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Survey and study of incidence of insect pests in tea (*Camellia sinensis* [L.]) ecosystem of Golaghat and Jorhat, Assam

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Abstract
North-east India has been known for its contribution in tea production since time immemorial. India is the second largest tea producing state after China and Assam stands first among the states after West Bengal. It also contributes a major portion of country's national income and GDP. However, tea pest infestation has been one of the major concerns of tea gardeners every year. In this research article, five tea gardens of Jorhat and Golaghat districts of Assam have been assessed to find out the major tea pests, its behavior, damage pattern as well as control methods. Following the survey, it has been observed that most of the pests found belonged to the order Hemiptera followed by Lepidoptera, Thrombidiformes and Thysanoptera. Combating tea pests is of utmost importance for healthy yield for which knowledge on control measures are of foremost need.

Keywords: tea, insect pest, Jorhat, golaghat, pest management, Assam

Introduction

Tea, *Camellia sinensis* (L.) O. Kuntze is the plantation crop that has traditionally been regarded as a powerful source of nutraceuticals. It is produced in more than 58 countries, and its yearly output of 5 million tonnes, valued at around $20 billion, helps to reduce rural poverty and strengthen the value chain. Tea is grown in Assam's flat valleys at elevations between a few and around 200 metres above mean sea level. For 22.7% of the world's total tea production, the Indian tea sector generates over 1.2 million tonnes from roughly 5.64 million hectares of land. On average, 18% of entire production is exported, with the remaining 82% being consumed domestically (Hajra, 2019) [7]. India is fourth in the world for exports of tea, which account for 10% of all exports. In 2021, India exported tea worth roughly US$ 687.9 million. Over the course of 2021 and 2022, India exported 201 million kg of tea. More than 25 countries receive tea from this country (Choudhury and Dey, 2022) [4].

The highly managed tea monoculture is linked to 1031 species of arthropods globally. At least one pest species feeds on every component of the plant, including the leaf, stem, root, flower, and seed, which can lead to a yield loss of 11% to 55% if left unchecked. Organosynthetic pesticides have been extensively used since the 1950s to protect the plant from these pests, which has caused a rapid emergence of pest species, the development of resistance, and unfavourable chemical residues in tea. Pesticide residues are now a significant issue for the tea business due to importer and consumer worries. The usage of pesticides and ensuing residues may be prevented by integrated pest management or IPM (Hazarika *et al*., 2009) [8]. An extensive knowledge on the incidence of tea is of utmost importance for evaluating and deciding the correct preventive measure which needs to be applied. This survey has put an effort to do the same in few of the most-rich tea ecosystem of the country.

Materials and method

The survey of insect pests was performed in five tea estates of Golaghat and Jorhat districts of Assam from May 2022 to October 2022. Both the districts are located in upper Assam. Golaghat district lies on the southern bank of the mighty river Brahmaputra with an geographic area of 3,502 km^2. It lies on 25°50'N to 26°47'N latitude and 93°16'E to 94°10'E longitude respectively. It is bordered by the state of Nagaland towards its southern side, Jorhat district towards east and Karbi Anglong and Nagaon towards west. On the other hand, Jorhat district is bordered to the north by Majuli district, to the south by Nagaland state, to the east by Sibsagar, and to the west by Golaghat. With a current population of 1,092,256 as per 2011 census report of India the district spans upto 2,851 square kilometers. The district has 135 tea estates in it.

The five tea estates surveyed belonging to the above-mentioned districts are as follows.

1. **Borjan tea estate**
   With an area of 447 hectares, the estate is managed by the Kamarbandha Police station in Assam and is located in the Golaghat District. In this garden, there are 850 permanent employees. The estate also offers the workers labour quarters, nearby medical services, and other amenities. It is further subdivided into three sections: Chotajan, Borjan, and Batubari.

2. **Moheema tea estate**
   Located in Golaghat district, it covers an area of 576 hectares. The Newar Group of Company acquired this tea farm in 2013. This tea estate's subdivision is named Sonakhet. This garden employs 762 people in total.

3. **Dukhenhengera tea estate**
   Belonging to the same district and undertaken by the same Newar Group of Company, it stretches over an area of 445.52 hectares. It is located near the

Kakudonga river. Almost 799 people are employed in this tea estate.

4. **Sangsua tea estate**
It is located in the Jorhat District. Baooah and Associate Company has undertaken the management of this garden. The Tea Estate employs a total of 1026 people. It covers a geographical area of 387 hectares.

5. **Gatoonga tea estate**
With a gross area of 261.97 hectares, this tea estate come under Jorhat district as well. In 1963, Hemendra Prasad Barua bought the Gatoonga tea estate from Williams and Mayer. Thereafter, it was undertaken by Barooah and Associate firm which has been managing it.

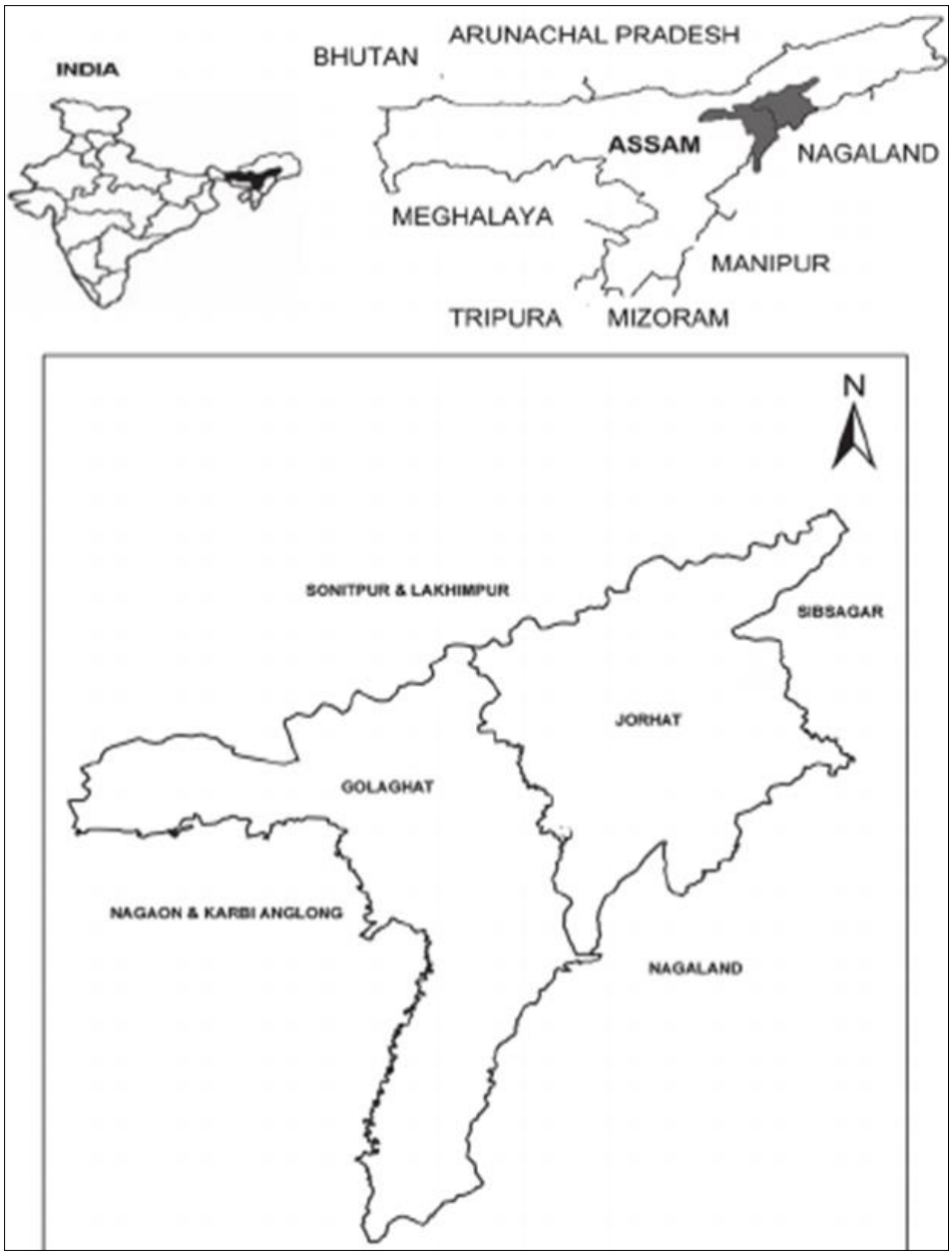

Fig 1: Location of survey area, i.e., Golaghat and Jorhat districts of Assam, India (Saikia and Khan, 2012)

Result and discussion

A total of 11 insect pests belonging to four orders have been recorded from the surveyed tea estates. Of them, *Helopeltis theivora, Empoasca* sp., *Oligonychus coffeae* and *Buzura suppressaria* have been found from all the five tea estates surveyed implying its severity in terms of incidence. *Scirtothrips dorsalis* have been found in three out of five estates namely Gatoonga, Sangsua and Dukhenhengera. Two tea gardens *viz*., Gatoonga and Moheema have shown the incidence of *Eterusia magnifica*. Following these, *Toxoptera aurantii, Pseudococcus* sp., *Eterusia aedea, Gracilaria theivora, Scirpophaga* sp. have been found in one tea estates each. The biological as well as chemical control measures followed in the estates for suppressing each of the insect pests have also been surveyed and are recorded in the following table:

Table 1: Insect pests found in different tea estates of Golaghat and Jorhat districts of Assam and their control measures (Biological and Chemica

1. Borjan Tea Estate				
Pests Found	**Scientific Name**	**Symptoms**	**Control Method**	
			Biological (Predator)	**Chemical**
Tea Mosquito Bug (Major)	*Helopeltis thiovora* (Order: Hemiptera)	Leaves curl up, badly deformed and shoots dry up.	Praying mantis, *Oxyopes sp.* (spider)	a) Thiamethoxam 25% WG b) Thiacloprid
Red Spider Mite (Major)	*Oligonychus coffeae* (Order: Trombidiformes)	Affected leaves become reddish brown and bronzy	Predatory mites, Thrips	Propargite (Acaricide)
Looper Caterpillar (Major)	*Buzura suppressaria* (Order: Lepidoptera)	Plants with holes in outer leaves, feces And caterpillars feeding on edge of hole.	Reduviid bug, Dragon fly, Red ants etc	Emamectin benzoate 5% SG (insecticide)
Tea Jassid	*Empoasca species* (Order: Hemiptera)	Appearance of light brownish discoloration of the tip and basal part of the leaves.	Ladybird beetle, Praying mantis	Thiamethoxam
Red Slug Caterpillar	*Eterusia Aedea* (Order: Lepidoptera)	In severe infestations bushes can become completely defoliated and sometimes bark is also damaged.	Birds, Frogs, Ground beetles	Bifenthrin
Tea Leaf Roller	*Gracilaria theivora* (Order: Lepidoptera)	Rolls the leaves from tip downwards.	Spider, Ladybird beetle	Quinalphose
Stem Borer	*Scirpophaga sp.* (Order: Lepidoptera)	Appearance of round hole in the stem.	Ladybird beetle, Praying mantis	Deltamethrin
2. Moheema tea Estate				
PESTS FOUND	SCIENTIFIC NAME	SYMPTOMS	CONTROL METHOD	
			BIOLOGICAL (PREDATOR)	CHEMICAL
Red Slug	*Eterusia magnifica* (Order: Lepidoptera)	Eats outer paret of the stem and make it hollow.	Ladybird beetles and birds	Acalux
Mealy Bug	*Pseudococcus sp.* (Order: Hemiptera)	Leaves and shoots are covered by a powdery white coating or waxy filaments.	Ants, Ladybird beetles	Lime Sulpher
Tea Mosquito Bug	*Helopeltis thiovora* (Order: Hemiptera)	Leaves curl up, badly deformed and shoots dry up.	Praying mantis, *Oxyopes sp.* (spider)	Thiamethoxam, Deltamethrin
Red Spider Mite	*Oligonychus coffeae* (Order: Trombidiformes)	Affected leaves become reddish brown and bronzy.	Predatory mites, Thrips	Spiromecifen, Fenazaquin
Looper Caterpillar	*Buzura suppressaria* (Order: Lepidoptera)	Plants with holes in outer leaves, feces and caterpillars feeding on edge of hole.	Reduviid bug, Dragon fly, Red ants etc	Emamectin benzoate, Flubendemide
Green fly	*Empoasca sp.* (Order: Hemiptera)	Appearance of light brownish discoloration of the tip and basal part of the leaves.	Ladybird beetles, Praying mantis.	Quinalphose
3. Dukhenhengera Tea Estate				
PESTS FOUND	SCIENTIFIC NAME	SYMPTOMS	CONTROL METHOD	
			BIOLOGICAL (PREDATOR)	**CHEMICAL**
Thrips	*Scirtothrips dorsalis* (Order: Thysanoptera)	Yellow or silvery streaks on the leaves. Terminal rolling and drying of leaves from tip to base.	*Amblyseius cucumeris*	Thiamethoxam
Tea Mosquito Bug	*Helopeltis thiovora* (Order: Hemiptera)	Leaves curl up, badly deformed and shoots dry up.	Praying mantis, *Oxyopes sp.* (spider	Thiamethoxam, Deltamethrin
Red Spider Mite	*Oligonychus coffeae* (Order: Trombidiformes)	Affected leaves become reddish brown and bronzy.	Predatory mites, Thrips	Spiromecifen, Fenazaquin
Looper Caterpillar	*Buzura suppressaria* (Order: Lepidoptera)	Plants with holes in outer leaves, feces and caterpillars feeding on edge of hole.	Reduviid bug, Dragon fly, Red ants etc	Emamectin benzoate, Flubendemide
Green Fly	*Empoasca sp.* (Order: Hemiptera)	Appearance of light brownish discoloration of the tip and basal part of the leaves.	Ladybird beetles, Praying mantis.	Quinalphose
Aphids	*Toxoptera aurantii* (Order: Hemiptera)	Leaves curled up and shriveled and in some cases galls are formed on the leaves.	Birds, Ladybird beetles	Thiachloropid
4. Sangsua Tea Estate				
PESTS	SCIENTIFIC	SYMPTOMS	CONTROL METHOD	

FOUND	NAME		BIOLOGICAL (PREDATOR)	CHEMICAL
Thrips	*Scirtothrips dorsalis* (Order: Thysanoptera)	Yellow or silvery streaks on the leaves. Terminal rolling and drying of leaves from tip to base.	*Amblyseius cucumeris*	Thiamethoxam
Tea Mosquito Bug	*Helopeltis thiovora* (Order: Hemiptera)	Leaves curl up, badly deformed and shoots dry up.	Praying mantis, *Oxyopes sp.* (spider	Thiamethoxam, Deltamethrin
Red Spider Mite	*Oligonychus coffeae* (Order: Trombidiformes	Affected leaves become reddish brown and bronzy.	Predatory mites, Thrips	Spiromecifen, Fenazaquin
Looper Caterpillar	*Buzura suppressaria* (Order: Lepidoptera)	Plants with holes in outer leaves, feces and caterpillars feeding on edge of hole.	Reduviid bug, Dragon fly, Red ants etc	Emamectin benzoate, Flubendemide
Green Fly	*Empoasca sp.* (Order: Hemiptera)	Appearance of light brownish discoloration of the tip and basal part of the leaves.	Ladybird beetles, Praying mantis.	Quinalphose
5. Gatoonga Tea Estate				
PESTS FOUND	SCIENTIFIC NAME	SYMPTOMS	CONTROL METHOD	
			BIOLOGICAL (PREDATOR)	CHEMICAL
Thrips	*Scirtothrips dorsalis* (Order: Thysanoptera)	Yellow or silvery streaks on the leaves. Terminal rolling and drying of leaves from tip to base.	*Amblyseius cucumeris*	Thiamethoxam
Green Fly	*Empoasca sp.* (Order: Hemiptera)	Appearance of light brownish discoloration of the tip and basal part of the leaves.	Ladybird beetles, Praying mantis.	Quinalphose
Tea Mosquito Bug	*Helopeltis thiovora* (Order: Hemiptera)	Leaves curl up,badly deformed and shoots dry up.	Praying mantis, *Oxyopes sp.* (spider	Thiamethoxam, Deltamethrin
Red Spider Mite	*Oligonychus coffeae* (Order: Trombidiformes)	Affected leaves become reddish brown and bronzy.	Predatory mites, Thrips	Spiromecifen, Fenazaquin
Looper Caterpillar	*Buzura suppressaria* (Order: Lepidoptera)	Plants with holes in outer leaves, feces and caterpillars feeding on edge of hole.	Reduviid bug, Dragon fly, Red ants etc	Emamectin benzoate, Flubendemide
Red Slug	*Eterusia magnifica* (Order: Lepidoptera)	Eats outer part of the stem and make it hollow.	Ladybird beetles and birds	Acalux

Source

Kabir and Das, 2015; Bulletin on Integrated Management of Tea Pests of North-East India by Tocklai Research Association; Roy *et al.*, 2017 [15]; Dubey, 2018 [5]; Kumaravadivelu, 1994 [12]; Nadda *et al*., 2013 [14]; Muraleedharan *et al*., 1988 [13]; Hazarika *et al*., 2001 [9]; Basu *et al*., 2012) [2]

The number of tea estates in which each of the pests were viewed have been summarized in the following table according to the order of the pests.

Table 2: Order wise distribution of pests

S. No.	Order	Pests found	No. of tea estates in which the Orders are found	
1	Hemiptera	*Toxoptera aurantii*	1	12
		Helopeltis thiovora	5	
		Empoasca sp.	5	
		Pseudococcus sp.	1	
2	Trombidiformes	*Oligonychus coffeae*	5	5
3	Lepidoptera	*Buzura suppressaria*	5	10
		Eterusia aedea	1	
		Gracilaria theivora	1	
		Scirpophaga sp.	1	
		Eterusia magnifica	2	
4	Thysanoptera	*Scirtothrips dorsalis*	3	3

A graphical representation of the above-mentioned data has been depicted in Figure 2. Following it, a pie diagram showing the percentage of pests in each of the order has been given in Figure 3.

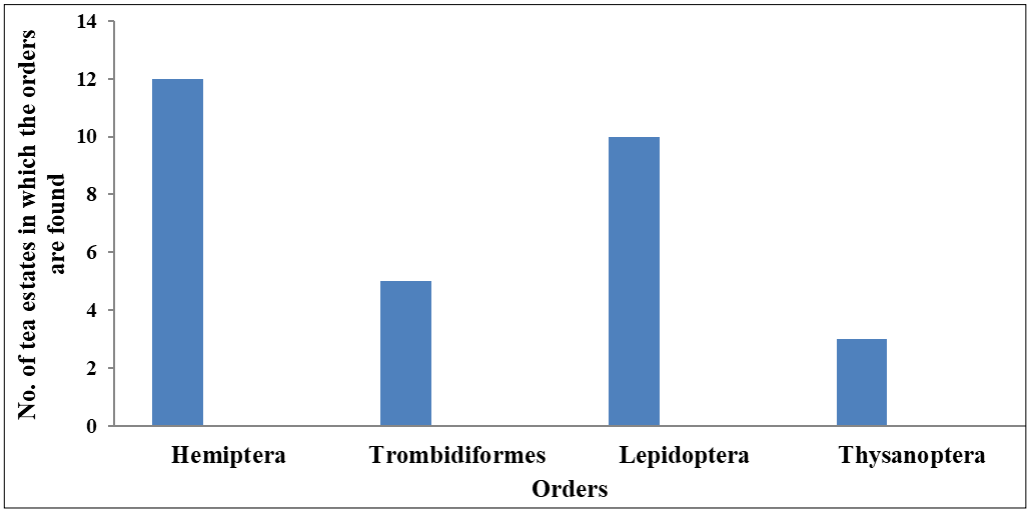

Fig 2: Clustered Column diagram depicting the total number of pests found in each area

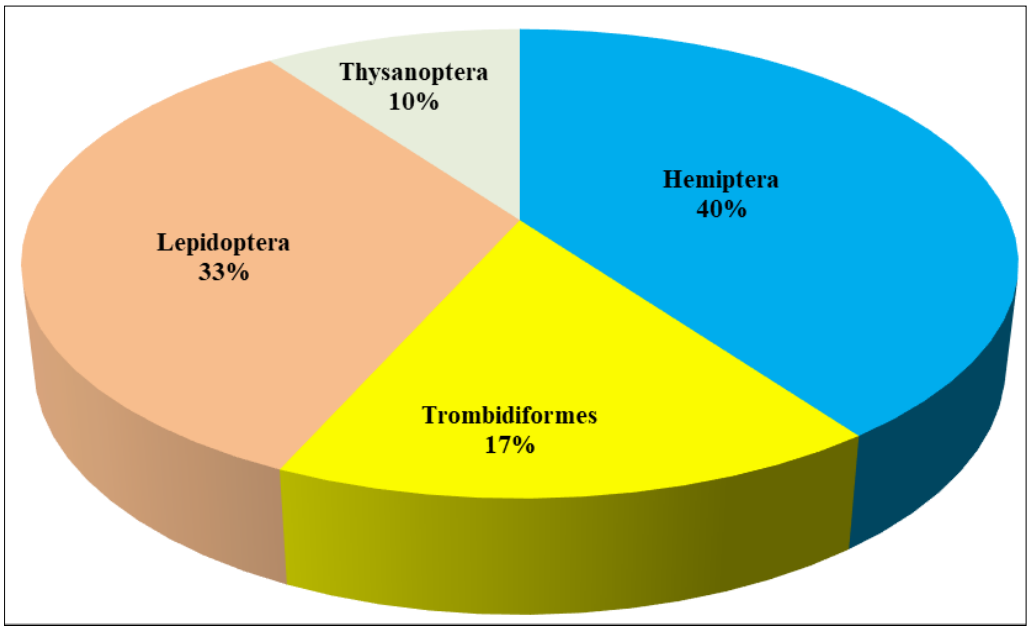

Fig 3: Pie diagram depicting number of pests found in each order in terms of percentage

Conclusion

About 17% of the workforce in Assam works in the tea business. Plantations in Assam mostly produce black tea, though they also produce a small amount of green and white teas. Over 850 tea plantations and more than 2500 tea gardens are spread out over thousands of acres of land. Around half of all daily employees employed by the tea industry worldwide, or more than six lakh people, are working in Assam's tea sector (Arya, 2013) [1]. Being such an economically essential industry for the state as well as the country, the producers' main focus now is to have a healthy yield and production and minimize pest infestation and its risks using various preventive measures.

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