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Review Article

DIAPHANIA PULVERULENTALIS, A 'LEAF WEBBER' DEFOLIATOR PEST DAMAGES MULBERRY LEAVES

***Sanjai Kumar Gupta**
Department of Zoology, Silkworm/Entomology Laboratory,
GGPGC Government Post Graduate College,
Ghazipur-233001 U.P (India)
**Author for Correspondence: drsanjaigupta1976@gmail.com*

ABSTRACT
In sericulture, particularly in southern India, where mulberry plants are the main food source for the silkworm Bombyx mori, Diaphania pulverulentalis is a significant pest. It causes significant damage to mulberry plants. It differs from other important mulberry leaf webber species in terms of larval appearance, damage type, and peak activity timing, all of which impair the mulberry plant and significantly restrict leaf availability. In contrast to other webber whose transparent to light green larvae with spots tend to cause widespread defoliation, the larvae of this species begin as fluorescent yellow, gradually changing into a deep orange or pinkish brown color, and primarily attack the growing tender leaf tips of the plant. Due to the fact that mulberry is the sole food source for Bombyx mori, it is susceptible to a wide range of pests and illnesses that harm the quantity and quality of the mulberry leaves, which in turn impacts cocoon and silk production. Diaphania pulverulentalis is one of these pests that cause significant impairment to mulberry farms. Maximizing high quality leaf production per unit area is a crucial element affecting the productivity and profitability of sericulture. This pest flourishes between July and October under ideal autumn like circumstances (about 26±1°C, 80±5% relative humidity, and 12±1 hours of ideal condition), with the fourth and fifth instar of mulberry larval stages inflicting the greatest detriment. Even though the insect can still locate good feeding and reproductive locations on mulberry leaves, using infested foliage to feed silkworms has a detrimental effect on their growth and development, resulting in inferior silk quality and impeding the silk industry's overall advancement. These defoliator pests interfere with the biochemical makeup of mulberry leaves, which in turn has a negative impact on silkworm growth and health, leading to low quality silk. The goal of this research is to comprehend the population dynamics of Diaphania pulverulentalis, a significant mulberry pest, in a sericulture farm, with the purpose of determining the rate at which it spreads and the degree to which it infests.

***Keywords*:** *Diaphania pulverulentalis, Mulberry, Pest*

INTRODUCTION
Throughout their Bombyx mori larval stage, silkworms depend only on mulberry leaves for food, utilizing the leaf's protein to make cocoon and silk thread. Mulberry is a vital source of nutrients and a significant component of cocoon manufacture as a result. Nevertheless, mulberry leaves are susceptible to harm from several pathogens and pests. Diaphania pulverulentalis (Hampson), a lepidopteran leaf webber belonging to the Pyralidae family, is one of the pests that have become especially problematic in Indian sericulture rearers. High quality silk production is the key to the sericulture industry's success, which is dependent on silkworms feeding nutritious mulberry leaves, which are the only source of sustenance for Bombyx mori L. However, mulberry growing is fraught with difficulties due to pest infestations from different insects and non-insects alike. Favorable conditions for the propagation and spread of pests are produced by its perennial growth, high biomass production, and dense growth under ideal irrigation and

management techniques. Mulberry is constantly vulnerable to a variety of harmful creatures because it grows all year long. Although pest infests may be seasonal or sporadic, they can still cause considerable damage. Insect pests cause between 20 and 25 percent of crop losses worldwide by interfering with every aspect of sericulture (Philip, *et al.,* 2018). The importance of leaf quality for silkworm growth and silk production has been extensively documented (Kulbir, S., 2017 & Mir, GN., 2013). More than 300 species of insect and non-insect pests are known to infest mulberry at varying intensities throughout its growth stages and seasons (Reddy, DNR *et al.,* 1988). In India, the plant is consumed by over 70 species belonging to the orders Lepidoptera, Hemiptera, Coleoptera, Thysanoptera, Orthoptera, Isoptera, and Acarina (Naik, SL., 2018). On mulberry in the agro-climatic zones of the Tarai Belt of Uttar Pradesh a survey conducted two year discovered a number of novel lepidopteran pests. At the Temperate Sericulture Research in leaf webber infestation was between 20 and 40% (Zeya, SB *et al.,* 2010 & Dar, MA., 2011). About 20% of all silk production is lost due to insect damage. Between July and October, leaf webber alone caused 20 to 25 percent of the damage, according to a survey conducted by (Zeya, SB *et al.,* 2011). These insects change the biochemical and photosynthetic pigment of mulberry leaves by disrupting their physiological and chemical processes. The growth and development of silkworms are damage when they feed such infected leaves, which leads to a decline in the quality of the silk and silk thread. Because this cycle encourages the rapid multiplication of pests, it results in significant decline in the health of mulberry plants and a corresponding decrease in the output of sericulture.

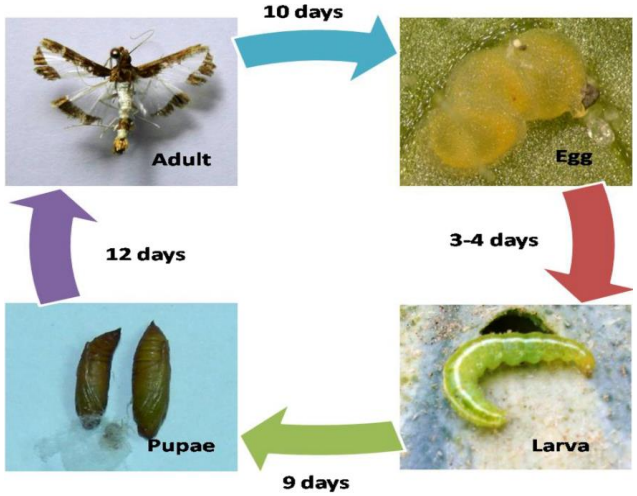
LIFE CYCLE OF LEAF WEBBER

The entire life cycle of the Morus leaf webber (Diaphania pulverulentalis) lasts between 17 and 24 days, during which it goes through the egg, larval (with five instar stages; holometabolous insect), pupal, and adult stages. Females deposit between 80 and 150 eggs on young leaves, which usually hatch in two to four days. The larvae feed by joining mulberry leaves together with silk and staying in this stage for 12–15 days before entering the pupal stage, which lasts 7–9 days and typically takes place in soil or folded leaves. The systemic position is kingdom Animalia, phylum Arthropoda, class Insecta, order Lepidoptera, and family Crambidae are all used to categorize leaf webber (Diaphania pulverulentalis). This species also goes through complete metamorphosis which represent holometabolous insect, going through the egg, larval, pupal, and adult stages, and its development is very similar to that of the silkworm (Biradhar, N., 1990 & Dasgupta, KP., 1961). Each female adult moth is nocturnal and lays about 200 rounds, pale yellow eggs, each about 0.2 mm in size, on the undersides of leaves. It takes 5 to 6 days for these eggs to hatch. At first, the developing larvae are 0.2 mm long and grow to around 2 cm in length. They are segmented, thin, and fusiform. They have a pair of anal prolegs, four pairs of abdominal prologs the meaning of proleg defined as Prolegs are little, meaty, stubby appendages that can be seen on the ventral surface of the abdomen of the majority of lepidopteran insect larvae, but they can also be seen on the larvae of insects like sawflies and three pairs of thoracic legs. The larvae complete their whole life cycle in about a month, turning into brown pupae as they mature before finally emerging as adult moths (Farooz, H., 2008 & Manjunath, D *et al.,* 2015). The life cycle demonstrated as **Egg:** The eggs are light yellow in hue and are laid one at a time or in small groups on the underside of young mulberry leaves. The incubation period lasts between two and four days. **Larva** (5 different larval Instars): The larval stage, which consists of five developmental stages, lasts between 12 and 15 days, according to some sources, between 8 and 12 days. The early stages of the larvae (first and second in stars) are pale yellow or orange, but the later stages (third through fifth instars) turn green or pinkish-brown as they start eating leaf chlorophyll and folding leaves for protection. **Pupa:** The pupation process occurs within folded leaves and, at times, in soil. The pupal stage, which lasts seven to nine days, is when the pupae acquire their dark brown hue. **Adult:** The adult moths are a yellowish-gray color. On average, women live longer than men, with an average lifespan of 7.5 days against 4 days for men.

A- Adult Stage of Leaf webber Pest

B- Fifth instar larvae of Leaf webber

C- Damage of Mulberry leaf by Leaf webber



D- Life cycle of Leaf webber

Fig: Life Cycle Stages of Mulberry defoliator Leaf webber pest (Diaphania pulverulentalis).

ECONOMIC DAMAGE

Rather than causing a simple change in one process, pest invasions often initiate or accelerate a complicated array of metabolic problems in the host. There are three different ways that pests affect photosynthesis in crops by causing leaf deformities of mulberry. It impairs photosynthetic activity, lowers light capture, and upsets the normal nutrient allocation throughout the plant. Ultimately, this results in fluctuations in the plant's overall productivity. The leaves are clearly lacking in vital nutrients. Therefore, if silkworms feed the mulberry leaves that have been damaged by insect's pest, it will have a detrimental effect on their growth and development, which might lead to cocoon production failures (Zeya, SB *et al.,* 2003 & Muthulakshmi, M *et al.,* 2012). It is known that using mulberry leaves for silkworm feeding that are infected with pests and diseases can negatively impact the commercial qualities of the cocoons. Since mulberry plants are the main source of nutrition for silkworms, it is necessary to take appropriate steps to manage diseases and pests that harm them. The infestation of Diaphania pulverulentalis is mostly seen in mulberry trees in the agro climatic regions of Tarai Belt of Uttar Pradesh July to October. Due to the qualitative and quantitative harm it causes to mulberry plants, Diaphania pulverulentalis (leaf webber) has become more significant in recent years. As they consume fresh tender mulberry leaves, newly hatched larvae secrete thin, silky fibers around themselves, leaving behind a transparent cuticular layer. These fine threads hold the larvae's feces, making the mulberry leaves inedible to silkworms. Due to the drop in leaf quality caused by this parasite, silk worm species perform poorly, especially during the fall season.

Therefore, the success of sericulture depends heavily on the quality and amount of mulberry leaves used in raising silkworms. By robbing the leaves of nutrients and halting the development of the plants, the defoliator pest causes damage. It is simple to recognize infested leaves in the mulberry garden. Infestation levels are highest during the fourth and fifth mulberry silkworm larval stages, while the damage occurs throughout the larval stage. The inner leaf tissues are eaten by the infested defoliator pest larvae, which also bind the leaves together. They transform the mulberry leaf into a skeleton by consuming the whole green photosynthetic green pigment inside. The afflicted parts of the leaf lack several macro, micro bioactive elements, including proteins, sugars, chlorophyll, and moisture content, and seem dark brown in color and damage the mulberry leaf.

MANAGEMENTS

The control methods include removing Diaphania pulverulentalis infested folded leaves, using light traps, and spraying a 0.076% DDVP solution (1 ml in 1 liter of water) between 12 and 15 days after pruning. ***Different control techniques can be used to control the invasion of this pest, including:***

1. Physically collecting and killing larvae.
2. Larvae that are dormant are killed by intensive weeding and plowing.
3. Burning infected (fallen) leaves in September and October.
4. Covering trees with straw bands.
5. Capturing moths with light traps.
6. Spraying 0. 04% DDVP on mulberry leaves can reduce the pest issue by 80–90%.
7. The parasitoid species, such as Apantelis species, can be used as a biological control agent.

DISCUSSION

In Sericulture Garden of Tarai Belt of Uttar Pradesh India is mulberry trees are severely threatened by the Diaphania pulverulentalis. The presence of this pest has been reported in several regions of India, as well as in sericultural nations like China and Japan. The larvae live in the tender, succulent tips of the shoots during the early stages of development, inflicting harm that causes stunted growth and a noticeable decrease in leaf production, averaging a 12.8% drop with a 21.77% average incidence rate (Qadari, SMH *et al.,* 2003). The leaf webber pest normally shows up between June and February, causing significant harm to young mulberry plants and resulting in substantial losses in fragile chawki leaves, which are essential to the young first instar silkworm larvae. Environmental factors, such as temperature, humidity, and rainfall, have a significant impact on the expansion of pest populations. Insect pest survival, growth, and reproductive potential are all heavily influenced by climate variables (Gururaj, R *et al.,* 2001). Recent intensive farming techniques and overuse of nitrogen fertilizers and pesticides have led to the emergence of several pests and illnesses as significant impediments to mulberry leaf production. The kinds of insect leaf webber pests that may be found in mulberry have changed as a result of changes in the environment and agricultural meteorology (Velavan, SS., 2011). Furthermore, monoculture practices and the use of high yielding varieties have made pest problems worse, turning little pests into serious threats. The seasonal occurrence of this pest has been studied by several researchers, who have discovered that significant infestations were observed in between October and February and between October and December in India (bai, MG *et al.,* 2012). Understanding the population dynamics of the leaf webber pest is essential for developing effective management strategies, which is evaluate the seasonal population fluctuations of Diaphania pulverulentalis in connection to meteorological factors. The study concentrated on the population dynamics of leaf webber and the seasonal incidence of the pest in mulberry groves at a Sericulture Basic Seed Farm. This study's findings may illuminate significant environmental variables, particularly weather related variables like temperature, humidity, and precipitation that are crucial for the development and spread of insect pests, thereby guiding pest management research to mulberry and boost the seric-cocoon productivity by sericulture rearers.

CONCLUSION

The life history study's findings will be essential to controlling Diaphania pulverulentalis since they will provide a better understanding of its life cycle and ability to thrive on different host plants. It is crucial to have this information in order to develop successful integrated pest management tactics for this pest. The ability of Diaphania pulverulentalis to thrive on these plant species points to the possibility of its spread, distribution, and establishment in new areas. Considering that the quality and quantity of mulberry leaves have a significant impact on the success of silkworm production, it is imperative to tackle the problem of Diaphania pulverulentalis leaf webber infestations in mulberry by using authorized integrated pest management methods while minimizing environmental damage, particularly when large-scale autumn rearing is intended. As a result, if not handled appropriately, the Diaphania pulverulentalis leaf webber may become a major biological factor affecting silk manufacture in sericulture.

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