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Mesta hairy caterpillar (*Euproctis scintillans*), A defoliator pest, damages mulberry leaves

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Abstract
Mulberry leaves, which must be fresh, soft, and appropriate for the particular larval stage of the silkworm, are its primary food source. Although there are many variables that influence the success of silkworm raising, mulberry leaves are the most important, accounting for 38.2% of the overall results. Mulberry cultivation has a significant impact on the yield, quality, and commercial worth of silk cocoons. About 70% of the silk produced by silkworms is derived from micronutrients, pigments, minerals, and bioactive compounds in these leaves, and the cultivation of mulberry accounts for about 60% of the cost of making cocoons. About 20–25% of crop losses are attributable to pests and diseases. The yellow-tail moth, Euproctis scintillans, is a significant pest. Its larvae are polyphagous, reddish-brown, hairy caterpillars that are known to consume crops like apple, mango, castor, and particularly green mulberry, sometimes resulting in complete defoliation. The larval phase of these larvae lasts between 20 and 28 days, and they have a reddish head, a yellow-striped body, and thick clumps of black hair. For the first time in eastern Uttar Pradesh, India, this research sought to explore the meteorological patterns, infestation rates, and impact of major weather factors such as rainfall, relative humidity, and temperature on the population dynamics of Euproctis scintillans. The number of pests in a number of green mulberry orchards in the area was tracked every month. According to the data, the pest was active in the field from June to November, with the greatest infestation occurring in September. A very significant positive relationship ($p \leq 0.01$) was found between pest numbers and peak temperature, morning, evening, and average relative humidity using statistical analysis. Average and lowest temperatures also exhibited a statistically significant positive correlation ($p \leq 0.05$). However, average precipitation had little influence on pest numbers. This study provides crucial information on the biology, seasonal occurrence, nature and severity of damage, and management tactics for mulberry defoliating pests.

Keywords: Euproctis scintillans (walker), defoliator pest, mulberry, sericulture

Introduction

Mulberry trees are susceptible to a number of pests, some of which have significant detrimental impacts on leaf production, nutrition, and biochemistry. Sap-sucking insects are particularly harmful. Because it feeds on harmed leaves, this has a detrimental impact on silk quality and cocoon output. The invasive pest Euproctis scintillans Walker poses a serious threat to mulberry orchards in eastern Uttar Pradesh. Regular inspections of mulberry orchards have shown that the voracious insectivorous Euploctis scintillans walker caterpillar causes significant leaf damage to the mulberry orchard and, in severe infestations, can even defoliate entire trees. According to certain writers, the larvae of this pest are polyphagous and prey upon a wide range of trees. In (Gupta R. and Tara J. S. 2018) [18], first identified Euproctis scintillans as a significant pest of soft leaves in Eastern Uttar Pradesh, India. This year, the comprehensive ecology of this pest was documented for the first time in eastern Uttar Pradesh, India, in light of the paucity of documentation on biological and demographic research on Euproctis scintillans Walker in mulberry trees. The purpose of this research was to gather data about the meteorological variability and population dynamics of Euproctis scintillans walker in mulberry orchards kept in orchard settings. Since this is a significant mulberry pest in eastern Uttar Pradesh, data regarding the peak infestation of this pest in mulberry plantations may be helpful in implementing timely control measures. This pest is expected to grow into more severe and damaging forms in the near future if adequate management steps are not implemented right away. This necessitates close and accurate control, which is only possible with the participation of local gardeners. The research was conducted because of the significance of this pest and the lack of information on the meteorological incidence of leaf miner in eastern Uttar Pradesh. Mulberry trees (Morus spp.) are the sole food source for the silkworm. The quality of mulberry leaves has a direct impact on the growth and development of silkworm larvae and the caliber of the cocoons they produce. However, mulberry production is frequently threatened by a variety of pests, which may seriously lower the yield and quality of the leaves. Regular agricultural techniques like irrigation, fertilization, weeding, and pest and disease management are necessary to enhance the growth and quality of mulberry leaves. The vast majority of all living things on Earth are herbivorous insects (Arif M., Kumar N., 2001) [4]. In recent decades, there has been a great deal of study on their diversity and ecological significance. With around 1,55,000 species now identified (Bhardwaj SP, Bhardwaj S, 1983) [9], Lepidoptera (butterflies and moths) is one of the biggest taxis in this family. Recent estimates indicate that more than 1,27,000 species of moths have been reported from all over the world (Alfred *et al*., 1998), with India accounting for over 12,000 of these species (Atwal AS, Dhaliwal GS (1999) [5]. One of the most successful species on Earth is the one with their great variety and capacity to thrive in almost any environment. The majority of lepidopteran larvae consume plants, and the adults

consume nectar. They are a key element of terrestrial ecosystems because they serve as herbivores, pollinators, and prey, and they are also one of the most harmful pest groups for agriculture (Abraham CC, Ramamony KS 1999) [2]. About a quarter of the 6,000 or so Lepidoptera species that are thought to be economically significant belong to the Noctui forms order (Abraham, C C; Ramamony KS 1976) [1]. Some of them, however, can be attributed to what (Barwal RN, Joshi S, 1996) [6], others are frequently found in the super family Noctuidae, also known as the "pest clade," which has over 500 genera. Every year, armyworm larvae of several genera cause a considerable economic loss (Kalia S, Pandey VP 2014; Doureswamy S, 1999) [12, 15]. Additionally, adults of certain genera harm fruit crops by puncturing the skin in order to extract the juice (Browne, FC 1988; Belgumpe, S and Sathe, TV., 2016) [8, 10]. In many developing nations, lepidopteran pests' economic destruction of field crops and stored grains exacerbates food insecurity and malnutrition. For this reason, it is critical to establish a consistent, extrapolative higher-level classification framework for the main lineages of these butterflies in order to conduct research on pest bionomics. Furthermore, various mulberry cultivars experience significant changes in their biochemical makeup, photosynthetic pigments, and macronutrient and micronutrient concentrations as a result of infestation.

Life cycle (Euproctis scintillans)

The ecology and traits of Euproctis scintillans larvae are as follows: The body is hairy, the head is tan, and the complexion is brownish. The body is characterized by a prominent tuft that contains a thick anterior anal chamber and a reddish central line, along with a yellowish dorsal stripe. The larval stage might last anywhere from 18 to 21 days, or even 28 days. They frequently attain five or six instars. Food Habits Pests consume plants ravenously, destroying delicate foliage and frequently causing extensive defoliation of their host trees. A larva pupates within a hair cocoon during pupation (which is created in the soil or in the folds of leaves). Euproctis scintillans eggs typically hatch five to nine days after being deposited in clusters on the underside of leaves in nature. The deciduous insect pest, frequently referred to as Euproctis scintillans, goes through a number of stages in its life cycle. The eggs are yellow and hatch in 3 to 9 days from waxy sacs. The first nymphal stage is called a vine, and it's yellow and moves around, looking for good places to eat on young leaves and fruits. The following second and third instar larvae establish themselves in the same area, feed on the plant's sap, and produce a white wax. The larval development of males consists of four stages, including the prepupal and pupal stages, whereas the larval development of females consists of only three stages. The wingless adult female, which is still covered with a thick layer of wax, is approximately 2.2 mm long and 1.4 mm wide. In the pupal and adult phases, males are around 1. 0 mm in length, have a little, extended oval body, well-developed wings, 10-segmented antennae, and a pinkish hue. They live short lives and consume nothing. Although the average number of eggs laid by each female of this sexually reproducing species ranges from 108 to 296, each lays between 100 and 600 eggs. The whole life cycle, which lasts between 15 and 32 days, or around a month on average, depends on the weather. This indicates that there are 11–13 generations every year. Its taxonomic classification places it in the phylum Arthropoda, class Insecta, order Lepidoptera, family Erebidae, genus Euploctis, and species Scintillans (Walker). This pest is very polyphagous, destroying photosynthetic pigments in over 80 plant species across 25 genera, including economically important plants like the horticultural mulberry. Although it happens throughout the year, the harm is worst during the summer. They eat phloem sap from the leaves and stems of mulberry trees using their sharp mouthparts, which causes water loss and lower nutritional content. Additionally, they introduce harmful substances into plants by feeding. A plant infestation may manifest as cholrosis (yellowing), leaf curling, premature defoliation, slowed development, and in severe instances, even plant death. Insect-released honeydew encourages the development of a black, sooty mold on the leaves, which lowers photosynthesis and, in extreme cases, spreads into mulberry fields. Good management includes identifying and removing contaminated plant components like leaves and branches as soon as possible, then burning them to prevent the illness from spreading. All crop trash that supports mealy bug populations must be eliminated and burned. Another approach to physically managing pests is using water jet to remove them from plants and wash them away. Releasing natural enemies like parasites during the initial opening can help to accomplish biological control. In regulating populations of the deciduous pest Euproctis scintillans, certain parasites have proven to be more effective than chemical insecticides.

A- Euproctis scintillans (walker) Mature larval

B- Euproctis scintillans (walker) Adult stage

C- Euproctis scintillans (walker) Larval nymph D- Euproctis scintillans (walker) life cycle

Fig: Life Cycle Stages of Mulberry sap sucking Paracoccus marginatus (mealy bug).
(Ref. All Photographs viewed from Google site.)

Economic damage of mulberry

Between July and October, depending on the surrounding agro climatic conditions, most mealy bug Paracoccus marginatus infestations in mulberry trees at sericulture rearers occur. This sap-sucking bug has increased in significance in recent years because of the significant qualitative and quantitative damage it causes to mulberry trees. Soon after they hatch, the larvae start eating the interior tissue of young leaf shoots, leaving behind a fragile cuticle layer. Additionally, they produce fine, silky threads that cover them. The threads, which retain larval waste, render the leaves unfit for silkworms to eat the biochemical component of photosynthetic pigments. The pest reduces the quality of the leaves, which leads to subpar silkworm rearing outcomes, especially in the autumn. Since the quantity and quality of mulberry leaves are crucial to the success of sericulture, this sort of harm has a direct effect on the output of production. The pest damages leaves, depletes essential nutrients, and stunts the overall growth of mulberry trees. The affected areas of the plantation are plain to observe. The majority of the harm is done during the larval stage, with the fourth and fifth instars of mulberry larvae being the most destructive. By binding the leaves together with silk, these larvae gradually skeletonize them as they eat the green parenchyma from the inside. Infected leaf areas exhibit obvious deficiencies in key components such as proteins, sugars, chlorophyll, bioactive compounds, and moisture, in addition to being coated in black, whitish fungal pathogenic development.

Management and control

The sap-sucking bug pest consumes the chlorophyll, micro and macronutrient sap, and phloem of mulberry plants, drawing nutrients from both the stem and leaves, leading to moisture loss and reduced nutritional value. Typical signs include cholrosis (yellowing), leaf distortion (curling), early leaf loss, stunted growth, and eventual plant death. In severe infestations, the honeydew produced by the insect can cause a thick layer of black sooty mold to form on the leaves. This mold has the ability to spread throughout the entire mulberry farm, infecting numerous plants and impairing their photosynthetic capacity. Unique management techniques are required to manage these defoliator bugs.

Host Plants and Damage

Crops Affected: Euproctis scintillans is known to feed on castor, castor, mestha, capsicum, apple, and various forest trees.

Damage Type: Early stages scrape leaves, while later instars feed on the foliage entirely.

Management: Management typically includes removing infested plant parts and applying foliage sprays like dimethoate or methyl demeton.

Physically: Immediately chop and remove the affected Tukra apical tips (top 10–15 cm).

Cultural considerations: Don't use too much nitrogen fertilizer. Keep the field tidy and eliminate weeds. Chemical: To stop the spread, spray 0.2% Dichlorvos (DDVP 76% EC) or 0.2% Dimethoate (30% EC).

Different management strategies, such as the ones listed below, can be used to manage this pest Paracoccus marginatus infestation:

1. Manually picking and removing larval stages.
2. To destroy the dormant larvae, it is dewed and deep ploughed.
3. The burning of diseased (fallen) leaves during the months of September and October.
4. Trees are tied together using straw bands.
5. Using moth light traps.
6. Applying 0.04% DDVP to mulberry leaves can reduce the infestation by 80 to 90%.
7. Similar to Apanteles spp, the parasitoid can be used as a biocontrol agent.
8. The most effective way to get rid of the bug is to clip off the infested branches and leaves and burn them during the early stages of the infestation. It is essential to burn all crop leftovers in the afflicted garden that support mealy bug populations.
9. Water jetting uses mechanical force to dislodge and wash away the insects from infested plant components, ensuring a mealy bug-free mulberry garden.

Discussion

The yellow-tail moth (Euproctis scintillans) is a defoliator pest that attacks the apical shoots and young leaves of mulberry trees, preventing their development. Green pigments known as chlorophylls are found everywhere in the tissues of autotrophic plants, where they function as the primary photosynthetic catalysts. They are found in large amounts in chloroplasts. The quantity of chlorophyll present is one factor in determining the rate of photosynthesis. In order to link other biochemical changes in plant tissues,

chlorophyll estimates may need to be used (Mahadevan, A., 1982; Beeson CFC 1951) [7, 19]. The chlorophyll content in the mealy bug-infested mulberry leaves of Kanva cultivars decreased by 4.00% and increased by 28.00% (Prasad, SK, 2002; Shree, MP., 1989) [21, 22]. The total chlorophyll, chlorophyll-a, chlorophyll-b, and chlorophyll-a/b ratio were all substantially lower in yellow-tail moths (Euproctis scintillans) infected by Tukra. The rise in total chlorophyll, chlorophyll-a, chlorophyll-b, and the chlorophyll-a/b ratio was modest in M. australis, intermediate in M. macroura, and considerable in Morus nigra. Diseases affect both the proportion of chlorophyll-a to chlorophyll-b and the quantity of chlorophyll. The insect pests' feeding behavior, which causes the loss of pigment(s) and per of laminar area, lowers the photosynthetic efficiency and production of the mulberry leaves. As a result, mulberry leaves have lower nutritional value (Mahadeva, A *et al*., 2011 & Mahadeva, A *et al*., 2012) [16, 17]. The total chlorophyll content of mulberry cultivars was increased. The mulberry cultivar S30 has a lower concentration of chlorophyll. Changes in chlorophyll concentration, which are bad for photosynthetic activity (Heldt, HW., 1997 and Zaman, A, et. al., 2017) [14, 24], also cause a reduction in protein synthesis (Burd, JD, *et al*, 1996; Veerna, G, 1997) [11]. The mulberry leaves will thus have a lower nutritional value. Silkworms fed mulberry that is nutrient-poor and has pests will suffer a negative impact on their growth and development, leading to failures in the cocoon harvest (Mahadeva, A *et al* 2000; Mathur RM, Singh B, 2014) [18, 20]. Mulberry leaves that are infected by pests or diseases are nutritionally deficient and not fit for feeding the silkworm since they are known to have an impact on the amount and quality of silk produced. The mulberry plant is the only food source for silkworms; therefore its pests and diseases must be managed by appropriate methods.

Conclusion

A variety of pests attack mulberry, which causes a rapid decline in leaf production and lowers its quality. Silkworm larvae that feed on such leaves produce silk of poor quality and a low cocoon yield. Based on how they feed on mulberry leaves that are infested with pests, the insect pests of mulberry are categorized as defoliators and borers. The nutritional value of mulberry leaves can be negatively impacted by the pests, which can in turn have an impact on the growth and development of the mulberry larvae and, ultimately, affect the quality and quantity of silk produced. Since the quantity and quality of mulberry leaves are crucial to the success of silkworm culture, it is important to use the approved integrated pest management strategies to manage the threat of Euproctis scintillans (walker) infestation of mulberry without inflicting significant environmental damage, especially if autumn rearing is to be done commercially. The mulberry's pest infestation lowers production volume and negatively impacts the quality of the leaves by causing nutritional deficiencies or physiological problems that result in malformation, deformity, cholrosis, and nutritional inadequacy. The poor commercial qualities of silk production are a result of the diverse nutritional condition of mulberry leaves, which affects how silkworms grow and develop. We must concentrate on lowering greenhouse gases by using conservation agricultural techniques such crop residue management, cultural practices to reduce pest infestation, adhering to region-specific cropping systems that are more susceptible to climate change, and breeding hardy varieties that are resistant to biotic and abiotic stress factors. To effectively manage the quarantine-sucking insect pests of national importance, all accessible management strategies must permeate down to every area of the stakeholders. As a result, the pest is harmful and causes financial harm to farmers on several fronts by reducing the potential mulberry leaf output as well as the quantity and quality of silkworm cocoons. As a result, farmers must be educated on the proper eco-friendly Integrated Pest Management (IPM) techniques to safeguard mulberry leaves against pest infestation.

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