



Research Journal of  
**Parasitology**

ISSN 1816-4943



Academic  
Journals Inc.

[www.academicjournals.com](http://www.academicjournals.com)

## Community Analysis of Plant Parasitic Nematodes Prevalent in Vegetable Crops in District Durg of Chhattisgarh, India

R. Sahu, P. Chandra and A.N. Poddar

Parasitology Lab, School of Studies in Lifesciences, Pandit Ravishankar Shukla University, Raipur (CG), India

Corresponding Author: A.N. Poddar, Parasitology Lab, School of Studies in Lifesciences, Pandit Ravishankar Shukla University, Raipur (CG), India

### ABSTRACT

Community analysis of plant nematodes is an important criterion for assessment of their pathogenic potential in a particular region and identification of hotspots of nematode attack. This investigation involves a study of the community structure of phytonematodes associated with the vegetable crops in the district Durg of Chhattisgarh. Collection of soil and root samples was done during mid cropping season from the rhizosphere of vegetable crops. Extraction of the nematodes was done by Cobb's sieving and decanting method, followed by modified Baermann's funnel technique. Species were identified on the basis of perineal patterns of females. The estimation of nematode population was done in a multichambered counting dish under a stereoscopic binocular microscope. The predominant nematode species were *Meloidogyne incognita*, *M. javanica* and *Meloidogyne* spp. associated with Tomato, Egg plant, Cowpea and Bottle gourd. Others were *Rotylenchulus reniformis*, *Tylenchorhynchus indicus*, *Pratylenchus* spp. *Helicotylenchus* spp. and Tylenchidae. The highest absolute density was of *M. incognita* and *Meloidogyne* spp. followed by *M. javanica*, *M. arenaria* and *R. reniformis* while, *Helicotylenchus* spp. and Tylenchidae had the lowest density. *T. indicus*, *R. reniformis* and *M. javanica* were most frequent while, *Meloidogyne* spp. *Helicotylenchus* spp. and Tylenchidae were the least frequent. Highest prominence value was recorded for *M. javanica*, followed by *M. incognita*, *Meloidogyne* spp. *R. reniformis* and *M. arenaria*. *Pratylenchus* spp. *Helicotylenchus* spp. and Tylenchidae were the least prominent nematodes. This is the first record of various species of phytonematodes associated with vegetable crops in this tribal state.

**Key words:** Community analysis, population density, prominence value, plant parasitic nematodes, vegetable crops, Chhattisgarh

### INTRODUCTION

Chhattisgarh is a newly formed and developing state, partitioned from Madhya Pradesh, a large part of Central India. 2/3rd of the population happens to be tribal. One of the most populated districts of Chhattisgarh is Durg, occupying the southwestern part of Chhattisgarh plain. The 8.95% of its geographical area is covered by dense forests. Durg generally has a dry subtropical weather which is moderate but on a warmer side in the summer season. Agriculture occupies a vital place in the economy of Durg district. Around 62% population of the district is engaged in agricultural activities. The total cultivable area of this district is 8.12 lakh ha which accounts for 64 percent of the total geographical area of the district (<http://durg.gov.in/DistrictProfile.html>).

One of the major pests of high valued agricultural crops are the Phytonematodes which are highly diversified organisms exhibiting variations in distribution patterns. The degree of damage done, depends upon the pathogenic potential and population growth of nematodes which are greatly influenced by their initial population densities (Chandra *et al.*, 2010; Udo and Ugwuoke, 2010). The abundance and distribution of the plant parasitic nematodes in turn are influenced by the soil texture, crop cycle and anthropogenic factors (Chirchir *et al.*, 2008). Thus, community analysis of plant nematodes is important, not only to assess the pathogenic potential of the nematodes in a particular region, but is also an important criteria for identification of hotspots of nematode attack.

Several works have been documented for plant parasitic nematodes associated with various crops in India and include (Senthilkumar and Rajendran, 2005) (Tamilnadu); Joymati and Mema, 2007 (Manipur) and Tiwari *et al.* (2000) and Singh *et al.* (2010) (Madhya Pradesh). Community analysis of plant parasitic nematodes have been studied by Ansari and Ahmed (2000) (Guava), Roy *et al.* (2007) (leguminous vegetable crops, West Bengal) Patel *et al.* (2007) (agricultural crops, Gujarat and Diu union territory, Devi (2007) (Pineapple ecosystem, Meghalaya), Negi *et al.* (2009) (Pine trees, Himachal Pradesh), Nath *et al.* (2009) (Litchi plantations, Tripura) and Srinivasan *et al.* (2011) (Banana, Thanjavoor, Tamilnadu). Nematode diseases reported in various crop plants of Chhattisgarh include-*Aphelenchoides besseyii* in Rice, *Rotylenchulus reniformis* in Pulse crops, *Meloidogyne* spp. and *M. incognita* in vegetable crops and *Radopholus similis* in Banana (Khan *et al.*, 2010). However, no work has yet been reported on the community structure of the phytonematodes associated with crop plants of this tribal state. Hence, this investigation on the community structure of the phytonematodes associated with the vegetable crops in the district Durg of Chhattisgarh may be considered to be the first recorded documentation for this tribal state.

## **MATERIALS AND METHODS**

A survey of Durg district of Chhattisgarh state of India was conducted during October 2009 to March 2010 to determine the plant parasitic nematodes associated with the various vegetable crops. Diseased fields were selected on the basis of above ground symptoms of the crops, such as, wilting, slow growth, stunting and yellowing of leaves. Samples were collected from the galled roots by digging. Soil samples from the associated rhizosphere were collected from a depth of 10-15 cm at the rate of one unit sample per acre crop area. Each unit sample was a composite of 20 cores obtained from four corners and centre of the field. Root soil sub samples (prepared from the unit samples) were stored in polythene bags and kept at 4°C in a refrigerator for not more than 7 days. Altogether 13 soil and root samples were collected during mid cropping season from the rhizosphere of different vegetable crops (tomato, brinjal, beans, cowpea and bottle gourd) from different villages of Durg district and stored. Extraction of the nematodes was done by Cobb's sieving and decanting method, followed by modified Baermann's funnel technique and nematode suspension collected. Infected roots were stained in cotton blue- lacto phenol and observed for the presence of nematodes. The females of root-knot nematodes were dissected out from the galled roots and the perineal sections prepared for species identification. The estimation of nematode population per 10 g root sample and 200 g soil sample was done in a multichambered counting dish under a stereoscopic binocular microscope. The population densities of nematode species in the samples were calculated using the formulae (Norton, 1978):

$$\text{Absolute frequency} = \frac{\text{No. of samples containing a species}}{\text{No. of samples collected}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Sum of frequencies of all spp.}} \times 100$$

$$\text{Relative density} = \frac{\text{No. of individuals of a species in a sample}}{\text{Total of all individuals in a sample}} \times 100$$

$$\text{Absolute density} = \frac{\text{No. of individuals of a species in a sample}}{\text{Volume or mass or units of the sample}} \times 100$$

$$\text{Prominence value} = \frac{\text{Absolute density} \times \sqrt{\text{absolute frequency}}}{100}$$

## RESULTS AND DISCUSSION

**Occurrence and community structure of nematodes on the roots of vegetable crops:** The nematode populations occurring in vegetable crops in district Durg of Chhattisgarh are shown in Table 1. An analysis of nematode communities (Table 2) revealed the presence of 9 species, spread over 6 genera of plant parasitic nematodes. *Tylenchorhynchus indicus* was the most frequently occurring nematode having absolute an frequency of 46.15%, followed by *Meloidogyne javanica* and *Rotylenchulus reniformis* each having 38.46% absolute frequency. These were followed by *Pratylenchus* spp. (30.77%), *Meloidogyne* spp. (23.08%) and *M. incognita* and *M. arenaria* (15.38%) each. *Helicotylenchus* spp. and Tylenchidae were least frequently occurring species (7.69%) each.

Table 1: Occurrence of nematode populations per 200 cc soil+10 g root in vegetable crops in district Durg of Chhattisgarh, India

Village	Crop	Plant parasitic nematodes						Free living nematodes				
		MG	RR	TI	PT	HT	TY	DL	AA	CB	MC	RB
Kotni A	Tomato	100	-	20	-	-	-	-	125	100	-	-
Kotni B	Beans	-	-	-	125	-	-	-	100	50	-	-
Kotni C	Tomato	200 *	125	100	-	-	-	125	100	-	-	-
		400**										
Birejhar	Tomato	2125	-	-	-	-	-	-	100	225	-	-
Jatagharra A	Tomato	-	-	75	-	-	-	75	100	-	25	-
Jatagharra B	Tomato	150	-	-	-	125	50	75	125	-	50	-
Jhola A	Brinjal	550***	-	-	50	-	-	166	116	-	-	-
Jhola B	Tomato	500 (2)	250	110	-	-	-	-	117	-	-	-
Paatan	Beans	-	2000	150	56	-	-	-	200	-	-	-
Jatagharra C	Tomato	1000**	-	-	-	-	-	-	-	-	-	28
		650***										
Kotni D	Cowpea	1750*	200	-	-	-	-	-	-	-	-	-
Jatagharra D	Tomato	125**	-	-	-	-	-	-	215	-	-	-
Kotni E	Bottle gourd	1250**	222	266	44	-	-	-	216	-	-	-

Abbreviations used: *Meloidogyne* spp. (MG), \**M. incognita*; \*\**M. javanica*; \*\*\**M. arenaria*; *Rotylenchulus reniformis* (RR), *Tylenchorhynchus indicus* (TI); *Pratylenchus* spp. (PT); *Helicotylenchus* spp. (HT); Tylenchidae (TY); Dorylids (DL); *A. avenae* (AA); Cephalobid (CB); Mononchids (MC); Rhabditids (RB)

Table 2: Community analysis of plant parasitic nematodes associated with different crops in district Durg of Chhattisgarh

Nematode	Average (Range)	Absolute frequency	Relative frequency	Absolute density	Relative density	Prominence value	Relative prominence value
<i>Meloidogyne incognita</i>	975 (200-1750)	15.38	6.90	487.50	24.72	191.18	19.92
<i>M. javanica</i>	655 (125-1250)	38.46	17.24	327.50	16.60	203.10	21.16
<i>M. arenaria</i>	600 (550-650)	15.38	6.90	300.00	15.21	117.65	12.26
<i>Meloidogyne</i> spp.	791.67 (100-2125)	23.08	10.35	395.84	20.07	190.17	19.82
<i>Rotylenchulus reniformis</i>	559.4 (125-2000)	38.46	17.24	279.70	14.18	173.46	18.07
<i>Tylenchorhynchus indicus</i>	120.17 (20-266)	46.15	20.69	60.06	3.04	40.80	4.25
<i>Pratylenchus</i> spp.	68.75 (44-125)	30.77	13.79	34.38	1.74	19.07	1.99
<i>Helicotylenchus</i> spp.	125	7.69	3.45	62.50	3.17	17.33	1.81
Tylenchidae	50	7.69	3.45	25.00	1.27	6.93	0.72

*M. incognita* and *Meloidogyne* spp. (487.5% and 395.84%), respectively have the highest absolute densities, followed by *M. javanica* (327.5%), *M. arenaria* (300%) and *R. reniformis* (279.7%). These were followed by *Helicotylenchus* spp. (62.5%), *T. indicus* (60.06%), *Pratylenchus* spp. (34.38%) and Tylenchidae (25%). Likewise, the highest relative density was recorded for *M. incognita* and *Meloidogyne* spp. (24.72 and 20.07%, respectively) followed by *M. javanica* (16.60%), *M. arenaria* (15.21%) and *R. reniformis* (14.18%). These were followed by *Helicotylenchus* spp. (3.17%), *T. indicus* (3.04%), *Pratylenchus* spp. (1.74%) and Tylenchidae (1.27%).

Considering both frequencies and densities, the highest prominence value (203.10) was recorded for *M. javanica* followed by *M. incognita* (191.18), *Meloidogyne* spp. (190.17) and *R. reniformis* (173.46). These were followed by *M. arenaria* (117.65), *T. indicus* (40.80), *Pratylenchus* spp. (19.07), *Helicotylenchus* spp. (17.33) and Tylenchidae (6.93).

Singh *et al.* (2010) reported *Meloidogyne incognita* to be the most frequently occurring phytonematode in Madhya Pradesh with the highest absolute frequency (50), followed by *Rotylenchulus reniformis* (40.38) and *Helicotylenchus dihystra* (23). The maximum absolute density was recorded for *R. reniformis* followed by *H. dihystra* and *Tylenchorhynchus indicus* with 205, 121 and 110 individuals per 100 g soil, respectively. The highest prominence value was recorded for *M. incognita* (17.12), followed by *H. dihystra* (13.78) and *Hoplolaimus indicus* (11.20). Patel *et al.* (2007) also recorded highest frequency of *Meloidogyne* species in Diu union territory. Besides, highest frequency, density and prominence value of *R. reniformis*, *M. indica* and *M. javanica* associated with Leguminous vegetable crops in west Bengal have also been recorded by Roy *et al.* (2007). *Hemicriconemoides litchi*, *Rotylenchulus reniformis* and *Meloidogyne incognita* have been found to be the most abundant, frequent, prominent and important nematode species in all of the four litchi plantations in North Tripura district (Nath *et al.*, 2009). In the present case, prominence values of *M. javanica* (203.10) and *M. incognita* (191.18) were found to be highest among all nematodes present, being far greater than the values reported by the above mentioned authors and hence are a matter of grave concern.

Table 3: Predominant plant parasitic nematode species associated with vegetable crops in district Durg of Chhattisgarh

Sl. no.	Crops	Predominant nematode species	Other nematode species
1	Tomato	<i>Meloidogyne incognita</i> , <i>M. javanica</i> , <i>M. arenaria</i> , <i>Meloidogyne</i> spp. <i>Rotylenchulus reniformis</i> , <i>Tylenchorhynchus indicus</i>	<i>Helicotylenchus</i> spp. Tylenchidae
2	Beans	<i>Rotylenchulus reniformis</i> , <i>Tylenchorhynchus indicus</i>	<i>Pratylenchus</i> spp.
3	Brinjal	<i>Meloidogyne arenaria</i>	<i>Pratylenchus</i> spp.
4	Cowpea	<i>Meloidogyne incognita</i> , <i>Rotylenchulus reniformis</i>	
5	Bottle gourd	<i>Meloidogyne javanica</i> , <i>Rotylenchulus reniformis</i> , <i>Tylenchorhynchus indicus</i>	<i>Pratylenchus</i> spp.

Table 4: Hot-spots of nematode infestation in various vegetable crops in district Durg of Chhattisgarh

Crops	Nematode spp./Villages								
	<i>M. incognita</i>		<i>Meloidogyne</i>				<i>Pratylenchus</i> spp.	<i>Helicotylenchus</i> spp.	Tylenchidae
Tomato	Kotni C	Kotni C Jhola B Jatagharra C Jatagharra D	Jatagharra C	Kotni A Birejhar Jatagharra B	Kotni C Jhola B	Kotni A Kotni C Jatagharra A Jhola B	-	Jatagharra B	Jatagharra B
Beans	-	-	-	-	Paatan	Paatan	Kotni B Paatan	-	-
Brinjal	-	-	Jhola A	-	-	-	Jhola A	-	-
Cowpea	Kotni D	-	-	-	Kotni D	-	-	-	-
Bottle gourd	-	Kotni E	-	-	Kotni E	Kotni E	Kotni E	-	-

**Crop-wise distribution:** The predominant plant parasitic nematodes associated with various crops are listed in Table 3. *M. incognita*, *M. javanica*, *M. arenaria* and *Meloidogyne* spp. were found to be predominant on tomato, brinjal, cowpea and bottle gourd; *R. reniformis* on tomato, beans, brinjal, cowpea and bottle gourd and *T. indicus* on tomato, beans, brinjal and bottle gourd. *Helicotylenchus* spp. and Tylenchidae were also found to be associated with tomato; *Pratylenchus* spp. with beans, brinjal and bottle gourd. Khan *et al.* (2010) reported the presence of only *Meloidogyne* spp. and *M. incognita* in vegetable crops of Durg district of Chhattisgarh. The present work additionally reports the presence of *R. reniformis*, *T. indicus*, *Helicotylenchus* spp. Tylenchidae and *Pratylenchus* spp.

**Hot-spots of nematode infestation:** The hot-spots of nematode infestations were identified based on the nematode densities with populations exceeding the damage threshold (>1/100 g soil), in order to map out the possible problem areas Table 4. It was revealed that hot-spots for *M. javanica* were Kotni C, Jhola B, Jatagharra C and D and Kotni E on tomato and bottle gourd crops. Kotni C and Kotni D were the problem areas for *M. incognita* on tomato and cow pea. The hot-spot for *M. arenaria* was at Jatagharra C and Jhola A on tomato and brinjal, respectively. Severe infestation of *Meloidogyne* spp. was observed on tomato in Kotni A, Birejhar and Jatagharra B. The hot-spots for *R. reniformis* were Kotni C and Jhola B for tomato, Paatan for beans, Kotni D for cowpea and Kotni E for bottle gourd. Severe infestation of *T. indicus* was observed on Kotni A, Kotni C, Jatagharra A and Jhola B for tomato, Paatan for beans and Kotni E for bottle gourd. Infestation of *Pratylenchus* spp. was observed on Kotni B and Paatan in beans and Jhola A and Kotni E in brinjal and bottle gourd, respectively. Furthermore, *Helicotylenchus* spp. and Tylenchidae may pose threat to the tomato cultivation in Jatagharra B.

The results obtained in the present case are similar to previous work done by Sao *et al.* (2008), showing highest average population density (2169 nematodes/10 g root and 29993 nematodes/200 cc soil) in the village Funda (Patan). Among the several genera of vegetable crop plants surveyed *Lycopersicon esculentum*, *Dolichus lablab* and *Momordica charantia* showed the presence of root galls with the highest average population density being in *Dolichus lablab* in the month of January. The hot spots of nematode infestations marked in the present case prove beyond doubt that the vegetable crops in district Durg of Chhattisgarh are severely infested with phytonematodes.

## CONCLUSION

The newly formed state of Chhattisgarh has been partitioned from Madhya Pradesh. Crop-wise surveys in some areas of Madhya Pradesh have been conducted by many workers like Ali (1993), Khan *et al.* (1994) and Singh *et al.* (2010). Presence of some nematode diseases have also been reported in various crop plants of Chhattisgarh, such as *Aphelenchoides besseyii* in Rice, *Rotylenchulus reniformis* in Pulse crops, *Meloidogyne* spp. and *M. incognita* in vegetable crops and *Radopholus similis* in Banana (Khan *et al.*, 2010). However, till date no works on population dynamics or community structure of Phytonematodes have yet been documented for any region of Chhattisgarh state except work done by Sao *et al.* (2008). Hence, this work is the first record of phytonematodes associated with crop plants of this state. Most of the species recorded in the present study are highly pathogenic, hence, their occurrence may pose a serious threats to the affected crops and need urgent attention of farmland owners and researchers. Special emphasis must be given to the hotspots of nematode attack identified in the present case.

## ACKNOWLEDGMENTS

Sincere thanks are due to the Division of Nematology, Indian Agricultural Research Institute, New Delhi for guidance in the isolation and identification of nematodes.

## REFERENCES

- Ali, S.S., 1993. Prevalence of plant-parasitic nematodes associated with chickpea in Gwalior district of Madhya Pradesh. *Int. Chickpea Newslett.*, Vol. 28.
- Ansari, M.A. and W. Ahmad, 2000. Community analysis of plant parasitic and predatory nematodes in Guava (*Psidium guajava*) orchard. *Med. Fac. Lanudbouww. Univ. Gent.*, 65: 557-562.
- Chandra, P., R. Sao, S.K. Gautam and A.N. Poddar, 2010. Initial population density and its effect on the pathogenic potential and population growth of the root knot nematode *Meloidogyne incognita* in four species of cucurbits. *Asian J. Plant Pathol.*, 4: 1-15.
- Chirchir, A.K., J.W. Kimenju, F.M. Olubayo and G.K. Mutua, 2008. Abundance and distribution of plant parasitic nematodes associated with sugarcane in Western Kenya. *Asian J. Plant Pathol.*, 2: 48-53.
- Devi, G., 2007. Community analysis of plant-parasitic nematodes in pineapple ecosystem in Meghalaya. *Indian J. Nematol.*, 37: 106-107.
- Joymati, L. and W. Mema, 2007. Association of *Meloidogyne incognita* and other plant parasitic nematodes with different crops of Manipur. *Zoos Print J.*, 22: 2933-2934.
- Khan, M.R., R.K. Jain, R.V. Singh, A. Pramanik and T. Lin, 2010. Economically Important Plant Parasitic Nematodes Distribution Atlas. Directorate of Information and Publications of Agriculture, New Delhi, Pages: 145.

- Khan, T.A., S.T. Khan and S.K. Saxena, 1994. Occurrence of different races of *Meloidogyne incognita* on *Carica papaya* L. in three districts of Madhya Pradesh, India. *Ann. Plant Prot. Sci.*, 2: 46-48.
- Nath, R.C., B.C. Sinha, B. Mukherjee and M.K. Dasgupta, 2009. Community analysis and diversity of plant parasitic nematodes associated with litchi plantations in North Tripura district. *Pest Manage. Horticult. Ecosyst.*, 15: 51-59.
- Negi, S., D.C. Kalia, K.K. Walia, R.K. Walia and H.K. Bajaj, 2009. Community analysis of plant parasitic nematodes associated with rhizosphere of chir pine nurseries and pine trees in natural forests of Himachal Pradesh, India. *Ind. J. Nematol.*, 39: 182-187.
- Norton, D.C., 1978. *Ecology of Plant Parasitic Nematodes*. John Wiley and Sons, New York, ISBN: 9780471031888, Pages: 268.
- Patel, A.D., B.K. Panickar, B.A. Patel and D.J. Patel, 2007. Community analysis of plant parasitic nematodes associated with agricultural crops in Junagadh district of Gujarat and Diu-union territory. *Ind. J. Nematol.*, 37: 68-71.
- Roy, K., A.K. Mukhopadhyay and A. Pramanik, 2007. Occurrence, distribution and community analysis of plant parasitic nematodes associated with leguminous vegetable crops in West Bengal. *Ind. J. Nematol.*, 37: 58-62.
- Sao, R., P. Chandra and A.N. Poddar, 2008. Prevalence of root knot nematode (*Meloidogyne incognita*) infection in vegetable crops in Chhattisgarh. *Bio. Nat.*, 28: 61-67.
- Senthilkumar, T. and G. Rajendran, 2005. Plant parasitic nematodes associated with grapevine in Coimbatore district of Tamil Nadu. *Madras Agric. J.*, 92: 592-595.
- Singh, R.K., D. Jola and G. Sudershan, 2010. Documentation of plant parasitic and beneficial soil nematodes and their communities in madhya pradesh, India. *Indian J. Nematol.*, 40: 66-73.
- Srinivasan, R., S. Kulothungan, P. Sundararaju and C. Govindasamy, 2011. Biodiversity of plant parasitic nematodes associated with banana in Thanjavur district of Tamil Nadu. *Int. J. Plant Anim. Environ. Sci.*, 1: 63-69.
- Tiwari, S.P., I. Vadhera and G.S. Dave, 2000. Burrowing nematode *Radopholus similis* associated with banana crop in Madhya Pradesh. *Ind. J. Nematol.*, 30: 38-41.
- Udo, I.A. and K.I. Ugwuoke, 2010. Pathogenicity of *Meloidogyne incognita* race 1 on turmeric (*Curcuma longa* L.) as influenced by inoculum density and poultry manure amendment. *Plant Pathol. J.*, 9: 162-168.