

Original Research Article

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Spatial and Temporal Distribution of Plant Parasitic Nematodes in Eastern Vidarbha Zone, India

N. V. Lavhe^{1*}, D. B. Undirwade¹, Nandini Gokte-Narkhedkar² and A. V. Kolhe¹

¹Department of Entomology, College of Agriculture, Nagpur, Dr. PDKV, Akola, India

²ICAR-CICR, Nagpur, India

*Corresponding author

ABSTRACT

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A survey was conducted for Eastern Vidarbha region of Maharashtra state which aimed to provide a map of the status of plant parasitic nematodes in the region. More than 266 Soil samples were collected from 44 talukas of 4 districts covering 19 crop systems. About 16 genera of plant parasitic nematodes were recorded from the samples. Predominant ones recorded in all the districts were *Rotylenchulus*, *Hoplolaimus*, *Helicotylenchus*, *Pratylenchus*, *Meloidogyne*, *Tylenchulus* and *Tylenchorhynchus* were prominently recorded in all the districts. Whereas genera *Hemicycliophora*, *Psilenchus*, *Radopholus*, *Ditylenchus*, *Xiphinema* and *Criconema* were recorded sporadically. All these nematode genera showed higher prominence values while Shannon index and Shannon evenness index indicated uniform trend of richness and evenness in all the talukas of eastern Vidarbha region.

Introduction

There are numerous estimates of the economic importance of nematodes in crop production on a world wide and individual country basis, but precise estimation of losses is lacking. Systematic studies on prevalence and distribution have not been done for Vidarbha region of Maharashtra state. Nematodes are of major importance to agricultural crops as environment is congenial for nematode

population build up. Importance of nematodes as disease causing entities have often been overlooked. Symptoms caused due to nematode infestation are non-specific and mistaken for nutritional deficiency ones. Nematode damage to crops is dependent on nematode density in soil. Damage caused by nematodes gets manifested only when nematode populations cross threshold level of economic damage. Therefore, Studies on prevalence of plant parasitic nematode is

important to estimate role of nematodes in agricultural crops.

Vidarbha is one of the five regions of Maharashtra state comprising of eastern, western and central vidarbha. Vidarbha having eleven districts is divided into two subdivisions i.e. Amravati and Nagpur subdivisions.

About 58% of forest cover of Maharashtra State is in Vidarbha region. Forest percentage is much more in eastern part i.e. in Bhandara & Gondia (51.07%), Chandrapur (46.4%), Gadchiroli (94.49%).

The percentage forest cover is 38.27% as against the national policy of 33%. The overall level of ground water development in the region is only 34 %.

In different regions of the Maharashtra state the nematodes reported in 1978,1984 and 1990 were root knot nematode (*Meloidogyne incognita*) and reniform nematode (*Rotylenchulus reniformis*) on cotton, pulses and fruit crops; the citrus nematode (*Tylenchulus semipenitrans*) on sweet orange and mandarins and burrowing nematode (*Radopholus similis*) on banana.

Whereas, the harmful nematodes identified are cyst nematodes i.e. *Heterodera zea* on maize, *Heterodera cajani* on pigeonpea and *Heterodera sorghi* on sorghum, respectively (Anonymous, 2010).

Materials and Methods

The survey was conducted for 04 districts of Eastern Vidarbha zone of Nagpur division. The soil samples were collected from each taluka and evaluated for presence of plant parasitic nematodes. This study will provide a map of the status of plant parasitic nematodes in the region.

Experimental details

The soil samples were collected from different cropping systems at different locations in the Vidrabha region during the respective seasons and analysed at Nematology Laboratory, Central Institute for Cotton Research, Nagpur.

Collection of soil sample for plant parasitic nematodes

Representative soil samples were collected from different agroecosystems i.e. pigeon pea, paddy, vegetables, sugarcane, forest trees, pomegranate, beetlevine, chilli, turmeric, banana etc.

The sample was taken from the rhizosphere area of the crop. The soil sample were taken from depth of approximately 0-15 or 30 cm using a hand shovel/small kudal.

For extraction of nematodes from soil sieving and decanting technique developed by Dr. N.A.Cobb (1918) was followed using the material i.e. Two plastic pan, 5 sieves (18, 60,100, 200, 350 mesh), 250ml beakers, aluminium wire mesh molded in a shape which can be placed on Petri-plate, facial tissue paper, petriplates.

Extraction of Plant parasitic nematodes was done by Cobb's Sieving and Decanting Technique. Nematodes were identified based on morphological characters visible under stereobinocular microscope. Identification was confirmed under compound microscope. Statistical analysis was done by analysing population of nematodes using the following indices and factors.

$$\text{Shannon Evenness Index (E)} = \frac{H}{\ln S}$$

$$\text{Shannon Diversity Index(H)} = - \sum_{i=1}^S p_i \ln p_i$$

Where,

P- The proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found(N).

Ln- Natural log. Σ - Sum of the calculations s- Number of species

The population densities of nematode species in the samples were calculated using the formulae (Norton, 1978).

Absolute frequency
 No. of samples containing a species
 ----- x100
 No. of samples collected

Relative frequency
 Frequency of a species
 ----- x100
 Sum of frequencies of all spp.

Relative Density
 No. of individuals of a species in a sample
 ----- x100
 Total of all individuals in a sample

Absolute Density
 No. of individuals of a species in a sample
 ----- x100
 Volume or mass or units of the sample

Prominence value
 Absolute density X
 $\sqrt{\text{Absolute frequency}}$

 100

Morphological Characterization was done by preparing slides by picking individual nematodes (Juveniles or adults) singly and

placed it on glass slide, and comparing the characters observed with the characters recorded in the Identification keys for agriculturally important plant parasitic nematodes developed by CIMMYT, Mexico and others, and from books.

Results and Discussion

The soil samples were collected from each taluka and evaluated for presence of plant parasitic nematodes. This study will provide a map of the status of plant parasitic nematodes in the region

Experimental findings

The investigations were carried out to study the prevalence and distribution of plant parasitic nematodes in Eastern Vidarbha region.

In view of the importance of the plant parasitic nematodes causing losses to the different agricultural crops, the occurrence of different plant parasitic nematodes in Eastern Vidarbha region were assessed by survey and collection of soil samples and analysing it in the laboratory.

Prevalence and distribution (Spatial and temporal) of plant parasitic nematodes in Eastern Vidarbha region

All the 04 districts of EVZ were surveyed and the 266 samples were evaluated for the presence of plant parasitic nematodes. About 16 genera of plant parasitic nematodes from 04 districts were reported.

The genera *Rotylenchulus*, *Hoplolaimus*, *Helicotylenchus*, *Aphelenchoides*, *Pratylenchus*, *Meloidogyne*, *Tylenchulus*, *Paratylenchus*, *Hirschmanniella* and *Tylenchorynchus* was prominently recorded in all the districts. Whereas genera

Hemicyclophora, *Psilenchus*, *Radophilus*, *Ditylenchus*, *Xiphinema* and *Criconema* were recorded in 1 district each. The population recorded was analysed for 05 factors and 2 indices which represent the intensity, prevalence and the distribution of the population in the region (Table 1–4).

Absolute and Relative frequency of Plant parasitic nematodes

Gondia district recorded absolute and relative frequency *Helicotylenchus*, *Hoplolaimus*, *Pratylenchus*, *Tylenchulus*, *Meloidogyne*, *Hirschmanniella*, *Paratylenchus*, *Rotylenchulus* was most prominent in almost all districts followed by *Aphelenchoides* and *Tylenchorynchus*. Gadchiroli district recorded absolute and relative frequency highest for genera *Helicotylenchus* followed by *Hoplolaimus*, *Pratylenchus*, *Tylenchulus*, *Rotylenchulus*, *Aphelenchoide*, *Hirschmanniella*, *Meloidogyne*, *Ditylenchus*, *s Paratylenchus* and *Radophilus*.

Absolute and relative frequency recorded for Bhandara district was highest for genera *Helicotylenchus* followed by *Tylenchulus*, *Pratylenchus*, *Hoplolaimus*, *Rotylenchulus*, *Hirschmanniella*, *Aphelenchoides*, *Meloidogyne*, *Paratylenchus*, *Tylenchorynchus* and *Xiphinema*. In Chandrapur district the absolute and relative frequency recorded highest for genera *Tylenchulus* followed by *Helicotylenchus*, *Pratylenchus*, *Rotylenchulus*, *Hoplolaimus*, *Aphelenchoides*, *Hirschmanniella*, *Meloidogyne*, *Paratylenchus*, *Cricone*, *Hemicyclophora*, *Psilenchus* and *Tylenchorynchus*.

Free living nematodes i.e. *Aporcelaimus*, *Longidorus*, *Acrobelus*, *Aporcelaimellus*, *Dorylaimida*, *Mononchus*, *Cephaobus*, *Acrobolaidus*, *Rhabditonema*, *Dorylaimus*, were recorded in varying numbers in all the

districts of Eastern vidarbha region.

Absolute and relative density of plant parasitic nematodes

Gondia district recorded absolute and relative density highest for genera *Pratylenchus* followed by *Helicotylenchus*, *Hoplolaimus*, *Tylenchulus*, *Meloidogyne*, *Hirschmanniella*, *Rotylenchulus*, *Paratylenchus*, *Aphelenchoides* and *Tylenchorynchus*.

Absolute and relative density recorded for Gadchiroli district was highest for genera *Helicotylenchus* followed by *Hoplolaimus*, *Tylenchulus*, *Hirschmanniella*, *Aphelenchoide*, *Rotylenchulus*, *Pratylenchus*, *Meloidogyne*, *Tylenchorynchus*, *Ditylenchus* and *Radophilus*.

Bhandara district has recorded highest absolute and relative density for genera *Helicotylenchus* followed by *Pratylenchus*, *Tylenchulus*, *Hoplolaimus*, *Hirschmanniella*, *Rotylenchulus*, *Meloidogyne*, *Aphelenchoides*, *Paratylenchus*, *Tylenchorynchus* and *Xiphinema*. In Chandrapur district the absolute and relative density recorded highest for genera *Tylenchulus* followed by *Pratylenchus*, *Helicotylenchus*, *Rotylenchulus*, *Hoplolaimus*, *Aphelenchoides*, *Hirschmanniella*, *Meloidogyne*, *Paratylenchus*, *Cricone*, *Hemicyclophora*, *Psilenchus* and *Tylenchorynchus*.

Prominence value of Plant parasitic nematodes in districts of Eastern Vidarbha zone

Gondia district recorded prominence value highest for genera *Helicotylenchus* followed by *Pratylenchus*, *Hoplolaimus*, *Tylenchulus*, *Meloidogyne*, *Hirschmanniella*, *Rotylenchulus*, *Paratylenchus*, *Aphelenchoides* and *Tylenchorynchus*.

Table.1 Absolute & Relative frequency percent of Plant parasitic nematodes in different districts of Eastern Vidarbha region

S. No.	Genera	Gondia		Gadchiroli		Bhandara		Chandrapur	
		Abs. Freq.	Rel. freq	Abs. Freq.	Rel. freq	Abs. Freq.	Rel. freq	Abs. Freq.	Rel. freq.
1	<i>Helicotylenchus</i>	75.00	13.49	74.47	12.57	100	18.09	61.25	11.75
2	<i>Hoplolaimus</i>	71.15	12.80	63.83	10.77	58.82	10.64	53.75	10.31
3	<i>Pratylenchus</i>	71.15	12.80	61.70	10.41	67.65	12.23	61.25	11.75
4	<i>Tylenchulus</i>	69.25	12.46	55.32	9.34	70.59	12.77	75.00	14.39
5	<i>Meloidogyne</i>	42.31	7.61	30.85	5.21	17.65	3.19	18.75	3.60
6	<i>Hirschmanniella</i>	38.46	6.92	48.94	8.26	50.00	9.04	22.50	4.32
7	<i>Paratylenchus</i>	26.92	4.84	6.38	1.08	8.82	1.60	11.25	2.16
8	<i>Rotylenchus</i>	25.00	4.50	50.00	8.44	50.00	9.04	56.25	10.79
9	<i>Aphelenchoides</i>	23.08	4.15	48.94	8.26	17.65	3.19	38.75	7.43
10	<i>Tylenchorynchus</i>	13.46	12.46	24.47	4.13	70.59	1.60	1.25	0.24
11	<i>Ditylenchus</i>	0	0	24.47	0.54	0	0	00	0
12	<i>Radophilus</i>	0	0	3.19	0	0	0	0	0
13	<i>Xiphinema</i>	0	0	0	0	2.94	0.53	0	0
14	<i>Cricone</i>	0	0	0	0	0	0	11.25	2.16
15	<i>Hemicyclophora</i>	0	0	0	0	0	0	5.00	0.96
16	<i>Psilenchus</i>	0	0	0	0	0	0	5.00	0.96
17	Freeliving	100	17.99	100	16.88	100	18.09	100	19.18

Table.2 Absolute & Relative density percent of Plant parasitic nematodes in different districts of Eastern Vidarbha region

S. No.	Genera	Gondia		Gadchiroli		Bhandara		Chandrapur	
		Abs. den.	Rel. den.	Abs. den.	Rel. den.	Abs. den.	Rel. den.	Abs. den.	Rel. den.
1	<i>Helicotylenchus</i>	1.67	12.86	1.75	12.54	2.15	17.02	1.42	11.09
2	<i>Hoplolaimus</i>	1.56	12.01	1.49	10.64	1.32	10.48	1.30	10.13
3	<i>Pratylenchus</i>	1.67	12.88	0.92	6.56	1.49	11.80	1.45	11.30
4	<i>Tylenchulus</i>	1.40	10.78	1.32	9.41	1.45	11.48	1.69	13.21
5	<i>Meloidogyne</i>	1.08	8.32	0.81	5.81	0.43	3.38	0.48	3.75
6	<i>Hirschmanniella</i>	1.02	7.89	1.31	9.38	1.19	9.46	0.58	4.51
7	<i>Paratylenchus</i>	0.59	4.57	0.15	1.06	0.18	1.43	0.26	2.04
8	<i>Rotylenchus</i>	0.63	4.88	1.22	8.72	1.18	9.39	1.44	11.22
9	<i>Aphelenchoides</i>	0.57	4.36	1.23	8.78	0.35	2.77	0.94	7.33
10	<i>Tylenchorynchus</i>	0.23	2.25	0.55	3.94	0.17	1.37	0.03	0.21
11	<i>Ditylenchus</i>	0	0	0.59	4.23	0	0	0	0
12	<i>Radophilus</i>	0	0	0.08	0.56	0	0	0	0
13	<i>Xiphinema</i>	0	0	0	0	0.07	0.53	0	0
14	<i>Cricone</i>	0	0	0	0	0	0	0.25	1.98
15	<i>Hemicyclophora</i>	0	0	0	0	0	0	0.18	1.38
16	<i>Psilenchus</i>	0	0	0	0	0	0	0.11	0.87
17	Freeliving	2.49	19.18	2.57	18.38	2.53	20.89	2.69	20.98

Table.3 Prominence value of Plant parasitic nematodes in different districts of Eastern Vidarbha region

S.No.	Genera	Gondia	Gadchiroli	Bhandara	Chandrapur
1	<i>Helicotylenchus</i>	0.14	0.15	0.21	0.11
2	<i>Hoplolaimus</i>	0.13	0.12	0.10	0.10
3	<i>Pratylenchus</i>	0.14	0.07	0.12	0.11
4	<i>Tylenchulus</i>	0.12	0.10	0.12	0.15
5	<i>Meloidogyne</i>	0.07	0.015	0.02	0.02
6	<i>Hirschmanniella</i>	0.06	0.09	0.08	0.03
7	<i>Paratylenchus</i>	0.03	0	0.01	0.01
8	<i>Rotylenchus</i>	0.03	0.09	0.08	0.11
9	<i>Aphelenchoides</i>	0.03	0.09	0.01	0.06
10	<i>Tylenchorynchus</i>	0.01	0.03	0.01	0
11	<i>Ditylenchus</i>	0	0.03	0	0
12	<i>Radophilus</i>	0	0	0	0
13	<i>Xiphinema</i>	0	0	0	0
14	<i>Cricone</i>	0	0	0	0.01
15	<i>Hemicyclophora</i>	0	0	0	0
16	<i>Psilenchus</i>	0	0	0	0
17	Freeliving	0.25	0.25	0.26	0.27

Table.4 Population indices of nematode population in different districts of Vidarbha region

S. No.	District	Shannon Diversity Index	Shannon Evenness Index
1	Gondia	2.26	0.94
2	Gadchiroli	2.36	0.90
3	Bhandara	2.17	0.85
4	Chandrapur	2.29	0.87

Prominence value recorded for Gadchiroli district was highest for genera *Helicotylenchus* followed by *Hoplolaimus*, *Tylenchulus*, *Hirschmanniella*, *Aphelenchoide*, *Rotylenchulus*, *Pratylenchus*, *Meloidogyne*, *Ditylenchus*, *Tylenchorynchus*, *Paratylenchus* and *Radophilus*.

Bhandara district has recorded highest prominence value for genera *Helicotylenchus* followed by *Tylenchulus*, *Pratylenchus*, *Hoplolaimus*, *Rotylenchulus*,

Hirschmanniella, *Meloidogyne*, *Aphelenchoides*, *Paratylenchus*, *Tylenchorynchus* and *Xiphinema*.

In Chandrapur district the prominence value recorded highest for genera *Tylenchulus* followed by *Pratylenchus*, *Helicotylenchus*, *Rotylenchulus*, *Hoplolaimus*, *Aphelenchoides*, *Hirschmanniella*, *Meloidogyne*, *Paratylenchus*, *Hemicyclophora*, *Psilenchus* and *Tylenchorynchus*.

Shannon diversity index

Shannon index ranges in the range of 1.5 to 3.5 and rarely it reaches 4.0 which indicates the Shannon index increases as both the richness and the evenness of the community increase.

Shannon index recorded for Gadchiroli is 2.36 followed by, Chandrapur (2.28), Gondia (2.25) and Bhandara (2.17), respectively which indicates that all the districts show a similar trend of richness of nematode genera. (Table 4).

Shannon evenness index (SEI)

Species evenness ranges from zero to one, with zero signifying no evenness and one, a complete evenness. Shannon evenness index recorded highest in Gondia (0.94) followed by Gadchiroli (0.89), Chandrapur (0.87) and Bhandara (0.84) respectively. This indicates that the SEI for all district shows evenness of population of plant parasitic nematode genera in the region. This indicates that the SEI for all district shows evenness of population of plant parasitic nematode genera in the region.

In the studies entitled “Prevalence and distribution of Plant Parasitic nematodes in Eastern Vidarbha region” survey of 04 districts with 44 talukas shows prevalence of about 16 genera of plant parasitic nematodes and about 6-10 genera of free living nematodes.

The prominently occurring genera whose population was prominently high were identified as *Rotylenchulus*, *Meloidogyne*, *Hoplolaimus*, *Pratylenchus*, *Helicotylechus*, *Tylenchulus*, *Tylenchus* etc. About 16 crop systems were sampled and it was noticed that almost all the crop systems were infested with at least 4-5 genera of plant parasitic nematodes. This also indicates the likely to be

increase towards the damage threshold in future.

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