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Maconellicoccus Hirsutus, a "Tukra" Sucking Pest, Damages Mulberry Leaves

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Abstract:

Mulberry plants are susceptible to a variety of pests that severely impair their growth, leading to a decrease in the quantity and quality of mulberry leaves, which are essential for raising silkworms. Pink Mealy bug (Maconellicoccus hirsutus), locally known as 'Tukra,' is a significant mulberry sucking pest, according to sericultural studies. It causes significant leaf wrinkling, thickening, yellowing, and clump top symptoms, which lead to stunted growth. The pink mealy bug (Maconellicoccus hirsutus) causes Tukra disease by feeding on mulberry chlorophyll sap, which causes leaves to curl, thicken, and change color from dark green to yellow. This infestation causes chlorophyll degradation (cholrosis), which results in lower photosynthetic activity and a decline in the nutritional value of mulberry, making the mulberry leaves that cause stunted development and nutrient depletion, making leaves unpalatable and inappropriate for silkworms. The maximization of high-quality mulberry leaves per unit area is one of the primary elements that determines the productivity and profitability of sericulture. Tukra is a significant pest that severely damages mulberry, particularly during the months of July through October, when the weather is conducive to its growth. The majority of the damage occurs during the fourth and fifth larval stage of the pest from July to October under sericulture station. Feeding mulberry leaves to silkworms has a detrimental effect on their growth and development, which in turn lowers the quality of silk production, which has a negative impact on the silk industry's total growth, even if the bug continues to have enough time and space to feed and reproduce on mulberry leaves.

Key words: Pink Mealy bug (Maconellicoccus hirsutus), Tukra Pest, Mulberry, Sericulture.

Introduction:

The only food source for the silkworm, Bombyx mori, is the mulberry tree (Morus spp.). As a result, the quality of mulberry leaves has a significant impact on the growth and development of silkworms, as well as the quality of cocoons. Due to interference from a variety of insect pests, the production of mulberry leaves is frequently hindered. Because the silkworm Bombyx mori L is vulnerable to predation by a variety of species, mulberry leaf is its only food source due to its year-round growth. A large number of pests attack mulberry, as they do many other field crops and commercial plantations. Despite the enormous number of pests that attack mulberry trees worldwide, only a small percentage of them are economically significant. Based on the portion of the plant they target and their method of feeding, they are categorized as sap suckers, defoliators, and stem borers, stem girdlers, root feeders, and so forth. The issue is that the pests that severely harm mulberry are sporadic and occasionally seasonal. Insect pests are known to significantly interfere with all aspects of sericultural practices and are responsible for 20 to 25 percent of cocoon production losses globally **(Sengupta, et al., 1990; Ahmed, N et al., 2019)**. The quality of mulberry leaves has been shown to have a significant impact on the growth, development, and

silk output of silkworms (**Das gupta., 1961; Yokoyama, 1963; Kulbir, 2001** and **Mir, GN. , 2003)**. Mulberry is currently known to be infested by over 300 species of pests, both insect and non-insect, in varying degrees depending on the crop stage and season **(Reddy and Kotikal, 1988 and Zeya, et al., 2003)**. Over 70 species of insects and non-insects from the orders Lepidoptera, Hemiptera, Coleoptera, Thysanoptera, Orthoptera, Isoptera, and Acarina are known to consume mulberry crops in India (Biradhar2 and Naik8). Mealy bugs, leaf rollers, and Bihar hairy caterpillars are a few of the main insect pests of mulberry. They are known to cause crop losses of 10–15%, 12–15%, and 25–30%, respectively **(Manjunath, et al., 2000)**. According to **Zeya, et al., (2019)**, the mulberry sericulture station's cocoon crop experiences significant qualitative and quantitative losses throughout the year due to the susceptibility of nearly all mulberry genotypes to a variety of insect pests. In 1995–96, a thorough investigation was carried out in several agro climatic regions to determine the insect pests of mulberry. On mulberry, a variety of insects belonging to different families of the order Lepidoptera were discovered for the first time. At Temperate Sericulture Research Institute, the Tukra infestation in the sericulture station was discovered to range from 20 to 40% among several pests. It is well known that insect pests significantly impede every stage of sericultural procedures. The insect pests harm the physiochemical processes of the mulberry plant's foliage during infestation, which leads to changes in the plant's biochemical components. Silkworm growth and development are impacted by the consumption of leaves infected with Maconellicoccus hirsutus, which lowers the quality of the silk that is produced. The sole food plant of the silkworm Bombyx mori L., mulberry (Morus sp.), is essential to the sericulture business. One of the main mulberry pests is the pink mealy bug (Maconellicoccus hirsutus), which causes significant damage and repeated loss in leaf yields of around 3,000 to 6,000 kg/hectare/year **(Kumar, P et al., 1988)**. The pest causes a distinctive disease Tukra in both irrigated and rain-fed gardens. Mealy bugs' feeding habits, which include sucking, cause the leaves of apical shoots to curl and crinkle, while the apical internodes become bloated and twisted. The shoots become brittle as a result, and the leaves take on a dark green hue and become distorted. According to **Hadique, PK et al. (2000)**, the pest lives in the creases and knots of the crumpling. Among the effects of the tukra's morphological modifications on the plant are the cessation of the stem's linear growth and the subsequent thickening of the petiole. According to **Chatterjee, KK, et al. (1993)**, the leaf's lamina was significantly smaller and misshapen, which eventually resulted in early leaf drop. Clusters of immature and mature mealy bugs can be seen on the stems under the overlapping leaf sheaths, below the node, and extending up and down to the other internodes and buds. Mealy bug hosts generate a lot of honey dew, which supports the growth of sooty mold fungi and plays a crucial role in the spread of viruses **(Eid, MA et al. , 2011)**. Because mealy bugs feed on cell sap, mulberry canes that are infested become thin, yellow, and stunted, eventually lacking vital nutrients in the affected plant sections. The current investigation was conducted to ascertain the effects of Maconellicoccus hirsutus infestation on the biochemical components and photosynthetic pigments in the leaves of several well-known native mulberry leaves, which have a direct influence on the feeding habits of mulberry larvae and, consequently, on their growth, cocoon weight, and silk output.

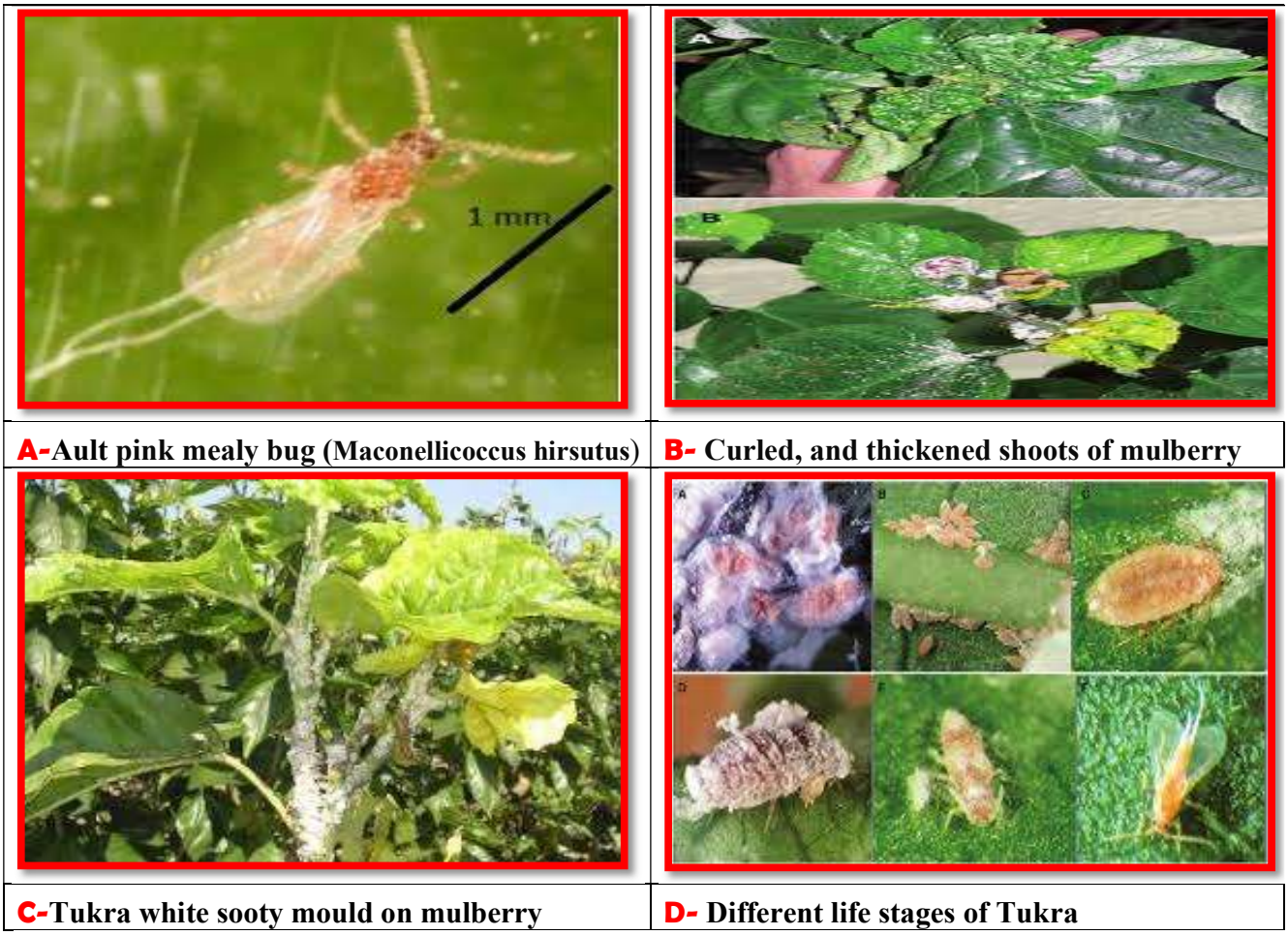
Life Cycle:

The pink mealy bug (Maconellicoccus hirsutus), which feeds on mulberry sap and causes thick, twisted, and bunched shoots, is a significant pest in sericulture. The insect completes its life cycle in around 23–27 days, with 10–12 generations each year, and it flourishes in hot, dry weather, especially in the summer. The mealy insect goes through a three-stage life cycle, similar to Egg, Nymph, and Adult. The mealy bug Maconellicoccus hirsutus is one of the sap-sucking insect pests. Taxonomic standing Arthropoda is the phylum. Insecta is the class. Hemiptera is the order; Family: Pseudococcidae; Maconellicoccus is the genus. Hirutus is the species name. Description and

history of life The length of adult males and females is approximately 3 mm. Females are pink with a white waxy covering and are wingless. Males can fly, and they have two wings and two lengthy, waxy tails. Each female lays between 350 and 600 eggs in cotton-like mealy substance-covered ovisacs, and females have the ability to reproduce parthenogenetically. In 6–9 days, the eggs will hatch. There are just three nymphal instars in females, whereas males have four. The total lifespan is completed in a month period, and the nymphal stage lasts between 23 and 27 days. A year will have 10 to 12 generations. They have a wide range of food sources, and over 350 host plants have been identified worldwide. Significant host plants include teak, cotton, maize, pigeon pea, mango, soybean, sugarcane, coffee, guava, grapevine, citrus, chrysanthemum, croton, pumpkin, beans, hibiscus, and more. They happen on mulberry throughout the year, but they are more prevalent during the summer (March to August). Their numbers are insignificant during the rainy season. Nymphs consume by extracting sap from the stem and soft leaves. The afflicted apical shoots thus exhibit a bunchy appearance as a result of leaf curling, internodes shortening, and stem thickening. In India, this symptom is widely referred to as **"Tukra."** As the infestation progresses, white sooty mold grows on the honeydew produced by the mealy bug, covering the afflicted region. Due to stunted plant growth and a decline in the nutritional content of the leaves, the pest causes both quantitative and qualitative loss in mulberry output. Infested apical shoots are clipped off by management techniques and either burnt or dunked in a soap solution to kill them. Avoid cultivating alternative host plants for the mealy bug near mulberry gardens. Spray 0.05% Dimethoate (36% EC) 12–15 days after pruning. The safe period for silkworms is between 20 and 25 days. To prevent the pest from returning during the growth phase of mulberry plants, it is necessary to apply a second dose of 0.2% DDVP (76% EC) during the summer, 10 days after the first application. The safe period is 15-17 days. In two divided doses at an interval of six months, release predatory ladybird beetles Cryptolaemus montrouzieri at 250 adults or Scymnus coccivora at 500 adults per acre per year.

Eggs: On soft leaves or shoots, the females lay 350–500 yellow eggs in soft, cottony, white, waxy ovisacs. It takes six to nine days for eggs to hatch. Crawlers are the nymphal stage. The nascent crawlers are orange in color, highly mobile, and spread out to eat sap. Over a period of 23 to 27 days, they experience three nymphal instars in girls and four in boys. Following the initial stage, they become less active, releasing white, powdery, waxy chemicals that tend to clump together on the plant.

Adult Phase: Females: live for 10–12 days, have a pinkish body with a waxy covering, and are wingless (apterous-insect with no wings at all). Males are tiny, winged, and have a lifespan of just three to four days, during which time they do not eat. Generation Time: There are 10–15 generations annually, with greater activity in the summer and high humidity, and the entire life cycle lasts between 23 and 35 days.



A-Ault pink mealy bug (Maconellicoccus hirsutus) | **B- Curled, and thickened shoots of mulberry**

C-Tukra white sooty mould on mulberry | **D- Different life stages of Tukra**

Fig: Life Cycle Stages of Mulberry Tukra (Maconellicoccus hirsutus) pest.
(Reference: Above Photographs viewed from Google site)

Economic damage of mulberry:

The majority of pink mealy bug (Maconellicoccus hirsutus) infestations in mulberry trees in sericulture stations are recorded between July and October under agro climatic conditions. Due to the qualitative and quantitative harm it causes to mulberry plants, Maconellicoccus hirsutus has gained increasing importance in recent years. After hatching, the larvae immediately begin to eat the leaf flush, leaving a clear cuticle layer behind, and spin a beautiful, silky net of threads around themselves. Leaves are not suitable for silkworms because the larvae's excrement is kept in the delicate, silky threads. This insect pest reduces the quality of the leaves, which results in a lower performance of silk worm breeds, particularly during the fall. As a result, the success of sericulture depends on the number and quality of mulberry leaves used in rising. The pest harms foliage, depletes nutrients, and inhibits the development of mulberry trees. The damaged leaves caused by the pest are readily visible from the mulberry garden. The larval stage is responsible for the damage; the infestation range is primarily concentrated in the 4th and 5th larval stages. The larvae feed from inside the leaves after weaving them together. Mulberry leaves are skeletonized by the larvae, which consume the entire inside green flesh. The contaminated area of the leaf is covered with dark white molds and is devoid of several elements such as proteins, sugars, chlorophyll, water content, and other things.

Management and Control:

Physical: Immediately chop and remove the affected Tukra apical tips (top 10–15 cm).
Cultural factors: Avoid using too much nitrogen fertilizer. Maintain a clean field and get rid of weed hosts.
Chemical: Use 0.2% Dimethoate (30% EC) or 0.2% Dichlorvos (DDVP 76% EC) as a spray to prevent the spread.
Different management strategies, such as the ones listed below, can be used to manage this pest infestation:

1. Manual selection and removal of larval stages
2. It is Dewed and deep plow to kill the dormant larvae.
3. The burning of infected (fallen) leaves during the month of September through October.
4. The use of straw bands to bind trees together.
5. Moth light trapping.
6. The infestation can be reduced by 80 to 90 percent by spraying mulberry leaves with 0.04% DDVP.
7. The parasitoid, similar to Apantel is spp, can be employed as a biocontrol agent.

Discussion:

Chlorophylls are ubiquitous in all autotrophic plant tissues as green pigments and serve as the fundamental photosynthetic catalysts. They are present in chloroplasts in significant quantities. The photosynthetic rate is measured in part by the amount of chlorophyll present. It may be necessary to use chlorophyll estimates in order to correlate other biochemical alterations in the plant **tissues (Mahadevan, A., 1982).** In the mealy bug-infested mulberry leaves of Kanva varieties, the chlorophyll concentration fell by 4.00% and rose by 28.00% **(Prasad, SK, 2002; Shree, MP., 1989)**. In Tukra affected Maconellicoccus hirsutus, the overall chlorophyll, chlorophyll-a, chlorophyll-b, and chlorophyll-a/b ratio were all significantly reduced. The increase in total chlorophyll, chlorophyll-a, chlorophyll-b, and the chlorophyll-a/b ratio was significant in Morus nigra, marginal in M. macroura, and minimal in M. australis. The chlorophyll content as well as the ratio of chlorophyll-a to chlorophyll-b are both impacted by diseases. The mulberry leaves' photosynthetic efficiency and productivity are reduced as a result of the insect pests' feeding habits, which lead to the loss of pigment(s) and per of laminar area. Consequently, the nutritional content of mulberry leaves declines **(Shree, MP., 1989; Mahadeva, A et al., 2011 & Mahadeva, A et al., 2012).** The overall chlorophyll concentration in mulberry cultivars was raised. The chlorophyll concentration in the mulberry cultivar S30 is lower. Changes in chlorophyll concentration, which have a detrimental impact on photosynthetic activity **(Heldt, HW 1997)** also result in decreased protein production **(Burd, JD et al., 1996; Veerna, G 1997)**. As a result, the mulberry leaves will have a lower nutritional value. Silkworms fed mulberry that is so low in nutrition and has pests will experience a detrimental effect on their growth and development, resulting in failures in the cocoon crop **(Mahadeva, A et al 2000; Doureswamy, S et al., 1999)**. Because it is known that diseased or pest-infested mulberry leaves affect the quantity and quality of silk produced, they are nutritionally deficient and unsuitable for feeding the silkworm. As the sole food source for silkworms, the mulberry plant's diseases and pests must be controlled by necessary measure.

Conclusion:

Pink mealy bugs (Maconellicoccus hirsutus) on mulberry (Morus sp.) plants significantly lower the leaf output and, as a result, harm the leaf's quality. Thus, an effort was made to ascertain the alterations in the photosynthetic pigments and biochemical components of mulberry leaves infected with mealy bugs. The components of the mulberry tree that was infested with pests varied. Feeding silkworms mulberry leaves that are infested with pests can negatively impact the nutritional content of the leaves, which can in turn have an impact on the growth and

development of the mulberry larvae and, ultimately, affect the quality and amount of silk produced. Given that the quantity and quality of mulberry leaves are critical to the success of silkworm culture, it is essential to use the approved integrated pest management methods to control the threat of Maconellicoccus hirsutus infestation of mulberry without causing significant environmental harm, particularly when autumn rearing is to be carried out commercially. Therefore, if not treated seriously, Maconellicoccus hirsutus may be identified as one of the major biological factors contributing to sap sucker infestation in the silk production under the sericulture business.

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