AmbujaNeotia

THE NEOTIA UNIVERSITY

ज्ञानम् आत्म प्रदीपाय

Practical Manual
Commercial Beekeeping (ELP)
(EL-AGP 805)




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PREFACE

The practical manual for the B. Sc. (Agriculture) course "Commercial Beekeeping (ELP)" has been compiled following the prescribed syllabus of the revised ICAR Fifth Dean Committee. The manual would provide hands on training about the production, processing, harvesting and storage of honey, bee wax, pollen, propolis, royal jelly and bee venom to the undergraduate students of Agriculture. I am confident that this practical manual would be helpful as a handy reference to understand the basic principles and methodology of the beekeeping. It is my prerogative to thank Prof. Swapan Kumar Mandal, former-Head and Professor, Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya (BCKV), Mohanpur and Professor, School of Agriculture and Allied Sciences, The Neotia University (TNU) for his valuable support and guidance during the preparation of this manual.

DR. KOUSHIK SEN

CONTENTS

INTRODUCTION TO BEEKEEPING

Objective: To familiarize the students with beekeeping

Definition –

Beekeeping or Apiculture is the practice of scientific maintenance of honey bee colonies, commonly in hives, by humans in order to collect bee products like honey, beeswax, propolis etc. and marketing them professionally. Apiculture is synonym of the beekeeping and is derived from Latin word 'Apiscultura'. Apis means 'bee' and cultura means 'cultivation through education'. The place where the hives are maintained is called an Apiary. Beekeeping is a high profit enterprise which can be taken up both as subsidiary industry as well as whole time profession.

Systematic position of Honey bees –

Kingdom: Animalia

Phylum: Arthropoda

Subphylum: Mandibulata

Class: Insecta

Subclass: Pterygota

Division: Endopterygota

Order: Hymenoptera

Suborder: Apocrita

Family: Apidae

Genus: *Apis*

What are the different species of honey bees suitable for commercial rearing?

The genus *Apis* is divided into several species and sub-species/races but the 7 main species are: *Apis cerana*, *A. florea*, *A. dorsata*, *A. andreniformis*, *A. laboriosa* and *A. koschevnikovi* which are indigenous to India and *A. mellifera* which has been introduced from European countries. The commercialized honey bees in India are two domesticated/hive bees, *Apis mellifera* Linn. and *Apis cerana* F. and two well-known wild species, *Apis dorsata* F. and *Apis florea* F. They have well developed stings. The Dammer bee or little bee, *Trigona iridipennis* (Meliponinae) has only a vestigial sting. All five species are social insects living in colonies with remarkable degree of social instincts and division of labour among the different members of the colony. Among all the above mentioned species, *Apis cerana* and *Apis mellifera* are the two most best species in India for commercial point of view.

Why the bees are important?

Honeybees play an essential role for rural communities and the environment. Honeybee products, especially honey and beeswax, are an important source of income, nutrition, and medicine, while the bees themselves play an equally or even more important role as pollinators for agriculture and natural ecosystems. As pollinators, they support agricultural production, forestry, and the maintenance of biodiversity. They also help to combat soil degradation by enhancing the replenishment cycle: more pollination, more seed set, more plants, more biomass returned to the soil, leading to less soil erosion, less flooding, and a more conducive environment for sustainable living. All four groups of bees play a role in pollination – bumble bees, stingless bees, solitary bees, and honeybees – but the honeybee is the most important. It is estimated that one third of the human diet comes from insect-pollinated plants, and that honeybees provide 80% of that pollination.

Apis dorsata

Apis cerana

Apis florea

Apis mellifera

Why Beekeeping?

Beekeeping has both direct and indirect benefits. The direct benefits are the hive products: honey, beeswax, pollen, royal jelly, bee venom, propolis, and bee colonies. These can be consumed to improve a family's nutrition, sold for cash income, or used as a basis for enterprise development, for example cosmetics based on beeswax. The indirect benefits include pollination, which leads both to increased crop productivity and maintenance of natural biodiversity, including sustaining the natural products used by farmers (Figure 2). Beekeeping also generates off-farm employment opportunities in different fields including hive carpentry, production and sale of honeybee colonies, honey trading, renting of bees for pollination, and bee-based micro enterprises. Beekeeping is ideally suited as a means of income generation for a wide range of people with otherwise limited opportunities, including the poorest of the poor, women, and people from disadvantaged groups. It usually needs only a very small start up investment, can be carried out in a small space close to the house, and yields profits within the first year of operation.

What are the different castes of honey bees and what is the role of each caste?

The honeybee is a social insect and lives in colonies with a highly organized system of division of labour. Every honey bee colony comprises of a single queen, a few hundred drones and several thousand worker castes. Queen is a fertile, functional female, worker is a sterile female and the drone is a male insect. Each caste has its special function in the colony.

Queen: The only individual which lays eggs in a colony (Mother of all bees) and only one queen is found in a colony except under supersedure or swarming instinct. She is largest in size with no wax glands. Live for about 3 4 years. Her function is to lay eggs and a good queen may lay eggs at the rate of 1500-2000 per day. Queens are raised in specially constructed queen cells, which have peanut like shape and structure.

Drone: Drones, the functional males of the colony are produced from unfertilized eggs, and are larger and darker than the worker. It is smaller than queen and measures about 15-17 mm in length. Drones can live up to about 60 days. Sting and wax gland absent. The sole duty of drone is to fertilized the virgin queen.

Worker: The workers are imperfectly developed female (sterile female) which develops from fertilized egg. They are smaller than the drones and queen and have yellowish-dark brown abdominal stripes. They have well-developed sting and hind legs have "pollen basket" for collecting pollen. The workers perform all the useful work in the colony except egg laying. Duties of workers include: cleaning of the hive, feeding of larvae, raising queen cells when required, ventilate hive, guard the hive entrances, secrete bees wax to construct the combs,

collect the nectar and convert it into honey, collection of pollen, water and propolis, produce a pre-digested food of royal jelly for feeding queens and young larvae and scouting for a new nest site during swarming. Workers usually live for 5-6 weeks.

What are the different products of beekeeping?

The main product of beekeeping is honey. But apart from it, we also get other valuable products like bee wax, pollen, propolis, bee venom and royal jelly.

1. **Honey:** Honey is a sweet, viscous fluid produced by honey bees. They collected as nectar from nectaries at base of flower and also collected from extra floral nectaries (nectar secreted by parts other than flowers) as well as from fruit juice, cane juice. Honey is a nutritious food, rich in energy and vitamins. It is used to prevents cold, cough and fever.
2. **Bee wax:** Beeswax is secreted by the wax glands located on the underside of the last four abdominal segments (4th to 7th) of the worker bee which are usually active when they are 12–18 days old. Wax secreted from these glands flows onto wax 'mirrors' where it is in contact with the air and solidifies to form wax plates. The bees remove the wax plates with the help of their pollen rake, pass them to the mandibles, and chew and soften the wax by mixing with saliva before using to construct combs and seal cells. It is used in making of candles, creams, lotions, lipstick, formation of comb foundation (wax foundation in apiaries).
3. **Royal jelly:** The glandular secretions of young worker bees (4-10 days old), produced by the hypopharyngeal gland in the head. Used in treatment of diabetes, osteoporosis etc. It also aids in healing wounds and boosts immunity.
4. **Bee venom:** Bee venom is a bitter colourless liquid, containing proteins, which causes local inflammation. Bee venom is given as a shot for rheumatoid arthritis, nerve pain (neuralgia), multiple sclerosis (MS), desensitizing the people allergic to bee sting.
5. **Propolis:** It is a resinous mixture that honey bees produce by mixing saliva and beeswax with exudate gathered from tree buds. It is used by bees to seal unwanted spaces in hive. Used to treat cough and throat irritation.
6. **Pollen:** Pollen is the primary food of bees which is collected from anthers of flowers using worker honey bee's pollen baskets. Part of collected pollen used to pollinate flowers and the rest is brought back to the hive. Collected pollen appears red, yellow or brown based on the visited flower source. It is rich in protein being very important for brood rearing. Most of the pollen is collected by the bees during the morning hours (10 to 11 am) when it is moist and easy to collect. It is primarily used in food, traditional medicines, as nutritional supplements and in cosmetics such as shampoos, creams and even perfume.

1. Business idea: Production and Marketing of Quality Honey, Bee Wax and Pollen

Objective: To acquainted with techniques and procedure for quality honey production, extraction, processing and storage, pollen collection and its storage as well as extraction and purification of bee wax

A. Quality Honey Production

Requirement: Movable frame hive, nucleus hive, comb foundation sheets, queen excluder, bee feeder, queen cage, queen gate, honey extractor, smoker, bee veil, gloves, decapping knife, food grade plastic container, sugar syrup.

1. Procurement of bee hive

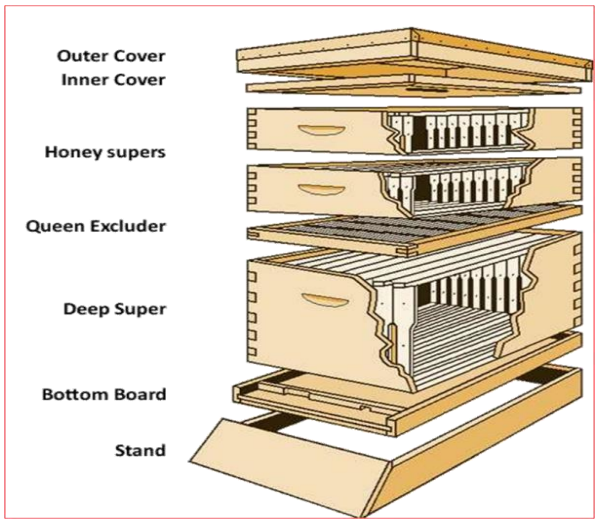
Movable frame hive

A movable frame hive has two types of chambers, the super chamber for honey production and the brood chamber. The super chamber is only added during the honey flow season. The standard design used for *Apis mellifera* is a Langstroth hive, first patented in 1852 and still used throughout the world. The advantage of this hive is that the bees build honeycomb into frames – wooden rectangles designed to hold a comb, which are slotted downward into grooves from the top of the hive and can be easily lifted out. The frames are set at a fixed distance from each other, which is calculated to prevent bees from attaching honeycombs where they would connect adjacent frames or connect the frames to the walls of the hive.

Nucleus beehive

A nucleus hive is a small beehive with only four or five frames which is used for colony division or to maintain bees.

Both of these types of bee hives are commercially available at reasonable price.



Movable frame hive

Nucleus hive

2. Procurement of comb foundation sheets

Prepared comb foundation sheets made of beeswax with a raised pattern of cell outlines are used to maximize the profit in modern beekeeping. Comb foundation for *Apis mellifera* is designed to fit the Langstroth hive brood frames and can be cut to fit the super frame. Comb foundation saves the bees time and energy in building new combs, which increases the honey yield. Comb foundation sheets are also available in the market at reasonable price.

Comb foundation sheet

3. Installation and storage of comb foundation sheets

Installation

i. Take purchased wax comb foundations of *Apis mellifera*. Place pre-wired hive frame flat on the work table (make sure to place the frame with the 3/8 x 5/8 grooved top bar facing up to allow foundation and wedge strip to be inserted).

ii. Place wax comb foundation sheet into hive frame and insert its one length wise edge into the groove of top bar of frame. Pour molten bees wax through a container or burning candle on the sheet along the groove to fix it into the frame. To give extra strength fix the wires of the frame attached to the face of the comb with drops of melted wax or by pressing the wire into the comb foundation with a sharp heated knife or hive tool.

iii. Wire embedder (small tool with a spur or round wheel on the top) can also be used to fix comb foundation with the frame wires.

iv. Foundation is mainly used in the brood chamber and in or just before the honey flow season. If combs are needed in the super of a bee colony, it is best to use stored old combs, or to move honeycombs from the brood chamber to the super and place new comb foundation in the brood chamber.

v. The frame with foundation can be placed at the centre or side of the hive according to the colony status and season. It should be placed at the side in a strong colony and at the centre in a weak colony.

Storage

i. In case of newly prepared or purchased comb foundation sheets, they should be wrapped in clean newspaper, with individual sheets separated by a piece of paper, and stored safely in a cool dry place for later use.
ii. In case of old combs wrap them in newspaper and store safely in a cool, dry place protected from fungi and insects. Make sure they are free from wax moth or other pests before reusing.
iii. After opening a packet of old combs, select ones that are reusable and air them in the open for 24 hours in a safe place.
iv. Immerse the combs in clean water for a short time, drain the water from the cells on both sides, dry in the shade, and then use.

4. Installation of bee colony in the hive

This process is done when a new colony is purchased for starting beekeeping.

i. Spray the bees with sugar syrup before removing them from the package and then remove the bee feeder and the queen. Before removal of queen, ensure its viability.
ii. Place the queen into the hive hanging between the two middle frames.
iii. When bees get into the hive, they will eat the sugar candy and the queen will be able to get out.
iv. Shake the bees from the package over the queen. Spray the inside of the hive with sugar syrup.
v. After the completion of transferring bees into the hive, place the remaining frames and close up hive immediately and reduce entrance of hive. After 3 days check to see if the queen has been released.
vi. Provide continuous feeding with sugar syrup until the bees draw out all foundation in deep super.

5. Careful inspection of honey bee colonies

Once the hive is occupied and the bees are busy, it is said to be colonized and it is important to inspect the colony to monitor its performance. Inspection should be carried out during clear and calm weather and not during hot and bright, cold, cloudy, or threatening storms or rain. Colony inspection is easier when a large number of bees are out for foraging and fewer are in the hive. Observe the following simple guidelines while carrying out inspection.

i. Stand beside the hive as standing in front of the hive disturbs incoming and outgoing bees.
ii. Puff smoke gently around the entrance of the hive and remove the top cover carefully.

iii. Remove a few empty bars to create a gap at one end of the hive. This should not disturb the bees. Thereafter, remove one bar at a time. Smoke the gap gently and hold the bar vertically so as not to break off the comb.
iv. Use a hive tool or knife to separate bars that are glued together by propolis.
v. Inspect the brood frames carefully on both sides one after the other by holding and rotating; make sure that the pollen, nectar, and queen and nurse bees don't fall outside the hive.
vi. Check on the strength of the colony by observing the brood: eggs, larvae and pupae.
vii. If disease is present in the colony make sure not to cross infect another colony. Clean up your gloves and all hive tools – change your gloves if necessary.
viii. If the disease is noticed, reduce the entrance to minimise robbing by bees from other colonies and follow the management practices.
ix. Replace the brood frames carefully after each has been inspected.
x. Replace any dummy boards or frame feeders, and/or replace with frames with empty combs or comb foundation.
xi. Replace the super, refit the inner cover, and cover the hive with the outer cover.

6. Procedure of dividing or multiplication of bee colonies

Colony division is a method of multiplying bee colonies, i.e. producing two or more colonies from a mother colony. Colony division is used to control swarming as well as in commercial beekeeping to increase the number of colonies. There are two methods of colony divisions.

(i) Natural division using queen cells developed during swarming

The presence of multiple queen cells in a colony during the swarming season indicates a need for division. Dividing such colonies and using the queen cells in new daughter colonies can help control swarming. However, although it solves the immediate problem of swarming it does not help improve the genetic traits.

(ii) Colony division from queen production

Select the best colony based on the selection criteria. Produce queens from this colony before the onset of honey flow. These queens can be used to replace the old queen and to start new daughter colonies. The mother colony can be multiplied into several nucleus colonies but each should have at least 2 brood combs and 3–4 combs with food (nectar and pollen). The prepared colonies can then be sold or migrated according to need. Following steps should be taken for consideration.

i. Select the most appropriate mother colony.
ii. Move the hive about 1 foot (30 cm) to the left of the existing location.

iii. Place an empty hive about 1 foot (30 cm) to the right of the previous location, leaving the old location empty.

iv. Take 3 to 4 brood combs from the mother colony together with the existing queen and place in the empty hive.

v. Keep 1 mature queen cell with 3 to 4 brood combs in the mother colony.

vi. Divide the combs with food stores equally between the hives. Remove any remaining queen cells. Divide the adult bees equally between the hives.

vii. Check whether the incoming foragers are entering both hives equally.

viii. If more foragers are entering one of the hives, move it further from the previous location and move the other hive closer to the previous location. Continue to adjust until equal numbers of foragers are entering both hives. Add frames with empty combs or comb foundation to the colony with the queen after colony division.

ix. Close and cover the hives.

x. Divided colonies can be moved to the desired position by increasing the distance from the old position at a rate of 1 to 1.5 feet (30 to 45 cm) per day in the evening after the bees have stopped foraging.

xi. Divided colonies should be fed with sugar syrup in the evening for 3 days after division and comb foundation added as necessary.

7. Uniting bee colonies

Uniting two colonies into one is done when one of them is weak or queen less or for other reason like bad traits etc. The newspaper method is the safest way of uniting colonies. A perforated paper is placed between the two hives (colonies) to be united. This allows mixing of the pheromones of the two colonies, resulting in a single united colony. Always unite the weak colony with the strong colony, not the strong with the weak.

Preparation

- Identify the colonies to be united. Bring distantly placed colonies closer before uniting. A weak colony can be brought close to the stronger, queen-right colony by moving at a rate of about 2 feet (60 cm) per day.
- Feed the colonies continuously with sugar syrup for 3 days before uniting if food stores are insufficient.
- Remove the queen of the weaker colony 24 to 48 hours prior to uniting.
- Remove all the empty combs and super/s from the colonies to be united during daytime.

- If laying workers need to be removed, the colony should be taken about 200 m away from its existing location and all the bees shaken off the comb before the hive is replaced in its original location. Only the bees that return to the original location should be united.
- Remove combs with worker eggs from worker laying colonies before uniting.

Method

The steps are as follows-

- The colonies to be united should already have been moved close to each other.
- Give a light puff of smoke at the entrances of the colonies.
- Remove the (outer and inner covers) of the queen-right (strong) colony and place a perforated paper over the frames to fully cover the brood chamber.
- Spread honey or 2:1 sugar syrup lightly on the paper.
- Remove the bottom board of the queenless colony and place the hive on the perforated paper on top of the brood chamber of the queen-right colony. The smoke will have encouraged the bees to withdraw to the combs so that there are no bees left on the bottom board.

8. Seasonal management of honey bee colony

a. Summer Management

(i) Keep the colonies in thick shade.

(ii) Regulate the microclimate of the apiary by using wet gunny bags over top cover and sprinkling water around the colonies in the apiary during noon hours.

(iii) Provide proper ventilation in the colony by widening the entrance gate of the colony, providing additional gates to multi chambered colonies, placing thin small stick pieces between two adjacent chambers for the passage of fresh air, reducing the number of frames by 1 and allow 9 in the chamber.

(iv) Provide fresh water in/near the apiary.

b. Monsoon Management

(i) Clean and bury deep the debris lying on the bottom board.

(ii) Keep the surroundings of the colony clean by cutting the unwanted vegetation which may hamper free circulation of the air.

(iii) Provide artificial feeding (sugar syrup and/or pollen substitute) as per requirement of the colony.

(iv) Check the robbing within the apiary.

(v) Unite weak/laying worker colonies.

(vi) Control predatory wasps, ants, frogs, lizards in the apiary.

c. Post Monsoon Season Management

(i) Provide sufficient space in the colony.

(ii) Strengthen the colonies to stimulate drone brood rearing.

(iii) Control ectoparasitic mites, wax moth and predatory wasps.

(iv) Extract autumn honey before the winter sets in.

d. Winter Management

(i) Examine the colonies and provide winter packings in weak colonies specially in hilly areas.

(ii) Feed sugar/pollen substitute to weak colonies as stimulative feeding to provide energy and initiate brood rearing.

(iii) Shift the colonies to sunny places.

(iv) Protect the colonies from chilly winds by using wind breaks.

(v) Unite the weak colonies with stronger ones.

e. Spring Management

(i) Unpack the colonies, clean the bottom board, replace the worn-out hive parts and provide sufficient space.

(ii) Provide stimulative sugar/pollen substitute to increase brood rearing.

(iii) Equalise the colonies.

(iv) Extra frames should be raised by providing comb foundation sheets.

(v) Replace the old queens with new ones through mass queen rearing or divide the colonies.

(vi) Manage the colonies in such a way to prevent swarming.

(vii) Monitor regularly for ectoparasitic mites and adopt control measures.

(viii) Extract honey frequently during this season.

9. Procedure for harvesting a honey comb

Harvesting is the process of extracting honey from honeycombs taken from honeybee colonies.

Procedure

i. 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.

ii. Knock the top bars to see which of them have combs, they will sound heavier than empty ones.

iii. Use the decapping knife or hive tool to remove the first bar from one end of the hive.

iv. Puff smoke gently into the gap to drive the bees to the other side of the hive.

v. Start removing the frames from the super one by one, until 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.

vi. 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.

vii. 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.

viii. 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.

ix. Start the process again at the other end of the hive.

x. Close the hive carefully, replacing the lid.

xi. Transfer the containers containing the honey combs to the extraction room.

10. Extraction process of honey from honey comb

- Set up the extractor in a closed room or in a tent made of fine mesh netting away from the apiary. Use a big tray to collect drips.
- Lift each frame from the super and identify combs ready to harvest. Lift out frames containing combs in which more than 70% of cells are capped. Brush the bees off the comb back into the hive. Take as many frames as will fit in the extractor (2,4, or 8). If all frames are filled, they can all be harvested.
- Replace the frames taken for harvesting with old frames with cleaned comb if available.
- The frames in the brood chamber with honey should be left to fulfil the colony's needs. Although it is possible to harvest frames from the brood chamber, this is not good practice and will weaken the colony.
- Take the frames to the honey extractor in a bowl or other container to prevent dripping.
- Remove the caps from the cells on both sides of the comb with a sharp knife; collect the caps in a dish.
- Place frames in the extractor and rotate it to force the honey out of the combs. Pour the honey collected at the base of the extractor into a stainless steel container or glass jar.
- Put the frames with empty combs back into the hive if no extras were available, or store for later use.

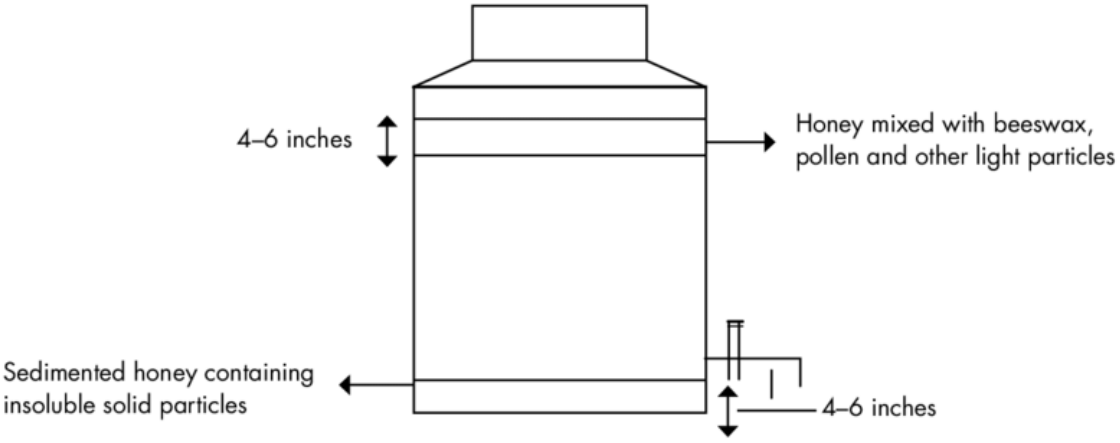
11. Processing of extracted honey

In honey production, processing mainly refers to removing any wax particles, brood, or foreign materials from the honey extracted from the combs, and on occasion treating the honey to obtain a particular consistency. Honey processing refers to the indirect heating of honey at

controlled temperature and duration, to liquify it, destroy all the yeast cells to prevent fermentation and delay granulation and reduce excess moisture, besides retaining its natural flavour, colour and taste. At household level/small scale following techniques are used to process the honey.

(i) Sedimentation method

The honey is filtered through a double layer of muslin cloth and kept for at least 48 hours in a container holding more than 100 kg of the liquid to allow most of the air bubbles and small foreign particles to rise to the top and mineral and metallic particles to settle at the bottom. The portion at the bottom with sediment is removed through an outlet at the bottom of the container, and the remainder stored and used for bottling and sale. The honey with sediment can be used to feed the bees during the dearth period.



Honey sedimentation

(ii) Heating method

In the heating method, honey is heated in a water bath to a temperature below 40˚C and then filtered through muslin or steel mesh before cooling and storing in airtight bottles. Heating is also used to evaporate excess moisture and improve the keeping quality.

12. Packing and storage of honey

- 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.
- Use glass containers with wide mouth for storing the honey.

- The cap of the container should be made of non-corrosive and non-reactive materials.

13. Quality testing of honey

Test 1

Requirement: Honey, water, glass.

Procedure

- Pour water into a glass.
- Spoon out a tablespoon of honey sample from the honey jar to test.
- Place the spoon in the glass of water.
- Gently shake the glass.

Observations and result

If the honey forms a small lump and sinks to the bottom of the glass, it is pure. Whereas, if the honey starts dissolving and mixes with the water, it's impure and some amount of water has been added to it.

Test 2

Requirement: Honey, methylated spirit/denatured alcohol.

Procedure

Mix equal parts of honey and spirit in a glass.

Observations and result

If pure, honey will form a lump and sink. But if it is adulterated, it will dissolve in the spirit and turn it milky white.

Test 3

Requirement: Honey, a 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.

Observations and Result

If the candle wick burns, the honey is pure. But if it fails to burn, water has been added to the honey.

Test 4

Requirement: Honey, a blotting paper or a white cloth.

Procedure

Drop a few drops of honey on the paper/cloth.

Observations and Result

If the honey is pure, it will remain solid on paper. Impure honey will be absorbed by the paper. With the cloth, try washing off the honey. If it does not stain, it is pure.

B. Extraction of Bee Wax

There are mainly two methods of wax extraction which are most popular. The requirement and procedure of each method are given below.

A. Direct of Hot Water Bath Method

Requirement: Honey comb, stainless steel utensils, muslin cloth bag or sackcloth or a sack made of jute, jute or plastic string, stove, sticks, large stainless steel spoon, mould for collection of wax.

Procedure

1. Take the combs, cut into pieces, wash thoroughly in clean warm water and soak for 24 hours so that any dirt, pollen or honey can be removed from the combs.
2. Put the cleaned comb pieces into a stainless steel pot, add equal volume of water to cover and heat gently with continuous stirring until the wax is completely melted.
3. After the combs have melted, pour the mixture into a muslin cloth bag or jute sacking by tightening the opening of the sack or muslin cloth with the string.
4. To extract all the melted wax, squeeze the cloth bag or jut sacking with two sticks and collect the filtrate in a clean stainless steel container or bucket.
5. Keep the bucket containing hot water and molten wax safely in a room or in the shade overnight to cool.
6. As the wax is lighter than the water it floats on the top surface and forms a waxy scum over the water surface.
7. Any particles that have escaped through the bag will settle below the wax layer. Scrape off any material stuck to the underside of the wax disc.
8. Keep the clean and dry wax block safely in a plastic bag and store in a clean dry room.

B. Solar Wax Extraction Method

In this method a solar extractor for bee wax is used. It is a rectangular box made of metal covered by a double-paned piece of glass or transparent plastic which need to be placed under the sun and uses solar heat for melting the wax. To obtain maximum heat absorption, paint inner wall of the box with black colour.

Requirement: Cleaned honey comb, aluminium foil sheet, stainless steel knife, stainless steel container, solar wax extractor.

Procedure

1. Take the combs, cut into pieces, wash thoroughly in clean warm water until they are free of dirt and honey.
2. Put these properly cleaned comb pieces inside the aluminium foil sheet, wrap properly and make a small hole in the foil to be act as a drain point.

Solar Wax Extractor

3. Place this wrapped foil on the metal sheet inside the extraction box and keep a container under the drain point of the foil to collect the molten wax.
4. Place the extraction box containing wrapped wax foil under the sun.
5. Once the inner temperature of the box rises above 61˚C, the wax start melting and runs down the metal slope to the container through drain point.
6. Keep a small screen of wire mesh at the bottom of the metal slope before the container so that pieces of comb and other debris can be prevented from slipping down into the container.
7. Collect all the wax by repeating the process for few days.
8. The extractor should be bee-proof. For best results the solar extractor should be used on a hot, sunny and calm day.

Purification of Bee Wax

Removal of dirt and other undesirable ingredients from the extracted wax is known as purification of the wax.

Requirement: Cleaned wax, stainless steel container, stainless steel spoon, heat water bath containing outer and inner pots with space between two for boiling water.

Procedure

1. Take required quantity of water in the outside container of the double boiler and heat over oven or stove.
2. Take the solid wax and break or cut them into small pieces.
3. A suitable plastic mould should be prepared by making the inside with soap or oil coating to prevent sticking of the wax to it.
4. Now put the wax pieces into the inner container of the double boiler and keep boiling the water until the wax melts completely.

5. Hold and loosely tie the straining material over the top of the mould. To prevent the wax from spilling over the edge, the material should have a dip in it. It is preferable to have someone hold the materials in place because the wax will solidify before it has completely passed through the cloth. The cloth can be moved to allow the final wax to pass through it.
6. Pour the melted wax through a strainer having very fine mesh. It is best to use cotton cloth that is tightly woven or clean t-shirt.
7. The wax cools and solidifies in the mould and can be removed when solid.
8. The dirt remained on the cloth can be cleaned carefully for reuse.
9. All utensils should be washed quickly while the wax is liquid.

Precautions

1. Always avoid using copper, zinc, brass or iron utensils during processing, solidification or storage as wax is highly acidic in nature and reacts with them and turn dark.
2. Use aluminium, good quality stainless steel, nickel, tin, unchipped enamel containers or plastic pots to prepare the wax.
3. Always use same type of combs for processing. Do not mix dark combs with light combs as this will lower the grade of the best wax.
4. Do not heat the bee wax on a direct flame. Always heat it in a container of water due to fire hazard. Heat slowly and do not boil when melting the wax.
5. Never heat the wax for longer than necessary as excessive heat can cause discolouration of the wax and loss of scent from it.
6. Cool the melted wax slowly to avoid cracking.
7. Store the processed wax in air tight containers to prevent infestation by wax moth.

B. Harvesting and Storage of Pollen

Another essential component of beekeeping is pollen, which is collected by the worker bees while foraging from flower to flower. The beekeepers collect these pollen grains when the bees return to their hives. During the pollen flow season, honeybees collect plenty of pollen than their requirement, leaving an excess that the beekeeper can harvest without affecting the brood rearing. These collected pollen grains are then sold for a variety of uses.

Requirement: Bee hive, pollen trap, bee veil, gloves, spatula, glass test tube, container.

Procedure

1. Pollen can be collected by installing a pollen trap at the entrance of the hive. Before placing the pollen trap, do not forget to remove the entrance rod of the hive. The pollen trap looks like a metal sheet full of holes or a 5 mm wire mesh.

2. When the pollen foragers return to the hive, they have to pass through the holes of the pollen trap. The pollen balls attached to the pollen baskets get dislodged on a finer mesh and fall into a drawer type of receiving tray beneath the mesh.

3. Pollen trap should only be placed for a few hours per day and repeated after 2 to 3 days from a strong colony so that bees can also collect pollen for brood rearing.
4. Collect the pollen using spatula and dried to less than 10% moisture by spreading in a thin layer under shade.

5. Remove any foreign particles like insect parts, wax moth, debris, moulds etc. from the collected pollen.
6. Keep the collected pollen in sealed dry glass test tube and store in a cool dry place or in refrigerator to avoid moisture.

Precaution

- Pollen must not be collected from a weak colony.
- Do not dry the pollen under the sun directly as the sun will destroy the vitamins in the pollen.

Another most important product obtained from an apiary after honey is the bee wax. Bee wax is light yellow to white in colour. Old combs turn brownish. Bees wax melts at 61–64˚C and becomes cracked and powdery if very cold. There is great demand of different forms of bee wax and the beekeeper can get better price from the bee wax owing to its varied uses. A good skill is the prerequisite for the extraction and purification of bee wax and the obtained wax fetches good price in the market.

Video Link:

https://www.youtube.com/watch?v=g1WNyAEtlYU&pp=ygUYcXVhbGl0eSBob25leSBwcm9kdWN0aW9u

https://www.youtube.com/watch?v=aWqG6o_2oo0

https://www.youtube.com/watch?v=Pvr3M8Q3aXs

https://www.youtube.com/watch?v=g0kOJd2XW7Y

https://www.youtube.com/watch?v=TjtislrM6J0

https://www.youtube.com/watch?v=-BmYXyFrQLg

https://www.youtube.com/watch?v=Oy7VPdImRpQ

Preparation of Balance Sheet

Objective: To learn the process of calculation of cost of production.

Procedure: Collect all the data related to all inputs required, cost of labour, collection of data and market study for production of honey, wax and pollen.

Observation: Calculate the cost of production, Net profit and calculation of B: C ratio.

Sl. No	Items	Quantity	Unit Rate (Rs.)	Amount (Rs.)
1	Empty hives with super			
2	Bee colonies (4 frames)			
3	Nucleus hives (5 frames)			
4	Managing kits (Hive stand; queen cage; queen excluder; queen protecter; bee feeder; queen gates-one with each box)			
5	Handling kits (honey extractor, smoker, pollen trap and other appliances like gas cylinder, oven, decapping knife, bee veil, gloves; hive tool, hammer; nail puller; swarm bag; frame gripper, food grade plastic containers, honey extraction net, tent) etc.			
6	Sugar during dearth period			
7	Comb foundation sheets			
8	Medicines			
9	Sublimed sulfur			
10	Formic acid			
11	Cost of LPG gas Refilling			
12	Labour charges (Unskilled labour)			
13	Transportation for migration			
14	Marketing expenses			
Total Cost of Production (Rs.) =				
Income				
1	Yield of Honey			
2	Yield of bee wax			
3	Yield of Pollen			
4	Divided extra colonies (5 frames)			
Total Income (Rs.) =				
Net Profit (Rs.)				
B:C Ratio				

Conclusion:

2. Business idea: Production and Marketing of Queen Bees

Objective: To acquainted with techniques and procedure for commercial rearing of queen bees

For successful beekeeping, the most important aspect is the quality of a queen bee in the colony. The genetic improvement of all the castes in a colony can be achieved through continuous selection and multiplication of the best colonies in an apiary. The queen's genetic quality determines the various colony characters such as population growth, longevity, pollen and nectar collection, storage capacity, disease resistance, gentleness, temperament, swarming tendency etc. which helps to keep drones and workers strong and healthy by requeening colonies annually. Therefore, based on the progeny potential of such queens like increased honey production and other characters, selection of a breeder colony (colony providing brood for grafting and raising quality queens) is to be done. For selecting breeder colony, best performing colony in the apiary is marked and brood from this colony is used for raising quality queens. There are many methods for queen production available but 'Doolittle Method' and 'Nicot Method' are the most suitable and popular for mass rearing of queen bees.

Pre-requisites to produce good queens

- Presence of well fed larvae (24 hour old or younger).
- Strong cell builder colonies to provide surplus royal jelly and proper care for queen cells.
- Large number of mature drones of desired stock near queen mating yard.
- Stimulation of cell builder colony by constant feeding during development period.
- Nucleus of adequate strength to keep ripe cell (matured queen cells) warm and proper care of emerging queen.

Timing for queen rearing

The ideal time for queen rearing varies depending on the specific geography and climatic situation of the country. Ideally it should be carried out during the honey flow period and under favourable weather conditions (warm and dry). This means March to April and September to October in plains, hills, and mid-hills areas, and around June in mountain areas.

Requirements:

1. Apiary with numerous hive honeybee colonies
2. Breeder colony
3. Cell Builder colony
4. Sugar
5. Candy

6. Oven

7. Queen cell cups made of wax

8. Queen cell cup holder

9. Cell cup socket

10. Queen cell forming rod

11. Queen cell holding frames

12. Purified beeswax

13. Grafting needles

14. Queen cell protector

15. Queen mailing cage

16. Queen bank

17. PVC cell cups and cup holder

18. Nicot queen rearing kit

19. Feeders

20. Mating Nucleus Hive

Procedure

1. **Breeder colony:** It represents the selected stock of mother queens from which new queens are to be reared. Prepare at least one Breeder colony to get very young larvae (less than 24 hours age) from this colony for getting them transformed into the high quality queen bees.

   Preparation:

   i. The hive body of the breeder colony should be divided into two compartments by placing a vertical queen excluder. One compartment should contain six or seven combs of honey and pollen and the other one contains one comb of open brood and one comb of sealed brood.

   ii. Keep one slightly dark coloured empty comb with worker brood cells in between these two brood combs for egg laying by the queen. Confine the mother queen bee into this three combs compartment of the breeder colony.

   iii. In order to enhance egg laying and brood rearing by the nurse bees, supplementary feeding with sugar syrup need to be provided to breeder colony.

   iv. When the empty dark comb filled with freshly hatched larvae after three days of egg deposition, transfer them to the cell builder colony or queen cell cups for grafting. Replace the larval comb with an empty egg-laying comb each time during removal of larvae.

   v. Replace the previous sealed brood comb after adult emergence with a new one so that an adequate number of nursing bees in the colony should be maintained.

2. **Cell Builder colony:** It represents such colonies where the queen cells are reared. Select a strong and healthy colony with productive young bees. Strength of cell builder colony should be more than 20000 worker bees (one frame full of bees has about 1600 number of bees). The colony should have nine combs containing sealed brood, honey and plenty of pollen with 2 combs of young brood in the centre, next to where queen cups affixed on queen rearing frames are to be placed. Prepare cell builder colonies which have to be established four days prior to larval grafting by dequeening at least a ten bee-frame strength colony.

   Preparation:

   i. From different existing colonies select the strong one for small scale queen rearing.

   ii. Carefully observe the colony if queen is present before taking the brood and bees.

   iii. To boost the population of strong colonies, addition of sealed brood from healthy colonies needs to be done.

iv. For grafting the selected colony, add the frame containing sealed brood in which emerging workers are present in that colony to ensure having maximum bee population

v. Queen removal is to be done 48 hours prior to grafting and the removed queen can be transferred to another colony.

vi. Inspect the cell builder colonies at least 12 hours before grafting. If the queen cells are observed, destroy them.

vii. Regularly feed the colony with sugar syrup.

Preparation of queen cell cups

1. With the help of queen cell forming rod prepare queen cell cups using light coloured molten pure bee wax having cell size of 10 mm in length and 9 mm in diameter for *Apis mellifera* while for *A. cerana* it should be 9 mm in length and 8-8.8 mm in diameter. The depth of rod should be 9 mm.
2. Melt the bees wax in a water bath and hold it at melting point temperature.
3. At first, dip the queen cell cup forming rod into a soap solution (Fig. 1), take it out and then remove excess droplets off the rod by shaking or jerking.
4. Next, dip the rod in molten bee wax just straight up-right to a depth of 9-10 mm in case of *A. mellifera* and 8-9 mm for *A. cerana* (Fig. 2).

Figure 1

Figure 2

5. Immediately withdraw the rod and hold it in air for a moment for the wax to solidify. Repeat the process 2-3 times.
6. Allow the wax to cool by dipping the rod in cold water to further solidify the bee wax.
7. Then remove the queen cell cup from the rod by slightly twisting and rotating with thumb and index finger. The obtained cups must have thin walls especially at the open end and thick base.

8. Now these prepared queen cell cups are ready for attachment in the grafting frame which is prepared by fixing the queen cell cups with melted wax on the bar affixed with queen cell cup holder and socket. Prepare similar two bars and fix on to the modified frame for grafting (Fig. 3).

9. Alternatively, good quality PVC queen cell cups are available in the market and can be used.

Larval Grafting

1. Transfer of young worker larvae from the breeder colony into the affixed queen cell cups is called larval grafting which is best done in the grafting room or in a shady place under proper light preferably at 25-30˚C and 50-60% relative humidity (Fig. 4 and 5).

Figure 4

Figure 5

2. The larval grafting is either dry or wet grafting. In case of dry grafting, there is no need of priming the cell cups with royal jelly whereas in wet grafting, a drop of royal jelly (1:1 diluted with water) is placed in queen cell cups before grafting.
3. Cover the larval brood frame and grafted frame with a wet cloth. Select and mark the area on brood frames with good quality larvae for grafting (24 hours old larvae only). Keep the materials such as grafting needle, grafting bar etc. ready before grafting.
4. For grafting, lift the selected larvae of 24 hours old from the comb of breeder colony, one at a time with grafting needle by moving down it from the side of the comb cell and after reaching under the ‘C’ larva, it is moved up with the larva on its tip and place them into the queen cell cups of grafting frame by dislodging them at the bottom without changing its original position.
5. Keep the bar with queen cups on the wet foam and cover with wet cloth immediately after grafting.

6. Fix two such bars in the queen rearing frame and in this way 15 to 30 queen cups can be grafted with larvae and once grafting is complete, the frame with grafted cells is immediately moved to cell builder colony.

Management of cell builder colonies

1. Cell builder colony needs proper management and same colony can be used to rear queen cells during entire season.
2. Cell builder colony is made queen less by removing its queen. Grafted cells are accepted within few hours after making it queen less (Fig. 6). For better acceptance, dequeening should be done in morning and then first lot of cells should be given in afternoon or next day.

Figure 6

3. This colony being queen less needs sealed brood or nurse bees to maintain sufficient population. For this purpose, two frames of brood (1 with uncapped cells) are sufficient which should replace 2 brood less combs.
4. Frame containing grafted queen cups is placed in the centre of cell builder colony and workers start raising queen cells once accepted by them (Fig. 6).
5. Destroy any queen cell reared on other brood combs, since these queen cells are not from selected stock.
6. After 10 days of larval grafting, transfer finished queen cells (Fig. 7) to individual queen mating nucleus or use queen cell protector to prevent cell destruction by any of the emerging queens (Fig. 8).

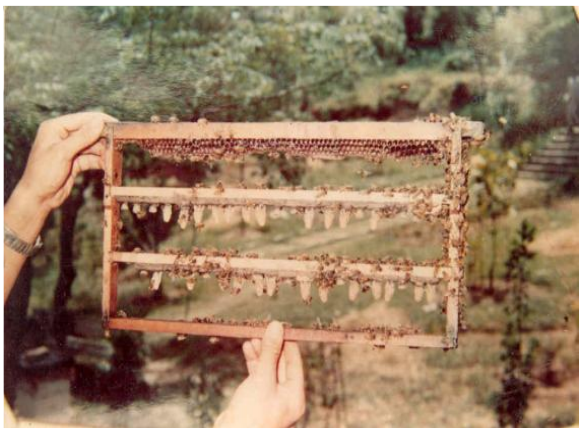


Figure 7

Figure 8

7. Mating nuclei can be baby nuclei (Fig. 9) or large 2-3 frame full depth nuclei. However, generally baby nuclei are preferred by breeders as these are easy to feed, easier to stock and easier to find mated queen.

Figure 9

Mating of queens

1. Young queens ready to mate within 5 to 10 days of emergence.
2. A mated queen starts laying eggs after 7-10 days of mating.
3. Such queens are ready for future use.

Transportation of mated queens

After successful mating of the queens, they are ready to be transported using queen mailing cages. The process includes-

1. Standard wooden mailing cages are used for transportation of mated queens (Fig. 10).
2. Place candy in one end of the mailing cage and staple the wire mesh cover.
3. Then the mated queen should be marked carefully using marker pen and insert it into the mailing cage.
4. Transfer 6-8 young worker bees as attendant into the cage and close the other end with a piece of foam.
5. Paste a label with all the information regarding the queen (such as queen age, date of mating, date of transportation etc.) at the back of mailing cage.
6. In this way, queens can be transported to long distances using such wooden mailing cages.

Figure 10

Preparation of honey-sugar candy

Mix 800 g honey with 1.82 kg sugar (1:2.27 w/w mixtures). Prepare the mixture by warming honey to 65.6˚C, adding powdered sugar with continuous stirring and then kneading the mass produced. This candy can be fed to the bees when queen is transported in mailing cage or introduced in to a new colony.

Nicot Method of Queen Rearing

In this method, rearing of queens is done without grafting which gives a high level of control over the age of larvae. The Nicot kit of queen rearing is made of plastic cups where queen bee directly lay her eggs. To complete larval development, the cells with laid eggs from the laying box are transferred to an isolated box. In Nicot method, larvae do not have to be handled directly.

Procedure

1. Cut a hole in the centre of a frame made of empty comb so that a Nicot box may fit perfectly inside, or use wire string to secure the box to the underside of a top bar (Fig. 11).

Figure 11

2. Keep the prepared frame uncovered inside the colony and wait for 24 hours so that the bees can polish the cells and acquire the hive smell.
3. To trap the mother queen inside the Nicot box, a queen excluder should be placed in front of the Nicot box so that only worker bees are allowed for free movement while the queen remain confined.
4. To increase egg laying and brood rearing, supplementary feeding with sugar syrup needs to be provided to the mother colony.
5. After 3 to 5 days, check the queen cell cups if eggs or larvae present there (Fig. 12).
6. The back cover of the Nicot box should be removed to transfer the eggs or larvae in the queen cell cups into the queen cell holding frame.

Figure 12

7. Place the queen rearing frame inside the cell builder colony and keep it under careful observation for 1 or 2 days.
8. Inspect the cell builder colony on next morning or evening whether the introduced queens were accepted or not.

9. If there is 80-90% larval acceptance observed then left the cell builder colony undisturbed for about 10 days.

Video Link:

https://www.youtube.com/watch?v=iWtoIzT1wA4

https://www.youtube.com/watch?v=4YmOO3DuH7I

https://www.youtube.com/watch?v=mkVTvmoXbrY

https://www.youtube.com/watch?v=tJHj-UaUNMs

https://www.youtube.com/watch?v=lxTJMhg0eac

https://www.youtube.com/watch?v=ZO9u9T8li-Q

https://www.youtube.com/watch?v=xnNtR7GjJvA

Preparation of Balance Sheet

Objective: To learn the process of calculation of cost of production.

Procedure: Collect all the data related to all inputs required, cost of labour, collection of data and market study for production of honey, wax and queen bee.

Observation: Calculate the cost of production, Net profit and calculation of B: C ratio.

Sl. No	Items	Quantity	Unit Rate (Rs.)	Amount (Rs.)
1	Empty hives with super			
2	Bee colonies (4 frames)			
3	Mating nucleus hives (5 frames)			
4	Managing kits (Hive stand; queen cage; queen excluder; queen protecter; bee feeder; queen gates-one with each box)			
5	Handling kits (honey extractor, smoker, and other appliances like gas cylinder, oven, decapping knife, bee veil, gloves; hive tool, hammer; nail puller; swarm bag; frame gripper, food grade plastic containers, honey extraction net, tent) etc.			
6	Sugar during dearth period			
7	Comb foundation sheets			
8	Medicines			
9	Sublimed sulfur			
10	Formic acid			
11	Cost of LPG gas Refilling			
12	Labour charges (Unskilled labour)			
13	Transportation for migration			
14	Marketing expenses			
Total Cost of Production (Rs.) =				
Income				
1	Yield of Honey			
2	Yield of bee wax			
3	Production of queen bees			
Total Income (Rs.) =				
Net Profit (Rs.)				
B:C Ratio				

Conclusion:

3. Business idea: Production, Extraction, Storage and Marketing of Royal Jelly

Objective: To acquainted with techniques and procedure for the production, extraction and storage of Royal Jelly

Production, Extraction and Storage of Royal Jelly

Royal jelly is another very important hive product of beekeeping. It is being used in many preparations. Since secretion of royal jelly by worker bees is low in quantity, hence production and harvesting of royal jelly requires special technical skills. Royal jelly is commercially produced when colonies are stimulated to produce queen bees. However, it is abundantly produced by nurse bees when queen bees are artificially reared using the Doolittle larval grafting technique, which is used to produce royal jelly. During a 5 to 6 months season, a well-managed hive can produce upto 500 g of royal jelly.

Requirement: Bee hive, mature queen cell, PVC cell cups and cup holder, queen cell holding frames, grafting needle, royal jelly extractor, spoon, refrigerator, dark glass vials, sugar syrup.

Procedure

1. Transfer two days old larvae to queen cell cups attached to the bar of the queen cell frame. Each queen cell frame may contain 30 to 90 cells. During larval grafting, ensure not to change the original position of the larva.
2. As soon as possible, place the grafted frame in strong queen right colonies in the centre close to the open brood to allow the nurse bees attend the frame.
3. Cell acceptance can be increased by supplementary feeding with sugar syrup.
4. After 3 days of larval grafting, remove the frames containing grafted cells for harvesting.
5. For easy and quick collection, cut the open narrow part of the cell.
6. Then with the use of soft forceps, remove the larvae very carefully to prevent injury and contamination of the jelly.
7. Extraction of royal jelly is done by emptying each cell with a small spatula or by using sucking device.
8. The extracted royal jelly then must be filtered using a fine nylon net for the elimination of any fragments of wax and larvae. Metal filters should be avoided for contamination.
9. Keep the extracted royal jelly into dark glass vials or food-grade plastic containers to prevent excessive exposure to air and store immediately in refrigerator.

Precaution

- Before extraction, make sure that the laboratory equipment and hands are clean and extraction should never be performed outside or in direct sunlight.
- Any material or equipment that comes into contact with royal jelly, including hands, must be cleaned and disinfected with heat or pure alcohol.

Video Links:

https://www.youtube.com/watch?v=67YgdnkrIMY

https://www.youtube.com/watch?v=vqaeQtSmiwQ

https://www.youtube.com/watch?v=yktPIu-_uv4

Preparation of Balance Sheet

Objective: To learn the process of calculation of cost of production.

Procedure: Collect all the data related to all inputs required, cost of labour, collection of data and market study for production of honey, wax and queen bee.

Observation: Calculate the cost of production, Net profit and calculation of B: C ratio.

Sl. No	Items	Quantity	Unit Rate (Rs.)	Amount (Rs.)
1	Empty hives with super			
2	Bee colonies (4 frames)			
3	Nucleus hives (5 frames)			
4	Deep Freezer 200 lit.			
5	Managing kits (Hive stand; queen cage; queen excluder; queen protecter; bee feeder; queen gates-one with each box)			
6	Handling kits (honey extractor, smoker, and other appliances like gas cylinder, oven, decapping knife, bee veil, gloves; hive tool, hammer; nail puller; swarm bag; frame gripper, food grade plastic containers, honey extraction net, tent) etc.			
7	Sugar during dearth period			
8	Comb foundation sheets			
9	Medicines			
10	Sublimed sulfur			
11	Formic acid			
12	Cost of LPG gas Refilling			
13	Labour charges (Unskilled labour)			
14	Dark glass vials			
15	Electricity charges			
16	Transportation for migration			
17	Marketing expenses			
			Total Cost of Production (Rs.) =	
Income				
1	Yield of Honey			
2	Yield of bee wax			
3	Yield of royal jelly			
3	Divided extra colonies			
			Total Income (Rs.) =	
Net Profit (Rs.)				
B:C Ratio				

Conclusion:

4. Business idea: Production and Marketing of Propolis and Bee Venom

Objective: To acquainted with techniques and procedure for extraction and storage of propolis and bee venom

In addition to honey and wax, other significant by products of beekeeping include propolis and bee venom. Due to their numerous applications and health benefits, the demand of these products is getting much attention in the market. Considering the market value, extraction of these two products have been started by many beekeepers. The extraction of these products requires skill and special equipment.

Extraction of Propolis

Requirement: Bee hive, propolis screen or trap, container, refrigerator.

Procedure

1. The most common method of collection is by using propolis screen or trap. The screen is made of steel wire mesh or plastic looks very similar to a queen excluder except that the openings are much smaller. Worker bees can not move through the screen.
2. Put the propolis screen in place of the inner cover in the hive.
3. The bees will fill the holes of the mesh with propolis as they will consider this to be the boundary of the nest.
4. The propolis can be scraped with a hive tool from the top bars and crevices in the hive during the propolis flow season or placing the screen for 24 hours in a refrigerator or freezer. This will make it easier to knock or scrape off the hardened propolis.
5. Once cooled, the propolis becomes brittle and can be removed from the screens by simply flexing and brushing them.
6. Collect the scraped propolis in clean jar or container and stored in freezer or refrigerator.

Extraction and Storage of Bee Venom

Requirement: Bee hive, venom extractor, dark glass jar, refrigerator.

Procedure

1. The most common method for extraction of bee venom is using electric shock without harming the bees.
2. Collection of bee venom is done by installing a venom extractor (an electrically charged grid) with a thin synthetic material stretched under it on glass plank at the base of the beehive.

3. The device stimulates bees using mild electric shock via wires suspended above the collecting tray.
4. The tray is either placed at the hive entrance between the bottom board and brood chamber, or in a special box between the supers and the hive cover.
5. Bees that come into contact with the wires received a mild electrical shock and stung onto the glass plank leaving venom on it. The alarm odour, which evaporated from the venom, mobilized and irritated the other bees and they also started to sting.
6. Some devices may use a thin (0.l3 mm thick) plastic membrane of nylon or silicon or rubber under which a collecting plate or absorbent tissue placed to collect the bee venom.
7. On glass plates, venom dries quickly and the dried bee venom is later scraped off with a razor blade or knife.
8. Absorbent tissue is washed in distilled water to extract the venom, which then should be freeze-dried.
9. Collection on glass plate is generally easier and produces a product which is easy to store and process.
10. Dried bee venom should always be packed in dark bottles and stored refrigerated or preferably frozen.

Precaution

- During handling of dry bee venom, protective gloves, glasses and dust masks should be used to avoid any contact or inhalation of the highly concentrated venom.
- Only 1 gm of venom could be collected from 20 bee colonies in a period of one to two hours. One cycle is of 15 minutes.
- Stimulation at interval of 3 days repeated after 2 to 3 weeks.

Different types of Venom Extractor

Video Link:

https://www.youtube.com/watch?v=sHFUO3G0I-A

https://www.youtube.com/watch?v=NBT5AfFzE4g

https://www.youtube.com/watch?v=RJn_8fOQozg

https://www.youtube.com/watch?v=Q6tOMv9I2oA

https://www.youtube.com/watch?v=SZ9WqSFGRs4

https://www.youtube.com/watch?v=zs0SiV5xReo

https://www.youtube.com/watch?v=a347UrMihos

Preparation of Balance Sheet

Objective: To learn the process of calculation of cost of production.

Procedure: Collect all the data related to all inputs required, cost of labour, collection of data and market study for production of honey, wax and queen bee.

Observation: Calculate the cost of production, Net profit and calculation of B: C ratio.

Sl. No	Items	Quantity	Unit Rate (Rs.)	Amount (Rs.)
1	Empty hives with super			
2	Bee colonies (4 frames)			
3	Nucleus hives (5 frames)			
4	Deep Freezer 200 lit.			
5	Cost of propolis screen			
6	Cost of bee venom extractor			
7	Managing kits (Hive stand; queen cage; queen excluder; queen protector; bee feeder; queen gates-one with each box)			
8	Handling kits (honey extractor, smoker and other appliances like gas cylinder, oven, decapping knife, bee veil, gloves; hive tool, hammer; nail puller; swarm bag; frame gripper, food grade plastic containers, honey extraction net, tent) etc.			
9	Sugar during dearth period			
10	Comb foundation sheets			
11	Medicines			
12	Sublimed sulfur			
13	Formic acid			
14	Cost of LPG gas Refilling			
15	Labour charges (Unskilled labour)			
16	Electricity charges			
17	Battery 9V			
18	Transportation for migration			
19	Marketing expenses			
			Total Cost of Production (Rs.) =	
Income				
1	Yield of Honey			
2	Yield of bee wax			
3	Yield of propolis			
4	Yield of bee venom			
5	Divided extra colonies			
			Total Income (Rs.) =	
Net Profit (Rs.)				
B:C Ratio				