant place or use barrier between the two splits.
- Two days or three days after splitting, inspect queen less split whether bees start to construct queen cells.
- Nine or ten days after splitting harvest sealed queen cells.
- Keep the harvested queen cells in the queen cages and return to the same colony by using nursery frame and queen cage as indicated in figure below

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Figure2.10:Nursery frame for mounting queen cage.

- Three days later after harvesting queen cells, inspect the colony to check for the hatching of a virgin queen.
- After the queens hatched, form **nuclei colonies** using the newly reared queen honeybees.
- In **forming nuclei colonies**, take a few worker bees, sealed brood combs and food combs from a strong colony. Here the newly reared virgin queen remains in a cage for **one day**, then she will be released into the colony to be mated and start her life. Inspect the nuclei colony, whether queen starts to lay eggs. **Finally**, transfer the colony from nuclei to standard beehive when they are strong



Figure 2.11:Forming nuclei colony by using reared queens (left) and queen cage with hatched queen (right)

**Advantages of splitting queen rearing method** -This technique is simple so that any beekeeper can rear queens using this method. There is no risk of losing mother colony. It is good technique of controlling swarming.

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**Disadvantages of the technique-** Sometimes it may fail. Only a few queens can be reared by this method.

## **Overcrowding method of queen rearing**

### **Overcrowding method**

This method involves forcing of a colony to become over populated, so that the colony will be stimulated to construct queen cells to undergo reproduction swarming

- Is the formation of reproductive swarming , that occur when the colony approach the peak of their development.
- Such queen cells are found at the **bottom of the combs**.

It is done or implemented **by two methods**.

- ✓ By not adding supers
- ✓ By reducing the supers.

### **Procedures**

- Select the colony for rearing purposes
- Strengthen the selected colony by providing feeds.
- Overcrowd the selected colony
- Inspect the overcrowded colony to check for the formation of queen cells.
- After you observe sealed queen cell, harvest cells and keep the harvested queen cells in the queen cages and return back to the same colony.
- Keep the harvested queen cells in the queen cages and return to the same colony by using nursery frame and queen cage
- Three days later after harvesting queen cells, inspect the colony to check for the hatching of a virgin queen.
- After the queens hatched, form nuclei colonies using the newly reared queen honeybees.
- In forming nuclei colonies, take a few worker bees, sealed brood combs and food combs from a strong colony. Here the newly reared virgin queen remains in a cage for one day, and then she will be released into the colony to be mated and start her life.
- Inspect the nuclei colony; check whether queen starts to lay eggs.

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**Finally**, transfer the colony from nuclei to standard beehive when they are strong

**Advantages**- Superior quality of queens can be reared.

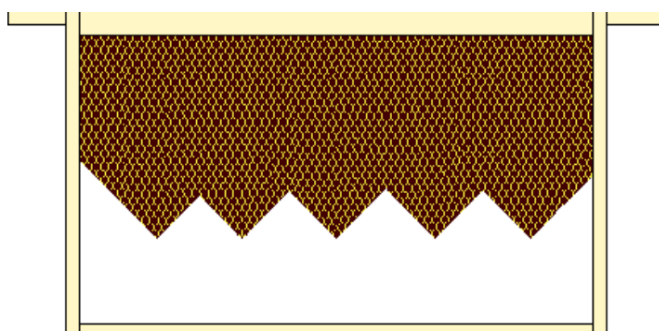
**Disadvantages**-If there is no regular follow up of the colony, it will swarm.

## The Miller method

### Miller method

- This method was developed by medical physician Dr. C.c Miller.
- This method involves the providing of trimmed comb.
- A comb which bottom portion is cut in a zig- zag fashion and provided to queenless colony and the colony start to construct queen cells.

**NB:**The comb, which is going to be trimmed, should have young worker larvae or eggs in worker cells.



Frame of brood is cut into V shapes

Figure2.12 :zig- zag fashion

## Procedures

- The first step is to print foundation sheet
- The foundation sheet is fixed to standard frames.
- The frame is placed between the two brood nests in the best colony by removing the already existing brood.
- At about a week the comb will contain egg and larvae is taken out from the colony.
- The lower edge of the comb is trimmed to expose several larvae/ eggs to hatch toward the bottom edge of the comb.

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- Dequeen the colony before giving the trimmed combs (24 hours before).
- After Nine or ten days harvest sealed queen cells and keep the harvested queen cells in the queen cages and return back to the same colony.
- Keep the harvested queen cells in the queen cages and return to the same colony by using nursery frame and queen cage
- Three days later after harvesting queen cells, inspect the colony to check for the hatching of a virgin queen.
- After the queens hatched, form nuclei colonies using the newly reared queen honeybees.
- In forming nuclei colonies, take a few worker bees, sealed brood combs and food combs from a strong colony. Here the newly reared virgin queen remains in a cage for one day, then will be released into the colony to be mated and start her life.
- Inspect the nuclei colony; check whether queen starts to lay eggs. Finally, transfer the colony from nuclei to standard beehive when they are strong

**Advantages of this method** -This technique is simple so that any beekeeper can rear queens using this method. There is no risk of losing mother colony. It is good technique of controlling swarming.

**Disadvantages of the technique**- Sometimes it may fail. Only a few queens can be reared by this method.

### **Punching a day old larva**

This technique can be done by covering comb with the queen excluder screen and enclose the queen in it for laying, after the queen complete her laying the comb is taken to punching room and the cell containing a day old larvae are punched out with a simple handmade punch, the cell are then transferred on to queen cell bar , thus the larvae remain on the original place and the natural food bases. The advantages of punching a day old larva is that , the larva transferred to the cell bar easily and perfectly with its cell base and food and can easily accepted by queenless or starter colonies.

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## Commercial method of queen rearing

### Grafting method

This method involves the transferring of young larvae (**1-day-old larvae**) from a brood comb into artificial queen cups. The Doolittle or grafting method involves the transferring or grafting of small larvae (24 hours old) into **artificial queen cell cups** and is generally employed by commercial queen breeders. The age of larvae is timed giving the breeder queen an empty comb to lay eggs in 4 days before grafting. The grafting method allows a large number of queens to be reared throughout most of the season. A beekeeper with a few hives can raise a few queen cells (10–12) by using this method.

### equipment for grafting

**Grafting needle:** Used to transfer larvae from brood comb into artificial queen cups.



Figure2.13:Grafting needle

**2. Artificial queen cups:** used to hold grafted larvae. It could be plastic or a wooden base with beeswax cup.



Figure2.14:Artificial queen cups

**Dipping sticks:** Used to make artificial cell cups. It can be made through dipping the sticks into molten beeswax, then put in the cold water.

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Figure2.15:Dipping sticks

**4. Cell bar and frames:** Cell bar used to hold cell cups were as the frame used to hold the cell bar itself



Figure2.16:Cell bar and frames

**Nuclei box:** Is a three or four frames box. It used to keep newly reared queen with a few number of worker honeybees until it will be transferred to the normal hive.



Figure2.17:Nuclei box

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**Magnifying glass:** Used to see the larvae to be transferred clearly.

**Grafting room:** room should be suitable and conducive. It should have a temperature of 75oF (24-25 degree Celsius) and humidity of at least 50%.

**Royal jelly-** should be collected beforehand from uncapped queen cells. Cells with three day-old larvae will contain the maximum amount of royal jelly. To collect the royal jelly use a special small spoon to scoop it out, or squeeze the cell from the base so that the royal jelly comes out like toothpaste. The queen larvae should first be removed using forceps or a toothpick. It should be stored in a well- sealed small bottle in a freezer. In this way storage it will be keep for over a year

## Grafting procedure

Select a breeder colony with good traits you wish to encourage in your bees. The traits of this colony will be inherited in the new colonies headed by the queen raised. A frame containing young hatching larvae is selected from the breeder queen's hive to graft larvae from.

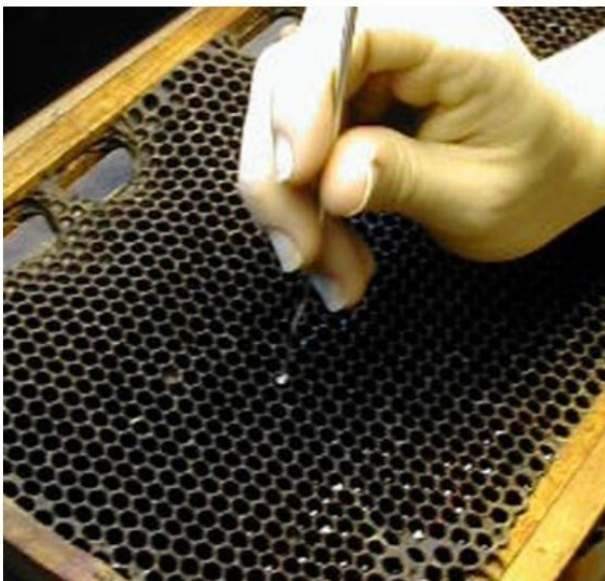
- Prime each queen cup with small drop of diluted royal jelly. Dilute the royal jelly beforehand with tap water (1:1). To achieve about the consistency of the food in a cell containing a typical one day- old worker larvae. 3mm of diluted royal jelly should be dropped in the middle of queen cup by using an eyedropper just before grafting. It is possible to graft without royal jelly, but the success rate will probably be lower. The bars contain the primed cups should be covered with a damp cloth or placed inside nucleus box with dampened inner surface. To prevent the drops from drying out.
- Obtain one or more frames of brood containing a sufficient supply of 1-day-old larvae from the chosen parent colonies. The frame should be removed from its colony only when you are ready to graft. Otherwise, the larvae in the cells will gradually dry out and grafting is impossible

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- Seated comfortably, with a bright source of illumination (lighting) behind you. Place one end bar of the frame with the young larvae on your knee and hold other end bar up. So that the frame is in front of you at angle of about 45 degrees. Place a bar of queen cups on the side of the top bar, holding it there with your hand
- Arrange the light to see the bottom of the cells and look for an area containing the youngest larvae. Larvae to graft are almost transparent, skinny (skeletal) and not yet reached complete 'C' shape, or it should be about one-and-a half times the length of an egg
- When all cups on a bar contain newly grafted larvae the bar is put in to the moistened nucleus or put under a damp (moist) cloth. When all the grafting is done insert the bars in to the frames and put them in the starter colony. Aim at getting grafted larvae in to the starter colony as soon as possible to minimize any drying out. The sun is a good source of light, but grafting outdoors encourages robbing by bees. Since the larvae themselves attract robbers, and bees will pluck them from an exposed comb. The sun also dries out larvae very quickly
- Transfer 1-1.5 day old larvae from worker cells in a brood comb from the breeder colony into artificial queen cups held on 1-2 sticks or bars. The artificial cups should be fixed on the bar beforehand with molten beeswax, and each queen cup primed with a small drop of diluted royal jelly. Priming cells with royal jelly delays drying of the larva. Some queen breeders use dry grafting (transferring the larva into dry cell, not primed with royal jelly). The larvae are transferred on the tip of the grafting tool. The grafting tool is inserted underneath the larva to lift it from the worker cell with royal jelly as much as possible. Be careful not to damage the larva, a damaged larva will not be accepted by the bees.

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Grafting from a brood frame



Transferring or grafting a larva into artificial cell cup

Figure2.18:grafting

When grafting is done, fix the stick into the modified frame and transfer the frame immediately to a strong queenless hive to minimize any drying out. The cell building is prepared a day beforehand by removing the queen and unsealed brood, so that the colony is queenless and broodless. Place the frame between combs of capped brood with pollen and honey. Up to 20 cells

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are given to the cell-building colony. The bees being queenless will attempt to raise queens in these artificial cells by adding wax to the cells and feed the larvae royal jelly.



The bars of grafted cells are placed in a frame.

Figure2.19 :grafted cell in frame



The frame of cells being placed in a queenless cell breeder hive

Figure2.20:grafted cell in queenless hive

On the 10th day after grafting, remove and put the ripe (capped) queen cells into colonies made queenless a day or two previously for requeening, or transfer the queen cells to small nucleus for mating before a queen emerges from her cell. Put one cell in a nucleus. A virgin queen will emerge from the cell and be accepted by the bees

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Ripe queen cells ready to be transferred to hives or to mating nucs



A ripe cell is pressed into the surface of a comb near sealed brood

Figure2.21:ripe queen cell transferred into hive

### 2.2.9. [Making up a mating nucleus](#)

A mating nucleus is a small colony, in which a ripe queen cell is placed, and in which the virgin queen emerges and from which she flies and mates. Nuclei should be made up one or two day before the ripe queen cells are ready to be transferred. A traveling box or a new hive can be used for this purpose, or a full size hive may be divided into two sections with a flight entrance facing

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in different direction. A nucleus should have at least two frames of brood and one frame of honey, and sufficient bees to look after the brood and a feeder for syrup to feed the nucleus. Block the entrance with grass and move it to a new location at least 50 meters away, or leave the nucleus in the same apiary. Open the entrance in a day or two.



A Mating Nucleus



Queen Mating Yard

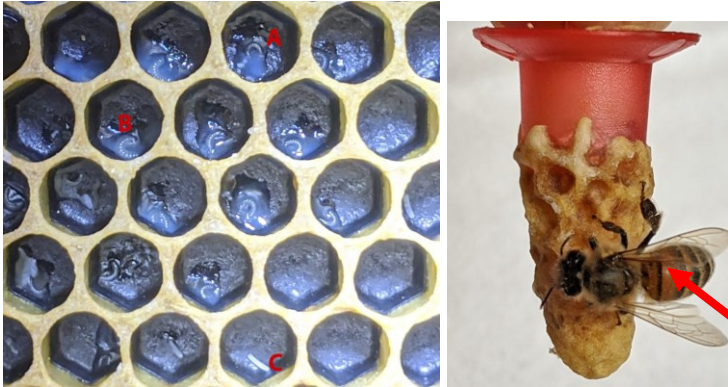
### 2.3. Selecting *Day-old larvae* for grafting and transferring

#### 2.3.1. Selecting *Day-old larvae* for grafting

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Before grafting, a cell builder or starter must be available to receive the grafted larvae and Information about cell builders can be found in **Cell Builder Basics**.

- and selecting the brood frame from cell builder frame
- look for day-old larvae on frames where eggs and older larvae are also present.
- Larvae suitable for grafting will be **very small** with a slight **comma-shaped curvature**, while **older larvae** are larger with a more defined **C-shape** below.



A capped queen cell and nurse bee.

Figure 2.22: Eggs and larvae in brood cells (A) Graftable larva. (B) Older, larger larva. (C) Egg.

- Gently brush nurse bees from the selected frame to prevent damaging the delicate larvae.
- The larvae must be grafted quickly upon their removal from the colony, as they are vulnerable to chilling, desiccation, or starvation without nurse bees to regulate the temperature and humidity, or to provide feeding visits.
- A damp towel draped over the frame will keep the humidity high and should be used to cover the part of the frame that is not in use.
- Optimal environmental conditions for grafting include a warm, draft-free room. For grafting, the donor frame is often placed on an incline (Figure below ) and a flashlight or headlamp is used to identify the best larval candidates.

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Figure 2.23: Grafting frame on a stand with a damp towel to maintain humidity.

Many beekeepers graft into colorful plastic cell cups, while others make their own from wax. There are several commercially available brands, the most common style is the plastic base mount cell cup (Figure 4.A). These cell cups are inserted into a grooved bar (Figure 4.B) that fits in a specially made frame. Alternatively, a grooved top bar in a standard frame may be used.



Figure 2.24: (A) Plastic base mount cell cup. (B) Grafting bar with cell cups.

Before grafting, many beekeepers prime their **cell cups** with a small amount of **royal jelly** mixed with **water**, although water alone can be used. **Priming prevents larvae from drying** and may provide a small amount of nutrition. Too much liquid, however, can drown the larvae. Nurse bees will remove the **priming liquid and replace it with royal jelly in the cell builder**.

### 2.3.2. Transferring Day-old larvae

Grafting is delicate work that requires patience, a steady hand and excellent vision. To graft, lower the grafting tool behind the curve of the larva, maneuver the tool under the larva and the small pool of royal jelly, and gently lift and transfer the larva to the **center of the cell cup** (Figure 2.15). If using the **Chinese grafting tool**, simply deposit the larva and royal jelly in the **center of the cell cup**. When using the **German grafting tool**, surface tension from the **priming liquid** helps to **transfer the larva** from the **grafting tool to the cell cup**. Mastering this

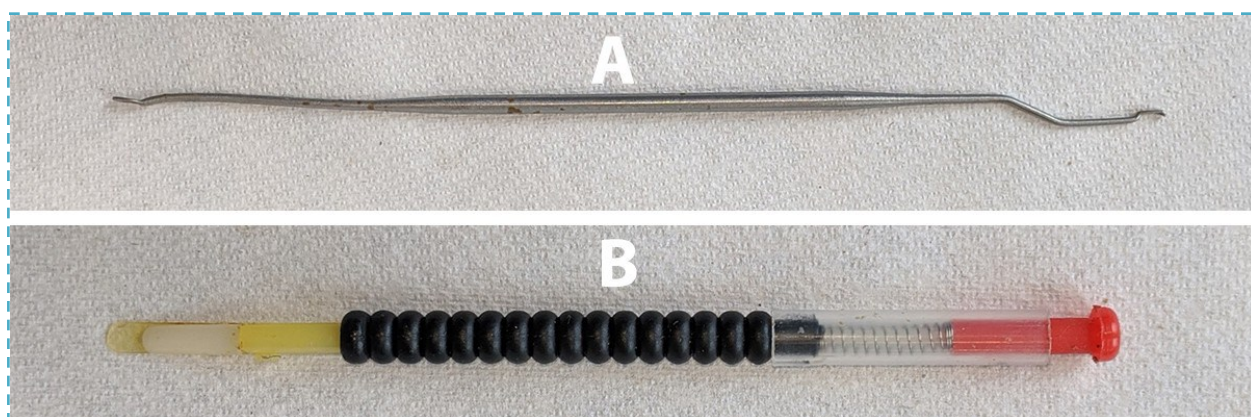
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technique takes practice and repetition. Damaged, submerged, or poorly positioned larvae will not survive.



**Figure 2.25:** (A) Young larva in brood cell. (B) Larva and royal jelly on a Chinese grafting tool. (C) Larva and royal jelly in detail. (D) Grafted larva in cell cup.



**Figure 2.26:** (A) German grafting tool. (B) Chinese grafting tool.

#### 2.4. Confirming adequate numbers of nurse bees in cell raising colonies

Numbers of nurse bees in cell raising colonies should have adequate number of nurse bees in hive. The strength and production of hive bee expressed by the number and duty of nurse bee in the hive like feeding larvae, guarding and ripening honey.

#### 2.5. Placing grafted cells into starting colonies and finishing colonies

##### 2.5.1. Starter colony preparation

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After grafting, the frames of queen cups with young larvae are immediately transferred to a specially prepared starter colony. Starter colony must be prepared before hand and should be strong with many workers. But not brood or queen Begin preparations several days before you graft by feeding a strong colony extra sugar syrup (unless there is a honey flow) to get the bees in top shape.

### **Methods of starter colony preparations**

**Pritchard method-** In this method the colony is left in position, but the queen, all the brood (unsealed brood), and most of the frames are removed. As frames are removed, most of the adult bees clinging to them are shaken off so that they remain in the starter colony. Leave behind just one single hive body containing six to eight frames including at least two frames of honey and two with pollen. The frames of grafted larvae are put in to the middle of the colony 24 hours after removing the queen and brood.

### **Swarm box method-**

- In this method about 3kg of bees from one strong colony without queen or brood are put in to a nucleus box
- Inside the box two frames containing pollen and at least two containing honey frames are given
- Frames of grafted larvae are inserted a few hours after making up the swarm box
- The swarm box is then taken indoors, to a place where the temperature will not vary much and fed with sugar syrup
- With either method, up to 100 larvae in a queen cups can be given to a starter colony, but the success rate may be greater if only 40-50 are given

### **Cell-builder colony preparation**

- A cell builder colony should be strong and fed with sugar syrup for a few days before, and during the cell-building process for 4-5 days
- After 20-30 hours in the starter colony, larvae in the queen cups are transferred in to cell builder colony
- For each cell builder should be given 20 or fewer cells to build depending on the food stores and the population of nurse bees in the colony

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- The frame containing the started queen cups is put above a queen excluder, directly over the brood chamber
- Frames containing young brood and pollen are put on either side to attract some nurse workers to the area of the hive containing the queen cups
- So, the colony stays storing with lots of nurse bees, as its adult queen is active and laying below the excluder
- In this state they will be accepted and fed by strong queen right colony
- When the bees have plenty of resources to feed the developing queen larvae, heavybodied and highly fertile queen are produced
- Since the quality of the queen produced will depend on the care they receive in the cell builder colony
- After 5 days, the queen cells are all capped
- The young queen in a capped cell should not be handled at all until 9 or 10 days after grafting
- Cells 10 or more days after grafting are referred to as 'ripe'
- At this stage, until 24 hours before adult emerge, the pupae inside the cells can be still quite delicate so take care

### 2.5.2. nucleus development (nucs)

**Nucleus colonies (nucs):** are simply known as small colonies. Often they are in specially made from four to five frame boxes with built-in bottom boards. Always use frames of standard dimensions, so that they can be interchanged with other beekeeping equipment. Nucs should be made up a few days before the ripe queen cells are ready to be transferred, and they should be queenless

#### Methods of nucs colony formation

##### Method-1

- Put a few frames of bees, brood and honey in to a nuc box

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- Block the entrance with a piece of screen, tape (mask), or even grass and move it to a new location, at least 1km away
- Open the entrance in a day or two and make sure that the bees do not overheat and suffocate
- Provide shade or water in a feeder, if necessary to overcome this problem

### Method-2

- Do the same, but leave the nuc in the same yard
- Many of the bees will drift back to the parent hive so use more bees and include a frame of merging brood

### Method-3

- Take strong colony standing on its own
- Surround it with empty nucs and split the entire colony equally in to three to six nucs
- However, the exact number of nucs depending on the strength of the original colony
- The queen should be taken away; if she is left in one of the nucs most of the bees will join (merge) that nuc
- Remove the empty hive bodies from the original colony
- Returning forager bees will distribute themselves fairly among all the nucs

### 2.5.3. Finishing colonies

crowded and queenless bees in a starter hive are eager to begin raising new queens (Figure below). However, starter colonies are not up to finish a large number of cells. Their resources are too **limited to continue feeding many queens**. If left in the starter hive, the bees will selectively feed only some of the **larvae, abandoning the others**. For this reason, the beekeeper must move the queen grafts to a strong hive which can **finish rearing them**. A finisher hive contains the **resources and population** to care for many developing queens at once. **Finishers** must be **strong and queenright** and, therefore, will not be **inclined** to start new queen cells on their own. However, since the queen cells have already been started by other bees, those in the finisher hive will continue feeding them and seal the cells.

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Figure2.27: Bees in the starter hive begin elongating the queen cups and provision the cells with large quantities of royal jelly.

- Any healthy populous bee colony with at least two **deep hive bodies** and **ample food stores** can be used as a finisher hive.
- To prepare the hive, be sure the queen is in the lowest box and place a queen excluder above her. If not confined below, the laying queen will quickly find and destroy all developing queen cells.
- Remove the frame of grafted queen cells from the starter hive after 24-36 hours and place it into the prepared finisher hive
- There is no need to shake or brush the nurse bees from the grafting frame.
- These bees are queenless and will not fight with the bees in the finisher hive. They will continue to assist in caring for the grafted larvae.
- The bees in the finisher hive will quickly recognize new queen cells and begin to provision them with an ample supply of royal jelly. Once the new queen cells have been sealed, another frame of grafts can be placed into the same hive to be finished.

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Figure2.28: The bees on the cell bar frame can be added to the finisher hive. They will continue to care for the grafted queen larvae.



Figure2.19: A finisher hive should be strong, well-fed and queenright. An excluder keeps the queen in the lower box, but allows workers to access both section

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## 2.6. Transferring ripe queen cells into nucleus

### 2.6.1. Transferring of ripe queen cells to nuc colonies

- Cut off the cell base from the cell bar and carefully lay the ripe queen cells in an area of brood in a mating nuc or a colony to be requeened
- Protect the ripe cells from the sun and do not chill them
- So, the queen cell should be quickly transferred in to queenless nucs or a colony to be requeened
- The queen cell is wedged between the top bars of two frames in the part of the nuc having the most brood and bees, or wedged (stuck) at lower down in the actual brood area

**Note:**

- ✓ Each nuc should have at least two frames of bees and one frame of honey
- ✓ starving nucs are unable to keep a queen cell warm

### 2.6.2. Harvesting queen cells procedure

- Harvest all capped queen cells 10 days after grafting.
- Keep cells around 85°F (30°C), and avoid colder or warmer temperatures, as these might damage the developing queen
- Avoid rough handling
- Queen cells can be sold, used in queenless splits to requeen full-sized colonies, or introduced into mating nucs.
- If mating nucs are used, check for acceptance of and successful mating by examining for eggs two weeks after introduction.
- Mark queens at this time so you will know their age when it is time to requeen.

### 2.6.3. Transferring bee colonies

An established colony in nuclei box or in a traditional hive should be transferred to a standard movable frame hive or movable comb hive. Transferring bee colonies from fixed

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hives either from captured swarms or purchased from traditional beekeepers is an important method of obtaining bees in easy management situations.

### **Season (time) of transferring**

The best time or season to transfer colonies of bees from one hive to the other is at the onset of active beekeeping season. The reason is that during this time honeybee plants(forage) start bloom and bees could exploit the environmentally available flowering plants and build up their population during the fellow period.

### **Preparations for transferring bee colonies**

In order to undertake transferring bee colonies the following materials should be provided:-

- The hive in which the colony will be transferred
- Knife to cut the honeycombs from the original hive
- Bee brush to guide (draw) the bees to the new home
- Big dish (bowl) to collect the cut combs and others
- Water sprayer to hinder (cool dawn) the bees from flying up
- Straw mat, plastic sheet, or canvas to save the bees from falling on the ground or in the grass
- Frame wire, sisal rope, or rubber band etc to tie (attach) honey and brood combs that drawn from old hives to the new frames or top bars
- Smoker with good quality smoking materials
- Hand torch as a source of light
- Two or three persons who assist the transferring process

### **Ways of transferring**

- Cut all the combs and searching for a queen
- Cut all the combs and simply drum the bees to the new hive
- Placing the original hive with bees on or under the new hive and draw the bees with smoke

### **Procedures of transferring and some requirements to be taken**

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- The colony, which is going to be transferred, should be placed in its new site (place) at least three days in advance. This is very important to orient the bees to their new environment and foraging direction.
- The hive which will be used, as a new home for the colony has to be transferred with wired and attached wax foundation frames / or with wax smeared top bars.
- The site (place where transferring will take place, and colony will be placed) should be cleaned
- The beekeeper must prepare his / her protective clothes dress them properly before opening beehive
- The smoker should be filled with fire and smoking materials at least 10 minutes in advance.
- Put the new hive with full components on the top corner (side) of the straw mat (canvas)
- Place the hive with bee colony on bottom part (corner) of the straw mat (canvas)
- Use your smoker to drive the bees; open the hive on one end, smoke on the bees and cut the combs one by one carefully, brushing of any bees. Smoke makes the bees to go down to the other end of the hive thus by so doing it would be easy to cut the combs out
- After cutting all the combs drum the old hive to draw out the bee colony from the hive
- Great care should be taken not to damage the queen while cutting and drumming the bees colony
- If the queen is seen it would be better to catch it with bare hand carefully on her thorax and then put it in the queen catcher cage for few days and release approximate after 3 days
- Place at least two frames combs of young brood in addition to some pollen and honey at the middle of frames or top bars sugar solution. The young brood emerged will strength the population of a colony and helps to induce adoption in the new home

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- After the bees totally enter in to the new hive, put the new hive in its place
- Take far away the old empty hive and put it in a dark place where bees never arrive
- Follow up after transfer

**Once the colony is transferred to the new hive the beekeeper should:**

- Undertake external hive inspection always against the ants attack, monitor the normal in and out bees flight
- Inspect the colony internally to check whether the colony started comb building
- Observe or examine for the egg laid by the queen
- Carry out the necessary hive manipulation for the building up of the colony fortnightly or once in a month.

**2.6.4. Confirming the availability of drones during mating**

- Adequate rearing and maintenance of healthy drones are essential for successful queen bee matings.
- Information on drone bees and their management during an extended queen bee mating season has been checked:-
  - ✓ to assist in the development of management programs
  - ✓ to increase drone numbers.
- A well reared, healthy drone can produce 5–10 million sperm. Drones mature at about 16 days of age, and become less suitable for mating after 28 days of age. The average life span of a drone is 55 days, and varies with seasonal conditions.

**Capacity of a colony to rear and maintain drones**

- Strong colonies with large numbers of worker bees rear and maintain more drone brood and adult drones than weaker colonies.
- Adult drones do not feed themselves but depend on an abundant supply of healthy **nurse bees** to feed them on honey, pollen and gland secretions.
- Low numbers of healthy nurse bees may contribute to problems with -reared drones.
- The ability of a colony to maintain a high population of adult drones depends on a continuous supply of pollen coming into the colony and not on stored pollen.

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- Only pollen stored in close proximity to brood shows a positive influence on drone rearing.
- Strong colonies require 300–400 g of high quality pollen daily (2.1 – 2.8 kg/week). If this is not naturally available then pollen should be fed to the colony each 3-5 days. Colonies in which pollen had been added to a sugar syrup feed were found to have better-fed brood than colonies in which pollen had been fed dry.
- Colonies receiving a continuous supply of pollen maintain maximum drone populations whereas colonies which do not receive a continuous supply of pollen have fewer drones.

#### 2.6.5. Factors affecting the removal of drones

Drone removal occurs when a colony stops feeding its drones due to a **lack of incoming pollen supplies**. Over a number of days drones become **weakened** and are forcibly removed from the hive. The most important factor is the **amount of fresh pollen being collected**. If pollen supplies coming into the colony are terminated, then drones are evicted; if pollen supplies into the colony are prolonged beyond the normal seasonal span then eviction of drones is reduced.

The **absence of a queen** bee also reduces eviction, though not by as much as an abundance of pollen.

A **reduction in external hive temperature in hives** containing a laying queen or laying workers contributes towards drone eviction. The **age of the queen** was found to be important, with higher rates of drone eviction from colonies with young queens. Weather **conditions unsuitable** for pollen production by plants or which prevent pollen collection by foraging worker bees may result in drone eviction.

#### The four basic requirements

- The provision of surplus quality pollen at all times is essential to **produce adequate numbers of mature drones**, as is sufficient sugar syrup or honey stores. The pollen may be either a natural pollen or a protein supplement
- Use **strong colonies** headed by a proven queen preferably more than one year old.

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- Drones are produced earlier if a drone comb is placed in the **middle of the brood** chamber in autumn, preferably a comb with a mixture of drone and worker cells. In spring add one or two frames containing drone cells as hive strength and weather conditions allow.
- **Drone mother colonies** require the same amount of management as **queen cell raising colonies**.

## 2.7. Assessing Vigor of the current queen

### Vigor queen

- the presence and performance of queen is used to identify health status of a honeybee colony

### Signs of lack of vigor in a queen bee may include:

- aggressive bees
- drone laying queens
- poor disease resistance
- poor performance by workers
- queens older than 12-18 months
- Swarming

### Requirements to obtain good queens

Successful raising of queens requires:

- ample supply of nectar and good quality pollens
- an abundance of sexually mature, high-quality drones for mating with the newly emerged virgin queens
- suitable weather for mating of drones and queens
- suitable starter and cell raising colonies
- a queen mother to breed from, whose offspring worker bees (and colonies) display ideal characteristics such as gentle temperament, disease resistance, low swarming tendency and excellent honey production.

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## 2.8. Monitoring signs of queen replacement

Before replacement of colony queen, we have to check or monitor the necessity of replacement queen; requeen needed for the following requirements:-

- When there is Scattered or spotty Brood Pattern
- When the Queen lay Drone
- When there is Multiple Eggs per Cell
- When the Colony is Queen less
- When the bee become aggressive
- When there is poor disease resistance
- When the performance of worker become low
- When the queen become older than 12-18 months
- If there is frequent swarming in the colony
- High honey consumption
- Poor honey production
- Defensiveness
- Too much debris on hive floor (non-hygienic)

sustainable queen replacement, including **purchased queens**, is so important. How ever, **Purchased queens** may come from various sources. like originate from bee breeders, whereas the rest were of **unknown origin** which is the main source of disease-dissemination risk.

## 2.9. storing queen replacement and escort worker

handling and storage of valuable, highly perishable honey bee queens is the a key part of beekeepers' economy and management decisions. A beekeeper may need to store queens in reserve until they can be placed in colony settings. To safely hold queens, a beekeeper can use a special colony configuration called a '**queen bank**.' Beekeepers can build a bank colony by removing the original queen, then placing individually caged queens in the bank by suspending the cages inside the bank colony in a removable frame. Worker bees will

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tend to each queen to keep them warm and fed, and the cages prevent queen aggression towards each other.

Holding queens in a bank colony can serve beekeepers in many ways:-

- to replace failing queens in colonies
- to extend dividing colonies or assembling nucs
- producers may need to store surplus queens for a days or weeks after mating
- to accommodate shipping preferences of customers.

## 2.10. Raising Queen bee from a nucleus colony and re-queen

### 2.10.1. Raising Queen bee from a nucleus colony

The queen honey bee is fundamental to a colony's survival and function. queen is the only member of the hive capable of producing more female offspring to keep the colony. The **chemical pheromones** produced by a queen bee impart a unique identity to each colony and its members. The presence of these pheromones also keeps the colony cohesive and orderly.

A queen is the repository of a colony's heritable genetic traits. These genetics influence many aspects of colony behaviors, such as their defensiveness, parasite tolerance and disease resistance, rate of population growth, and the efficiency of winter food consumption. The importance of a quality queen bee cannot be over emphasized. **A colony of bees with undesirable traits can be remedied by requeening.** Within six weeks of replacing a queen, most of the worker bees are replaced by the new queen's offspring, and noticeable changes in temperament and behavior will be evident.

Beekeepers choose to raise queens for many reasons. They can stock their own hives when **queens die** or **need replacing**. They can **save money** by raising their own queens. Every beekeeper can maintain one or more small nucs with a few frames holding a laying queen, just in case one is needed. By selectively raising their own queens, beekeepers can take control of the characteristics they desire in their own bee stocks.

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### 2.10.2. Applying re-queening techniques

- Beekeepers can change the strain (or type) of bee in a colony, by removing the queen and replacing her with a queen of the desired strain - this procedure is known as **requeening a colony**.
- Requeening is also used to replace queens that are old or have reduced egg laying capacity.
- The requeening techniques of Laying queens may be bought from a **queen breeder**, or **reared by a beekeeper** who has a **good understanding of bee behaviour**, bee **handling** and **beekeeping**.

### 2.10.3. Introducing queens

- For best results, do not introduce a new queen until a hive has been **queenless for at least 24 hours**. Look for eggs to be sure a laying queen is not present. If so, the workers will kill the new queen.
- When replacing a queen, remove (kill) the old one at least 24 hours before introducing the new queen.
- If a colony has started making queen cells, these bees may reject the new queen and continue raising their own. If no eggs are visible, the hive may have a virgin queen or a newly mated queen who will soon begin laying eggs. Check the hive after 6 p.m. to spot a virgin queen which may have been out on a mating flight earlier in the afternoon.
- A colony will not accept a new queen if a virgin queen is already present.
- Do not remove the candy plug from the queen cage. Allow time for the new queen's pheromones to permeate the hive.
- Only remove the cork or plastic cap that is covering the candy. Do not directly release the queen into the hive.
- Hang the queen cage in the center of the brood nest area.

**NB: Always position the cage so that the candy plug faces up!**

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- If the candy plug faces down, dying attendant bees may fall and block the queen's access to the exit.
- ✓ Allow your bees three to five days to release the new queen. After this time, you may open the cage and release her.

## 2.11. Monitoring egg laying and level of hatching

- For their natural mating, hatched queens or queen cells before hatching will be introduced into mating nuclei of various types and sizes.
- After mating and egg laying, they can be taken from the nuclei and placed in transport cages as a rule or in other types of cages with accompanying bees.
- **Until capitalization**, they will be kept in mating nuclei or in laboratory conditions – in individual cages with accompanying bees.
- The type of **mating nucleus** is the one preferred by the beekeeper, but generally in the conditions of **continental climate** when nights with low temperatures are registered even during the summer, it is recommended:
- The number of bees should be at least 200 gm., and the amount of brood at the formation of the nucleus should be at least 2 dm<sup>2</sup> of capped brood.
- The nuclei formed by 2-4 adjacent compartments are preferable, with bee entrances in different directions, these ensuring a better thermoregulation.
- If the mating nuclei do not ensure the optimum temperature of 30-34°C during the migration of sperm from the **lateral oviducts into the spermatozoa**, the amount of **sperm reaching the spermatozoa is greatly diminished**, these queens having a **shorter shelf life**, often being replaced even from the first year.
- During non-harvesting periods, mating nuclei feed on sugar syrup or sherbet.
- If there is a **partial depopulation** of some mating nuclei and **overpopulation** of others, the depopulated nuclei will be restored by taking a honeycomb with a capped brood, ready to hatch, from an overpopulated nucleus and inserting it into that nucleus.
- The nuclei are numbered, and in the case of several nuclei kept in the same shelter, each nucleus (compartment) will receive its own identification number.

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Self-check 2	Written test
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Name..... ID..... Date.....

**I.** choice the best answer and encircle it

- A colony of bees with undesirable traits can be improved by -----
  - removing queen
  - requeening
  - supering
  - Aand B
- one is the importance of artificial queen rearing
  - decrease colony
  - produce emergency queen
  - replace worker bee
  - all
- why queen bee fly some distance away from hive to mate drone
  - need free space
  - avoid inbreeding by nature
  - run from other caste bee
  - Aand B

**II.** Direction: answer all the question listed below

- write the sign indicate queen replacement(5point)
- what are the factor for the removal of drone(5)
- write and discuss methods of nucs colony formation(10 point)

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## Operation sheet 2

### 2.1 Techniques of Transferring nucleus to hive box

#### A. Tools/ Equipments/ Material required

- Overall
- bee veil
- gloves
- rubber boots
- Nucleus (Nuc)
- hive (without colony)
- frames,
- hive tool
- sugar syrup (sugar: water in ratio of 1:1 ie., 100g sugar in 100ml water),
- smoker
- cow dung cake and wood shavings for smoker
- match box
- used grease

#### B. Procedure

- Prepare materials and equipment
- Wear overall, bee veil, gloves and rubber boots.
- Setup a base on the hive stand beside the nuc to be transferred
- Face the entrance of the hive in the same direction as the entrance of the nuc.
- Place a hive box on the base. Remove 6 frames from the hive as other 4 frames will come from your nuc.
- Put 3 of your 6 empty frames of comb or foundation back into your hive against the side of your hive box farthest from the nuc. Put the other 3 empty frames outside the hive
- Gently smoke the entrance of your nuc. Make sure that the smoke is cool and that it blows into the nuc. Wait a few seconds.
- Using your hive tool lift the lid up a bit. Blow a few puffs of smoke under the lid and over the frames. Remove the lid and place it upside down on the hive stand. Do not put it on the ground.
- Using your hive tool, gently lift the outside frame out of the nuc. Hold it over the

nuc box so that if the queen falls off she will fall back into the nuc.

- Place this frame into the new hive box and push it to the far side up against the 3 empty frames that are already there.
- Repeat this with the 3 remaining frames. Place them into the new box in the same order and direction as they were in the nuc. Examine both sides of each frame for the queen.
- Once all 4 frames have been transferred place the remaining empty frames one at a time into the new box. Slide them up against the frames from the nuc.
- There will be some bees still in the nuc box. Using brush transfer the remaining bees out of the nuc box into the hive.
- Slide or move the hive into the same place on the hive stand where the nuc had been. Spray some smoke over the frames of the hive. When the bees have gone down into the hive carefully put the lid on.
- Leave the nuc box on the stand next to the entrance of the hive for a few hours
- Inspect the hive in 10 to 14 days to make sure that the queen is laying eggs and the bees have started moving onto the empty frames.

## 2.2. Carry out grafting

### A. Tool and equipment for grafting

- Grafting needle
- Artificial queen cups
- Dipping sticks
- Cell bar and frames
- Nuclei box
- Magnifying glass
- Grafting room

### B. Grafting procedure

- Prepare materials and equipment
- Select a breeder colony with good traits
- Transfer 1-1.5 day old larvae from worker cells in a brood comb into artificial queen cups held on 1-2 sticks or bars.

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- fix artificial cups on the bar beforehand with molten beeswax, and each queen cup primed with a small drop of diluted royal jelly.
- Transfer larvae on the tip of the grafting tool.
- When the grafting is done, fix the stick into the modified frame and transfer the frame immediately to a strong, queenless hive to minimize any drying out.
- Place the frame between combs of capped brood with pollen and honey.
- add wax to the cells and feed the larvae with royal jelly to raise queens
- On the 10th day after grafting, remove and put the ripe (capped) queen cells into colonies made queenless a day or two previously for requeening
- transfer the queen cells to small nucleus for mating before a queen emerges from her cell.
- Put one cell in a nucleus.

### 2.3. splitting method

#### A. Tools and Equipment required

- Improved or transitional hive
- Nuclei hive
- Queen cage
- Scale peel
- Holder frame
- Feeder frame
- Protective cloth
- Hive tools
- Smoker
- Strong colony
- Sugar
- Feederer

#### B. Procedure of Splitting

- Select a strong colony with important parameter.
- Provide supplementary feed three weeks ahead.
- Rearrangement of the frame, sharing of the brood in two chambers equally.
- Split the selected colony into two parts.
- Move the split by chance to a distance place.
- Three days after splitting inspect both splits to identify the queen less split.

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- Nine or ten days after splitting the capped queen cells will harvest and caged by living two queen cells for the colony.
- Later at the 16<sup>th</sup> days the virgin queen will observe in the cage and can provide to queenless colony.
- Finally inspect the nuclei colony to check whether queen starts to lay eggs or not.

## 2.4. Supering and Reducing

### A. Material required

- Complete frame box with fixed comb foundation
- Complete protective cloth
- Smoker
- Bee brush
- Chisels

### B. Procedures

- Inspect the colony which need supering at flowering stage
- Prepare necessary equipments and hive boxes to be added
- Smoke to the colony by standing at a side or back
- Take off the lid from the hive by chisel
- Take out 3-4 frames which contain eggs and young larvae from the existing box and place it in the newly added box to familiarize the bees to the new box
- Replace new comb foundation frame instead it in the existing box
- Put the new box on existing box and cover it.

## 2.5. The Miller method

### A. Toola and equipment required

- foundation sheet
- queen caged
- hive
- queenless colony
- trimmer
- comb

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## B. Procedures

- The first step is to print foundation sheet
- The foundation sheet is fixed to standard frames.
- placed frame between the two brood nests in the best colony
- trimming the lower edge of comb
- Dequeen the colony before giving the trimmed combs (24 hours before).
- After Nine or ten days harvest the sealed queen cells
- Keep the harvested queen cells in the queen cages and return to the same colony by using nursery frame and queen cage
- Three days later after harvesting queen cells, inspect the colony to check for the hatching of a virgin queen.
- Finally, transfer the colony from nuclei to standard beehive when they are strong

## 2.6. Techniques of Transferring Day-old larvae

### A. Tools and equipment required

- grafting tool
- PPE
- hive
- queen cell

### B. procedure

- Lower the grafting tool behind the curve of the larvae
- operate the tool under the larvae and the small pool of royal jelly and
- gently lift and transfer the larva to the **center of the cell cup**

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LAP TEST	PERFORMANCE TEST
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Given necessary template, materials, tools and equipment you are required to perform the following task in 12 hours. the project is expected from the all student to do it

**Task 1:** perform Transferring nucleus to hive box

**Task2:** Carry out grafting

**Task3:** perform splitting method of queen rearing

**Task4:** perform Supering and Reducing

**Task5:** perform miller method

**Task6:** perform transferring Day-old larvae

LG# 9

## L03 Prepare Honey Bee Brood to Manipulate

### *Instruction sheet*

This learning guide is developed to provide you the necessary information regarding the following content and topics:

- Selecting tools and equipment
- Observing any site quarantine or other bio security protocols
- Identifying and minimize Risks to colony, brood and queen bee
- Conducting hive inspection
- Monitoring hive and colony
- Cleaning and disposing waste materials

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Select tools and equipment
- Observe any site quarantine or other bio security protocols
- Identify and minimize Risks to colony, brood and queen bee
- Conduct hive inspection
- Monitor Hive and colony
- Clean work areas and disposing waste materials

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information sheet 3

### 3.1. Selecting tools and equipment

#### 3.1.1. Introduction

##### What is brood?

‘**Brood**’ is the eggs, larvae and pupae of the bee. All these stages of the bee’s development can be found within a colony at the same time.

##### What manipulation of brood mean?

It refers to opening the hive and removing and repositioning brood frames safely and with minimal damage or unintended disturbance to the brood.

#### 3.1.2. Tools and equipments for manipulation of brood

##### *a. personal protective equipment*

- bee veil
- gloves
- overalls
- safety goggles
- steel capped boots

##### *b. others tools and equipments*

- bee smoker
- fire extinguishing equipment
- hive tool
- spare boxes
- matches
- smoker fuel

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- safety box for smoker
- newspaper to first start the smoker
- water to wash hands and put out smoker

### 3.2. Observing site quarantine or bio security protocols

- Biosecurity considerations, including:
  - ✓ Pests and diseases that occur in honey bees
  - ✓ Signs of pests and diseases in swarms
- If you are collecting a swarm to add to your apiary, you must also practice sound biosecurity:
  - keep the swarm isolated for three months before placing the bees with your other hives
  - Regularly check the brood for disease and catch and examine the worker bees for pests and parasites.
  - If you find signs of any notifiable pest and disease, you must report this to the appropriate authorities

### 3.3. Identify and minimize Risks to colony, brood and queen bee

#### Identify risk to colony

While you are manipulating honey bee brood, you have to be aware of possible risks to yourself, bee and others:

- bee stings
- dust
- airborne and soil micro-organisms
- fire
- holes in uneven surfaces
- aggravation of Nosema disease in adult bees by manipulation of combs early in the season (i.e. winter or early spring)
- noise
- incorrect manual lifting
- wildlife, including snakes and spiders
- domestic stock
- solar radiation

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- chilling of adult bees and brood as a result of:
  - ✓ forcing expansion of brood to beyond where nurse bees can keep it warm
  - ✓ manipulating combs during extreme cold weather
  - ✓ replacing combs in incorrect sequence
  - ✓ introduction of disease when frames are swapped from one hive to another
  - ✓ Killing of queen bee by crushing when frames are being removed.
  - ✓ Lower quality product through discolorations and contamination with dislodged brood and larvae when removing honey from a brood nest

#### **Action taken to minimize risk to colony**

- **Never transfer** frames between colonies that show symptoms of any **brood disease**.
- If the disease is notifiable, contact your State **Apiary section**, and stop all work on the apiary.
- **Avoid careless handling**: careless handling can lead to the death of the colony queen.
- **Avoid incorrect placement** of combs or replacing too many combs.
- **Manipulating combs** during extremely cold or changeable weather can result in chilled brood.
  - ✓ This occurs where the adult bees are not able to keep the brood at the required temperature of 35 °C. The brood becomes chilled and dies.
  - ✓ If combs of brood are left in direct sunlight on a hot day the brood can die of overheating and combs that are starting to melt.

### **3.4. Conducting hive inspection**

Regular brood examinations are an essential part of competent management and lead better production and profit by:

- Early detection of any particular disease problems thus reducing losses.
- Swarm control before the swarm escapes.
- Indicating the brood, honey and pollen stored in the brood nest

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- The condition of the queen and the ability of egg layer
- The temperament of the colony
- Indication of brood rearing condition if the brood nest is reducing or expanding
- Indication it may be possible to divide the hive
- To cull combs
- Encouraging hive population size.

#### **3.4.1. Time of manipulating**

- The best time is a warm sunny day when the majority of the foragers are in the field.  
Days of gusty winds and rain are not the time to open colonies to examine the brood nest.

#### **3.4.2. Opening Hive**

##### **procedure**

- First puff smoke at the entrance under the lid. Remove the supers if necessary.
- Puff smoke over the frames to expose the brood nest.
- The best time is a warm sunny day when the majority of the foragers are in the field.  
Days of gusty winds and rain are not the time to open colonies to examine the brood nest.

#### **Quantity of brood**

There is a ratio between the quantity of brood and the adult population. Provided the hive is healthy, brood manipulation can be beneficial to the colony.

#### **Queens may go ‘off the lay’ for the following reasons:**

- disturbance due to migration
- swarming
- change in nectar or pollen flow
- weather that stops flight of workers
- antibiotic treatment
- Failing queen.

#### **3.4.3. Removing the combs**

- Puff smoke over the frames

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- Remove the frame using the hive tool, second from the wall on the side of the box you are standing.

#### 3.4.4. Holding the comb

- Always hold the comb by its lugs and suspend it as near vertical as possible.
- Hold it at eye level so you can examine the bees. You can also tilt the frame for a better view.
- Look at both sides.
- If you wish to examine the brood, you must shake the bees off at the entrance or back into the hive first.
- Once the examination of the first comb is complete, it is best to place it into an empty box beside the hive.
- You can then remove and examine all the frames by removing the wall comb and placing it back into the brood box.
- Then work across the box, replacing the frames back into the brood box in the same order.
- Once finished, take the first frame you removed and if bees are on it, shake the bees at the hive entrance so they are not squashed when the frame is returned to the brood nest and place the frame into its original position.
- Replacing combs in the same order is a habit that all beekeepers should acquire as this ensures the security of the colony.

#### 3.4.5. Replacing frames in a new sequence or removing

beekeepers can interfere and adjust the brood nest to make the hive more productive, or increase the number of hives for the following reasons:

#### Controlling Swarm

If a colony becomes over-populated, it is likely to swarm thus losing half the colony's field bees. You can control this by removing frames of brood and bees and replacing the brood frames with **comb foundation**. This is only even done in the **swarming season in warm weather**. Place the **foundation between frames of brood** so you have the wall comb and

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frame of foundation The frames of bees removed can be used to strengthen weaker hives or start new colonies. This is done by moving the removed bees and brood to a new site. Always check the health and condition of bees before combining them with others.

### Expanding the colony

The combs are replaced with drawn combs of worker brood and are placed on both sides of the original brood nest as the hive may be down in adult bee numbers.

### Culled combs

- Brood combs quickly become **dark in color** and the cell size decrease bee leaves a larval skin.
- Most beekeepers replace two brood combs every year.
- Select the dark combs and replace them with drawn new worker comb foundation, placing the combs between existing brood combs, making that the bees cover the comb.
- Also cull combs if they contain too many drone cells or if broken wires or top bar lugs.

**NB:** melt down the culled combs and recover the beeswax if free from disease

## 3.5. Monitoring Hive and colony

### 3.5.1. Colony inspection

Beehive or colony inspection is one of the **basic colony management methods**, which enables to monitor honeybee's activity and ensure that the maximum strength of the colony coincides with the maximum nectar flow in order to obtain **optimum honey yield**. there are two ways (method) of colony inspection: external and internal colony inspection.

#### External colony inspection

During external hive inspection, the beekeeper should observe the following important points.

- The normal **flying in/out** of the colony which can be categorized as high, medium or low forager.
- **Type of food source** being brought to the hive by the honeybees

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- Whether the bees **accumulated on the hive entrance**, which can be due to swarm preparation, ants or other enemies attack, and ripening of honey.
- Whether **dead bees (extra ordinary dead bees) found on the entrance** of the hive due to starvation, poisonous by different chemicals

### Internal hive inspection

This kind of hive inspection works for movable comb hives like **top bars** and **frame type hives** only, but not appropriate for local fixed comb type hive such as **Traditional hive**.

### 3.5.2. Prerequisites for internal inspection

- Always use only **light coloured** protective clothes. This just to minimize the sting by using proper protective to handling of honeybees (bees are not so irritated by clean and light coloured cloths).
- Have **good quality smoke** source at hand
- Keep working materials clean and protective clothes free of any **odour that attract** bees
- Keep your body **clean (wash your body)**. do not use any perfumed soap or cosmetics.
- **Adjust working time**- it is very important to carry out internal hive inspection either in the early morning or late in the afternoon
- Select a clear and **calm day** for inspection. Do not open hive in bad weather (rainy and windy days).
  - Prepare all the necessary hive operation tools such as **smoker, chisel, bee brush and**
  - clean protective cloth for your safety.

### Procedures for internal hive inspection

- Fill your smoker with fire and good quality smoke source at least 10 minutes inadvance before you start hive inspection.
- Dress comfortably and carefully your light coloured and pre-clean protective clothes.

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- Then collect all your working tools within your reach.
- Take your smoker and approach the hive to be inspected with gentle movement either from sides or from the back. When approaching an established hive of bees with intent to open, do not move in to the line of flight of the worker bees leaving for and returning from the field. Approaching the hive directly in front of the entrance will may cause the guard bees alert and result in the complete communication of the colony. Always approach the hive from the side or from the back. In order to suppress (calm down) the bees, smoke of **good quality** must be puffed into the entrance.
- After you reach the hive from the back or side, send at least five quality slow puffs of smoke into the entrance of the hive. A few good puffs of smoke create communication barriers in the guard bees and this in turn disorganizes the defense system of the hive. Using smoke also prompt the bees gorge themselves with honey, they are less likely to sting.
- Wait a minute for the smoke to penetrate to the corners of the hive to ensure that the disorganization of the colony is complete, before opening the hive.
- Then open the hive lid (the outer cover ) by using the chisel/hive tool.
- To open the hive, place the hive tool into the tight spaces between the boxes and lid and slowly press downward to break the propolis seal.

Next, lift (do not remove) the outer lid of the hive and shoot several puffs of smoke slowly and replace the lid. Wait a minute and bellow smoke into the hive entrance. This can complete the disorganization of the colony.

**NB:** Do not over smoke the hive because over smoking can harm the bees and larva and hot smoke can burn them.

After the disorganization of the colony is completed, remove the outer lid and place it upside down near the hive for your easy reach and to makes a convenient resting hive bodies during hive operation

- Now you will be looking into the top bars of the top box or the top bars of the transitional hive. A puff or two puffs of smoke blown across the top of the frames/bars will induce the bees to go further down into the hive body.
- Then start inspecting from one end of the hive.

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- ✓ Keep to use cool smoke and to a minimal when treating the colony during inspection.
- ✓ Take an end frame or top bar out of the hive and look
- ✓ After checking, put the first one or two frame after inspected on the hive cover placed upside down near the hive.
- ✓ Pull a frame or lift a top bar one by one and slowly rise by removing the cluster of bees using the brush until all frames examined.
- ✓ During inspection pay lots of attention

During inspection please note two precautions: first, the **queen should not fall down on the ground**, second, the **young brood frames should not place longer outside of the hives to protect the brood in case excessive cold or dry wind** prevail in the apiary.

The important points to be observed during internal colony inspection are:

- The **presence of the queen**: the queen is mostly found around the warm brood, nearer to the egg laid
- **presence of spotty brood pattern**, many drones egg etc. are observed, the queen is said to be non-vigorous and the brood is said **poor pattern**
- **Swarm preparation**: when bees form several /numerous peanut shaped wax cells, which contain immature queen, and the hive is quite populous, it indicates swarm preparation.
- **Starvation**: when there is no stored food (pollen and nectar) the colony is in **need of supplementary food**.
- **Health condition**: it is important to observe the signs or presence of any pests and diseases of bees in the hive (such as wax moth, sugar ants etc. and disease symptoms).
- **Availability of space-during inspection**, if the beehive is full of bees and brood combs, with the upcoming season to be flowering period or is already in **blooming state**, the colonies might **swarm** and **supering should be an option**.and also
- **Checking for the ripening of honey**

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## Precautionary measures to be taken before and during inspection

### *The general rules for hive inspection*

- Wear protective clothes and cover the body thoroughly, Avoid wearing clothes made from hair & wool
- Open the hive when necessary
- Beekeeper should always work in **pairs** one operating the smoker and the other working on the hives frames & combs.
- Always work at the side or back of a hive away from the **bees flight paths** in front of the hive entrance
- All movement should be smooth and deliberate not jerky or rough.
- Get good smoker with large bellows.
- Always first blow the smoke at the flight entrance.
- Keep boxes of frames of bees covered to reduce the number of bees flying and to prevent robbing manipulating cloth can be useful for this purpose.
- Avoid carrying strong smells (perspiration alcohol soap & perfume) because bees strongly react to strong smells.
- Don't keep animal near the bee colony.



Figure 2.1: Opening up the hive and Preparing the hive for inspection



Figure3.2: Removing a brood frame and Inspecting brood comb

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### 3.6. Cleaning work areas and disposing waste materials

#### 3.6.1. Cleaning beekeeping equipment and work areas

It is good practice to clean and sterilise beekeeping equipment:

- when you bring it from the field for storage (e.g. at the end of the season) or reuse;
- when your colonies have experienced infection or infestation;
- before using/reusing spare or empty hives, **especially** any second hand items;
- when reusing any items which may have been associated with foul brood infection;
- whenever it is necessary to move items between colonies.

#### 3.6.2. Properly dispose of waste materials

- It is important for beekeepers to keep their yards clean and properly dispose of all beekeeping waste and hive by-products.
- Burr comb, broken equipment, and old wax should be sealed in garbage bags (to prevent robbing) and placed in garbage bins.
- Hive feeders and syrup containers should be rinsed out, so any sugar residue is washed away.
- It is important that your apiary is not attracting any pests like wasps, rodents

#### 3.6.3. Honey bee biosecurity

- Honey bee biosecurity is a set of measures designed to protect your honey bees from the entry and spread of pests.
- Honey bee biosecurity is the responsibility of every beekeeper and every person visiting or working in an apiary.
- Maintain good hygiene practices around the apiary and remove beeswax scraps, old combs and dead-out hives, which can attract and harbour pests and diseases.

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Self check 3	Written Test
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Name: \_\_\_\_\_ IDNO \_\_\_\_\_ Date: \_\_\_\_\_

**I. choice the best answer and encircle on it**

1. -----is opening the hive, removing and repositioning brood frames safely and with minimal damage or unintended disturbance to the brood.
  - A. swarming
  - B. manipulation of brood
  - C. queen replacement
  - D. grafting
2. important point to be considered during internal inspection of hive is---
  - A. presence of queen
  - B. presence of spotty brood pattern
  - C. health condition
  - D. all
3. -----and -----used for colony inspection
  - A. super and reduce
  - B. swarm and mating
  - C. internal and external inspection

**II. Answer all the following questions**

1. In which direction shall the beekeeper always approach the hive? What is the reason?  
(5points)
2. Why the beekeepers puff the smoke at the entrance of the hive before opening it? (5points)
3. What is the recommended time to open the hive ? (5points)
4. write at least 10 Precautionary measures to be taken before and during inspection (10points)

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## Operation sheet 3

### 3.1. Internal inspection of hive

#### A. Tools and Equipments required

- Gloves
- mask
- smoker
- hive tool
- bee brush
- bee veil
- bucket
- and sealed container
- Smoking material (e.g saw dust)
- Torch
- Bee brush
- Hive's spare box

#### B. Procedure

- Before start internal inspection check external.
- Puff the smoke at the entrance of the hive and wait 10 to 20 seconds until the smoke penetrate to all the corners of the hive
- Then carefully push the back of the hive tool under one back corner of the lid, pushing down and lifting the lid upwards with your other hand.
- Remove supers if any and place them close to the front of the hive – they will tend to attract the returning bees and make inspection easier.
- Carefully remove the queen excluder and check to ensure that the queen is not on it.
- Clean up any brace comb or propolis on the queen excluder at this stage so that you are able to quickly **re-assemble** the hive if necessary.
- Smoke between the two boxes.
- Carefully remove either an end frame, or dummy board if there is one, to give space to easily remove or move the other frames without damaging the bees. After inspecting to

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see if the queen is on it, place it in a safe place at the side of the hive preferably not in direct sunlight.



**Figure3.1a:Opening of beehives**

- Examine each comb thoroughly for the presence of brood, queen, honey, pollen and presence of any disease or enemy.
- Always replace combs in the same sequence and same orientation as they were at the start of the inspection.
- After finish the examination, Re-assemble the hive making sure that frames are tightly pushed up together to provide correct bee space.
- Ensure that the hive is stable on its stand or the ground and that it is properly assembled with no gaps between boxes.
- Check that the site is clean and tidy and make the notes on your record card before leaving the site.

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**Figure3.2b:Examination of bee colony**

### 3.2. Harvesting a honeycomb

#### A. Tools and Equipments required

- Overall
- bee veil
- gloves
- rubber boots
- uncapping knife
- smoker
- hive tool
- stainless steel
- vessel
- bee brush/feather

#### B. Procedure

- Put on your protective clothing.
- Arrange all the materials at the workplace.
- Load your smoker, and puff some smoke gently around the hive for a few minutes. Wait a few more minutes, then puff smoke around the entrance hole.
- After puffing the smoke, open the lid.
- Knock the top bars to see which of them have combs, they will sound heavier than empty ones.
- Use the knife or hive tool to remove the first bar from one end of the hive.

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- Puff smoke gently into the gap to drive the bees to the other side of the hive.
- Start removing the frames from the super one by one, until you get to the first comb, which will be white and new. It may be empty or it may contain some unripened honey. Replace it and leave the comb for the bees to develop.
- Remove only the capped or partly capped combs, which will be quite heavy. Use a brush or feather to sweep and bees back into the hive.
- Cut the comb off, leaving about 2 cm for the bees to start building on again. Put the comb in a container and replace the top bar.
- Carry on harvesting until you come across a brood comb, which will be dark in colour and contain pollen too. Leave this honey for the bees.
- Start the process again at the other end of the hive.
- Close the hive carefully, replacing the lid.
- Transfer the containers containing the honey combs to the extraction room.

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LAP TEST	PERFORMANCE TEST
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Given necessary template, materials, tools and equipment you are required to perform the following task in **4** hours. The project is expected from the all student to do it.

**Task1:** perform internal and external inspection

**Task2:** carry out harvesting of honeycomb

LG#10

## LO 4 Manage honey bee swarm and swarming behavior

### *Instruction sheet*

This learning guide is developed to provide you the necessary information regarding the following content and topics:

- Obtaining and confirming swarming equipment
- Undertaking swarm catching and collecting procedure's
- conducting quarantine of swarm
- quarantining and monitoring hive health
- Monitoring and determining egg laying performance
- Monitoring signs of honey bee swarming
- selecting and implementing option for controlling swarming
- Assessing and managing colony swarming behavior
- Identifying risks associated with catching and collecting bees

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Obtain and confirm swarming equipment
- Undertake swarm catching and collecting procedure's
- conduct quarantine of swarm
- quarantine and monitor hive health
- Monitor and determine egg laying performance
- Monitor signs of honey bee swarming
- select and implement option for controlling swarming

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- Assess and manage colony swarming behavior
- Identify risks associated with catching and collecting bees

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

## Information sheet 4

### 4.1. Obtaining and confirming swarming equipment

#### 1. Protective equipments

- bee veil
- bee-proof overalls and gloves
- steel capped boots/shoes/gaiters
- sunhat

#### 2. Other equipments and tools

- a beehive with active bees
- swarms to be collected
- brood box
- frames or ventilated bee proof box
- ladder
- saw
- bucket
- clippers
- rope
- bee brush
- bee smoker and fuel
- water sprayer
- hive tool
- Transformer 12 volt

**Note:** Always check that the tools and equipment you need are available in good working order. If any items look worn or damaged, or if any are missing, you need to improve before going any further.

### 4.2. Undertaking swarm catching and collecting procedure's

Swarming is the natural means of **reproduction of honey bee colonies**. A new honey bee colony is formed when the queen bee leaves the colony with a large group of worker bees, a process

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called **swarming**. When a colony of honey bees becomes large, it divides in to two units. About 30 to 70 percent of the bees remain in the **parent colony**; the rest leaves as a swarm.

### Types of swarms

When the old queen leaves the colony with half the workers – this is known as the **prime swarm**. The **parent colony** is left with a number of **ripe queen cells** to produce a replacement queen for the original colony. At times, another swarm will leave the original colony with a **virgin queen hatched from these queen cells**. This swarm is much smaller and is called a **secondary or after swarm**.

In other cases, the whole colony, headed by the original queen of that colony, **absconds the hive**. This is often a very small swarm and is called an **absconding swarm**. An absconding swarm can be **triggered by starvation, invasion of pests or disease**.

### What do honey bees do after swarming?

- On leaving the original colony, the swarm will cluster as a group on a shrub, a tree branch or a fence.



Figure4.1:swarm bee clustered on shrub

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- Prime and absconding swarms headed by an old queen will usually cluster within ten meters of the hive they swarmed from. This is the ideal time to catch them. Swarms headed by virgin queens fly a longer distance and often cluster higher.
- Then, bees from the cluster will seek out a **suitable cavity** in which to set up their new colony. They can find a suitable location within a few hours. The cluster **leaves their temporary resting place** with the queen and goes to the **new location** to set up their new hive.

#### 4.2.1. catching swarm

##### Steps of catching a swarm and putting the swarm inside a hive

- **Prepare your new hive first** – clean it and by rub it with some beeswax or propolis so it smells familiar for the bees. Both propolis and beeswax, can be softened in hot water, near fire or in the sun before using them.
- **Use your smoker and bee veil** and suit when catching a swarm, as some swarms may be hungry and difficult to manage. Generally swarming bees are docile as they have no brood to protect but always be careful with strange bees, as they may be aggressive! Keep your smoker alight nearby in case you need it.
- **Check where the swarm is located**(location). Bees clustering on a branch where you can catch them are easy. A natural swarm **hanging from a tree** is normally **docile** and can be easily removed and hived. If the swarm is in an awkward place then use your smoker (or any smell they instinctively move away from, such as squashed marigold leaves) to move the swarm to a place where you can get underneath and catch it easily.
- **Check the size of the swarm**. Don't waste time with very small swarms (smaller than a person's head), as they are more trouble than they are worth.
- **Spray or sprinkle the bees with water (preferably with sugar added) to wet their wings**. This will stop them flying away and they will lick each other and become more satisfied. Also blow smoke gently and repeatedly over the swarm without arousing it.

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- You can catch a swarm in a container such as a **cardboard box**, a **wide mouth basket** or even a **bag made from cloth**. The container needs to be easy to close, easy to carry and be ventilated. Do not use a plastic bag as the bees will **suffocate**! Bee veils that are tied at the **bottom** can also **make good swarm catchers**.
- **Hold the container under the swarm**. Now **shake or brush the whole swarm** of bees with a feather or brush made from soft leaves, directly into the container. But never brush bees without smoking before hand. If the swarm is hanging from a branch then a firm blow on the branch (or one or two hard shakes) will make the bees drop into the container. Alternatively you may cut the branch if it is thin and carry the swarm to the container.
- **Now observe the bees, if most of the bees have entered**, you can be certain for the queen.
- **Close the container and quickly( gently) turn it upside down**, so the entrance is at the bottom. The bees sit or hang from the top of the inside of the container. Wait for about 20 minutes for all the bees to settle. but if you are not sure that you have the queen and want to be on the safe side, then shake the swarm on to a white sheet or cloth and find the queen bee. Seize her gently by the chest or wings (never her abdomen).
- **Place the queen in a queen cage such as a matchbox**. Slightly open the matchbox so the bees can communicate with the queen and feed her but she cannot escape.
- Place the cage with the queen in the upper part of the container. This indicates bees follow the queen and cluster around the cage.

Leaving the container in a shady place until evening covered with a damp cloth. Shaking the bees into your empty hive when evening comes. Placing the caged queen in the hive. Giving the bees a comb with some uncapped honey and a brood comb with eggs (but without bees!) from another hive.

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**Figure 4.2: Catching a swarm**

**note:-**A beekeeper capturing the swarm wearing protective clothing. After capturing, the swarm can be transferred into the beehive

- Fixing queen gates or inclusers in front of the entrance holes.
- Releasing the queen after a few days when the bees have settled down.
- Feeding the bees in the first few evenings to help the swarm to settle during the nights.
- Checking that bees are entering and leaving the hive.

You can also **trap swarms** in a **swarm(catcher) box, bait hive or(mini top bar hives)** to catch swarms – but boxes, baskets or gourds may also be used as bait hives. The best catcher boxes have top bars from which the bees can build combs.



**Figure 4.3:Swarm Traps & Bait Hives**

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Figure 4.4: bee swarm on tree branch and collecting a bee swarm

### Collecting Swarm on a tree branch or any other objects

Three considerations to keep in mind before attempting to collect a swarm which rests on tree, shrub, fence post, on side of the building or any other objects are (1) how long the swarm has been there, (2) where the swarm is located, and (3) its size.

- ✓ When possible, remove the swarm gently, disturbing the cluster as little as possible, and put it directly into a hive or enclosed container (a cardboard box with a tight-fitting lid works well) to transport it to a new hive or location. If the swarm cannot be cut down, either shake or scrape the bees into a lightweight box.
- ✓ When a swarm settles in a very high tree or on any other inaccessible structure, it is best to leave it.
- ✓ Once you have successfully captured a swarm, you can introduce the swarm into your own equipment by either shaking or dumping the bees into an open hive with several frames removed or simply by shaking it in front of the hive.
- ✓ Using drawn combs is better than foundation when introducing swarms to an empty hive, but one or two drawn combs, preferably with pollen, brood, and/or honey (disease-free colony), combined with foundation.

### why collecting swarm is necessary?

- ✓ To increase numbers of hives in apiary
- ✓ To obtain worker bees to repair damaged combs and draw foundation
- ✓ To Remove swarms in urban areas that represent a public nuisance

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#### 4.2.2. Putting the swarm in a hive

##### procedure

- Once you have the swarm of bees, leave or hang the container in a shady place or dark corner until evening. Make sure the bees do not become hot in the container - covering it with a damp cloth can help.
- When evening comes, take the bees to the apiary.
- Remove half of the top bars from an empty hive, with the remaining top bars covering one end of the hive.
- If you have other hives give the bees a capped brood comb and a brood comb with eggs (but without bees!) to encourage them to stay. Also give the swarm a comb with some uncapped honey and pollen and frame the brood combs with them.
- If you have caged the queen then fix the cage to a top bar.
- Lower the swarm into the hive and with a sudden jerk, shake the bees into your empty hive. They gather under the bars near the queen.
- If the queen is caged then release her after a few days when the bees have settled down. Push the matchbox open near a cluster of bees and the queen quickly creep among the other bees. Do not cage the queen for longer than 3 days.
- If no brood comb and food combs are available for your newly hived swarm you can fix queen gates or inclusers in front of the entrance holes with soft wax.
- Initial feeding in the first few evenings will help the swarm to settle during the nights. It is best not to open the hive during the next 4 weeks, as the colony has to settle undisturbed. But remember if you caught the swarm during a poor flowering season it is better continue feeding sugar water for 2 weeks.
- Check that bees are entering and leaving the hive. If the bees are carrying pollen this is a good sign, as it means they are making and feeding new brood and are happy in their new home.

#### 4.2.3. Conducting transferring procedure's

##### Transferring bee colony

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An established colony in nuclei box or in a traditional hive should be transferred to a standard movable frame hive or movable comb hive. This is because in these domiciles (dwelling place) the combs are crooked (run cross wise) or across-diagonally. As a result they cannot be managed properly and they produce only small amount of honey. Transferring honeybee colonies from fixed hives is an important method of obtaining bees in **easy management situations**.

### **Necessary preparations for transferring bee colonies**

To undertake Transferring bee colonies the following materials should be provided:-

- The beekeeper must prepare his/her protective clothes dress them properly and also prepare the other necessary equipments
- The hive to which the colony is going to be transferred with its full components
- Knife to cut the honeycombs from the original hive.
- Bee brush to guide (draw) the bees to the new home
- Big dish (bowl) to collect the cut combs and others
- Water sprayer to hinder (cool down) the bees from flying up
- Straw mat/ plain iron sheet, or canvas to save the bees from falling on the ground or in the grass.
- Frame wire, sisal rope, or rubber band etc to tie (attach) honey and brood combs to the frames top bars.
- The colony, which is going to be transferred, should be placed in its new site (place) at least three days in advance. This is very important to orient the bees to their new environment and foraging direction.
- The site (place where transferring will take place, and colony will be placed) should be cleaned
- The hive which will be used, as a new home for the colony has to be filled with wired and attached wax foundation frames/ or with wax smeared top bars.
- The smoker should be filled with fire and smoking materials at least 10 minutes in advance. .

#### **4.2.4. Season (time) of transferring**

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The best season to transfer colonies of bees from one hive to the other is a period of honey flow. An ideal time is during honey bees plant bloom at the first week of active season (at the end of heavy rainy season or the end of dry season) in order that the bees could exploit the environmentally available flowering plants and build up their population.

If the transferring place is away from the reach of people and animals, it is quite possible to do the transferring during **day time** starting from morning to late afternoon. If the operation of transferring is near resident areas or at backyard, the possible and safe operation time is after all animals, school children and other walking living things are under their respective shelters. It is not advisable to do transferring alone. Two or more people can do better jobs and safe.

### Follow up after transferring

- Once the colony is transferred to the new hive the beekeeper should:
  - ✓ Under take external hive inspection always against the ants attack
  - ✓ Inspect the colony internally to check whether the colony started comb building
  - ✓ Observe or examine for the egg laid by the queen
  - ✓ Carry out the necessary hive manipulation for the building up of the colony once in a month.

### 4.3. conducting quarantine of swarm

#### monitoring hive health

- Obtain **sound information** and understand the pest and disease risks for each apiary.
- Develop **appropriate measures for pest and disease control** and **recording all** treatment for overall hive.
- Implement a **barrier management** system to reduce the risk of spreading pests and diseases within and between apiaries.
- Control swarming in colonies by providing **extra space for the colony during build up**, and **remove queen cells to keep the colony population strong and healthy**.
- Regular comb **replacement** can lead to improvement in the health of your honey bees.
- Brood combs should be replaced with **new foundation** at least once every three years.
- Inspect brood combs on a regular basis throughout the year.

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#### 4.4. Monitoring and determining egg laying performance for requeening

- the primary function of queen is **reproduction**.
- produces both fertilized and unfertilized eggs.
- During peak production, queens may lay ~1,500-2000 eggs per day.

egg laying queen is:-

- elongated in abdomen
- queen's thorax is slightly larger
- wings cover only about two-thirds of the abdomen and
- Her body is normally much longer than either the drone's or worker's, especially during the egg-laying period

#### 4.5. Monitoring signs of swarming

##### 4.5.1. Signs of swarming.

The major and most important Signs of Swarm Preparation are the following:

- Rapid increase of worker bees population
- Drone combs and drone rearing increase
- Queen cells construction at lower frame (combs edges) becomes evident
- Body lose of the original queen and her restlessness
- Field bees are less active and aggregate at the hive entrance
- Egg laying by the queen reduced as a result the number of eggs reduced
- No more comb is built
- Fewer bees fly out to forage
- The bees become less active
- Limited number of eggs that can be laid by the queen

##### 4.5.2. Reasons (Stimulating factors) for Swarming:

- Different factor will trigger swarming but the major factors are the following
  - ✓ **congestion in the brood area**, which is related to population size and availability of space.
  - ✓ **Overcrowding** may serve as means of multiplying colony

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- ✓ **Aged or failing queen**
- ✓ **Genetic predisposition** or races of honey bees
- ✓ **Poor ventilation**, poor O<sub>2</sub> circulation because of overcrowding
- ✓ **Decline in queen pheromone production:-** The **production and distribution of chemicals (queen substance)** secreted by the queen also mediates swarming. When there is a **shortage of these secretions**, whether from lack of production by a **failing queen** or **poor distribution due to congestion in the brood area**,
- ✓ **Restricted egg laying of the queen** due to less empty cells and idleness of nurse bees

#### 4.6. Monitoring (controlling ) of swarm

Unless swarm is controlled or the swarm is captured; it shows the sign of the beekeepers negligence and results in loss of production of honey and other hive products. So to prevent this production loss, we have to prevent or control swarm of honey bee. Colony has to be monitored to ensure that swarming behavior has been controlled and if necessary further control options are implemented. We can Prevent and Control Swarm by different mechanism:-

- **Relieving overcrowding by adding more room or super.** This can be done by supering early (at the right time), removing partition, removing old combs.
  - Remove queen cells and the queen pupa (damage or harvest)
  - Artificially swarming colony by removing part of colony
  - Make a new nucleus colony
  - Manipulating brood box
  - Moving colony to a honey flow
  - Interchanging weak colonies with strong colonies
  - Insert queen excluder to partially limit the egg laying of the queen
  - Reduce (remove) some brood and give it to the weak colonies
  - Select races or hybrid queens with less swarming tendencies
  - Bait the swarm.

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- Re-queening colony with a young queen from a strain of bees known to be less likely to swarm
- Split the colony (artificial swarm): Do this when there are enough drones, but just before there are swarm cells.

There are several methods for making such artificial swarms, but the principle is the same: the colony is divided into two, one with the old queen, the artificial swarm and one without, but with queen cell(s) or brood combs with eggs and young larvae from which the bees can produce new queen cells.

- **When dividing a colony it is important to plan the activity carefully and to consider the following points:**
  - ✓ what conditions are needed for both new colonies and where to position them,
  - ✓ which one in the old place, where all flight bees return and which one in a new place, where only the young bees will stay.
  - ✓ the beekeeper must take all open brood combs and also the capped brood combs, except one or two and put them into a new hive, a few meters away. In this new bee hive the bees will make queen cells out of some the cells with newly hatched larvae.
  - ✓ No empty combs are needed here, nor foundation sheets, as there is no queen yet to lay eggs or flight bees to collect nectar or pollen.
  - ✓ Only one or two frames with honey and a frame with some pollen are needed in this hive for survival until the new queen lays her eggs and young bees have developed into flight bees.
  - ✓ In the old colony the queen will continue to lay eggs and empty combs and foundation sheets are needed.

**In general there are two possibilities:**

1. **The old queen stays in the old place** and this will be where all the flight bees will stay. In this case the beekeeper must take all open brood combs and also the capped brood combs, except one or two and put them into a new hive, a few meters away. In this new bee hive the bees will make queen cells out of some the cells with newly hatched larvae. No empty combs are needed

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here, nor foundation sheets, as there is no queen yet to lay eggs or flight bees to collect nectar or pollen.

Only one or two frames with honey and a frame with some pollen are needed in this hive for survival until the new queen lays her eggs and young bees have developed into flight bees. In the old colony the queen will continue to lay eggs and empty combs and foundation sheets are needed. Young bees will emerge from the capped brood which has remained and these will nurse the larvae. In the meantime flight bees will continue to bring pollen and nectar.

## **2. The old queen is moved to a new place.**

In this hive queen stay with young bees that must be shaken from the brood combs. The easiest way to do this is to hold the frame in one hand over the new hive and then tap it firmly with your other hand, so that the bees fall off. Two thirds of the combs must be treated in this way. most of the flight bees return to the old hive and therefore the new hive must be overcrowded. Put foundation frames and empty comb frames in this new hive together with pollen and honey frames so that the queen can continue to lay eggs. Do not put brood combs in the hive. These must stay in the old hive where the colony make new queen cells.

### **For traditional hives**

- Removing combs
- Destroying the pupa
- Providing extra hive

#### **4.6.1. Identifying types of swarm**

##### **Types of swarming**

**There are three types of Swarm:**

- Reproductive swarm
- Migration and
- Absconding

##### **1. Reproductive swarm**

- Occurs as the result of reproduction of the colony
- It is a way of perpetuation of the species

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- Can be triggered due to overcrowding
- However, since it is a natural phenomenon it can occur even in non congested colony
- Tropical African honey bees have high reproductive swarming tendencies
- In modern beekeeping reproductive swarming is not acceptable

## 2. Absconding

When the entire original colony totally departs (leave) their home it is known as absconding. Totally it is movement of the colony due to disturbances and unknown reasons.

**Possible causes of absconding could be:**

- Starvation
- Diseases and parasites such as mites
- Wax moth infestation
- Poor ventilation
- Excessive disturbance of the colonies by the beekeepers
- Excessive disturbance by other animal pests
- Bad weather e.g. very high temperatures
- Damaged or poor hives.

## 3. Migratory swarm

- Migratory swarm is a movement of the whole colonies move from one ecology to the other following dearth period
- Mostly due to shortage of food, water and high temperature

### 4.6.2. Types of queen cells

**There are also three types of queen cells which will be produced by honey bee**

- Reproductive queen cells
- Supersede (Supersedure) queen cells and
- Emergency queen cells

When we remove queen cells we have to identify the nature of the queen cells.

#### 1. Reproductive queen cells

- Mostly at the periphery of the comb

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- 10 – 20 queen cells
  - Occur at peak flowering period
  - In overcrowded colony
2. Supersede (Supersedure) queen cells and
- It is built when the queen becomes old to be replaced
  - Queen cells are few in number
  - Mostly at the face of the comb
  - The brood pattern is normal as that of young queen
  - When we remove the queen cells leave at least 2 proper queen cells
3. Emergency queen cells
- Emergency queen cells built when there is sudden loss or death of the queen during hive operation.
  - If there is no egg and young larvae, queen cells are built from workers larvae by modifying workers cells.
  - Mostly found at the center of the comb .
  - So during removing such queen cells we have to leave at least two queen cells.

#### 4.6.3. Requeening Swarm honey bee

Why replace MOM? Several reasons include, reduced swarming, bees swarm less with a young queen. Improved genetics, since the queen is mom to all others in the colony, her genetics determine the characteristics of the entire colony. Desired characteristics, we want a lot from our bees, gentleness, disease & parasite resistance, long productive life, and high egg laying rate, solid brood pattern, pretty color & markings, less propolis, prolific pollinators, proper timing of build up & shut down of brood rearing, appropriate with the seasons, and reduced swarming.

The hive to receive the queen must have no queen or queen cells already present. Ideally, the hive should be queenless for at least 24 hours prior to introduction.

The cage should be placed in the middle of the brood nest (if no brood is present, place the cage in the middle of the cluster). Position the cage between two frames, so that the candy end points up and the screen is not blocked. Squeeze the frames around the cage to firmly suspend it, any

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damage to the comb will be repaired by the bees when the cage is removed. Make sure the hole at the candy end is not blocked.

**Note:** If 10 frames are used, one frame may have to be removed to accommodate the cage.

#### 4.7. Selecting and implementing controlling options of swarm

Prevention or control of swarming is essential to achieve success in beekeeping. An important step in preventing swarming is reducing the congestion in the brood nest. You can do this by:

##### 1. Re-queening the colony annually (or at least every two years)

This is one of the best methods for limiting swarming in your colonies, especially if you are a commercial beekeeper and have perhaps thousands of hives. It is difficult under these circumstances to keep such a close eye on matters but, if you re-queen annually, you will at least know that even in your absence the number of colonies swarming in your bee yards will be low. For a beekeeper with only a few colonies it is an easy method to employ.

##### 2. Lifting the brood combs to the super

Some combs of brood maybe transferred to the super from the brood chamber this will draw up some of the nurse bees out of the bottom brood box reducing congestion. Replacing the combs in the brood nest with worker cell drawn combs or foundation this given the queen more room to lay.

##### 3. Reversing hive bodies

Reversing hive bodies can be a useful and effective method of swarm prevention. This simply involves swapping the positions of the upper and lower boxes (if you have them). Alternatively you can place a second brood box on top of the first. This box should have frames of empty comb, and a frame of capped brood from the existing brood box should be placed in the middle of it. Bees tend to work upwards, and so giving the colony more room for brood and for themselves reduces overcrowding and, in turn, reduces the inclination to swarm.

##### 4. Supering up

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This involves putting honey supers on to the brood body(s) in time for the honey flow. The first box should be filled with comb, especially if the season is early – bees have difficulty producing wax early on in the year. Putting supers on in time is not only essential for honey storage preparation but it also limits swarming by giving the bees more room in the hive.

### **5. Removing brood combs**

This can be done in two ways. You can move frames of brood from strong colonies in danger of overcrowding to weaker colonies, or you can swap the positions of weak and strong hives. This latter manipulation can also be quite effective on hives that are near to swarming. In both cases you should ensure that both colonies are free from disease, otherwise you risk the chance of spreading it. You must also make sure the weaker hives aren't weak because of some disease; otherwise you are wasting your time and your bees.

### **6. Ventilating your hives**

Good hive ventilation goes a long way to lessen the swarming impulse if other methods are employed as well. Ensure that your entrances are appropriate for the time of year; that in really hot climates your lids are painted white; and that you use a stainless-steel mesh floor. The use of shade boards over the hive entrance is also a good idea in hot climates.

### **7. Destroying swarm cells**

If swarm cells are present, reducing the swarm cell.

### **8. Exchanging the position of weak and strong colonies**

Swap the position of strong and weaker colonies. The field bees will strengthen the weaker hives from the strong ones.

### **9. Removing honey combs**

Removing surplus frames of honey in the brood nest and extracting them replacing them with drawn worker combs or foundation.

## **4.8. Assessing and managing colony swarming behavior**

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- The honey bee colony is a complex society which commands a wide range of **behaviours** to protect itself from predators and diseases and to enable its reproduction and survival.
- One of the most important behaviours for the honey bee colony is reproduction.
- Another well-known type of behaviour in honey bees is colony defence consisting of recognition of predators, alerting nestmates and enacting antipredator behaviour.
  - ✓ example, the natural way for honey bee colonies to reproduce is swarm, and this behaviour is thus intimately connected to fitness, but in contrast to this, beekeepers favour colonies that never swarm. Likewise, defensive behaviour is not favoured by beekeepers, but very docile honey bee colonies can easily fall prey to natural enemies, like wasps, birds or mammals.
- Hence maintaining honey bees with optimal behaviour used for
  - ✓ **continuous artificial selection**
  - ✓ **Health and disease control**, such as hygienic behaviour and grooming have gained more interest among selection programmes
  - ✓ Increasing hygienic or grooming behaviour should help the bees to **remove several pathogens and parasites**

## 4.9. Identifying risks associated with catching and collecting bees

### 4.9.1. Risks

If you decide to collect swarms the risks are:-

#### OHS hazards

To some extent, these will depend on where the swarms have settled and may include:

- bee stings
- exposure to solar radiation
- falls from ladders.
- Diseases and pests
- Property damage

### 4.9.2. Measures to be taken to minimize the risks

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Apply OHS requirements in accordance with regulations/codes of practice and enterprise safety policies and procedures. This may include:

- Using of relevant protective clothing and equipment
- use of tooling and equipment
- workplace environment and safety handling of material
- use of firefighting equipment,
- Checking and fulfilling required safety devices before starting operation
- Apply safe operating procedures regarding:
  - ✓ electrical safety
  - ✓ machinery movement and operation
  - ✓ manual and mechanical lifting and shifting
  - ✓ working in proximity to others and site visitors
- Apply emergency procedures :
  - ✓ emergency shutdown and stopping of equipment,
  - ✓ using extinguishing fires,
  - ✓ First aid application and site evacuation.
- placing collected swarms in **quarantine** for one month following collection and observing them for signs of disease
- Reporting any signs of disease observed to appropriate authority and other appropriate action has to be taken to control or/and prevent the disease

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Self check 4	Written Test
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Name: \_\_\_\_\_ IDNO \_\_\_\_\_ Date: \_\_\_\_\_

**I. choice the best answet and encircle on it**

- when original colony totally d leave their home is called-----  
 A. absconding  
 B. reproduction  
 C. migrating
- how you can control sawrming in the apiary site  
 A. by Removing queen cells  
 B. by Making a new nucleus colony  
 C. Interchanging weak colonies with strong colonies  
 D. all
- select the most important point to collect swarm bee from tree branch  
 A. height of tree  
 B. size  
 C. location  
 D. all

**II. Answer all the following questions**

- write the types of swarming ( 5 point )
- List the factor that raise swarming ( 5point )
- As commercial bee keeper how you can control swarming(10point)
- How can we apply the appropriate procedures to minimize risks? ( 10point )

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## Operation sheet 4

### 4.1. Catching a swarm

#### A. Tools and Equipments required

- Overall
- bee veil
- gloves
- rubber boots
- swarm basket
- hive tool
- sugar syrup
- smoker
- pen
- knife
- string
- hessian cloth
- decoy bee hive
- cow dung for smoker,
- match box
- first aid box
- water
- ladder
- cardboard box(wide mouth basket)

#### B. Procedure

- Prepare equipment and supplies.
- Check the size of the swarm.
- Take a swarm basket and pour some sugar syrup on it.
- Spray or sprinkle the bees with water (preferably with sugar added) to wet their wings.
- Place the basket underneath a decoy beehive hanging to a branch of a tree or post.
- Now observe the bees, if most of the bees have entered
- Once the bees enter the basket, close the mouth of the basket with a hessian cloth and tie with string.
- Remove the roof, supers and queen excluder of a hive.
- Take the swarm basket to a new brood chamber and transfer them into the chamber by shaking.

- Replace the super chamber and the roof in their original position.
- Feed the swarm on sugar syrup or a mixture of 2/3 honey and 1/3 water.
- Do not allow the bees to go out for at least 24 hours by sealing the entrance of the hive with some dry grass.
- Allow the bees to leave the hive after 24hrs by opening the entrance in the evening

#### 4.2. Exchanging the position of weak and strong colonies

##### A. Tools/ Equipments/ Material required

- Overall
- bee veil
- gloves
- rubber boots
- hive(with weak and strong colony)
- hive tool
- sugar syrup (sugar: water in ratio of 1:1 ie.,100g sugar in 100ml water)
- smoker
- cow dung for smoker
- match box
- newspaper
- queen excluder
- water

##### B. Procedure

- Wear the protective clothing
- Move the two colonies close together taking all the steps for moving bees carefully
- Smoke three to four puffs on the entrance of the hives to be united
- Remove the queen from the weak colony
- Remove supers shaking the bees into their brood box
- Place a single sheet of newspaper over the queen less colonies brood box. Ensure that there are no gaps and use two overlapping sheets if necessary
- Make two or three holes or slits with the hive tools to give the bees a starting point
- Place the queen right colony on top of the queen less brood box
- If you have to remove supers and there are still some bees in them it is safer to put them above the top brood box with a queen excluder and another sheet of paper.

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LAP TEST	<b>Performance test</b>
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Given necessary template, materials, tools and equipment you are required to perform the following task in 6 hours. The project is expected from the all student to do it

**Task 1:** perform catching of swarm

**Task 2:** perform Exchanging the position of weak and strong colonies

**LG# 11**

## **L05. Remove honey crops from hive and extract**

### ***Instruction sheet***

This learning guide is developed to provide you the necessary information regarding the following content and topics:

- Obtaining and confirming tools and equipment
- Determining and monitoring ripeness of honey
- Planning Time and location of honey removal
- Using Suitable methods for removing bees
- Undertaking honey harvesting procedures
- Transporting Honey filled frames to extracting facility
- storing of ripe honey in pest and bee protected environment
- Extracting, purifying and checking the moisture content of honey
- Labeling and storing honey

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Obtain and confirm tools and equipment
- Determine and monitor ripeness of honey
- Plan Time and location of honey removal
- Use Suitable methods for removing bees
- Undertake honey harvesting procedures
- Transport Honey filled frames to extracting facility

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- storage of ripe honey in pest and bee protected environment
- Extract, purify and check the moisture content of honey
- Label and store honey

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”





## Information sheet 5






### 5.1. Tools & equipment required to harvested honey

- The major equipment which are necessary to harvest honey are the following:-
  - ✓ Bee blower
  - ✓ Bee brush
  - ✓ Butterfly entrances fitted to escape boards
  - ✓ Escape boards
  - ✓ Fresh water
  - ✓ Loading equipment
  - ✓ Means of transport for honey-filled frames to extracting facility
  - ✓ Wheelbarrow
  - ✓ Queen excluders
  - ✓ Spare boxes
  - ✓ Smoker
  - ✓ Honey extractor
  - ✓ Honey Presser
  - ✓ Honey Containers
  - ✓ Uncapping fork
  - ✓ Honey filtering cloth
  - ✓ Uncapping table
  - ✓ Honey Scrapper
  - ✓ Honey melter
  - ✓ Homogenizer
  - ✓ Refractometr
  - ✓ Bee blower
  - ✓ Honey strainer
  - ✓ Queen rearing equipment
  - ✓ Tarpaulins or other waterproof coverings.



**The uncapping fork** is used to remove wax caps on honeycomb-filled cells, especially those with unevenly capped surfaces. For a better sliding on the wax surface of the honeycomb and greater efficiency, pre-heat the fork in hot water when it is not equipped with electric resistance.

	<p><b>Uncapping machine</b> :-is a specially-built stainless steel machine that uses two vibrating spring-loaded knives to uncap both sides of the comb at the same time. The cutting depth is adjustable. The blades are heated by steam or hot water. Uncapping machines are chain-driven with forward and reverse controls. They are powered by an electric motor. An uncapping machine can uncap about eight frames a minute. They are very popular with both commercial and small beekeepers.</p>
	<p><b>The uncapping knife</b> is used, as the uncapping fork, to remove the wax caps from the honeycomb cells</p>
	<p>hand-held knife:- Depending on the design, hot water-heated knives are immersed in hot water or hot water is circulated through a jacket in the knife. An electrically-heated knife is heated by an electric element for continuous use. A steam knife has a jacket which circulates steam, also for continuous use.</p>
	<p><b>The uncapping tray and table</b> re made of stainless steel. They serve to uncap the honeycombs.</p>
	<p><b>The honey extractor</b> is a device used to extract honey from honeycombs. There are several types of extractors depending on how the frame is placed:</p> <ul style="list-style-type: none"> <li>✓ tangential extractors in which the frames are placed perpendicularly to the rotor shaft. They can be provided with 2, 3, and 4 frames usually mechanically operated</li> <li>✓ radial extractors when the frames are placed along the axis of the extractor and it is no longer necessary to turn the frames, because the extraction is done simultaneously on both sides.</li> </ul> <p>They can be operated manually, when the number of frames is reduced and</p>

	with an electric motor, when they are high capacity (12, 16, 28, 32, 36, and 56 frames).
	<i>The honey filtering strainer</i> is used, during extraction, to filter the honey from wax and bee bread remains.
	<i>The settling tank (barrel)</i> is used for honey clearing and storing.
	<i>The steam wax melter</i> is a low-efficiency machine used in the processing of raw materials having a high wax content. It consists of a double-walled tin dish and is covered with a lid that is attached tightly to the walls. Inside the vessel there is a sieve on which the melting combs are fixed and which will retain the marc and the other debris that are left after their processing (wires, wood scraps, etc.).  Water is poured into the space between the walls, which by boiling causes steam to melt the wax or, in the case of another model, the water enters the vessel acting directly on the melting material, the wax rising to the surface.
	<i>The solar wax melter</i> is a machine that melts the wax contained in honeycombs and caps with the help of solar energy, the heat emitted by the sun during the summer. This tool is to be placed in the sunniest places in the apiary or yard to benefit from as much heat as possible from the sun.  By using the solar wax melter you get a clean, yellowish, pleasant-smelling wax.
	<b>The wax press</b> allows the extraction of wax from recast honeycombs, not only from new caps and honeycombs because it uses, in addition to temperature, the action of pressing, in waste (marc) resulting a small amount of wax (10-30%), of a lower quality, which can be extracted only by industrial processes.

### 5.1.1. Occupational health and safety (OHS)

While we are harvesting we have to apply OHS requirements in accordance with regulations/codes of practice and enterprise safety policies and procedures. This safety policies and procedures may include:

- Using of relevant protective clothing and equipment,
- use of tooling and equipment, workplace environment and safety handling of material
- use of firefighting equipment, enterprise first aid,
- Hazard control and hazardous materials and substances.
- Using gowns, rubber boots of appropriate size, Goggles, respirators, cap, and head phones , gloves etc,

While harvesting honey; beekeepers have to apply safe operating procedures regarding:

- Chemicals and hazardous substances
- Dust, airborne and soil-borne micro-organisms.
- Bee stings
- Fire
- Holes and slippery and uneven surfaces
- Incorrect manual handling
- Noise
- Sharp hand tools and equipment
- Solar radiation

### 5.1.2. Identifying and controlling Risks to colony

The main risks associated with removing a honey crop from a hive are

- contamination of honey with dust(airborne and soil micro-organisms)
- Lower quality product through discoloration and contamination with dislodged brood and larvae when removing honey from a brood nest.
- loose nectar in a comb indicates that nectar honey is not yet ripe
- Two-thirds of the comb cells must be cap.

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- Introduction of disease when frames are swapped from hive to honey extractor or external environment.
- Killing of queen bee by crushing when frames are being removed.
- chilling of adult bees and brood as a result of Harvesting honey during extreme cold weather
- So these Risks which are associated with removing a honey crop from a hive have to be identified and actions have to be taken by the beekeeper while harvesting honey to minimize likelihood and consequences of risks.

## 5.2. Determining and monitoring ripeness of honey

Beginners always and most experienced beekeepers in some cases ask the question” when to the honey is ready for harvest or ripe?” The answer is honey is said to be ripe when the bees cap it with a thin layer of bees wax. Thus, when most of a comb contains **capped honey**, it is ready for harvesting. Thus any capped or sealed honey may be removed from the hive. Other indicates for honey ripe includes **strong aroma of honey smelling, clustered bees around the entrance, lees bee traffic at entrance**. But, all the indicates must be combined with internal inspection for capping of honey combs is mandatory to harvest the crop.

The reason for looking **caped honey** is that **partially ripe honey** also has similar sign and it will distinguish the beekeeper and cause harvesting of **unripe honey**. The moisture content of uncapped (unripe) honey is too **high for the honey to be self-preserving**. If uncapped honey is harvested, it will **ferment**. So, care must be taken in harvesting honey even though the season is appropriate for honey harvesting. However, during the nectar flow when nectar is coming in very rapidly it frequently happens that the capping is a little bit behind.

- **generally honey** is ready to harvest should be removed immediately. The honey will become ready when it became ripe or when 70% of the comb is sealed, because
- **Unripe honey** is: -
  - Not matured
  - In open combs

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- High moisture content
- Fermented shortly after harvest
- **Ripe honey is: -**
  - Matured
  - In sealed combs
  - Kept indefinitely

### **determine and monitoring factors affecting quantity and quality of honey**

#### **Factors Affecting Quantity of Honey**

Honey yield fluctuates from one year to another and varies between colonies.

**The most important factors that affect quantity of honey production are:**

- Availability of bee pasture
- The queen's condition
- Hive population
- Nutrition
- Swarming.
- Space in the hive for expansion of the brood nest and storage of honey
- The colony's freedom from disease
- The beekeeper's experience
- The weather condition
- Adequate nectar producing plants and trees, colonies with vigorous queens and large number of foraging bees, proper hive management techniques and favourable weather conditions will ensure greater honey crop.

### **5.3. Planning Time and location of honey removal**

The time to harvest honey depends on the flowering period of the bee forage plants and the extent of the honey flow. Some areas with plants such as coconut that flower all year round can have honey throughout the year. In any particular area, the best way the beekeeper has to know whether the honey crop is at the maximum is to observe that his colonies are getting ready to

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swarm, brood-rearing ceases and these are characterized by foraging bees sending little or no pollen into the hive. Few bees are seen at the entrance during the day; the bees seem to become lazy, as foraging activity in general seems to have come to an end, but most of the bees continue buzzing and ventilate the hive at night. The honey cells are capped, The hive smells of honey when it is approached, The guards at the entrance become more aggressive than ever, The population of the hive is now at its peak, The brood nest is overcrowded, There is congestion at the entrance, During the night, the bees form a large cluster there, waiting for the cool wind, because they cannot cope with the heat in the hive. All these signs that the colony is getting ready to swarm are also signs that its honey reserves are maximum. But not every colony will be at this point at the same time, and therefore the beekeeper should weigh his hives during his inspection. The heavier hives may be ready for harvesting, while others will have to wait a little longer.

### 5.3.1. Contamination of honey

Since honey is a food, it should be free from contamination. Therefore, caution and care should be taken to avoid contamination before, during and after harvesting until it reaches to consumers.

Honey can be contaminated if it is from contaminated area (air or water or soil). As honeybees are bio-indicators of air or environmental pollution, honey analyses can also indicate the pollution of honey with radioactive substances, pesticides, antibiotics, hormones, heavy metals and other impurities.

**To minimize contamination**, apiary should not be placed in contaminated areas. Beekeeper or processor body and clothes have to be clean as honey is **Hygroscopic** (attract foreign odor to be contaminated). Processing equipment and places must be food grade and clean/hygienic.

**Processing areas and rooms must be free from dust**, particles and transporting and storing must be in presence of any contaminant, Anything that comes in contact with honey must be

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hygienic, Honey should not be exposed to insects and fly, use mesh wire at the windows and doors during honey processing/extraction.

### 5.3.2. Management of honey quality

The production of a good quality honey starts from apiary, For example, harvesting honey from brood chamber and old combs:-

- Increases the pollen content of a honey
- Darken the color of honey,
- Affects its odor

To get **light color** honey always use new combs. So remove old combs before brood rearing starts

To **reduce Moisture content** of honey beekeepers can assist the bees to make their efforts more efficient by:-

- Providing proper ventilation of the hive;
- Slightly sliding the suppers and the lid to facilitate air circulation
- During harvesting harvest only by identifying only properly ripen honey (harvest when 75% of the honey capped).

Honey is preserved because of its **high sugar content** (or conversely its **low moisture content**), which prevents micro-organisms (bacteria, yeasts and moulds) from growing in it. Despite this, it must be **handled hygienically**, and all equipment must be properly cleaned.

The aroma and taste of honey are its most important **quality characteristics**, but honey is often judged according to its **colour**. The colour of honey depends mainly on the source of the nectar. Usually **dark-coloured honeys** have a strong flavour whereas pale honeys have a more delicate flavour. Generally light-coloured honeys are highly valued than dark products. Some honeys have a high pollen content, which makes them appear cloudy, and this may be considered as lower quality by some customers.

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**The main causes of loss in quality of honey are:**

- An increase in moisture content - too much water in honey (greater than 19-20%) causes it to ferment. Honey is ‘hygroscopic’, meaning that it will absorb moisture, and all honey processing equipment must therefore be completely dry. Honey should also be processed as soon as possible after removal from the hive to prevent it absorbing moisture from the air, especially in humid climates. In areas with a very high humidity it can be difficult to produce honey of sufficiently low water content.
- Development of HMF (Hydroxymethylfurfural). This is a break-down product of fructose (one of the main sugars in honey) that is formed slowly during storage but very quickly when honey is heated.
- Colour can also be an indicator of quality because honey becomes darker during storage and heating. The amount of HMF present in honey is used as a guide to the age of the honey and/or the amount of heating that has taken place.
- Contamination by insects. Honey processing is a sticky operation, and the sugar in honey attracts ants, cockroaches and flying insects.
- Careful protection is needed at all stages of processing, including insect screens on doors and windows to prevent contamination by insects. All honey residues on equipment should be removed by proper cleaning to prevent them attracting insects. The presence of any other contaminations (e.g. particles of wax, parts of bees, splinters of wood, dust etc.) make the honey very low value.

**generally good quality honey is:-**

- Must be **clean and clear** - no dirt, dead bees, wax, dust, splinters of wood or ashes.
- Must have a **good taste**. It should not be too smoky or have a fermented taste.
- Must have a **good smell**. Harvesting old dark combs and brood combs can affect the smell and colour of the honey. **Over smoking** the combs can also affect its smell.

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- Must have a **good colour** – This depends upon the nectar source and age of the combs. Usually dark honey has stronger flavor and light colored honey a more delicate flavors.
- **Free from Presence of pollen.** The Presence of pollen can make the honey appear muddy.
- **Must be ripe** and have a **low moisture** content

#### 5.4. Use suitable *methods for removing bees*

Methods for removing bees from the hive may include:

- Shaking and brushing
- Removing the super and letting bees walk or fly out
- Escape boards and
- Bee blowers

#### 5.5. undertaking honey Harvesting procedure

The first time of honey harvest will depend on the time, when the hive was colonized by bees. If the locality has been experiencing some degree of drought, honey must be stored for use during the dearth season, when bee food will be scarce in the field.

In harvesting honey from log or box hives, the beekeeper applies a little smoke and then uses a sharp, thin bladed knife to cut the combs containing honey from the hive walls or ceiling from which they are suspended. The sections of comb containing honey storage cells are separated from the brood and pollen cells.

The advantages of movable-frame beekeeping become especially evident at the honey-harvesting stages. Not only can the hives be opened for inspection to determine the availability and ripeness of the honey they contain, but individual Frames containing capped ripe honey can be removed from the hive, leaving the pollen and brood cells intact. Finally, the honey can be extracted mechanically, and a better-quality product obtained.

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General rules which you should keep in mind while harvesting honey:-

- Only remove combs with capped honey: uncapped honey contain too much water and start to ferment.
- Do not take any honey combs containing brood. In the fixed comb hives only take away the combs at the side of the hive.

#### 5.6. Transport Honey filled frames to extracting facility

- When the honey transported to an extracting plant, cover the load with escape boards or a tarp to prevent dust and bees from entering the boxes.
- **Factors to be considered when transporting honey-filled frames may include:-**
  - ✓ Keeping load impervious to dust, bees and water
  - ✓ Placing removed supers of honey on drip trays to catch and
  - ✓ Any honey drips during transport
- Honey should be extracted immediately after it is taken out of the hive.
  - As soon as the honey is taken out of the hive, it is warm and in a liquid state and this reduces the extra work and it makes extraction easier.

#### 5.7. storage of ripe honey in pest and bee protected environment

Apart from improper processing and handling, storage and transportation under unfavorable conditions **spoils** honey.

**Storage conditions should not create opportunities for:-**

- Increases of HMF amount,
- Decreases of enzyme levels,
- Darken the honey,
- Loss of its flavor
- Increases of its Moisture content

**Storage conditions should be:-**

- in air tightened containers
- In dry places less than 65% Relative humidity

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- Away from direct sunlight(Both sunlight and artificial light further affect honey stored in clear glass bottles), preferably in a covered storage area where the temperature between 70°–75°F (21°–24°C). Unprocessed honey is best stored below 50°F (10°C). For long-term storage, keep liquid honey in a freezer at 0°F (–18°C).
- Low moisture content (managed at harvesting)
- Storage temperature should not be favorable for fermentation (temperature <11°C is very good for honey storage)
- label the storage containers with the type of honey, floral source, date extracted and tracing identification data
- Keep only finely crystallized or creamed honey in a refrigerator or in similar cool environments.

Ripen honey comb are stored in a pest and bee protected environment to prevent robbing, damage and contamination according to workplace procedures

## 5.8. Extracting, purifying and checking the moisture content of honey

### 5.8.1. Honey Extractor

It has been estimated that in making 1 kg of wax for building comb, the bees consume 8 kg of honey. The honey extractor makes it possible for the beekeeper to save the comb for re-use by the bees and to increase his honey crop accordingly. Basically, the honey extractor is a device that spins the combs so rapidly (up to 300 rpm) that the honey is flung out of them by centrifugal force. Different types and sizes are available, ranging from the motor-operated extractor accommodating hundreds of frames (see Fig.11) to the manually-operated two-frame extractor. Normally, the beekeeper working with several hundred hives will find a hand-operated extractor adequate for his needs (see Fig. 5/16); stainless steel models (see Fig. 5/12).

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**Figure5.1:Honey Extractor**

### **Prepare Honey for Extraction**

- Before extracting honey, you need to consider the following:
- Where you will be extracting honey
- The equipment you need
- The timing of the extraction
- Quality assurance and food safety requirements
- Occupational health and safety
- Other special requirements, for example, for organic honey

### **Methods of Extracting Honey**

There are three methods of extracting honey:

- **Floating Method**
- **Pressing Method,**
- **Centrifuging Method**

#### **Floating**

Floating is the simplest, but takes the longest, which is especially disadvantageous in the rainy season (honey is hygroscopic and will absorb water from the air in times of high humidity) unless you work with closed containers.

#### **Pressing**

Pressing honey is more work, but takes less time.

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## Centrifuging

The advantage of centrifuging is that you can extract the honey very quickly and that you can use the combs again. Honey should be processed in a space where bees cannot enter (all openings must be closed with fine wire mesh). It is also possible to work in the evening. You can also spin honey in a tent which seals well with the ground so that there are no gaps. If necessary you can store well-capped frames in a well-sealed container.

### 5.8.2. Remove the Impurities from Honey

**The processing of removing debris from honey for the quality of honey is purifying.**

**Impurity May include:**

- dead bees
- Broken wax
- Left over feeds
- Propolis and
- Pollen and brood

### Removing wax

Extracted honey has to be heated to 30degree centigrade and strained or settled through fine wire mesh or a double thickness of cheese-cloth. Some beekeepers prefer to chop the comb into small pieces and allow the honey to drain out; this method is said to be more hygienic and to yield a clearer honey, with less foam. The rest of the comb, with its pollen and brood, is usually consumed or sold in the market, as a delicacy.

### 5.8.3. Moisture Content of Honey

- Honey is hygroscopic, that is, it will absorb moisture from the atmosphere or damp surfaces that it comes into contact with. It is the moisture and wild yeast in honey that causes fermentation to begin. This can seriously affect the quality and longevity of your product.
- The international standard of first grade honey moisture content is between 17.5%-18.5%.
- The moisture content should not be greater than 19% or the honey is likely to ferment.

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- Harvesting incompletely sealed combs can result in excessive water content in honey.
- The moisture content of honey is measured by using **refractometer**.
- observation in jar by naked eye (**traditional**)

### Hand Held Honey Refractometer

- This refractometer will allow you to quickly and easily measure the moisture content of your honey

### Digital honey [refractometer](#)

- The digital Honey Refractometer features a precision-machined stainless steel sample well with a cover that helps prevent further absorption of water.



**Figure 5.2: Hand Held and Digital Honey Refractometers**

### Estimating the level of moisture in honey (traditional)

A simple way to test the density of honey and therefore estimate the moisture content of your honey is to place the honey in a jar, leaving a small amount of air and put the lid on it. Turn the jar upside down. The longer it takes for the bubble to rise to the 'top', the denser the honey and the lower the moisture content

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Figure5.3:Estimating moisture content

#### 5.8.4. Use suitable Containers for Honey Store

- Honey containers should be stainless, tight lid and should not let in moisture.
- Container used for other things like cooking oil, butter or gas should not be used for storing honey.
- Locally, containers like skin bag, clay pots and local beer pots are used and studies show that these containers affect the quality of honey.
- Honey containers should be made of materials which enable to maintain the quality of honey.
- Containers made of aluminum and stainless steel are preferred and recommended.

#### 5.9. Label correctly and storing honey

The honey sample must be labelled with the following information:

- Date of extraction
- Apiary identification
- Floral source (code)
- Batch number (if relevant)

Identification number of the industry bee council (IBC) from which the sample has been taken

- Honey should be stored in cool, dry and dark areas.

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- The honey should be filled shortly after extraction in glass jars with screw-on lids or food grade plastic buckets or food grade metal containers with well-sealing lids.
- If honey is stored in improperly sealed containers, it will absorb water from the air and ferment easily.
- Honey should be packaged in lightweight, low cost, and preferably transparent containers, so that customers can see the product.
- Glass and plastic containers or even sachets are commonly used. Honey is a product which can be stored for a long time.

The label on the container is important for **attracting customers and a professionally designed label that describes the source of the honey** (e.g. sunflower, mixed blossom, tree honey etc.), its **purity**, and the **district it was produced in**, can give a marketing advantage. label should have the following information:

- The name of the product (i.e. pure honey)
- The name and address of the producer.
- The weight of honey in the container (the net weight).

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<b>Self-check 5</b>	<b>Written test</b>
---------------------	---------------------

Name..... ID..... Date.....

**I. chioce the best answer**

**1. one of the following is indicate unripe honey**

- |                          |              |
|--------------------------|--------------|
| A. open combs            | C. fermented |
| B. high moisture content | D. all       |

**2. which one of the following is affect honey quantity**

- |                        |                    |
|------------------------|--------------------|
| A. forage availability | C. hive population |
| B. number of beekeeper | D. Aand B          |

**3. honey is ----**

- |                 |                         |
|-----------------|-------------------------|
| A. hygroscopic  | C. low moisture content |
| B. absorb water | D. all                  |

**4. which one of the following should be applied during harvet honey**

- |                                       |        |
|---------------------------------------|--------|
| A. Bee stings                         | D. all |
| B. Incorrect manual handling          |        |
| C. Chemicals and hazardous substances |        |

**5. -----is used to measure the moisture content of honey**

- |               |                  |
|---------------|------------------|
| A. lactometer | C. thermometer   |
| B. secc disk  | D. refractometer |

**II. Answer all the questions listed below.**

1. write the indicator of ripeness of honey
2. List the method of bee removal from combs
3. write the factor that affect quanti and quality of honey
4. write why honey is preseved for along period of time under hygiene condition

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## Operation sheet 5

### 5.1. Extraction of honey From honeycomb

#### A. Tools and Equipments required

- Apron
- disposable gloves
- mask
- beehives
- having sealed honey
- hive tool
- uncapping knife
- drip tray
- honey extractor (radial or tangential)

#### B. Procedure

- Wear apron, disposable gloves, mask and headwear.
- Smoke the colony or super before removing frames.
- Remove the combs with sealed honey only. Select only those combs in which more than 70% of cells are capped. Do not select honey combs having sealed/unsealed brood.
- Gently brush them off the comb.
- Keep the removed honey frames separately in an empty chamber and cover it.
- Honey extraction process should be done in a closed room or in a tent made of fine mesh netting away from the apiary.
- Uncap the wax seals on both sides of the honey-filled combs with uncapping knife by placing the combs in the drip tray. Knives are heated before uncapping the sealed honey in the hot water. Usually two knives are used by putting one for heating while second one is used to uncap the wax capping. The capping can also be removed by steam operated or electrical uncapping knife. First uncap one side, then turn the frame and uncap the other side.
- Place uncapped honey combs in the honey extractor and rotate it to force the honey out of the combs by centrifugal force.

- Rotate the extractor slowly at first. If the extractor is turned too rapidly, the weight of the honey may break the combs.
- The extracted honey is passed through the muslin cloth or wire mesh for straining the extraneous material and wax capping.
- During honey flow season queen excluder should be used to restrict the queen within brood chamber.
- After honey extraction empty combs should be given back to the honey bee colonies (as many as were drawn out from every colony).

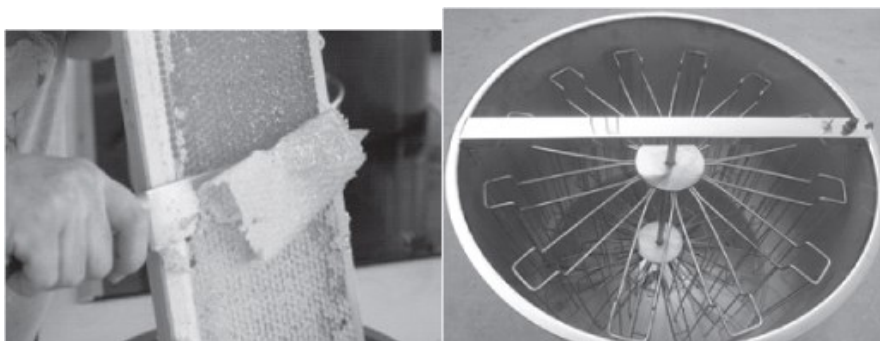


Figure 5.1a: Uncapping honey comb and Radial honey Extractor

## 5.2. Processing of extracted honey

### Tools and Equipments required

- Stainless steel utensils
- muslin cloth
- water bath
- thermometer for measuring the temperature
- stove
- water
- airtight bottles

### Settling procedure

- Place all the extracted honey into a honey bucket.
- Place a lid on the honey bucket.
- Allow the honey to sit for a couple of days.

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- check the light particle to float at the top and clean honey removed through the honey gate

### Straining procedure

- heat all the honey to 49°C
- allow it to pass through a fine mesh strainer into a honey bucket with the gate in the bottom.
- If any foreign particles pass through the strainer, rise to the top of the bucket.
- The clean honey is removed through the honey gate after a couple of days settling.



Figure5.2b:Straining

### 5.3. QUALITY TESTING OF HONEY

#### Water test

#### A. Tools/ Equipments/ Material required

- Honey
- water
- glass.

#### B. Procedure

- Get a bowl of water and Pour into a glass.
- put a tablespoon of honey sample from the honey jar to test.
- Place the spoon in the glass of water.
- Gently shake the glass.
- check whether settle down in the bottom or mix up with water

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### chemicla test

#### A. Tools and Equipments required

- Honey
- methylated spirit/denatured alcohol
- glass

#### B. Procedure

- Mix equal parts of honey and spirit in a glass.
- check whether honey will lump and sink or dissolved in the spirit and turn in milk white

### match stick test

#### Tools and Equipments required

- Honey
- candle
- match box

#### Procedure

- Take a candle with a cotton wick.
- Dip the wick into a small amount of honey.
- Allow the excess honey to drip off.
- Now light a match and hold it to the wick.
- check the candle wick to burn or fail

### paper test

#### A. Tools/ Equipments/ Material required

- Honey
- blotting paper or a white cloth.

#### B. Procedure

- Drop a few drops of honey on the paper/cloth.
- check whether absorbed or solid on paper

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## **Finger thumb test**

### **A. Tools and Equipments required**

- Honey
- clean finger thumb
- spoon.

### **B. Procedure**

- put adrop of honey on your thumb
- If it spread around right away or spill, it is not pure
- If it stay intact, it is pure

## **5.4. Packing and storage of honey**

### **A. Tools and Equipment required**

- Apron
- mask
- disposable gloves
- headwear
- water
- glass bottles/ food grade plastic bottles

### **B. Procedure**

- Wear apron, mask, disposable gloves and headwear.
- Keep bottles and labels ready.
- Pour honey into each jar using the spout on the side of the honey extractor.
- Screw jar lid on tightly.
- Take a warm, damp cloth and wipe each bottle, including the mouth.
- Place the label on the bottles.
- Store in a cool and dry place.

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<b>LAP TEST</b>	<b>PERFORMANCE TEST</b>
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Given necessary template, materials, tools and equipment you are required to perform the following task in 10 hours. The project is expected from all students to do it

**Task1:** perform Extraction of honey From honeycomb

**Task2:** carry out Processing of extracted honey

**Task3:** perform quality testing of honey

**Task4:** carry out Packing and storage of honey

LG# 12

## L06. Assess pest and disease of honeybee

### *Instruction sheet*

This learning guide is developed to provide you the necessary information regarding the following content and topics:

- Inspecting beehive for the sign of diseases, pests and enemies
- Observing adult bees and brood combs for signs of disease
- Observing flight paths of bees around hive entrance
- Implementing bio-security
- Recording results of inspections

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to :

- Inspect beehive for the sign of diseases, pests and enemies
- Observe adult bees and brood combs for signs of disease
- Observe flight paths of bees around hive entrance
- Implement bio-security
- Record results of inspections

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

## Information sheet 6

### 6.1. Inspecting beehive for the sign of diseases, pests and enemies

- You will be inspecting the brood to detect any variations from what you know healthy brood should look like.
- When inspecting colony brood, all brood combs must be checked.
- A disease can be identified after starting in one cell and so all cells must be closely examined for variations from what you know to be healthy brood.
- After you have shaken all the adult bees off the comb, hold the frame by the top bar with the light coming over your shoulder so the sun shines into the cells you are examining.
- You need to see the cell base, walls, larvae, pupae and cappings. To improve the light and visibility in the cells, try holding the frame at an angle.
- Examine each frame systematically in a regular pattern so that you check the whole frame.

**Generally the sign of bee disease are the following;**

- **Checking eggs**
  - ✓ If you see more than one egg in the cell base or walls of the cell, it indicates the queen is failing or laying workers may be present. This is not a pest or disease problem.
- **Checking larvae**
  - ✓ Disease or pests maybe present if the larvae are:
    - ✓ not white
    - ✓ dull and dry looking
    - ✓ In an unusual position in the cell edge or cell wall.
- **Checking pupae**
  - ✓ You may have a problem if the brood cappings:
    - ✓ have holes in them
    - ✓ are sunken
    - ✓ vary in colour

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### 6.1.1. Types of honeybee diseases

- Based on the etiological agents: honeybee diseases can be classified
  - ✓ **Bacteria** - American foul brood (AFB) and European foul brood (EFB)
  - ✓ **Fungi** - Chalk brood and stone brood
  - ✓ **Protozoa** - Nosema and Amoeba
  - ✓ **Virus** - paralysis, sac brood, etc
  - ✓ **Parasitic mites** – Varroasis, Acarin disease
- Based on their hosts : two types:
  - A. brood honeybee diseases**
    - ✓ AFB, EFB, Chalk brood, stone brood and sac brood.
- The most virulent diseases at present are those that affect the brood one.

#### Healthy brood

- Compact
- In the right sequence
- Up to 5% empty cells
- The brood capping are very similar in color
- Round hole at the center of the capping just before the pupae stage



Right sequence

empty cells

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### sick brood

- crossword puzzle appearance of the sealed brood
- Sealed and open brood mixed together
- Sunken sealed brood cells capping
- Un symmetric holes and not at the centre of the capping of the sealed brood
- Leftovers of dead larvae and pupae



diseased brood



Dead larvae leftover

### B. adult honeybee diseases

- ✓ Nosema, Amoeba, Paralysis, Varroasis and Acarine disease

#### Brood Diseases

**American Foul Brood** – The causing organism is *Bacillus* larvae. As its name suggests it is a **spore forming bacterium**. The spores are fed by nurse bees to larvae. The bacillus remains dormant until the cell is sealed and the larva is lying along the cell. At this time the bacillus breaks out of the stomach into the **body cavity, quickly killing the larva**. The cell will darken in color. Upon the larva's death the cell will be filled with glue like slim. During these cycles the bacillus has multiplied several million times. As the disease progresses, more and more cells will contain scales (seen with a back light), and become patchy. American Foul is the only disease the hive is burned.

- **Transmission:** The infection can be transmitted by;
  - ✓ Nurse bee

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- ✓ Wax contaminated with the spores
- ✓ Equipment's contaminated with spores
- ✓ Robber bees
- ✓ Drifting bees
- ✓ Swarms issuing from an infected colony
- ✓ The beekeeper exposing contaminated honey to other bees

### • Clinical Symptoms

The characteristic disease signs of AFB include some or all of the following:

- ✓ Uneven or 'Pepper-pot' brood pattern
- ✓ Sunken, greasy or perforated, darkened cell cappings
- ✓ Roping, sticky larval remains when drawn out with a matchstick
- ✓ Dark "scales", which are difficult to remove from cells
- ✓ Frames smell rotten or foul
- ✓ Dead larvae are brown or black colored.
- ✓ Larvae that die from AFB lay in upright position after capping. A pupa that has died in capped cell shows a fine threadlike tongue or mouthparts projecting in the center of the cell

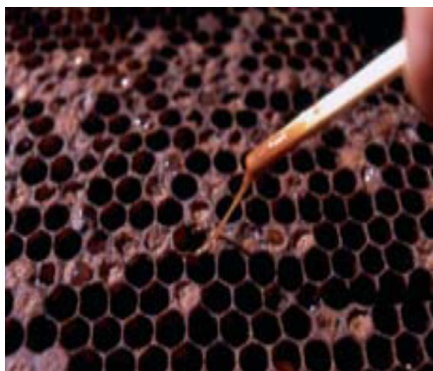


Figure6.1:Ropiness test

### Diagnosis

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**Ropiness test** - A match stick is inserted into the suspected cell, twist and then withdrawn slowly;

- If AFB is present, the larvae remains will be drawn out as a brown mucus thread or rope.

**Milk test** - macerate the dead body of the larvae on a glass slide by adding two drops of milk.

- If positive for AFBD it forms a firm curd within 1 minute, if negative may form the curd after 10 minutes.

**European Foul Brood** – This is a very different disease from American Foul Brood. The disease is caused by *Streptococcus pluton* a very **small non-spore forming bacterium**. The bacterium is in the brood fed to larvae by the nurse bees. Upon entering the stomach the larva proliferates and fills the gut, feeding on food in the larva's stomach. It does **not penetrate into the body cavity**. The **larva may die by starvation**. **Field diagnosis** is therefore the death of unsealed larvae still in the curled up position. However, this disease may be in the hive for some time without visible symptoms.

- The bacteria affect highly young larvae that are in uncapped cells.

#### Transmission

- ✓ contaminated beekeeping materials
- ✓ feeding infected pollen and honey
- ✓ Bees
- EFB is highly contagious but infection may remain without visible signs for a long period.
- Sudden outbreaks of disease can occur - these probably result from a change of seasonal conditions and other stress related factors such as:
  - ✓ Nutritional deficiencies
  - ✓ Cold weather

#### Signs of the disease

- Larvae are mostly affected in the unsealed, curled up stage, although in severe cases **brood of all ages** may be affected.
- Larvae die usually within 1-days prior to being sealed.

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- Diseased larvae collapse and become dislodged from their normal position in the cells.
- Their color changes from pearly white to yellow and finally, yellowish brown. After two to four weeks, larvae dry up to form a brown scale which can easily be removed from the cell.
- The odor of infected brood varies from odorless to sour or foul, depending on the secondary invading bacteria present.
- Dead brood probed with a matchstick usually has a watery consistency, although the sealed brown pupae may exhibit a slightly ropy consistency.
- Worker bees may remove and discard diseased larvae as they die and thus a colony may show few signs of disease.

### Diagnosis

- bacterial culture of suspected larval tissue is a definitive diagnostic method.

**Sac Brood** – Not a bad as other brood diseases, normally only a few larvae become infected. The virus appears to affect the process of molting, preventing the separation of new and old exoskeleton. There is **no cure**. Some evidence suggests it may be inherited. Requeening has been successful at correcting the problem.

Viral disease of the larval stage of the honeybees caused by *Moratoratetulus*. Sacbrood disease can become apparent after bees are stressed by beekeeping management practices such as requeening or moving hives.

### Signs

- Larvae affected by the virus die after the cell has been capped and larvae fail to pupate after four days.
- Affected larvae develop a sac of liquid at the anal end, giving the characteristic appearance of **sac like structure**.
- Head of infected larva lifted toward top of cell like a **canoe**

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- The affected larvae change color starting at the mouth parts from white through to yellow and dark brown.
- The brown larvae may dry to form wrinkled, brittle scales which are easily removed from the cell.
- The first appearance of sac brood should not be confused with American foulbrood disease.
- The distinguishing characteristics are that the brown larvae will not ‘rope’ as with American foulbrood disease and the beekeeper should test for ‘rope’ effect.
- Where American foulbrood and sac brood diseases occur in a hive at the same time, the visual signs and ‘rope’ effect of American foulbrood disease may become less obvious.



### Transmission

- ✓ Cross contamination by the beekeeper could spread the disease.

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- ✓ Bees ‘drifting’ from hive to hive, contaminated drinking water, contaminated equipment and wind may also transmit the virus.
- ✓ Honey bees act as a reservoir for the sac brood virus.
- ✓ Viruses appear to accumulate in the hypopharyngeal gland of worker bees, and these bees may transmit the infection to larvae through feeding.

### Control and Prevention

- ✓ Because sacbrood disease is caused by a virus, there is no method of treating affected bees.
- ✓ Re-queening hives showing persistent or severe signs of the disease is recommended.
- ✓ New queens should come from hives that show resistance to the disease.
- ✓ **Hygiene** is important in limiting or preventing;
  - Avoid introduction of bees and equipments from unknown sources
  - Avoid exposing honeycombs and equipments for robbing.
  - Regularly watch the colony for the signs of the disease

**Chalk Brood** – This disease is the result of larvae eating the spore of the fungus *Ascosphaera apis*. These germinate in the larvae and the mould grows until they have completely interwoven the whole body of the larva. The appearance is fluffy white pieces of cotton. Some will change from **white to blue / black**. **Requeening may correct the situation**. The **fungus only forms spores** during sexual reproduction. The most susceptible larvae are four days old.

### Effect on colony

- Under suitable weather conditions, **chalk brood** might reduce honey production but usually will not destroy a colony
- **Ways of transmissions**
  - ✓ Wind
  - ✓ Nectar, pollen, and water
  - ✓ Drifted bees or diseased robber bees
  - ✓ An infected queen
  - ✓ Bee equipment
  - ✓ During food exchange
  - ✓ Swarming
  - ✓ Robbing
  - ✓ Drifting

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- **Symptoms**

- ✓ Presence of hardened, white or black “mummies”
- ✓ Mummies are typically found on the bottom board.
- ✓ Mummies are also found on the ground directly outside the front entrance of a hive Brood killed by chalk brood: white and black mummies.



Figure6.2:white or black “mummies



Figure6.3:Mummies found on floor or in front of the hive entrance

**Prevention and control**

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- ✓ Chalk brood is largely a disease caused by stress. Thus maintaining a strong, healthy colony is the best preventive way of the disease.
- ✓ Chilling may also increase chalk brood, so ensure that there is an adequate adult population to keep the brood nest warm during cold weather
- ✓ Moves hives to sunny location, with plenty of air ventilation, and dry conditions
- ✓ Take out infected combs and melt them; replace with new foundations
- ✓ Keep bottom board dry throughout the year

**Stone Brood** – Similar to **chalk brood**. These turn the **larva or pupa into a mummy**. This disease can affect **birds and humans**.

- It attacks the brood and transforms the larva into a hard, stone-like colored object which is found lying in open cells.

### 6.1.2. Honey Pests and Predators

#### Ants

Few types of ants are the most prevalent enemy of honeybees in most beekeeping areas of the country, especially in moist or humid highland parts. Ants are not only the most prevalent pests but also share the greatest complaint in causing serious damages to honeybee colonies and their stores. Small ants commonly called “kuchach” are typically found between frame top bars and outer cover of the hive.

#### Damages they cause

##### Larger ants:-

- ✓ They kill bees
- ✓ Rob their combs contents, i.e., honey, brood and pollen which results in reduction of honey production
- ✓ Cause of aggressiveness and absconding of colonies

##### Small ants (kuchach), in the areas where they are considered as a problem

- ✓ Sense of irritation on the beekeepers during hive inspections

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**Figure 6.4:** Larger ants eating other insect and Larger ants on rotten material near the apiary

### Symptoms

- ✓ Some dead ants seen in the hive or near the hive entrance
- ✓ Dead bees' bodies that are broken into pieces as a result of ants' attack
- ✓ In some cases, when the ants consume the resources comb debris observed on the bottom board like a colony robbed by honeybees from other colonies

### Prevention and control

Beekeepers in areas vulnerable to ants attack need to protect their honeybee colonies. Some of the protective methods are outlined as follows:-

- **Remove brush and rotten wood** from the apiary and cut the grasses and weeds around the colonies to reduce ant nesting sites.
- Systematically **seek out the nests of these invaders** in the vicinity of the apiary and when found, dig the area and destroy the queen, the eggs, and all the broods. This could be the most effective method of ant control.
- **Avoid throwing any comb containing honey, nectar, brood and propolis** that may **attract ants** to the apiary then to the hive
- **Coat the posts of hive** stands with used engine oil or grease
- **Fix a cone shaped smooth iron sheet** or used tyre inner tube of a vehicle on the hive stand posts.
- **Frequent inspection** is necessary to keep clean the cone shaped smooth iron and inner tube.

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- A more reliable method to defend ants is to place the hive stand posts in **tin or plastic containers filled with used engine oil**.
- **Maintaining strong colonies** has its own contribution against ant defence.

### Wax moths

The adult wax moths are grey-brown in colour. Among the insect pests of the honeybees, the greater **wax moth**, **Galleria mellonella** is the most serious pest next to ants in Ethiopia. In addition to greater wax moth, **comb damage** is also caused by lesser **wax moth (Achroia grisella)** unless controlled at an early stage. The severe damage due to the larvae of these moths occurred in **high temperature areas and during long warm season**. Normally wax moths are not a treat to well managed normal colonies. Combs occupied by bees are rarely attacked by wax moths since strong colonies can defend themselves against wax moth. However, weakened colonies can be easily affected.

### Wax moths are of two species:-

- Greater wax-moth (*Galleria mellonella*)
- Lesser wax moth (*Achroia grisella*)



Figure 6.5: wax moth damage frame

### Damages they cause

- ✓ The larvae of both moths feed on wax, pollen, cocoon of the bee larvae
- ✓ They can also cause damage to frames and even on hive bodies under serious infestation

### Symptoms

It is easy to visually detect based on the followings symptoms.

- ✓ A tunnel through the comb midribs of weak colonies, stored combs, abandoned hives and not well cleaned bee equipment is seen
- ✓ Formation of silk cocoons on the sides of frame bars or top bars

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- ✓ A mass of webs and debris left behind (see fig. c below)



Figure 6.6: Combs devastated by wax moth with clearly seen debris

### Prevention and control

- ✓ **Maintain strong and healthy colonies**, and inspect weak colonies often. This is most effective method of fighting against wax moth.
- ✓ Employ all management practices like provision of adequate food, **reducing supers** and **unoccupied combs** and **reducing the hive entrance** can effectively minimize the wax moth if applied during dearth period
- ✓ **Remove the infested combs and debris on the bottom board** for already infested colonies
- ✓ **Remove empty (absconded) hives** with combs and manage the combs properly
- ✓ **Remove pieces of wax scattered around the apiary**, having a neat apiary is the best tool to keep the moth under control
- ✓ **Processing crude beeswax and combs** after honey harvesting
- ✓ **Never store unprocessed combs** with frames or combs from hives from which colonies have absconded

### Bee eating birds

Birds prey upon many insect species and honeybees are among these insects. The level of damage caused by bee eating birds varies. An attack by a single bird or by a few together seldom causes a serious problem. But when in a large mass on a few colonies or an apiary, causes substantial decline in the bee population. In our case the attack is more serious during cool and

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wet season, windy and cloudy days. Under these conditions they attack bees not only by landing on the entrance but also pick them while they are collecting nectar, pollen and at water collecting areas.

### Damage they cause

- They cause honeybee population decline under **mass attack Symptoms**
- Unlike other pests, there is no **clear symptom of birds after attack**
- Make apiary observation during **cool and wet season**, windy and cloudy days where there is bird attack or not



Figure6.7: Bee eating bird waiting for a bee being on the hive stand

### Prevention and control

Complete eradication of bee eating birds is very difficult. However it is possible to reduce the effect of birds on honeybee population through reducing bird number using different prevention methods. The following methods can help the beekeeper to reduce their population.

- ✓ Look for the nests of bee eating birds and destroy the nests found around the apiary
- ✓ Strengthen the colony so that the bees can fly faster and skip
- ✓ Use slings and whips to scare and drive away the birds

### Honey Badger

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Honey badger (*Mellivora capensis*) is the animal known by the names ‘Hama or Hamakosi or Hamagota or Kefo defi’ in different localities of Ethiopia. It is a serious pest of honeybee because it consumes everything found in the hive and does extensive damage to equipment, especially in the areas where it is more common. Either by inserting its hairy tail into hives or by scratching at the entrance, a honey badger tempts bees to come out of the hive, or as the bees crawl out, the honey badger eats them. As a result, the apiary could become devastated in a short period of time if the beekeeper does not take some counter measure to protect colonies.



**Figure6.8:**Honey badger

#### **Damages it causes**

- ✓ It feeds the whole hive content (bees, brood, honey & nectar)
- ✓ Destroy hive and hive parts

#### **Symptoms**

- ✓ The bees become defensive
- ✓ Grass near hive entrance is torn out
- ✓ Scratch marks on the hive front or earth at hive entrance
- ✓ Hive lids are off or skewed

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- ✓ The colony becomes weak for no other apparent reason
- ✓ During wet season, area near the entrance is muddy after a rain, and tracks and scat can be seen

### Prevention and control

Discouraging and eliminating this pest may be accomplished by:

- ✓ Shooting and trapping is a possible way but very temporary control measures. These actions may go very much against efforts by others to manage and conserve wildlife.
- ✓ Placing a strip of carpet tacking, nail side up, on landing board
- ✓ Tie hives onto firm objects
- ✓ Reduce the hive entrance so that a badger is not able to insert its tail.
- ✓ Fence around the apiary with thorns. Woven wire is also recommended for fencing.
- ✓ In the case of traditional beekeeping hang hives on a tree or two poles and place smooth iron sheet around the tree as it slipper while try to climb
- ✓ Moving hives closer to human habitation may be much more effective against this pest. Some beekeepers also use dogs to scare away the badger.

### Small Hive Beetle

The small hive beetle (SHB), *Aethina tumida* Murray, is a honeybee (*Apis mellifera* L.) colonies pest native to sub-Saharan Africa.

The **adult beetle is dark brown to black in colour**. Its larvae are similar in appearance to **wax moth larvae** but smaller than **wax moth larvae**. But anyone can differentiate the hive beetle from wax moth larvae by looking at their legs.

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Figure6.9:Small hive beetle, an adult male small hive beetle, *Aethina tumida* Murray

#### Damage it causes

- ✓ Adult small hive beetles consume the resources of the colony
- ✓ Adult beetles leave their excreta in the honey, causing it to ferment and run out of the combs
- ✓ Larvae also tunnel into through combs, damaging it, killing brood, and eating stores of honey and pollen
- ✓ Can cause colonies to abscond
- ✓ Destroy the marketability of honey and rendered combs, make them useless

#### Field symptoms

When a hive containing beetles is opened, they can be seen running across the combs to find hiding places

- ✓ Adults may also be detected under top covers or on the bottom boards
- ✓ If an infestation is heavy, both adults and masses of larvae may be seen on the combs and bottom board
- ✓ Like in the case of wax moth infestation combs can be full of holes
- ✓ Unlike wax moth larvae do, beetle larvae do not produce silken tunnels, webbing, or cocoons in the hive

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## Prevention and control

- ✓ The best defence against hive beetles is to maintain strong, healthy colonies. Strong colonies can defend themselves against this pest, whereas weak colonies cannot.
- ✓ In areas where this pest is found, keep your honey house clean; do not store full supers for long or leave honey filled wax capping exposed
- ✓ Use small hive trapping to suppress its population. Traps baited with pollen dough conditioned by allowing male SHB to feed on it for 3 days are effective in capturing SHB if the traps are located in a shade closer to the apiary.

## Varroa mite

Varroa mites are reddish-brown (tick-coloured) with flattened and oval body shape. The Varroa mite, Varroa destructor, is an external parasite of honeybees that has gained worldwide importance.

Varroa mites can be affect both brood and adult honeybees

## Damages it causes

The damage varroa mite does to bees is probably:

- ✓ Reduced flight activity of foraging bees
- ✓ Weight loss
- ✓ Reduced life span (by 34-68%)
- ✓ Reduced blood volume
- ✓ External damage (chewed wings, legs, stunted growth) if more mites per cell
- ✓ Transmission of virus and other pathogens

Thus, clearly detection and treatment are imperative to keep your bees from perishing.

## Field symptoms

- ✓ Presence of adult mites on adult bees, brood, or in hive debris on a bottom board
- ✓ Adults with shortened abdomens, misshapen wings, and deformed legs; there can also be bees crawling on the ground
- ✓ Dramatic decline in adult population and brood area, with spotty brood pattern

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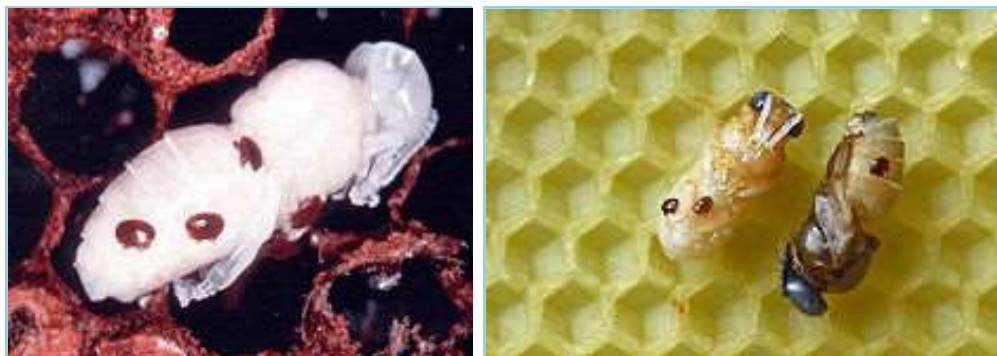


Figure 6.10: Adult mites on pupa



Figure 6.11: Destructor on adult honeybees

### Insects-

**Dragonfly** – can catch bees in the yard or hive entrance, and will take them back to their nest and eat them.

**Yellow-Jackets** – Are attracted by the sweet honey smell. They will try to rob the sugar water from the feeders.

**Wasp** – When a wasp nests being to break up the adults go foraging for sugar. The best defense is attack. Find the wasps' nest and kill them.

### Enemies of the Hive

#### The major and most common threats to your hive is:-

**Nosema** – single celled amoeba, *Nosema apis*, is spread via bee waste (poop). It spreads when bees clean out the hive waste. Nosema has the potential to kill the colony; The antibiotic Fumidil 'B' may help to recovery.

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**Pesticides** – are an outside factor on the immune system. The bee can be caught by sprays in three ways: when the crop on which it is working is sprayed, when the spray is used on the crop and when the bees are flying over a crop which is being sprayed to reach forage further away.

**Starvation** – (should never occur!) It will most likely happen when not enough honey was left in the hive.

## 6.2. Observing adult bees and brood combs for signs of disease

### Adult honeybee diseases

There are two commonly known protozoan adult honeybee diseases in the country namely: Nosema and amoeba. In temperate region, these diseases cause extensive losses to bees if not treated. But at the present situation, the diseases are everywhere in the country and reported to cause minimal losses of adult bees.

#### Nosema

Nosema, the common adult bee disease is caused by a microscopic protozoan called Nosema apis. This spore forming protozoan invades the digestive tracts of honeybee workers, queens, and drones. Spores of the disease are ingested with food or water by the adult bee. The spores germinate and multiply within the lining of the mid-gut. High incidences of nosema are directly related to stress such as periods of long confinement, rapid brood build up and bad weather.

#### Effect on colony

- ✓ Sever infestation can lead to reduction in a honey crop
- ✓ Ways of transmissions
- ✓ Through ingestion of spore contaminated food or water by adult bees
- ✓ Symptoms
- ✓ There is no single symptom of the disease
- ✓ Adults may have distended abdomens and defecate within the hive rather than take cleansing flights
- ✓ Prevention and control
- ✓ Since the disease can be caused by stress, maintaining strong, healthy colonies is the best means of prevention
- ✓ Use good colony management practices including:

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- ✓ Provide fresh water and feed to individual colony
- ✓ Locate hives at sunny sites, sheltered from piercing cold wind but with good ventilation
- ✓ Maintain adequate stores of pollen, honey or cured sugar syrup or bees should be fed with heavy sugar syrup (2:1 sugar to water)
- ✓ Keep only clean combs; replace combs with new foundation sheets seasonally

### **Amoeba**

Another protozoan adult honeybee disease is the amoeba. The amoeba that affects honeybee is called *Malighamoeba mellificae* which forms resistant spores called cyst. A single bee can have a half million cysts within three weeks of the initial infection. It can infect all adult honeybee casts. The bees ingest the cysts from contaminated food, water, fecal material or elsewhere in the hive. It is reproduced in the intestine.

### **Effect on colony**

- ✓ Colony population dwindling as bees die away from the colony
- ✓ The effect of heavy infestation results in reduced honey yield Symptoms
- ✓ No good symptoms of infection, identification by analysis of bee abdomens
- ✓ May see defecation in the hive, weak, crawling bees and retarded colony build up at the beginning of active season
- ✓ Heavy infections may lead to dysentery Prevention and control
- ✓ Maintaining hygienic conditions in the apiary and at the water source
- ✓ Replace those combs that are contaminated with fecal materials as in Nosema

## **6.3. Observing flight paths of bees around hive entrance**

### **Communication in Honey Bees**

- ✓ The entire activity of honeybees depends on communication.
- ✓ Honey bees can transfer and receive information through communication among the colony could be through;

### **I. Dance - Movement of the body**

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## II. Chemicals - pheromones

## III. Tactile - Antennae

## IV. Visual - eye

- Among all, dance and chemical communication is commonly used.

**I.Dance Language:** Bees perform a distinct and rhythmic pattern of body movement which is called bee **dance**. Through this language they inform other bees where the food source is located (distance and direction of the food source from the hive). Honeybees find their food source outside the colony. The foraging bee or scout bees return to the colony with nectar, she passes her load to any house bees and performs a dance like movement to communicate with other bees to show where the food source is found or available.

- **There are two types of bee dance:-**
  - ✓ **Round Dance:** This type of dance is performed when the source of food is very close to hive. (within 100 meter)
  - ✓ **Wag tail Dance:** The bees perform this type of dance, when the food source is more than 100 meters from the hive.

### Round Dance

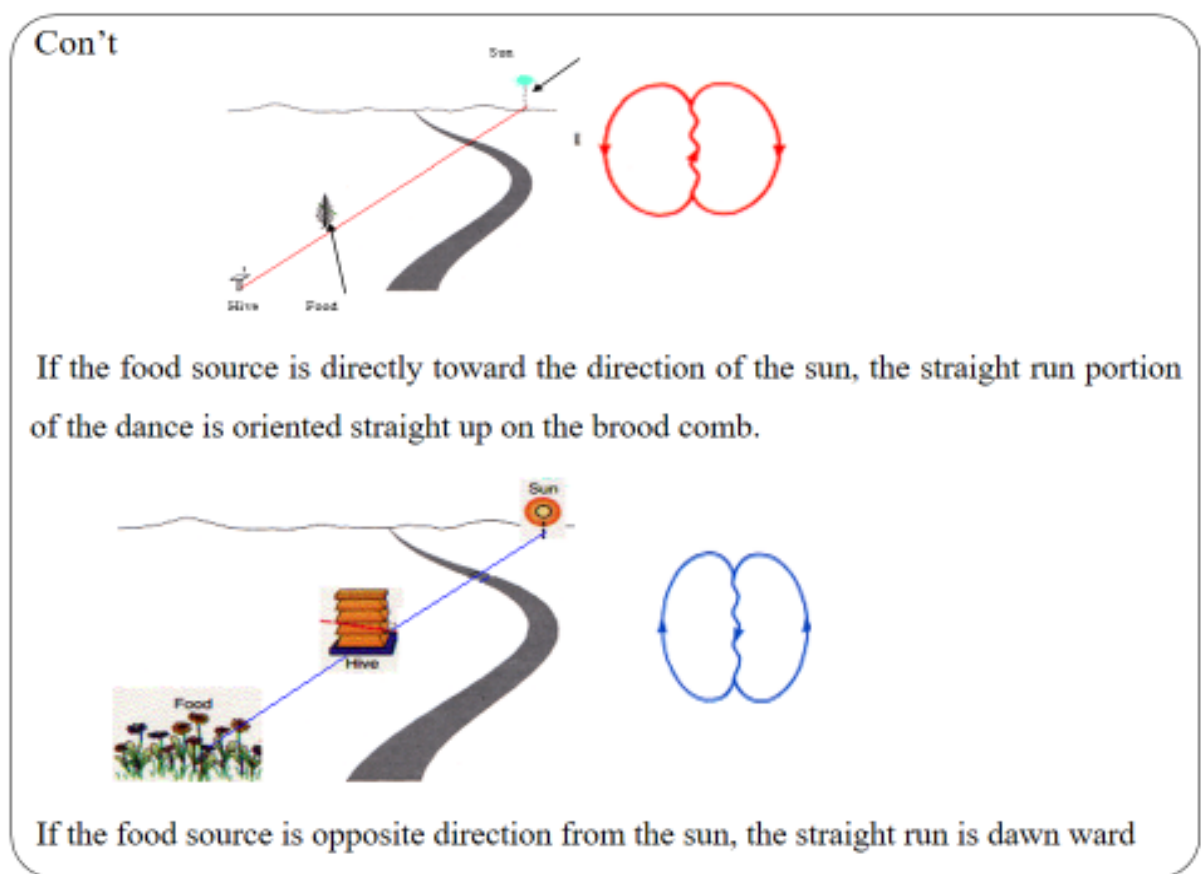
- ✓ is the simplest dance and does not communicate precise distance or direction information. Rather it simply informs workers that there is a resource within close proximity to the nest less than approximately 100 meters. It is a round dance with short steps, runs around narrow circle on a comb often changing direction to right/left.

During dancing there may be 2-3 stops to let others taste, the nectar and pollen for taste and fragrance check.

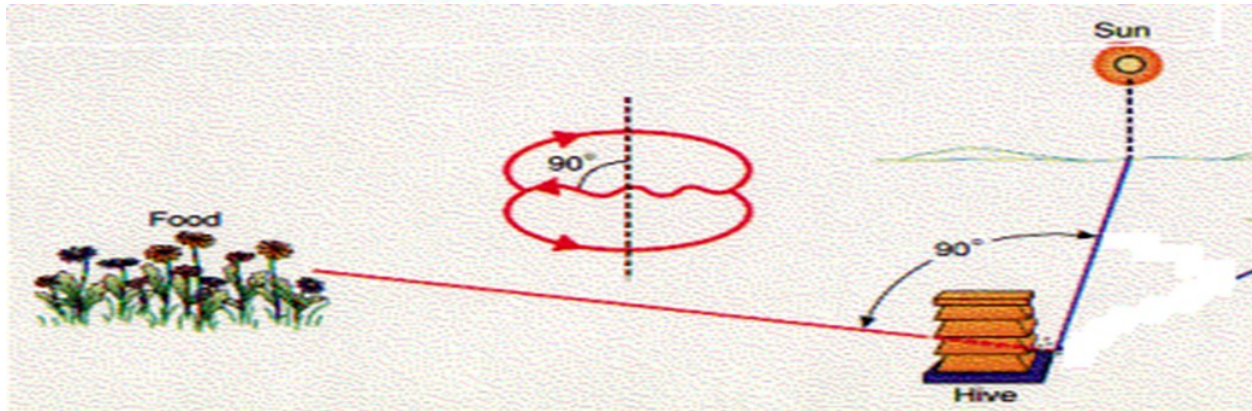
### Wag tail Dance

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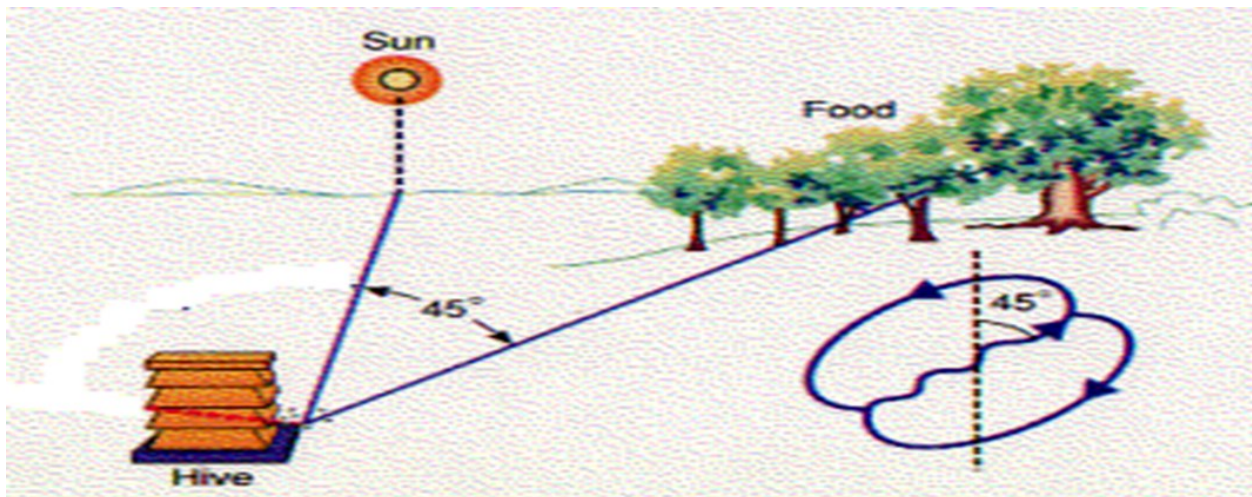
- ✓ Used to communicate information about the distance, direction and quality of resource at distances greater than 100 meters. Dancer makes a narrow half circle to one side then a sharp turn to run in a straight line to the starting point then makes a half circle in the opposite direction (full circle). move in “8” pattern of dance. The number of runs on the straight line/15 sec indicated the distance. The more number of straight line run/15 sec the shorter the distance is. e.g. 8-9 straight lines run/15 sec approximately 100m, 4 runs/15sec = 600m, 2 runs/15 sec = 1000m
- ✓ The direction/position of food sources is communicated in relative to the sun.







when food source is to the left of the sun, the bees dance at an angle counter clock wise to the line of gravity.



when food source is to the right of the sun, the bees dance to the right line of gravity.

Figure 6.12:Honey bee dance

### Chemical communication (through pheromone)

- ✓ In this type of communication, bees use chemical substance called Pheromone to pass the message between the bees.

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- ✓ Pheromones are chemical substances, which are produced by the gland in very small quantity, and they are discharged externally to convey the information to other individual members of bee colony.
- ✓ **Pheromones** are highly volatile (quick evaporation) substance.
- ✓ In the chemical communication the pheromones play an important or major role in the colony cohesion, mating, absconding, swarming, stinging and other behavior in the bees.
- **Queen Substance:** Only the queen bee produces this pheromone so it is called as queen substance.
  - ✓ It is produced in the mandibular gland
- This pheromone plays a major role in the maintenance of colony unity and suppression of development of ovaries in the worker bees.
- Nasonov Scent /Attractant Pheromone: Produced by nasonov gland in worker bees.
  - used to attract members of the colony who might have lost the location of the colony.
  - This pheromone helps in identification of individual bees
  - For guidance to the site (scout), swarming, foraging
- **Alarm pheromone.** This pheromone is produced by the sting apparatus of the worker bees. It consists of isopentyl acetate which initiates stinging behavior in honey bees.
  - it helps to indicate the position of intruders it helps to call other bees for defence

#### 6.4. Implementing bio-security

Biosecurity is the protection of livelihoods, lifestyles and the natural environment, all of which could be harmed by the introduction of new pests, or through the impact of pests. Biosecurity is a national priority, implemented off-shore, at the border or in an apiary. Biosecurity is essential for a successful beekeeping

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## 6.5. Recording results of inspections

### keep apiary records

Beekeepers should maintain a record system of their hives, apiaries, locations, and seasons.

#### Items to record include:

- Colony temperament
- Queen “rightness”
- Diseases and pests
- Honey production
- Management actions performed

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<b>Self-check 6</b>	<b>Written test</b>
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Name..... ID..... Date.....

**I. choice the best answer**

- sac like structure is the sign of -----disease
  - chalk brood
  - sac brood
  - nosema
  - AFB
- is the communication of information about the distance, direction and quality of resource at distances greater than 100 meters.
  - round dance
  - waggle tail dance
  - road dance
- which one of the following is brood disease
  - AFB
  - Chalk brood
  - stone brood
  - all
- The most common threats to your hive is -----
  - nosema
  - pesticide
  - Starvation
  - all

**II. Answer all the questions listed below.**

- write the indicator of bee dance
- write the disease of:-
  - brood disease and its prevention
  - adult bee disease and its prevention

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## ***Operation sheet 6***

### **Diseases and pests of honeybee**

#### **A. Tools and Equipments required**

- Infected bee colonies
- insect trap
- hand gloves
- plastic jars
- magnifying glass
- hand sprayer

#### **B. Procedure**

- Arrange a visit honey bee unit.
- Identify the different disease and pests present in bee colonies.
- Collect the infected samples in a jar.
- Bring it into the laboratory.
- Identify the diseases or pests.

LAP TEST	PERFORMANCE TEST
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Given necessary template, materials, tools and equipment you are required to perform the following task in 6 hours. The project is expected from all students to do it

**Task1:** carry out identification of Diseases and pests of honeybee

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## AKNOWLEDGEMENT

Ministry of Labor and Skills wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

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