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Diversity Host Range and Community Analysis of Plant Parasitic Nematodes in Hill Area Ecosystems of Meghalaya

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ABSTRACT

Diversity, host range and community analysis of major plant parasitic nematodes were studied in different crops at Umiam and adjoining areas in Meghalaya. Overall results revealed that about 13 genera belonging to 9 families of 2 orders of plant parasitic nematodes were found in Meghalaya. Amongst, *Helicotylenchus, Rotylenchulus* and *Meloidogyne* were predominant and have wide host range. The Spiral nematode, *Helicotylenchus dihystera* was the most frequently encountered species around the crop rhizosphere and ranked first in absolute density (172.60), relative density (67.61) and prominence value (344.94). The foliar nematode, *Aphelenchoides* spp. was observed in very few crops *viz*., tomato, cabbage, cauliflower, knol-khol, radish with 4% absolute frequency.

1. Introduction

North eastern hill region of India is a part of Indo-Malayan biodiversity hot-spot and it is exceptionally rich in terms of flora and fauna. North east India is geographically 'gateway' for much of India's flora and fauna (Chakravarty *et al*., 2012). The Meghalaya is a part of north eastern Himalaya and is one of the richest biomes of the world, high in endemism and rare species (Anonymous, 2005). Agro-climatic conditions of Meghalaya are highly suitable for multiplication of pests and pathogens (Azad Thakur *et al*., 2013). Nematodes are ubiquitous inhabitants of soil, subsisting on living organism of every type and in turn, contributing their biomass to other soil biota. Plant-parasitic nematodes are nearly microscopic, worm-shaped animals virtually invisible to the naked eye when in the soil. Nematodes can cause significant plant damage ranging from negligible injury to total destruction of plant material. The severity of plant injury resulting from nematode activity depends on several factors such as the combination of plant and nematode species and prevailing environmental factors including rainfall, soil types, land contour and cultural practices (Ravichandra 2014). They are the most dominant metazoan animal in the soil, exceeding in species diversity only by the arthropods. Extreme weather events e.g. uneven and untimely rainfall, flood, drought, heavy wind, hail storms *etc.* are now frequent in some parts of North east India. Owing to this, there is an increasing trend of farmers towards protected cultivation especially vegetables and flowers. Nematodes favor and more damage under protected cultivation particularly to cucurbits and flowers.

Despite of their ubiquity and dominance, the detail information on host range and community structure of nematodes in Meghalaya is limited. However, some preliminary information is available on host range, diversity and community structure of nematodes in Meghalaya (Azad Thakur *et al.,* 2005, Azad Thakur and Devi, 2005, Devi *et al*., 2007; Devi and Azad Thakur, 2007a; Devi and Azad Thakur, 2007b; Devi, 2007). To fill in the lacunae therefore, we studied the diversity, host range and community analysis of plant parasitic nematodes in Meghalaya.

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2. Materials and Methods

The experiments were conducted at Division of Crop Protection, ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2013 and 2014 to study the host range and community analysis of major plant parasitic nematodes in different agricultural and horticultural ecosystems of Meghalaya. Plant and soil samples were collected from more than 35 economically important plant species from different locations at Umiam and adjoining areas. The samples were processed by Cobb's decanting and sieving method. The nematodes were extracted by modified Baermann's Funnel Technique. Nematode suspension was concentrated by keeping the suspension undisturbed in a beaker for 30 minutes (to settle down the nematodes at the bottom of the beaker) and then carefully decanting the supernatant. Concentrated nematode suspension was poured into a Mc Carteney bottle and the nematodes were killed as well as fixed simultaneously by adding 8% (double strength) boil formalin. The fixed nematodes were stored with proper label. The population of nematode was assessed and community analysis was done as described by Norton (1978). Absolute frequency, relative frequency, Absolute density, relative density and prominence value were determined by using the following formulae (Beals, 1960)

Absolute frequency =

$$\frac{\text{Number of samples collected species}}{\text{Number of samples collected species}} \text{ X100}$$

Relative frequency =

$$\frac{\text{Sum of the frequency of species}}{\text{Frequency of species}} \text{ X100}$$

Absolute density of a species=

$$\frac{\text{Total number of individual of a species}}{\text{Total number of samples collected}} \text{ X100}$$

Relative density =

$$\frac{\text{Number of individuals of a species in samples}}{\text{Total of all individuals in a sample}} \text{ X100}$$

Prominence value=

$$\text{Density} \times \sqrt{\text{Frequency}}$$

3. Results and Discussions

Diversity of nematodes in multi-crop ecosystems of Meghalaya

The major plant parasitic nematodes obtained and identified during the survey were mainly belong to two major orders *viz*., Tylenchida and Dorylaimida.

In order Tylenchida, the major nematode species were from family Hoplolaimidae *viz*., *Hoplolaimus* spp. (Lance nematode), *Helicotylenchus* spp. (Spiral nematode), *Rotylenchulus* spp. (Reniform nematode) followed by family Heteroderidae *viz*., *Meloidogyne* spp. (Root knot nematode), family Criconematidae *viz*., *Macroposthonia* spp., *Criconema* spp. (Ring nematode); family Beloilamidae *viz*. *Tylenchorhynchus* spp. (Stunt nematode), family Pratylenchidae *viz*. *Pratylenchus* spp. (Lesion nematode), *Hirschmanniella* spp. (Rice root nematode) family Tylodoridae *viz*. *Cephalenchus* spp., family Anguinidae *viz*., *Ditylenchus* spp., family Aphelenchidae *viz*., *Aphelenchus* spp. and family Aphelenchoididae *viz*., *Aphelenchoides* spp. (Foliar nematode). In order Dorylaimida, the family Longidoridae *viz*. *Xiphinema* spp. (Dagger nematode) was commonly found particularly on vegetables.

Host range of major plant parasitic nematodes in Meghalaya

Host range of different plant parasitic nematodes is indicated in table 1. Among 13 nematode species, *Helicotylenchus dihystera, Rotylenchulus reniformis, Meloidogyne incognita, Tylechorhynchus leviterminalis* were found to have maximum host range; whereas *Aphelenchoides* spp., *Aphelenchus* spp., *Ditylenchus* spp. and *Hirschmanniella* spp. were observed on few host plants (Table 1)

Community analysis of different plant parasitic nematodes in Meghalaya

Out of the 13 major nematode species, *Helicotylenchus dihystera* was the most frequently encountered species around the crop rhizosphere (96% and 24.61%, absolute and relative frequency, respectively. n=250). The spiral nematode, *Helicotylenchus dihystera* also ranked first in absolute density (172.60), relative density (67.61) and prominence value (344.94). The foliar nematode, *Aphelenchoides* spp. was observed in very few crops *viz*., tomato, cabbage, cauliflower, knol-khol, radish with 4% absolute frequency (Table 2). Our findings are supported by the findings of Azad Thakur *et al.,* (2005), Devi and Thakur (2007) and Devi (2007); who studied host range of major nematode species in Meghalaya. Azad Thakur *et al.,* (2005) observed nine nematode species associated with vegetables and Devi and Thakur (2007) found five nematode species associated with mushroom in Meghalaya. Ten species of nematodes are known to occur in Pine apple ecosystem of Meghalaya (Devi, 2007). Azad Thakur *et al.,* (2005) studied the community structure of nematodes in vegetable ecosystems of Meghalaya and observed that the root knot

Table 1. Host range of different plant parasitic nematode species in Meghalaya

SN	Nematode species	Host range in Meghalaya
1	*Helicotylenchus dihystera*	Tomato, Cauliflower, Cabbage, Broccoli, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia, Mungbean, soybean, French bean, Lentil, Groundnut, Guava, Lemon, Mulberry, Peach, Gerbera, Marigold, Monster, Dieffenbachia, Philodendron, Anthurium, Chrysanthemum, Rose, Rice, Maize, Turmeric, Wheat, Pea and Pine apple
2	*Tylechorhynchus leviterminalis*	Tomato, Cauliflower, Cabbage, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia, Guava, Lemon, Mulberry, Peach, Gerbera, Marigold, Monstera, Dieffenbachia, Philodendron, Anthurium, Chrysanthemum, Rose and Pine apple
3	*Hoplolaimus indicus*	Mung bean, soybean, French bean, Guava, Lemon, Mulberry, Peach, Rice., Maize, Wheat, Pea, Lentil, Knol khol and cabbage
4	*Rotylenchulus reniformis*	Tomato, Cauliflower, Cabbage, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia, Mung bean, soybean, French bean, Guava, Lemon, Mulberry, Peach, Gerbera, Marigold, Monstera, Dieffenbachia, Philodendron, Anthurium, Chrysanthemum, Rose, Wheat, Pine apple and Pea
5	*Meloidogyne incognita*	Tomato, Cauliflower, Cabbage, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia, Mung bean, soybean, French bean, Groundnut, Guava, Lemon, Mulberry, Peach, Gerbera, Marigold, Monstera, Dieffenbachia, Philodendron, Anthurium, Chrysanthemum, Rose, Rice., Maize, Turmeric and Broccoli
6	*Cephalenchus leptus*	Tomato, Cauliflower, Cabbage, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia and Broccoli
7	*Prtaylenchus musii*	Tomato, Cauliflower, Cabbage, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia, Guava, Lemon, Mulberry, Peach, Pine apple and Pea
8	*Criconema* spp.	Tomato, Cauliflower, Cabbage, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia, Mung bean, soybean, French bean, Guava, Lemon, Mulberry, Peach, Rice, Maize and Pea
9	*Xiphinema radicicola*	Tomato, Cauliflower, Cabbage, Knol khol, Radish, Ash gourd, Pumpkin, Bottle gourd, Potato, Colocasia, Gerbera, Marigold, Monstera, Dieffenbachia, Philodendron, Anthurium, Chrysenthemum, Rose
10	*Aphelenchoides* spp.	Tomato, Cabbage, Cauliflower, Knol-khol, radish, Pine apple
11	*Aphelenchus* spp.	Tomato, Cabbage, Cauliflower, Knol-khol, radish
12	*Ditylenchus* spp.	Cabbage, Cauliflower, Knol-khol
13	*Hirschmanniella* spp.	Tomato, Cabbage, Cauliflower, Knol-khol, radish

nematode, *Meloidogyne incognita* is the most dominant species followed by *Helicotylenchus* spp. and remaining species were found lesser in rhizospere of vegetables in Meghalaya. However, *Helicotylenchus dihystera* was found to be a dominant species and *Meloidogyne* was observed to a limited extent in our study. This variation could be attributed to the nature and number of sampling, time of sampling and crops studied *etc*. The present study can be concluded that, about 13 genera belonging to 9 families of 2 orders of plant parasitic nematodes are found in Meghalaya. Amongst*, Helicotylenchus, Rotylenchulus* and *Meloidogyne* are predominant and have wide host range. Amongst*,* Spiral nematode, *Helicotylenchus dihystera* was the most frequently encountered species around the crop rhizosphere and ranked first in absolute density, relative density and prominence value.

The information generated by this study would certainly be helpful for further detailed studies on the diversity and community analysis of nematodes in different crops particularly in Meghalaya and other parts of North East India

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Table 2. Community analysis of different plant parasitic, free living and predatory nematodes in Meghalaya (n =252)

Nematode	No. of samples	Absolute frequency (%)	Relative frequency (%)	Absolute density	Relative density	Prominence value
Helicotylenchus dihystera	240	96.00	24.61	172.60	67.61	344.94
Tylenchorhynchus leviterminalis	45	18.00	4.61	2.00	0.78	1.71
Cephalenchus leptus	45	18.00	4.61	8.60	3.36	6.91
Rotylenchulus reniformis	150	60.00	15.30	21.80	8.54	34.07
Criconema spp.	30	12.00	3.07	1.40	0.50	0.88
Xiphinema radicicola	15	6.00	1.53	0.40	0.15	0.90
Hoplolaimus indicus	35	14.00	1.79	18.85	7.40	0.18
Meloidogyne incognita	95	38.00	9.74	10.40	4.07	12.92
Pratylenchus musii	40	16.00	4.10	1.70	0.67	0.96
Ditylenchus spp.	20	8.00	2.05	1.40	0.54	3.77
Aphelenchus spp.	25	10.00	2.55	1.50	0.59	10.01
Aphelenchoides spp.	10	4.00	1.02	0.70	0.27	1.07
Hirschmanniella spp.	25	10.00	2.56	1.80	0.71	1.14
Free living nematodes	195	78.00	19.89	10.30	4.06	18.33
Predatory nematodes	15	6.00	1.53	1.80	0.71	0.88

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