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Non-Chemical Approaches for Management of Tea Insects and Non Insect Pests in Northern Part of West Bengal, India

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The most popular beverage in the world is tea *Camellia sinensis* (L.) O. Kuntze, and by 2024, the global tea market is projected to be worth US$21.33 billion. India produces 21% of the world's tea and is the world's second-largest producer, behind China. The states of Assam and West Bengal, as well as the tea-growing regions of the Brahmaputra Valley, Barak Valley, Terai, Dooars, and Darjeeling, account for more than 80% of this production (anonymous, 2023). However, the most challenging problem currently being faced by North of West Bengal (North Bengal) tea growers is dealing with its pests and diseases (Mitra *et al*. 2018). The increasing use of chemical pesticides in tea cultivation has led to residue contamination thereby affecting both the trade and potential health risks to workers. Therefore, non chemical pest management methods such as biological control, cultural practices and botanicals are essential to ensure sustainable tea production while meeting safety standards for export in Northern Part of West Bengal.

Potential tea pests of Northern part of West Bengal

Mitra *et al*. (2018) reported that a total of 167 species which belongs to 139 genera of 42 families under 6 orders of insects from the tea gardens of North Bengal. Of them, Lepidoptera shares maximum number of species (77), followed by Hemiptera (29), Diptera (24), Coleoptera (19), Odonata (12) and Orthoptera (06). Among them, 20 species of Lepidoptera, 05 species of Hemiptera, 05 species of Coeloptera and 03 species of Orthoptera are found as tea pests. Among the mite pests of tea, 13 species of mites belonging to eight families were reported from India (Roy *et al*. 2014). Diseases and pests were already there, but in recent years they have gotten worse. Over the past 20 years, pest assaults have swiftly extended throughout the other tea-growing regions of Cachar, Tripura, Arunachal Pradesh, Darjeeling, and Terai in north India. Originally, they were restricted to a few sites in Dooars in West Bengal and the south bank of Assam. The major pests prevalent in north Indian tea plantations are tea mosquito bugs and looper caterpillars apart from thrips and the cost of plant protection measures. Over the past 20 years, the cost of plant protection in tea plantations in the country's northeast and northern West Bengal has increased dramatically, reaching up to Rs 25,000 to Rs 30,000 per hectare (Phukan, 2023).

Non-chemicals against tea insect pest management

In search for botanicals as an alternative remedy to synthetic chemicals in the pest control of tea plantations, ferns such as *Adiantum raddianum*, *Asplenium aethiopicum*, *Cyclosorus interruptus*, *Dicranopteris linearis*, Diplazium polypodioides, and Pteridium aquilinum were evaluated by Prabhakaran *et al*. 2017 against red spider mite Oligonychus coffeae Nietner and tea mosquito bug *Helopeltis theivora* Waterhouse. The extracts of *P. aquilinum* and *D.*

linearis showed good contact toxicity at a 5% concentration to *O. coffeae*. The acaricidal activity was observed in the order *P. aquilinum* > *D. linearis* > *C. interruptus* > *A. raddianum* > *D. polypodioides* > *A. aethiopicum*. Under field conditions, the extract of *D. linearis* and *P. aquilinum* showed a 50% reduction in the population of red spider mite and caused no phytotoxic effect to tea leaves. However, the botanicals were not effective against *H. theivora.*

Bhuyan *et al*. (2017) highlighted the use of variety of plants for developing the locally made pesticides in small tea gardens of Assam for control insect pests of tea like red spider mite, tea mosquito bug and looper caterpillar. These included aerial parts of *Polygonum hydropiper* leaves, seeds of *Azadirachta indica*, leaves of *Clerodendrum viscosum*, *Capsicum annuum* fruits, dried leaves of *Nicotianna tabacum*, *Aegle marmelos* and *Melia azedarach*.

An acaricidal activity of leaf extract of Lantana (Azad *et al.* 2020), *Xanthium strumarium* (Mamun *et al.* 2013) and *Acorus calamus*, *Polygonum hydropiper*, *Clerodendron infortunatum* and *X. strumarium* (Sarmah *et al*. 2009) have been reported against red spider mite, tea mosquito bug, looper caterpillar and tea thrips.

Four microbial bioformulations, viz., Biosona (*Beauveria bassiana*), Biotime (*Metarhizium anisopliae*, *Pseudomonas fluorescens* and *Trichoderma harzianum*), Biogreen-5 (powder formulation of *T. viride*, *P. fluorescens*, *Bacillus thuringiensis*, *B. bassiana* and *M. anisopliae*) and Biogreen-L (Liquid formulation of *T. viride*, *P. fluorescens*, *B. thuringiensis*, *B. bassiana* and *M. anisopliae*) were tested against tea insect pests under field conditions by Deb *et al*. (2017). Findings reported that among the microbial formulations tested, the lowest incidence of tea mosquito bug (7.24%), Red spider mite (6.17%), Looper caterpillar (6.16%), Aphid (0.0%) and Grey blight (4.86%) was recorded after application of 10 sprays of Biogreen-5 (2.0%).

The vital ecological services rendered by cover crops to monoculture tea plantations, including regarding the prevalent natural enemies and their pivotal role in the biocontrol of insect pests in the tea plantation, have been reviewed by Pokharel *et al*. (2023). Climate-resilient crops (sorghum, cowpea) and volatile blends emitting aromatic plants (semen cassiae, marigold, flemingia) are recommended as cover crops that can be intercropped in tea plantations. Authors also mentioned that the potential cover crops that can be intercropped in tea agroecosystem based on their ecosystem services delivery on pest control attributes were grouped into cereals (buckwheat, sorghum), legumes (guar, cowpea, tephrosia, hairy indigo, and sunn hemp), and aromatic plants (lavender, marigold, basil, and semen cassiae). The other potential cover crops with promising biocontrol prospects are maize, mountain pepper, white clover, round-leaf cassia, and creeping indigo.

Mamun and Ahmed (2011) concerned about the role of weeds in harboring different tea insect pests. They offer excellent hiding places and serve as alternate hosts for tea mosquito bug and red spider mites. Weeds like *Mikania cordata*, *Emilia* sp., *Polygonum chinese*, *Oxalis acetosella*, *Malastoma malabethricum* and *Lantana camara* offer excellent places and serve as alternate hosts for the Tea mosquito bug. *Malastoma malabethricum* weeds act as alternate host of Red spider mite. Weed free cultivation and trespassing of cattle, goat, and other animals from RSM-infested fields reduce its spread. *Ageratum conizoides*, *Borreria hispida*, *Commelina benghalensis*, *Pouzolzia indica* and *Oxalis corymbosa* are alternate host of Root knot nematode. So, growth of host plants in and around tea fields should be controlled and this will help to reduce the growth of pest population.

Conclusion

Management of insects as well as non insect pests in tea cultivation through non chemical methods is both sustainable and environment friendly approaches. Techniques such as biological control, cultural practices and the use of botanicals have proven effective in reducing pest populations without hampering beneficial organisms. Moreover, promoting biodiversity in tea gardens enhances natural pest regulation. Adoption of these non-chemical methods can support long-term productivity and ecological balance in tea plantations of Northern part of west Bengal.

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