

ALLIED ZOOLOGY-II

COMMERCIAL ZOOLOGY

(Based on Bharathidasan University Syllabus)



Compiled by
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I hope this notes will be committed to the intellectual life of the students.

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- 1. *Invertebrata –I***
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- 11. *Chordata and Cell and Molecular Biology (Practical Manual)***

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**ALLIED ZOOLOGY –II
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UNIT-I APICULTURE

Introduction to Apiculture

- Rearing of honey bee for honey is called Apiculture. This term is derived from the scientific name of honey bee *Apis*.
- It is also called *Bee-keeping*.
- Apiculture is an *Applied Zoology*. This is a cottage industry.
- Formerly this industry was called Bee-keeping. *L.L.Langstroth* is the "Father of bee-keeping"
- The honey bee is domesticated by the farmers to produce honey and bees-wax.
- As a result, bee-keeping is developed as a agro-based cottage industry.

Scope of Apiculture

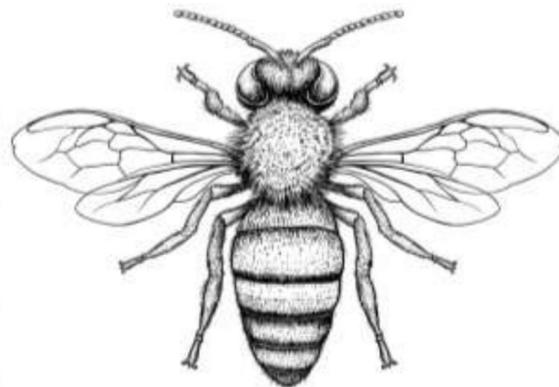
- Apiculture is an ideal and economically viable industry at the village level.
- The World production of honey is about 6, 00,000 tones per year and 7 million bee-keepers are totally involved in this industry. But in India, 1.5 lakhs of bee-keepers are employed to maintain hives in apiaries.

The scope of Apiculture can be summarized as follows:

- Apiculture provides employment to the rural people.
- Apiculture is a cottage industry, it needs minimum semi-skilled labourers
- It is economically important because it is a profitable rural-based industry.
- Apiculture develops as small scale industry with less capital investment
- Apiculture related research institution also offers employment to the research workers
- The important product of bee-keeping is the honey which is used as medicine and nutritive supplement
- Bees-wax is also used in pharmaceutical industries.
- Bees-wax is used to produce polishing material
- Thus the by-products of bee-keeping are exported to various countries and our economy grows.
- Honey is also the ingredient in bakery products.
- Wax is useful to make certain cosmetic products.
- Bee-keeping also provides indirect employment to the carpenters who make bee- hives.

Classification

Phylum	:	Arthropoda
Class	:	Insecta
Order	:	Hymenoptera
Family	:	Apidae
Genus	:	<i>Apis</i>
Species	:	<i>indica</i>



Honey Bee and their types

The most common species of Honey bee are,

- *Apis dorsata*
- *A. florea*
- *A. cerana indica*
- *A.mellifera*

A.dorsata and *A. florea* are wild varieties and *A. cerana indica* and *A.mellifera* are domesticated and reared for the commercial production of honey. Moreover, *A. dorsata*, *A. florea* and *A.cerana indica* are distributed in India but *A. mellifera* is an **exotic (foreign)** species introduced from European country.

Apis dorsata

- It is commonly called **rock bees**.
- It is distributed all over India.
- It is one of the **largest honey bees**.
- It is wild and **violent**.
- It is found in the **hills**.
- It builds a single comb which is **one meter in length**.
- It is found hanging down from the rocks and branches of tall trees.
- The comb consists of **hexagonal cells**.
- The queen bee is easily distinguished by its large size.
- The colour of the queen is darker in colour than worker bee.
- They are **good honey gatherers**.
- A single colony can yield **30 kg of honey** per year.
- Since these bees are **ferocious and venomous**, they are not domesticated.
- So they are also called **wild bees**.

Apis florea

- These are popularly called little bees. They are **small in size**.
- They are distributed all over India.
- They migrate from one place to another at regular intervals (5 months)
- The colony consists of a single comb which is small in size.
- The comb is suspended from the branches of bushes
- A single colony yields **200-500 gms of** honey per year
- These bees are helpful to **pollinate flowers**.
- They are **not domesticated**.

Apis indica

- They are generally called Indian bees.
- They are very calm.
- They are suitable for Apiculture
- They build their combs in dark places.
- They are yellowish-brown in colour.
- They have two types of combs.

- They are **honey comb and brood comb**.
- They can produce **2-3 kg** of honey per year.
- They are **domesticated** in South India.

Dammer bee

- These bees are **small**.
- The body is black in colour.
- The comb is built by a dark material called cerumen.
- The honey has high **medicinal value**.
- It is not easy to tame these bees.
- They bite enemies.
- The adults live for about 15 days only.

Bee Colony

- Honey bee is a social insect. They live in colonies. They show high degree of division of labour.

Colony Organization

- Honey bee is a social insect. It lives in well organized colonies. A colony has 40,000 to 50,000 bees. There are three castes, namely queen, drone and worker.
- There is only one queen in a colony. She is larger. Her duty is only to lay eggs. She is the mother for the entire colony.
- The drone is the male member of the colony. Their main duty is to copulate with her eggs. The drones are the laziest bees. Even for their food, they are begging for honey from the workers.
- The workers are the females. The total indoor and outdoor duties of the colony are performed by the workers. They sacrifice themselves for the well being of the colony.

Life History of Honey bee

- *Apis indica* is commonly called Indian bee.
- It is a **holometabolus** insect showing complete metamorphosis.
- They are social insects living in colonies.
- There are three main castes in a colony. They are **queen, worker and drones**.
- The development is **indirect** and it includes **complete metamorphosis** and **ecdysis**.
- The development is completed inside the **brood cells** of the **comb**.
- The life cycle consists of four stages namely **egg, larva, pupa** and **adult**.
- The eggs are laid by the queen. She lays upto **2000 eggs** per day, one egg inside each cell.
- The eggs of honey bees are **centrolecithal** type.
- The egg is white and cylindrical with one end enlarged.
- It is about **1.5 mm long**.
- The egg is covered by a **chorion** and a **vitelline** membrane.
- The vitelline membrane encloses the **cytoplasm, nucleus** and **yolk**.
- Queen lays two types of eggs **fertilized eggs** and **unfertilized eggs**.
- A fertilized egg is **diploid** and unfertilized egg is **haploid**.
- The egg hatches into a larva in 3 days.
- The larva of honey bee is also called "**grub**".

- The larva is cylindrical and *white in colour*.
- The newly emerged larva is 1.6 mm long.
- The larvae of queen and drone are larger than those of the worker.
- The body of the larva consists of a *head, a thorax* and an *abdomen*.
- In the thoracic region, two pairs of spiracles and wing rudiments are visible. The abdominal region bears 8 pairs of spiracles. The anus is in the last segment.
- The development time for the larva of queen is 5 days, 6 days for worker and 7 days for drone.
- Honey bee larvae are fed with *royal jelly* for the first two days.
- Queen larva is fed with *royal jelly continuously*.
- The worker and drone larvae are fed with bee bread from the third day
- As the larva grows, it sheds its outer skin. This process is called *moulting or oecdysis*.
- The larva moults 5 times moulting
 - 1 moulting - 1st day after hatching.
 - 2nd moulting - 2nd day after hatching.
 - 3rd moulting - 3rd day after hatching.
 - 4th moulting - 4th day after hatching.
 - 5th moulting - Converts the larva into pupa.
- Pupa is *inactive, and non - feeding*.
- Pupa inside the closed cell is referred to as "*capped brood*".
- Pupa has three distinct regions, namely a *head, thorax* and *an abdomen*.
- The wings and legs are free from the body and are movable. This type of pupal is called "*exarate*" pupa.
- The pupa moults before becoming the adult. This is the 6th moult.
- Emergence of adult from its pupal skin is called *eclosion*.
- The pupa then changes into adult.
- There are three types of castes in the adult bee. They are queen, workers and drones.
- Development time for the adult queen is 15 days worker is 21 days and for drone is 24 days. The queen emerges on the 16th day, worker emerges on the 21st day and the drone emerges on the 24th day.
- *Queen and workers are females*.
- Queen is the only egg laying member of the colony.
- Worker is a *sterile female*.
- Workers do all the duties for the survival of the colony.
- Drone develops from unfertilized egg by parthenogenesis.
- Drones are *fertile* males.
- The duty of drone is to fertilize the queen.
- The queen and workers are diploid but the drone is haploid.
- This type of sex determination is called haplo - diploid type of sex determination.

Bee-keeping Equipments

Equipments are accessories required for modern method of bee-keeping. The equipments are:

1. Comb Foundation Sheet

- It is a sheet formed of pure wax
- It is of proper size and attached to super frames by means of thin wires.
- The bees make comb cells over this sheet

2. Dummy Division Board

- It is a frame usually placed with regular frames.
- It provides limited space to the bees

3. Porter Bee Escape Board

- It is a board which covers the brood chamber
- It has one-way opening at the centre.
- It is useful to clean the super

4. Drone Excluder

- Drone excluder is otherwise called drone trap.
- Drones are trapped by this equipment

5. Swarm Trap

- It is a rectangular box which opens at the broad side and a wire guage is attached to the other side (2/3 of its height).
- The queen excluder is fixed onto the other one third.
- Then one or two frames with comb foundation sheets are placed inside the box
- When a swarm comes in this way, settles down along with queen and workers.
- Now the swarm is transferred to the hive

6. Queen Excluder

- It is equipment which is helpful to keep the queen in a particular portion of the hive
- Queen excluder can separate brood chamber from honey chamber
- It is a perforated zinc sheet mounted on a wooden frame
- The size of the pores is 3.5mm.
- The queen bee is prevented from passing through it.

7. Smoker

- Smoker is an equipment to produce smoke.
- Smoker is useful to handle the bees.
- Coconut fibres are used to produce smoke.

8. Uncapping Knife

- It is a steel knife with a double-edged blade.
- The cells of the honey combs are filled with honey.
- They are sealed with wax
- To remove the cappings, the uncapping knife is used.

9. Queen Gate

- It is a metal piece fixed at the entrance of the hive.
- It is used to prevent the escape of queen from the hive.
- It is made of a slit-like opening of 4 mm size.

10. Bee Veils

- It is a protective covering used when handling the bees.
- It is made up of various materials like silk, cotton and mosquito net.
- It can cover the face.
- It protects the essential parts of the head.

11. Bee Brush

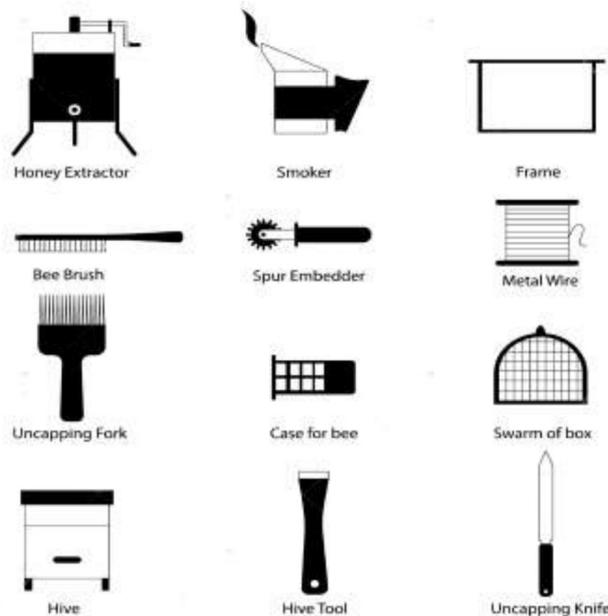
- It is a brush with soft bristles
- It is used to remove bees from the honey combs.

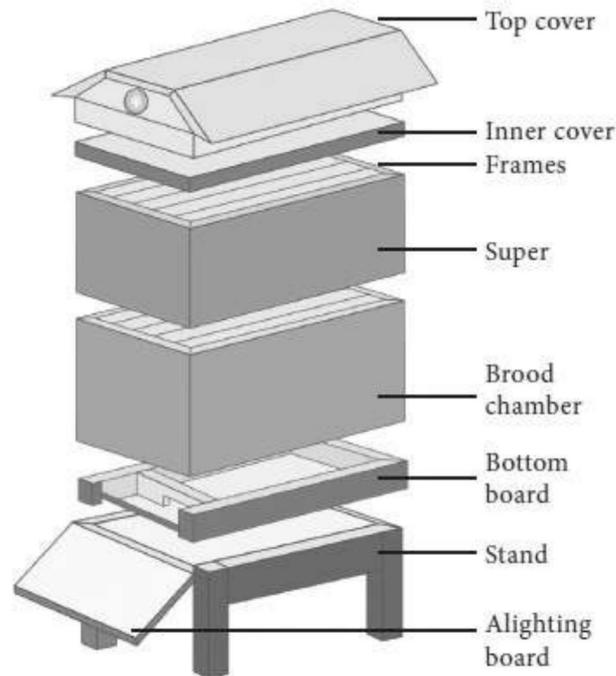
12. Feeders

- Feeders are the devices used to feed the sugar syrup.
- Bees are fed with honey syrup or sugar syrup when there is insufficient amount of honey in the hive.

Newton's Bee Hive

- It is a modern hive designed by *Rev. Fr. Newton in 1919*.
- It is formed of movable frames
- It is useful to rear small colony
- This hive consists of 5 components. They are
 - *Floor board*
 - *Brood chamber*
 - *Brood frame*
 - *Super chamber and super frame*
 - *Stand*
 - *Top cover*
- **Floor board** has a dimension of 40 cm x 30 cm.
- **Brood chamber** is a box of 27 cm x 25 cm x 15 cm size without top and bottom.
- At the base there is an entrance (8 cm x 1cm).
- The brood chamber is placed over the floor board.
- **Brood frame** has top bars and side bars.
- It is hanged down inside the brood chamber.
- The brood chamber consists of seven frames.
- A **super chamber** of 27 cm x 25 cm x 7cm size is placed over the brood chamber.
- There are seven **super frames** (20.5 cm x 14 cm x 6.1cm).
- **Stand** is a piece of wood (10 cm in diameter)
- It is fixed deep in the ground.
- A board is attached on its top.
- The hive is placed on the platform.
- The **top cover** consists of two sloping planks.





Social Life in Honey Bee

- Living together with mutual co-operation by the members of the same species is called *social life*.
- Honey bees are social insects
- Honey bees exist in several morphological forms in a species such as queen, drones and workers. This phenomenon is known as *polymorphism*.
- Honey comb is the nest of honey bees
- It consists of five types of chambers, *namely queen cells, drone cells, worker cells, storage cells and brood cells*.
- Each colony is formed of thousands of bees.
- The members of the colony co-operate with each other for *shelter, food, protection*, etc
- They show high degree of *division of labour*.
- Each colony consists of three castes. They are *queen, drones* and *workers*. This is called caste system.

Queen

- **The queen** is the largest member of the bee colony.
- The queen lives inside the queen cell
- Queen is the mother for all the members of the colony.
- Queen main function is to lay eggs. Hence queen is called egg laying machine.
- The queen bee lays up to 1500 eggs per day and *1,75,000-200,000* eggs per year
- The queen flies on a nuptial flight and is mated by drones. This process is called "swarming."
- It produces new colonies.

Drones

- Drones are **fertile** males.
- Their main function is to fertilize the eggs.

Workers

- The workers are **sterile** females.
- Each worker will perform different tasks based on their age. This is called age-related polytheism.

- Young worker bees nurse the young ones. They are called "*nurse bees*".
- 15-17 days old worker bees produce wax and they possess "*wax plates*".
- They build combs
- Above 18 days old worker bees guard the hives
- Three weeks old worker bees are "*field bees*".
- They collect pollen and nectar from the flowers.
- The bee colony functions as one unit by *chemical communication*
- The queen as the mother of the nest release *pheromones* which link all the bees into one unit.

UNIT –II
BEE PASTURAGE

Nectar composition

- Nectar, sweet viscous secretion from the nectaries, or glands, in plant blossoms, stems, and leaves.
- Nectar is mainly a watery solution of the sugars fructose, glucose, and sucrose but also contains traces of proteins, salts, acids, and essential oils.
- Sugar content varies from 3 to 80 percent, depending upon such factors as plant species and soil and air conditions.
- The production of nectar as a food reward for animals is a classic example of coevolution.

Honey extraction

- Removing honey from the honeycomb is called honey extraction. The process of honey extraction needs the following components;
 - *Honey extractor*
 - *Uncapping knife*
 - *Uncapping tray*
 - *Straining cloth*
 - *Collecting vessel*
 - *Bottles*
- The honey extraction is done in honey extraction house situated away from the hive, Remove the super frames from the hive.
- The super frames with honey are brought to the honey extraction house.
- The wax caps are removed from the combs.
- The removal of cap from the comb is called uncapping.
- Uncapping is done in the uncapping tray with the help of the uncapping knife.
- The uncapping knife should be kept warm for easy uncapping.
- The combs are uncapped on both sides
- The uncapped frames are loaded vertically in the wire gauze cage of the honey extractor
- A honey extractor is a mechanical device used to separate honey from the combs.
- The extractors may be tangential or radial
- In the tangential extractor, the combs are arranged facing the cage. In the radial extractor the combs are arranged radially like the spokes of a wheel.

- The rotation should be very gentle at first and the speed of revolution is increased gently.
- Run the rotation process for a few minutes.
- When the honey combs are rotated, the honey is thrown out into the reservoir of the honey extractor.
- Honey gets collected in the reservoir.
- When the reservoir at the bottom is full, the honey is drained off through the tap.
- Honey is collected in collecting vessels.
- The honey is heated.
- Filter the collected honey using a straining cloth.
- After filtering, the honey is allowed to stand for about 24 hours. This will remove the air bubbles.
- Finally the honey is poured into bottles for storage.
- After honey extraction the combs are reused.

Honey

- Flowers nectar is a solution of sugars and other minor constituents that bees collect and concentrate into honey. It is a sweet, viscous fluid, produced by honeybees.

Properties of the Honey

- The colour, taste and flavour of honey are contributed by aromatic compounds, colloids and pollens.
- Honey is **hygroscopic**.
- When the honey is exposed to air, it absorbs moisture.
- Honey has high **viscosity**. So it flows very slowly
- The density of the honey is high
- The specific gravity of the honey is 1.41
- The colour ranges from white to dark.

Chemical Composition

- Honey is a natural product.
- It consists of *water (17%), fructose (38%), glucose (31%), sucrose (1.3%), other sugars (9%), total acids (0.57%), ash (0.17%), nitrogen (0.04%) with negligible amount of enzymes and vitamins.*
- Honey is sweet because it contains **glucose** and **fructose**.
- The carbohydrates consist of both **monosaccharides** and **disaccharides**.
- Honey also contains **proteins** and free **aminoacids**.
- **Acids** found in the honey are citric acid, gluconic acid and hydrochloric acid.
- Honey also contains ash
- **Minerals**, namely iron, copper, manganese, magnesium, sodium, potassium, calcium, silica and phosphorus are also found in small quantities
- **Vitamins** occur in the honey are ascorbic acid, niacin, pantothenic acid, riboflavin and thiamine.

Nutritional Value of Honey

- Honey is full of energy, since it contains carbohydrates.
- A teaspoon of honey liberates **100 calories**.
- Honey is formed of dextrose and levulose which provides energy.
- Honey is also considered to be the "**Drug of immortality**".
- It has the antibacterial property.
- It **enhances appetite**.
- It is useful in relieving dryness of the mouth and body.
- It provides essential aminoacids required for the growth of the body.
- Honey improves metabolism.
- Honey is more effective with regard to digestion.
- Minerals found in the honey aids in blood circulation.

Medicinal Value

- Honey plays an important role as medicine.
- Honey possesses antibacterial property.
- Honey can cure cuts, burns and sore throat.
- It acts as an antibiotic.
- It protects the skin and eyes.
- It promotes the growth of healthy tissues.
- Honey is also used to treat cough, cold and intestinal disturbances.
- Honey cures headache due to sleeplessness.
- It has anti-eosinophilic property
- It enhances digestion and appetite.
- It acts as medicine to cure jaundice.
- It protects the deposition of fats.
- It is good for kidney patients.
- It is used as a medicine for bedwetting.
- Honey can be applied to any swelling.

Bee-wax

- Bee-wax is secreted by the abdominal gland of bees.
- It is used for the construction of comb. It is a yellowish solid insoluble in water.
- It is used for the preparation of paints, varnishes, candles, models, etc.
- It is used as a ground substance for the preparation of ointments, creams, etc.
- It has many industrial uses. It is used extensively in engineering industries, railways, textiles, leather industries, etc

Bee Venom

- Bee venom is secreted by the poison glands of stings.
- Bee venom is a curative toxin in humans.
- It is transparent and it has a bitter burning taste.
- It is acidic in nature. It contains formic acid, histamine, tryptophan, sulphur many proteins, volatile oils, enzymes like hyaluronidase and phospholipase and magnesium phosphate.

Clinically it has the following uses:

1. It is used to treat rheumatism.
2. It is used to treat certain eye diseases **like kerato conjunctivitis** (inflammation of cornea), **iritis** (inflammation of iris), **iridocyclitis** (inflammation of iris and ciliary body)
3. It is used to cure skin diseases like tuberculosis of the skin
4. The cholesterol level in blood falls by the treatment of bee venom
5. Bee venom controls blood pressure.

Propolis

- Plant resin and gum collected from plants and used to varnish or seal the inside of the hive by the bees.

Royal Jelly

- Royal jelly is a milky white secretion of the hypopharyngeal gland of young worker bees mixed with digested pollen and nectar of honey.
- Royal jelly contains a protein called **royalactin**, which causes a normal larva develops into a queen. It is the regular food for the queen. Hence the name royal jelly.
- Royal jelly is a creamy milky white and nitrogenous substance.
- It is strongly acidic with a slightly pungent odour and bitter taste.
- It is used to feed the queen bee throughout her larval and adult life
- It has a high nutritive value and hormonal action.
- A colony will produce approximately 500 g of royal jelly in a season (5-6 months).
- Royal jelly contains the following components
- **Water - 60-70%, Proteins - 12.5, Free amino acids - 0.6-1.5, Sugars – 11, Lipids - 5-6, Minerals - 0.8-3, Vitamins**
- The mineral content of royal jelly includes iron, calcium, cobalt, silicon, magnesium, nickel, sulphur, chromium and zinc.
- vitamin content of the royal jelly is vitamin B complex, vitamin E and trace amount of vitamin C
- It also contains enzymes, antibacterial and antibiotic components.

Importance of Royal jelly

- Royal jelly is the regular food for the queen. Hence the name royal jelly
- Royal jelly is used to feed larvae of worker bees and drone bees for the first two days.
- Royal jelly contains a protein called **royalactin** which causes a normal larva into a queen.
- Royal jelly has **anti- viral** properties.
- Royal jelly normalizes metabolism. It has a **diuretic effect**.
- It can be used to **prevent obesity** and infections.
- It regulates the functioning of **endocrine glands**

UNIT-III SERICULTURE

Introduction to Sericulture

- Sericulture is the rearing of silkworms to produce silk.
- Sericulture is one of the branches of Applied Zoology.
- The term sericulture is derived from a Greek word 'sericos'
- The word 'sericos' means 'silk'.
- The word "culture" refers to "rearing"

Silk

1. Silk is a commercial product of silkworm.
2. It is the fibrous protein secreted by silkworms.
3. Silk is also produced by other organisms such as mussels, spiders and lepidopteran insects
4. More than 400-500 species are known to produce silk
5. On the basis of animals producing silk, silk is grouped into two types. They are
 - i. Insect silk and*
 - i. Non-Insect silk*
6. Silk is produced by silkworms which belong to the family *Bombycinae*.
7. Most of the commercial insect silk is obtained from the mulberry silkworm.
8. The zoological name of the mulberry silkworm is *Bombyx mori*
9. The silk is used in *textiles*.
10. The silk is sold and exported as silk yarn.
11. Various articles are manufactured from silk. They are ties, sarees, shawls, carpets, etc Waste silk is used to produce spun silk-garments

Types of Silk

- Silks are classified into two groups, namely mulberry silk and non-mulberry silk

1. Mulberry Silk

- It is produced by silk worms feeding on mulberry plants. *Bombyx mori* produces this type of silk

2. Non-mulberry Silk

- It is produced by silk worms feeding on plants other than mulberry plants. The non-mulberry silk is of three types. They are as follows:

a. Eri silk

- It is produced by *Attacus reclinii*. It feeds on castor leaf.

b. Tasar silk

- It is produced by *Antheraea paphia*. It feeds on oak and fig trees.

c. Muga silk

- It is produced by *Antheraea assama*. It feeds on *Machilus* plants.

Moriculture



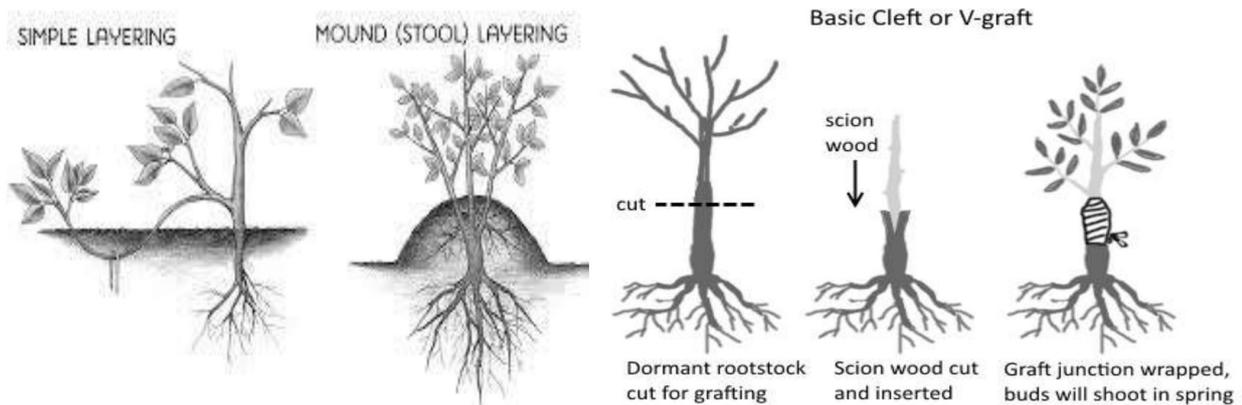
- Moriculture means the cultivation of mulberry plants for the production of mulberry leaves.
- The leaves are fed by the silkworms
- The leaves contain all the nutritive substances to produce quality cocoons.
- Moriculture is a labour-intensive process.
- In India, the following varieties of mulberry plants are cultivated:
- *Morus alba*, *Morus indica*, *Morus serrata*, *Morus laevigata*, etc
- Mulberry plant belongs to the family *Moraceae*.
- It is a dicot plant with tap root system.
- It can grow like a tree or bush.
- It has nodes with a bud and accessory buds.
- Buds are of two types. They are vegetative and reproductive buds.
- Vegetative parts arise from vegetative buds
- Reproductive parts arise from reproductive buds.
- Leaves are **simple** and **alternate**
- Flowers are unisexual
- Trees may be dioecious or monoecious.
- Fruits are ovoid in shape. They are white, purple to black in colour.
- Fruits are edible in nature

Methods of Propagation

- Propagation refers to the multiplication of plants. There are 3 methods of propagation. They are
 - *Vegetative propagation*
 - *Seedling propagation*
 - *Micro-propagation*

Vegetative Propagation

- Vegetative propagation is the asexual method of propagation using vegetative parts of the plant.
- Vegetative propagation involves 3 methods: They are,
 - *a. Cutting*
 - *b. Grafting*
 - *c. Layering*



a. Cutting

- Cutting is the raising of plants from twigs (Branch).
- Matured shoots with well developed buds are selected for cutting.
- The branches should be cut into 18-20cm long cuttings with 3 inter nodes.
- Later, the cuttings are grown in a nursery or in the field.
- The cuttings are watered for 10 days.
- From the nursery, the cuttings are transplanted to fields after to 3 months.

b. Grafting

- Grafting is the joining of the parts of two plants.
- It is a method of vegetative propagation.
- The two plants unite in to one plant.
- The part of the desire plant is called scion.
- The scion is inserted into the already rooted plant of very low quality called stock.

Based on the scion material used grafting may be classified into

1. **Root grafting**
2. **Shoot grafting**
3. **Bud grafting**

1. Root grafting

- It is a method where root is used as a stock.
- The scion bits are introduced in between bark and wood
- Later a plant develops from the bud of scion.

2. Shoot Grafting

- It is a type of grafting.
- The scion is attached to the stem portion. Hence the name, stem grafting.
- Shoot grafting is divided into 3 categories. They are
- 1. **Crown grafting** 2. **Wedge grafting** and 3. **Whip grafting**
- **Crown grafting** refers to the insertion of more than one scion into the stock.
- **Wedge grafting** involves in the making of 'V' shaped incision on the cut end of the stock.
- **Whip grafting** is a grafting where slopping cut is made on the scion and stock with a length of 3.5-5.0 cm.

3. Bud Grafting

- Bud grafting means grafting of buds.
- It is classified into 3 types. They are
- 1. *Flute budding* 2. *Patch budding* and 3. *T-budding*
- **Flute budding** involves the removal of bark of the stock to a length of 2.5 -3.5 cm then the bud of the scion is placed.
- **Patch budding** means the separation of bud along with bark from the stock
- **T-budding** involves in making T-shaped cut in the stock to which the scion is placed.

c. Layering

- It is a technique of vegetative propagation.
- It is a simple method.
- It is the development of rooted stem to grow as a new plant
- It is a very safe method

Layering is divided into 3 types. They are

1. *Air layering*
2. *Simple layering*
3. *Trench layering*

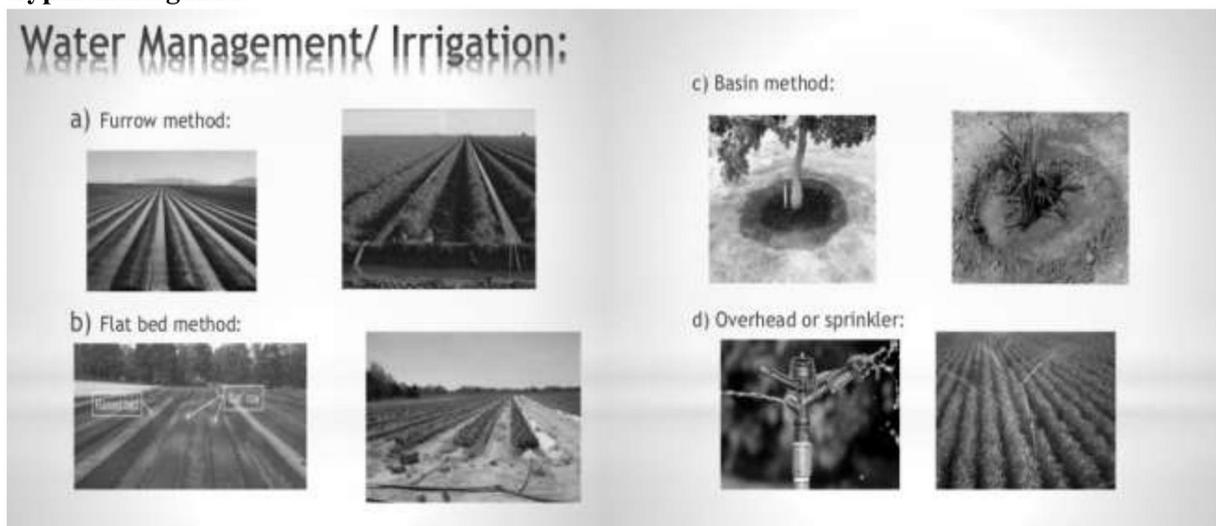
Irrigation

- The supply of water to crops at different intervals is called *irrigation*.

Frequency of Irrigation

- The frequency of irrigation varies, depending on the growth stage of the plant, soil type and other agro-climatic conditions.
- It varies, for example, from once in 8-10 days for sandy soils to once in 15 days for clayey soil. Young plants need more frequent irrigation than old ones.

Types of irrigation



i. Furrow Method: The field is laid out into series of ridges and furrows and the water flows through the furrows and by the capillary action, the ridges are also moistened.

In this method, water is economically used. Evaporation of water from soil surface is avoided. During rainy days the furrows serve as drainage channels

ii. Basin Method: In tree plantation, around the base of each tree, a shallow basin like depression is being made and water is allowed to flow into these basins by proper channels.

iii. Flat bed Method: The field is divided into 4 x 6m rectangular beds with bunds all around and channels on the sides. By this method soil erosion can be avoided the entire field can be irrigated quickly.

iv. Over head sprinklers: Under this method, the perpendicular pipes, having rotating nozzles on top, are joined to the main pipeline at regular intervals. When water is allowed to flow through the main pipe under pressure with the help of a pump, it escapes from the rotating nozzles. It gets sprinkled on the crop as if it is raining.

Manuring

- Application of fertilizers and manures not only increases the productivity but also improves the quality and quantity of leaves.
- Commonly, farmyard manure (FYM), compost, neem cake, ground nut cake, green manure crops etc. are applied in mulberry fields.
- **Nitrogen, phosphorus and potassium** are the three major chemical elements vital for increased production of quality leaves.
- **Nitrogen** increases the vegetative growth; leaves become large and deep green, indicating increased chlorophyll content.
- **Phosphorus** is essential for cell division in the growing regions. Phosphorus deficiency causes stunted growth with small, very dark green leaves. The older leaves become reddish purple.
- **Potassium** is essential for the normal development of woody parts of the stem and continuous yield of quality leaves

Method and time of application of fertilizers

- Generally fertilizers are applied as mixtures which are either broadcasted or placed deeply in the root zone and the latter results in better utilization
- In Tamil Nadu and Karnataka the recommended dosage of fertilizers varies.
- For rainfed crop 5-10 tonnes of farmyard manure or compost and fertilizers at the rate of 100 kg as nitrogen, 50kgs phosphorus and 50kg potash per hectare per annum. It should be applied before the onset of monsoon rain.
- For irrigated crop 10 – 20 tonnes of farmyard manure and 250 kgs nitrogen, 100 kgs phosphorus and 100 kgs potash per hectare should be applied
- The recommended dosage of N:P:K fertilizer is in the ratio 2.5:1:1

Pruning and Training

- Periodically some branches of the mulberry plant are methodically cut off, and this operation is called pruning.
- Removal of the branches will not devitalize the plant but, on the other hand, invigorate and rejuvenate it as the available energy is directed to fewer branches and fresh, young shoots sprout from the axillary buds.

Types of Pruning

There are four types of pruning. They are:

- a) **Bottom pruning or low-cut pruning**, in which the branches are cut to the base
- b) **Middle pruning**, in which the branches are cut around mid- height at about one metre
- c) **Top pruning or high-cut pruning**, in which the branches are cut at the top or to the soft portion.
- d) Kolar system, in which the branches are cut to the ground level, wherein the pruning and harvesting are done together.

Harvesting of mulberry Leaves

- It varies depending on the rearing practice in the locality, availability of labour etc. There are three methods of harvesting

1. Leaf Picking: The leaves are hand picked individually from the plant.

2. Branch Cutting: It is common in Kashmir, Karnataka and West Bengal etc. The entire branch with leaves is cut and fed to the worms and the method of rearing is shelf or floor rearing. It saves labour.

3. Whole shoot harvest: Commonly practised in Karnataka, West Bengal etc., it is suitable for places where budding occurs throughout the year. The branches are cut close to the ground level by bottom pruning and feeding the entire shoot to larvae after fourth moult.

Time of harvest

- Recommended time of harvest is the early morning hours.
- Fresh leaves with more water content will be better in their feed value.
- Due to active photosynthesis and transpiration during the day, the leaves harvested in the afternoon will have less water and more carbohydrate and will wither more rapidly than the leaves harvested in the early morning.

Store and Preservation of Leaves

- Fresh leaves have more nutritious, leaf preservation is essential.
- The ideal condition for preservation of leaves is below 20°C atmospheric temperature and over 90 percent relative humidity.
- Under tropical conditions soon after harvest, the branches are covered with wet gunny cloth.
- The leaves are collected in baskets and are covered with wet gunny cloth. Exposure to air current should be avoided.
- During storing, the leaves should be spread in thin layers and covered with wet gunny cloth. Leaves should not be stored for more than 24 hours

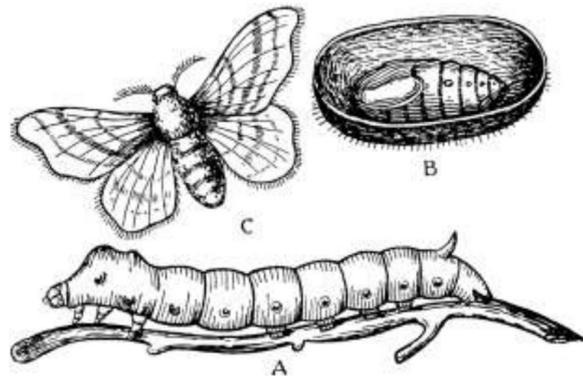
UNII-IV
THE MULBERRY SILK WORM

Bombyx mori

- *Bombyx* commonly called silk moth.
- Silk fibre produced by this silkworm is called mulberry silk.
- The caterpillar feeds on mulberry leaves
- The head bears a pair of compound eyes, a pair of antennae and mouth parts.
- The thorax bears 3 pairs of legs and 2 pairs of wings.
- The body is covered by scales.
- The female's body is distended due to the presence of eggs
- It is used in manufacturing silk cloths, fishing fibres, tyres of racing cars, in medical dressings, parachutes etc.
- It is exclusively cultivated in the states of Karnataka, Andra Pradesh and Tamilnadu.

Rearing of Silkworms

- The rearing of silkworm refers to the growing of silkworms in an ideal environment to produce cocoon for silk.
- In India, rearing is carried out 5-6 times in a year
- For a successful rearing of silkworms the following requirements should be fulfilled:
 - *Adequate supply of mulberry leaves.*
 - *Large number of labours.*
 - *Rearing house.*
 - *Rearing house must be a concrete building with ceiling of wood.*
 - *The house should be lighted.*
 - *Rearing appliances are needed.*

**Silkworm Rearing House**

- Silkworms are reared in a rearing house. It is a concrete building with thatched or tiled roof.
- There should be 3 rooms, 1.Rearing, 2.Keeping appliances 3.Storing mulberry leaves.

Rearing Appliances

- Silkworm rearing requires a set of appliances. They are the following:
 1. Rearing stand
 2. Rearing trays
 3. Chop sticks
 4. Feather
 5. Leaf basket
 6. Leaf chamber
 7. Chopping board
 8. Chopping knife
 9. Mats
 10. Feeding stand
 11. Cleaning net
 12. Mountages

1. Rearing Stand

- Rearing stand is used for keeping the rearing trays.
- It is made of wood or bamboo.
- The four legs of the stand are placed on ant wells
- It is filled with water. It is useful in preventing the entry of ants

2. Rearing Trays

- The trays are made of bamboo or wood
- The trays are coated with cow dung paste mixed with formalin
- The trays are stacked on the rearing stand
- The bottom of the tray is spread with paraffin paper. It prevents evaporation of water. It helps in regulating humidity

3. Chop Sticks

- Chop sticks are the two bamboo sticks (17.5cm).
- They are pointed at one end
- The other ends are tied by a small thread
- They work like a forceps
- They are used to pick up the larvae.

4. Feather

- Feather is a bird's feather.
- It is used to brush the newly hatched larvae from the egg card to the rearing trays
- It is also used to spread the larvae

5. Leaf Basket

- Leaf basket is a bamboo basket
- It is used to carry mulberry leaves from the field to the rearing house

6. Leaf Chamber

- Leaf chamber is made of wooden reapers.
- This chamber is closed on the sides and bottom.
- It is used to store the mulberry leaves.
- Wet gunny bags are placed on the leaf chamber to keep the mulberry leaves fresh

7. Chopping Board

- Chopping board is a rectangular mulberry board which is used for cutting leaves
- It is made of wood.

8. Chopping Knife

- Chopping knife is a sickle-like knife with a sharp blade
- It is used for cutting leaves.

9. Mats

- Mats are placed beneath the chopping board.

- They are used to collect cut leaves. Newspapers can also be used.

10. Feeding Stand

- Feeding stand is a stand on which the trays are placed after the removal of tray from the stand, to do feeding and other works.

11. Cleaning Net

- Nylon net is used to clean the bed. The net is spread over the tray. Fresh chopped leaves are spread on the net. Worms of the tray crawl through the meshes of the net and feed the fresh leaves
- The net is removed and the worms are transferred to a new tray. The old tray is removed.

12. Mountage

- Mountage is an appliance used to help the silkworms to spin the cocoon
- It is otherwise called cocoonage.
- It determines the quality and quantity of good cocoons.
- Mountages are made up of wood, bamboo, plastic, grass, dry leaves and twigs
- The mountages used in India are the following:
 1. *Paddy straw mountage*
 2. *Chandrika*
 3. *Screen-type mountage*
 4. *Plastic mountage*
 5. *Netrikka (Polymer mountage)*
 6. *Bottle brush mountage*
 7. *Bamboo strip mountage*
 8. *Plastic bottle brush*

Disinfection

- Disinfection of rearing house and appliances should be made twice before rearing that is once with 5% bleaching powder (immediately after the completion of previous crop) and another time with 2.5% Sanitech (Chlorine di-oxide) solution just 2 days before the next crop.

Maintenance of temperature and humidity

- The ideal temperature for the late age rearing is 26° C for III instar larvae, 25° C for IV instar and 24° C for V instar larvae. 80% humidity is required for III instar larvae and 70% is required for IV and V instar larvae.
- Adjust the temperature and relative humidity as per requirement by using cooling, heating and humidifying appliances such as air cooler, room heater, charcoal stove, wet gunny cloth or by sprinkling water on the roof or using wet sand.
- Good cross ventilation will help to reduce the body temperature of the silkworm.

Maintenance of hygiene

- Wash hands and feet with disinfectant solution before entering in to the rearing house. To begin with, the hands and feet should be washed with alkaline soap and then dipped in disinfectant solution (2.5% Sanitech/ Serichlor in 0.5% slaked lime solution or 2% Bleaching powder in 0.3% slaked lime).

- Wash hands in disinfectant solution and water after picking of diseased worms, after bed cleaning and before feeding.
- Pick the diseased worms every day into a basin with lime powder and bleaching powder mixture and dispose of carefully by burning or burying at a distant place.
- Keep the rearing room clean and well aerated during silkworm rearing.

Application of bed disinfectant

- Vijetha, Vijetha Green and Ankush are the silkworm body and rearing seat disinfectants for the prevention of silkworm diseases.
- Take the powder in a thin cloth and dust over the silkworms @ 5 g/square feet after every moult and once on 4th day of final instar after bed cleaning
- Note: Vijetha supplement is recommended for the use during rainy season and winter months to control muscardine.
- If muscardine disease is high during rainy and winter seasons, the use of Vijetha supplement is recommended to prevent this disease.
- Don't dust when silkworm are under moult or on eatable mulberry leaves.
- Feed silkworms 30 minutes after dusting.

Storage of Cocoons

- After stifling the cocoons may be reeled or it can be stored for many days.
- The cocoons are dried. During storage, the cocoons are damaged by beetles and fungi. The cocoons are also attacked by ants and rats
- For a proper storage, the storage room should be ventilated.
- Humidity should be maintained below 70%.
- Storage room should be well aerated

Marketing

- After grading the raw silk, the raw silk could be marketed
- India ranks 3rd among all the silk producing countries
- In India, raw silk is produced by handloom and power loom sectors
- Major states involved in the silk production are UP, Gujarat, Karnataka, Andhra Pradesh and Tamil Nadu.
- Marketing of raw silk can be possible only through merchants or brokers.
- In Bangalore, silk trade is controlled by merchants or brokers
- The raw silk will be sold to the weavers only through merchants or brokers.
- To compensate the deal, both the seller and the buyer should pay 3% commission to the merchants or brokers
- Market price was determined by these merchants.
- Here licensed weavers and traders are permitted to buy raw silk.
- Recently the Government established "Karnataka Silk Marketing Board (KSMB)" which will fix the price of raw silk and maintain the price level. Through this procedure, sellers are benefited.
- In Tamil Nadu, marketing is channelized through "marketing federation" in Kanchepuram.
- There is also a society called Silk Reelers and Handloom Weaving Society which transacts more than laksh kilograms of raw silk in Tamil Nadu.

UNIT-V VERMICULTURE

Organic farm

Organic farming is a technique, which involves cultivation of plants and rearing of animals in natural ways. This process involves the use of biological materials, avoiding synthetic substances (fertilizers, pesticides, growth regulators, genetically modified organisms and livestock food additives) to maintain soil fertility and ecological balance thereby minimizing pollution and wastage.

Vermiculture Techniques

- Rearing and multiplication of earthworms is called *vermiculture*.
- The vermiculture is the *artificial rearing* of earthworms in controlled condition to multiply the population.

Biology of earthworm

- It is worm like metamerically segmented animal
- Habitat: Moist place like soil, organic matters.
- Habit: free living
- They are burrowing animal
- They are **detritus**(waste matters) feeder
- Body cylindrical and elongated
- Anterior end is pointed and posterior end is blunt
- It is grown to about 15 cm
- They body divided in to 100-200 segments are called Metameres.
- External metamere marked is called Annuli and internal metamere is called septa.
- It has no head; the first segment is called Peristomium.
- Peristomium has mouth and Prostomium.
- The last segment is called anal segment or pygidium.
- The adult earth worm has 14-17th segments swollen into ring like structure called **Clitellum**.
- The clitellum divide in to 3 parts
- 1. Pre-clitellor region 2. Clitellor region 3. Post clitellor region

Need for Vermiculture

- To get plenty of earthworms.
- For vermicomposting.
- For inoculating earthworms into agricultural and horticultural fields (ex-situ vermiculture)
- To get vermicasts.
- To get vermicompost.
- To get vermiwash.
- To use earthworms as feed in aquaculture, dairy farming, poultry, etc.
- To use earthworms as bait.
- To use earthworms as medicines

Culturable Species

- Different types of worms are living in our soil. Though there are around 3,000 species of worms, only very few are used in vermiculture.

- The most commonly used species of earthworms to make compost from waste are
- *Eisenia foetida* (redwiggler's or manure worm)
 - *Lumbricus rubellus*
 - *Pheretima elongata*
 - *Pheretima asiatica*
 - *Perionys excavitus* (Indian blue worm)
 - *Eutrillus* spp.
 - *Megascolex* spp.

Materials required for vermiculture

The vermiculture involves the following steps:

1. Site selection
2. Species selection
3. Vermibed
4. Feedstock
5. Inoculation of earthworms
6. Feeding
7. Harvesting.

1. Site Selection for Vermiculture

- The site should be a slope area.
- There should be drainage facility
- Thatched huts should be raised over the place where vermiculture is done
- Plant and animal residues should be available near the site
- Shady areas of trees can be used
- Transport facility should be there for daily visit, marketing, etc

2. Species Selection

- The worms should have short life cycle.
- High rate of reproduction and growth
- They should feed voraciously
- High output of wormcasts
- Resistance to disease
- Adaptable to climatic changes.

3. Vermibed

- The earthworm is reared on a vermibed.
- Vermibed is the substratum on which the earthworms live, work and multiply.
- It is the house for the earthworms.

Vermibed Materials

- The materials used for the culture of earthworms constitute vermibed materials.
- The success of vermiculture depends on the selection of suitable vermibed materials.
- The following materials can be used for making vermibed

- Shredded cardboard, Grass clippings, Shredded paper waste, Packed papers and boards, Weeds, Dried leaves, Saw dust, Coffee grounds, Coir waste, Used tea leaves, Coconut husk, Crop wastes, Paddy husk, Hay, Crushed shells, Straw, egg, Grain husks, Crop residues

4. Preparation of Vermibed

1. The preparation of vermibed is started with basal layer at the bottom of the container

It includes:

- A layers of broken bricks or pebbles at the bottom
 - A layer of coarse sand.
 - A layer of loamy soil.
 - A layer of coconut husk is spread.
2. Then a layer of saw dust or shredded card board, or shredded paper or grass clippings or crop residues is laid
 3. Above this a layer of hay or straw is spread
 4. It is covered with broad leaves such as coconut leaves, or gunny bags
 5. Above each layer water is sprinkled.
 6. Watering is continued on alternate days
 7. The above set up is the vermibed. It is allowed to decompose for 15 days
 8. The total height of the vermibed should be 4 inches.

5. Inoculation of Earthworms

- About 100 earthworms are introduced on the pre decomposed vermibed after removing the covering
- The worms penetrate into the bed

Types of Vermiculture

There are two types of vermiculture namely:

1. *Monoculture*
2. *Polyculture*

1. Monoculture

- In monoculture method only one species of earthworm is cultured

2. Polyculture

- In polyculture method epigeic and anecic species of earthworms are used jointly.

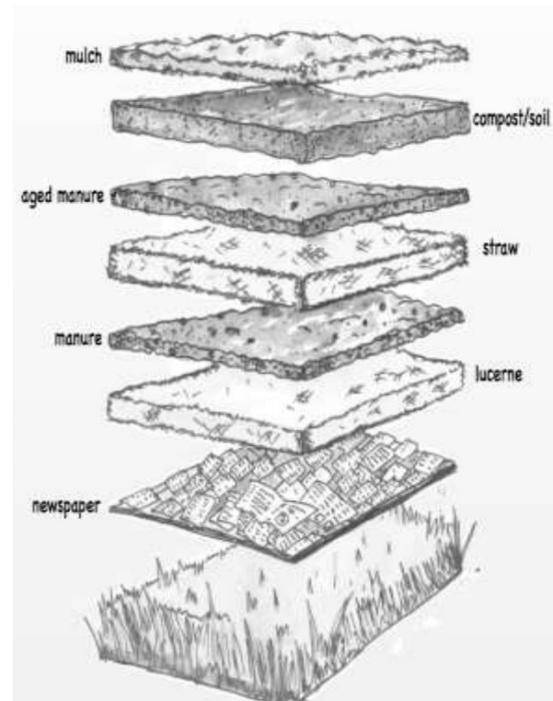
6. Feeding

- The earthworms are fed-with pre-decomposed feedstock. The feed is loaded on the top of the vermibed to a thickness of 8 inches.

Do Feed Worms

- Vegetable scraps
- Crop waste
- Tree, bush leaves and grasses and peels
- Fruit scraps

- Moldy bread and grains
- Used tea leaves
- Non-greasy food leftovers
- Coffee grounds
- Crushed egg shells
- Shredded paper products
- Shredded card board boxes
- Manures



Suitable Condition Required for Earthworms

1. Hospitable bed
2. Feeding
3. Moisture 75-90%
4. Adequate aeration
5. Optimum temperature 25-30°C
6. Neutral pH
7. The salinity of the soil should be less than 0.5%

7. Harvesting

- Harvesting is the collection of earthworms from the culture bed. The worms are ready for harvest in two months.

Vermiculture Process

- 1 Select a cool, shady place away from direct heat, strong sunlight and rains
2. Dig a pit measuring 2 x 2 2ft. Line the pit with polythene sheet to arrest the escape of earthworms through the crevices
3. Earthen pot, cement tanks, wooden boxes or buckets can also be used to culture earthworms
4. The pit is filled with bed materials and food materials with a total height of 1 foot
 - First layer - Broken bricks or pebbles
 - Second layer - Coarse soil
 - Third layer - Loamy soil
 - Fourth layer - Coconut husk, saw dust, paddy husk
 - Fifth layer - Hay straw

Dampen the bed by sprinkling water.

All the above layers form a basal layer. The height of the basal layer should be 4 inches. It filters and drains excess water. It also provides shelter to worms.

5. Above the basal layer bed materials are loaded to a height of 4 inches. The bed materials include
 - Shredded card board box
 - Shredded paper
 - Grass clippings
 - Coir waste,
 - Saw dust
 - Coconut husk

6. Above this layer water is sprinkled.
7. Microorganisms ferment the bed materials As a result heat rises. After two weeks, the heat begins to decrease
8. By the 2nd to 3rd weeks, production of heat inside the pit will cease and will come to 25 to 30°C.
9. In case no warmth is felt by hands, understand that the predigested vermicompost is ready for inoculation of worms
10. The feed of earthworms include the following raw materials
 - Cow dung
 - Green foliage
 - Vegetable remnants
 - Discarded parts of fruits
 - Droppings of horses, asses, pig, sheep
 - Biogas slurry

The feed materials are mixed, heaped and allowed to decompose for 15 days in a cool, shady place.

11. Release 50 earthworms per 10 kg of bed on the top of the vermicompost
12. The earthworms will penetrate in to the bottom
13. Pre-decomposed feed is loaded on the top of the vermicompost- Feeding is done thrice in a week.
14. Cover the surface with jute bags and keep them wet by sprinkling water
15. The vermicompost is turned upside down once in 15 days (fortnightly)
16. The earthworms breed and multiply in the vermicompost.
17. The earthworms are ready for harvest in 60 days.

Harvesting the Vermicompost

- The collection of vermicompost from the composted area is called harvesting.
- The finished material will be brown or earthy colour.
- The volume of material decomposed will be much reduced possibly down to 10% of its volume.
- In the tub method of composting, the castings formed on the top layer are collected periodically. The collection may be carried out once in the week.

Packing of Vermicompost

- Vermicompost is packed in polythene bags covered by gunny bags. They are stored in cool shady places

The nutrients profiles of vermicomposts are

- 1.6 percent of Nitrogen.
- 0.7 percent of Phosphorus.
- 0.8 percent of Potassium.
- 0.5 percent of Calcium.
- 0.2 percent of Magnesium.
- 1.75 percent of Iron.
- 96.5 percent of Manganese.
- 24.5 percent of Zinc.

Advantages of Vermicompost

- Vermicompost makes the soil more fertile.
- It provides vitamins, hormones and enzymes to plants for increasing the growth, vigour and yield.

- It provides disease resistance to plants.
- It prevents the leaching of mineral nutrients from the soil.
- It increases the microbial wealth on the soil.
- Mixing compost with soil also contributes to erosion control, soil fertility, proper pH balance and healthy root development in plants.
- The most beneficial feature of vermicomposting is that it eliminates foul smell of decaying organic wastes.
- Many industrial units covering paper, pulp and tanning make use of vermiculture technology for waste treatment.
- The vermiculture technology promises for waste disposal and manure generation.

Vocabulary

சொல்லகராதி

English	தமிழ்
Apiculture	தேனீ வளர்ப்பு
Arthropoda	கணுக்காலிகள்
Bee Comb	தேன்கூடு
Bee Hives	செயர்க்கை தேன்கூடு
Bee Veils	தேனீ கொட்டாமல் தடுக்கும் வலை
Begging	பிச்சை
Brood	குஞ்சுக்காக வழர்க்கப்பட
Capillary	தந்துகி
Commercial	வணிகம்
Commercial	வணிகம்
cottage industry	குடிசை தொழில்
Diploid	இரு தொகுதி
Domesticate	வீட்டிலேயேவளர்க்கும்
Drainage	வடிகால்
Ecdysis	தோலுரிதல்
Economic	பொருளாதாரம்
Emerged	வெளிப்படுவது
Employment	வேலைவாய்ப்பு
Equipment	உபகரணங்கள்
Erosion	அரிப்பு
Essential	அத்தியாவசிய

Evaporation	ஆவியாதல்
Excluder	தடுப்பான்
Ferocious	மூர்க்கமான
Fertile	வளமான
Fertilizer	உரம்
Fig	அத்திபழம்
Furrow	வரப்பு
Glands	சுரப்பிகள்
Grafting	ஒட்டுதல்
Grub	புழு
Haploid	ஒரு தொகுதி
Ingredient	மூலப்பொருள்
Irrigation	நீர்ப்பாசன
Manure	எரு
Moister	ஈரமான
Mulberry	மல்பெரி
Nectar	தேன்
Nuptial	திருமணம்
Nuptial flight	திருமணஓட்டம்
Patch	ஒட்டுதல்
Perpendicular	செங்குத்து
Pharmaceutical	மருந்து
<i>Polymorphism</i>	பல உருதன்மை
Propagation	இனப்பெருக்கம்
Pupa	கூட்டுப்புழு
Quality	தரம்
Quantity	அளவு
Rearing	வளர்ப்பு
Sallow	வற்றிய
Scion	சிரிய கொம்பு
Sericulture	பட்டுப்புழு

Silk yarn	பட்டு நூல்
Social insects	சமுதாய பூச்சி
Sprinkling	தூறல்
<i>Sterile</i>	மலட்டு தன்மை
Swarm	திரள்
Transplanted	இடமாற்றப்பட்ட
Violent	வன்முறை
Wax	மெழுகு
Wedge	ஆப்பு
Whip	சாட்டை
Farmyard	பண்ணை
Element	உறுப்பு
Indication	நோய்க் குறி
Efficiency	திறன்
Stunted	வளர்ச்சி குன்றிய
Yield	மகதூல்
Mixture	கலவை
Utilization	பயன்பாட்டுத்
Dosage	மருந்தளவு
Compost	மக்கிய
Nectar	தேன்
Annual	வருடாந்த
Monsoon	மான்சூன்
Periodically	குறிப்பிட்ட கால இடைவெளியில்
Methodically	முறையாக
Devitalize	உயிரூட்டக் கூறுகளை நீக்கு
Pruning	கத்தரித்து
Textile	ஜவுளி
Cultivation	சாகுபடி
Prevailing	மேலோங்கிய
Robust	வலுவான

Gunny bag	சாக்கு பை
Instar	இடைப்பருவம்
Disinfection	கிருமிநாசினி
Accumulate	குவிக்க
Humidity	ஈரப்பதம்
Ventilation	காற்றோட்டம்
Spill	கசிவு
Persist	தொடர்ந்து
Stifling	மறைத்தது
Silk	பட்டு
Pathogen	நுண்ணுயிரி
Adoption	தத்தெடுப்பு
Handloom	கைத்தறி
Wither	கவிழ்ந்துவிடும்
Vermiculture	மண்புழு வளர்த்தல்
Organic farming	இயற்கை வேளாண்மை
Livestock	கால்நடை
Pesticides	பூச்சிக்கொல்லி
Detritus	மக்கியதை உண்பவை
Annuli	வளையம்
Septa	இடைசுவர்
Vermicast	மண்புழு உரம்
Poultry	பறவை
Bait	தூண்டில்
Vermibed	மண்புழு படுக்கை
Pebbles	கூழங்கல்
Epidemic	தொற்றுநோய்
Biogas	உயிர்வாயு
Jute	சணல்
Vigour	வீரியம்
Microbial	நுண்ணுயிர்

QUESTION BANK**UNIT-I**
APICULTURE**I. Two mark questions**

1. Apiculture
2. Scope of apiculture
3. Species of honey bees
4. Queen bee
5. Drone
6. Worker bee

II. Five marks questions

7. Give a short note on *Apis dorsata*
8. Give a short note on *Apis florae*
9. Give a short note on *Apis indica*
10. Give a short note on *Apis mellifera*
11. Give a short note on colony organization of honey bee
12. Give a short note on division of labour in a bee colony
13. Explain about the structure of honey bee.
14. Discuss about newton's beehive with neat diagram.

III. Ten mark questions

15. Describe Life history of honey bee
16. Describe the bee handling equipments
17. Explain - Social life of honey bee
18. Give a detailed account on the different species of honey bees.
19. Give an account on the extraction instrument used in separation of honey.

UNIT-II
BEE PASTURAGE**I. Two mark questions**

1. Honey
2. Nectar
3. Properties of honey bee
4. Bee wax
5. Bee venom
6. Propolis
7. Royal jelly

II. Five mark questions

8. Give a short note on chemical composition of honey.
9. Write a short note on nutritional values of honey
10. Write the medicinal values of honey
11. Write a note on bee wax and bee venom.

III. Ten mark questions

12. Give an account on the extraction instrument used in separation of honey.
13. Give a detailed account on royal jelly and their importance
14. Write an essay on bee pasturage.

UNIT-III
SERICULTURE**I. Two mark questions**

1. Sericulture
2. Silk
3. Moriculture
4. Grafting
5. Cutting
6. Irrigation
7. Manuring
8. Pruning

II. Five mark questions

9. Give a short note on vegetative propagation
10. Give a short note on types of silk
11. Explain irrigation and their types
12. Describe the bed cleaning in silkworm rearing
13. Give an account on the tasar silk
14. Give a short note on optimum condition for mulberry cultivation

III. Ten mark questions

15. Explain harvesting, store and preservation of mulberry leaves
16. Enumerate the methods of propagation of mulberry plants.

UNIT-IV
MULBERRY SILK WORM**I. Two mark questions**

1. *Bombyx mori*
2. Mountage
3. Bed cleaning

II. Five mark questions

4. Give a short note on disinfection of silkworm
5. Give a short note on storage of cocoon
6. Describe the marketing of cocoon and silk
7. Explain the life cycle of mulberry silkworm
8. Describe the silkworm rearing house.
9. Explain feeding methods of silkworm
10. Analyze the commercial races of mulberry silkworm reared in india.
11. Explain about optimum condition required for the rearing of mulberry silkworm.

III. Ten mark

12. Discuss in detail about rearing appliances used for sericulture.
13. Give an elaborated account on the harvesting and storing of silkworm cocoon.

UNIT-V
VERMICULTURE

I. Two mark questions

1. Vermiculture
2. Organic farming
3. Types of vermiculture
4. Packing of vermicompost
5. Vermicompost

II. Five mark questions

6. Describe the optimum condition required for vermiculture.
7. Write a short note on advantages of using of vermicompost.
8. How will you select the suitable earthworm for vermiculture? Explain with example.
9. Write notes on material requirement for vermiculture
10. Advantages and benefit of vermicompost

III. Ten mark questions

11. Write a detailed note on the nutrient composition and advantage of using vermicompost.
12. Describe the methods of harvesting, packing and storage of vermicompost.

TWO MARK QUESTION BANK

UNIT-I
APICULTURE

I. Two mark questions

1. Apiculture

- Rearing of honey bee for honey is called Apiculture. This term is derived from the scientific name of honey bee *Apis*.

2. Scope of apiculture

- Apiculture is an ideal and economically viable industry at the village level.
- The World production of honey is about 6, 00,000 tones per year and 7 million bee-keepers are totally involved in this industry. But in India, 1.5 lakhs of bee-keepers are employed to maintain hives in apiaries.

3. Species of honey bees

The most common species of Honey bee are,

- *Apis dorsata*
- *A. florea*
- *A. cerana indica*
- *A.mellifera*

4. Queen bee

- **The queen** is the largest member of the bee colony.
- The queen lives inside the queen cell
- Queen is the mother for all the members of the colony.
- Queen main function is to lay eggs. Hence queen is called egg laying machine.

5. Drone

- Drones are **fertile** males.
- Their main function is to fertilize the eggs.

6. Worker bee

- The workers are *sterile* females.
- Each worker will perform different tasks based on their age. This is called age-related polytheism.
- They build combs
- They collect pollen and nectar from the flowers.
- The bee colony functions as one unit by *chemical communication*

UNIT-II BEE PASTURAGE

I. Two mark questions

1. Honey

- Flowers nectar is a solution of sugars and other minor constituents that bees collect and concentrate into honey. It is a sweet, viscous fluid, produced by honeybees.

2. Nectar

- Nectar is mainly a watery solution of the sugars fructose, glucose, and sucrose but also contains traces of proteins, salts, acids, and essential oils.
- Sugar content varies from 3 to 80 percent, depending upon such factors as plant species and soil and air conditions.

3. Properties of honey

- The colour, taste and flavour of honey are contributed by aromatic compounds, colloids and pollens.
- Honey is **hygroscopic**.
- When the honey is exposed to air, it absorbs moisture.
- Honey has high **viscosity**. So it flows very slowly
- The density of the honey is high
- The specific gravity of the honey is 1.41
- The colour ranges from white to dark.

4. Bee wax

- Bee-wax is secreted by the abdominal gland of bees.
- It is used for the construction of comb. It is a yellowish solid insoluble in water.

- It is used for the preparation of paints, varnishes, candles, models, etc.
- It is used as a ground substance for the preparation of ointments, creams, etc.
- It has many industrial uses. It is used extensively in engineering industries, railways, textiles, leather industries, etc

5. Bee venom

- Bee venom is secreted by the poison glands of stings.
- Bee venom is a curative toxin in humans.
- It is transparent and it has a bitter burning taste.
- It is acidic in nature. It contains formic acid, histamine, tryptophan, sulphur many proteins, volatile oils, enzymes like hyaluronidase and phospholipase and magnesium phosphate.

6. Propolis

- Plant resin and gum collected from plants and used to varnish or seal the inside of the hive by the bees.

7. Royal jelly

- Royal jelly is a milky white secretion of the hypopharyngeal gland of young worker bees mixed with digested pollen and nectar of honey.
- Royal jelly contains a protein called **royalactin**, which causes a normal larva develops into a queen. It is the regular food for the queen. Hence the name royal jelly.

UNIT-III SERICULTURE

I. Two mark questions

1. Sericulture

- Sericulture is the rearing of silkworms to produce silk.
- Sericulture is one of the branches of Applied Zoology.

2. Silk

1. Silk is a commercial product of silkworm.
2. It is the fibrous protein secreted by silkworms.
3. Silk is also produced by other organisms such as mussels, spiders and lepidopteran insects

3. Moriculture

- Moriculture means the cultivation of mulberry plants for the production of mulberry leaves.
- The leaves are fed by the silkworms

4. Grafting

- Grafting is the joining of the parts of two plants.
- It is a method of vegetative propagation.

5. Cutting

- Cutting is the raising of plants from twigs (Branch).
- Matured shoots with well developed buds are selected for cutting.

6. Irrigation

- The supply of water to crops at different intervals is called *irrigation*.

7. Manuring

- Application of fertilizers and manures not only increases the productivity but also improves the quality and quantity of leaves.

8. Pruning

- Periodically some branches of the mulberry plant are methodically cut off, and this operation is called pruning.

UNIT-IV
MULBERRY SILK WORM

I. Two mark questions**1. *Bombyx mori***

- *Bombyx* commonly called silk moth.
- Silk fibre produced by this silkworm is called mulberry silk.
- The caterpillar feeds on mulberry leaves
- The head bears a pair of compound eyes, a pair of antennae and mouth parts.
- The thorax bears 3 pairs of legs and 2 pairs of wings.

2. Mountage

- Mountage is an appliance used to help the silkworms to spin the cocoon
- It is otherwise called cocoonage.
- It determines the quality and quantity of good cocoons.
- Mountages are made up of wood, bamboo, plastic, grass, dry leaves and twigs

3. Bed cleaning

- Nylon net is used to clean the bed. The net is spread over the tray. Fresh chopped leaves are spread on the net. Worms of the tray crawl through the meshes of the net and feed the fresh leaves
- The net is removed and the worms are transferred to a new tray. The old tray is removed.

UNIT-V
VERMICULTURE

I. Two mark questions

1. Vermiculture

- Rearing and multiplication of earthworms is called *vermiculture*.
- The vermiculture is the *artificial rearing* of earthworms in controlled condition to multiply the population.

2. Organic farming

Organic farming is a technique, which involves cultivation of plants and rearing of animals in natural ways. This process involves the use of biological materials, avoiding synthetic substances (fertilizers, pesticides, growth regulators, genetically modified organisms and livestock food additives) to maintain soil fertility and ecological balance thereby minimizing pollution and wastage.

3. Types of vermiculture

There are two types of vermiculture namely:

1. *Monoculture*
2. *Polyculture*

4. Packing of vermicompost

- Vermicompost is packed in polythene bags covered by gunny bags. They are stored in cool shady places

5. Vermicompost

Vermicompost is the product of the decomposition process using earthworm.

UNIVERSITY QUESTIONS

S.NO: XXXX

Subject Code: 16SACZO2B., SC DEGREE EXAMINATION – NOVEMBER-2019Part III – AlliedZOOLOGY-II (COMMERCIAL ZOOLOGY)

Time: Three Hours

Maximum: 75 marks

SECTION A- (10×2=20)Answer ALL questions

Explain / Define the following:

1. Worker bee
2. *Apis indica*
3. Uncapping knife
4. Nectar
5. Muga silkworm
6. Silk producing organism
7. Disinfection
8. Silk marketing
9. Comment on earthworm species
10. Vermiculture

SECTION-B (5×5=25)Answer ALL questions, choosing either (a) or (b)

11. a). Describe the bee handling equipments. **(OR)**
b). Give a short note on division of labour in a bee colony
12. a). Write the medicinal values of honey **(OR)**
b). Write a short note on nutritional values of honey
13. a). Describe the bed cleaning in silkworm rearing **(OR)**
b). Give a short note on optimum condition for mulberry cultivation
14. a). Explain the life cycle of mulberry silkworm **(OR)**
b). Describe the silkworm rearing house.
15. a). Describe the optimum condition required for vermiculture. **(OR)**
b). Write a short note on advantages of using of vermicompost.

SECTION-C (3×10=30)Answer any THREE questions

16. Give a detailed account on the different species of honey bees.
17. Give an account on the extraction instrument used in separation of honey.
18. Enumerate the methods of propagation of mulberry plants.
19. Give an elaborated account on the harvesting and storing of silkworm cocoon.
20. Describe the methods of harvesting, packing and storage of vermicompost.

S.NO: XXXX

Subject Code: 16SACZO2B., SC DEGREE EXAMINATION – APRIL-2019Part III – AlliedZOOLOGY-II (COMMERCIAL ZOOLOGY)

Time: Three Hours

Maximum: 75 marks

SECTION A- (10×2=20)Answer ALL questions

Explain / Define the following:

1. *Apis indica*
2. Apiculture
3. Propolis
4. Royal jelly
5. Pruning
6. Muga silk
7. Mountages
8. Rearing house
9. Organic farming
10. Vermicompost

SECTION-B (5×5=25)Answer ALL questions, choosing either (a) or (b)

11. a). Explain about the structure of honey bee. (OR)
b). Discuss about Newton's beehive with neat diagram.
12. a). Give an account on honey extraction. (OR)
b). Write a note on bee wax and bee venom.
13. a). Analyze the optimum condition request for the mulberry growth. (OR)
b). Give an account on the tasar silk
14. a). Analyze the commercial races of mulberry silkworm reared in India. (OR)
b). Explain about optimum condition required for the rearing of mulberry silkworm.
15. a). How will you select the suitable earthworm for vermiculture? Explain with example. (OR)
b). Write notes on material requirement for vermiculture.

SECTION-C (3×10=30)Answer any THREE questions

16. Give a detailed account on beekeeping equipments used for apiculture.
17. Write an essay on bee pasturage.
18. Explain about the harvesting and storage of mulberry leaves.
19. Discuss in detail about rearing appliances used for sericulture.
20. Write a detailed note on the nutrient composition and advantage of using vermicompost

தேடிச் சோறுனிதந் தின்று - பல

சின்னங் சிறுகதைகள் பேசி - மனம்

வாடித் துன்பமிக உழன்று - பிறர்

வாடப் பலசெயல்கல் செய்து - நரை

கூடிக் கிழப்பருவ மெய்தி - கொடுங்

கூற்றுக் கிரையெனப் பின்மாயும்,,,,,,

