MAJOR SUCKING INSECT PESTS OF THE MULBERRY PLANT WITH REFERENCE TO BIOLOGICAL CONTROL

Abstract

Mulberry silkworm, *Bombyx mori*, is a monophagous silkworm that makes mulberry silk by feeding only on mulberry leaves (*Morus* spp.) of the Moraceae family. The quality of mulberry silk and its productivity are directly correlated with the quality of mulberry leaves. Mulberry is a perennial monoculture crop that offers pests, both insect and non-insect, a generally stable microclimate and a source of food. There are reports of 300 different pest species on mulberry trees, both insect and non-insect. Among them, sap-sucking insects cause serious damage to mulberry trees. To control such insect infestations, insecticide sprays are currently the most commonly used method, which harms beneficial non target insects as well as lowers the quality of mulberry leaves, affecting the health and silk quality of silkworms. Over the last few decades, due to repeated insecticide application, most of the insect pests have developed a high degree of resistance against insecticides, which has resulted in reducing the effects of insecticide application. Therefore, adoption of biological control has proved to be a necessary and alternative control method. This chapter review throws light on collection of work that has been done particularly with reference to the biological control on the major sap-sucking insect pests of mulberry.

Keywords: Sucking pests, Biological control, Thrips, Insecticides, Mulberry silkworm

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I. INTRODUCTION

Mulberry silkworm, *Bombyx mori*, is a monophagous silkworm that makes mulberry silk by feeding only on mulberry leaves (*Morus* spp.) of the Moraceae family. Around 20 species of mulberry trees found in India, with, *Morus latifolia, Morus. indica, Morus serrata,* and, *Morus alba* being the most often cultivated [1].Mulberry (*Morus* spp.) is a perennial, fast-growing, deeply-rooted plant with a high biomass yield that can be kept alive for about 15-20 years. The quality of Mulberry silk and its productivity are directly correlated with the mulberry leaves quality. Many factors, including biotic and abiotic components, impact leaf quality. Since mulberry is a perennial monoculture crop, it provides a suitable microclimate and food source for insect and non-insect pests. On mulberry, approximately 300 pest species, both insect and non-insect, have been reported [2]. Mulberry insect pests are categorized according to pest incidence as major pests and minor pests. Major pests include Mealybugs, Thrips, Whiteflies, Bihar hairy caterpillars, and minor pests include cutworms, Leaf roller/leaf Webber, Green Weevil, Stem Girdler, Jassid, Black Scale Insect, Soft Scale Insect, Spider Mites, Termites, and others.These pests significantly reduce leaf yield and degrade leaf quality. Feeding such affected leaves to silkworms has a negative impact on cocoon yield and silk quality [3]. Insecticide sprays are the most often utilized technique of managing insect pests nowadays. Nevertheless, their widespread usage harms beneficial insects such as predators, parasitoids, and pollinators, as well as lowering mulberry leaf quality. The heavy use of synthetic pesticides co-exists with adverse effects such as rise in primary pests, development of resistance to insecticide and secondary pest resurgence as well as residual effect in mulberry leaves, which ultimately affect the silkworms' health. To reduce these problems, the adoption of IPM is the only solution. Nowadays, most countries have adopted various methods of IPM that includes integration of different control strategies like, biological control, cultural control, physical and mechanical control and chemical control to reduce insect pests with minimal use of insecticides [4]. This review throws light on collection of work that has been done particularly with reference to the biological control on the major sap-sucking insect pests of mulberry.

II. MAJOR SUCKING PESTS OF MULBERRY AND THEIR BIOLOGICAL CONTROL

1. **Mealy Bug:** Mealybugs are sap-sucking insects with mouthparts of the sucking and piercing type (Homoptera: Pseudococcidae). In the process of sucking, they release extra sap as honeydew, which provides food for ants and encourages the growth of sooty mould on the surface of leaves, which reduces the plant's ability for photosynthetic activity [5]. There are 3 species of mealybug reported to attack the Mulberry plant which are –
    - Pink mealybug, *Maconellicoccus hirsutus*
    - Papaya mealybug, *Paracoccus marginatus*
    - Long-tailed mealybug, *Pseudococcus longispinus*

- **Biology:** Mature females may reproduce parthenogenetically, and each female lays between 350 and 600 eggs in a white powdery eggs sac with exception of long tailed mealybugs, which are ovoviviparous i.e., females directly gives birth to young larvae without egg laying. Their eggs hatch into first instar nymph called crawlers in 6-9

days. In the case of males, there are four nymphal instars; in the case of females, there are only three. Their entire life cycle is completed in 30 days, and the nymphal phase lasts for 23–27 days. Throughout a year, there are 10–12 generations [3]. Although they occur all year round, the summer is when they occur the most frequently.

- **Damage**
  - Infested growing points swell and becomes stunted.
  - They secret honeydew on mulberry leaves which attract ants and black sooty mould develop on leaves inhibiting the photosynthetic ability of the mulberry plant.
  - Curling and contortion of leaves occur due to injection of saliva during feeding in the soft tissue.
  - Leaf yield losses of 30 to 50% [6].

- **Biological Control:** Biological control is thought to be the most effective solution against mealybug infestations because parasites and predators persist even when mealybug populations are low and help to keep mealybug populations below economic injury levels. Important predators of mealybug nymphs are the coccinellid beetles, including *Scymnus coccivora* and *Cryptolaemus montrouzieri*. Parasitoids such as *Acerophagus papaya* and *Pseudleptomastix mexicana* are more effective than chemical control in controlling papaya mealybug [3].

- **Recommendation (Table.1)**
  - Release of *Cryptolaemus montrouzieri* @ 250 adults or *Scymnus coccivora* @500 adults per acre in a year in two split doses at an interval of six months is useful [3].
  - Release of *Acerophagus papaya* or *Pseudleptomastix mexicana* @ 250 parasitoids per acre of mulberry garden is found to be effective [3].

2. **Thrips:** Mulberry Thrips are sap-sucking insects that have piercing and rasping type of mouth part. There are various species of thrips found on mulberry, but the most common are *Pseudodendrothrips mori* and *Pseudodendrothrips bhatti* in several parts of India [3].

- **Biology:** Each female lays around 30 to 50 eggs on the ventral surface of the tender mulberry leaves, and they reproduce both sexually and parthenogenetically. The eggs hatch in 6-8 days. Their complete life cycle takes 20-22 days, with 15 generations per year. They occur all year, but the frequency is highest in the summer months (April – May) and decreases dramatically during the rainy season (October-November) [3].

- **Damage**
  - They use their mouth parts to pierce the epidermis of mulberry leaves and extract the sap.
  - Stunting, leaf curling and deformation occurred during severe infestation [3]
  - White streaks and blotch appearance on leaves.
  - Leaf yield losses of 25 -50% [7].

- **Biological Control**: Thrips are highly resistant to insecticides, which results in reduced effects of insecticide against thrips [8,9]. In this view, biological control of thrips is very important. The ladybird beetles, *Menochilus sexmaculatus and Scymnus coccivora, Anthocorid orius sp.,* and neuropterans and green lacewing, *Chrysoperla* are important predators of thrips [10,3]. Kakimoto et al. 2016 reported that *Haplothrips brevitubus* is a potential predator of *Pseudodendrothrips mori* and is useful for controlling thrips [11].

- **Recommendation (Table.1)**
  - Release of *Scymnus coccivora* @ 500 adults per acre, 7 day after insecticide spray is useful [3].
  - Release of green lacewings, *Chrysoperla* @1000 eggs per acre is useful after a week of insecticide spray [3].

3. **Whitefly:** There are two species of Whitefly consider as a major pest of mulberry in west Bengal which are *Dialeuropora decempuncta* and *Tetraleurodes mori*. *Dialeuropora decempuncta* is a highly destructive whitefly that has been infesting mulberry trees since 1994 [12].

- **Biology:** Females can reproduce as adults both sexually and parthenogenetically. On the underside of the tender leaves, the female lays around 120–150 eggs, which hatch after 8–9 days. There are four nymphal instars, which lasts 11 to 25 days. Fourth instar considered as pupa, produces blue thread like structures around its body. Females have a lifespan of 10–14 days compared to 4–8 days for males. Depending on the weather, the life cycle takes 30 to 45 days to complete [3]. They occur all year round, but their frequency is highest in the summer (March to June) and decreases in the winter (October- December).

- **Damage**
  - By sucking in excessive amounts of leaf juice from the underside of leaves, they damage mulberry leaves.
  - In severe situations, leaves get dry and curl.
  - On mulberry leaves, they produce honeydew, which encourages the formation of sooty mould, which reduces the plant's capacity to photosynthesize.
  - Leaf yield loss of 1630 kg/ha/season (24%) [13].

- **Biological control:** Whitefly predators include beetles like *Scymnus coccivora*, *Micraspis discolor, Menochilus sexmaculatus*, and *Cryptolaemus montrouzieri*. Kumar et al. (2018) found that *Micraspis discolor* Mulsant (Coleoptera: Coccinellidae) can be used as a predator in the mulberry field to control the whitefly, *Dialeuropora decempuncta* [14]. Their research also found that the fourth instar grub of *Micraspis discolor* is a voracious feeder, with females consuming more *Dialeuropora decempuncta* life stages than males. To suppress whitefly, two aphelinid parasitoids, *Encarsia haitiensis* Dozier and *Encarsia meritoria* Gahan, are most effective.

- **Recommendation (Table.1)**
  - Release of *Scymnus coccivora* beetles or *Micraspis discolor* @ 500 adults per acre is useful [3].

III. CONCLUSION

The chapter reveals that the major sucking pests cause significant damage to mulberry plants. They not only prevent further growth, but they also reduce the nutritional quality of the leaves, rendering them unsuitable for feeding silkworms. As a result, proper management practices must be used during mulberry crop production. The most popular technique for controlling such insect pests nowadays is to use insecticide sprays. The majority of insect pests have, however, evolved significant levels of insecticide resistance as a result of the increasing use of synthetic pesticides in recent years, which has decreased the efficiency of applying insecticides. The health and silk quality of silkworms are also impacted by insecticides because they lower the quality of mulberry leaves. As a result, biological control may prove to be an alternative control mechanism has recently received a lot of interest. As a result, farmers should control pest infestations with biological control and minimal insecticide application.

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Table 1: Major Sap Sucking insect pests of Mulberry and their recommended biological agent

Sl. No.	Family	Sap sucking Insect pests (Scientific Name)	Biological agent	Number to be released /ac/crop	Reference
1	Pseudococcidae	Pink mealybug (*Maconellicoccus hirsutus*)	**Predators** *Cryptolaemus montrouzieri, Scymnus coccivora*	250 adults 500 adults	[3]
2	Pseudococcidae	Papaya mealy bug (*Paracoccus marginatus*)	**Parasitoids** *Acerophagus papaya, Pseudleptomastix Mexicana*	250 adults	[3]
3	Thripidae	Thrips (*Pseudodendrothrips mori*)	**Predator** *Chrysoperla* spp.	1000 eggs	[3]
4	Aleyrodidae	Mulberry whitefly (*Dialeuropora decempuncta*)	**Predator** *Scymnus coccivora*, *Micraspis discolor*	500 adults	[3]

REFERENCES

[1] Tembhare, D.B. “Modern Entomology”.Himalaya Publishing House, Mumbai, India, (2012), 352-353.
[2] Naik, S. L. “Bio-ecology of thrips infesting mulberry”. M.Sc.(Seri.) Thesis, Univ. Agric. Sci., Bengaluru, Karnataka, India, 1997.
[3] Sakhtivel, N., Kumar, N. J. B., Dhahira, B. N., Devamani, M., & Teotia, R. S.. “Mulberry pests current status and management practices”. Central sericultural research & training institute, Central Silk Board, Ministry of Textiles, Government of India Srirampura, Mysuru-570, 2019a
[4] Awasthi, V. B. “Introduction to general and applied entomology”. Scientific Publishers, 2012, pp. 244-257
[5] Tanwar, R. K., Jeyakumar, P., & Monga, D. “ Mealybugs and their management Technical Bulletin 19, September, 2007. National Centre for Integrated Pest Management LBS Building, Pusa Campus, New Delhi, Vol.110, No. 12 (2007), pp.1-10.
[6] Vijaya Kumari, N.. “Eco-friendly Technologies for Disease and Pest Management in Mulberry-A Review”. Journal of Agriculture and Veterinary Science, Vol. 7, No. 2 (2011), pp.1-6.
[7] Sakthivel, N.. “Ecofriendly management of Pseudodendrothrips mori Niwa and its impact on abundance of predatory coccinellids in mulberry ecosystem”. Journal of Biological Control, Vol. 33, No. 2 (2019b), PP.143-146.
[8] Brødsgaard, Henrik F. "Insecticide resistance in European and African strains of western flower thrips (Thysanoptera: Thripidae) tested in a new residue-on-glass test." Journal of economic entomology 87, no. 5 (1994): 1141-1146.
[9] Immaraju, J.A., Paine, T.D., Bethke, J.A., Robb, K.L., Newman, J.P. “Western flower thrips (Thysanoptera: Thripidae) resistance to insecticides in coastal California greenhouses”. J. Econ. Entomol. 85 (1992), PP. 9–14.
[10] Bhat, A., Fatima, A., & Dar, K. A. “Bio control and its role in sericulture: A review paper. International Journal of Advance Research in Science and engineering”, 7(4) (2018): 1881-1885.
[11] Kakimoto, K., H. Inoue, N. Hinomoto, T. Noda, K. Hirano, T. Kashio, K. Kusigemati, and S. Okajima. "Potential of Haplothrips brevitubus (Karny)(Thysanoptera: Phlaeothripidae) as a predator of mulberry thrips Pseudodendrothrips mori (Niwa)(Thysanoptera: Thripidae)." Biological Control 37, no. 3 (2006): 314-319.
[12] Bandyopadhyay, U. K., S. K. Raina, N. Chakraborty, M. V. Santhakumar, S. K. Sen, and B. Saratchandra. "New record of a Homopteran pest on mulberry (Morus alba)." Sericologia, Vol.39, no. 2 (1999): 319-324.
[13] Bandyopadhyay, U. K., M. V. Kumar, K. K. Das, and B. Saratchandra. "Yield loss in mulberry due to sucking pest whitefly, Dialeuropora decempuncta Quaintance and Baker (Homoptera: Aleyrodidae)." International Journal of Industrial Entomology 2, no. 1 (2001): 75-78.
[14] Kumar, M. S., Bandyopadhyay, U. K., Lalitha, N., & Saratchandra, B.. “Biology and feeding efficacy of Micraspis discolor, a potential biological control agent of whitefly, Dialeuropora decempuncta”. Journal of Entomology and Zoology Studies, Vol. 6, no. 1, (2018), PP. 938-941,.

