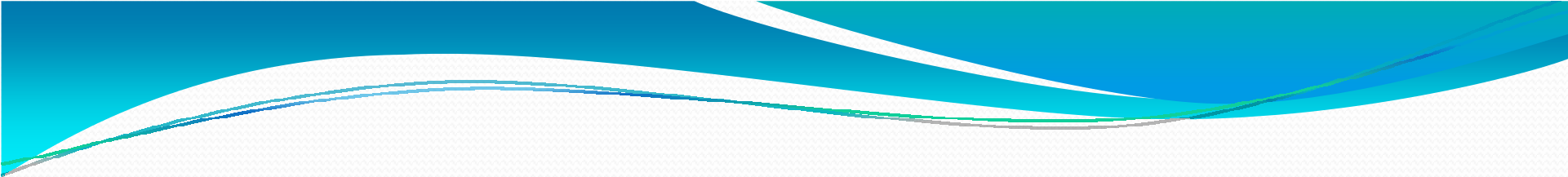




SILKWORM PATHOLOGY

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Pathology/Pathobiology - The scientific study of the nature of disease and its causes, processes, development, and consequences.

Due to continuous domestication from more than 4500 years, silkworm *Bombyx mori* is susceptible for

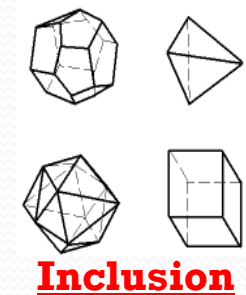
- 1. Viral – NPH, CPH, Densonucleosis, IF**
- 2. Protozoan- Pebrine**
- 3. Fungal – Aspergillosis
Muscardine -White, Green, etc.,**
- 4. Bacterial – Septicemia, sotto,
bacterial diseases of digestive system**

Also, stress conditions like adverse temperature and humidity, bad ventilation and nutritional deficiency may make them easily susceptible to various diseases.

Viral

Viral diseases of silkworm comprise of inclusion and non-inclusion types.

The inclusion virus form typical inclusion bodies *i.e.*, Polyhedral Bodies. They are Nuclear polyhedrosis (NPH) and Cytoplasmic polyhedrosis (CPH). The Pathogen are NPV & CPV respectively. Detected by light microscopy.



The non-inclusion type consists of Infectious Flacherie and Densonucleosis. Detected by electron/fluorescent microscopy

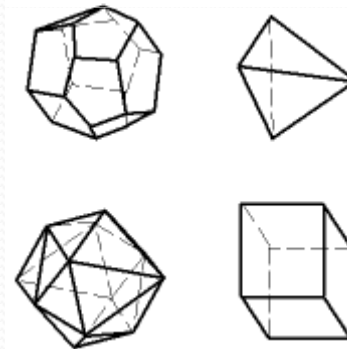
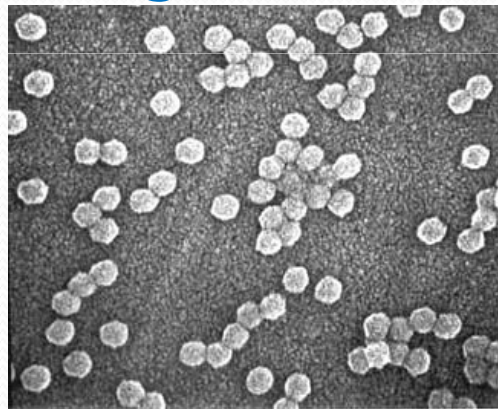


- ***Nuclear Polyhedrosis***

It is one of the most serious viral diseases in tropical countries and occurs throughout the year. This disease is otherwise known as **Grasseric, Jaundice, Milky Disease, Fatty degeneration and Hanging disease.**

- ***Causes of the disease***

- **This disease is caused by *Borrelina bombycis* virus belonging to the sub-group A of the family *Baculoviridae*. The shape is usually octadecahedral or hexahedral and sometimes tetragon or trigon.**



Polyhedral Bodies under Light Microscope & their Shapes

- **Infection mostly takes place through feeding, rarely wounds.**

Symptoms:

During early part of the disease no symptoms are noticed except the worms being slightly sluggish.

Initially the skin shows oily and shining appearance.

As the disease advances the skin becomes thin & fragile. The body becomes milky white with intersegmental swellings.

Silkworms becomes source for secondary contamination



Figure. 2. Grasserie affected larvae (early stage)



Figure. 3. Grasserie affected larvae (late stage)

Another symptom is that the larvae become restless and crawl aimlessly along the ridges or rims of rearing trays.

**Death - 4-5 days in the young larvae
5-7 days in the grown-up larvae.**

Diseased larvae lose the clasping power of abdominal legs except the caudal legs by which it hangs with the head downwards.

Melted Cocoons



Figure. 4. Grasserie affected larvae crawling on the edges of trays



Figure. 5. Grasserie affected larva hanging with head downwards

Prevention and control:

- ***Maintenance of hygienic condition by disinfection, etc.,***
- ***Optimum Environmental Conditions***
- ***Quality Leaf***

- **In addition, certain bed disinfectants prevent secondary contamination and spread of the disease.**
- **Paraformaldehyde compounds like Reshamkeet Oushadh - Dusted on the larvae and bed with the help of a thin cloth at the rate of 2-3 grams/0.1 m² area during early instars and 4- 5 grams/0.1 m² during IV and V instars. For 100 dfls (40,000 larvae) is 3-3.5 kgs.**



Figure. 6. Dusting of "Reshamkeet Oushadh"

PROTOZOAN DISEASES -Pebrine

Protozoa

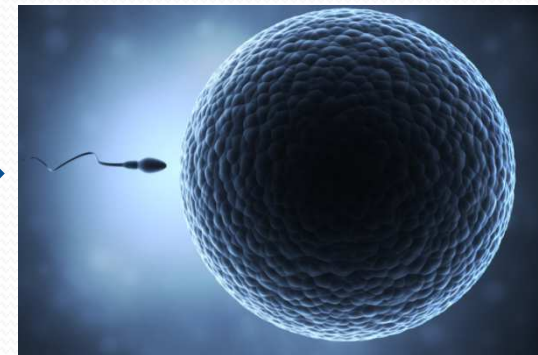
- **Class: Microsporidia**
- **Genera: *Nosema***
- **Species: *Bombycis***

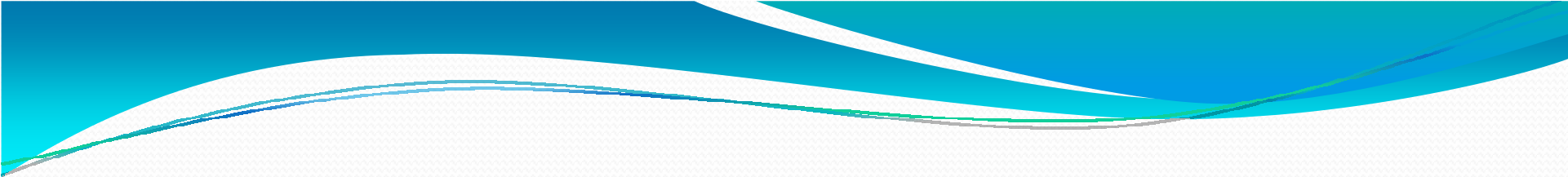
- **The major protozoan disease of the silkworm is the pebrine disease, named due to the appearance of black peppery patches following infection.**

Pebrine

- **Pebrine is a chronic and disastrous disease responsible for the sudden collapse of the sericulture industry of both France and Italy in 1965**
- **Louis Pasteur -The technique of mother moth examination for the supply of disease free silkworm eggs.**

Generalized size of an egg & sperm showing that the silkworm sperm can not carry pebrine spore as it is bigger than sperm head.



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- ***Causes of the disease: by* *Nosema bombycis* Nageli**
 - **Infection by both *peros* and transovarial**
 - **Primary and Secondary infection**

Symptoms:

- **In the egg stage:** poor fecundity, lack of adherence to the substratum, lack of egg uniformity, more of unfertilized and dead eggs, Pileup eggs.
- **Larvae:** Poor appetite, retarded growth and development, irregular moult leading to un-uniformity in size, sluggishness. The larval body shows wrinkled skin with rustic brown.

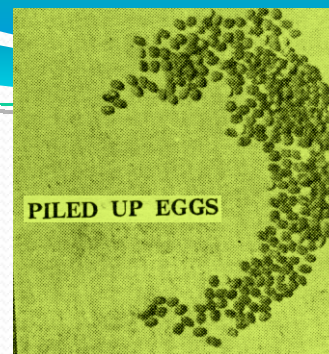
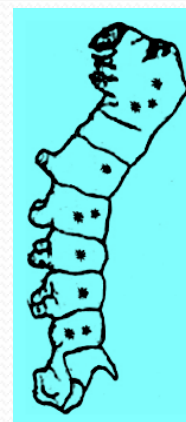
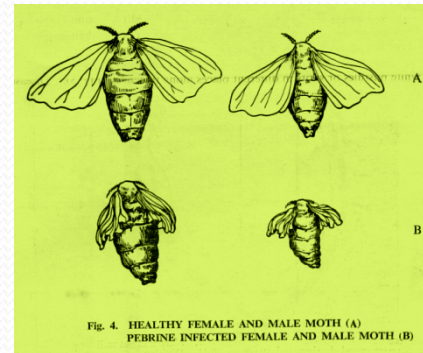


Figure. 10 Size variation in diseased larvae



Pepper like spots on the body affected by petriole

- **Pupa:** Pupae are flabby/soft and swollen with lusterless and softened abdomen. Sometimes irregular black spots are noticed near the rudiments of the wing and abdominal area.
- **Moth:** Have clubbed wings with distorted antennae and do not mate properly. The scales from wings and abdominal area easily come off.



Prevention and control:

- ***1. Disease Free Layings***
- **2. Strict Disinfection**
- **Besides,**
 - immersing of the silkworm eggs in hot water.**
 - high temperature treatment of the pupae.**
 - Dipping of the eggs in hot hydrochloric acid.**
- **Chemotherapy by fumagillin, benomyl, bengard, bavistin, ethyl and methyl thiophanate and some of their analogues with positive results.**

Fungal diseases-Mycosis

Two major kinds of such disease are Muscardine and Aspergillosis.

Muscardine – it may be of different types like white-muscardine, green-muscardine, yellow-muscardine, black-muscardine, red-muscardine *etc.*, depending up on the colour.

white muscardine is more Common & Virulent.

Since the silkworm attacked by a fungus in course of time turns hard and chalky, muscardine disease is also called **Calcino.**

Mummified Silkworms



White Muscardine

This is caused by *Beauveria bassiana*

Family Moniliaceae.

Order Moniliales.

Class Fungi imperfecti.

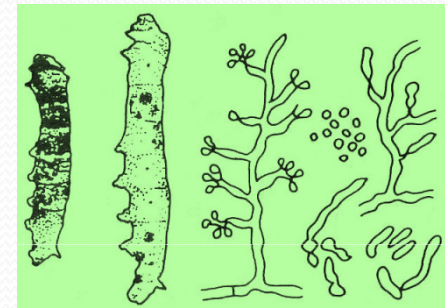
Infection is mainly by body contact, rarely through wounds.

Main sources of infection are the mummified larvae, infected seat paper, tray and dead wild lepidopteron insects from the mulberry field.

The disease is highly contagious as it is air born.

***Beauveria bassiana* consists conidium, vegetative mycelium and aerial mycelium.**

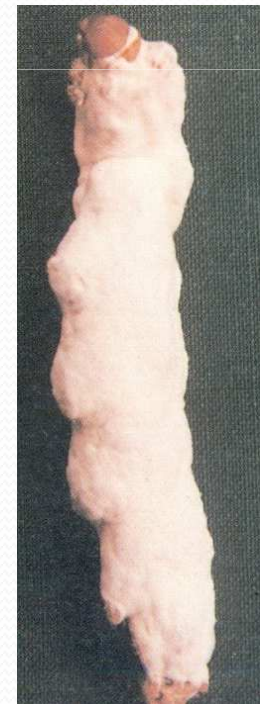
- ***The conidium is colourless, globular or rarely oval in shape and porcelain white in mass.***
- ***Under favourable conditions the conidium germinates on the body of silkworm invading the blood of the larvae and develops into vegetative hyphae.***
- ***The vegetative hyphae comes out of the skin to form aerial hyphae bearing innumerable conidiophores, which bear one or two conidia.***



Conidia: A spore produced asexually by various fungi at the tip of a specialized hypha.

Symptoms

- **Larvae lose appetite and become inactive. The body of the larvae becomes limp, loses its skin elasticity, stops movement and finally they die.**
- **Before death, symptoms of diarrhea and vomiting appear.**
- **After death, the body is initially soft, but within 6-8 hours it becomes stiff and hard.**



Management

- **Conduct disinfection of rearing house, its surroundings and rearing appliances.**
- **Control alternate hosts of the pathogen.**
- **Manage the humidity in the rearing house.**
- **Dust dry slaked lime powder when silkworms settle for moult.**
- **Feed silkworms with adequate quantity of mulberry leaves to avoid the accumulation.**
- **Regulate the climatic conditions.**

In addition, **anti-muscardine** powders can be used to control the this disease.

A few methods of applications are given below:

- ***Application of formalin chaff.***



- ***Application of Dithane M 45 or Captan.***
- ***Application of Reshamkeet Oushadh.***



Figure. 6. Dusting of "Reshamkeet Oushadh"

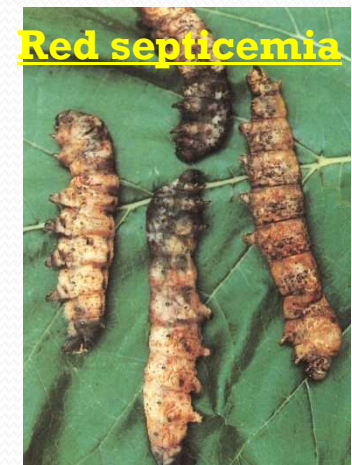
Bacterial Diseases

- **Bacterial diseases are collectively known as flacherie due to the flaccid nature of the diseased larvae.**
- **The incidence is high during hot and humid seasons.**
- **In general, massive out-break of these diseases are uncommon but due to unhygienic condition, large scale loss in crops sometimes occur.**
- **Bacterial diseases of silkworms are bacterial septicemia, bacterial diseases of the digestive tract and bacterial toxicosis (sotto).**

- ***Septicemia:***
- **This is a condition bacteria multiply in the blood (haemolymph).**
- **Septicemia during the larval stage leads to larval mortality whereas the infection in pupal and moth stages affects the egg production in the grainages.**
- ***Causes of the disease:*** caused by the bacilli, *streptococci* and *staphylococci* in the haemolymph. The route of infection is through injury or wounds and rarely per orally.

Two major types *i.e.*, black thorax septicemia and red septicemia

- **Symptoms:** Sluggish movement, decreased appetite, straightened body, swollen thorax, shrinkage of abdominal segments, vomiting & bead like faeces and loss of clasping power of legs. Further, the body becomes soft and discolored and the body wall ruptures easily emitting foul smelling fluid.
- **Difference:** In black thorax septicemia, the blackening starts from the thorax and till the whole body. **Red septicemia**, taking a slightly reddish tinge.



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***PREVENTION IS BETTER
THAN TREATMENT / CURE***



Acknowledgements **to**

- i. Internet
- ii. Hand book on pest and disease control of mulberry and silkworm, United Nations, Thailand 1990.