

## **DISEASES OF SILKWORM / SILK MOTH**

Diseases of silkworm are a big challenge for the rearers. Due to prolonged domestication, silkworm develops less immunity and less adaptability for which they are often attacked by different agents. Although some attempt has been made to develop disease resistant silkworm variety, but only a limited success is obtained till date. In spite of taking many efforts on the rearing environment, silkworms are vulnerable for infection of the following agents or pathogens-

1. Protozoa
2. Bacteria
3. Viruses
4. Fungi

### **1. Protozoan Diseases-**

A) **Pebrine-** This is one of the most virulent protozoan disease. The disease is caused by protozoa- *Nosema bombycis*. **NIK-2r, NIK-3h and NIK - 4m** are the three most virulent strain of this pathogen found in India. The protozoa complete its life cycle through two stages- infective spore stage and vegetative stage.

**Symptoms-** symptoms exhibited by the different stages of life cycle of silkworms are –

**Egg- i)** infected egg exhibit less attachment with the egg cards due to improper deposition of glue.

**ii)** Eggs turn pale yellow and may fail to hatch.

**Larvae-**

**i)** Primarily infected larvae normally die before exhibiting any prominent symptoms, while secondary and tertiary infected larvae shows symptoms like loss of appetite, unequal body growth, clean worm symptom due to irregular and incomplete moulting

**ii)** Infected worm also shows some piper like black spots on the body, irregular brown patches resulted due to dead hypodermal cells, spitting or wasting of silk instead of spinning cocoon, passing of soft faeces and generally die after spinning pupating .

**Pupa-** Live infected pupa if present inside cocoon or if they infected at the pupal stage only they show black colour, swollen body with black spote on either sides of the abdomen.

**Adult moth-**

**i)** Infected adult moth show black spots on the abdomen, deformed antennae, unstretched and discoloured wing.

- ii) Adult female usually laid eggs in irregular loose heaps. Body scales also fall off easily.

#### **Mode of transmission-**

The disease is transmitted to silkworm in three different ways-

- i) **Oral-** The leaves in the rearing bed normally get contaminated with the spores liberated through the faeces of infected worms or dead larvae. So, when such food is consumed by healthy larvae, they get infected. Contamination may also occur at the time of oviposition or after oviposition.
- ii) **Direct contact-** Infection may occur through the skin of larvae in the rearing bed when contacted with the *Nosema* spores contained in the faecal matter or dead tissues.
- iii) **Transovarial-** when infection occurs in the 5<sup>th</sup> instar larvae the adult moth immerses normally from the pupa. Under that situation the spores of *Nosema* sporulate within the oocyte and pass on to the egg. Thus the eggs acquire infection from the mother and hatch into primary infected larvae. However, most of these infected larvae grown up to 3<sup>rd</sup> instar only. These larvae again act as the source of secondary infection through dead larvae and contamination by faecal matter. Secondary infected larvae exhibit pebrine symptoms, unable to spin healthy cocoons and produce tertiary infection to 5<sup>th</sup> instar larvae.

**Detection of pebrine-** Disease can be detected by keen observation to the rearing bed, the symptoms and by microscopic observation of the homogenate, fluid from the body and faecal pellets, where the presence of the spores of *Nosema* can be detected. Nowadays, by advanced immune-enzymatic method presence of pebrine spores can be detected quickly.

**Control measure-** Following techniques are adopted generally to get rid of Pebrine-

- i) Only disease free layings are allowed for rearing in the grainages.
- ii) If diseased larvae detected in the rearing bed they should be removed immediately and burnt.
- iii) All rearing appliances including the rearing room should be disinfected with 4-5% formalin or bleaching powder. For rearing accessories instead of routine formalin benomyl/ Bavistin/Bengard etc. can be used.
- iv) Disease resistant races ( eg. Nistari) can be considered for rearing.

## 2. Bacterial Diseases-

Most common bacterial diseases are-

### a) Bacterial Flacherie-

Silkworm suffering from this disease exhibit diarrhea and vomiting. It is caused by *Bacillus bombycis*, *B. sotto*, *Streptococcus bombycis*, *Pseudomonas aeruginosa* etc.

**Symptoms-** symptoms include-

- i) Lack of appetite. Diarrhoea and vomiting occur as common symptoms.
- ii) Growth stunted and shrinkage of the body observed after moulting.
- iii) Skin become loose and soft and exhibit sluggish movement.
- iv) Body colour become dull to black-brown.
- v) The larvae show signs of pain and convulsions and ultimately die.
- vi) Body turns black and emits foul smell.

**Mode of transmission-**

- i) **Oral transmission-** After taking contaminated leaves by the larvae from the rearing bed bacterial growth occur in the gut of larva and consequent deposition of lactate, acetate etc. reduces the gut permeability and lower the p<sup>H</sup> and infection spreads all over the body of the larvae. Larvae release stool with bacterial spores and then next set of infection starts.
- ii) **Rearing environment** - Environmental physical factors like temperature and humidity of the rearing room also plays a vital role in disease transmission. Humid environment in the room may enhance the spreading of Flacherie bacteria.

**Detection of flacherie bacteria-**

Histopathological analysis of gut can detect the bacterial infection by the detection of cylindrical or goblet cells in case of streptococcus and Diplococcus infection respectively.

**Control measures-**

- i) Through maintaining optimum humidity and temperature in the rearing room.
- ii) Providing healthy and disease free leaves to the rearing bed.
- iii) Disinfection of the rearing room and the rearing appliances with 2% formalin should be done regularly.

**b) Septicemia-** It occurs due to infection of haemolymph by bacteria. It mainly causes by the infection of *Bacillus*, *Streptococcus* and *Staphylococcus* bacteria.

Transmission of the disease occur through intake of contaminated leaves and wounds in the skin.

**Symptoms-** the larvae exhibit-

- i) Body exhibit softening.

- ii) Body colour changes to brown.
- iii) Larvae release liquid excreta.
- iv) Loss of clasping power and death occurs frequently.

**Control measure-** Proper sanitation and hygiene should be maintained in the rearing room. Infected larvae should be immediately removed from the bed to prevent spreading of the disease. Handling of larvae should be done carefully to reduce skin wounds.

c) **Sotto-** This disease is caused by some bioinsecticidal bacteria. For eg, *Bacillus thuringiensis*, which is widely used as a bioinsecticide releases some endotoxin *thuricide*. When the larva consumes the toxin two types of effects occur. In one type the larvae of *B. mori* stop feeding, haemolymph turns alkaline and paralysis occurs within 60-80 minutes of infection. In another type lepidopteran larva only shows rapid inhibition of feeding.

**Symptoms-** Loss of appetite, sluggish movement, shrinkage of skin, diarrhea, loss of clasping power of prolegs, body turns black after death and foul smell emits from the body.

**Control measure-** Cleaning of rearing room with hot water to inactivate the toxins, immediate removal of the infected or dead larvae from the rearing bed, bacterial spores should be destroyed by exposing to 2% formaldehyde for 3hrs or 100°C for 5 minutes.

d) **Court disease-** In this bacterial disease the affected dead larvae turn flaccid and the colour changes to crimson red. This disease is also commonly known as *Rrangi* due to this formation of colour.

**Causative bacteria-** disease is caused by the infection of bacteria *Serratia marcescans* and *S. piscavotar* following the primary infection with *Streptococcus faecalis*.

**Infection occurs** through oral route or the skin wound.

**Control measure-** maintenance of the hygienic rearing room, removal of dead or infected larvae, cleaning of appliances with 2% formaldehyde are the measures for the diseases.

### 3. Viral diseases-

a) **Grasserie- Symptoms-** This disease is characterized by the jaundice like symptoms which are collectively known as **Grasserie-** or **Polyhedrosis**. Other symptoms include-

- i) Loss of appetite
- ii) Formation of loose and shiny white skin with swellings in the inter-segmental zones.
- iii) Release of milky white or yellowish fluid from the body containing polyhedral.

- iv) Infected larvae turn restless and do not undergo moulting.
- v) Translucent cephalothorax and opaque mid gut observed due to accumulation of polyhedral in the cytoplasm.

**Causative organism-** nuclear polyhedrosis of *B. mori* is caused by Nuclear Polyhedrosis Virus strain **Bm ( NPV Bm)**. This DNA virus multiplies only in the nucleus of the host cell. The virus embedded in a proteinaceous matrix called PIB ( Polyhedral Inclusion Bodies). In midgut polyhedrosis, the RNA *Smithia* virus forms polyhedra in cytoplasm in case of midgut cytoplasmic polyhedrosis or in nucleus in case of midgut nuclear polyhedrosis.

**Mode of transmission-**

- i) **Orally** through contaminated leaves with PIB from dead larvae or their excreta.
- ii) High temperature and Humidity may enhance the transmission of latent stage of virus to virulent stage.
- iii) Blocking of spiracle by some agents like dust, exposure to formalin etc. may enhance the spreading of the disease.
- iv) Skin wound also enhances the disease.

**Control Measure-**

- i) Maintenance of hygienic environment, proper ventilation in the rearing room.
- ii) Sterilization of the rearing room with 2% formaldehyde or Bleaching powder or Resham Keed Ouzhad (RKO) or Labex.
- iii) Immediate removal of dead or infected larvae from the rearing bed.
- iv) Oral administration of nalidixic acid, P- aminobutyric acid etc. or topical application of imanin can control NPV to some extent.

- b) Infectious Flaccidie-** Infectious flaccidie Virus (IFV) causes a type of flaccidie of the silkworm. This virus enters the body of an animal through the oral route along with the leaves.

Vomiting and shrinkage of the body along with appearance of transparent body are the symptoms of this disease.

The disease can be controlled by the following measures-

- i) Feeding the larvae with healthy and hygienic leaves.
- ii) Maintenance of proper hygiene of the rearing room.
- iii) Disinfection of rearing appliances with formalin.

- c) Gattine-** This disease is also known as **Clear head disease** as the affected worm shows transparent, particularly the anterior part of the body. **Causative organism** is primarily some virus while *Streptococcus bombycis* act as the secondary agent. Loss of appetite and vomiting of alkaline clear fluid are the other symptoms.

Supplying of proper healthy leaves, hygiene in the rearing room and Disinfection of rearing appliances are the measures to be taken for the controlling of the disease.

#### 4. Fungal diseases-

a) **Muscardine-** In muscardine the body of the larvae get mummified due to deposition of calcium oxalate . Hence the disease is also called as '**calcino**'.

**Symptoms includes-** Sluggish movement of the larvae, loss of appetite, vomiting , shrinkage of body with loose cuticle are observed. Larvae infected at the early stage do not spin, but those infected late may spin cocoon where the pupa die inside. Dead larvae generally covered with the spores of the infected fungi or may be mummified with white powdery material.

**Causative fungi** is different muscardine. Depending on the colour of the **conidiospores** name of muscardine is different.

##### Name of muscardine

White muscardine

Black muscardine

Yellow muscardine

Brown muscardine

Red muscardine

##### causative fungi

*Beauveria bassiana,*

*Metarrhizium arisopliae.*

*Poecilomyces farinosus*

*Aspergillus flavus* and

*A. oryzel*

*Sorospora uvella*

**Mode of transmission-** all types of muscardine infection occurs through contaminated leaves, through skin and spiracles. The fungal spores germinate after falling on the silkworm skin and gradually penetrate the cuticle by mechanical and enzymatic forces.

##### **Control measures-**

- i) Proper light, humidity and aeration should be maintained in the rearing room. Any factors that may help the growth of fungi should be avoided. Temperature should be kept above 22°C.
- ii) Infected larvae should be remove immediately and buried in a deep pits.
- iii) For the preparation of bed 0.45 formalinised husk can be use for 1<sup>st</sup> and 2<sup>nd</sup> instars, 0.5% for 2<sup>nd</sup> and 3<sup>rd</sup> instars. 0.6% for 4<sup>th</sup> instars and 0.8% for for 5<sup>th</sup> instars.
- iv) During moulting after every cleaning operation dithane-M45and kaoline can be applied to prevent the germination of fungal spores if any.
- v) For every 100layings, 3-4kg of Resham Keed Ouzhad (RKO) can be spread after each moulting and 30 minutes before the larvae resume feeding.
- vi) Laabex, a mixture of lime and bleaching powder has anti-musccardine and grasserie effects, also improve larval growth.

## Parasites of Silkworm

### Uzi fly larvae-

Uzi fly deposit their eggs on the lepidopteran larvae. Two well known Indian variety of this fly are *Tricholyga bombycis* and *Exorista sorbillans*.

**Mode of transmission-** After 2-3 days of oviposition, the legless maggot penetrates into the body of the silkworm larvae by making a hole in the cuticle. The maggot then consume the larval tissues and complete the instars and come out from the body of the host for pupation. The host larvae dies in the orocess.

**Symptoms-** infected larvae shows black spots o the body, which are actually the entry points of maggot. Larvae loss body weight due to loss of tissue. Exhibit sluggish movement and stop feeding.

### Control measure -

- i) Uzinet( a nylon net of fine mesh) can be use to prevent the entry of Uzi fly to the rearing room.
- ii) Uzicide or Vijeta can be spread on rearing tray to kill the uzi eggs without hampering the normal growth of the silkworm larvae.
- iii) Reproductive potential of uzi fly can be prevented by introducing radiation exposed sterile fly.
- iv) Biological control can be applied by introducing natural predators like spider in the field.
- v) Uzi larvae and pupae found in the rearing room should be collected and destroy by putting them into hot water.

Beetles, Ants and Straw mites also produce damage to the silkworm industry.

