APPLIED ENTOMOLOGY

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BIOLOGY, LIFE CYCLE, ECONOMIC IMPORTANCE OF HONEY BEE (*APIS INDICA*)

HONEY BEE

- Honey bee is one of the most important productive insect.
- Honey and honey bee species were well known in ancient India.
- Honey bees are the most important beneficial insects to man. The nutritious honey, the valuable wax and the bee venom are the chief pollinators.
- The systematic position of honey bees is given below.

Class : Insecta
Division : Endopterygota
Order : Hymenoptera
Super Family : Apoidea
Family : Apoidea

- Fameily Apididea is further divided into two sub families. They are,

Sub Family 1. Apinae
Sub Family 2. Meliponinae

HONEY BEE - KINDS

- There are four species of honey bees in India. In world wide there are eight species of honey bees. Of all the bees, the Italian or the European honey bee *Apis mellifera* is well known for its high yield of honey. In bee keeping or in apiculture, this Italian species is widely used. The important species of honey bees are,

a. Apis dorsata - The rock bee
b. Apis cerena indica - The Indian bee
c. Apis florea - The little bee
d. Apis mellifera - The Italian bee
e. Melipona irridipennis - Stingless bee

- In India, two species, *Apis cerena indica*, *Apis mellifera* are widely used in bee keeping.

a.
b.

APIS DORSATA

- ***Apis dorsata*,** the giant rock bees are found in the mountains, hills and sometimes in the plains.
- It builds its nests on branches of trees, in the high buildings, crevices of rocks etc.
- The comb is very large and yields about 38 kg of honey annually.
- Tribal populations in several parts of the country harvest honey and bee wax from rock bee colonies.
- The size of the queen is equal to other colony members.
- The size of the colony of rockbee may exceed 1,25,000.

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APIS INDICA

- ***Apis cerena indica,*** the Indian bees are smaller in size than ***A. dorsata.***
- It is also called as Asian bees.
- There are4 subspecies of the Apis - *Apis cerana cerana*, *Apis cerana indica, Apis cerana japonica* and *Apis cerana himalaya.*
- The bees are dark gray in colour and build their nests inside the hollow trunk, rock bamboo etc.
- This species is reared in South Indian apiaries.
- The average yield of honey is 40 - 42 kg per year.
- It is medium sized bee.
- It is commercially reared in India particularly in south India.
- The queen may deposit 350 - 100 eggs per day during breeding seasons.

APIS FLOREA

- ***Apis florea*,** the little bees are similar in their structure like that of **A.indica,** but smaller in size.
- It is the smallest species of all bees.
- It generally builds its nests in hollow trees bushes, crevices etc.
- The maximum annual yield is about 0.5 to 1.0 kg per year.
- It is seen only in plants.
- It is not commercially important bee.

MELOPONA IRRIDIPENNIS

- ***Melipona irridipennis,*** the dammer or the stingless bees are found constructing their nests in crevices, hollow trunks and so on.
- It is tiny with a vestigeal sting.
- The nest is constructed with earth, resin and wax**.**
- The comb is made of a dark material called derumen which is a mixture of wax and earth or resin.
- It is a very poor honey gatherer and yields only 60 to 180 ml per year.

APIS MELLIFERA

- ***Apis mellifora*,** the Italian bees, reared in Europe and U.S.A, Middle East and africa.
- It has several subspecies.
- It shows a very high annual yield of 50 - 180 kg per year.
- In India the species was introduced in the apiaries of Kashmir and Punjab.
- This species is introduced in India during 1960s and at present is being reared in Jammu Kashmir, Punjab, Haryana, Himachal Pradesh, Utter pradesh, Bihar and West Bengal.
- By nature, it is similar to Indian bee but the queen is more prolific, sarms less and has good honey gathering qualities.
- Because of its advantages, it is slowly replacing the Indian bee in apiaries.

BIOLOGY OF HONEY BEE

- The morphology and the internal anatomy of Apis indica are well studied. The body consists of the head, thorax and the abdomen. The head is triangular in shape with a pair of large compound eyes.
- The antenna is geniculate having a large scope, a small pedicel and ten flagellar segments (in the male 11 flagella segments). The mouth parts are of **chewing** and **lapping type**.
- The chewing and lapping type of mouth parts are adapted for licking the nectar from the flowers and also for collecting pollens.
- **Labrum** is semicircular in shape and is attached with the ciripeus.
- **Mandibles** are flattened spoon-shaped and used for comb building and scraping the pollen**s.**
- **Maxillae** are paired and in each maxilla the lacinia is very much reduced or absent. The galea is large bladde - like and larger than the stipes. The labial palps are very much reduced.

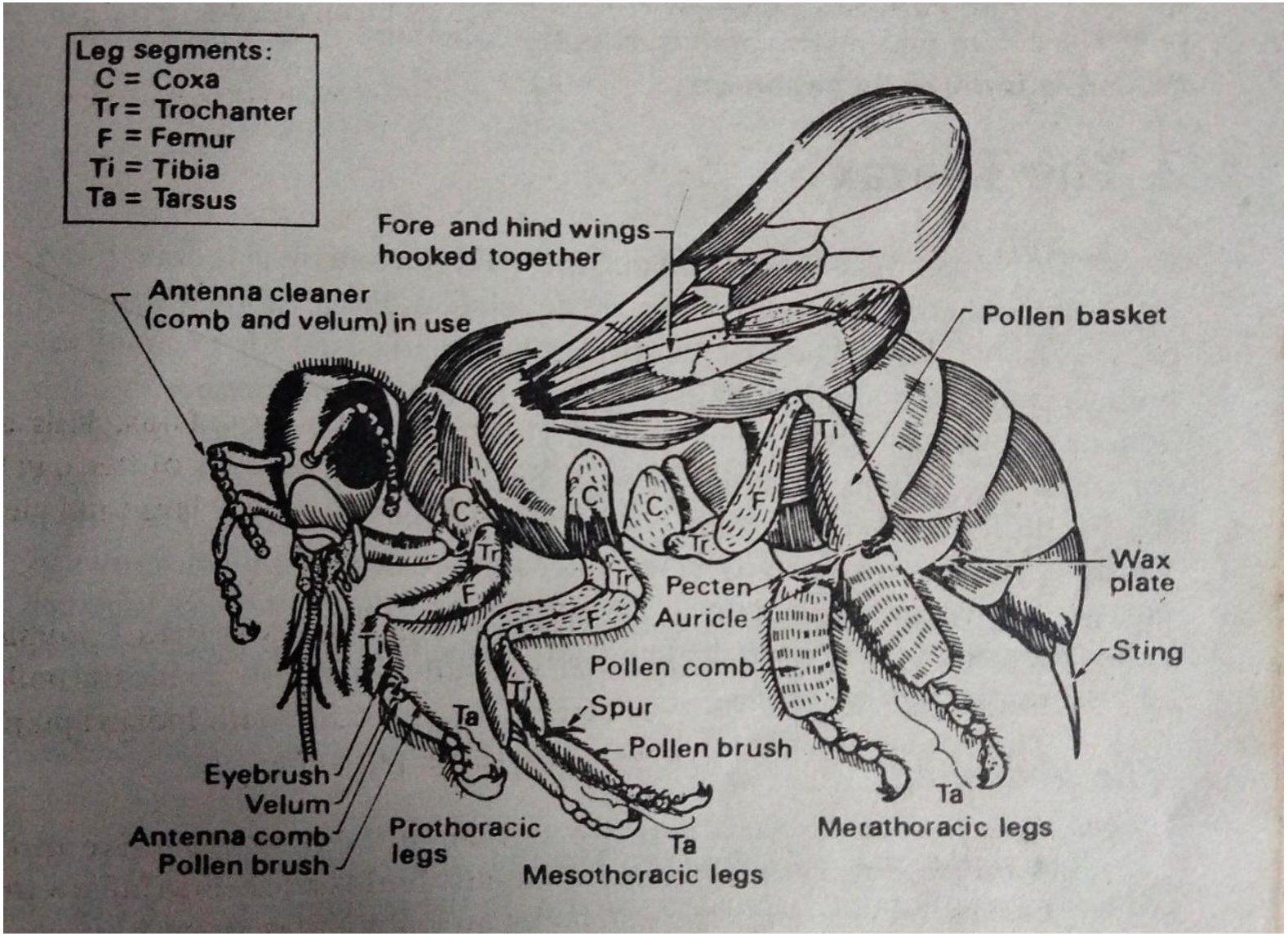
LABIUM

- **Labium** or the lower lip consists of the usual structures. The submentum is attached to the base of the mentum.
- Mentum is triangular in shape.
- The prementum is large.
- The labial palps are long consists of four segments.
- Paraglossae are very small while the glossae are modified as a long proboscis.
- The end of the proboscis is the labellum.
- The liquid food is sucked in through the proboscis.

THE THORAX

- The thorax consists of prothorax, mesothorax and metathorax.
- From meso and meta thorax paired wings are developed. Each thoracic segment consists of two legs.
- The first pair of legs have hairs used for cleaning the pollens from the body. In the first leg there is an **antenna cleaner** through which the antenna is drawn and cleaned, collecting pollens from the flowers. Each third leg of the honey bees has the pollen basket.
- The third pair of legs are modified for **pollen basket** the pollen basket and the pollen combs.
- The pollen basket consists of a concavity in the outer surface of the tibia with rows of curved bristle, along the edges.
- The auricle and the pectan are together called the pollen packer. On the inner side of the first tarsus there are rows of bristles, the **pollen combs**.

MORPHOLOGY OF A WORKER HONEY BEE



THE ABDOMEN

- The abdomen has 9 segments. The first abdominal segment is fused with the metathorax to form propodeum.
- In the segments 4-7 a pair of wax glands are found. The wax glands secrete the fluid secretion which hardens and deposits on the surface of the wax plates.
- The wax plates are the oval polished areas found just below the wax glands. The workers collect the wax from the wax plates and construct the combs.
- In the last segment of the abdomen of the workers a pointed sting is found. A poison gland lies in the 7^{th} segment.
- It is the modified accessory gland of the reproductive organs. The poison gland is an organ of defence.

MEMBERS OF BEE COLONY

- All species of honey bees are social insects.
- They live in a colony consists of different types of members.
- Each colony contains about 30,000 to 50,000 members developed from one mother, the queen.
- Each type or caste has certain specific functions, showing the phenomenon the **division of labour.**
- All the members of the colony belong to the same species.
- Thus the honey bees exhibit the phenomenon, polymorphism also.
- The different members of the bee colony are as follows.

THE QUEEN

- It is the mother of all the members of the colony. Each colony has only one queen and found among the other members in the brood chambers.
- The queen is larger than the drones and workers, but the head is smaller. Wax glands and the sting are absent.
- The queen is developed from the fertilized egg in the queen cell. On the third day the white grub is developed.
- The workers continuously feeds the grub with the royal jelly. It is composed of pollen, honey and the secretion from the pharyngeal glands
- The grub stage is only for 5-6 days. After 7^{th} day it becomes a pupa and the pupal period is for about a week. Finally the queen emerges out.
- The young queen with a few hundreds of drones leave the colony. This is known as the **nuptial flight.** During the flight**,** it mates with one of the drones.
- The mated queen returns to the hive and does not leave the colony for a long time. The sperms are stored in the spermatheca and when the eggs are liberated they may be fertilized or not.

THE WORKERS

- The workers are the sterile females which are smaller in size. Their number in the colony
- is highest. They are active and performing the following functions.
- They build the bee hives from the wax secretion of their abdomen.
- The workers feed the queen and the young ones.
- They collect the pollen and nectar from the flowers.
- The workers keep the bee hive clean by throwing out the debris, dead bees, excreta etc.
- They also defend the colony against the intruders or enemies. Hence they are provided with sting.
- In the absence of the queen they lay unfertilized eggs which develop into the drones.

THE DRONES

- The drones are the fertile males developed from unfertilized eggs.
- They are bigger in size compared to workers.
- Their number is very smaller than the workers.
- The drones are passive and always remain inside the hive.
- Their only work is to mate with the female, the queen.
- During the nectar flow season their number is raised, and are driven out by the workers during the death period.

MEMBERS OF HONEY BEE

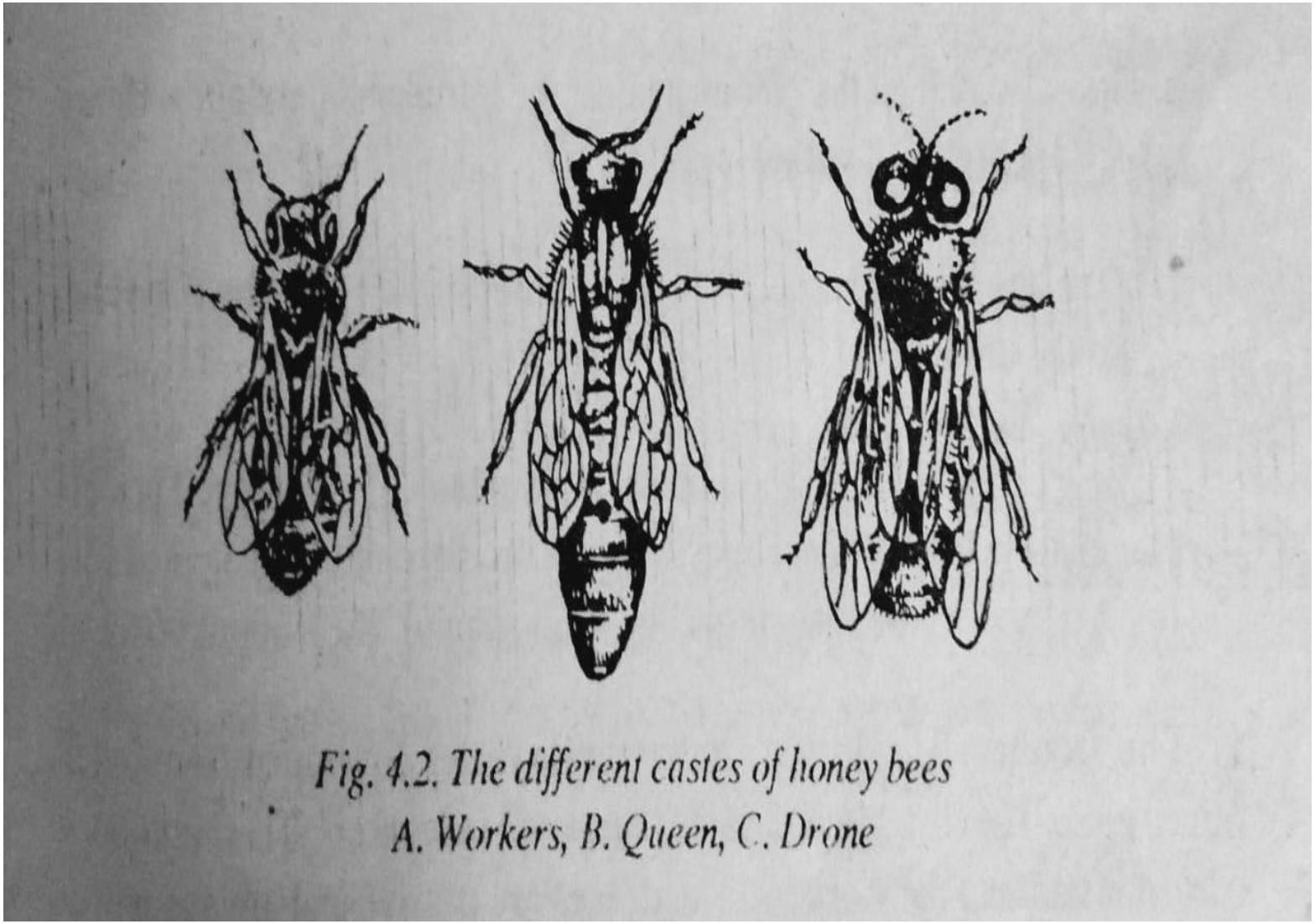


Fig. 4.2. The different castes of honey bees
A. Workers, B. Queen, C. Drone

HONEY BEE - LIFE CYCLE

- Mating takes place in air during Nuptial flight.
- A queen may mated twice, thrice, or up to five times during successive flights.
- The drones after mating fall dead and the queen returns to the hive .
- The spermatozoa received by the queen at one mating wil be sufficient to last the entire life of the queen.
- The queen lays eggs at the rate of about 500 a day and deposits the fertilized eggs in small cells in the comb which develop into workers.
- Each egg is pinkish, elongated and cylindrical and attached to the bottom of the cell
- The eggs hatch into small grubs after 2-3 days. All the grubs are feed by royal jelly by workers for 2-3 days. The queen bee feed by 5 or more days.
- After feeding the brood cells are sealed and the grubs undergo pupation.
- Before pupation, the last instar grub spins a thin silken cocoon in which it pupates.

LIFE CYCLE OF HONEY BEE

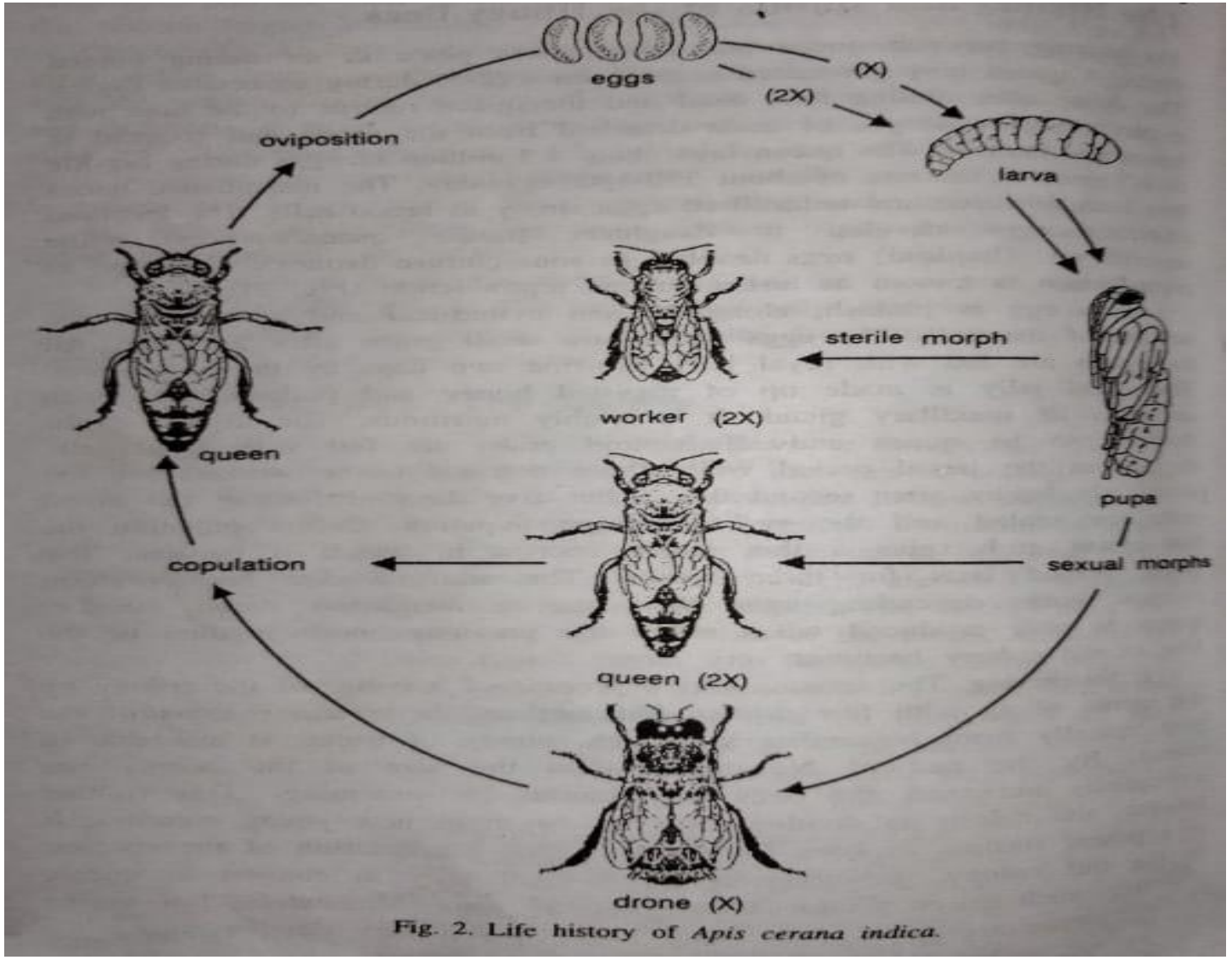


Fig. 2. Life history of *Apis cerana indica*.

ECONOMIC IMPORTANCE OF HONEY BEES – POLLINATION

- Primarily honey bees are the agents of cross pollination in plants. The honey bees are very busy in collecting pollens, nectar and propolis from the flowers.
- Such activities of honey bees are together known as **foraging.** When honey bees collect pollens from the flowers, they get smeared all over their body surface.
- When they visit to collect the nectar and pollens in other flowers, the pollens fall on the stigma and thus cross pollination takes place.
- The honey bees are thus the best pollinating agents and the flowers which are pollinated by the insects are called **entomophilous flowers**.
- Cross pollination results in healthy and viable varieties.

HONEY

- The honey produced by the honey bees contains rich proteins and minerals.
- It also contains high energy yielding substances and hence considered as a best food for the new born.
- Honey can be mixed with milk and other food substances to the old and ailing people. Generally honey has high nutritious substances.
- It is used as a carrier in many Ayurvedic and Unani medicines.
- Honey has certain medicinal values.
- It is a blood purifier and a laxative, stomach and the intestinal ulcers can be cured by taking honey every day.
- Sore throat and cough are cured by honey.
- It does not produce acidosis.

BEE WAX

- Bee wax is an yellowish solid with an aroma resembling that of honey.
- Bee wax is an important by-product of the bee keeping industry.
- It is produced from old combs, cappings collected after hoiney extraction and combs affected by wax moth.
- Bee wax is collected from the hives and it is a by-product.
- Cosmetics like cream, face lotion, boot polishes etc are produced from the bee wax.
- The giant bee *Apis dorsata* provides almost all the bee wax avilable in the markets.
- It is used in the manufacture of very many items of cosmetics like beauty lotions and creams, lipsticks, ointments, shoe polishes, floor and furnitures, lubricants, paints and varnishes, inks and candles.

PROPOLIS

- Honey bees gather the sap or resin from tree bark and leaves and combine it with nectar, their own enzymes and create propolis or bee glue.
- Honey bees use this substance to seal their hives, protecting it from outside contaminates.
- It is comprised of 50-70% resins and balsams, 30-50% was, 5-10% bee pollen and 10% essential oils.
- Except vitamin K, it has all the known vitamins.
- Propolis is an excellent natural antibiotics and immune system boosters.
- It offers antibacterial, antifungal, anti-inflammatory and antioxidant.
- It is commercially available in the forms of tincture, throat spray, chewing gums and soothing creams.

BIOLOGY, LIFE CYCLE, ECONOMIC IMPORTANCE OF SILKWORM (*BOMBYX MORI*)

SERICULTURE

- Silk is a valuable natural protein fibre produced by certain insects particularly, the moths belong to the insect Order Lepidoptera.
- Commercially there are four important species of moths. They are,

  Mulberry silkworm *Bombyxmori meridionalis* , feeds on mulberry leaves.

  Eric silkworm *Philosamia ricini*, feeds on castor leaves.

  Tasar silkworm *Anthereae paphia*, feedson *Shorea robusta.*

  Muga silkworm Antheraea assamensis, feeds on Som and Soalu.
- Mulberry silkworm belongs to the family **Bombycidae**, where as the non-mulberry silkworms such as eri, Tasa and Muga belong to the family S**aturniiae.**
- The silkworms yield th emuch valued silk. Apart from the silk, the chrysalids obtained from the dried cacoons are rich in protein, hence are used as fertilizers. The fatty matter is also used in soap manufacture.

BIOLOGY OF SILK WORM - *BOMBYX MORI*

- The rearing of silk worms to produced the raw silk is termed **sericulture.** Sericulture is a major cottage industry in the states mentioned above.
- ***Bombyxmori meridionalis*** (the Mulberry silk warm) is the common species cultured to produce the cocoon from which the silk thread is reeled.
- The adult silk moth is sluggish and measuring about 2.5cm long. After emerging from the cocoon the adult live for about three days only.
- After mating the female lays 300-400 eggs which are seed-like and brownish white in colour. The eggs are also laid in masses. The eggs are also laid in masses. The eggs are hatched in 8-12 days. The just hatched caterpillars are 3mm long and are dark in colour.
- The larval stage lasts for about 28-30 days. During the larval stage the caterpillar moult four times. The fully grown caterpillar is yellowish white in colour growing to the length of 5 cm.
- The oval cocoon is thus formed within the two days. Pupation takes place inside the cocoon. The whole life cycle takes place within 506 days.

LIFE CYCLE OF *BOMBYX MORI*

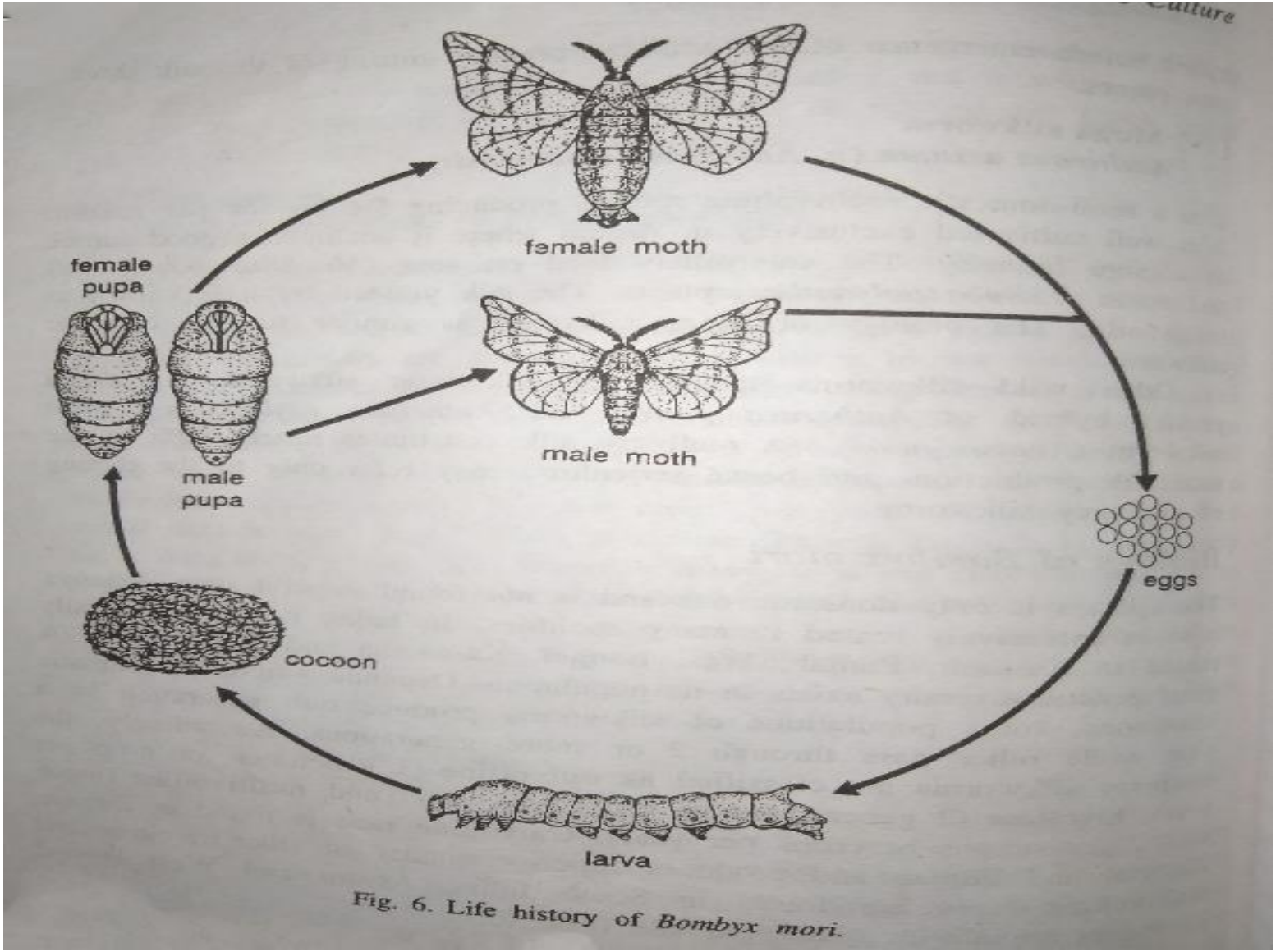


Fig. 6. Life history of *Bombyx mori*.

MORICULTURE

- The mulberry silk worm feeds on the leaves of the mulberry leaves. The cultivation of mulberry plants for rearing the silk worms is known as moriculture.
- The fertilized eggs are available from the grainage (Where eggs are produced). The eggs must be disease free. The eggs are incubated under the optimum temperature of 25-30 degree. The humidity must be in between 70 and 80%.
- The hatched out larvae are transferred to bamboo trays in which the paddy husk is spread and the chapped mulberry leaves are kept. The leaves are changed every 3 hours, for first three days.
- From 4^{th} day caterpillars can fed with full leaves. The caterpillars are voracious feeders and the consumption of leaves increase corresponding with the age. The unused leaves and the excreta must be removed periodically. This process is known as cleaning.
- The cylindrical caterpillar has a small anal horn in the last segment. It has three pairs of true legs 5 pairs of false legs in the abdominal segments.

SILK GLAND

- In the silk worm a pair of salivary glands is situated in the lateroventral side of the alimentary canal. It is about 20-25cm in each gland anterior narrow duct, the middle enlarged part and the posterior narrow part are found.
- The two anterior ducts unite with each other to form a short common duct. The common duct opens at the apex of a media cylindrical structure, the spinnert**.** The spinnert opens on the anterior margin of the labium.
- Besides, in the common duct paired Fillipis of Lyonets gland, an accessory structure is also found.
- The caterpillars are actively feeding on the mulberry leaves. They have cutting and chewing type of mouth parts in which the mandibles are well developed.
- At the time of cocoon formation, the caterpillar sluggish and stops feeding. The salivary glands secrete the viscous secrete which becomes a fine filament on contact with the air.
- The filament contains 75 percent of protein , the fibroin and 25 percent of gelatin protein, sericin. The caterpillar is capable of producing 650-1300 metre of silk.

REARING SILKWORM

- The practice of rearing silkworms for obtaining the silk is called sericulture. The accessories required for rearing silkworm are, A bamboo rack, Circular bamboo trays, Mnay bamboo baskets, Chopping knife, Chandraki or Cacoonage.
- The fully grown caterpillars are spread uniformly in chandraki for pupation. The cocoons formed are found attached on chadraki. The pupae must be 2 or 3 days before the emergence of moths
- Otherwise the silk thread is cut in to pieces. The cocoons exposed to sunlight or hot air over them or by fumigating with toxic chemicals. This process is known as stifling.
- The stiffed cocoons soaked with warm water to soften the gum that binds the silk threads. The treads from 4 or 5 cocoons are put in a spool of reeling machine and thus a single thread is made.
- This is the raw silk which forms about 60% and the remaining 40% is the waste silk. The raw silk is further processed and marketed.
- The silk worms are very often infested with the pathogenic organisms like bacteria, fungi and protozoans. They are thus susceptible to the diseases

SILKWORM DISEASES - MUSCARDINE

- It is a fungal disease caused by *Beauveria bassiana.* The disease spread through wind. The spores are carried by the wind and when they fall on the skin of the caterpillar they germinate. The germinating tube penetrates through the skin in the body, and latter grows in to the mycelium.
- The mycelium comes in contact with the body fluid and forms a cylindrical spore. The secondary spore is also formed by budding.
- The secondary spores germinate in the body fluid and the mycelia penetrate the varies organs of the body cavity. The symptoms of this disease are:
  - The infested worm becomes inactive and loses appetite.
  - The body of the worm becomes limp and its elasticity is also lost.
  - In the skin characteristics specks appear.
  - The body becomes rigid immediately after the death and the body surface is covered with white spores.

SILKWORM DISEASES - FLACHERIE

- It is a common disease of the silk worm. The bacteria bacillus and micrococcus are responsible for this disease.
- Some claim that this disease is caused due to physiological disorders. The following symptoms can be observed in the infested worms.
- The diseased silk worms lose their appetite and become sluggish in their movement.
- The skin loses its natural glossy appearance.
- The faeces become soft and stick to one another. The faeces later on become liquid and with foul odour.
- The moulted skin may not shed properly.
- The body colour of the affected worms changes to black in colour.
- Finally the worms become motionless, and putrefaction sets in.

SILKWORM DISEASES - PEBRINE

- This disease is caused by the protezoan parasite, *Nosema bombycis*.
- It is a common disease and found throughout the world.
- The disease is spread from the infested moth to the caterpillars through the eggs. Generally, the parasite attacks the last instar of the cater pillars.
- The common symptoms of the disease are the following:
  - The larva first stops feeding.
  - Ecdysis or moulting does not take place.
  - Dark brown or black spots appear all over the body.
  - The caterpillars finally become inactive and die.

CONTROL MEASURES

- Every day, the batches of caterpillars should be carefully observed whether any worm is infested with disease.
- If any worm is infested, it should be immediately removed from the batches.
- Eggs should be selected from the healthy moths. The pebrine disease can be thus prevented.
- Proper spacing and the periodical changing of silk worm beds with paddy husks will also prevent the spreading of disease.
- Proper ventilation and hygienic conditions are necessary for rearing healthy silk worms.

BIOLOGY, LIFE CYCLE, ECONOMIC IMPORTANCE OF LAC INSECT (*TACHARDIA LACCA*)

LAC INSECT

- ***Tachardia lacca or Kerria lacca*** is a species of insect in the family **Kerriidae**, the Lac insects.
- These are in the superfamily **Coccoidea,** the scale insects.
- This species is the most commercially important lac insect, being a main source of lac, a resin which can be redefined into shellac and other products.
- This insect is native to Asia.
- The lac insects are found in India, Pakistan, Sri Lanka, Burma, China and so on.
- In India it is seen in Bihar, North Orissa, Assam, Madya Pradesh and West Bengal.
- India produces about 70 percent of the total world production of lac.

BIOLOGY OF LAC INSECT

- The female lays about 300-1000 eggs at a time inside the encrustation. The eggs are hatched into the larvae or nymphs immediately after laying.
- The lac insects are ovoviviparous as fully developed larvae are found inside the eggs. The nymphs are minute (0.6 mm long) soft bodied and deep red in colour.
- The eyes are small and black. The antennae are long , and thin with hairs. Three pairs of appendages are found.
- In the beginning they move here and there and finally settle down and pierce the shoot. Then they secrete resin over their body.
- The resin is secreted by the resin glands. These glands are distributed over their body. When the larvae grow the resinous covering also increases in size.
- After the first moult both male and female nymphs lose their eyes, antennae and legs. The male regains the lost appendages at the final moult. But the female never regain them.

BIOLOGY OF LAC INSECT - Continues

- The female nymphs become swollen and there is no trace of segmentation. Finally the posterior end of the abdomen of the female is bent round in shape, occupying the entire space of the cell.
- The males are winged are apterous and emerge out of the cell, and live for a few days. The male cell grows up in its longitudinal axis, and slipper like in appearance.
- The female cell has grown up in its vertical axis and spherical in shape.
- The larva then passes through the prepupal and pupal stages. The antennae, eyes, legs and the other adult structures are developed.
- During the last pupal stage the mouth parts are atrophied and hence they do not feed. Finally, the males emerge out by pushing the operculum. They may or may not have wings.

BIOLOGY OF LAC INSECT - Continues

- The metamorphosis in the female is peculiar. During the first moult many organs except the antennae are cast off . At the second and the subsequent instars many of the female characters gradually develop.
- The end of the abdomen is directed upward. The anal and the tracheal lobes are now become distinct.
- Finally it becomes spherical in shape. After the third moult, the female becomes matured, and is fertilised by the male. After fertilization the lac is secreted by the female.
- The lac cells surrounding the female increase in size rapidly. The male has only a life span of 62-92 hours after emergence. The female lac insects are therefore the major source of lac secretion.

LIFE CYCLE OF *KERRIA LACCA*

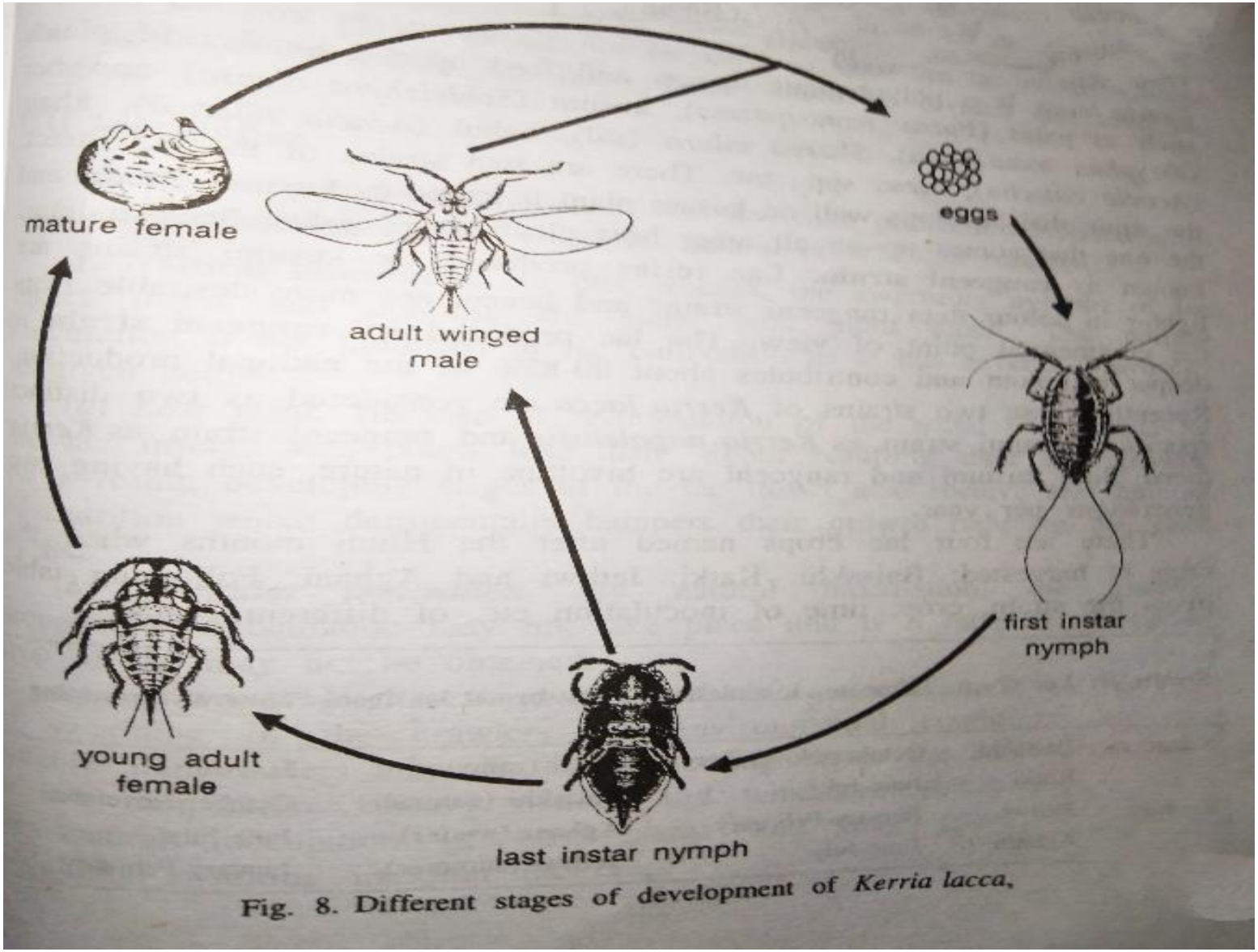


Fig. 8. Different stages of development of *Kerria lacca*,

LAC CULTIVATION

- The cultivation of lac is practised in the states like Bihar, Madhya Pradesh, West Bengal, Maharashtra and so on.
- About 41% of the total lac produced in India comes from Bihar. In India the lac industry is highly developed and it produces about 70-80% of the total lac production of the world.
- Hence in lac cultivating areas these trees are widely cultivated. In these host plants pruning is done very often so that new and fresh succulent branches are grown.
- The host plants are inoculated initially with certain quantity of purchased brood lac. Bundles of brood lac are placed in between the forks of branches.
- It is usually done in October to November. In April to May the lac cut is immature leaving about 20 percent of the crop on the tree it self for self inoculation, in the following June-July season.
- In October-November again a partial crop is taken, leaving some lac for future inoculation. The cycle is thus continued till the cultivated is forced to give cultivation on that host tree.

HARVESTING

- The cultivators cut the crop in immature stage (Aricuting) in April to May and also as matured (katki crop) in October to November.
- Hence, it is discouraged. The lac encrustation are dislodged from the branches by scraping with the knife. The scraping should be done immediately after the harvest.
- This is to avoid damage by the predators. There are five types of lac as given below.

A. Eri lac - The immature stage of lac which is harvested before reaching maturity.

B. Stick lac - Matured lac in the form of sticks obtained on maturity of the crop**.**

C. Seed lac - The lac in the stick is obtained by scraping.

D. Dust lac - It is obtained by grinding the crystals of lac**.**

E. Shellac – It is obtained by heating both the seed and dust lac together.

F. Button lac – The moulten lac is poured in to dies in a zinc sheet. Buttons lac is 7cm. Diametre and 0.6cm thick.

SHELLAC - USES

- Seed lac and shellac are used mainly to manufacture French polish, floor polish, paintings, inks, electric insulators, sealing wax etc.
- For the manufacturing of varnishes the shellac is a raw material.
- Shellac is used for painting the bottom and the sides of boats and ships to prevent leakage.
- Shellac is used for filling hollows in the ornaments.
- In Ayurveda, lac is mixed with other herbs for preparing ointments.
- It is also one of the ingredients for preparing oil medicines to cure fever and rheumatism.
- Lac is also used for dying silk sarees

HELPFUL INSECTS - POLLINATORS, SOIL BUILDERS, SCAVENGERS, MEDICINAL INSECTS

HELPFUL INSECTS

- Helpful or beneficial insects are insects that play a significant role in the welfare of human being and to the environment.
- Helpful or harmful is decided in the human perspectives.
- Insects pollinate plants, contribute to the decay of organic matter and the cycling of soil nutrients.
- Insects play a major role in controlling the pest population.
- Insects are the dominant biotic factors both in aquatic and land ecosystems.
- Their presence in any ecosystem is indispensable.
- It is because they pollinate the flowers, form food for other animals of the ecosystem and also the removable of dead organisms by feeding on them.
- Some insects are subterranean in their habit which facilitates aeration and fertility of the soil. Such insects are therefore known as helpful insects.

INSECT POLLINATORS

- In flowering plants the pollens from the stamens are transferred to the stigma of the gynaecium. This transference of the pollens is termed pollination.
- Pollination takes place by various agents like air water and animals.
- The insects are the chief pollinators among the animals.
- The flowers which are pollinated by the insects are called endomophilous.
- The endomophilous flowers are generally brightly coloured, attractive, scented and with nectar.
- Many insects feed on the pollens and nectar. Their mouth parts are adapted to suck the nectar from the flowers.
- When they feed on the nectar of the flowers the pollens, get attached among the bristles of the body.
- The insects when visit another flower the pollens from the body of the insects are transferred.
- Thus the cross pollination takes place in the endomophilous flowers

INSECT POLLINATORS - Continues

- Nectar is secreted by insect pollinated flowers to attract the insects.
- Honey bees are regarded as a highly potential pollinator species because the bees visit about 100 flowers during a field trip and make about four million field trips every year.
- Majority of the fruit crops are pollinated by honey bees.
- In Asclepidaceae (Eg. **Daemia, calotropis** etc). Lamiaceae (Eg. **Ocimum, Leucas** etc) and Fabaceae (Eg. **Beans, peas,** etc.,) the flowers are well adapted for entamophily. In such plants the pollination exclusively depends on insects.
- Fruit crops like apple, citrus, grapes, papaya, and most of the vegetable crops depend on the insects for pollination.
- Among the insects honey bees (**Apis spp**), solitary bees (**Andrena, Xylocopa** and **Halictus**), bumble bees (**Bombus** spp), many species of wasps, ants, aphids, thrips etc, are the well known pollinators.

SOIL BUILDERS

- Many insects during one or more of their life stages live inside the soil and some in the tunnels made by them.
- Members of almost all the orders of insects are seen in the soil and the most important are the ants, bees, beetles, larvae of flies, cutworms, crickets, collembola and pupae of moths.
- They are usually confines to the top 15 cm of soil.
- The insects such as ants, termites, crickets etc are subterranean in their habit.
- The nymphs or larvae of most of the insects found in the soil. Hence, they construct the nests in the soil.
- During the construction of the nest the subsoil is brought to the surface.
- During surface activities the soil is mixed with their saliva which enrich the fertility of the soil.
- The dead bodies, the excreta and the exuvae of the insects are abundantly found in the soil which also enrich the fertility of the soil.
- The activities of the subterranean insects generally facilitate the soil aeration.

SCAVENGERS

- There are insects which feed upon the dead and decaying plant and animal matter. Since insects help to remove from the earth's surface the dead and decomposing bodies, they are referred to as scavengers.
- The scavengers are insects which feed on the dead plants and animals and also on animal excreta. Like the decomposers scavengers are also important biotic factors of any ecosystem.
- The activities of scavengers remove the dead organisms from the environment. Otherwise they would be accumulated in the environment which would be detrimental. Some of the important scavengers are described below.

a. **Dung beetles:** These are otherwise known as scarabs. They mostly feed on dung of mammals which is rolled into balls of convenient size and buried in underground chambers. The beetles also breed in such dung rolls. The common Indian species are ***Heliocopris bucephalus.***

b. **Shining fungus beetles:** Both the adult and larvae feed on fungi, rotting woods, dead leaves and so on. The common Indian species are ***Scaphidium conjunctum*** *and* ***S. lunamum.***

SCAVENGERS - Continues

c. **Rove beetles:** These are minute to medium sized elongate black beetles found among the decaying vegetable and animal matter. The common Indian genera are **Bledius, Geodrmicus, Leptochirus** etc.

d. **Muscids:** The house flies lay their eggs on decaying animal or vegetable matter. Their maggots feed on the decaying matters and pupate. The common example is ***Musca domestica*.**

e. **Root maggot flies:** These are dark coloured flies which are phytophagous. However some of them are scavangers breeding on cow dungs. The common genus is **Anthomiya.**

f. **Termites:** The termites are the well known insects feeding on the dead leaves and wood of plants. The common wood – eating termites are **Kalotermes, Neotermes and Glyptotermes.**

- In the case of the dipterous insects - Order Diptera, it is only the larvae which feed upon decaying matter and serve as scavengers.

MEDICINAL INSECTS

- The medicinal uses of insects are well known. The are used as a potential supplier of bioactive components. The importance of insects as a source of food and medicine was familiar in India, China, South East Asian countries, Africa ands outh America.
- Certain insects have medicinal values. From the maggots of certain species of flies, a substance called **allantoin** is isolated to heal the deep wounds.
- The sting poison of ***Apis indica*** and ***A. mellifora*** is used to treat rhumatism and arthritis.
- The eggs of red ant ***Oecophylla smaragdina*** contains a substance which cures malaria.
- ***Lytta vesicatoris*** (the blistter beetle) contains a substance used to cure urinary infections. A substance extracted from the melloid beetles (**Mylabris**) is used as diuretics.

MEDICINAL INSECTS - Continues

- Termite is said to cure a variety oF disease, both specific and vague. Typically the mound or a portion of the mound is dug up and the termites and the architectural components of the mound are together ground into a paste which is then applied topically to the affected areas or more rarely mixed with water and consumed.
- This treatment was said to be cure ulcers, rheumatic diseases and anemia. It was also suggested to be a general pain reliever and health improver.
- The Jatropha leaf miner, a lepidopteran which feeds preferentially on Jatropha is an example of a major agricultural pest which uis also a medicinal remedy.
- The larvae of the insects are harvested, boiled and mashed into a paste which is administered topically and is said to induce lactation, reduce fever and soother gastrointestinal tracts.
- The traditional insect medicine of Africa is extremely variable. Grasshopper is both commonly eaten as a delicacy and an excellent source of protein and is consumed for medicinal purposes.

OTHER HELPFUL INSECTS

- Some species of insects are the best biological indicators. The naiads of the may fly Hexagenia are found in the bottom of the aquatic environment.
- It is present in the aquatic environment indicates that the water has adequate oxygen.
- It is because, the naiads of the insects function as biological indicators.
- Their disappearance from the fresh water habitats show that the water is not only highly polluted but also with less oxygen content.
- The fruit fly Drosophila is an ideal genetic material in which genetic experiments have been conducted. Certain species of butterflies and beetles are used as ornaments.
- Some insects oviposit their eggs inside the plant tissues producing galls. They are therefore known as gall insects.
- The acid is also used for dying the silk threads, wool and leather.
- Caramic acid is also used as medicine for woophing cough.

SOURCE

ECONOMIC ENTOMOLOGY - DR. N.T. KRISHNAN

ELEMENTS OF ECONOMIC ENTOMOLOGY - DR.B.VASANTHARAJ DAVID AND DR.T. KUMARASWAMI.

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