Community analysis of plant parasitic nematodes around the rhizosphere of vegetable crops in Jorhat district of Assam

ABSTRACT

To analyze the community composition, abundance, and distribution of plant-parasitic nematodes in the rhizosphere of vegetable crops in the Jorhat district of Assam, with the goal of identifying dominant nematode species and assessing their impact on vegetable crop health.A cross-sectional survey-based study employing nematode sampling, identification, and statistical analysis to evaluate nematode diversity and density.The study was conducted in five administrative blocks (Alengmora, Teok, Jorhat, Titabar, and Mariani) of the Jorhat district, Assam, India, from 2021 to 2022.A total of 146 composite soil and root samples were collected from the rhizosphere of 39 vegetable crops across five administrative blocks. Nematodes were extracted using Cobb's modified decanting and sieving technique for soil and the Baermann funnel method for roots. Identified nematode species were classified into eight genera, and community metrics such as absolute frequency, relative frequency, absolute density, relative density, prominence value, and plant-parasitic index were calculated following Norton's methodology. The index of similarity was used to compare nematode communities across administrative blocks. Eight nematode species from eight genera were recorded. *Meloidogyneincognita* was the most dominant species, exhibiting the highest mean absolute density (5356.01) and relative density (44.51%). It also had the highest prominence value (247.25). Alengmora, Teok, and Jorhat blocks harbored all eight nematode species, while Titabar and Mariani had six each. The index of similarity revealed considerable overlap in nematode species among the surveyed blocks. The study highlights the dominance of *M.incognita* in the Jorhat district, emphasizing the need for targeted nematode management strategies. The findings offer critical insights into nematode ecology and underscore the importance of site-specific interventions to reduce crop losses in vegetable production systems.

Keywords: Plant-parasitic nematodes, community analysis, vegetable crops, root-knot nematode,

1. INTRODUCTION

India's warm and humid climate is perfect for growing vegetables. One of the main obstacles to the productive development of crops, particularly vegetable crops, is the presence of plant parasitic nematodes. Nematodes that parasitize plants seriously threaten the successful cultivation of many commercial crops by reducing their output, productivity, and quality. Therefore, it is crucial to understand what nematode species are present and at what population level.

Since most developing nations are located in the tropical and sub-tropical regions, where the climatic conditions are best suited for plant growth, development, and reproduction, crops grown there suffer more from the attack of plant parasitic nematodes. As a result, the

problem is more serious in developing nations than in developed ones. The sandy, warm soil in many underdeveloped nations is better suited for nematode invasion.

The amount of plant parasitic nematodes in the soil and crop loss is directly correlated, with more nematodes causing higher yield loss. The density of nematodes can be used to determine whether treating soil with fumigants or other nematicides is cost-effective before planting or after that. The kind of cultivation, season, prior crop, soil type, environmental factors, and worm control strategies can all impact the population density and distribution of nematodes in fields.

2. MATERIAL AND METHODS

A roving survey was conducted during 2021-22 in five administrative blocks of the Jorhat districts of Assam. A soil tube auger was taken for collecting soil and root samples from thirty-nine different vegetable crops from five administrative block of the Jorhat district.

A total of one hundred and forty-six soil samples along with roots were collected in zig-zag method from the rhizosphere of brinjal, knol-khol, tomato, potato, bean, French bean, squash, pea, cowpea, mustard green, radish, bitter gourd, bottle gourd, cauliflower, onion, garlic, Chinese mellow, broccoli, pumpkin, cabbage, cucumber, chilli, carrot, spinach, beetroot, ivy gourd, sweet potato, ginger, pointed gourd, ash gourd, taro, yam, coriander, lesser yam, sponge gourd, okra, zucchini, amaranthus, tapioca, watermelon, and ridge gourd; grown at different places of Jorhat district. Each composite sample of 250 cc was made up of several sub-samples. Extraction of nematode from soil was done by Cobb's modified decanting and sieving technique (Christie and Perry, 1951). The extraction of nematodes from the root samples (5 gm) was done by modified Baermann's funnel technique (Christie and Perry, 1951).

According to Norton's formula (1978), each nematode's absolute frequency, relative frequency, absolute density, relative density, plant-parasitic index and prominence value were determined.

3. RESULTS AND DISCUSSION

In the present investigation, eight species of plant parasitic nematodes belonging to eight genera, *viz.*, *Meloidogyne*, *Helicotylenchus*, *Rotylenchulus*, *Macroposthonia*, *Hoplolaimus*, *Tylenchorhynchus*,*Scutellonema*, *Xiphinema* were recorded from the rhizosphere of different vegetable plants of Jorhat district.

Of these eight species *Meloidogyneincognita* (71.58%), *Rotylenchulusreniformis* (61.36%), *Helicotylenchusdihystera* (56.71%) and *Macroposthoniaonostris* (50.76%) were predominant in respect of mean absolute frequency. Other nematode species recorded were *Hoplolaimusindicus* (26.81%), *Tylenchorhynchusannulatus* (10.83%), *Scutellonemabrachyurus* (10.78%) and *Xiphinemaradicicola* (3.83%). *Meloidogyneincognita* (24.18%) ranked first in mean relative frequency followed by *Rotylenchulusreniformis* (20.84%), *Helicotylenchusdihystera* (19.84%), *Macroposthoniaonostris* (17.42%), *Hoplolaimusindicus* (9.16%), *Tylenchorhynchusannulatus* (3.69%), *Scutellonemabrachyurus* (3.53%) and *Xiphinemaradicicola* (1.30%). (Table: 1.)

Meloidogyneincognita ranked first in mean absolute density and mean relative density (5356.01% and 44.51% respectively) and was followed by *Helicotylenchusdihystera* (1882.70% and 18.93%), *Rotylenchulusreniformis* (1433.71% and 13.28%), *Macroposthoniaonostris* (1331.57% and 11.92%), *Hoplolaimusindicus* (836.09% and

7.64%), *Tylenchorhynchusannulatus* (199.84% and 2.02%), *Scutellonemabrachyurus* (168.899% and 1.22%) and *Xiphinemaradicicola* (56.81% and 0.43%). (Table: 1.)

Xiphinemaradicicola was the most predominant species having highest plant-parasitic value of 0.204 and followed by *Rotylenchulusreniformis* (0.126), *Macroposthoniaonostris* (0.119), *Scutellonemabrachyurus* (0.115), *Helicotylenchusdihystera* (0.095), *Hoplolaimusindicus* (0.094), *Meloidogyneincognita* (0.045) and *Tylenchorhynchusannulatus* (0). (Table: 1)

A perusal of results revealed that *Meloidogyneincognita* recorded the highest prominence value of 247.25 followed by *Helicotylenchusdihystera* (77.62), *Rotylenchulusreniformis* (59.37), *Macroposthoniaonostris* (51.51), *Hoplolaimusindicus* (22.47), *Scutellonemabrachyurus* (4.26), *Tylenchorhynchusannulatus* (3.45) and *Xiphinemaradicicola* (0.80). (Table: 1)

Out of the five administrative blocks surveyed in the Jorhat district of Assam, all eight nematode species belonging to eight genera has been recorded from Alengmora, Teok and Jorhat. Soil and root samples collected from Titabar and Mariani revealed the presence of six nematode species belonging to six genera.

So, based on the finding, the index of similarity between Titabar&Alengmora, Titabar&Teok, Titabar& Jorhat, Alengmora& Mariani, Teok& Mariani, and Jorhat & Mariani is 0.75. The index of similarity value is 1 in the case between Titabar& Mariani, Alengmora&Teok, Alengmora& Jorhat, and Teok& Jorhat.

The populations of soil nematodes may offer fresh perspectives on various soil processes. Because most nematodes are active year-round in soil, they may be able to offer a comprehensive assessment of the biotic and functional state of soils and other organisms living there. Representative samples of soil nematode communities are more readily available than samples from other soil microbial communities.

Nevertheless, the majority of recent research on nematode ecology has been survey-based or solely observational in nature, with an ongoing emphasis on in-depth taxonomic analysis of nematode communities. Das and Rahman (1996) reported that *Helicotylenchusdihystera*, *Tylenchorhynchusannulatus* and *Meloidogyneincognita* were the most predominant plant-parasitic nematode species in and around the field and horticultural crops. A study conducted in Jorhat, Deuri and Das (2012) and Deori*et al*. (2014) also reported that *Helicotylenchusdihystera* and *Tylenchorhynchusleviterminalis* and *Meloidogyneincognita* were the most prominent nematodes around the rhizosphere of medicinal and aromatic plants and banana. Kavitha and Das (2016) recorded the association of eight species of plant parasitic nematodes viz., *Meloidogyne* sp. *Rotylenchulus* sp. *Pratylenchus* sp. *Helicotylenchus* sp. *Hoplolaimus* sp. *Heterodera* sp. *Trichodorus* sp. and *Xiphinema* sp. with brinjal from Rangareddy village of Hyderabad. Archidona-Yustue*t al*. (2018) reported that *Meloidogyne* spp. can be found in all horticultural areas of Spain. El-Nudy *et al*. (2019) identified *Belonolaimus*, *Criconema*, *Criconemoides*, *Helicotylenchus*, *Hoplolaimus*, *Meloidogyne*, *Pratylenchus*, *Rotylenchulus*, *Tetylenchus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchus* and *Xiphinema* from the soil samples collected from the vegetable growing areas of Sania Penninsula of Egypt. Tileubayeva*et al*. (2021) recorded eleven plant parasitic nematodes viz., *Scutellonema*, *Helicotylenchus*, *Aphelenchoides*, *Hemicriconemoides*, *Ditylenchus*, *Meloidogyne*, *Rotylenchulus*, *Xiphinema*, *Quinisulcius*, *Pratylenchus*, and *Tylenchulus* from around the rhizosphere of greenhouse vegetable crops. All these reports are in line with the findings of the present investigation.

4. CONCLUSION

This study provides key insights into the community structure and distribution of plant-parasitic nematodes in the rhizosphere of vegetable crops in Jorhat district, Assam. Eight nematode species from eight genera were identified, with *Meloidogyneincognita* emerging as the most dominant species, exhibiting the highest absolute density, relative density, and prominence value. Significant variability in nematode diversity was observed across the five administrative blocks, with Alengmora, Teok, and Jorhat harboring all eight species, while Titabar and Mariani reported six species each.

The identification of economically significant species such as *Rotylenchulusreniformis*, *Helicotylenchusdihystera*, and *Macroposthoniaonostris* highlights the potential threat to vegetable production in the region. The study emphasizes the importance of adopting region-specific nematode management strategies to mitigate crop damage and improve productivity. These findings contribute to the broader understanding of nematode ecology and offer critical insights for developing site-specific integrated pest management (IPM) strategies aimed at sustaining vegetable production systems in tropical and subtropical regions.

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Table: 1 Community Analysis among various plant-parasitic nematodes associated with different vegetable crops in Jorhat district of Assam during 2021-2022

	Average Absolute Frequency Value	Average Relative Frequency Value	Average Absolute Density Value	Average Relative Density Value	Average Plant-Parasitic Index Value	Average Prominence Value
Meloidogyneincognita	71.58	24.18	5356.01	44.51	0.045	247.25
Helicotylenchusdihystera	56.71	19.84	2185.28	18.93	0.095	91.15
Rotylenchulusreniformis	61.36	20.84	1473.71	13.28	0.126	61.02
Macroposthoniaonostris	50.76	17.42	1331.57	11.92	0.119	51.51
Hoplolaimusindicus	26.81	9.16	836.09	7.64	0.094	22.57
Scutellonemabrachyurus	10.78	3.53	168.89	1.22	0.115	4.26
Tylenchorhynchusannulatus	10.83	3.69	199.84	2.02	0	3.45
Xiphinemaradicicola	3.83	1.30	56.81	0.43	0.204	0.80