# Model Answer of AV-9026

## B.Sc. (R.T.) III Semester-2015

## R.T. - 308: Sericulture

### Section-A

Q.1. objective type questions:

(i) China (ii) Saturnidae (iii) Muga (iv) V Instar
(v) Low cut (vi) 65-85 % (vii) Ecdysone
(viii) Univoltine (ix) Charkha (x) Wrinkled Cocoons

### Section-B (Short answers)

Q.2. Describe the host plants of Mulberry and non-mulberry silk moths.

(i) Morus alba: Family- Moraceae

- Other species of Morus are M. indica, M. serrata, M. rubra, etc. used in sericulture.
- It is commonly known as mulberry or Shahtoot.
- It is a perennial plant which produces leaves for sericulture upto 15 years.
- Its distribution is worldwide (India, China, Japan, Korea, America, etc.).
- Leaves are fed to mulberry silkmoths.
- It is also used for fruits & timber.
- It can be propagated by seedling, cutting, budding, grafting and layering.

(ii) Terminalia arjuna: Family- Combretaceae

- Leaves are fed to tasar silk moth.
- It is commonly known as Arjuna.
- Leaves are green on top and brown below
- Bark is smooth and grey.
- Flowers are pale yellow in colour appear in March & June while fruits are fibrous woody appear between Sept. & Nov.
- It is distributed in W.B., South & central Asia.
- It is used in wound healing & ulcer & heart diseases.
- It is said to have used for achieved enlightenment.

(iii) Terminalia tomentosa: Family – Combretaceae
- It is commonly as Asan.
- It is distributed in forest of Southern India.
- It is fed to tasar silk moth (Leaves)
- Bark is fire resitant.
- Leaves and flowers are similar to arjuna.
- Bark is used medicinally against diarrhoea.
- Chemicals are obtained to dye and tan the leather.

(iv) Shorea robusta; Family – Dipterocarpaceae
- It is commonly known as Sal.
- In India, it is distributed in Assam, Bengal, Odisa, Jharkhand, C.G., etc.
- Leaves are similar to Ashok plant leaves.
- It is deciduous in dry rejon but evergreen in wet areas.
- In Hindu tradition, it is favoured by Vishnu.
- It is important source of hardwood timber.
- Leaves are fed to tasar silk moth.
- Leaf plates and bowls are prepared by dry leaves.
- Seeds are source of lamp oil and vegetable fat.

(v) Zizyphus Jujuba → Family – Rhamnaceae
- It is commonly known as Ber.
- It is a spiny shrub and small tree.
- It is distributed throughout the world in sub-tropical & tropical regions.
- Few species are deciduous & few are evergreen.
- Fruits are edible.
- Leaves are fed to the tasar silk moth.
- It is believed to nourish the heart.
- It is used to treat irritability, insomnia, etc.

(vi) Ricinus communis: Family → Euphorbiaceae
- It is commonly known as Castor oil plant.
- It is widely distributed in tropical regions.
- It is fast growing perennial shrub.
- Leaves are glossy. Young leaves are dark reddish purple but mature are dark green.
- Flowers are yellowish green.
- Fruits are spiny and greenish capsule.

- Leaves are fed to the Eri silkmoth's larvae.
- Medicinally used as anti-toxin, anti-microbial, anti-inflamatry and antiallergic

(VII) Ficus bengalensis: Family → Moraceae
- Commonly known as Banyan tree or Bargad.
- It produces aerial roots & canopy is largest.
- Figs are eaten by birds
- Leaves are eaten by tasar silk moth.
- It is having religious importance.

(VIII) Ficus religiosa: Family - Moraceae
- It is commonly known as Peepal.
- Also have religious importance.
- Most characters are similar to Bargad.
- Used in traditional medicines like Asthma, epilapsy, etc.
- Leaves are fed to tasar silk moth.

(IX) Ficus carica: Family - Moraceae
- It is locally known as Anjeer (Common fig).
- It is cultivated since ancient time for fruits.
- Flowers are not visible
- Fruits are edible.
- Leaves are fragrant & fed to tasar silk moth.
- Seeds are dispersed by birds & mammals
- Fruits are used in Jam & Cookies.

(X) Machilus bombycina -
- It is commonly known as Som.
- It is cultivated in temperate regions.
- It is mainly found in Assam.
- Leaves are fed to the muga silk moth
- This plant has great importance in the production of highly priced muga silk.

Q.3. Describe metamorphosis in silkmoth.

- Transformation of an immature larva into a sexually mature adult is known as metamorphosis.
- There are four types of metamorphosis in insects:

① Ametabolous metamorphosis: Metamorphosis is absent. Newly hatched creature looks like an adult except in size and other appendages eg. Lepisma

② Hemimetabolous metamorphosis: It is incomplete metamorphosis. Immature stages are nymphs which are aquatic while adults are aerial eg. Dragon fly.

③ Paurametabolous metamorphosis: It is a gradual metamorphosis. Nymphs resemble an adult but lacks wings & external genitalia. Nymphs moult many times to become an adult. eg. Grasshoppers

④ Holometabolous metamorphosis: It is complete metamorphosis. Four developing stages are present → Eggs, larva, Pupae & adults.
eg. Silk moth, Honey bee, etc.

- Hormonal Control of metamorphosis:

① BH → It is secreted by brain cells and activates Corpora cardiaca.

② PTTH → Secreted by Corpora Cardiaca & stimulates prothoracic gland.

③ Ecdysone → It is secreted by prothoracic gland and is responsible for moulting, pupation & initiation of adult characters.

④ JH → secreted by Corpora allata & promotes metamorphosis. It also maintains larval characters after each moult. When JH becomes low or absent larva is changed into pupa then into adult.

- Metamorphosis in silkmoth → It is accompained by histolysis and histogenesis. It takes place in the presence of mild concentration of Ecdysone & absence of JH.
- JH maintains larval characters from I to V instar larvae
- Ecdysone is also known as moulting hormone which promotes moulting after each instar.

Q.4. Write a brief account on incubation of mulberry leaves.

- The fresh leaves are more palatable and nutritious to the silkworm.
- Generally leaves are harvested twice a day and are preserved for successive feedings upto 24 hrs as per the necessity. During this period, the leaves should be preserved in moist, cool and clean places in order to preserve their succulency.
- The branches soon after harvesting are kept in buckets and them are preserved by covering them with wet gunny cloths while being transported to the rearing house.
- Care must be taken to the keep place, where the leaves are preserved, as cool and moist as possible.
- The ideal condition is below 20°C atmospheric temperature and over 90% of relative humidity.
- Heating up leads to fermentation and high storage temp. To avoid this, the leaves should be spread loosely in layers and covered with gunny cloths/alkathene sheets.
- We should not store the leaves for long time, because considerable nutritional changes take place in the leaves. The proteins are broken down to amino acids and the carbohydrates to simple sugars in the harvested leaves. These substances are utilized by the leaves for respiration during long preservation, in addition to the loss of water due to transpiration. Thus leaves become poor in nutrients.

Q.5. Write short notes on (a) Voltinism
(b) Harvesting of Cocoons

(a) Voltinism: The production of number of generations of silkmoth in a year is called voltinism.

- Voltinism is of three types: on the basis of races & crops:

(1) Univoltine races → These produce only one generation/crop in a year. The eggs undergo in diapause during winter till the onset of next spring. These races have comparatively longer life cycle. They spin large sized cocoons of superior quality. They are reared only in spring.

These races are sensitive to high temp. and humidity, therefore are not suitable for autumn and summer seasons.
eg. Mulberry silkworm (All tybes)

(2) Bivoltine races: These produce two generations in a year. These are stronger as compared to univoltine races. These are reared in spring and autumn seasons. The first generation reared in spring which lay non-hibernating eggs, from which second generation develops. Second generation lays hibernating eggs. The life cycle is slightly shorter than the univoltine race.
eg. Tasar silk moth

(3) Multivoltine races: These produce several generations in a year. These are highly strong and resistant to high temp. and humidity. They have very short life cycle. The cocoons are small and much inferior to those produced by uni or bivoltine races. The silk produced is not preferred in the international market. These are mainly reared in spring, summer & autumn seasons.
eg. Muga Silkworm.

(b) Harvesting of Cocoons:- Early harvesting of cocoons should be avoided because they are soft & may be ruptured.
- When the pupa turns dark brown, harvesting can be done.
- Generally harvesting is carried out after 7th or 8th day of spinning of cocoons.
- Late harvesting is avoided because parasitic insects may damage the cocoons.
- Cocoons are normally harvested by hand but simple devices may be used (Forceps, knives, scissors, etc.).
- After harvesting, the cocoons are ~~harvested~~ sorted as good and defective.
- Good cocoons are cleaned and marketed at once to get good price

Q.6. Write a brief account on stifling of cocoons.

— The moths emerge out by piercing the cocoon shell within 10-12 days after cocoon formation which break the cocoon thread. Therefore cocoons are to be stifled to kill the pupae and to dry the cocoons. Following are the popular methods to stifle cocoons:

① Sun drying: It is very simple and cheap method but not ideal as it affects the realability and quality of silk.

② Steam stifling: It is most common method in India.

ⓐ Basket steaming: This method is followed by all small scale reelers. This method utilizes small quantity of cocoons at a time (For filature reeling machine).

- About 10-15 kg of cocoons are filled in a bamboo basket covered with a wet gunny cloth. It is placed over a mouth of a vessel containing boiling water. Pupae are stifled within 30 minutes.
- The freshly steamed cocoons are dried in air till the weight of cocoons reduced upto one third.
- The charkha reelers often use the reeling basin itself for this purpose.

ⓑ Chamber steaming: This is done to stifle of large quantity of cocoons. This is done in a specially designed chamber connected with steam pipes from the boiler. The chamber is provided with movable shelves and trays filled with live cocoons. steam with pressure is released and cocoons are stifled within 15 minutes. Then cocoons are air dried.

③ Hot air drying: It is also carried out in a specially designed chamber. This method kills the pupae and also dry them. This method provides superior quality of silk threads. There are two types of hot air drying chambers ⓐ Self carrier dryers ⓑ Conveynor type dryer.

- This method is suitable only for automatic reeling machine, which requires a large number of cocoons.

④ Boiling with water: Small quantity of cocoons are stifled by this method which is having a number of advantages:

- Dust, dye and gelatinous materials are removed.
- Easy to get origin point for reeling.
- Continuous thread is obtained easily.
- Cheap and simple method.
- Air drying is required to avoid fungal contamination.

Q.7. Describe nutrient management in mulberry cultivation.

- Soil contains various micro and macro elements which are essential for normal growth of the mulberry plants
- The macro elements such as N, P, K, Ca, Mg & S and micro-elements such as Fe, Bo, Mn, Zn, Cu, Cl & Mo play very important role in various morphological, physiological and biochemical activities of the plants and any imbalance of these elements produces symptoms similar to those of diseases.
- Critical limit of soil nutrients:

N → 18 lb/acre, P → 60 lb/acre, K → 225 lb/acre

Cu → 6 ppm, Zn → 20 ppm, Mn → 50 ppm, Mo → 0.1 ppm.

- Significance of nutrients:

① Nitrogen :- It is an essential component of proteins, enzymes, chlorophyll, vitamins and hormones, etc.
- Deficiency shows feeble growth, produces less branches with yellowish leaves. Excess of it makes plants easily susceptible to pests and diseases & burning of tips of leaves.
- Nitrogen deficit soil should be treated with nitrogen fertilizers like Urea, ammonium nitrate, DAP, etc.

② Phosphorus → It is a component of nucleic acid, proteins and phospholipids. It is important for metabolism of fats, carbohydrates and proteins.
- Deficiency of it shows less growth, chlorosis & necrosis resulting in defoliation. Excess 'P' causes mottling in leaves.
- 'P' deficiency is prevented by phosphate fertilizers like single super phosphate.

③ Potassium → It plays important role in photosynthesis and synthesis of carbohydrates & proteins. It also imparts some tolerance to the plants to stresses.
- Its deficiency causes scorching of leaves, weak root system, etc. Excess of it causes mottled appearance of tissues.
- Soil should be treated with Muriate of Potash.

④ Calcium → It plays important role in cell division, cell wall formation and permeability of membrane.
- Its deficiency causes pale and deformed leaves & necrosis. Excess of it makes the soil alkaline.
- Use of lime is most suitable to correct the deficiency.

(5) Magnesium → It is structural component of chlorophyll.
- Its deficiency causes chlorosis and necrosis and finally premature defoliation.
- Its deficiency is controlled by the use of magnesium sulphate or magnesium oxide.

(6) Iron → It is an component of many enzymes used in respiration and chlorophyll synthesis.
- Deficiency causes chlorosis. Excess results in the production of new mottled leaves.
- Foliar spray of iron sulphate is useful.

(7) Copper → It acts as a catalyst in many chemical reactions and as a co-factor of many enzymes. It is essential for normal growth and colour of plants.
- Its deficiency causes wilting of tender leaves. Excess of it causes death of bark.
- Deficiency is corrected by the use of copper sulphate.

(8) Molybdenum → It is constituent of enzyme nitrate reductase.
- Deficiency results in chlorosis, necrosis and in reduction of activities of symbiotic nitrogen fixing bacteria.
- Correction may be done by the use of ammonium molybdate or sodium molybdate.

(9) Zinc → It is important component for auxin metabolism hence regulates the stem elongation and cell enlargement.
- Deficiency causes triangular leaves. Excess is injurious to root system and therefore causes stunt growth.
- Deficiency is corrected by zinc sulphate, zinc chloride, zinc ammonium sulphate, etc.

## Section – C'

Long answer type questions:

Q. 8. Describe the factors influencing growth and development of silk moth.

- Mulberry leaves are highly nutritious, so rural people use these as food besides in sericulture.
- Several compounds of Ca, P, Si, Mn, Mg, Fe, Cu, Zn, etc. & vit. C' are found in abundance in mulberry leaves. These nutrients ultimately affect the growth of silkworms.

- Chemical composition of mulberry leaves →

Moisture → 81.75 %, Proteins → 6.8 %, Carbohydrates → 2 %, Fat → 0.6 %, Minerals → 3.6 %, others → 11.85 %.

- The absorbed nutrients are converted into various substances essential for growth.
- The amount of ingestion is more in advanced larvae than those of younger ones but on the contrary, digestibility is higher in younger larvae than in grown larvae.
- About 25 % of leaves is converted into silk substances.
- Environmental factors →
  1. Light → Fond of dim light, 16 hrs dark & 8 hrs light & vice-versa
  2. Temp. → 20 - 30°C
  3. Humidity → 70 - 90 %
  4. Air flow → well aerated to avoid $CO$, $CO_2$, $SO_2$, $NH_4$, $CH_4$, etc.
- Hormonal factors → Ecdysone and JH. These keep longer duration of larvae and size of silk gland increases
- Genetic factors → DNA & RNA contents
- Growth of larvae → Soon after hatching, silkworm starts feeding and grow. In fifth instar stage they eat more display a remarkable growth rate. Due to these nutrients, number and cell size of cells is increased, hence weight is increased (Size and weight is increased than new born larva → 8000 and 10,000 times respectively)
- Another type of growth is exhibited by haemocytes. Size remain same but number of haemocytes is increased by cell division

Q. 9. Write a detail account on propagation of mulberry plants.

- Raising of plants either from seeds or through stem or root is called propagation.
- Vegetative propagation having following advantages:
  (a) Maintenence of particular characters of the plant
  (b) Raising samplings in large number
  (c) Adaptability of plants to a particular habitat
  (d) To develop resistant to pests and diseases & to modify the growth of plant.

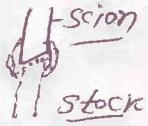
- However seedling propagation has some limitations
  (a) Triploid plants can not be propagated
  (b) Genetic various are produced due to biparental origin.

- Types of Propagation:

I. Seedling propagation → It is carried out for hybridization.
- It includes following steps:
  (a) Sowing of seeds (b) Germination of Seeds (c) Seedlings

II. Vegetative propagation: It includes:

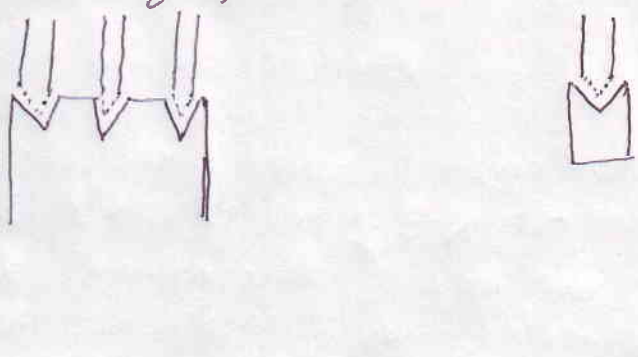
(a) Cutting → (i) Preparation of Cuttings and
(ii) Formation of roots.




(b) Grafting → It includes shoot, root & bud grafting.

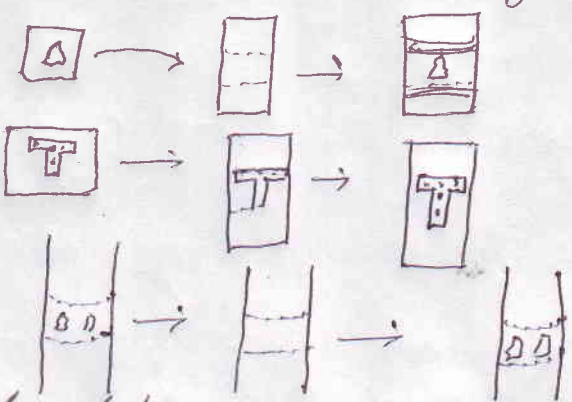
- Shoot grafting → It requires →
- Grafting clay → Clay two parts + Cow dung one part + Chopped hay + water
- Grafting wax: Tallow one part + bee wax one part + resin four parts and melting the mixture.
- Shoot grafting is following types:

(1) Wedge grafting →
(2) Crown grafting →
(3) Whip grafting →



- Root grafting → When the root is used as stock for grafting.
- Bud grafting → This grafting is used when scion are limited in number. Following types:

(1) Patch budding →
(2) T-budding →
(3) Flute budding →

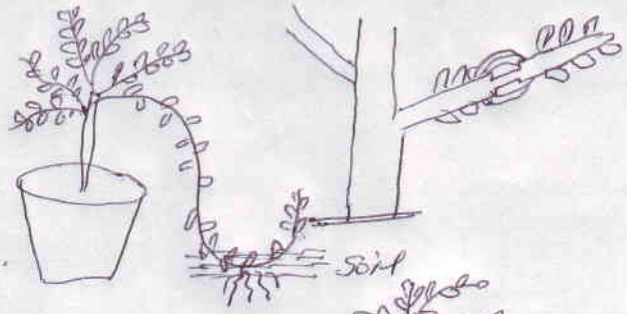


- Layering → It is development of roots on the stem. This rooted stem is then cut and planted.
- It is of three types:

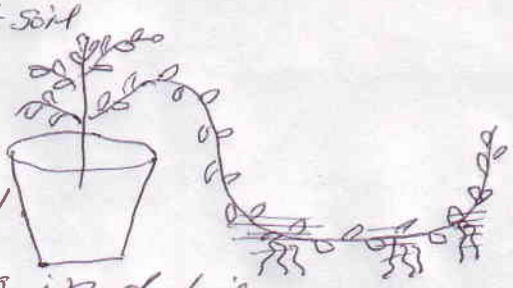
① Air layering →

② Simple layering

③ Trench layering.




— Saplings → Tree is pruned at bottom level. Saplers are produced which are transplented



Q.10. Describe late age rearing in detail:

Q.10 Late age rearing

The IV and V instars silkworms are reared and it is comparatively easy. Size of caterpillar is increased 29 times, body weight by 25 times and silk gland wt. by 200 times.

- Environmental Conditions:

① Temperature: 24-25°C

② Humidity → Less than 75%

③ Light → 16 hrs light and 08 hrs dark

④ Air → Continuous air flow to remove injurious gases.

- Mulberry leaves: Thick leaves are highly nutritious with low moisture contents are fed to late age larval.

- Methods of Rearing: There are three methods employed to rear the worms

ⓐ Shelf rearing: Rearing of silkworms in rearing trays arranged one over the other in tiers on rearing stands is called shelf rearing. Generally rearing stands are arranged in two rows parallel to the wall with adequate space in the centre. Each rearing stand can accomodate upto 10 rearing trays. 3-4 feedings are given a day. Nets are used for cleaning the rearing bed once a day. This method of rearing requires greater labour

ⓑ Floor Rearing → This type of rearing is performed on fixed sheets which are arranged in two to three tiers to accomodate more silkworms as possible as. The space between the tiers should be 0.6 — 0.8 m. The rearing sheet is is usually made of wood or bamboo strips. Silkworms are fed with leaves or branches cut small. (3-4 times/day. Bed cleaning is carried out less frequently. Floor rearing is less laborious.

(c) Shoot Rearing → It is very similar to floor rearing. Silkworms are reared on big branches arranged in one or two tiers. The big shoots are fed straight away to the worms. The gap between the tiers should be about 10 m. In this rearing better aeration is provided and so to more moths are accomodated. Cleaning is also reduced to a minimum. It is done with the help of ropes. It is very less labour consuming process in feeding and cleaning. This method is becoming more popular in Japan.

# Diseases & Pests of Mulberry



- There are several diseases which effect the plants qualitatively and quantitavely resulting in the poor health of silkworms thereby quality and quantity of the produce/silk. Therefore, management of mulber diseases is a pre-requisite for successful sericulture.

Some of the major diseases & pests of mulberry in India and their management strategies are as follows

I Fungal diseases (Diseases) → causes maximum loss

① Mulberry leaf spot → In temperate region, it is caused by Cercospora mori and in tropical areas by Cercospora moricola. This disease accounts for 10-35% reduction in leaf yield. In initial stage, brown patches appear on the leaves surrounded by light yellow lining. In advance stge, spores turns dark brown and form lesions resulting in defoliation. Brown colour is of phenolic compounds produced by the host as a defence reaction towards the pathogen.

- The pathogens are soil born. In rainy season, pathogens produce conidia which are released and infect leaves through stomata.

- Control: ① Field sanitation ② Use of disease resistant varieties ③ Foliar spray of fungicides → Carbendazim and Bendate ④ Use of antagonistics → Streptomyces and Pseudomonas

② Powdery Mildew → It is caused by Phyllactinia corylea. It is more prominent in temperate regions. It reduces the nutritive value of leaves.

- The disease is characterised by the apperance of white powdery patches on the under surface of leaves which then turns to dark brown or black. After that defoliation of leaves takes place. Ascospores infest fresh leaves.

- The disease is air born which generally appears in summer and autmn.

- Control → ① Burning and destroying of infected leaves.

② Use of disease resistant varieties ③ Wide spacing among plants and training ④ Folier spray of fungicides → Bavistine & Kathane ⑤ Use of predators eg. Yellow lady beetles.

③ Mulberry Leaf Rust → It is caused by Accidum mori (red leaf rust) in temperate and sub-tropical regions during summer. Yellowish-brown circular spots are appeared on both side of leaves. Leaves wither and fall prematurely.

– Disease is air or water born through uredospores.

– Control → ① Field sanitation ② Adoption of proper agronomical practices ③ Folier spray of fungicides → Saprol & Foltaf

II Bacterial disease → Bacteria are next to fungi to cause heavy loss.

① Bacterial leaf blight → It is caused by Pseudomonas mori mostly in rainy season. It causes 5–10% loss in foliage yield.

– Disease is characterised by appearence of transparent water soaked spots on the leaves. Later the spots turn to blackish brown surrounded by yellow margin. Leaves fall prematurely.

– Disease is soil or plant residue born which spreads through water, wind or insects.

– Control → ① Proper cultural practices ② Removal and burning of infected leaves/parts ③ Use of disease resistant varieties ④ Folier spray of anti-bacterial agents streptomycin and streptopenicillin

② Bacterial Rot disease → It caused by Bacterium mori and B. moricolum. These inject the proximal portion of shoots, buds and leaves. After that leaves become dry and wither off. Phloem decays and colour change to blackish brown. Twigs become fragile and then break off.

– Pathogens are soil born which inject the plant through cut.

- Control → ① Burning of diseased and dead parts of plants ② High cut pruning ③ Treatment of soil with Calcium cyanide (Lime nitrogen) ④ Use of Bordeaux mixture in the drench of soil around the infected plants.

III Viral diseases →

① Leaf Mosaic disease → It is caused by leaf mosaic virus which is transmitted through grafting or insect vectors. Fleshy protuberance appears on the back side of leaves causing wrinkles, chlorophyll reduction and deformation of leaves.

- Control → ① Removing and burning of diseased plants ② Use of disease free saplings and cuttings ③ Eradication of injurious insects which may be vectors.

② Dwarf disease → It is caused by Mycoplasma type micro-organisms. Disease is transmitted by grafting & by Leaf hoppers. Symptoms of disease are → Wrinkled & yellow leaves, defoliation, formation of deformed branches, low transpiration rate, fragile shoot, etc.

- Control → ① Use of healthy saplings & cutting, ② proper cultural practices, ③ Proper sanitation ④ Use of disease resistant varieties

IV. Nematode diseases → It is caused by Meloidogyne incognita. It is found in root knots and root lesions.

- Symptoms are → Retarted growth of plants, yellowing and reduced growth of leaves
- It is a soil born disease.
- Control: ① Deep ploughing helps in exposing the eggs and larvae to sunlight to kill these ② Destruction of weeds which serve as alternate hosts of the nematodes ③ Fumigation of soil with 5 ml D-D (Dichloropropane - Dichloropropane) mixture per pit ④ Treatment of soil with neem oil cake at 200 kg per acre is highly effective ⑤ Use of bacterial and fungal antagonists

## Insect Pests

① Mulberry Pyralid (Glyphodes bylaalis) → It is an lepidopterian insect which attacks the mulberry plants

in temperate regions during summer and autmn. It causes extensive damage to the leaves.

- Larvae spin silky net around themselves and eat leaves. Excreta make the leaves unfit for silkworms. Leaves are left behind as the network of veins.

- Control → ① Digging of soil destroys the hibernating larvae ② Burning of diseased leaves ③ Use of insecticides like Quinalphos or Dichlorvos ④ Use of natural enemies like Apenteles and Chelonus sps.

② Bihar hair caterpillar (Spilosoma obliqua). It is a lepidopteran insect. It is polyphagous in nature. Larvae feed voraciously on leaves.

- Control → ① Use of light traps ② Destruction of eggs, ③ Foliar spray of Nuvan (Dichlorves) or Dimethoate.

③ Scale insect (Pseudococcus comstocki kuwana). It is an hemipteran insect. Pest sucks the plant sap causing leaf curling, yellowing of leaves and then withering of leaves.

- Control → ① Use of light traps ② Spray of 0.2% Fenthion

④ Stem borer (Bactocera rufomaculata). It belongs to order of Coleoptera. Grub damages 24 to mulberry plantation by boaring tunnels into stem and other branches and feed on it. Foliage yield is greatly reduced and plant dies.

- Adults are nocturnal and feed on barks and tender leaves.

- Control: ① Pruning of dead and infested parts ② Use of chloroform (5 ml/bore).