Survey and identification of plant parasitic nematodes associated with tea gardens in Dibrugarh district of Assam

ABSTRACT

The present investigation was carried out to know the occurrence and distribution of plant parasitic nematodes associated with tea plants of different tea gardens in Dibrugarh district. Soil samples were collected from different tea gardens of seven blocks from Dibrugarh district. Survey of plant parasitic nematodes revealed that eight genera of plant parasitic nematodes were found to be associated with tea plants of Dibrugarh district. The genera of plant parasitic nematodes recorded were *viz*., *Helicotylenchus, Hoplolaimus, Tylenchorhynchus, Paratylenchus, Meloidogyne, Xiphinema* and also nematodes genera found under Tylenchs and Criconematids. Community analysis of plant parasitic nematodes revealed that the genus *Helicotylenchus* ranked first in relative frequency, absolute frequency, absolute density, relative density and prominence value. The genus *Hoplolaimus* ranked second in relative frequency, absolute frequency, absolute density, relative density and prominence value. The genus *Paratylenchus* ranked third in relative frequency, absolute frequency, absolute density, relative density and prominence value.

INTRODUCTION

Tea (*Camellia sinensis* L.) belongs to the family Theaceae is one of the important plantation crop grown in India and other parts of the world including China, Kenya, Sri Lanka, Turkey & Vietnam. The tea industry is one of the oldest organized industry in India with a large network of tea producers, retailers, distributors, auctioneers, exporters and packers. In India, tea is mainly cultivated in Assam, West Bengal, Kerala, Tamil Nadu and Karnataka. In Assam, tea is mainly cultivated in the valley of the Brahmaputra on the North and of the Barak on the South. Assam alone occupies about 3.37 lakh ha with a production of 691.91 million kg in 2018 (Anon., 2020). Hence, it is considered that tea industry occupies a very prominent place in the economy of Assam in terms of production of quality tea and contributing in generation of highest number of employment generation.

The tea crop suffers from number of pest and diseases like fungi, bacteria, virus and nematodes. Among various constraints in tea production, plant parasitic nematodes are considered

to be one of the important pest which can cause considerable loss in tea production (Srivastava and Singh, 1967 and Whitehead, 1969). The first report of root-knot nematode in young tea was made from South India where large number of tea seedlings were found to be infected by this nematode (Barber, 1901). Among different species of root-knot nematode ,the species like *Meloidogyne incognita, M. javanica*, *M. hapla* and *M. thamesi* are some of the economically important species causing severe damage to the nursery seedling of lesser than one year old except *M. bravicauda* (Rao, 1970 and Sivapalan, 1972). However, *M. incognita and M. javanica* were found to be most harmful nematode species on nursery tea while *M. bravicauda* on mature tea (Whitehead, 1969). Neog (1997) found that one juvenile of *M. incognita* per gram of soil was pathogenic in tea seedling in Assam. Large scale failure of nursery seedlings raised from both seeds and vegetatively propagated clones due to severe damage caused by root-knot nematode also reported by many workers (Banerjee, 1967; Basu, 1967, 1968; Basu and Roy, 1976, 1979) from the north-eastern region of India showed that generally both young tea and mature tea are highly susceptible to *M. javanica* and *Pratylenchus coffeae* (Visser and Vythilingam, 1959).

Very little work has so far been done on tea. Therefore, a detailed study on this nematode is felt highly essential for better understanding of problem so that efforts can be made for management of the pest more efficiently. Therefore, the present studies have been carried out with the survey and identification of plant parasitic nematodes associated with tea gardens in Dibrugarh district of Assam

MATERIALS AND METHODS

A Roving survey was carried out during 2014-2016. Soil and plant samples were collected from seven Blocks of Dibrugarh district *viz*., Barbaruah, Lahowal, Panitola, Khowang, Tengakhat, Tingkhong and Jaipur to have a clear picture about the occurrence and distribution of plant parasitic nematode in tea plants.A total of 162 samples were collected from the rhizosphere of tea plant from different blocks of Dibrugarh district of Assam. Each bulk sample was constituted of several sub samples. Samples were collected randomly and all relevant informations were recorded at the time of collection of samples. The samples were transferred to laboratory and stored in refrigerator at 4°C till the extraction of nematodes was made. Extraction of nematodes from soil samples were done by modified Cobb's sieving and decanting technique (Christie and Perry, 1951). Killing and fixing of nematodes were done in 8 per cent hot formalin.

Community analysis of plant parasitic nematode

Community analysis of plant parasitic nematode was done by using the methods given by Norton (1978).

Absolute frequency is expressed as a percentage

$$\text{Absolute frequency} = \frac{\text{Number of samples containing a species}}{\text{Number of samples collected}} \times 100$$

Relative frequency is calculated as

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Sum of frequency of all species}} \times 100$$

Relative density is expressed in percentage and was calculated as

$$\text{Relative density} = \frac{\text{Number of individuals of a species in a sample}}{\text{Total of all individuals in a sample}} \times 100$$

Absolute density is calculated as

$$\text{Absolute density} = \frac{\text{Total number of individual of a species}}{\text{Total number of samples collected}} \times 100$$

Prominence value (P.V) of Beals (1960) was calculated as

$$PV = \text{density} \times \sqrt{\text{frequency}}$$

RESULTS AND DISCUSSION

Survey and identification of plant parasitic nematodes associated with tea

Eight of plant parasitic nematode species recorded from the seven blocks of Dibrugarh district were *Helicotylenchus* sp., *Hoplolaimus* sp., *Tylenchorhynchus* sp., *Paratylenchus* sp., *Meloidogyne* sp., *Xiphinema* sp., Criconematids and Tylenchs.

The nematodes found to be associated with 14 corporate sector gardens are *viz*., *Helicotylenchus* sp., *Hoplolaimus* sp., *Tylenchorhynchus* sp., *Paratylenchus* sp., *Xiphinema* sp., Criconematids and Tylenchs.

The maximum population of spiral nematode, *Helicotylenchus* sp. (44.28) was recorded from Tengakhat block whereas, minimum population (15) was recorded from Lahowal block. Similarly, the lance nematode, *Hoplolaimus* sp. with maximum population of 21.66 was recorded from Lahowal block and the minimum population (4) was recorded from Jaipur block. Further, the nematode *Paratylenchus* sp. with maximum population of (22) was recorded from Tingkhong block. The maximum population of *Tylenchorhynchus* sp. (24) was recorded from Khowang block. The nematode, *Xiphinema* sp. was found with a population of 18 only from block Jaipur.

The highest frequency of occurrence(100%) for *Helicotylenchus* sp. were recorded from two gardens of Barbaruah, Jaipur, Panitola, Tengakhat and Khowang blocks and from one garden of Tingkhong and Lahowal block and the lowest frequency of occurrence (66.66%) were recorded from one garden of Lahowal block. The lance nematode, *Hoplolaimus* sp. with a frequency of occurrence (100%) were recorded from one garden of Barbaruah, Jaipur, Lahowal, Panitola, Tingkhong and Khowang block and the lowest frequency of occurrence (40%) was recorded from one garden of Jaipur block. The nematode *Paratylenchus* sp., with a frequency of occurrence (100%) were recorded from two gardens of Barbaruah, one garden of Jaipur, Panitola, Tingkhong and Khowang block whereas, the lowest frequency of occurrence (40%) was recorded from Panitola block. Further, the nematode *Tylenchorhynchus* sp., with highest frequency of occurrence (100%) were recorded from two gardens of Barbaruah, one garden of Panitola and Khowang block whereas, the lowest frequency of occurrence (50%) was recorded from Lahowal block. Similarly, The nematode, *Xiphinema* sp. with frequency of occurrence (80%) was recorded highest from Jaipur block. Highest frequency of occurrence (20%) for Criconematids was recorded from Barbaruah block. The nematodes found under Tylenchs was recorded only from block Tingkhong with a frequency of occurrence 40% (Table 1).

The nematodes found to be associated with 14 small tea grower gardens are *viz*., *Helicotylenchus* sp., *Hoplolaimus* sp., *Tylenchorhynchus* sp., *Paratylenchus* sp., *Xiphinema* sp., *Meloidogyne* sp. and Criconematids.

The maximum population of spiral nematode, *Helicotylenchus* sp. (36) was recorded from Barbaruah block whereas, minimum population (13.75) was recorded from Tingkhong block. Similarly, the lance nematode, *Hoplolaimus* sp. with maximum population of 18.33 was recorded from Jaipur block and the minimum population (6.66) was recorded from Tengakhat block. Further, the nematode *Paratylenchus* sp., with maximum population of (22) was recorded from Barbaruah block. The maximum population of *Tylenchorhynchus* sp. (21) was recorded from Jaipur block. The nematode, *Xiphinema* sp. was found with a population of (11.66) from Tingkhong block.

The highest frequency of occurrence (100%) for *Helicotylenchus* sp. were recorded from two gardens of Barbaruah, Jaipur, Lahowal, Panitola, Tengakhat, Tingkhong and Khowang block. The lance nematode, *Hoplolaimus* sp. with a frequency of occurrence(100%) were recorded from two garden of Khowang, Lahowal, Barbaruah and Jaipur and from one garden of Panitola and Tingkhong and the lowest frequency of occurrence (50%) was recorded from one garden of Tengakhat block. The nematode *Paratylenchus* sp., with a frequency of occurrence (100%) were recorded from two gardens of Lahowal, one garden of Barbaruah, Jaipur, Panitola, Tengakhat, Tingkhong and Khowang block whereas, lowest frequency of occurrence (50%) was recorded from Jaipur block. Further, the nematode *Tylenchorhynchus* sp., with highest frequency of occurrence (100%) were recorded from two gardens of Jaipur, one garden of Panitola and Khowang block whereas, the lowest frequency of occurrence (66.66%) was recorded from Khowang block. Similarly, the nematode, *Xiphinema* sp. with frequency of occurrence (83.33%) was recorded highest from Tingkhong block. The highest frequency of occurrence (50%) for Criconematids was recorded from Panitola block. The root-knot nematode, *Meloidogyne* sp. was recorded highest from block Tingkhong and Tengakhat with a frequency of occurrence 50% (Table 2).

Of the eight genera of plant parasitic nematodes recorded from Dibrugarh district from the rhizosphere of tea plants,maximum population of *Helicotylenchus* sp. (152.50) was recorded from Barbaruah block and minimum population (95.83) was recorded from Lahowal block. In Lahowal block the maximum population recorded for *Hoplolaimus* sp. was (90.00) and minimum population (55.00) was recorded from Khowang block.Maximum population of *Paratylenchus* sp. (75.00) was recorded from Barbaruah block and minimum population (45.00) was recorded from Lahowal block. Similarly, maximum population of *Tylenchorhynchus* sp. (80.00) was recorded from Khowang block and minimum population (32.00) was recorded from Tingkhong block. In Tengakhat block the population of *Meloidogyne* sp. was recorded to be maximum (3.00) and the minimum population (2.00) was recorded from Tingkhong block.Maximum population of *Xiphinema* sp. (40.00) was recorded from Tingkhong block and minimum population (32.50) was recorded from Jaipur block. Criconematids with a highest population (20.00) was recorded from Barbaruah block and minimum population (1.20) was

recorded from Tengakhat block. The nematode under Tylenchs with a population of (5.00) was recorded only from Tingkhong block. The spiral nematode, *Helicotylenchus* sp. was found to be present in all the samples with highest frequency of occurrence 100 per cent in soil was recorded from Barbaruah, Jaipur, Khowang, Tengakhat and Panitola. Highest frequency of occurrence for *Hoplolaimus* sp. was recorded from Lahowal block (91.66%) and lowest frequency of occurrence (66.66%) was recorded from Tengakhat block. Highest frequency of occurrence for *Paratylenchus* sp. (90%) was recorded from Barbaruah block and lowest frequency of occurrence (56%) was recorded from Tingkhong block. Highest frequency of occurrence (82.60%) for stunt nematode, *Tylenchorhynchus* sp. was recorded from Khowang block whereas, lowest frequency of occurrence (28%) was recorded from Tingkhong block. Highest frequency of occurrence (16.66%) for root-knot nematode, *Meloidogyne* sp. was recorded from Tengakhat block and lowest frequency (8.69%) was recorded from Khowang block. In Jaipur block, highest frequency of occurrence of *Xiphinema* sp. was recorded to be 40.90%, which was found to be highest among all the blocks where as the lowest frequency of occurrence (40%) was recorded from Tingkhong block. Highest frequency of occurrence (12.50%) for criconematids was recorded from Lahowal block whereas, lowest frequency of occurrence (4.10%) was recorded from Tengakhat block. The nematodes under tylenchs were recorded only from Tingkhong block with a frequency of occurrence 8% (Table 3).

Among the nematodes from the seven block, *Helicotylenchus* sp., *Hoplolaimus* sp., *Paratylenchus* sp. were found to be associated with all the blocks *viz*., Barbaruah, Lahowal, Panitola, Khowang, Tengakhat, Tingkhong and Jaipur, *Tylenchorhynchus* sp. was found to be associated with all the blocks except Tengakhat, *Meloidogyne* sp. was found to be associated with blocks Khowang, Tengakhat and Tingkhong, *Xiphinema* sp. was found to be associated with block Jaipur and Tingkhong. Criconematids was found to be associated all the blocks except Jaipur and Khowang. Tylenchs was found only in block Tingkhong.

Among the eight genera of nematodes from the seven blocks, the spiral nematode, *Helicotylenchus* sp. was recorded from all the 28 tea gardens, the lance nematode, *Hoplolaimus* sp. was recorded from 27 gardens, the pin nematode, *Paratylenchus* sp. was recorded from 23 gardens, the stunt nematode, *Tylenchorhynchus* sp. was recorded from 16 gardens, Criconematids was recorded from 7 gardens, *Xiphinema* sp. was recorded from 4 gardens, the nematodes under Tylenchs were recorded from one garden, and the root-knot nematode *Meloidogyne* sp. was recorded from 4 gardens.

A total of eight genera of plant parasitic nematodes *viz.*, *Helicotylenchus, Tylenchorhynchus, Paratylenchus, Hoplolaimus, Xiphinema, Meloidogyne*, criconematids and tylenchs were recorded from the rhizosphere of tea plants of Dibrugarh district (Table 4).

Basu and Banerjee (1967) recorded the species of *Hoplolaimus, Rotylenchus, Helicotylenchus, Tylenchorhynchus, Tylenchus Paratylenchus* and *Aphelenchoides* from the soil collected around the rhizosphere of tea plants from tea nurseries in Jorhat. Some of the important species like *Scutellonema brachyurum, Pratylenchus brachyurus, Paratylenchus curvitalus, Aphelenchoides compositicola, Tylenchus agricola, Meloidodera fleridensis, Tylenchorhynchus mashhoodi*, *Hoplolaimus columbus* and *Aphelenchus agricola* associated with tea crops were reported from Tocklai Experimental Station, Jorhat (Anon., 1968). Singh (1989) recorded *Tylenchorhynchus, Helicotylenchus, Hoplolaimus* and *Paratylenchus* from soil and roots of plantation crops namely tea, coffee, betel vine, black pepper, coconut and arecanut from Jorhat district. Further, the nematodes *Helicotylenchus, Hoplolaimus, Tylenchorhynchus, Meloidogyne, Xiphinema* have already been reported from Assam in different crops (Phukan and Sanwal, 1980; Choudhury, 1985; Das, 1993). Campos *et al*. (1990) also reported several species of plant parasitic nematodes associated with tea plantation in different countries of the world.

3.1 Community analysis of plant parasitic nematodes associated with tea in Dibrugarh district

In the present investigation, out of eight genera recorded from Dibrugarh district from the rhizosphere of tea plants, *Helicotylenchus* sp. is the most frequently occurred species with absolute density (24.44%), relative density (43.08%), absolute frequency of (98.14%), relative frequency (30.50%) and prominence value of 241.95. In earlier studies also, *H. dihystera* was reported with high frequency of occurrence from Assam. Choudhury *et al*. (2004) reported, *Helicotylenchus* sp. with high prominence value from Assam. The lance nematode, *Hoplolaimus* sp. ranked second in absolute density (12.09%), relative density (21.31%), absolute frequency (81.48%), relative frequency (25.32%) and prominence value of 109.05. The pin nematode, *Paratylenchus* sp. ranked third in absolute density (10.49%), relative density (18.49%) absolute frequency of (66.04%), relative frequency (20.52%) and prominence value of 85.17. The stunt nematode, *Tylenchorhynchus* sp. ranked fourth in absolute density (7.25%), relative density (12.77%), absolute frequency of (50.61%), relative frequency (15.73%) and prominence value of 51.54. The nematode, *Xiphinema* sp. ranked fifth in absolute density (1.79%), relative density (3.15%), absolute frequency of (11.25%), relative frequency (3.49%) and prominence value 5.99. The root-knot nematode, *Meloidogyne* sp. ranked seventh in absolute density (0.20%), relative density (0.35%), absolute frequency of (4.93%), relative frequency (1.53%) and prominence value

0.44. The nematode, criconematids ranked sixth in absolute density (0.35%), relative density (0.61%), absolute frequency of (8.02%), relative frequency (2.49%) and prominence value 0.99. The nematodes under tylenchs ranked eight in absolute density (0.12%), relative density (0.21%), absolute frequency of (1.23%), relative frequency (0.38%) and prominence value of 0.13.

Das and Rahman (1996) presented a comprehensive account of community structure of twenty plant parasitic nematodes in and around the field and horticultural crops. Out of twenty species of plant parasitic nematodes, *Helicotylenchus dihystera*, *Tylenchorhynchus annulatus*, *Hirschmanniella oryzae* and *Meloidogyne incognita* were most predominant species. Out of these *H. dihystera* ranked first in relative frequency, absolute density, relative density and prominence value. Nandwana *et al.* (2005) also reported *Helicotylenchus* with highest prominence value from Rajasthan in sugarcane ecosystem. Absolute density and prominence value are the most important parameters for estimating the dominance of a particular species. Patel *et al*. (2007) reported the frequency of few plant parasitic nematodes *viz*., *Rotylenchulus reniformis*, *Helicotylenchus* sp., *Tylenchorhynchus* sp., *Meloidogyne* sp. and *Pratylenchus* sp. in certain medicinal plants from Gujarat and they recorded the highest frequency of occurrence of *Helicotylenchus* sp. (40.9%) followed by *Tylenchorhynchus* sp. (36.3%).

CONCLUSION

The plant parasitic nematode genera recorded were *viz*., *Helicotylenchus* sp., *Hoplolaimus* sp., *Tylenchorhynchus* sp., *Paratylenchus* sp., *Meloidogyne* sp., *Xiphinema* sp., few genera under criconematids and tylenchs. *Helicotylenchus* was recorded from all the 28 tea gardens with 100 per cent frequency of occurrence.

Helicotylenchus ranked first in relative frequency, absolute frequency, absolute density, relative density and prominence value. The genus *Hoplolaimus* ranked second in relative frequency, absolute frequency, absolute density, relative density and prominence value. The genus *Paratylenchus* ranked third in relative frequency, absolute frequency, absolute density, relative density and prominence value.

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Table 1. Plant parasitic nematodes associated with tea in different corporate sector tea gardens in Dibrugarh district

Sl. No	Block	Total no of sample collected	Type of tea gardens	Nematode	Population range in 250 cc soil	Frequency (%)	Average population
1	Barbaruah	5	Corporate sector(a)	*Helicotylenchus* sp.	20-40	100	28
				Hoplolaimus sp.	10-20	100	16
				Paratylenchus sp.	10-20	100	14
				Tylenchorhynchus sp.	10-20	100	16
		5	Corporate sector (b)	*Helicotylenchus* sp.	20-30	100	26
				criconematids	0-5	20	1
				Hoplolaimus sp.	0-10	60	6
				Paratylenchus sp.	10-30	100	18
				Tylenchorhynchus sp.	10-20	100	16
2	Jaipur	5	Corporate sector(a)	*Helicotylenchus* sp.	30-40	100	34
				Hoplolaimus sp.	10-20	100	14
				Xiphinema sp.	10-30	80	16
		5	Corporate sector(b)	*Helicotylenchus* sp.	10-30	100	18
				Hoplolaimus sp.	0-10	40	4
				Paratylenchus sp.	10-30	100	18
3	Lahowal	6	Corporate sector (a)	*Helicotylenchus* sp.	10-30	66.66	15
				Hoplolaimus sp.	10-20	83.33	13.33
				Tylenchorhynchus sp.	0-10	50	5
		6	Corporate sector (b)	*Helicotylenchus* sp.	20-30	100	21.66
				Hoplolaimus sp.	20-30	100	21.66
				Paratylenchus sp.	0-10	50	5
4	Panitola	7	Corporate sector(a)	*Helicotylenchus* sp.	20-30	100	22.85
				Hoplolaimus sp.	0-10	71.42	7.14
				Paratylenchus sp.	10-20	100	12.85
				Tylenchorhynchus sp.	0-10	71.42	7.14
		5	Corporate sector(b)	*Helicotylenchus* sp.	20-30	100	18
				Hoplolaimus sp.	10-20	100	16
				Paratylenchus sp.	0-10	40	4
				Tylenchorhynchus sp.	10-20	100	14
5	Tengakhat	7	Corporate sector (a)	*Helicotylenchus* sp.	30-70	100	44.28
				Hoplolaimus sp.	20-30	71.42	15.71
		6	Corporate sector(b)	*Helicotylenchus* sp.	20-50	100	30
				Hoplolaimus sp.	10-20	50	8.33
				Paratylenchus sp.	10-30	83.33	15
6	Tingkhong	6	Corporate sector (a)	*Helicotylenchus* sp.	20-40	83.33	21.66
				Hoplolaimus sp.	10-20	66.66	10
				Paratylenchus sp.	0-10	50	5
		5	Corporate sector (b)	*Helicotylenchus* sp.	10-40	100	22
				Hoplolaimus sp.	10-20	100	14
				Paratylenchus sp.	10-30	100	22
				tylenchs	0-10	40	4
7	Khowang	7	Corporate sector(a)	*Helicotylenchus* sp.	20-40	100	24.28
				Paratylenchus sp.	10-20	85.71	11.42
				Tylenchorhynchus sp.	10-30	71.42	11.42
		5	Corporate	*Helicotylenchus* sp.	20-30	100	26

			sector(b)	*Hoplolaimus* sp.	10-20	100	14
				Paratylenchus sp.	10-20	100	14
				Tylenchorhynchus sp.	20-30	100	24

Table 2. Plant parasitic nematodes associated with the gardens of small tea grower's in Dibrugarh district

Sl. No	Block	Total no of sample collected	Type of tea gardens	Nematode	Population range in 250 cc soil	Frequency (%)	Average population
1	Barbaruah	5	Small tea growers (STG) (a)	*Helicotylenchus* sp.	30-40	100	36
				criconematids	10	40	2
				Hoplolaimus sp.	10-20	100	16
				Paratylenchus sp.	10-30	100	22
				Tylenchorhynchus sp.	0-10	80	8
		5	STG(b)	*Helicotylenchus* sp.	20-40	100	32
				Hoplolaimus sp.	10-20	100	14
				Paratylenchus sp.	0-10	60	6
2	Jaipur	6	STG(a)	*Helicotylenchus* sp.	20-30	100	21.66
				Hoplolaimus sp.	10-20	100	13.33
				Paratylenchus sp.	10-30	100	15
				Tylenchorhynchus sp.	10-20	100	21
		6	STG(b)	*Helicotylenchus* sp.	10-40	100	21.66
				Hoplolaimus sp.	10-30	100	18.33
				Paratylenchus sp.	0-20	50	10
				Tylenchorhynchus sp.	10-30	100	15
				Xiphinema sp.	10-20	66.66	8.33
3	Lahowal	5	STG(a)	*Helicotylenchus* sp.	20-40	100	34
				criconematids	4	20	0.8
				Hoplolaimus sp.	10-20	100	16
				Paratylenchus sp.	10-20	100	16
				Tylenchorhynchus sp.	0-10	80	8
		6	STG(b)	*Helicotylenchus* sp.	10-30	100	16.66
				criconematids	12	33.33	2
				Hoplolaimus sp.	10-20	100	11.66
				Paratylenchus sp.	10-20	100	11.66
				Tylenchorhynchus sp.	10-20	100	13.33
4	Panitola	6	STG(a)	*Helicotylenchus* sp.	20-40	100	23.33
				criconematids	0-12	50	2
				Hoplolaimus sp.	10-20	100	11.66
				Paratylenchus sp.	10-20	100	13.33
		7	STG(b)	*Helicotylenchus* sp.	30-40	100	31.42
				Hoplolaimus sp.	0-10	85.71	8.57
				Paratylenchus sp.	10-20	71.42	11.42
				Tylenchorhynchus sp.	10-20	100	12.85
5	Tengakhat	5	STG(a)	*Helicotylenchus* sp.	20-40	100	26
				criconematids	0-2	20	0.4
				Hoplolaimus sp.	10-20	60	10
				Meloidogyne sp.	0-4	20	0.8
				Paratylenchus sp.	10-20	80	12
		6	STG(b)	*Helicotylenchus* sp.	20-50	100	25
				Hoplolaimus sp.	10-20	50	6.66
				Meloidogyne sp.	8	50	1.33
				Paratylenchus sp.	10-30	100	16.66
6	Tingkhong	6	STG(a)	*Helicotylenchus* sp.	20-30	100	21.66
				Hoplolaimus sp.	10-20	100	13.33

Sl. No	Block	Total no of sample collected	Type of tea gardens	Nematode	Population range in 250 cc soil	Frequency (%)	Average population
				Paratylenchus sp.	10-20	100	15
				Xiphinema sp.	10-20	83.33	11.66
				Meloidogyne sp.	12	50	2
		8	STG(b)	*Helicotylenchus* sp.	10-30	100	13.75
				criconematids	9	37.5	1.62
				Hoplolaimus sp.	10-30	75	15
				Xiphinema sp.	10-20	62.5	11.25
				Tylenchorhynchus sp.	10-20	87.5	10
7	Khowang	5	STG(a)	*Helicotylenchus* sp.	10-20	100	16
				Hoplolaimus sp.	10-20	100	16
				Paratylenchus sp.	10-20	100	16
				Tylenchorhynchus sp.	10-20	100	14
		6	STG(b)	*Helicotylenchus* sp.	10-30	100	16.66
				Hoplolaimus sp.	10-20	100	11.66
				Tylenchorhynchus sp.	0-10	66.66	8.33
				Meloidogyne sp.	9	33.33	1.5

Table 3. Average Population (per 200 ml of soil) and Frequency of plant parasitic nematodes associated with different tea gardens in Dibrugarh district

Block	Total no. of samples	*Helicotylenchus* sp.	*Hoplolaimus* sp.	*Paratylenchus* sp.	*Tylenchorhynchus* sp.	*Meloidogyne* sp.	*Xiphinema* sp.	criconematids	tylenchs
Barbaruah	20	152.50 (100)	65 (90)	75 (90)	50 (70)	-		20 (10)	-
Jaipur	22	130 (100)	70 (85)	60 (63.63)	40 (54.54)	-	32.50 (40.90)	-	-
Khowang	23	120 (100)	55 (69.56)	57.50 (69.56)	80 (82.60)	2.25 (8.69)		-	-
Lahowal	23	122.50 (95.83)	90 (91.66)	45 (58.33)	37.50 (54.16)	-		4 (12.5)	-
Tengakhat	24	192.50 (100)	62.50 (66.66)	62.50 (62.5)	-	3 (16.66)		1.20 (4.10)	-
Panitola	25	140 (100)	62.5 (88)	65 (80)	52.50 (68)	-		3 (12)	-
Tingkhong	25	120 (96)	82.50 (84)	57.50 (56)	32 (28)	2 (12)	40 (40)	3.25 (12)	5 (8)

Figure in the parentheses are frequency of occurrence

Table 4. Community analysis of different plant parasitic nematodes associated with tea in Dibrugarh district

Nematodes species	Absolute density	Relative density (%)	Absolute frequency (%)	Relative frequency (%)	Prominence value
Helicotylenchus sp.	24.44	43.08	98.14	30.50	241.95
Hoplolaimus sp.	12.09	21.31	81.48	25.32	109.05
Paratylenchus sp.	10.49	18.49	66.04	20.52	85.17
Tylenchorhynchus sp.	7.25	12.77	50.61	15.73	51.54
Xiphinema sp.	1.79	3.15	11.25	3.49	5.99
Meloidogyne sp.	0.20	0.35	4.93	1.53	0.44
criconematids	0.35	0.61	8.02	2.49	0.99
tylenchs	0.12	0.21	1.23	0.38	0.13
Total	56.73		321.70		