

CHAPTER – 1 BEE KEEPING TECHNIQUES

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SYNOPSIS

Introduction, Beekeeping in India, benefits of beekeeping, honey bee products and marketing potential, honey bee species and its importance, bee biology, castes of bees, stages of development in honey bees, sex differential in honey bees, bee food plants, communication among bees.

Beekeeping in India

- Traditional beekeeping in India was mainly forest based as mostly the tribal farmers were involved in it.
- The farmers have been keeping Indian bee, as it is a good pollinator and accustomed to the Indian climatic conditions.
- The Sunderban forests in West Bengal are rich in Rock bee and the organic honey from these forests is in great demand.
- The exotic bee, popularly known as Western bee, was successfully introduced from Europe during 1960's in foothills of Himachal Pradesh and agricultural plains of Punjab.
- It has become popular among commercial beekeeper because of its higher honey yield.
- It spreads gradually to Himachal Pradesh, Bihar, Uttar Pradesh, West Bengal, Kerala, Karnataka and Maharashtra. In 1980s, Khadi and Village Industries Commission (KVIC) was established for promotion of modern beekeeping through various schemes.
- Beekeeping is now being practiced on a large scale in several States of India, which include Haryana, Punjab, Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh, Bihar, West Bengal, Tamil Nadu, Kerala and Karnataka.
What is your state? Is beekeeping popular in your region?

Benefits of beekeeping

Beekeeping is the secondary source of income. Because of the following reasons you may adopt it:

- (i) Production of bee hive products: Honey bees are the sole source of honey and beeswax. The bee hive products namely honey, pollen or bee bread, royal jelly, bee propolis, bee venom and beeswax can be produced by bee keeper after adoption of beekeeping for generation of income and self employment among rural masses of the country.
- (ii) Utilization and harvesting of nectar and pollen of highly nectariferous plants: About 30 – 50 kg honey can be produced and harvested by one hectare highly nectariferous crop plants occupied area such as lahi (*Brassica campestris* var. toria), mustard, litchi, pigeon pea, sunflower, eucalyptus, anola, ber, jamun, drumstick, karanj, junglejalibi, mahua, shisam, siris, semal, palas, cucurbits, coriander etc. The natural floral reward i.e. nectar and pollen may be utilized for production of bee hive products as food source otherwise these produce may be wasted in nature.
- (iii) Enhancement of yield through bee pollination: If you are associated with growing crops in your field, beekeeping may give you dual benefit by enhancing crop production. The transference of pollen during floral visit is performed by worker bees and consequently stigma of flowers is pollinated by highly suitable highly feasible and acceptable pollen grains. Services of bees resulted in enhancement of yield and improvement of seed quality. About 20-25% yield is increased by bee pollination as compared to the natural pollination of the various crops.

(iv) Apitherapy for cure of diseases: Bee hive products are used as medicinal agent. These materials such as honey, royal jelly, propolis and bee venom can cure more than 50 human diseases. Few are mentioned below –

- (a) Honey : The honey consists of antimicrobial substances. It is useful for respiratory infection and is beneficial against heart diseases. It is also a rapid source of energy.
- (b) Royal Jelly : This bee hive product is anti- tumourous, antimicrobial and most nutritious substance, secreted by the young worker bees for feeding of queen and queen larva. It is used for the treatment of high blood pressure, arthritis and joint pain.
- (c) Propolis : It is beneficial for the treatment of skin diseases as antimicrobial agent, skin burns, joint pain, throat and dental diseases.
- (d) Bee venom : This is the poison that makes bee stings painful. Bee venom is used to make medicine for curing muscular diseases, arthritis and gout.

(v) Generation of income and self employment as natural agro-based cottage industry: The potential of generation of income per colony per year is about Rs. 3000 – 4000 annually through honey production and multiplication of bee colony. Only two trained man power is required for management of apiary of hundred bee colonies.

(vi) Beekeeping does not require farm land. Farmers with small land holding or even landless can adopt this and become self reliant.

(vii) It does not require heavy physical work. Even women and children can adopt it.

(viii) It encourages rural artisans to undertake the job of manufacturing equipments required for beekeeping.

(ix) It does not require heavy investment. Inputs are very low as raw material for production of honey is obtained free from nature so output to input ratio is very high.

(x) It provides proportionately more and immediate return than any other agro based profession

Honey bee products and marketing potential

(i) Honey:

- Honey is the natural sweet substance produced by honey bees from the nectar of blossoms, which honey bees collect, transform and combine with specific substances of their own, store and leave in the honey comb to ripen and mature.
- Bees normally take about 3-4 weeks for storing, ripening and sealing of honey in comb cells.
- The colour of honey varies from nearly colourless to dark brown. It also indicates quality, because honey becomes darker during storage or if it is heated.

(ii) Pollen:

- When bees visit flowers, pollen sticks to the fine feather-like hair which covers the body.
- Bees remove the pollen from the hairs using the pollen comb; a structure on the hind legs.
- Then she forms the pollen into small pellets with the pollen press, and sticks it into the pollen basket to carry it back to the hive.
- Pollen is stored in cells immediately surrounding the brood nest where it is readily available for feeding brood and for consumption by the nurse bees.

(iii) Beeswax:

- It is a complex mixture of organic compounds secreted by four pairs of special glands on the worker bee's abdomen. It is used for building wax comb. Beeswax can be secreted only at relatively high temperatures and after a large intake of honey or nectar.
- It is produced by 12 to 18 days old honey bees. A bee converts 15kg of honey into 1 kg of wax. It is used in medicine, confectionery items cosmetics and polish.



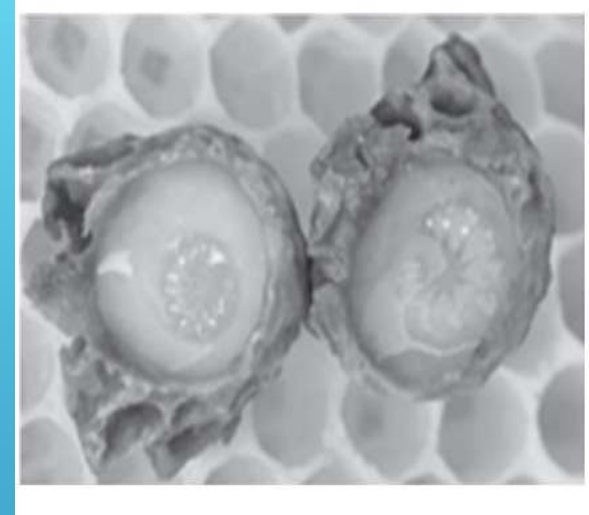
Fig. 1.1: Honey



Fig. 1.2: Beeswax cake

(iv) Royal Jelly:

- Royal jelly is the food produced by the young worker bees through glandular secretion.
- It is given to freshly hatched larvae.
- Royal jelly has many different components including proteins, sugars, fats minerals and vitamins.
- It contains many insect growth hormones and is valued as a medicine or tonic in various parts of the world.
- It reduces the aging process in human beings. The beekeepers remove the larvae and harvest the royal jelly for marketing.
- Royal jelly deteriorates quickly after harvest and must be kept frozen or freeze-dried during handling, storage, transport and marketing.



(v) Propolis:

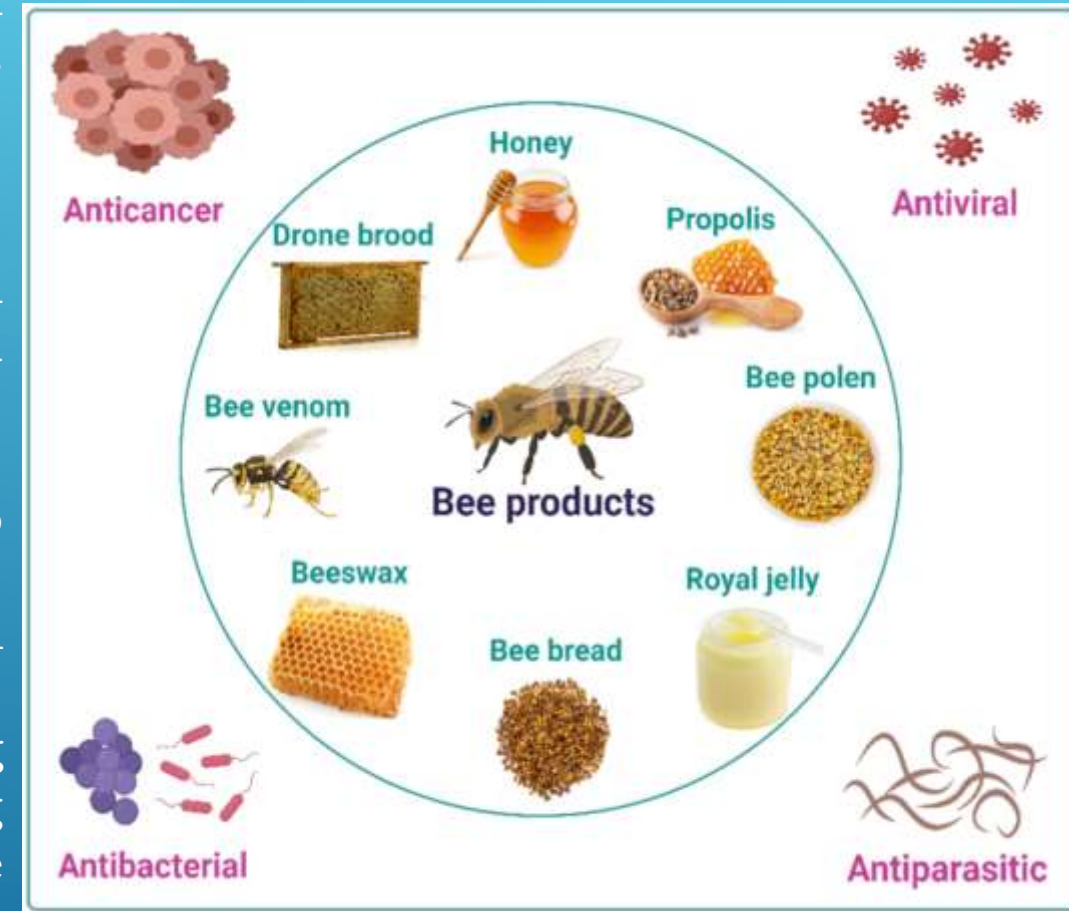
It is a gummy reddish brown substance gathered by the bees from resinous substance found on trees and buds of plants. It is also called 'bee glue' and is used to close small crevices in the hive. It is very sticky in warm weather and brittle in cold weather. Bees use propolis as building materials to decrease the size of nest entrances and to make the surface smooth for passing bee traffic and to varnish inside brood cells before a queen lays eggs in them, providing a strong, waterproof and hygienic unit for developing larvae. It is used as an antibiotic and helps in curing the crack feet in human beings. It is used as an ingredient in toothpaste, soaps and ointments.

(vi) Bee Venom:

It is present in the sting of honeybee and having medicinal value. Bee venom is clear, odourless, watery liquid having somewhat sharp and bitter taste and hydrolytic blend of proteins with basic pH. It is produced by venom glands associated with the sting apparatus of worker bees and used as a defensive agent against enemies specially predators. The worker bee injects the venom into the victim while stinging. A single worker has about 0.5 mg venom.

POTENTIAL MARKET OF HONEY

- Before initiating beekeeping it is important to understand the potential market of honey. The natural honey is in demand throughout the year, as it is extensively used in making Ayurvedic medicines, candies, wax candles, cosmetic products, etc.
- Direct or indirect marketing of honey can be done to (i) Individuals (ii) Local Vegetable Market (iii) Local Grocery Stores (iv) Cooperatives/Associations (v) Food markets/Supermarkets and (iv) Wholesale Dealers. Indian honey has a good export market.
- India has exported 29,578.52 MT of natural honey to the world for the worth of Rs. 535.07 crores every year. The major export destinations are United States, Saudi Arabia, United Arab Emirates, Libya and Morocco.
- With the use of modern collection, storage, beekeeping equipment, honey processing plants and bottling technologies the potential export market can be tapped.

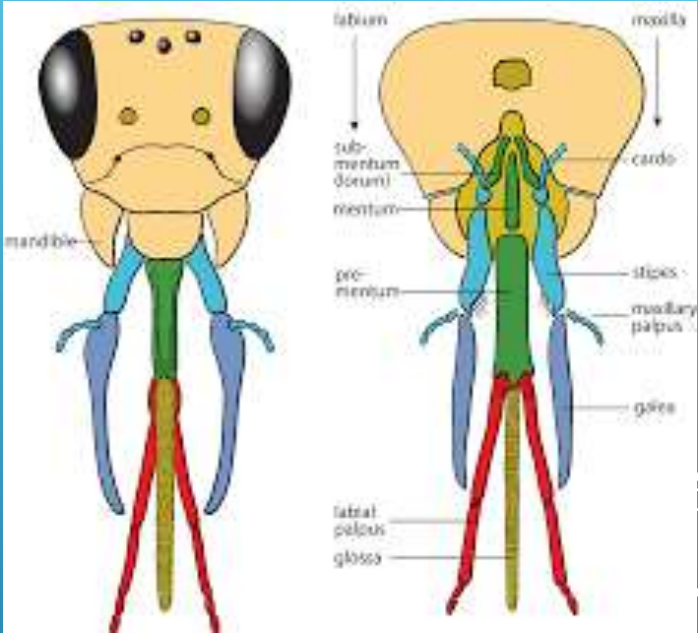
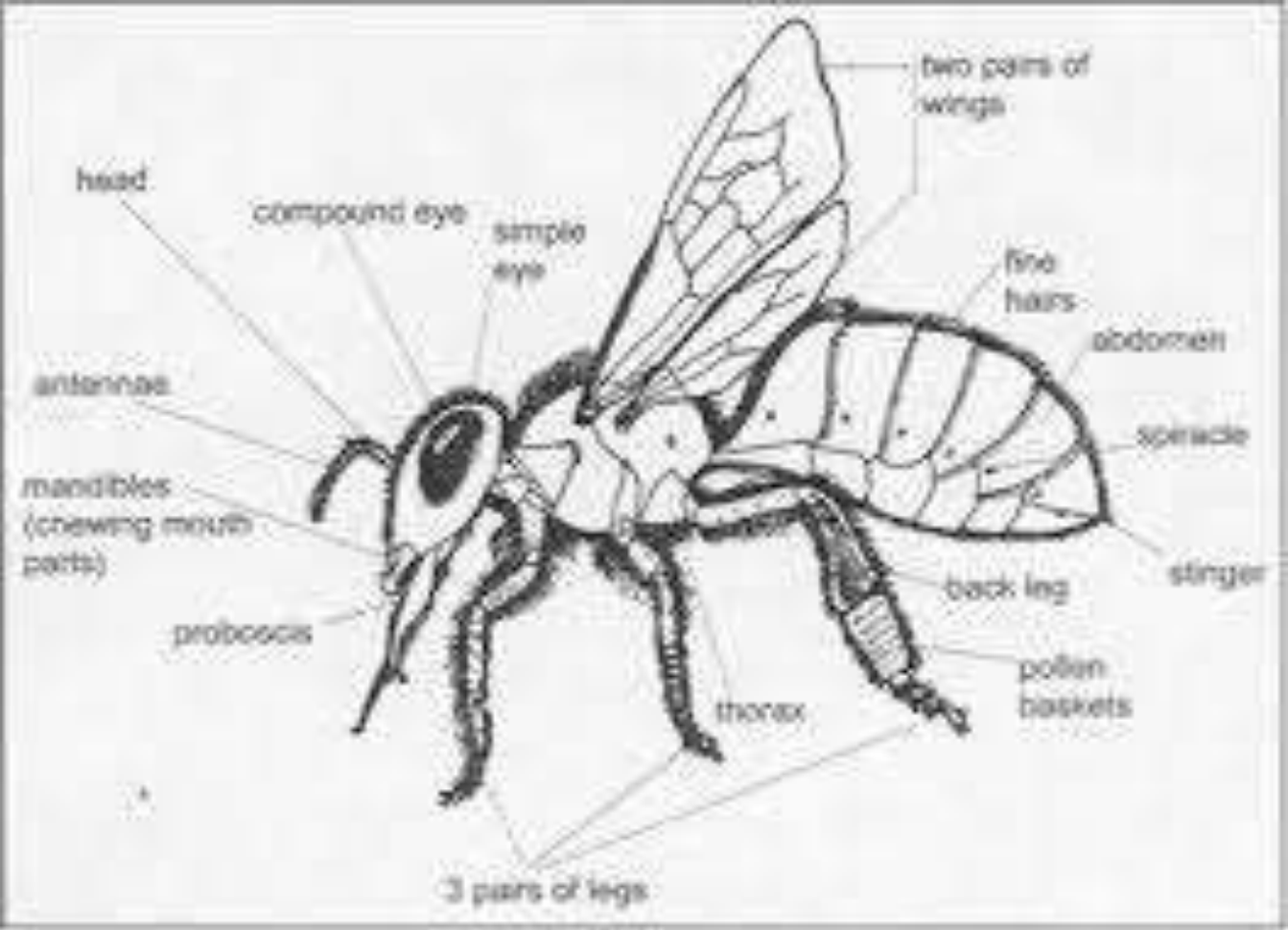


Honey bee species and its importance

- On our planet we count **8 honey bee species**.
- There are many types of bees and honey bees represent only a small fraction of the roughly **20,000 known species of bees**
- There are:
- -> **2 small honey bee species (Micrapis)** with single exposed combs: *Apis florea* and *Apis andreniformis*
- -> **2 large honey bee species (Megapis)** with single exposed combs: *Apis dorsata* and, *Apis laboriosa*
- -> **4 middle sized honey bee species (Apis)** nesting with multiple combs in cavities: *Apis mellifera*, *Apis cerana*, *Apis koshevnicovi*, *Apis nigrocincta*.



Bee Biology



1. Head

The head of worker bee is triangular, queen bee is triangular but a little roundish and that of drone is almost round (Fig.2.4). The head contains the antennae, eyes and mouth parts.

Antenna: The head contains a pair of antennae which serve as nose of the bee. The antennae's functions are to feel or touch, detect smell and to help balance the body during walking and fighting.

Eyes:

- The visual apparatus of the bee consists of a pair of compound eyes and three small simple eyes called the ocelli.
- The compound eyes can detect the shape and colour of objects, but not light intensity, and are used for distant sight. The simple eyes detect light intensity and are used for near sight.
- The compound eyes of drone bee are large, black, kidney shaped and unite with each other at the vertex, whereas in workers and queen bees, compound eyes are comparatively much smaller and do not meet at the vertex.

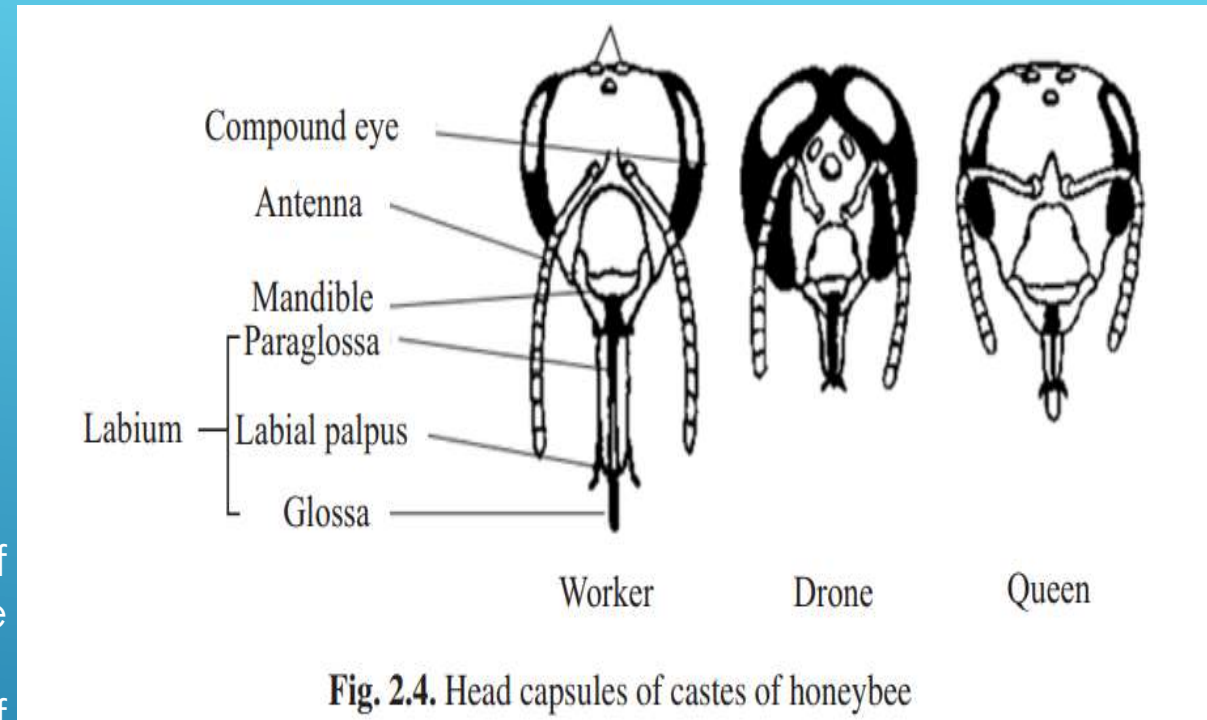


Fig. 2.4. Head capsules of castes of honeybee

Mouth parts:

- The mouth parts of honeybees are classified as the chewing and lapping type, meaning that they can manipulate solid material as well as lap up liquids.
- The mouth is composed of the proboscis, mandibles, labrum, and labium.
- The proboscis is a flexible tube used to suck up liquids (nectar, water, honey) into the mouth. The sickle shaped mandibles are like paired 'teeth' one on each side of the mouth.
- They are used to collect pollen and propolis, to soften and manipulate wax by chewing, to clean other bees, and to bite workers from other colonies or pests. The labium assists in chewing.
- The labrum is equivalent to the upper lip and supports the sucking process.

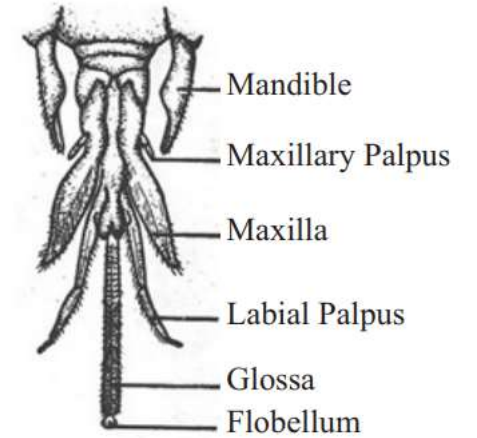


Fig. 2.5. Mouth parts of honeybee

2. Thorax

The thorax is the centre for locomotion and is composed of three segments namely prothorax, mesothorax and metathorax. Each segment bears one pair of legs. Both mesothorax and metathorax bears one pair of wings.

Legs:

The three pairs of legs are structurally and functionally modified to perform various functions. Each leg of honey bee comprises of usual six segments, viz. coxa, trochanter, femur, tibia, tarsus and pretarsus.

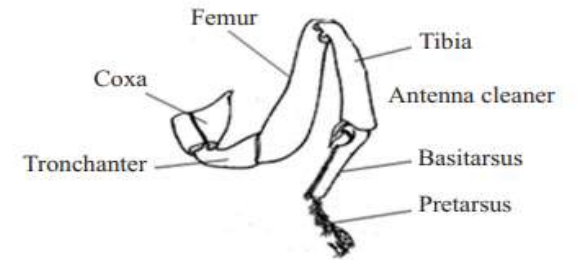


Fig. 2.6. Prothoracic/ Fore leg of honey bee (worker)

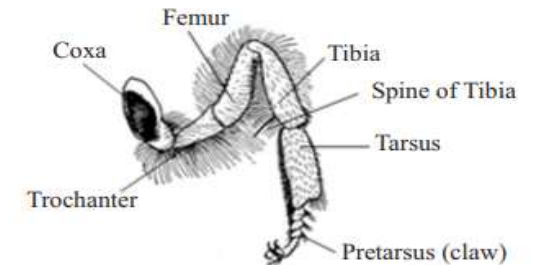


Fig.2.7. Mesothoracic/ Middle leg of honey bee (worker)

- Prothoracic or fore legs are used for antenna cleaning (Fig 2.6). Mesothoracic or middle legs (Fig. 2.7) are used mainly for removing wax scales and constructing comb.
- In worker bees, Metathoracic or hind legs (Fig. 2.8) are largest in size and concave outer surface of hind tibia is fringed with long curved hairs to form pollen basket or corbicula. They are used for collecting pollen grains.

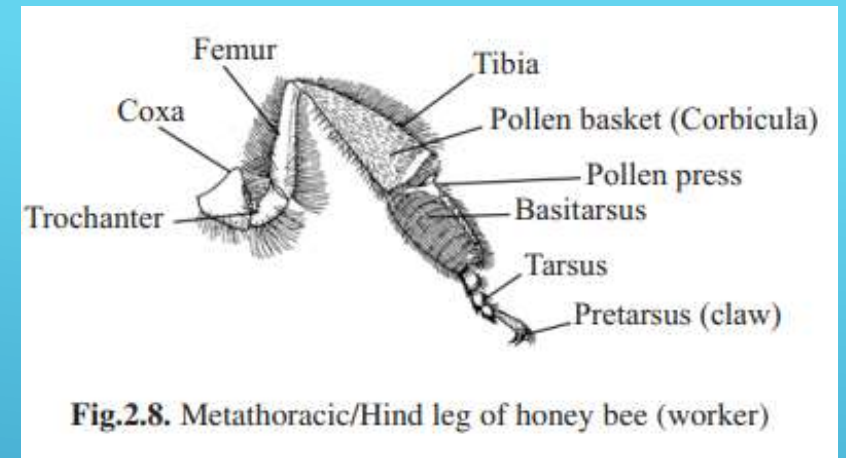


Fig.2.8. Metathoracic/Hind leg of honey bee (worker)

Wings:

- Two pair of wings are present on mesothoracic and metathoracic segments. During flight, two wings of each side get coupled with each other by means of hooks (hamuli) (Fig. 2.9).
- Forewings are larger than the hind wings. The wings of honey bee are generally transparent, except in case of the Giant/ rock bee (*Apis dorsata*) which has smoky wings.

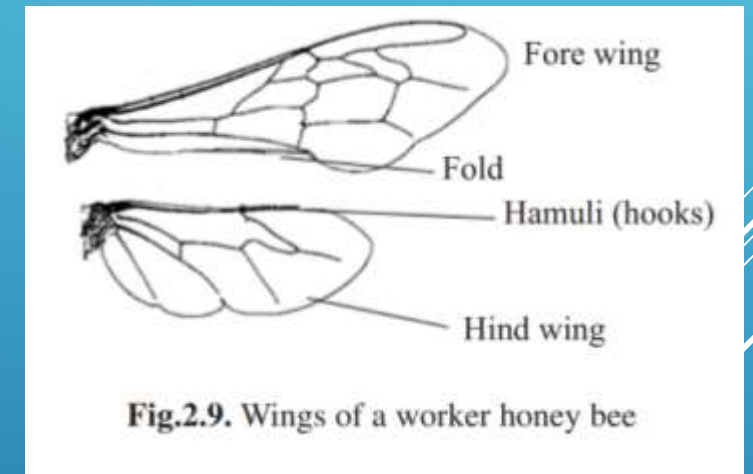








Fig.2.9. Wings of a worker honey bee

3. Abdomen

- The abdomen of adult worker and queen appears to be six segmented. Segment 8-10 are reduced in size whereas first abdominal segment is united with the metathorax.
- The abdomen bears sting, wax, scent glands and genitalia. The underside of 4th to 7th abdominal segments have one pair of wax glands each which secrete beeswax for comb construction.
- The bee sting is modified ovipositor and serves as an instrument of defence for worker bees and for killing rival queen bees by a queen bee.

Castes of Bees

Type of adult bee	What they do	How many in a honey bee colony	How many in a bumble bee colony	What they look like in a honey bee colony	What they look like in a bumble bee colony
Queen	Lay eggs	1	1		
Worker	Take care of larvae, build and clean nest, forage	10,000-50,000	Less than 50 to over 400, depending on species		
Male	Leave nest to mate, then die	100-500	0-50, depending on species and season		

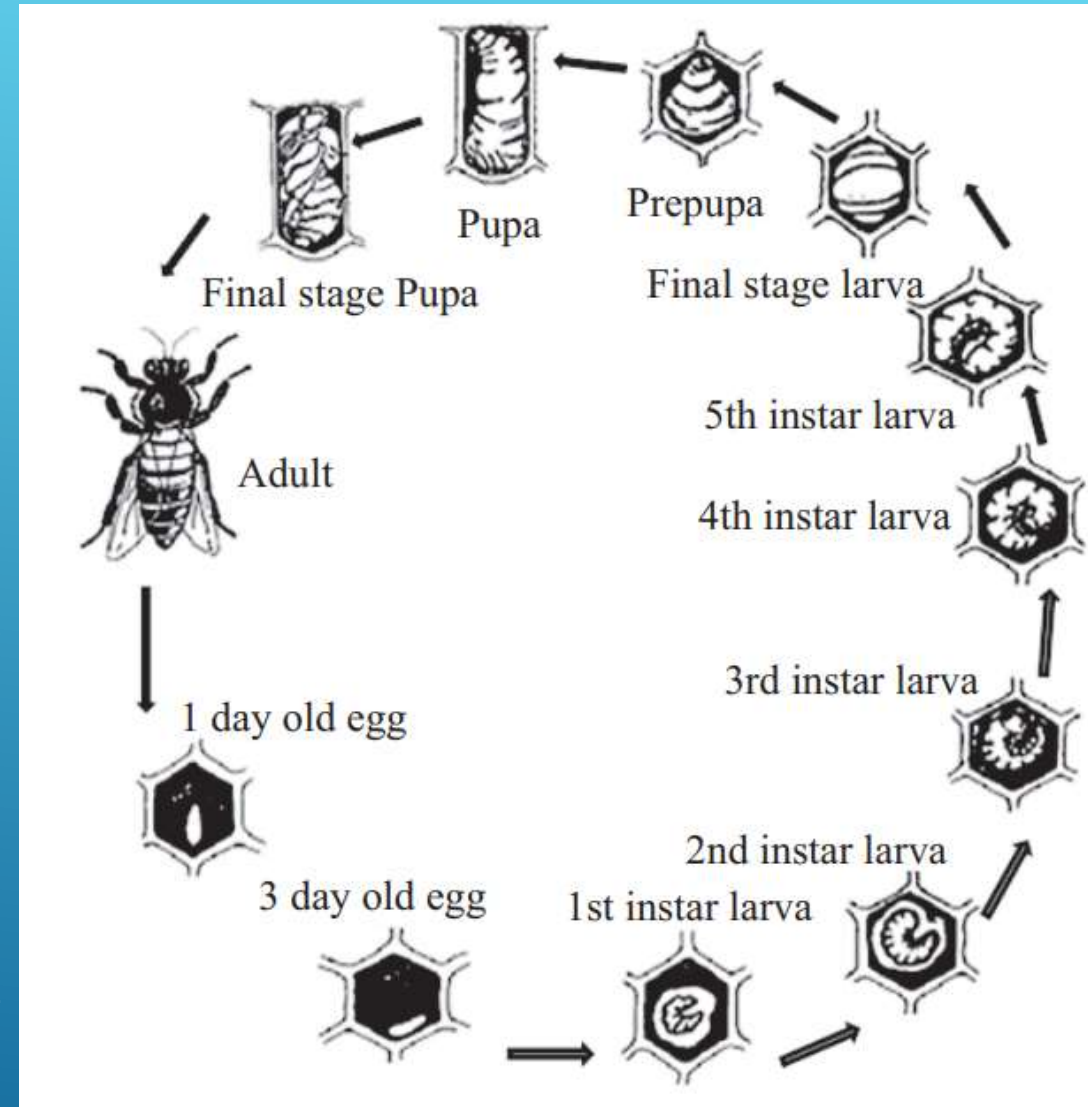
STAGES OF DEVELOPMENT IN HONEY BEES

(i) Egg

- Queen lays pearly white, slightly curved eggs in the cells singly and vertically with the thin end attached to the bottom of the cell.
- Queen bee lays both fertilized (giving rise to females i.e. worker or queen bee) and unfertilized eggs (giving rise to males i.e. drone bees).
- The egg stage lasts for 3 days. At the start, the egg stands vertically on the base of the cell, then slants, and finally lies flat on the base before hatching.

(ii) Larva

- Small, shiny white larvae hatch from the egg after 3 days.
- Initially the larvae are loop shaped lying on the bottom of the cell but towards cell capping, they get stretched on their back in the cell with head facing distal end of the cell. Larvae of all the castes moult four times.
- The average larval period is 5 days for a queen, 6 for a worker, and 7 for a drone. After the cell is sealed (at the end of 8th day) and the cocoon has been spun (at the end of 9th day) the larva passes gradually and without moulting into pre-pupa.



(iii) Pupa

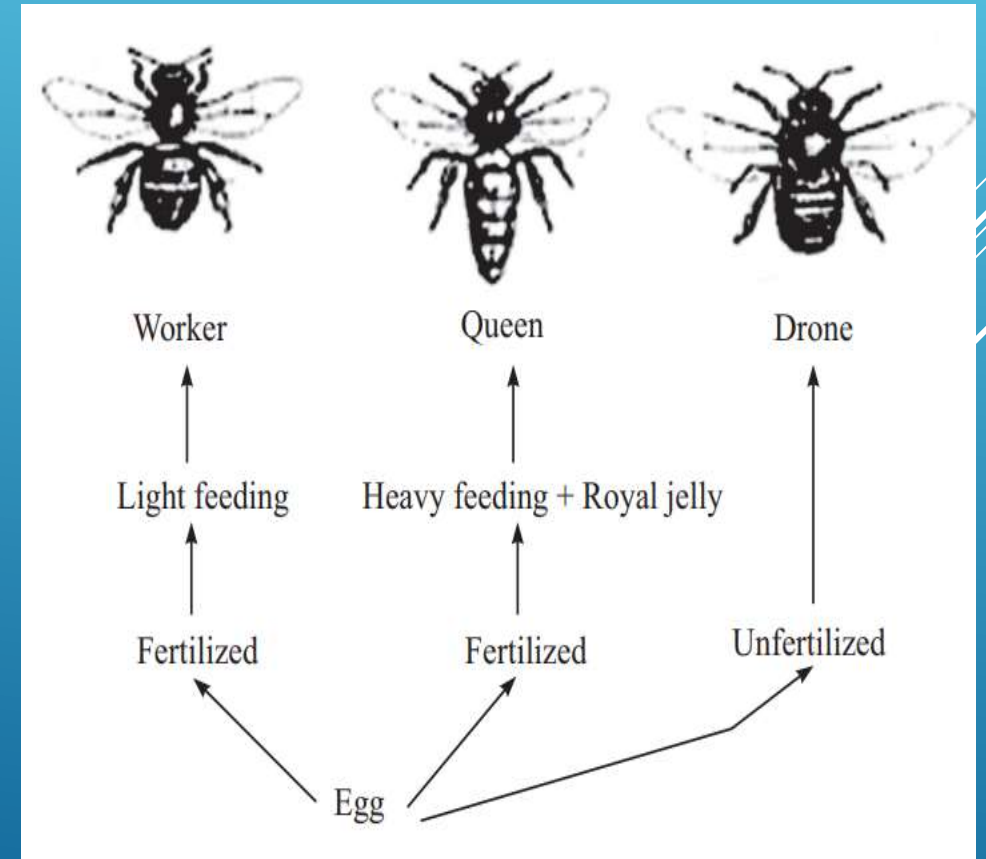
- The pupal stage is the dormant stage. Worker bees seal the cells with a porous beeswax cap and the larva spins a cocoon around itself.
- The developing bee remains inside the cocoon without eating or moving. The pupal stage lasts for 7–8 days for a queen, 11–12 days for a worker, and 14 days for a drone.
- Worker cells are a little smaller than drone cells. The comparative sizes are five worker cells per linear 25.4 mm of comb and four drone cells per linear 25.4 mm of comb in case of Italian bee.
- During this stage, the internal organs and body appendages develop. Finally the adult bees emerge.

(iv) Adult

- The adults emerge from the cocoon and bite a hole in the top of the sealed cell to come out.
- Immediately after emergence, the adult workers are a light colour, and then become darker.
- The total time taken to develop from egg to adult is 15–16 days for a queen, 20–21 days for a worker, and 24 days for a drone.

Sex Differentiation

- The queen lays two types of eggs: (i) Fertilized, and (ii) Unfertilized. The queen and workers comes out from the fertilized eggs, while the unfertilized eggs produce drones
- Royal jelly is prepared and fed to the larvae by the nurse bees. The queen larvae are fed only royal jelly. The queen gets the royal jelly throughout her life. Upto 3 days, all young stages of bees get protein rich food known as 'royal jelly'.
- Royal jelly is fed to the worker and drone larvae only for the first 3 days and then they are fed "bee bread".
- Thus, the worker do not get the royal jelly after three days of development and so develop into sterile (cannot reproduce) female.



Bee food plants

- The food of the bees comes from 'forage' or 'bee flora' i.e. the flowering plants which provide nectar and/ or pollen for bees. The worker bees that collect pollen, nectar, water and propolis for the colony are also called as 'forager'. Thus, foragers collect following substances for the colony:
 - (i) Nectar
 - (ii) Pollen
 - (iii) Propolis
 - (iv) Water
- Bees get carbohydrate from honey and proteins from pollen. Water is mixed with honey and pollen before bees eat it or feed it to the brood (egg, larvae & pupa).
- Bees visit flowers and extra- floral nectarines of about 500 flowering plants and trees to collect pollen and nectar for food. Some of the commonly visited by bees in India for collecting nectar from the flowers are as follows:
 1. Vegetables: Okra, Cucumer, brinjal, tomato, bottle gourd, spinach, cauliflower, turnip, sweet gourd, onion, radish
 2. Field crops: Mustard or toria, sunflower, cotton, jute, pulse, wheat, gram
 3. Fruit plants: Litchi, apple, guava, jamun, imli, papaya, karonda, ber, jackfruit, anar, lemon, bel, mango, banana, papaya, drum stick, citrus, pear, apricot, malta, mausami, orange
 4. Ornamental plants: Marigold, rose, cosmos
 5. Trees: Eucalyptus, acacia, albizia, calliandra, gemelina, prosopis, babool, neem, arjun, palm, sandal wood, dhak, bottle brush, amaltas
 6. Herbs and spices: Tulsi, coriander
 7. Plantation crops: Rubber, coconut, cashewnut, coffee

Communication among bees

They communicate with each other and pass their information using various pheromones. However, worker bees communicate information through their peculiar 'dance'.

(a) Round dance:

- It is used to indicate a short distance of food source. The bee runs in circles, first in one direction and then in opposite direction (clockwise and anticlockwise).
- For example. If the source of the food is less than 100m away, then the bees perform 'round dance' making small circles.
- The number of circles formed by them indicates the distance of beehive from the food source. Workers dance vigorously, if the quantity of food is more and of superior quality.
- If the food is inferior and the quality is less, then the dance is slow and shorter.

(b) Tail wagging dance or Wag-tail dance:

- This is used to indicate long distance of food source (more than 100m).
- Here the bee makes two half circles in opposite directions with a straight run in between.
- During the straight run, the bee shakes (wags) its abdomen from side to side, the number of wags per unit time inversely proportional to the distance of the food (more the wags, less the distance).

