

Original Research Article

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Association of Nematodes with Fruit Crops in Bhubaneswar, India

Pranaya Pradhan*, Mukesh Kumar Patra and Niranjana Kumar Sahoo

Department of Nematology, OUAT, Bhubaneswar, Odisha, India

*Corresponding author

ABSTRACT

A survey was carried out to study the distribution of plant parasitic nematodes associated with fruit crops of Bhubaneswar- The capital of state Odisha, India. Around 240 soil samples were collected from the rhizosphere of fruit crops; cashew nut, guava, papaya and lime across the different places of Bhubaneswar. Nematodes were isolated by Cobb's sieving and decanting method followed by modified Baermann's funnel technique. Communities of plant parasitic nematodes were analysed. The analysis of nematode community revealed the association of 13 nematode species with these fruit crops. *Rotylenchulus reniformis* was found above pathogenic level which cause disease incidence in fruit crops in different places of Bhubaneswar. Other nematode species reflected low densities which were below pathogenic level. In consideration to prominence value of plant parasitic nematodes *Rotylenchulus reniformis* exhibited highest Prominence value(207.85), followed by *Helicotylenchus dihystra* (36.08), *Tylenchorhynchus mashhoodi* (21.52), *Hoplolaimus indicus* (19.77), *Meloidogyne spp*(11.66) and *Aphelenchus avenae* found the lowest prominence value as (3.74). So far as the free living nematodes are concerned *Dorylaimids* were having the highest frequency of occurrence (232) with absolute frequency (96.67%) followed by *Rhabditid* (93.33%) and *Mononchid* (80%). *Dorylaimid* was also having highest density (52.68) followed by *Rhabditid* (36.64) and *Mononchid* (23.79).

Keywords

Community analysis,
Prominence value,
Fruit crops,
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Introduction

India ranks as the second largest producer of fruits after China. It has emerged as the largest producer of fruits like mango banana, sapota, papaya, and acid lime as well as plantation crops like coconut, arecanut, and cashewnut. Apart from that, new crops like kiwi fruit, olive and oil palm have been successfully introduced for commercial cultivation in the country. Despite the

augmentation of fruit and vegetable production in the country, major constraints in production of fresh fruits and vegetables are non-availability of quality seeds or planting materials, inadequate irrigation, lack of integrated nutrient management, huge post-harvest losses and risk of pests and diseases. 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 twelve.3% (\$157 billion dollars) worldwide. Out of that \$40.3 million is reportable from Republic of India.

The alarming problem of citrus nematode (*Tylenchulus semipenetrance*) in citrus at Aligarh, Root knot nematode (*Meloidogyne incognita*) and citrus nematode in pomegranate in Maharashtra, devastation of banana crop due to wide spread attack of *Radopholus similis* in Tamilnadu, Karnataka and Andhrapradesh gear up for a preliminary investigation of nematode survey with various fruit crops such as cashewnut, guava, lime, papaya from the localities of Bhubaneswar. Since study of nematodes in fruit plants is few and far between (Ray and Das, 1989), so it was planned to study the association of nematodes in fruit crops of Bhubaneswar- the capital of state Odisha.

Materials and Methods

A survey was conducted from different localities of Bhubaneswar, Odisha during the year 2015-2017 to determine the presence of various plant parasitic nematodes associated with certain fruit crops. Requisite soil samples were collected and processed within a week after collection. Subtotal of 240 soil samples were collected from certain plants belongs to fruit crops; such as cashewnut, guava, lime, papaya in different localities placed under the circulance of Bhubaneswar (The city of Temples) Odisha, India.

Cobb's sieving and decanting method was done for the extraction of the nematodes followed by Baermann's funnel technique (Southey, 1986) and nematodes suspension was obtained. Killing of nematodes and fixing in formalin glycerol fixative was used followed by counting the fixed nematode population /200 cc soil sample was done in a multi chambered counting disc under a stereoscopic binocular microscope and

identification of nematodes done by observing the nematode morphology and characteristics. Infected roots were stained in cotton blue lacto phenol solution and observed for the presence of nematodes. 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 (Norton, 1978).

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
= [No. of individuals of a species in a sample / Total of all individual of a sample] × 100
5. Prominence value (PV) = Absolute Density / √Absolute Frequency

Results and Discussion

During the year 2015-2017, 240 soil samples were scooped from the rhizosphere of various fruit plants like cashew nut, guava, lime, papaya in different localities of Bhubaneswar, Odisha. After processing the soil samples through Cobb's sieving and decanting technique (Cobb, 1918) 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 nematode community revealed the association of 13 nematode species with these fruit crops. Among the different plant parasitic nematodes *Rotylenchulus reniformis* was highest frequency of occurrence (196), followed by *Hoplolaimus indicus* (104), *Tylenchorhynchus mashhoodi* (84), *Helicotylenchus dihystra* (80) and the least frequency of occurrence *Meloidogyne spp.* (20).

With the absolute frequency higher *Rotylenchulus reniformis* (81.67%), followed by *Hoplolaimus indicus* (43.33%), *Tylenchorhynchus mashhoodi* (35%), *Helicotylenchus dihystra* (33.33%) and the least absolute frequency *Meloidogyne spp.*(8.33%). Relative frequency of *Rotylenchulus reniformis* was recorded maximum (14.33%), followed by *Hoplolaimus indicus* (7.60%), *Tylenchorhynchus mashhoodi* (6.14%), *Helicotylenchus dihystra* (5.85%) and the least relative frequency found in *Meloidogyne spp.*(1.46%). *Rotylenchulus reniformis* occurred in high densities, which was (230) nematodes per 200cc soil followed by *Helicotylenchus dihystra* (62.50), *Meloidogyne spp.* (40.40), *Tylenchorhynchus mashhoodi* (36.38), *Hoplolaimus indicus* (30.03) and the lowest density found in *Aphelenchus avenae* (8.73). Among the plant parasitic nematodes *Rotylenchulus reniformis* was found above Pathogenic level which cause disease incidence in fruit crops in different places of Bhubaneswar. Other nematode species reflected low densities which were below pathogenic level. Highest relative densities was recorded in *Rotylenchulus reniformis* (39.65%) followed by *Helicotylenchus dihystra* (10.77%), *Meloidogyne spp.* (6.96%), *Tylenchorhynchus mashhoodi* (6.27%), *Hoplolaimus indicus* (5.18%) and the lowest density found in *Aphelenchus avenae* (1.50%). In

consideration to prominence value of plant parasitic nematodes *Rotylenchulus reniformis* exhibited highest Prominence value (207.85), followed by *Helicotylenchus dihystra* (36.08), *Tylenchorhynchus mashhoodi* (21.52), *Hoplolaimus indicus* (19.77), *Meloidogyne spp.*(11.66) and *Aphelenchus avenae* found the lowest prominence value as (3.74).

So far as the free living nematodes are concerned *Dorylaimids* were having the highest frequency of occurrence (232) with absolute frequency (96.67%) followed by *Rhabditid* (93.33%) and *Mononchid* (80%). *Dorylaimid* was also having highest density (52.68) followed by *Rhabditid* (36.64) and *Mononchid* (23.79).

Among nematodes encountered from 240 samples, overall *Dorylaimid* (PV=51.79) and *Rhabditid* (PV=35.40) were as the most frequent nematodes but *Rotylenchulus reniformis* was the most prominent species in context to density of Prominence value. As regards to cashewnut, *Aphelenchus avenae*, *Hoplolaimus indicus*, *Rotylenchulus reniformis*, *Tylenchorhynchus mashhoodi* as plant parasitic nematodes and *Dorylaimids*, *Mononchids* and *Rhabditids* as free living nematodes were reported. Among them *Dorylaimid* was the most Prominent species followed by *Rhabditids* and *Tylenchorhynchus mashhoodi*. But (Orisajo, 2012) while surveying seven localities in North Central Nigeria found ten plant parasitic nematodes when *Meloidogyne spp.*, *Helicotylenchus coffeae* and *Radopholus spp.* were wide spread in all localities and *Rotylenchulus reniformis* in three locations. But *Rotylenchulus reniformis* in cashewnut as per the current result was found in Nine locations. The variation might be due to various edaphic factors.

Table.1 Occurrence and distribution of nematode species associated with different fruit crops in localities of Bhubaneswar, Odisha, India

SL. No	Name of the Fruit crops	No. of sample collected	Soil sample containing nematode species(No.)												
			Aa	Ch	Hd	Hm	Hi	Ms	Pc	Rr	Tm	Xi	D	M	R
1	Cashewnut	60	24	-	-	-	28	-	-	36	40	-	52	52	52
2	Guava	60	20	12	20	8	16	20	36	44	28	20	60	40	52
3	Lime	60	-	16	24	24	28	-	16	56	-	16	60	48	60
4	Papaya	60	-	16	36	12	32	-	-	60	16	16	60	52	60
	Total	240	44	44	80	44	104	20	52	196	84	52	232	192	224

(*Aphelenchus avenae* (Aa), *Caloosia heterocephala* (Ch), *Helicotylenchus dihystra* (Hd), *Hemicriconemoides mangiferae* (Hm), *Hoplolaimus indicus* (Hi), *Meloidogyne spp.*(Ms) *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 fruit crops in Bhubaneswar, Odisha

Sl. 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	3.22	8.73	1.50	3.74
2	<i>Caloosia heterocephala</i>	240	44	18.33	3.22	20.90	3.60	8.95
3	<i>Helicotylenchus dihystra</i>	240	80	33.33	5.85	62.50	10.77	36.08
4	<i>Hemicriconemoides mangiferae</i>	240	44	18.33	3.22	13.63	2.35	5.84
5	<i>Hoplolaimus indicus</i>	240	104	43.33	7.60	30.03	5.18	19.77
6	<i>Meloidogyne spp.</i>	240	20	8.33	1.46	40.40	6.96	11.66
7	<i>Pratylenchus coffeae</i>	240	52	21.67	3.80	12.61	2.17	5.87
8	<i>Rotylenchulus reniformis</i>	240	196	81.67	14.33	230.00	39.65	207.85
9	<i>Tylenchorhynchus mashhoodi</i>	240	84	35.00	6.14	36.38	6.27	21.52
10	<i>Xiphinema insigne</i>	240	52	21.67	3.80	11.84	2.04	5.51
11	<i>Dorylaimid</i>	240	232	96.67	16.96	52.68	9.08	51.79
12	<i>Mononchid</i>	240	192	80.00	14.04	23.79	4.10	21.28
13	<i>Rhabditid</i>	240	224	93.33	16.37	36.64	6.32	35.40
				570.00	100.00	580.13	100.00	

So far as association of nematodes in guava was concerned guava was the only fruit crop where all ten plant parasitic and three free living nematodes were reported. This corroborates the findings of (Khan *et al.*, 2007), who also reported ten plant parasitic nematodes. Moreover *Rotylenchulus reniformis* was adjudged with most prominent species. But the present results contradicts to (Ansari and Khan, 2012) who made extensive survey of plant parasitic nematodes in 14 localities of Aligarh and found *Meloidogyne* spp. as the most prominent spp, followed by *Hoplolaimus* spp. Climate of Aligarh and the varieties of guava differ from the Odisha climate and the varieties of guava might have contributed variations in prominence of different plant parasitic nematodes.

With respect to nematode diversity in lime, seven plant parasitic nematodes and three groups free living nematodes altogether ten genera were recorded. This is in consonance with the results of (Vyas *et al.*, 2008), who also surveyed lime crop reporting 8 genera of nematodes. The present report contradicts the results of (Ganguly, 1988), who found high density of *Xiphinema basiri* and moderate population of *Rotylenchulus reniformis*. This might have resulted because *Rotylenchulus reniformis* is more adopted than *Xiphinema* spp. in Odisha, but in Northern state *Xiphinema* spp. might be more adopted compared to *Rotylenchulus reniformis*.

In context to association of nematodes in papaya, it was observed that seven plant parasitic and three groups of free living nematodes were found in the rhizosphere of papaya. *Rotylenchulus reniformis* obtained 100% Absolute frequency, considering this species as the most prominent nematode, followed by *Helicotylenchus dihystera*, the least prominent nematode being *Xiphinema insigne*, *Rotylenchulus reniformis* as the most prominent species was also reported by (Mc

Sorley, 1992), (Castillo and Barcina,1993), (Ganguly *et al.*, 1995) and (Sayeed *et al.*, 2008).

It is concluded that, *Rotylenchulus reniformis* is adjudged as the most prominent species in guava, lime, papaya and *Dorylaimids* in cashewnut. Similarly least prominent species was recorded as *Hemicriconemoides mangiferae* in guava, *Xiphinema insigne* in lime and papaya, *Aphelenchus avenae* in cashewnut, but altogether in four fruit crop *Aphelenchus avenae* was considered as the least prominent species.

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