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Diseases of silk warm (*Bombyx mori*) and protocol for treatment

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Abstract
Diseases are the behavioral and physiological changes induced by pathogens in an organism. All diseases have specific symptoms and characteristics. Similarly, silkworms are also affected by various types of diseases caused by protozoa, fungi, bacteria and viruses. Since they cause substantial financial loss to the industry, their prevention and control assumes utmost importance.

Keywords: diseases, silk, pathogens, protozoa, *Bombyx mori*

Introduction
The Uzi Fly, Exorista bobmycis is a serious endo-larval parasitoid of the silkworm. The loss estimated from this fly is 10-20%. The pest occurs throughout the year. Its incidence is high from August to November. Presence of black scar on the body of parasitized silkworms and maggot emerge hole in cocoon indicate the uzi infestation. The silkworms parasitized in early instars are killed before attaining spinning stage, while those parasitized in the late fifth instar spin cocoons of weak built and from such cocoons uzi maggots emerge by piercing, thus rendering cocoons unfit for commercial reeling**.**

Pebrine Disease
Pebrine is caused by *Nosema bombycis*, which is a protozoan. The disease is transmitted through contaminated leaves or from mother moths through eggs. It is the most serious disease in silkworms as it is highly infectious and infects the young silkworm larvae causing considerable loss.

Fig 1

Symptoms of egg stage
- Poor egg number.
- Reduction in size and weight.
- Lack of adherence of substratum, disuniform with more of dead and unfertilized eggs.
- Irregular hatching.

Symptoms at larval stage
- Loss of appetite, retarded growth and disuniformity in size
- Irregular moulting.
- Heavy mortality after 2nd moult if infected at egg stage.
- Larvae shrink in size and vomit gut juice.
- Dark brown or black spots may be seen sometimes on the body.

Control measures of pebrine disease
- Follow strict mother moth microscopic examination method to produce disease free layings. Individual moth examination or group moth examination for industrial seed must be resorted to, in order to eradicate pebrinized layings.
- Periodical microscopic examination of silkworm larvae during rearing. If pebrine spores are detected, the whole lot should be discarded /rejected.
- Carry out surface sterilization of disease free layings by dipping egg cards in 2% formalin solution for 10 minutes followed by washing in running water.
- Follow strict disinfection of rearing room, appliances and surroundings of rearing area.
- Maintain strict sanitation and hygienic conditions during rearing.
- Apply bed disinfectant as per recommended schedule and quantity. Infected silkworm faeces and bed refuse are important source of infection and should be disposed off to prevent cross infection and spread of disease.

Grasserie Disease
Grasserie is a viral disease in silkworm caused by Nuclear Polyhedrosis (NPV), Cytoplasmic polyhedrosis (CPV) and infectious flacherie. Nuclear polyhedrosis (NPV) is a major viral disease in silkworm. It is caused due to the presence of high temperature, high humidity and feeding of poor quality mulberry leaves. It is highly infectious.

Fig 2

Symptoms

In the early larval stage of infection, it is difficult to detect the disease. Microscopic examination of larvae may indicate the presence of polyhedral bodies. As the disease advances, the larvae loose appetite and skin becomes shiny before moulting. The inter-segment membrane becomes swollen. The haemolymph or body fluid becomes turbid white. Microscopic examination shows presence of large number of polyhedral bodies.

Control measures for grasserie

- Rear the larvae under clean and hygienic condition.
- Thorough disinfection of rearing room, appliances and surroundings.
- Ensure proper disinfection of egg surface.
- Incubate eggs under hygienic conditions. Avoid touching with hands.
- Provide suitable and timely feed during rearing.
- Maintain proper spacing and adequate ventilation.
- Pick out diseased, weak and injured larvae and destroy them properly.
- Apply bed disinfectants as per recommended schedule and quantity.

Muscardine (Fungal disease)

Muscardine is a fungal disease in silkworm. Various types of muscardine diseases have been reported i.e. white, green, yellow etc. but white muscardine is commonly found in Kashmir valley. The white muscardine in silkworm is caused by a fungus, *Beuveria bassiana*. The disease is caused due to body contamination by the fungus. The fungus grows well under low temperature.

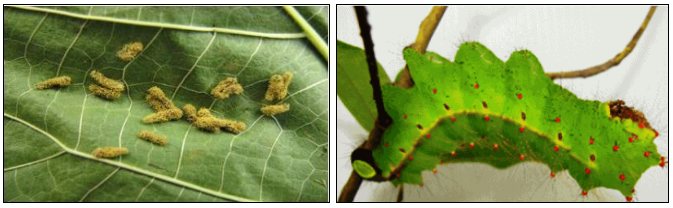

Fig 3

Symptoms

- The larvae loose appetite, become sluggish, ceases to move and finally die.
- The dead larvae become harder and mummified.
- The body after death is covered with white mycelia. Conidia develops in the body.
- Finally whole body of dead larvae looks chalky white.
- The pupa and moth are also infected by white muscardine disease. In heavy infection, pupal body gets cowered with conidia.

Control measures for muscardine disease

- Infected larvae should be picked up and burnt.
- Maintain good ventilation and proper humidity in rearing room.
- Regulate humidity by dusting lime at the time of each moult and in between.
- Apply bed disinfectants as per recommended schedule and time.
- Provide quality leaves and maintain proper spacing during rearing. Avoid dusty leaves.
- Follow strict disinfection of rearing house, rearing appliances and surrounding area.
- Practice proper disinfection of silkworm egg surface.
- Maintain hygienic conditions during rearing.
- As a specific measure, dust Diathene M-45 in Kaolin or Captan in slaked lime on silkworm body immediately after every moult as per following schedule.
- I-II instar -1% dust
- III-V instar-2% dust
- Apply formalin chaff to silkworm body. The formalin chaff is prepared by partially burning paddy husk and mix formalin of 0.6% to 0.8% concentration (0.6% for chawki and 0.8% for late stage) in the ratio of 10:1. The chap is sprinkled uniformly on the silkworms 30 minutes before feeding.

Management

1. Physical Method

Collect and destroy the uzi infested silkworms and uzi maggots and pupa. Keep the rearing house floor free from cracks and crevices. Uzi infested larvae spin cocoons a day or two earlier than other silkworms and such cocoons are flimsy and bad quality. Fixing wire mesh or nylon mesh to the window of the rearing house with an arrangement to construct anteroom would physically prevent uzi fly entering the rearing house

2. Chemical Methods

Uzi Powder: It is an ovicidal dust formulation. It is dusted on the body of silkworms on the 2nd day during III instar, 2nd and 4th days during IV instar and 2nd, 4th and 6th days in V instar. Uzi powder should be dusted after bed cleaning and silkworms should be fed half an hour after dusting. 4-5 kg uzi powder is required for 100 dfls**.**

Uzicide: It is an ovicidal formulation. It is sprayed on the body of silkworms starting from 2nd at in III instar through 4th or 6th day of V instar on alternate days except during moulting. Uzicide should be sprayed after bed cleaning or 2 to 3 hours after feeding. Silkworms should be fed half an hour after spraying uzicide. 4 to 5 liters is required for rearing 100 dfls.

Biocontrol Agent: *Nesolynx thymus* is a ecto-pupal parasitoid to kill the pupae. One lakh adult females should be released in 3 doses corresponding to IV and V instars and within one or two days after cocoon harvest at 8000, 16000 and 76000 adults, respectively.

Conclusion

Comprehensive integrated steps can result in prevention of silkworm diseases. Prevention is better than cure is the correct approach for controlling silkworm diseases. The following preventive measures will result in controlling silkworm diseases.

- Follow strict disinfection of rearing houses, rearing equipments and surrounding areas.

- Rear only disease free layings. Infected layings should be isolated through strict moth examination and discarded.
- Control mulberry pests (alternate hosts of muscardine causing pathogens) in the field and provide disease free and quality leaves according to age of silkworms.
- Maintain strict sanitation and hygienic conditions during rearing.
- Enhance vigour of silkworms by providing suitable and timely feeding. This will enhance resistance against disease.
- Isolate sick and diseased worms and dispose off properly.
- Maintain appropriate spacing during rearing.
- Isolate infected material/equipment and follow strict disinfection.
- Faeces (silkworm litter) and bed refuse should be disposed of properly by burying it.
- Adjust the humidity of rearing room and trays. Dust lime at the time of each moult.
- Apply bed disinfectant (Vijetha/Labex/RKO) as per recommended schedule and time.
- Intensive rearing management and close monitoring is essential.

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