**Studies on Indigenous Technical Knowledge for Non-Chemical Pest Management in Tea Plantations of Sivasagar, Jorhat, Golaghat, and Biswanath districts of Assam, India**

**Abstract**

The present study investigates Indigenous Technical Knowledge (ITK) utilized by small tea growers in Assam for sustainable pest management. The study was conducted during 2023–24 across Sivasagar, Jorhat, Golaghat, and Biswanath districts, the research involved structured interviews with 100 farmers to document traditional, non-chemical pest control methods. Twelve major tea pests were identified which causes significant losses, notably the red spider mite (*Oligonychus coffeae*), tea mosquito bug (*Helopeltis theivora*), and tea looper (*Buzura suppressaria*). Growers employed various locally available plant species such as *Azadirachta indica* (neem), *Pongamia pinnata*, and *Polygonum hydropiper* , to deter or eliminate pests. Additionally, 52% of the growers used cow dung and cow urine in their pest management practices. The effectiveness of these indigenous products in controlling tea pests ranged in between 60% to 80%, aligning with findings from similar studies. However, adoption of these traditional practices is limited due to factors like the effort required to prepare formulations, perceived lower efficiency compared to synthetic chemicals, and delayed results. To enhance adoption, further research is needed to validate and standardize preparation and application methods, supporting small tea growers in producing organic tea to meet the growing demand for sustainable and residue-free products.

Key words- Tea, pest , ITK, organic farming, botanicals

**Introduction**

Tea (*Camellia sinensis* L. O. Kuntze) is a significant perennial monoculture commercial crop grown extensively between latitudes 41°N and 16°S across Asia, Africa, Latin America, and Oceania, occupying over 2.71 million hectares in more than 34 countries (Barua 1994, Deka et al. 2006 & Hazarika et al 2008). This crops supports the livelihoods of millions and contributes significantly to the economies of several producing nations. Despite its global economic importance, tea production is severely hampered by insect and mite pests, which can cause yield losses ranging from 5% to 55% (Muraleedharan 1992, Sivapalan 1999). To mitigate pest-related damage, planters often rely heavily on organosynthetic pesticides. However, excessive chemical use has led to several ecological and agronomic issues, including pest resurgence (Sivapalan 1999), secondary pest outbreaks (Cranham 1966), pesticide resistance (Kawai 1997 & Hazarika et al. 2023), contamination of the environment, and the presence of residues in made tea (Chaudhuri. 1999). In this context, there is a pressing need for eco-friendly pest management alternatives rooted in Indigenous Technical Knowledge (ITK). These traditional practices, originating from the early transition of humans from hunters to cultivators, these practices have evolved over millennia and continue to influence agricultural methods even in the era of modern farming (Saikia et al. 2008). ITK is particularly relevant for sustainable agriculture, offering ecologically beneficial, low-cost, and accessible solutions to farming challenges (Majumder et al. 2013). These methods are still widely used in remote and resource-poor regions, where access to commercial pesticides is limited (Saikia et al. 2008). India, with its vast diversity of medicinal and aromatic plants, has long-standing traditional practices involving natural pesticides (Isman 2006). Scientific studies have demonstrated that many of these botanicals possess oviposition deterrent, antifeedant, or toxic effects against key pests in crops like tea (Hazarika et al. 2008). Consequently, ITK is gaining renewed attention in scientific and development circles as a cornerstone of sustainable agriculture, providing eco-friendly, affordable, and accessible solutions to smallholder farmers (Saikia et al. 2008). By considering aforementioned issues, the present study aimed to document Indigenous Technical Knowledge (ITK) on herbal pest management practices among small tea growers in Assam, focusing on natural, chemical-free methods across various districts.

Methodology

The study was conducted during the year 2023-24 across four districts of Assam: Sivasagar, Jorhat, Golaghat, and Biswanath. A total of 25 tea growers were selected from each district, making a sample of 100 respondents. The purpose was to gather information about Indigenous Technical Knowledge (ITK) used by farmers for managing pests in tea plantations. Data were collected through personal interviews using a structured interview schedule. During these interviews, details about the materials used, the methods followed, and the techniques applied in traditional pest control practices were carefully noted. Further, the methodology adopted for data collection was based on the approach described by Bhuyan *et al.* (2017).

Results and discussion

The study conducted among 100 small tea growers across the districts of Sivasagar, Jorhat, Golaghat, and Biswanath in Assam revealed the presence of 12 significant pests affecting tea cultivation. Among these, the Red Spider Mite (Oligonychus coffeae), Tea Mosquito Bug (Helopeltis theivora), and Tea Looper (Buzura suppressaria) were identified as major pests due to their substantial damage on tea crops.

Table no-1: List of Tea pest causes significant losses

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl no** | **Common name** | **Sc. Name** | **Family** | **Damaging stage** | **Site of Attack** |
| 1 | Red Spider mite | *Olignychus coffeae* | Tetranychidae | Nymphs and adults | Mature leaves |
| 2 | Tea Mosquito Bug | *Helopeltis theivora* | Miridae | Nymph and adult | Young tender shoots and leaves |
| 3 | Tea thrips | *Scirtothrips dorsalis* | Thripidae | Nymphs and adult | Young leaves and buds |
| 4 | Tea Looper | *Buzura suppressaria* | Geometridae | Nymph and adult | Growing shoots and buds |
| 5 | Black Inch worm | *Hyposidra talaca* | Geometridae | Larval stages | Tender and mature leaves |
| 6 | Tea Jassid | *Empoasca flavescens* | Cicadellidae | Nymph and adult | Young leaves and tender shoots |
| 7 | Red Slug Caterpillars | *Eterusia Aedea* | Zygaenidae | All larval stages | Mature leaves |
| 8 | Aphids | *Toxoptera aurantii* | aphididae | Nymphs and adults | Buds, young leaves and tender stems |
| 9 | Tea Whitefly | *Aleuroparvus theae* | Aleyrodidae | Nymphs and adults | Ventral surface of tea leaves |
| 10 | Termite | *Microtermes sp.* | Termitidae | Adult | Shoot, bark tissue |
| 11 | Scale insect | *Fiorinia theae* | Diaspididae | Adult | Buds, young leaves and tender stems |
| 12 | Tea Flushworm | *Cydia leucostoma* | Tortricidae | Larval stages | Buds, top leaves of young shoot |

To manage these pests, growers have been utilizing various locally available plants and traditional practices. Sixteen plant species with insecticidal properties were documented, including Polygonum hydropiper (Pothorua bihlongoni), Azadirachta indica (Neem), Pongamia pinnata (Karanj), Melia azedarach (Ghora neem), Clerodendrum viscosum (Dhopat teeta), Capsicum annum (Chilli), Allium sativum (Garlic), Nicotiana tabacum (Tobacco), and Musa acuminata (Banana pseudostem). These plants are often processed into extracts or concoctions and applied to tea plants to deter or eliminate pests. (Table no 2)

Table no 2- List of plants use for pest management in Tea plantation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl no** | **Common Name** | **Scientific Name** | **Family** | **Parts Used** |
| 1 | Pongum (Pothorua bihlongani) | *Pongamia pinnata* | Fabaceae | Leaves |
| 2 | Knot weed (Pothorua bihlongani) | *Polygonum hydropiper* | Polygonaceae | Aerial parts |
| 3 | Mohaeem | *Azadirachta indica* | Meliaceae | Leaves and seeds |
| 4 | Basaka (bahek) | *Adhatoda vasica* | Acanthaceae | Leaves and stems |
| 5 | Clerodendrun (Dhopat teeta) | *Clerodendrum viscosum* | Lamiaceae | Leaves |
| 6 | Chilli pepper | *Capsicum annum* | Solanaceae | Fruits |
| 7 | Garlic | *Allium sativum* | Amaryllidaceae | Whole plant |
| 8 | Water hyacinth | *Eichhornia crassipes* | Pontederiaceae | Whole plant |
| 9 | Tabacco (Dhopat) | *Nicotinna tabacum* | Solanacae | Dried Leaves |
| 10 | Amla | *Phyllanthus emblica* | Phyllanthaceae | Leaves and fruits |
| 11 | Ghost pepper (Bhoot jolokia) | *Capsicum chinensis* | Solanaceae | Fruits |
| 12 | Ghora Neem | *Melia azedarach* | Meliaceae | Leaves |
| 13 | Banana | *Musa acuminata* | Musaceae | Pseudostem |
| 14 | Tulsi | *Ocimum tenuiflorum* | Lamiaceae | Leaves |
| 15 | Lemongrass | *Cymbopogon citratus* | Poaceae | Leaves |
| 16 | Citronella | *Cymbopogon nardus* | Poaceae | Leaves |

The study found that 52% of the growers used cow dung and cow urine in their pest management practices, followed by 45% using Neem, 35% using Ghora neem, 32% using Pothorua bihlongoni, and 30% using Karanj while, other ingredients were used less frequently. Traditional practices used in relation to insect/pest management is presented in Table 1. The effectiveness of these indigenous products in controlling tea pests ranged between 60% to 80%, aligning with findings from similar studies conducted by Saikia et al. (2008), Bhuyan et al. (2019), Deka et al. (2006). These traditional practices are particularly beneficial for small-scale tea plantations, where growers can manage pests effectively using locally sourced materials. However, the preparation methods for these indigenous formulations vary across different regions and among individual farmers. This variability is attributed to the lack of standardized information and the reliance on personal experience for determining appropriate dosages.

Table no- 3 Traditional practices for tea pest management

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl no** | **Target pest** | **Materials used** | **Practice/preparation/method of application** | **Farmer’s observation** |
| **1** | Tea mosquito bug | Materials: Cow urine- 10 L and Water-15L. | Urine is first collected in a container and then diluted with water before being promptly applied to pest-infested tea bushes using a sprayer. | Satisfactoty Control |
| **2** | Tea mosquito bug | Ghost pepper - 1 kg, onion- 3kg, cow urine- 5 L, Water- 5 L | Ghost pepper and onions are crushed and mixed with water, then left to ferment for one day. The resulting mixture is filtered and combined with cow urine and water @ 1:3 before being sprayed onto infested tea bushes at six-day intervals. | About 60 Per cent |
| **3** | Tea mosquito bug | Neem - 10kg Pothorua bihlongoni- 5kg Water hyacinth- 10 kg Water- 50L | Neem, Pothorua bihlongoni and water hyacinth are crushed and soaked in water for 10 days. After that filtered and sprayed in the field at 1L in 3L of water. | About 70 Per cent |
| **4** | Tea mosquito bug | Ghora neem - 5kg, Pothorua bihlongoni- 10kg, Tabacco - 2kg, Jarmoni bon- 10kg, Water- 15L, Fresh cow dung- 5kg and Cow urine- 5L. | The ghora neem, pothorua bihlongoni, tobacco, jarmoni bon are crushed and mixed with cow dung, cow urine, and water, then left to ferment for 10 days. After fermentation, 10 liters of the prepared solution are diluted in 100 liters of water and applied to the infested tea bushes. | About 80 Per cent |
| **5** | Tea mosquito bug | Neem- 10kg, amla-5kg Cowdung- 10kg, cow urine- 10L and Water- 50L. | Amla and neem are crushed and mixed with cow dung, cow urine, and water, then left to ferment for 7 days. After fermentation, 2 liters of the mixture are diluted in 15 liters of water and sprayed on infested tea bushes at 10-day intervals. | Satisfactoty Control |
| **6** | Tea mosquito bug | Karanj - 5 kg , Neem- 5kg, Chilli- 5kg Garlic- 1 kg, cow dung- 1 kg, Cow urine- 10L and Water- 50L. | Neem, karanj, chilli and garlic are crushed and mixed with cow urine and dung and kept it for 7days and then water is added to it. Sprayed in the infested bushes at 2L in 15L of water at an interval of 10days. | About 50 Per cent |
| **7** | Tea Lopper | karanj- 10 kg Pothorua bihlongoni- 5kg neem- 5kg Water- 50L | Karanj, Pothorua bihlongoni, and neem are crushed and soaked in water for 7 days to allow fermentation. The mixture is then filtered, and 10 liters of the extract are diluted in 100 liters of water before being sprayed in the field as and when required. | About 60 Per cent |
| **8** | Tea Lopper | Dhopaat tita- 5kg Bahek tita- 5kg  neem- 50 Kg garlic- 3 kg cow urine- 15 L Water- 20L | Dhopat tita, bahek tita, neem, garlick are crushed mixied with water and urine for 24 hours and sprayed in the field @ 1 lit in 2 ltr water.It was sprayed when required. | About 60 Per cent |
| **9** | Tea Lopper | Rice starch- 1L and Water- 1L. | Rice starch is mixed with water and the solution is used for spot spraying directly on the infested tea bushes. | Satisfactoty Control |
| **10** | Red spider mite | Karanj- 10kg Cow dung- 5kg Cow Urine-20L Water-100L | Karanj leaves are crushed and soaked in water for one day, then mixed with cow dung, cow urine, and additional water. This mixture is left to ferment for 5 to 7 days, after which it is filtered. The resulting solution is diluted at a ratio of 20 liters in 100 liters of water and sprayed on infested bushes at 14-day intervals. | Satisfactoty Control |
| **11** | Red spider mite | Neem -5kg, citrenella -5kg, Pothorua bihlongoni- 2kg,   cow urine - 5L and Water- 50L. | Neem, citrenella, Pothorua bihlongoni chilli are crushed and mixed with cow urine and water and kept it for 7 days and then it is filtered and sprayed as spot application in the field at 1L in 2 L of water. . | Satisfactoty Control |
| **12** | Red spider mite | Neem- 10kg Dhopaat tita- 5kg vermi wash-10 L Water-50L | Neem and Dhopaat tita are crushed and boiled in water, then mixed with vermiwash. The solution is filtered and diluted at a ratio of 1 liter to 3 liters of water before being sprayed on infested bushes at 10-day intervals. | 60 Per cent |
| **13** | Red spider mite | Neem- 15 kg Dhapaat tita- 10 kg Ghost pepper -0.5kg Gur- 5kg Water- 15L | Ghost pepper, Neem, and Dhopaat tita leaves are crushed and mixed with gur and water, then left to ferment for 7 days. After fermentation, the solution is filtered and diluted with 10 liters of water, applying 2 liters of the mixture as a spray on infested bushes as needed. | Satisfactoty Control |
| **14** | Red spider mite | Neem -1kg,  Datura seed-500gm,  Karanj - 2kg and Water 10L. | Leaves of neem and datura seeds are boiled together in water for two hours. The mixture is then sieved, and the filtered solution is cooled and left to ferment for one day. After fermentation, 1 liter of the solution is diluted in 50 liters of water and applied to the plants at 10-day intervals. | 80 Per cent |
| **15** | Red spider mite | Neem -2kg, Karanj -2kg, Pothorua bihlongoni- 2kg,  Chilli- 2kg, Vermiwash- 5L and Water- 50L. | Neem, karanj, Pothorua bihlongoni, and chilli are crushed and mixed with vermiwash and water, then left to ferment for 2 days. After fermentation, the mixture is filtered and diluted at 10 liters in 50 liters of water before being sprayed in the field at 7-day intervals. | 80 Per cent |
| **16** | Red spider mite | Dhopat tita- 10kg, Chilli -5 kg Fish waste- 3kg, Water- 50L,  and Cow urine- 5L. | Dhopat tita leaves are crushed and combined with water, fish waste, and cow urine, then left to ferment for 3 days. The mixture is filtered, and 1 liter of the solution is diluted in 10 liters of water before being sprayed on infested bushes at 10-day intervals. | Satisfactoty Control |
| **17** | Red spider mite | Karanj -2kg, Pothorua bihlongoni - 2kg, Chilli - 2kg, Cow urine- 5L and Water- 20 L. | Karanj, Pothorua bihlongoni, and chilli are crushed and mixed with cow urine and water, then left to ferment for 7 days. After fermentation, the mixture is filtered and diluted with 5 liters of the solution in 50 liters of water before being sprayed in the field at 10-day intervals. | 50 Per cent |
| **18** | All pest | Neem- 2kg, Karanj - 2kg, Pothorua bihlongoni- 2kg, Bahek teeta - 2kg, Water- 50L, Cow urine- 5L and Vermi wash- 2L. | Pothorua bihlongoni, Bahek teeta, neem, and karanj leaves and stems are crushed and mixed with water, cow dung, vermiwash, and cow urine, then left to ferment for 5 to 7 days. After fermentation, the solution is filtered and diluted with 10 liters of the extract in 100 liters of water before being sprayed on infested bushes at 10-day intervals. | Satisfactoty Control |
| **19** | All pest | Bihlohongni- 5 kg, Dhopat tita- 5 kg, Ghora neem-5kg Karanj- 5kg Garlic-1kg onion-1 kg Cintronella Grass-2kg Cow urine-15L Water-50L | Bihlongoni, Ghora neem, karanj, garlic, onion, dhopat tita, and citronella are crushed and mixed with cow urine and water, then stored for 7 days. After fermentation, the solution is filtered and diluted with 20 liters of the extract in 100 liters of water before being sprayed on infested bushes at 7-day intervals. | 70 Per cent |
| **20** | All pest | Ghora neem-5kg Karanj- 5kg Cow urine-15L Water-50L | Ghora neem, karanj, garlic, and onion are crushed and mixed with cow urine and water. The mixture is then filtered and sprayed on the infested bushes @ 1 in 5 Ltrs | 50 Per cent |
| **21** | All pest | Garlic- 05kg, Neem- 2kg, Pothorua bihlongoni, karanj -2 kg- and Water- 50L | Garlic, neem, and Pothorua bihlongoni are crushed and mixed with water. The extract is then filtered and diluted at a ratio of 15 liters to 15 liters of water before being sprayed on infested bushes at 14 day intervals. | Satisfactoty Control |
| **22** | All pest | Peepal tree root zone soil-4kg, Cintronella Grass- 2kg, Cow dung- 10kg, Cow urine- 20L and Water- 100L | Citronella is crushed and mixed with soil from the Peepal tree root zone, along with cow dung, cow urine, and water. This mixture is sprayed in the field and applied at 10 day intervals. | Satisfactoty Control |
| **23** | All pest | Neem- 5kg, Pothorua bihlongoni,- 10kg, Water hyacinth- 2 kg, Banana pseudostem- 5kg, Mustard cake- 3kg, Chilli- 1kg, Cow dung- 10kg, Cow and urine- 5L. | Neem, Pothorua bihlongoni, water hyacinth, and banana pseudostem are crushed and mixed with chilli, cow dung, and cow urine, then left to ferment for 7 days. After fermentation, the solution is filtered and diluted at 5 liters in 100 liters of water before being sprayed in the field at 10 day intervals. | Satisfactoty Control |
| **24** | All Sucking pest | Cintronella Grass- 10kg,  lemongrass- 10kg & cow urine- 5 ltr, water- 20 ltr | Citronella grass and lemongrass are crushed and boiled in water, then mixed with cow urine and left to ferment for 7 days. After fermentation, the solution is diluted at 5 liters in 100 liters of water and sprayed in the field at 10-day intervals | Upto 60 Per cent |

Despite their potential, the adoption of these traditional practices is limited due to several factors, such as botheration to prepare indigenous formulations, perceived lower efficiency compared to synthetic chemicals, and delayed results in pest control. To enhance the adoption of these eco-friendly practices, there is a need for further research to validate and standardize the preparation and application methods. Such efforts could support small tea growers in producing organic tea, meeting the growing demand for sustainable and residue-free tea products.

Table no-3 Distribution of respondent on selected dimensions of using ITKs

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No | Dimension | Response category | Percentage |
| 1 | Regularity of use | Use regurly | 45.21 |
| use some times | 38.34 |
| use rarely | 16.45 |
| 2 | Reason of not using regulary | Botheration of use | 41.21 |
| less in efficient | 30.46 |
| Not quick in action | 28.33 |

**Conclusion**

The study highlights the continued relevance and potential of Indigenous Technical Knowledge (ITK) in managing pests in small-scale tea plantations. Traditional pest control practices, using locally available botanicals and organic materials, demonstrated notable effectiveness and ecological benefits. However, widespread adoption is limited by inconsistent preparation methods, lack of standardization, and lower perceived efficacy compared to synthetic pesticides. To support sustainable tea cultivation, further research is essential to scientifically validate, standardize, and promote these eco-friendly practices. Enhancing awareness and accessibility can empower small tea growers to reduce chemical dependence, improve crop health, and meet the rising demand for organic and residue-free tea.

**Future prospects**

The integration of Indigenous Technical Knowledge (ITK) into mainstream tea pest management presents a promising avenue for sustainable agriculture in Assam. Future research should focus on scientifically validating and standardizing these traditional practices to ensure their efficacy and consistency across different regions. Collaborative efforts between researchers, extension services, and local communities can facilitate the documentation and dissemination of effective ITK methods. Moreover, policy support and educational initiatives are essential to encourage the adoption of eco-friendly pest management strategies among small tea growers. By embracing ITK, the tea industry can reduce reliance on synthetic pesticides, enhance environmental sustainability, and meet the growing consumer demand for organic and residue-free tea products.

**AI disclaimer**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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