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Nematode Trophic diversity in agricultural ecosystem of The Nilgiris, Tamil Nadu, India

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ABSTRACT

The cryptic nature of nematodes in Nilgiris has led to their underexplored status, primarily due to the major focus on the Golden Cyst Nematode (GCN), Globoderarostochiensis, infesting potatoes. Moreover, nematodes are abundant creatures on Earth, occupying various feeding and trophic levels, making them potential proxies for assessing soil health. To connect the dots, a comprehensive study on nematodes was conducted in the high-altitude Nilgiris region. The study revealed the presence of 32 nematode species, including non-plant parasitic nematodes like *Wilsonema* sp. in wheat fields. Over a two-year period, analysis of Nematode-trophic diversity showed that incorporating wheat and mustard enhanced soil nematode biodiversity. GIS-based mapping of nematode data demonstrated the feasibility of gathering information from unsampled areas. For a better understanding of changes in soil nematode biodiversity in Nilgiris, future research should consider nematode functional guilds.

INTRODUCTION

The discovery of the Golden Cyst Nematode (GCN), Globodera rostochiensis, infesting potatoes in Nilgiris (Jones 1961), is considered

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a significant milestone in the development of Nematology in India. Since then, research efforts have primarily focused on managing GCN in the Nilgiris, with only a few studies conducted on other nematodes. Furthermore, it should be noted that not all nematodes are harmful and many nematodes are beneficial for the ecosystem. They are one of the abundant animals on the earth, distributed universally, occupy all trophic level and form the major portion of the soil food web. Thereby has the potential to act as indicators of soil health.Moreover, the highly undulating terrain of the Nilgiris makes many fields inaccessible. Therefore, integrating a GIS-based spatial distribution map can help to speculate the presence of nematodes in unsampled areas. As a result, we initiated this comprehensive study on nematodes in the agricultural ecosystem of the high-altitude Nilgiris region (~1850 MSL) with the objective to quantify the nematode biodiversity, analyzing the soil health using the nematodes and integrate them with GIS to obtain the information on nematode diversity from unsampled area.

MATERIALS AND METHODS

The soil samples were collected from various agricultural fields in Nilgiris, Tamil Nadu, along with their geographical coordinates. At each sampling location, soil samples (five cores) were collected at a depth of 15 cm using a hand trowel. These samples were thoroughly mixed, and a representative sample of 100 cc was taken for nematode extraction. The nematodes were extracted using standard procedures described by Cobb (1918). The nematode suspension was then concentrated in self-standing 50 ml centrifuge tubes, and quantification was performed using a Sedgewick rafter counting chamber under a compound microscope (Nikon E 600) following the method by Berliner et al. (2021). The nematodes were categorized into four feeding groups: herbivore, bacterivore, fungivore, and omnivore–predator, to estimate diversity based on Shannon (1948) index. Computation of diversity indices and analysis were conducted using Paleontological Statistical Software (PAST V3). Part of the extracted nematode samples were processed for identification as described by Seinhorst (1959).GIS-based studies were carried out in the research farm area (43.5 acres) of ICAR-IARI, Regional Station, and the interpolation was performed using Arc-GIS software.

RESULTS AND DISCUSSION

Our investigations for the presence of nematodes in agricultural crops in Nilgiris revealed the existence of 32 nematode species (Table 1), with 22 observed in wheat fields. Notably, we reported the presence of several non-plant parasitic nematodes in agricultural soils, including the first-ever record of Wilsonema sp. in high-altitude wheat crops. Furthermore, we conducted a comparative analysis of Nematode-trophic (NT) diversity between different cropping sequences in the Nilgiris over a two-year period (Fig 1). Our findings indicated that incorporating wheat and mustard into the cropping sequence can enhance soil nematode biodiversity.

Table 1: Nematode species observed in Agro-ecosystem of Nilgiris

Nematode species	Nematode species	Nematode species
Acrobeles	*Globodera pallida*	*Paratylenchus sp.*
Aphelenchoides	*Helicotylenchus*	*Pratylenchus sp.*
Aphelenchus sp.	*Helicotylenchusdihystera*	*Rhabditis*
Criconema sp.	*Hemicycliophora sp.*	*Rotylenchulusreniformis*
Cactoderaestonica	*Heterodera cajani*	*Trichodorus sp.*
Diptherophora	*Hoplolaimus sp.*	*Tylenchorhynchus spp.*
Discolaimus sp.	*Longidorus sp.*	*Tylenchus*
Dorylaimids	*Meloidogyne hapla*	*Wilsonema*
Ecphyadophora	*Meloidogyne incognita*	*Xiphinema spp.*
Filenchus sp.	*Monohystera*	*Unidentified*
Globodera rostochiensis	*Mononchus sp.*	

To visualize the spatial distribution of NT diversity, we prepared a map using interpolation from data collected at 95 locations in our research farm (Fig 2). The results showed that 77% of the land exhibited medium (H=0.7-1.2) NT diversity during the winter, while the percentage increased to 92.09% during the summer. This suggests that continuous intensive cultivation may lead to a decrease in soil NT diversity in the Nilgiris. Moreover, during our observations, we noticed that the presence of nematode-susceptible weeds and freshly applied organic matter influenced NT diversity by promoting the population growth of herbivore and bacterivore nematodes.

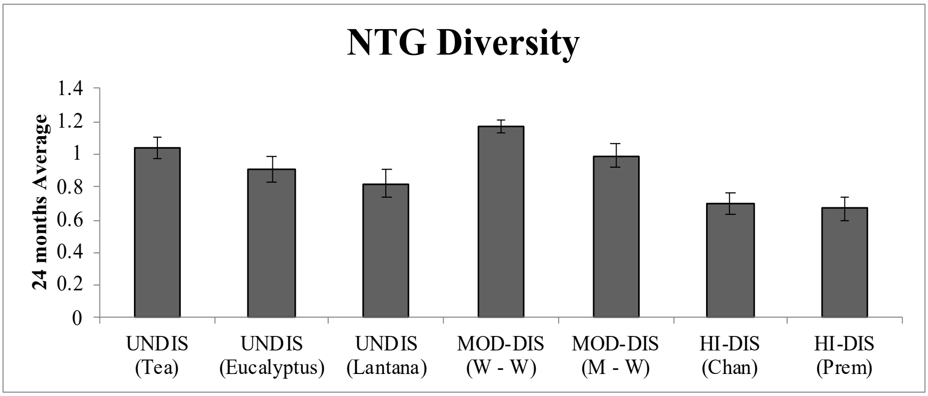

Figure 1: Nematode-Trophic diversity in different cropping sequence of Nilgiris. (UNDIS – Undisturbed area; MOD-DIS – Moderately disturbed fields with less input; HI-DIS – Highly disturbed fields with input intensive vegetables)

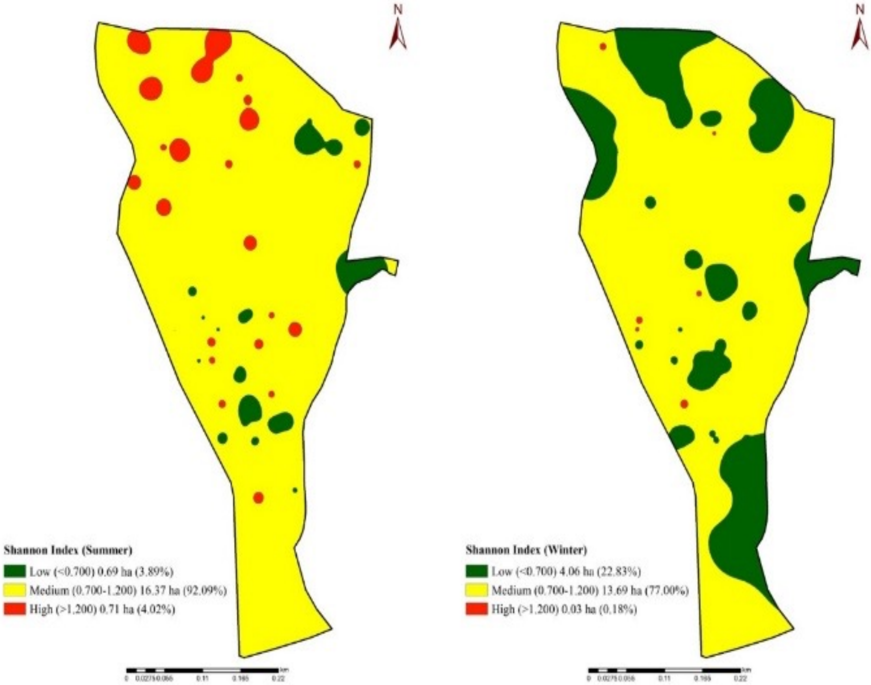

Figure 2: Nematode-trophic diversity at ICAR-IARI, Regional Station, Wellington during summer and winter

CONCLUSION

The current investigation provides us with information on plethora of untapped nematode diversity yet to be tapped and documented. The present input intensive cropping method followed by farmers in Nilgiris is found to deplete the soil nematode biodiversity. The indiscriminate use pesticide on the vegetables may be the main reason for the decreased soil nematode diversity. The GIS based mapping based on interpolation can be used to speculate the presence of nematode in unsampled area. However, the highly dynamic nature of nematode population should not be ignored. Hence, in the future, expanding our research to encompass nematode functional guilds based on coloniser - persister value (c-p value)to provide more robust evidence regarding changes in soil nematode biodiversity in relation to shifts in land use patterns of the Nilgiris.

REFERENCES

- Cobb, N. A. 1918. Estimating the nema population of soil, with special reference to the sugar-beet and root-gall nemas, Heterodera schachtii Schmidt and Heterodera radicicola (Greef) Müller. Agri-cultural Technology Circular. Bureau of Plant Industry, US Department of Agriculture, Government Print Office, USA.
- Seinhorst, J. W. 1959. A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. Nematologica, 4: 67-69.
- Berliner, J., Mhatre, P. H., Kalai, P. V., Kalaiarasan, P., Parvez, R. and Manimaran, B. 2021. Nematode trophic diversity in the pristine and cultivated fields of Nilgiris using Sedgewick–Rafter slides. Indian Journal of Nematology, 51: 149-154.
- Shannon, C. E. 1948. A mathematical theory of communication. Bell System Technical Journal, 27: 379-423.