Survey and identification of plant parasitic nematodes associated with citrus in Dibrugarh district

Abstract:

The present investigations was were carried out to know determine the occurrence and distribution of plant parasitic nematodes associated with citrus plants of different citrus orchards in Dibrugarh district. Soil sample were collected from the different citrus orchards of seven blocks from Dibrugarh district. Eight genera of plant parasitic nematodes were found to be associated with citrus plants of Dibrugarh district. Genera of plant parasitic nematodes recorded were namely *Tylenchulus*, *Hoplolaimus*, *Helicotylenchus*, *Tylenchorhynchus*, *Meloidogyne*, *Xiphinema*, *Paratylenchus* and also nematodes genera found under criconematids.

Community analysis of plant parasitic nematodes revealed that the genus *Hoplolaimus* ranked first in relative frequency, absolute frequency, absolute density, relative density and prominence value. Genus *Helicotylenchus* ranked second in absolute density, relative density and prominence value and genus *Tylenchorhynchus* ranked third in case of absolute density absolute frequency and prominence value. Results shown that *Tylenchulussemipenetrans* ranked second in absolute frequency and relative frequency and fourth in prominence value.

NB:Your abstract should contain at least two lines introduction, method of sample collection, nematode extraction, results and result interpretations. Specify the number of orchard from which samples were collected within the blocks in Diburugard district. This abstract should be one paragraph statement and not two as seen here.

KEY WORDS: Survey , community structure, citrus orchard , nematodes

Introduction

Population densities of plant parasitic nematodes vary greatly in time and space under the influence of a complex of abiotic and biotic factors in their niche. The host growth, temperature, moisture and some physicochemical properties of the soil have been identified as the most important factors responsible for the spatial heterogeneity in nematode population

densities both horizontally and vertically in the soil profile as well as with time (Norton, 1979).

Chona *et al.*(1966) reported that *T.semipenetrans* is widely distributed in India and its association with decline of the tree has been recorded in Punjab, Delhi, Assam,Rajasthan, Orissa, West Bengal, Kerala and Maharastra. Phukan and Sarmah(1983) recorded high population of *T.semipenetrans* from Dibrugarh district. The high population of nematode was also recorded from Karbi Anglong district(Anon.,1985). Sinha(1986) recorded presence of citrus nematode *T.semipenetrans*in five district of Assam. (Cachar, Kamrup, Jorhat, Sivasagar, Dibrugarh). Sinha(1986;1988) reported that the citrus nematode, *T. semipenetrans* was as high as 38,000per 200g and 1842 per 250g of soil respectively in Tinisukia district. Singh (1997) recorded that maximum population of citrus nematode during the month of January in Vidarbha region of Maharastra.Crozzoli*et al.* (1998)surveyed the main citrus growing areas ofVenezuela and collected a total of 1110 soil and root sample and analyzed. They found that thirty four species were associated with citrus and among them *T.semipenetrans* was mosteconomically important and wide spread sp.. Bark *et al.*(2005) carried out a survey to know the frequency of occurrence of both root-knot nematodes *Meloidogyne* sp., and citrus nematode *T.semipenetrans*(Cobb,1913) in the new reclaimed lands in three different governorates in Egypt. Results revealed that percentage of occurrence of *Meloidogyne* sp.,was 96.26% in the surveyed fields while *T.semipenetrans* was 85.18%. Nandwana*et al*.(2005) recorded that five phyto-nematodes were associated with citrus trees in orchards and nurseries in and around Jhalawar district, and among them *T.semipenetrans*was predominantly and most widely prevalent with highest prominence value followed by *Pratylenchus* sp.; *Helicotylenchus indicus*; *Rotylenchulus reniformis*and *Hoplolaimus indicus* respectively.

Zalpuri *et al.*(2013)surveyedoccurrence of important plant-parasitic nematodes associated with citrus crops during 2008-2009 inJammu Regionand they found that *Meloidogyne javanica, Hoplolaimus*sp., *Xiphinema*sp., *Pratylenchus*sp., *T.semipenetrans*were mostly associated with the citrus crop. Anon.(2013) surveyed for the plant parasitic nematode associated with citrus growiing areas of Tinisukiya district. Soil and root samples were collected randomly from the different khasi mandarin orchards. Results revealed that seven species of plant parasitic nematodes wereassociated with khasi mandarin plants the Ibrahim Said K. *et al.* (2016) reported that the root knot nematode (*Meloidogyne*sp.), *Tylenchulus*sp., *Xiphenema*sp., *Rotylenchus*sp., *Pratylenchus*sp.,

*Longidorus*sp., *Tylenchulus*sp. and *Radhopholus* sp. were most common on citrus trees in Lebanon.

Very little work has so far been done on citrus crop in Assam , except work done by Phukan and Sarmah (1983); on survey of citrus nematode in Dibrugarh district, Assam. Therefore present investigation is an attempt to study the plant parasitic nematode associated with citrus and to study community structure of soil inhabiting nematodes in citrus orchards of Dibrugarh district of Assam**.**

NB: The references here are too old, insert resent references. The introduction should also contain the relevance of citrus to the people of Dibrugarh district and the effects of plant parasitic nematodes on the sustainability of citrus which could have necessitated the study.

Materials and Methods

Roving survey was carried out to know the different plant parasitic nematodes associated with citrus in Dibrugarh district .Soil samples including root were collected from the rhizosphere of various citrus plants. Each bulk sample was constituted of several sub samples. Samples were collected randomly and all relevant information was recorded at the time of collection of samples. The samples were transferred to laboratory and stored in refrigerator at 4°C till the extraction of nematode was made. The extraction of nematode from soil samples were done by modified Cobb's sieving and decanting technique (Christei and Perry 1951) and extraction of nematode from roots by Baermann funnel technique. The killing and fixing of nematodes were done in 8% hot formalin.

3.20. Community analysis of plant parasitic nematode

Community analysis of plant parasitic nematode was done by using the methods given by Norton, (1978).

3.21. Absolute frequency is expressed as a percentage

$$\text{Absolute frequency} = \frac{\text{Number of samples containing a species}}{\text{Number of samples collected}} \times 100$$

NB: Specify the number of soil and roots samples collected. Specify number of sub samples gotten from the bulk samples. Specify how long the samples were stored in the refrigerator. Specify the

number of orchard from which samples were collected within the blocks in Diburugard district. Every step taken in the cause of the study should be specified.

Results and Discussion

Eight genera of plant parasitic nematodes were recorded from the rhizosphere of citrus plants in different citrus orchards of Dibrugarh district.

The nematode genera recorded from seven blocks of Dibrugarh district were *viz.*, *Hoplolaimus*sp.,*Helicotylenchus*sp.,*Tylenchorhynchus*sp.,*Paratylenchus*sp.,*Tylenchulussemipenetrans, Meloidogyne* sp.,*Xiphinema*sp.andCriconematids.(Table-1.)

High population of *T. semipenetrans* was recorded from citrus growing areas of Dibrugarh district (Phukon and Sarmah; 1983) and from Karbi Anglongdistrict.(Anon 1985). Sinha (1986) recorded presence of citrus nematode, *T.semipenetrans* in five district of Assam.Anon. (2013)recorded seven genera of plant parasitic nematodes from the rhizosphere of khasi mandarin in Tinsukia district.Crozzoli*et al.*(1998) surveyed the main citrus growing areas of Venezuela and reported that 34species were associated with citrus including *Hoplolaimus*sp.,*Helicotylenchus*sp.,*Tylenchorhynchus*sp.,*Paratylenchus*sp.,*Tylenchulussemipenetrans, Meloidogyne* sp., *Xiphinema*sp.andCriconematids.

5.2 Community analysis of plant parasitic nematodes

In the present investigation, Out of eight genera recorded, *Hoplolaimus* sp was found to be the most frequently occurred plant parasitic nematode with an absolute frequency of 59.73 percent, the next most frequently occurring nematode was *Tylenchulussemipenetrans*(51.00%), followed by *Helicotylenchus* sp. (48.32) *Tylenchorhynchus* sp. (42.95%) *Paratylenchus*sp.(40.26%) *Meloidogyne*sp.(28.85%), *Xiphinema*sp. (26.17%) and Criconematids (21.47%) (Table)

In relative frequency *Hoplolaimus* sp. ranked first with 18.73 percent followed by *Tylenchulussemipenetrans*(16.00%), *Helicotylenchus* sp. (15.15%), *Tylenchorhynchus* sp. (13.47%), *Paratylenchus* sp. (12.63%). Three nematode species *viz*. *Meloidogyne* sp., (9.05) *Xiphinema* sp. (8.21) and Criconematids (6.73) occupied the last position in respect of relative frequency. (Table2).

It The result is revealed that *Hoplolaimus* sp has had the highest absolute density and relative density (22.59 and 20.82% respectively) followed by *Helicotylenchus* sp. (18.64 and 17.18%), *Tylenchorhynchus* sp. (17.45 and 16.09%), *Tylenchussemipenetrans*(15.36 and 14.16%), *Paratylenchus* sp. (14.20 and 13.09%), *Meloidogyne* sp.(8.52 and 7.85%), *Xiphinema* sp. (7.00 and 6.45%) and Criconematids (4.69 and 4.32%). Considering both frequencies and densities,

prominence values for all the nematodes were calculated. *Hoplolaimus* sp. was found to be the most prominent with a prominence value of (174.58) followed by *Helicotylenchus* sp. (119.57), *Tylenchorhynchus* sp. (114.36), *Tylenchulussemipenetrans*(109.69), *Paratylenchus* sp. (90.10), *Meloidogyne* sp. (45.76), *Xiphinema* sp. (35.80) and Criconematids (21.73).

*Hoplolaimus*sp. is the most frequently recordedspecies with relative frequency of 18.73%, absolute density of 22.59 per cent, relative density 20.82 percent. Genus *Helicotylenchus* ranked second in absolute density 18.64 per cent and rlelative density 17.18 per cent and genus *Tylenchorhynchus* ranked third in absolute density 17.45 per cent and relative density 16.09 per cent and *Tylenchulussemipenetrans* ranked forth in absolute density 15.36 per cent and relative density 14.16 per cent. It is revealed that *Hoplolaimus*sp. has had the highest prominence value of 174.58 followed by *Helicotylenchus*sp., *Tylenchrhynchus*sp. and *Tylenchulus*sp. which were recorded as 119.57, 114.36, 109.69 respectively. The highest absolute frequency recorded in *Hoplolaimus*sp. which was 59.73 per cent followed by *Tylenchulussemipenetrans* 51.00 per cent, *Helicotylenchus*sp. 48.32 per cent and *Tylenchrhynchus*sp. 42.95 per cent.

Nandwana*etal*.(2005) recorded that five phyto-nematodes were associated with citrus trees in orchards and nurseries in and around Jhalawar district, and among them *Tylenchulus*semipenetrans was predominantly and most widely prevalent with highest prominence value followed by *Pratylenchus* sp.; *Helicotylenchusindicus*; *Rotylenchulusreniformis* and *Hoplolaimusindicus*respectively. Rathour*et al.* (2010) made a study on community structure of plant parasitic and mycetophagus nematodes from different cereals, oilseed, fruit, pulse, cash and medicinal plants in Madhya Pradesh. Among the plant parasitic nematodes , *Meloidogyneincognita* was found to be the most frequently occurring with the highest absolute frequency(50), followed by *Rotylenchulusreniformis*(40.38), *Helicotylenchusdihystera*(23). The maximum absolute density was recorded for *R.reniformis* followed by *H. dihystera* and *Tylenchorhynchus indicus*. The highest prominence value was recorded for *M.incognita*(17.12), followed by *H. dihystera*(13.78) and *Hoplolaimus indicus*. Zalpuri*etal*. (2013) recorded the frequency of few plant parasitic nematodes associated with citrus, to be *viz*.*Meloidogyne javanica*, *Hoplolaimus*sp., *Xiphenema*sp., *Pratylenchus*sp. and *Tylenchulussemipenetrans* in Jammu Region. Among them *Xiphinema*sp., *Pratylenchus*sp. and *Hoplolaimus*sp. were most abundant and frequently occurring nematodes. They also recorded that *Xiphenema* was

predominantly predominant and most widely prevalent with highest prominence value i.e. of 20, followed by *Hoplolaimus*sp.

Table -1.Plant parasitic nematodes associated with citrus orchards in Dibrugarh district

Name of district	No. sample Collected	Nematode species	Soil		Root	
			Nematode population range	Frequency range	Nematode population range	Frequency range
Dibrugarh	149	*Hoplolaimus*sp	0-80	59.73		
		*Helicotylenchus*sp	0-70	48.32		
		*Tylenchorhynchus*sp	0-80	42.95		
		*Paratylenchus*sp	0-70	40.26		
		Tylenchulussemipenetrans	0-50	51.00	0-50	28.57-66.66
		*Meloidogyne*sp	0-50	28.85		
		*Xiphinema*sp	0-50	26.17		
		Criconematids	0-40	21.47		

Table 2. Population of different plant parasitic nematodes associated with citrus in Dibrugarh district

Sl. No	Block	Total no of sample collected	Citrus orchards	Nematode	Population range in 250 cc soil	Average population	Frequency (%)
1	Tingkhong	8	Korangani	*Tylenchulussemipenetrans*	0-40	17.5	62.5
				*Tylenchorhynchus*sp.	0-80	46.25	75
				*Hoplolaimus*sp.	20-60	36.25	100
				Criconematids	0-30	11.25	50
		8	Nemupathar	*Tylenchulussemipenetrans*	0-50	25	62.5
				*Tylenchorhynchus*sp.	20-70	28.75	75
				*Hopolaimus*sp.	20-70	42.5	100
				*Helicotylenchus*sp.	0-40	15	62.5
				*Meloidogyne*sp.	0-50	22.5	62.5
		6	Tingkhongchariali	*Tylenchulussemipenetrans*	0-30	18.33	66.66
				*Paratylenchus*sp.	20-70	45	100
				*Xiphinema*sp.	0-40	21.66	66.66
				*Meloidogyne*sp.	0-30	16.66	66.66
2	Jaipur	8	Powalipathar(1)	*Tylenchulussemipenetrans*	0-50	30	75
				*Tylenchorhynchus*sp.	30-70	42.5	100
				*Xiphinema*sp.	0-50	21.25	62.55
				*Helicotylenchus*sp.	0-60	36.25	75
				*Meloidogyne*sp.	0-50	20	62.5
		7	Powalipathar(2)	*Tylenchulussemipenetrans*	0-50	24.28	71.42
				*Paratylenchus*sp.	0-30	14.28	71.42
				*Hoplolaimus*sp.	30-60	41.42	100

				*Helicotylenchus*sp.	0-40	18.57	57.14
		5	Asabam	*Helicotylenchus*sp.	20-60	42	100
				*Hoplolaimus*sp.	20-50	38	100
				Meloidogyne sp.	0-30	22	80
				*Paratylenchus*sp.	0-30	12	60
Sl. No	**Block**	**Total no of sample collected**	**Citrus orchards**	***Nematode***	**Population range in 250 cc soil**	**Average population**	**Frequency (%)**
		3	Tanti pathar	*Tylenchorhynchus*sp.	20-40	30	100
				*Helicotylenchus*sp.	0-30	16.66	66.66
				*Xiphinema*sp.	0-50	33.33	100
				*Hoplolaimus*sp.	0-40	22.5	100
3	Barboruah	5	Dulia	*Hoplolaimus*sp.	20-80	46	100
				*Paratylenchus*sp.	20-50	36	100
				*Tylenchorhynchus*sp.	0-60	24	80
				*Meloidogyne*sp.	0-40	16	60
		7	Dibuwal(1)	*Tylenchulussemipenetrans*	0-50	27.14	71.42
				*Helicotylenchus*sp.	30-70	42.85	100
				*Hoplolaimus*sp.	0-60	22.85	71.42
				Criconematids	0-30	11.42	42.85
				*Xiphinema*sp.	0-30	8.57	42.85
		7	Dibuwal(2)	*Tylenchulussemipenetrans*	0-40	15.71	57.14
				*Tylenchorhynchus*sp.	20-80	42.85	100
				*Hoplolaimus*sp.	20-70	40	100
				*Xiphinema*sp.	0-40	14.28	57.14
		4	Changmaigohaingaon	*Helicotylenchus*sp.	30-70	45	100
				*Paratylenchus*sp.	20-40	27.5	100
				Criconematids	0-30	15	75
				*Meloidogyne*sp.	0-40	17.5	50
4	Tengakhat	7	Abhaypuria(1)	*Tylenchulussemipenetrans*	0-50	21.42	71.42

				*Tylenchorhynchus*sp.	0-60	35.71	85.71
				*Hoplolaimus*sp.	20-80	41.42	100
				*Meloidogyne*sp.	0-50	20	57.14
		7	Abhaypuriya (2)	*Tylenchulussemipenetrans*	0-40	11.42	57.14
				*Tylenchorhynchus*sp.	Oct-70	40	100

Table-3. Community analysis of different plant parasitic nematodes associated with citrus in Dibrugarh district

Nematodesspecies	Absolute density	Relative density(%)	Absolute frequency(%)	Relative frequency(%)	Prominence value
*Tylenchulus*semipenetrans	15.36	14.16	51.00	16	109.69
Hoplolaimus sp.	22.59	20.82	59.73	18.73	174.58
*Helicotylenchus*sp.	18.64	17.18	48.32	15.15	119.57
Tylenchorhynchus sp.	17.45	16.09	42.95	13.47	114.36
*Paratylenchus*sp.	14.20	13.09	40.26	12.63	90.10
*Meloidogyne*sp.	8.52	7.85	28.85	9.05	45.76
*Xiphinema*sp.	7.00	6.45	26.17	8.21	35.80
Criconematids	4.69	4.32	21.47	6.73	21.73
Total	**108.45**		**318.75**		

NB: The discussion is not explicit. Rewrite. Do well to present the resul, suggest why such result and compare it with previous references. Rework the references.

References

Anonymous, (1985). Biennial report of AICRP project on Nematode pests of crops and their control, Jorhat Centre, page 13. Presented the VIIth Workshop of AICR Project on Nematode Pests of Crops and Their Control at Sukhadia University, Udaypur, Rajasthan on 14-16th May, 1985.

Anonymous (2013). Annual Report of AICRP on Tropical fruits held in 18th Group meeting of AICRP on Tropical Fruits at Venkataramannagudim (8-11 Feb 2013)

Christie, J.R. and Perry, V.G. (1951). Removing nematodes from soil. *Proc. Helminth Soc. Wash*. **18**: 106-108.

Crozzoli, R.; Lamberti, F.; Greco, N. and Rivas, D. (1998). Plant parasitic nematode associated with citrus in venezeulea. *Nemato. l Medit.* **26**: 31-58

, Norton, D.C. (1978). Ecology of plant parasitic nematodes. Wiley and Sons, New York, pp. 143-147.

Phukan, P.N. and Sarma, D.K. (1983).Plant parasitic nematodes associated with citrus in Assam. *J. Res. Assam Agril.Univ*. **1**(b): 66-71.

Singh, B. (2004). Control of*CitrusNematode,TylenchulusSemipenetrans* in Nagpur Mandarin Orchard. *Indian J. Nematol*; **34**(1): 70.

Sinha, A. K. and Chawla, M.L (1985). Plant parasitic nematode associated with trees with reference to citrus nematode. In: *Proc. IVth Nat. Citrus Seminar*. Ranchi, pp.125-131.

Sinha, A.K. (1986). The citrus nematode *Tylenchulussemipenetrans* Cobb,1913. In: *Proc. IIIrd Nat. Citrus Seminar*. Salt Lake *City, Calcutta*, pp.96-102.

Zalpuri, L.; Tara J.S. and Singh, V.K. (2013).Plant Parasitic Nematodes Associated with Citrus Plantations in Jammu Region. *Indian J. Nematol***43**(2): 217-219.

Key: 1.Delete every word highlighted in yellow in the body of the work

2. Insert the words highlighted in red

3. NB: highlighted in red should be taking note while rewriting this manuscript.