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Nematodes associate with big fruit trees and their community analysis survey of state Odisha, India

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Abstract

Around 240 soil samples were collected from the rhizosphere of fruit crops across the different places of Odisha. That revealed the presence of *Rotylenchulus reniformis* (120.63), *Tylenchorhynchus mashhoodi* (108.97), *Hoplolaimus indicus* (40.76), *Hemicriconemoides mangiferae* (32.10), *Helicotylenchus dihystera* (20.00), *Xiphinema insigne* (17.34), *Caloosia heterocephala* (10.80), *Pratylenchus coffeae* (7.20), *Aphelenchus avenae* (6.36), *Dorylaimid* (65.06), *Mononchid* (29.73), *Rhabditid* (13.40) exhibiting varying population densities. Among the different plant parasitic nematodes, *Hoplolaimus indicus* was highest frequency of occurrence (168), with absolute frequency (70%). Moreover *Rotylenchulus reniformis* found the most prominent species with higher prominence value (96) followed by *Tylenchorhynchus mashhoodi* (90.08), with the lowest prominence value (2.08) recorded in *Pratylenchus coffeae*. Among free living nematodes *Dorylaimid* were highest frequency of occurrence (240), with absolute frequency (100%) followed by *Mononchid* and *Rhabditid* (86.67%), (75%). *Dorylaimids* were also having the highest prominence value (65.06) followed by *Mononchid* (27.68) and *Rhabditid* (11.60).

Keywords: Community analysis, prominence value, big fruit trees, nematode association, Odisha

Introduction

As per National Horticulture Database published by National Horticulture Board, during 2018-19, India produced 96.8 million metric tonnes of fruits. The area under cultivation of fruits stood at 6.5 million hectares.

After China, India ranks 2nd largest producer of fruits, it has emerged as the largest producer of fruits like mango, banana, sapota, litchi and acid lime as well as during the past one decades, the shifting in cropping pattern has been more towards horticulture sector. Agricultural diversification is an important component for economic growth and it is meagrely dependent on the opportunities and responsiveness of farmers to technological breakthrough, consumer demand, government policies, trade arrangements and development of infrastructure. Among various pests and diseases, the role of plant parasitic nematodes in limiting the production and yield of fruits cannot be ruled out. They caused projected yield loss of 12.3% (\$157 billion dollars) worldwide, out of which \$40.3 million is reported from India. So, the future threat according to the findings of ^[5, 6] due to the infectious nematodes like; *Rotylenchulus reniformis*, *Meloidgyne incognita*, *Radopholus similis*, *Tylenchulus semipenitranche* and *Hemicriconemoides mangiferae* enhance the idea to investigate various nematodes associated with the big fruit trees such as jackfruit, litchi, mango and sapota of the state Odisha, India.

Materials and Methods

A survey was conducted from the different places of the state Odisha, during the year 2015-2017 to determine the presence of various plant parasitic nematodes associated with certain fruit crops.

Soil Sample Collection: Requisite soil samples were collected and processing of the soil samples are done within a week after collection. Subtotal of 240 soil samples were collected from certain plants belongs to fruit crops; such as jackfruit, litchi, mango and sapota in different localities placed in Odisha, India.

Nematode Extraction: Cobb's sieving and decanting method, where different mesh sieves are used accordingly to screen the nematodes was done for the extraction of the nematodes followed by Baermann's funnel technique ^[3] and a clear nematode suspension was obtained.

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Killing and Fixing of Nematodes: Killing of nematodes by hot water treatment and fixing in formalin glycerol fixative was used followed by starrng the fixed nematode population /200cc soil sample was done in a multi chambered counting disc under a stereoscopic binocular microscope according to [1]. Infected roots were stained in cotton blue lacto phenol solution and observed for the presence of nematodes.

Community Analysis: Communities of plant parasitic nematodes were analysed for computing absolute frequency, relative frequency, absolute density, relative density and prominence value as per the following formulae given by [2].

1. Absolute frequency = [Number of samples containing a species / Number of samples collected] × 100

2. Relative frequency = [Frequency of species / Sum of frequency of all species] × 100

3. Absolute density = Number of individuals per unit of soil.

4. Relative density = [Number of individuals of a species in a sample / Total of all. individual of a sample] × 100

5. Prominence value (PV) = Absolute Density $\sqrt{\text{Absolute Frequency}}$

Results and Discussion

During the year 2015-2017, 240 soil samples were scooped from the rhizosphere of various fruit plants like; jackfruit, litchi, mango and sapota in different places of Odisha. After processing the soil samples through Cobb's sieving and decanting technique followed by Modified Baermann's technique clear nematode suspension was obtained. The nematode suspension includes various plant parasitic nematodes. Community structure of plant parasitic and free living nematodes associated with these fruit plants in different places from Bhubaneswar has been presented in the Table-1 and Table-2.

The analysis of nematodes communities revealed the association of 12 nematode species with these fruit crops. Among the different plant parasitic nematodes, *Hoplolaimus indicus*, was highest frequency of occurrence (168), followed by *Tylenchorhynchus mashhoodi* (164), *Rotylenchulus reniformis* (152), *Hemicriconemoides mangiferae* (84) and the least or lowest frequency of occurrence *Pratylenchus coffeae*(20), with the absolute frequency higher in *Hoplolaimus indicus* (70%) followed by *Tylenchorhynchus mashhoodi* (68.33%), *Rotylenchulus reniformis* (63.33%), *Hemicriconemoides mangiferae* (35%) and the lowest absolute frequency in *Pratylenchus coffeae*(8.33%). Relative frequency of *Hoplolaimus indicus* was recorded maximum (12.14%), followed by *Tylenchorhynchus mashhoodi* (11.85%), *Rotylenchulus reniformis* (10.98%), *Hemicriconemoides mangiferae* (6.07%) and the lowest frequency recorded in *Pratylenchus coffeae* (1.45%). *Rotylenchulus reniformis* occurred in high densities, which was (120.63) nematodes per 200cc soil followed by *Tylenchorhynchus mashhoodi* (108.97), *Hoplolaimus indicus* (40.76), *Hemicriconemoides mangiferae* (32.10),

Helicotylenchus dihystera (20) and the lowest density found in *Aphelenchus avenae* (6.36). Among these plant parasitic nematodes *Rotylenchulus reniformis* was found above pathogenic level which cause disease incidence in fruit crops in different places of Odisha. Other nematode species reflected low densities which was low pathogenic level. Highest relative density was recorded in *Rotylenchulus reniformis* (25.54%) followed by *Tylenchorhynchus mashhoodi* (23.07%), *Hoplolaimus indicus* (8.63%), *Hemicriconemoides mangiferae* (6.80%), *Helicotylenchus dihystera* (4.23%) and lowest found in case of *Aphelenchus avenae* (1.35%).

In consideration to prominence value of plant parasitic nematodes *Rotylenchulus reniformis* exhibited highest prominence value (96) followed by *Tylenchorhynchus mashhoodi* (90.08), *Hoplolaimus indicus* (34.10), *Hemicriconemoides mangiferae* (18.99), *Helicotylenchus dihystera* and *Xiphinema insigne* having the same prominence value (7.75), *Caloosia heterocephala* (4.41), *Aphelenchus avenae* (2.72) and *Pratylenchus coffeae* found the lowest prominence value as (2.08). So far as the free living nematodes are concerned *Dorylaimids* were having higher frequency of occurrence (240) with absolute frequency (100%) followed by *Mononchid* (86.67%), *Rhabditid* (75%). *Dorylaimid* was also having highest density (65.06) followed by *Mononchid* (29.73) and *Rhabditid* (13.40). Among nematodes encountered from 240 soil samples, overallly *Dorylaimid* (PV=65.06) and *Mononchid* (PV=27.68) were adjudged as the most frequent nematodes but, *Rotylenchulus reniformis* was found the most predominant species in context to density of prominence value. In consideration to the study of nematodes in jackfruit 5 plant parasitic nematodes and 3 free living groups altogether 8 genera were reported. This finding is in agreement with [7] reporting the same 8 genera in Jackfruit, but they have not studied the community analysis. Hence *Tylenchorhynchus mashhoodi* is more prominent as plant parasitic nematodes. But first time jackfruit was reported worldwide as a host of *Meloidogyne entorolobii* in China according to [10]. But here no such cases were found. In context to litchi crop it was evident that 6 plant parasitic nematodes and 3 free living group of nematodes were associated with litchi crop where *Hemicriconemoides mangiferae* was the most prominent species. This result is in agreement with the findings of [8, 12]. While studying the association of nematodes in mango it was noticed that 7 plant parasitic and 3 free living nematodes were associated with mango. *Rotylenchulus reniformis* recorded as the most prominent species followed by *Tylenchorhynchus mashhoodi*. [4, 9, 11] also reported very high population of *Rotylenchulus reniformis* and *Hemicriconemoides mangiferae* in mango crop. Nematode associated with the rhizosphere of sapota indicated that free living *Dorylaimids* happened to be the most prominent species followed by *Hoplolaimus indicus*. *Aphelenchus avenae* was found the least nematode species. According to [13] *Meloidogyne enterolobii* spp was found in case of sapota crops but as a poor host, but in this Odisha condition there is total absent of this *Meloidogyne* spp. that actually indicates as the non host quality of sapota to this species.

Table 1: Occurrence and distribution of nematode species associated with different big fruit trees of Odisha

S. No	Name of the Fruit crops	No. of sample collected	Soil sample containing nematode species											
			Aa	Ch	Hd	Hm	Hi	Pc	Rr	Tm	Xi	D	M	R
1	Jack fruit	60	0	0	12	0	60	0	44	48	28	60	52	52
2	Litchi	60	16	0	24	40	36	0	36	40	0	60	48	48
3	Mango	60	16	20	0	28	44	0	52	36	20	60	52	52
4	Sapota	60	12	20	0	16	28	20	20	40	0	60	56	28
	Total	240	44	40	36	84	168	20	152	164	48	240	208	180

Aphelenchus avenae (Aa), *Caloosia heterocephala* (Ch), *Helicotylenchus dihystrera* (Hd), *Hemicriconemoides mangiferae* (Hm), *Hoplolaimus indicus* (Hi), *Pratylenchus coffeae* (Pc), *Rotylenchulus reniformis* (Rr), *Tylenchorhynchus mashhoodi* (Tm), *Xiphinema insigne* (Xi), *Dorylaimid* (D), *Mononchid* (M), *Rhabditid* (R).

Table 2: Prominence, frequency of occurrence and population density of nematodes associated with different big fruit trees of Odisha

S. No.	Nematode species	Total no. of samples collected	No. of samples containing the species	Absolute frequency	Relative frequency	Absolute density	Relative density	Prominence value
1	<i>Aphelenchus avenae</i>	240	44	18.33	3.18	6.36	1.35	2.72
2	<i>Caloosia heterocephala</i>	240	40	16.67	2.89	10.80	2.29	4.41
3	<i>Helicotylenchus dihystrera</i>	240	36	15.00	2.60	20.00	4.23	7.75
4	<i>Hemicriconemoides mangiferae</i>	240	84	35.00	6.07	32.10	6.80	18.99
5	<i>Hoplolaimus indicus</i>	240	168	70.00	12.14	40.76	8.63	34.10
6	<i>Pratylenchus coffeae</i>	240	20	8.33	1.45	7.20	1.52	2.08
7	<i>Rotylenchulus reniformis</i>	240	152	63.33	10.98	120.63	25.54	96.00
8	<i>Tylenchorhynchus mashhoodi</i>	240	164	68.33	11.85	108.97	23.07	90.08
9	<i>Xiphinema insigne</i>	240	48	20.00	3.47	17.34	3.67	7.75
10	<i>Dorylaimid</i>	240	240	100.00	17.34	65.06	13.77	65.06
11	<i>Mononchid</i>	240	208	86.67	15.03	29.73	6.29	27.68
12	<i>Rhabditid</i>	240	180	75.00	13.01	13.40	2.84	11.60
				576.67	100.00	472.35	100.00	

Conclusion

So, *Rotylenchulus reniformis* was adjudged as the most prominent species in mango, *Tylenchorhynchus mashhoodi* in jackfruit, *Hemicriconemoides mangiferae* in litchi and *Dorylaimids* in sapota. While, *Rotylenchulus reniformis* was considered as the most prominent species as a whole in all fruit crops. Similarly least prominent species was recorded in *Aphelenchus avenae* in litchi, mango, sapota and jackfruit altogether in 4 fruit crops, but *Pratylenchus coffeae* was considered as the least prominent species.

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