Practical 4

COLONY ORGANIZATION, DIVISION OF LABOUR AND LIFE CYCLE

Aim: 1) To observe organization of a honey bee colony and become familiar with their duties.

2) To become familiar with developmental stages and life cycle of different castes of honey bees.

Colony organization and division of labour

Honey bees are social insects and live in colonies. A normal colony, during active season is composed of 3 kinds of individuals: one queen, thousands of workers (10000 to 30000 or even more) and few hundreds of drones, which vary in size. In addition, each colony has different developmental stages viz eggs, larvae and pupae which are collectively known as brood.

Queen:

- Only one queen is found in a colony except under supersedure or swarming instinct
- She is the mother of the whole colony producing workers and drones and is the only perfectly developed female member of the colony
- Her function is to lay eggs. She does not have motherly instinct or ability to feed the brood. She is fed lavishly by a large number of nurse bees with highly nutritious food known as royal jelly
- A good queen can lay 1500-2000 eggs per day
- A laying queen is the longest bee in the colony. It has larger thorax than worker and her abdomen gets greatly distended during egg laying
- The queen lays both fertilized and unfertilized eggs. Fertilized eggs produce workers (also queens) and unfertilized eggs produce drones (Figure 4.1)

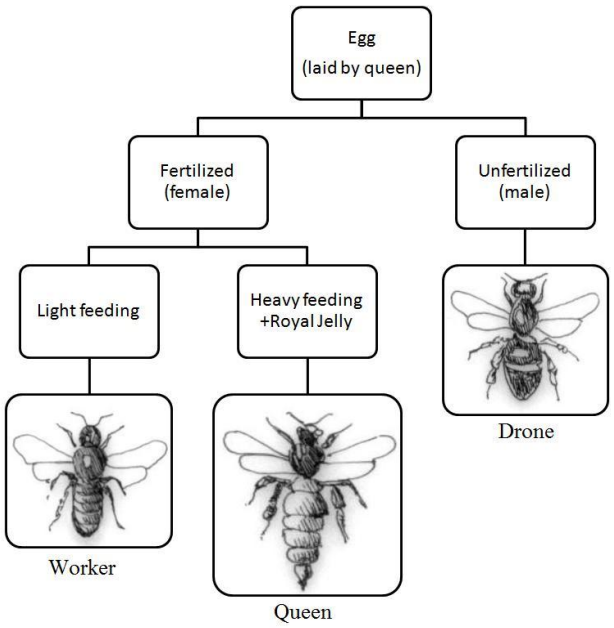

Figure 4.1 Development of different castes of honey bees based on quality and quantity of food and whether fertilized or unfertilized (After Winston)

- A good mated queen may work satisfactorily for 2 or more years, although queens can live eight years or longer. However, in commercial beekeeping, queen is replaced every year to keep high brood rearing in a colony.

- Queen releases queen substance (pheromone) which helps in the colony organization. It acts as worker attractant and inhibits ovary development in worker bees as well as raising new queen. Absence of queen pheromone is detected after about 30 minutes of queen loss and colony may start raising new queen. The pheromones in queen substance stimulate brood rearing, comb building, hoarding and foraging in a colony and thus play important role in normal working of a colony.
- The virgin queen mates with a number of drones (5-7) within 5-10 days of emergence in the air (not inside the hive) and spermatozoa are stored in spermatheca. Stored sperms are utilized to fertilize eggs throughout her life till exhausted.

Worker:-

- Workers are imperfect females. They are unable to mate though they may start egg laying if a colony remains queen less for long period
- The workers perform all the useful work in the colony
- **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, construct the combs, collect the nectar and convert it into honey (Fig. 4.3), collection of pollen, water and propolis, produce a predigested food of royal jelly for feeding queens and young larvae and scouting for a new nest site during swarming. The workers also feed the drones but when not needed, they are thrown out of hive.

- **The duties are related to the age of the worker:**

Age of Worker Bee	Duties performed
a) Till 3rd day of emergence	Maintain wax cells in sanitary state, cleaning their walls and floors after the emergence of young bees.
b) From 4th-6th day of emergence	Feed older larvae with mixture of honey and pollen and making flights around the hive for getting layout of the hive, (play flights or orientation flights)?
c) From 7th-11th day of emergence	Hypopharyngeal glands (food glands) get developed and start secreting royal jelly and feed younger larvae.
d) From 12th to 18th day	The bees develop wax glands and work on building of comb, construction of cells etc., Receive the nectar, pollen, water, propolis etc., from field gatherers and deposit in the comb cells and help in keeping the brood warm.
e) From 19th day onwards	The worker bees take the duty of field i.e. exploring or foraging for nectar and pollen; collecting water and propolis.

Worker bees release alarm pheromone on stinging from lining of sting chamber and it assists in defense of the colony by alerting other colony members of the threat.

- A worker has an average life of only 40-50 days during honey flow season (active period) and her life may extend up to 6 months during off season.
- **Laying workers**: Under queenless conditions for a long duration, ovaries of some of the workers start developing and they can lay even eggs but since these are unfertilized, give rise to only drones. The eggs laid by the laying workers have haphazard pattern and many eggs are laid in each cell of the comb. The colonies with laying workers ultimately perish. *A. mellifera capensis* is the exception where even from the eggs of laying workers queen and workers are raised by the bees.

Drone:

- Drones neither perform any duty inside the hive nor do they collect food from flowers. Each drone is fed by 3 to 4 worker bees. A colony rears and tolerates the drones only during breeding season when new queens are being produced and are later driven out of the colony to die of starvation. The sole function of a drone is to mate once which costs him his life. Maximum life of drone honey bee in summer is 59 days.

Life cycle: Queen deposits egg at the base of cell and fastens with mucilaginous secretion. After 3 days egg hatches and workers provide pearly white food in which "C" shaped larva floats. Cell is sealed when larva is fully grown. In the sealed cell it turns into pupa from which adult emerges. Larva sheds skin five times during development. The sealed cells containing worker and drone brood and honey can be differentiated on the basis of appearance.

Development: The developmental stages of honey bees are: egg, larva, pupa and the adult.
Duration of life stages of different castes of honey bee varies which is given in the table and presented through Fig 4.2 below:

Caste	Egg period (days)		Larval Stage(days)		Pupal Stage (days)		Total (days)	
	A. cerana	*A. mellifera*	*A. cerana*	*A. mellifera*	*A. cerana*	*A. mellifera*	*A. cerana*	*A. mellifera*
Queen	3	3	5	5	7-8	8	15-16	16
Worker	3	3	4-5	5	11-12	12-13	18-20	21
Drone	3	3	7	7	14	14	24	24

In a comb, workers rear brood in the central part where temperature can easily be maintained and honey is stored in the upper and peripheral part. Pollen is stored around brood area so that it is easily available for rearing brood. Drone brood area can be differentiated from worker brood as the sealed brood cells in the former case are raised.

Practical things to do:

i. Check a bee colony and note variations in the size and shape of a worker, drone and queen. Draw well labelled diagrams.
ii. Note the workers performing different duties inside the colony and record what you have seen.
iii. Check a brood frame containing brood and honey and differentiate between: sealed brood and sealed honey; sealed worker and drone brood if present. Draw a diagram of brood frame to show position of brood, honey and pollen.
iv. Observe egg laying pattern of a good queen (eggs at the base of cell)
v. Follow a returning forager and observe its activities in side a colony in an observation hive.