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Nuclear Polyhedrosis Virus (*Bm*NPV) in Silkworm (*Bombyx mori* L.)

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Silkworms (*Bombyx mori*) are the backbone of the global silk industry, yet their susceptibility to diseases-particularly Nuclear Polyhedrosis Virus (NPV)-poses a major threat to sericulture. NPV, a highly contagious infection caused by *Bombyx mori* nuclear polyhedrosis virus (*Bm*NPV), leads to severe larval mortality, thereby hampering silk production. This article explores the symptoms, transmission pathways, and economic consequences of NPV, also outlining effective strategies for its prevention and management. A deeper understanding and timely intervention can help sericulturists safeguard their income and ensure the sustainability of silk farming.

Introduction

Sericulture, the rearing of silkworms for silk production, provides a livelihood to millions of people across the globe. The silkworm *Bombyx mori* is at the heart of this industry, yet it is highly susceptible to various diseases such as pebrine, muscardine, and grasserie. Among these, Nuclear Polyhedrosis Virus (NPV), caused by the *Bombyx mori* nuclear polyhedrosis virus (*Bm*NPV), is the most harmful. This virus can wipe out entire silkworm populations, with mortality rates reaching up to 80–100% in infected groups. In India-one of the leading producers of silk globally-NPV outbreaks can lead to a 20–30% reduction in silk output, resulting in heavy economic setbacks.

Silkworms infected with NPV exhibit symptoms like loss of appetite, lethargy, and eventual death, severely impacting farmers who depend on successful cocoon harvests. These losses not only hinder silk production but also threaten the income and stability of small-scale sericulturists. To minimize the damage caused by NPV, adopting improved silkworm rearing techniques, ensuring proper hygiene, and using disease-resistant breeds are essential. Implementing such preventive measures can significantly reduce the impact of the virus and contribute to a stronger, more sustainable sericulture sector.

Nuclear Polyhedrosis

Among viral diseases affecting silkworms, Nuclear Polyhedrosis (NPV) is considered the most severe and widespread in India as well as other silk-producing countries. The disease can occur throughout the year but is more frequently observed during the summer and rainy seasons. It is also referred to by several names, including Grasserie, Milky Disease, Fatty Degeneration Disease, Jaundice, and Hanging Disease.

Etiology

The causal organism is *Bombyx mori* Nuclear Polyhedrosis Virus (*Bm*NPV), which belongs to the Baculoviridae family, subfamily Eubaculovirinae. The virus primarily invades the nuclei of cells such as tracheal epithelial cells, adipose tissue, dermal cells, and haemocytes.

Viral Structure

Paillot named the virus as *Borrelina bombycis*, which is rod shaped, with a size of 330 x 80 nm, and consists of a membrane and a capsid, with the envelope being on the outside and the capsid at the center, and in between, the colloidal layer. Inside the capsid is the helical core. The capsid and the viral nucleic acid form the nucleo-capsid. Four layers of peplomer are found at the anterior part of the capsid, which may be the apparatus enabling absorption of the virus to take place. The nucleic acid is double stranded DNA (dsDNA). The viral particle contains 7.9 per cent nucleic acid, 77 per cent protein and also lipids and carbohydrates. The infective part of the virus is the nucleic acid, the protein part being non-pathogenic.

The Polyhedron

The polyhedra are visible under the 400 magnification of microscope, 2-6 microns in size, each being the shape of an octadecahedral hexahedron, sometime a trigon or a tetragon. Generally, in any one-cell nucleus, the sizes of the polyhedra are uniformly the same. The virus can exist both inside and outside the polyhedra. The former is called the polyhedra virus and the latter free virus. The stability of the polyhedral virus is greater than that of the free virus. The polyhedron is composed of 3-5 percent viral particles, the rest being protein. It is highly refractile, with high density, insoluble in water and organic, solvents but soluble in alkaline solutions. Thus, in the digestive tract of the silkworm the polyhedra dissolve, releasing the virions, which cause infection to the larvae. Virus inactivation occurs using bleaching powder solution containing 0.3 percent active chlorine for three minutes, or 2 per cent formalin for 15 minutes.

Infection Route and Pathogenesis

Infection by the virions and polyhedra is peroral. But, the free virus can also enter through the wounds. After being swallowed, the polyhedra on reaching the digestive tract are dissolved by the alkaline digestive fluids with the release of the virions. A portion of the virion is inactivated by the red fluorescent protein and excreted with the feces. Those particles, which escape inactivation, penetrate the peritrophic membrane, some enter the coelom and parasitize the susceptible cells there, and some may reside in the cells of the midgut, but the latter do not form polyhedra. *Bm*NPV forms polyhedra in the nuclei of tracheal cells, adipose tissue cells, dermal cells, blood cells and occasionally the nucleus of the middle and posterior portion of silk glands. The virus can multiply in the cell nucleus of the larval tissues and form polyhedra in it, the most susceptible cells being the haemolymph, tracheal epithelial cells, adipose tissue cells and dermal cells. The virions and the polyhedra progressively increase in number and size within the nucleus causing the nucleus to swell gradually. Bursting results from the accompanying distension of the whole cell. The free virus, polyhedra and cellular debris in the haemolymph of the infected larvae give the haemolymph its milky appearance. Parasitism of the dermal cells results in their dissolution, leaving only chitinous skin, which bursts easily.

Factors Favouring Disease

1. Consumption of contaminated mulberry leaves.
2. High or fluctuating temperature and humidity.
3. Excessive moisture in rearing beds.
4. Poor sanitation and ineffective disinfection.
5. Feeding tender leaves to late-instar larvae.
6. Overcrowding of larvae.
7. Inferior leaf quality.
8. Use of infected layings.

Alternate Host

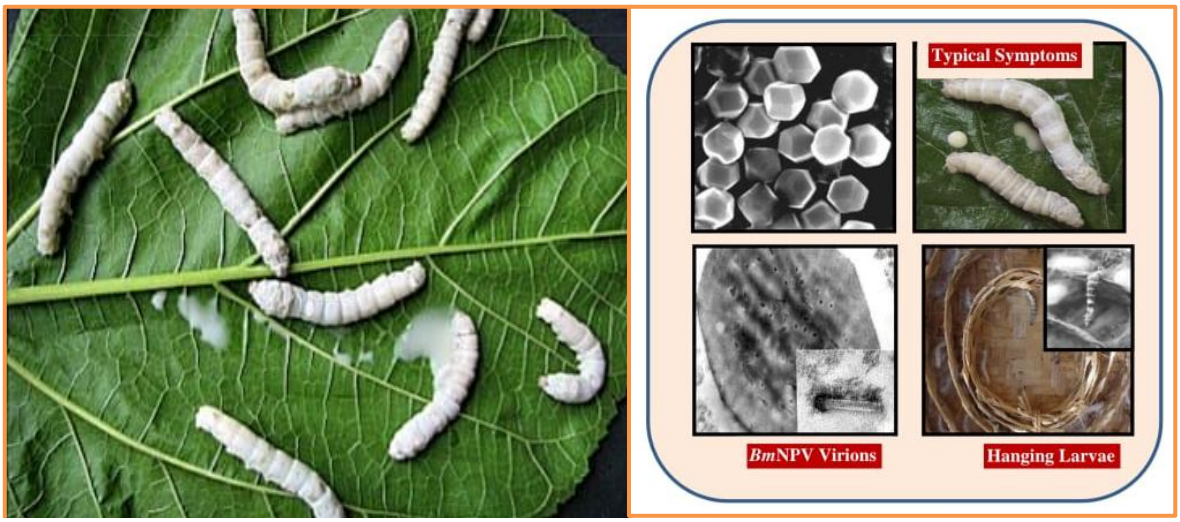
Apart from *Bombyx mori*, *Bm*NPV can infect other lepidopterans such as *Philosamia*, *Lymantria*, *Dendrolimus*, and *Samia ricini*.

Virus Persistence

The *Bm*NPV polyhedra have been recorded to persist in the rearing environment for 5 years as dry pills and 20 years at 4°C. The survival of virus suspended in haemolymph is better than in pure water. The occlusion bodies of baculovirus withstand freezing and thawing and can retain activity during prolonged exposure to normal temperature. The baculoviruses persists for longer duration in soil. Various disinfectants viz., formalin, sodium hypochlorite, lime, calcium hydroxide, chlorinated lime etc. are reported to be germicidal fór *Bm*NPV.

Symptoms

1. Early infection shows no clear signs except sluggishness.
2. Appetite decreases, skin loses tension, and body becomes translucent with oily shine.
3. Intersegmental swellings give the larva a bamboo-like appearance.
4. The skin becomes fragile and ruptures easily, releasing milky body fluid filled with polyhedra.
5. Larvae may fail to moult if infection occurs before moulting.
6. Infected worms show restlessness, crawl aimlessly, and often fall off trays.
7. Death usually occurs within 4–7 days, depending on larval stage.
8. In advanced stages, larvae hang by the caudal legs with head downward (hanging disease).
9. Pupae show no early signs but eventually become fragile and may die before cocoon formation.



***Bm*NPV Infected silkworms**

Preventive Measures

1. Thorough disinfection of rearing houses, equipment, and grainage rooms.
2. Surface sterilization of layings before brushing.
3. Maintain optimal temperature and humidity for each larval stage.
4. Ensure good hygiene and sanitation during rearing.
5. Provide fresh, nutritious mulberry leaves, especially for young larvae.
6. Avoid overcrowding and ensure proper ventilation.
7. Prompt removal and safe disposal of diseased larvae (burning or deep burial).
8. Frequent replacement of rearing paper and trays.
9. Keep rearing beds thin and dry, especially during rainy season.
10. Apply bed disinfectants such as RKO, Vijetha, Labex, or Resham Jyothi to minimize contamination.

Conclusion

Addressing NPV in silkworms is more than just ensuring larval health-it is about safeguarding a time-honoured tradition that sustains millions globally. Early detection of the disease, rigorous sanitation measures, and the use of resistant silkworm breeds can greatly

minimize the likelihood of infection. Although NPV continues to pose a serious challenge, the integration of scientific advancements with practical rearing techniques provides hope for effective management. With continued innovation and adaptability, the silk industry can navigate such threats and preserve its heritage. Ultimately, sustained vigilance, farmer education, and eco-friendly practices are essential to protect silkworm populations and maintain the legacy of sericulture for future generations.

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