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Locating Areas of High Density of Plant Parasitic Nematode, *Rotylenchulus* spp. in Vidarbha Region of Maharashtra State, India

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A B S T R A C T

Vidarbha region of Maharashtra comprising of two divisions i.e. Amravati and Nagpur was surveyed for locating high density spots of plant parasitic nematodes, *Rotylenchulus spp.*. About 737 soil samples were collected from 16 crop systems in 119 talukas and evaluated for presence of plant parasitic nematodes. In literature, amongst the genera of plant parasitic nematodes, threshold levels of damage have been standardised for only 5 genera. Mapping of plant parasitic nematodes was done crop ecosystem wise. Reniform nematode, *Rotylenchulus reniformis* was the most prevalent and predominant nematode species. This may be attributed to the fact that major crops of the region viz. Cotton, Soybean and pigeon pea are also good hosts for this nematode. The areas where the population exceeds the threshold of damage (200/100cc soil) for reniform nematode *R. Reniformis* were identified and mapped. Maximum number of samples from Cotton crop showing high population density of reniform nematode was recorded in Yavatmal district followed by Buldhana while population was less in Nagpur and Gadchiroli. For Pigeon pea crop also high density spots were recorded highest in Yavatmal followed by Buldhana and Amravati with lowest in Gadchiroli. Variation in population density may probably be correlated to gradual spread of irrigation availability through drip irrigation.

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. 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.

In areas as Buldhana where cotton is increasingly being grown under drip under intensive cultivation, reniform nematode infestation is being reported (Agro one, 2 Nov, 2016). Root-knot nematode (*M. incognita*) is emerging as major problem in pomegranate growing areas in and around Rahuri. Similarly, burrowing nematodes (*R. similis*) is also being reported from banana growing areas. Survey on various crops grown in polyhouses has reported severe infestation of species like *M. incognita, R. reniformis and Xiphinema sp.* In Pune, Satara, Sangli and Kolhapur districts.(Anonymous, 2010). There is a general lack of awareness of nematodes due to its microscopic size and non-specific symptoms. Symptoms of nematode damage are non-specific and resemble those of nutrient deficiency. Furthermore nematode distribution and damage within a field occurs in patches. Nematode damaged crops infestation appears as irregular patches or streaks that may vary in size, shape, and number. These variations usually reflect the compounding of nematode stress on a plant by such other factors as nutritional denomolies, physical soil differences and irrigation and drainage patterns. Spread of nematodes is aided by irrigation water. Dozens of different genera of plant parasitic nematodes have been reported to spread through irrigation canals. Nematode damage is density dependent. Damage due to nematodes gets manifested only when population crosses damage threshold which vary with nematode species as well as host crop. To create awareness about plant parasitic nematodes, diagnosis of symptoms on plants is first step towards ameliorating losses caused due to nematodes.

Nematode problems are more severe in tropics and horticultural crops, annuals under irrigation and in protected cultivation. Nematode damage is density dependent and gets manifested when population exceeds threshold level of damage.

Materials and Methods

The research work was carried out to Locate areas of High density of plant parasitic nematode, *Rotylenchulus* spp. in Vidarbha region". The survey was conducted for two divisions i.e. Amravati and Nagpur comprising of 119 talukas covering about 9762 kms. The soil samples were collected from each taluka and evaluated for the high density spots of nematode population were determined.

Experimental details

The soil samples were collected from different cropping systems at different locations in the Vidrabha region.

The Samples were collected from different agroecosystems i.e. cotton, pigeon pea, paddy, vegetables, sugarcane, citrus, forest trees, pomegranate, beetle vine, chilli, turmeric, banana etc. which represent the crop ecosystem. These samples were brought to the laboratory and further extraction of nematodes was done by soil sieving and decanting technique developed by Dr. N.A.Cobb (1918) in the Nematology Laboratory, Crop Protection Division, CICR, Nagpur.

Statistical analysis

Shannon Evenness Index (E) = H/Ln S

S

Shannon Diversity Index(H) = - ∑pi ln pi

i=

The population densities of nematode species in the samples were calculated by the formulae given by Norton 1978.

Morphological characterization

Nematodes were killed and fixed by adding equal amount of hot fixative formaldehyde acetic acid (FAA).

Morphometric studies were undertaken for identification and characterisation of nematodes.

Results and Discussion

The survey was conducted for two divisions i.e. Amravati and Nagpur comprising of 119 talukas covering about 9762 kms. The soil samples were collected from each taluka and evaluated for presence of plant parasitic nematodes and high density spots were determined by mapping the nematodes qualitatively and quantitatively crop ecosystem wise.

Experimental Findings

The present investigations for Locating areas of High density of plant parasitic nematode, Rotylenchulus spp. were carried out from all 11 districts and 119 talukas of Vidarbha region. In about 16 crops plant parasitic nematode *Rotylenchulus spp.* were reported. This was the first ever work done in Vidarbha region.

Amongst all the genera *Rotylenchulus, Hoplolaimus, Helicotylenchus, Pratylenchus, Meloidogyne, Tylenchulus, Paratylenchus* was prominently recorded in all the districts.

Crop ecosystem wise mapping of plant parasitic nematodes on the base of prevalence and distribution

On the basis of prevalence and distribution, mapping of plant parasitic nematodes was done crop ecosystem wise. From the mapping the high density spots were identified based on the nematode densities with populations exceeding the damage threshold to point out the possible problem areas with potential damage in Table 1 to 5.

Genera wise high density spots of plant parasitic nematodes

Amongst genera of plant parasitic nematodes isolated and identified. The genera *Rotylenchulus, Hoplolaimus, Helicotylenchus, Pratylenchus, Meloidogyne, Tylenchulus, Paratylenchus* was prominently recorded in all the districts. According to the damage threshold of the nematodes the high density spots were identified. The damage thresholds for genera *Rotylenchulus* (200/100cc soil) (Gokte-Narkhedkar *et al.*, 2004).

From this it was evident that genus *Rotylenchulus spp* has recorded the high density population on 170 spots in 119 talukas comprising of 39 crop ecosystems of Vidarbha region.

Crop wise high density spots

Cotton

It was revealed that high density spots for cotton crop for genera *Rotylenchulus* were 59 from 9 districts with 3 talukas from Nagpur, 12 talukas from Buldhana, 5 talukas from Wardha,04 talukas from Washim, 16 talukas from Yavatmal, 07 talukas from Chandrapur, 3 talukas from Gadchiroli, 5 talukas from Akola and 4 talukas from Amravati.

Pigeonpea

High density spots identified for Pigeon pea crop for genera *Rotylenchulus* were 75 from 11 districts with 14 talukas from Buldhana district, 5 talukas each from Wardha and Akola,4 talukas each from Gondia and Washim, 12 talukas from Amravati, 15 talukas

from Yavatmal, 3 talukas from Nagpur, 7 talukas from Chandrapur and 2 talukas from Bhandara and Gadchiroli each.

Citrus

High density spots where the population has exceeded the threshold level for citrus crop for genus *Rotylenchulus* were at 2 locations in 2 districts 1 taluka each from Wardha and Nagpur.

Brinjal

Genera *Rotylenchulus* recorded 4 spots where the population has exceeded the threshold level from 4 districts with 1 taluka each from Gadchiroli, Gondia, Bhandara and Nagpur.

Soybean

It was revealed that high density spots were identified for soybean crop for genera *Rotylenchulus* were 23 from 6 districts with 10 talukas from Buldhana, 6 talukas from Washim, 3 talukas from akola, 2 talukas from Wardha and 1 taluka each from Amravati and Nagpur respectively.

Chilli/ Wal/ Tomato/ Onion/ Cowpea/ Turmeric

High density spots identified for Chilli crop was Korpana, for Wal crop were Narkhed for genera *Rotylenchulus*. In Tomato crop high density spots were recorded where the population has exceeded the threshold level were in 3 districts with 1 taluka each from Gadchiroli, Wardha and Gondia for genera *Rotylenchulus.* While Onion crop was identified with 1 high density spot each in Nagpur district for genera *Rotylenchulus*. High density spots where the population has exceeded the threshold level were recorded for crop Cowpea were from 3 districts with 1 taluka each from Gadchiroli, Chandrapur and Gondia for genera *Rotylenchulus*. However high density spots with exceeded threshold level were identified for genera *Roylenchulus* from 1 taluka each of Yavatmal Gadchiroli and Gondia district for Turmeric and Bendi crop.

Bhendi/ Cucumber/ Gerbera/ Radish

High density **s**pots for Bhendi where the population has exceeded the threshold level were identified for genera *Rotylenchulus* were 1taluka each from Gadchiroli and Gondia,

In Cucumber crop Gadchiroli district has identified 1 taluka as high density spot for genera *Rotylenchulus,* high density spots where the population has exceeded the threshold level were identified for Gerbera crop for genera *Rotylenchus,* 1 taluka from Gondia district.

Radish crop recorded high density spots for genera *Rotylenchulus,* in 1 taluka of Gadchiroli district.

Table.1 High density spots of plant parasitic nematode *Rotylenchulus spp. in* Vidarbha region

Isolate	District	Nagpur	Buldhana	Wardha	Washim	Yavatmal	Chandrapur	Gadchiroli	Akola	Amravati	Gondia
		1	2	3	4	5	6	7	8	9	10
Rotylen chulus		13	36	14	14	32	16	11	13	17	8

Table.2 High density spots of plant parasitic nematodes *Rotylenchulus spp.* in Districts (No. of talukas)

S.No.	Crop	District	No. of talukas
1	Cotton	Nagpur	3
		Buldhana	12
		Wardha	5
		Washim	4
		Yavatmal	16
		Chandrapur	7
		Gadchiroli	3
		Akola	5
		Amravati	4
2	Pigeonpea	Nagpur	5
		Buldhana	14
		Wardha	5
		Washim	4
		Yavatmal	15
		Chandrapur	7
		Gadchiroli	2
		Akola	5
		Amravati	12
		Gondia	4
		Bhandara	2
3	Citrus	Nagpur	1
		Wardha	1
4	Brinjal	Nagpur	1
		Gadchiroli	1
		Gondia	1
		Bhandara	1
5	Soybean	Nagpur	1
		Buldhana	10
		Wardha	2
		Washim	6
		Akola	3
		Amravati	1
6	Chilli	Chandrapur	1
7	Wal(Dolichos)	Nagpur	1
8	Tomato	Wardha	1
		Gadciroli	1
		Gondia	1
10	Onion	Nagpur	1
11	Cowpea	Chandrapur	1
		Gadciroli	1
		Gondia	1
12	Turmeric	Yavatmal	1
13	Bhendi	Gadchiroli	1
		Gondia	1
14	Cucumber	Gadchiroli	1
15	Gerbera	Gondia	1
16	Radish	Gadchiroli	1

Table.3 Talukawise average population of plant parasitic nematode *Rotylenchulus spp.* in 100gm soil in Cotton crop in Vidarbha region

Isolate	Taluka	Khamgaon	Jalgaon (Jamod)	Sangrampur	Murtizapur	Etapalli	Shegaon	Gondpipri	Aheri	Sindkhedraja	Sironcha	Ner	Deulgaon raja
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Rotylenchulus		470	380	367	360	340	320	320	320	310	300	300	**300**

Isolate	Taluka	Chandur Rly	Umarkhed	Jivati	Warud	Maregaon	Manora	Malkapur	Korpana	Karanja(Lad)	Warora	Mehkar	Kelapur
		13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Rotylenchulus		300	290	288	280	280	280	280	280	280	272	270	**270**

Isolate	Taluka	Kalamb	Ghatanji	Mahagaon	Deoli	Yavat3mal	Telhara	Pandharkawada	Narkhed	Nandura	Motala	Dhamangaon RLy	Chimur
		25	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
Rotylenchulus		270	270	267	260	260	260	260	260	260	260	260	**260**

Isolate	Taluka	Chikhali	Ashti	Zarijamani	Patur	Malegaon	Ralegaon	Wardha	Samudrapur	Arni	Wani	Mangrulpir	Chandrapur
		37	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
Rotylenchulus		260	253	250	250	250	248	247	247	247	240	240	**240**

Isolate	Taluka	Barshitakli	Arvi	Rajura	Risod	Katol	Parseoni	Buldhana	Tiwasa	Balapur (Wadegaon)	Babhulgaon	Darwha
		49	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**
Rotylenchulus		240	240	233	230	230	220	220	210	210	210	200

Table.4 Talukawise average population of plant parasitic nematode *Rotylenchulus spp.* per 100gm soil in Pigeonpea crop in Vidarbha region

Isolate	Taluka	Khamgaon	Deori	Tirora	Shegaon	Jalgaon(Jamod)	Balapur (Wadegaon)	Dhamangaon RLy	Sangrampur	Motala	Warud	Dharni	Achalpur
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Rotylenchulus		390	380	370	370	360	360	340	330	320	320	313	**310**

Isolate	Taluka	Chikhaldara	Korpana	Ralegaon	Mahagaon	Umarkhed	Bhatkuli	Daryapur	Warora	Manora	Nandgaon Khandeshwar	Gondpipri	Ner
		13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Rotylenchulus		308	300	300	300	300	300	296	290	290	290	280	**280**

Isolate	Taluka	Lonar	Nagbhid	Mangrulpir	Malkapur	Wani	Arvi	Risod	Mehkar	Darwha	Kelapur	Chandurbazaar	Tiwasa
		25	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
Rotylenchulus		275	270	270	270	270	260	260	260	260	260	260	**260**

Isolate	Taluka	Amravati	Gadchiroli	Zarijamani	Patur	Murtizapur	Telhara	Sakoli	Maregaon	Ramtek	Wardha	M.Arjuni	Gondia
		37	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
Rotylenchulus		260	250	250	250	250	250	247	247	240	240	240	**240**

Isolate	Taluka	Rajura	Chimur	Malegaon	Karanja (Laad)	Deulgaon raja	Chikhali	Sindkhedraja	Ghatanji	Arni	Ashti	Chamorshi	Pusad
		49	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Rotylenchulus		240	240	240	240	240	240	240	240	240	233	230	**230**

Isolate	Taluka	Buldhana	Parseoni	Samudrapur	Sadak arjuni	Mul	Kalamb	Barshitakli	Tumsar	Nandura	Narkhed	Babhulgaon	Digras	Chandur rly
		61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**
Rotylenchulus		227	220	220	220	220	220	220	210	210	200	200	**200**	**200**

Table.5 Talukawise average population of plant parasitic nematode *Rotylenchulus spp.* per 100gm soil in various crops in Vidarbha region

S.no.	Crop	Taluka	Damage threshold (200/100cc soil)
1	Citrus	Ashti	240
		Kalmeshwar	230
2	Brinjal	Hingna	220
		Armori	220
		M.arjuni	200
		Sindewahi	200
3	Soybean	Amravati	370
		Jalgaon(Jamod)	360
		Balapur(wadegaon)	340
		Mangrulpir	300
		Motala	300
		Buldhana	300
		Sindkhedraja	280
		Malkapur	260
		Mehkar	260
		Khamgaon	250
		Karanja	240
		Ashti	240
		Karanja(Laad)	240
		Chikhali	240
		Lonar	240
		Barshitakli	240
		Shegaon	230
		Patur	220
		Washim	210
		Deulgaonraja	210
		Katol	200
		Risod	200
		Malegaon	200
4	Chilli	Korpana	200
5	Wal (Dolichos)	Narkhed	220
6	Tomato	Etapalli	270
		Samudrapur	240
		Morgaon arjuni	240
7	Onion	Hingna	210
8	Cowpea	Gadchiroli	340
		Bhadravati	260
		Goregaon	200
9	Turmeric	Mahagaon	200
10	Bhendi	Gadchiroli	260
		Gondia	200
11	Cucumber	Gadchiroli	270
12	Gerbera	Gondia	200
13	Radish	Mulchera	200

On the basis of prevalence and distribution, mapping of plant parasitic nematodes was done crop ecosystem wise. From the mapping the spots were identified based on the nematode densities with populations exceeding the damage threshold to point out the possible problem areas. The damage thresholds for genera *Rotylenchulus* (200/100cc soil) (Gokte-Narkhedkar *et al.*, 2004).

Rotylenchulus reniformis recorded high frequency and density in all the 11 districts, 119 talukas and 39 crops of Vidarbha region.

Major crops infested by *Rotylenchulus* are brinjal, cabbage, chilli, cotton, citrus, pigeon pea, soybean, okra, pomogranate, radish, beetle vine, turmeric etc. *Rotylenchulus* is a polyphagus pest which has very wide host range.

Along with major infestation it also prevails with other forest and plantation crops also. Cotton is a very good and preferred host crop of this nematode (Gokte-Narkhedkar *et al.*, 2006).

The high density spots were determined by mapping the nematodes crop ecosystem wise. On the basis of prevalence and distribution, mapping of plant parasitic nematodes was done crop ecosystem wise.

Most predominant nematode genera was *Rotylenchulus* and based on the population density hot spot areas for Cotton crop were recorded highest in Yavatmal followed by Buldhana with lowest in Nagpur and Gadchiroli.

Most predominant nematode genera was *Rotylenchulus* and based on the population density hot spot areas for Pigeon pea crop were recorded highest in Yavatmal followed by Buldhana and Amravati with lowest in Gadchiroli and Bhandara. However Genera Rotylenchulus has shown predominance in Buldhana and Washim districts with 10 and 6 high density spots respectively in Soybean crop. Out of 19 genera, only five of the nematode genera has defined damage threshold levels and other genera so far not having defined level of damage threshold due to limited research work around the globe. The areas where the populations exceeding the damage threshold of nematode species *Rotylenchulus spp.* were also pointed out for genera *Rotylenchulus* (200/100cc soil) which constitute all crop ecosystems and districts of Vidarbha region.

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