Pest Management in Tea Cultivation: Focusing on *Helopeltis theivora* (Tea Mosquito Bug) and *Oligonychus coffeae* (Red Spider Mite) in Northeast India

Raj Kusum Basumatary*

*Department of Zoology, University of Science and Technology, Meghalaya

Abstract

Tea (*Camellia sinensis*) is the world's most popular non-alcoholic beverage, with India being one of the largest producers. In Northeast India, tea cultivation is highly susceptible to damage from insect pests and mites, leading to significant economic losses. Two of the most problematic pests for tea are the Tea Mosquito Bug (*Helopeltis theivora*) and the Red Spider Mite (*Oligonychus coffeae*). These pests feed on the tender parts of the tea plant, such as leaves, buds, and young shoots, resulting in decreased yield and quality. This review discusses the biology, damage, and management strategies for both pests, focusing on cultural, mechanical, and biological control methods. Integrated Pest Management (IPM) strategies including the use of natural predators, entomopathogens, and botanical treatments are highlighted as effective and sustainable approaches to mitigate pest-related losses.

Keywords: *Camellia sinensis*, Northeast India, *Helopeltis theivora*, *Oligonychus coffeae*, integrated pest management (IPM)

Introduction

Tea [*Camellia sinensis* (L.)] is the largest non-alcoholic beverage consumed throughout the world. It is grown on over 2.71 million ha in more than 34 countries **(Hazarika et al,. 2009)**.In India, tea plantation covers an area of 566.6 thousand ha, producing annually 1233.14 million kg of tea, of which approximately 53% (652.95 million kg) is harvested from Assam **(Directorate of Economics and Statistics, Assam, 2016).** Tea being a perennial crop has long been a prime target for pests and diseases **(Dutta, 1989**). **(Hazarika et al,. 2009)** reported that 1031 species of arthropods are associated with tea monoculture globally. The insect pests attack all parts of tea plant viz. root, stem, leaf, flower and seed causing 10-15% loss in yield **(Hazarika et al,. 2001)**. **Glover et al,. *(*1961)** assessed a crop loss of 29 million kilograms of made tea and this accounts for 13% of crop production in North east India.

Every year pest infestations wreak havoc on tea plants, causing significant damage to the crops and resulting in substantial economic losses. This study intends to review *Helopeltis theivora (*Tea Mosquito Bug) and *Oligonychus coffeae* (Red Spider Mite), two of the major pests of tea and its management.

*Helopeltis theivora (*Tea Mosquito Bug)

The tea mosquito bug (TMB), *Helopeltis theivora* Waterhouse (Heteroptera: Miridae) is a major sucking pest of tea in most tea-growing areas of North-East India, including Assam. It was first recorded on tea in India in 1968 in the Cachar district of Assam **(Watt and Mann 1903). Mukhopadhyay and Roy 2009** reported that although, it is a polyphagous pest, having several food plants, the most preferred and principal host of the TMB is tea. **Bora et al,. 2007** stated that about 80% of tea plantation in India is affected by TMB infestation**. Sarmah et al,. (2011)** estimated that the economic threshold level (ETL) and economic injury level (EIL) for TMB infestation in Assam to be 2.81 and 3.75% shoot infestation respectively.

Somchoudhury et al,. (1993) reported that the presence of one pair of TMBs might cause economic damage of 10 bushes within 14 days. The nymphs and adults of TMB suck the sap from tender leaves, buds and young shoots, which results in heavy crop losses**. Rahman et al,. 2007** reported that the rate of feeding by the female was higher compared with males. **Sudhakaran and Muraleedharan, 2006** observed that, feeding punctures made by adult females were comparatively large than those made by males. **Sana and Haq, 1974** studied on nocturnal and diurnal feedings activities of the TMB and revealed that the number of feeding punctures/shoot was much greater during the night than during the day.

In northeast India, **Das, 1957** reported that the TMB attack began in May, June and July and often extended to September when there were more rainy days. **Roy et al,. 2009e** stated that nymphal development is completed within a short time from May to October, whereas it is longer in the month of January. **Sudhakaran and Muraleedharan, 2006** reported that the average longevity of females was 48 days, whereas males lived for only 28 days.

Das, 1957 observed sexual dimorphism in the TMB. The male was smaller than the female and was slim with a black pronotal area and a bluish abdomen. The female was bigger and had a distinct orange pronotum in the thoracic region. **Hazarika et al,. 2009** reported that a mated female of TMB embeds eggs singly inside the tissues of a succulent stem by splitting it open with the ovipositor. Oviposition causes the stems to develop cracks and causes over – callusing, which also results in stunted growth and the dieback of stems **(Das 1957).**

Management practices

Cultural control

Cultural controls are the earliest and most traditional methods used to manage pest populations. **Das 1965** reported that frequent plucking schedule helped to remove inserted eggs and early nymphs on the young shoots preventing them from growing large enough to cause significant damage. **Satake et al,. 2006** stated that the intensity of plucking plays a crucial role; the more frequently it's done, the more effectively it reduces the pest population. **Das 1965** reported that hard plucking, black plucking and level off skiff were effective in cases where there was total or severe attack.

According to Roy, **Gurusubramanian, and Mukhopadhyay (2010a),** it's essential to keep the boundary between the forest and tea plantations free of weeds and non-economic plants and the cleared area needs to be treated with suitable insecticides to prevent migration of the TMB. Integrated control techniques are needed to control TMB and minimize the use of conventional pesticides applied to tea plants **Hazarika et al,. 2009**. **Gurr et al,. 2004** reported that a trap crop helps alter the habitat within an agro ecosystem, making it a valuable tool in ecological engineering for Integrated Pest Management (IPM).

Mechanical and physical control methods

In some tea gardens, handpicking of adults and nymphs is done during minor pest outbreaks, but it should begin as soon as any signs of damage are observed. The most effective times for collecting the TMB by hand are in the morning and afternoon when the insects are most active on the tea bushes. **Borthakur et al,. 2011** stated that ultrasound based control may be a potential components of IPM for TMB, which suffered early mortality when exposed to 20KHz frequency for 15, 30 and 30 minute per day from 1st instar onwards.

Biological control

Smith, 1919 coined the term "biological control," which refers to using natural predators or enemies to keep insect pests in check. This method stands out as the only pest management strategy that not only protects the environment but also enhances species diversity and biodiversity within agricultural ecosystems**. Das (1974**) recorded 11species of Coccinellid predators, six species of syrphid predators and one species of antlion that feed on active form of tea aphid. **Gurusubramanian et al,. (2009)** reported that spraying of the entomopathogen, Beauveria bassiana (Bals.- Criv.) Vuill, at 3 kg/ ha minimized infestation of the TMB by 42%_62% compared with the control under field conditions. **Barbora and Singh (1994**) stated that among these predators a spider, *Oxyopes* sp., preying mantids and reduviids was dominant.

***Oligonychus coffeae* (Red Spider Mite)**

Mites are a group of persistent and most serious pests of tea found in almost all tea producing countries (**Cranham 1966**). **Gupta 1989** reported 13 species of mites belonging to eight families in India. **Watt and Mann. 1903** stated the red spider mite (RSM), *Oligonychus coffeae* Nietner (Acarina: Tetranychidae) as the most important mite which was discovered in 1868 in Assam, India. **Banerjee, 1971** reported RSM economic threshold level (ETL) in tea to be 4 mites per leaf in South India [41, 44] and in North East India 2–3 mites/cm2

Das 1959a reported that the damage to the tea plant is caused by larvae, nymphs and adult mites, which feed on the sap of the leaves and occasionally on leaf stems. Nymphs and adults lacerate cells, producing minute characteristic reddish brown marks on the upper surface of mature leaves, which turn red in severe cases, resulting in crop losses from 17 to 46% (**Hazarika et al,. 2009). Das 1959a** also observed that both males and females are sexually mature on emergence where males emerge earlier and wander about in search of female deutonymphs. **Rao 1974a** reported that males are short-lived whereas females are known to live for about 3 weeks during summer and for a couple of months or more during winter. The egg is ovoid or spherical, smooth, with a slight depression on the exposed top side and flattened on the lower surface **(Das 1959a; Rao 1974a). . Banerjee and Das 1969** observed that light may affect the oviposition rhythm of RSM**. Gotoh and Nagata, 2001** reported that the optimal temperature for growth and development is 30°C.

Management practices

Cultural control

Pruning of tea plants involve trimming and shaping the branches to promote healthy growth and improve the overall yield. It improves air circulation and light penetration, both of which are important for reducing pest infestations. **Das 1959b** reported that pruned tea is much less attacked than skiffed tea. **Borthakur (1993)** mentioned that bushes under longer pruning cycle harbour more mites. Therefore, **Das 1959b** stated that the time of pruning also appears to have a significant influence on mite attack. Well built drainage system plays an important role in plant growth and pest management. **Hazarika et al,. 2009** reported that poor drainage not only harms tea plants by preventing proper root health, but it also creates a favorable environment for the growth of RSM.

Botanicals

Roobakkumar et al,. (2010) indicated that Neem Kernel Aqueous Extract (NKAE) @ 5.0% concentration was effective against RSM. Formulation containing azadirachtin and their combination with synthetic acaricides such as ethion and dicofol were reported as effective tools for RSM management **(Rahman et al,. 2007). Roy et al,. 2011a** reported that the water extract of Clerodendrum viscosum (Verbenaceae), a common weed in India, and Melia azadirach (Meliaceae) showed great promise in controlling RSM population at field level. **Kalaivani et al,. (2013)** suggested that pumpking

phloem lectin may be considered as a potent control component of integrated pest management (IPM) of RSM due to its propensity to control the survival rate and fecundity of the RSM. **Deka et al,. 2022** reported that aqueous extracts from five traditional plants (Murraya paniculata, Cassia tora, Amphineuron opulentum, Tithonia diversifolia, and Cassia alata) effectively control RSM on tea plants without harming the tea plants or affecting the tea quality and support natural enemy populations.

Biological control

Sarkar et al,. (2007) reported that the period of peak incidence of the predatory mites groups was March– April followed by another small peak during October–November. The density of predatory mites (*Amblyseius* sp. and *Agistemus* sp.) coincided with that of RSM population in N.E India. **Saha et al,. (2001)** suggested that Amblyseius coccosocius Ghai and Menon was the most suitable predator of tea RSM in North East Indian tea plantation. **Banerjee, 1971** reported that adults and larval stages of S. gilvifrons predate indiscriminately on the eggs, nymphs and adults of the RSM. **Roy et al,. (2010)** reported that *Micraspis discolor* F. was the dominant coccinellid predator of RSM in the conventionally managed tea plantations in North Bengal, India.

Table 1: Tea pests of North-east India.

Name of Pest	Damaging Stage	Site of Attack	Seasonal Incidence	Damaging Symptoms
Helopeltis theivora (Tea Mosquito Bug)	Nymphs and adults	Leaves, buds, young shoots	Attack begins in May/June and extends to September	Sucking sap from tender parts, causing stunted growth, dieback, and wilting of young shoots. Feeding punctures lead to deformities.
Oligonychus coffeae (Red Spider Mite)	Nymphs and adults	Upper surface of mature leaves and occasionally leaf stems	Peak incidence during summer (March–April) and another smaller peak in October–November	Feeding on leaf sap causes characteristic reddish-brown marks, leaf discoloration, and severe crop loss.

Conclusion:

Sustainable and integrated pest management (IPM) practices are crucial for addressing the challenges posed by *Helopeltis theivora* (Tea Mosquito Bug) and *Oligonychus coffeae* (Red Spider Mite) in Northeast India's tea cultivation. By combining biological control methods, such as the use of natural predators and entomopathogens, with cultural practices like frequent plucking, pruning, and habitat management, tea growers can reduce the reliance on chemical pesticides. These eco-friendly approaches not only help manage pest populations effectively but also support the long-term health of the tea ecosystem.

The use of minimal chemical interventions where necessary should be integrated with sustainable practices to prevent environmental degradation and preserve biodiversity. Effective IPM strategies will not only mitigate economic losses due to pest infestations but will also contribute to the sustainability of the region's tea industry. Ultimately, the adoption of sustainable pest management practices will play important role in safeguarding the region's tea production while fostering environmental conservation and promoting ecological balance.

Reference

1. Banerjee B. The threshold values in mite pest control. Two Bud. 1971; 18(1):20-21.
2. Banerjee B, Das SC (1969) The effect of light on the oviposition rhythm of the tea red spider mite Oligonychus coffeae (Nietn.). Bull Entomol Res 59:371–376.
3. Barbora, B. C. and Singh, K. (1994). All about *Helopeltis theivora:* A serious pest of tea. Two and a Bud 41 (2): 2-4.
4. Bora S, Sarmah M, Rahman A, Gurusubramanian G. 2007. Relative Toxicity of pyrethroid and non-pyrethroid insecticides against male and female tea mosquito bug, *Helopeltis theivora* Waterhouse (Darjeeling strain). J Entomol Res.31:37_41.
5. Cranham JE. 1966. Tea pests and their control. Annu. Rev. Entomol. 11:491–514.
6. Das GM. 1957. Pests in relation to environment. Two and a Bud. 4:14-16.
7. Das GM (1959a) Bionomics of the tea red spider, Oligonychus coffeae (Nietner). Bull Entomol Res 50:265–274.
8. Das GM (1959b) Occurrence of red spider mite in relation to cultural practices in North-East India. Two Bud 6(4):3–10.
9. Das, S. C. (1974). Parasites and predators of pests of tea, shade trees and ancillary crops in Jorhat circle in North East India. Two and a Bud 21: 17-21.
10. Deka B, Babu A, Baruah C and Sarkar S (2022) Plant Extracts as Potential Acaricides for the Management of Red Spider Mite, Oligonychus coffeae Nietner (Acarina: Tetranychidae), in the Tea Ecosystem: An Eco-Friendly Strategy. Front. Agron. 4:685568. doi: 10.3389/fagro.2022.685568.
11. Directorate of Economics and Statistics. Department of Agriculture and Cooperation, Government of Assam, 2016.

12. Dutta, B.K. (1989) "Pests and disease problems in Darjeeling tea plantations" Joint Area Scientific Committee Meeting, TRA, Darjeeling (9,h- 1l 'hNov, 1989) : 31-39.
13. Glover, P.M. Das, G.M., Mukherjee, T.d. (1961) "Pesticide residue and taint in tea" span 4(3): 137-140.
14. Gotoh T, Nagata T (2001) Development and reproduction of Oligonychus coffeae (Acari: Tetranychidae) on tea. Int J Acarol 27(4):293–298.
15. Gupta SK (1989) Mites occurring on tea plants in India with a key for their Identification. In: Channabasavanna GP, Viraktamath CA (eds) Progress in acarology, vol 2. Oxford and IBH, New Delhi, pp 177–182.
16. Gurr GM, Wratten SD, Altieri MA, eds. 2004. Ecological Engineering for Pest Management: Advances in Habitat Manipulation for Arthropods.Wallingford, UK: CABI Publ.
17. Gurusubramanian G, Senthil NK, Tamuli AK, Sarmah M, Rahman A, Bora S, Roy S. 2009. Biointensive integrated management of tea pests for sustainable tea production in North East India. Int J Tea Sci. 7:45_59.
18. Hazarika, L. K.; Puzari, K. C. and Wahab, S. (2001). Biological control of tea pests. In "Biocontrol Potential and Its Exploitation In Sustainable Agriculture", (eds. R. K. Upadhyay, K. G. Mukerji and B. P. Chamola), Kluwer Academic / Plenum Publishers, New York, pp. 159-180.
19. Hazarika LK, Bhuyan M, Hazarika BN (2009) Insect pests of tea and their management. Annu Rev Entomol. 54: 267-284.
20. Kalaivani A, Sathyapriya P, Arvinth S, RajKumar V, Mohankumar P (2013) Bio-efficacy of pumpkin phloem lectin on red spider mite, Oligonychus coffeae (Nietner) infesting tea. J Plant Crop 41(2):247–250
21. Muraleedharan, N. (1983) "Tea Entomology: an overview" UPASI TRI, Cinchona, India, occasional publication, no. 4. pp 1-11.
22. Kumara D.V, Roobakkumara A, Rahmana V.J, Babub A(2011). Impact oftemperature and pesticide applications on the prey consumption of *Mallada desjardinsi* (Navas)(Neuroptera: Chrysopidae), a predator of red spider mite infesting tea. Two Bud, 59, pp. 43-48Rao GN (1974a) Control of tea mites in South India-I. Planters' Chron 69(5):91–94.
23. Mukhopadhyay A, Roy S. 2009. Changing dimensions of IPM in the tea plantations of the North Eastern sub Himalayan region. In: Ramamurthy VV, Gupta GP, editors. Proceedings of National Symposium on IPM Strategies to Combat Emerging Pest in the Current Scenario of Climate change; 28-30 January; Arunachal Pradesh (India): Central Agricultural University Pasighat; p. 290-302.
24. Rahman A, Sarmah M, Gurusubramanian G (2007) Bioefficacy of Neem formulations combined with reduced dosages of acaricides and insecticides against Oligonychus coffeae Nietner and Scirtothrips dorsalis Hood in tea. J Plant Crops 35(1):59–63.
25. Roobakkumar A, Subramaniam MSR, Babu A, Muraleedharan N (2010) Bioefficacy of certain plant extracts against the red spider mite, Oligonychus coffeae, Nietner (Acari: Tetranychidae) infesting tea. Int J Acarol 36(3):255–258.
26. Roy S, Mukhopadhyay A, Gurusubramanian G. Baseline susceptibility of *Oligonychus coffeae* to acaricides in North Bengal tea plantations, India. International Journal of Acarology. 2010; 36(5):357-362.
27. Roy S, Gurusubramanian G, Nachimuthu SK (2011a) Anti-mite activity of Polygonum hydropiper L. (Polygonaceae) extracts against tea red spider mite, Oligonychus coffeae Nietner (Tetranychidae: Acari). Int J Acarol 37(6):561–566.
28. Saha K, Somchoudhury AK, Sarkar PK, Gupta SK (2001) Effect of temperature on the rate of development, fecundity, longivity, sex ratio and mortality of Amblyseius coccosocius Ghai and Menon (Acari, Phytoseiidae), an important biocontrol agent against tea red spider mite in India. In: Halliday RB, Walter DE, Proctor HC, Norton RA, Colloff MJ (eds) Acarology: proceedings of the 10th international congress. CSIRO Publishing, Melbourne, pp 470–472.
29. Sana DL, Haq MI. 1974. Feeding intensity of tea mosquito bug during daily rhythm-I. Tea J Bangladesh. 10:7-11.
30. Sarkar PK, Somchoudhury AK, Sekh K. Role of predators in management of *Oligonychus coffeae* Nietner in tea in India. In: The 5th international symposium on biocontrol and biotechnology. At Khon Kaen University, Nong Khai Campus, Nong Khai, Thailand, 2007, 15p.
31. Sarmah M, Phukan AK. Seasonal incidence and extent of damage by tea mosquito bug *Helopeltis theivora* (Waterhouse) on tea *Camellia sinensis*. Two Bud. 2004; 51(1-2):45-48.
32. Somchowdhury AK, Samanta AK, Dhar PP. 1993. Approach to integrated control of tea mosquito bug. In: Proceedings of International Symposium of Tea Science and Human Health; 11–14 January; Kolkata (India): Tea Research Association; p. 330-338.
33. Satake A, Ohgushi T, Urano S, Uchimura K. 2006. Modeling population dynamics of a tea pest with temperature-dependent development: predicting emergence timing and potential damage. Ecol. Res. 21:107–16.
34. Smith, H. S. On some phases of insect control by the biological method. Journal of Economic Entomology, 1919:12:288-292.
35. Sudhakaran R, Muraleedharan N. 2006. Biology of *Helopeltis theivora* (Hemiptera: Miridae) infesting tea. Entomon.31:165-180.
36. Watt G, Mann HN. 1903. The Pests and Blights of the Tea Plant. Calcutta: Gov. Printing Press. 429 pp.