Association and community structure of plant parasitic nematodes in horticultural crops

ABSTRACT

Aims: Study the occurrence, diversity and community structure of plant parasitic nematodes associated with different production blocks of Horticultural Orchard of Biswanath College of Agriculture, Assam Agricultural University.

Study Design: Random sampling and community analysis

Place and Duration of Study: Biswanath College of Agriculture, Biswanath Chariali, Assam during March 2024 to August 2024.

Methodology: Soil samples were collected from different production blocks of Horticultural Orchard of Biswanath College of Agriculture. From each crop block 10-15 subsamples were collected to make a composite sample. Extraction of nematodes from collected soil samples was done by modified Cobb's sieving and decanting technique followed by Baerman's funnel technique. The plant parasitic nematodes present in the suspension were identified using taxonomic key and nematode population in each sample was counted three times in a multi chambered counting dish under a stereoscopic binocular microscope and mean was taken. Community analysis of plant parasitic nematodes were done by determining absolute frequency (AF), relative frequency (RF), density (D), relative density (RD) and prominence value (PV).

Results: Seven species of plant parasitic nematodes *viz.*, *Meloidogyne* sp, *Helicotylenchus dihystera*, *Hoplolaimus indicus*., *Tylenchorhynchus leviterminalis*., *Xiphinema* sp. and *Pratylenchus* sp., were isolated and identified from soil samples collected from rhizosphere of different production blocks. Analysis of nematode communities revealed that, in fruit block 100% absolute frequency was recorded in case of *H. dihystera*, *H. indicus* and *T. leviterminalis*. In vegetable and floriculture block 100% absolute frequency was recorded in case of *H. dihystera*, *H. indicuas*, *Meloidogyne* sp. and *T. leviterminalis*. *H. dihystera* was found to be most prominent in all the production blocks

Conclusion: In the present study all recorded plant parasitic nematodes may involve in all sorts of interaction with other disease-causing organisms resulting in forming disease complexes. Hence, intensive study regarding management aspects of these nematodes is very essential.

Key words: Community analysis, horticultural crops, plant parasitic nematodes, rhizosphere,

1. INTRODUCTION

Plant parasitic nematodes are considered as major production constraints of successful cultivation of horticultural crops. A number of plant parasitic nematodes have been found to be associated with horticultural crops and reported from different parts of the country [1, 2, 3]. They can cause considerable yield losses in different fruit, vegetable and ornamental crops. In India, overall plant parasitic nematodes cause 21.3% crop losses amounting to Rs. 102,039.79 million

(1.58billion USD) annually; the losses in 19 horticultural crops were assessed at Rs. 50,224.98 million [3].

Nematode infestation in horticultural crops is an acute problem, considering the possible economic losses they may cause. However, some plant parasitic nematodes exhibit high parasitic activity, thereby posing serious threats to growers. In this regard, it is very important to identify the species diversity and the study of community analysis of plant parasitic nematodes. A few extensive surveys on the study of community analysis of plant parasitic nematodes associated with horticultural crops in the country have been already taken by various workers from time to time [4,5,6]. However, very scanty information is available on community structure of plant parasitic nematodes associated with horticultural crops of Assam. Hence, the present investigation was undertaken to determine the community analysis of plant parasitic nematodes associated with the rhizosphere of different production blocks of Horticultural Orchard of Biswanath College of Agriculture, Biswanath, Assam.

2. MATERIALS AND METHODS

A survey was conducted during March 2024 to August 2024 in different production blocks of Horticultural Orchard of Biswanath College of Agriculture, Assam Agricultural University to record the occurrence, diversity and community structure of plant parasitic nematodes. In the survey programme soil samples were collected from different production block (floriculture, fruit and vegetable blocks). From each crop block 10-15 subsamples were collected to make a composite sample. Extraction of nematodes from collected soil samples was done by modified Cobb's sieving and decanting technique followed by Baerman's funnel technique [7]. The plant parasitic nematodes present in the suspension were identified using taxonomic key and nematode population in each sample was counted three times in a multi chambered counting dish under a stereoscopic binocular microscope and mean was taken. Laboratory works were conducted at the Department of Nematology, Biswanath College of Agriculture, Biswanath Chariali, Assam. Community analysis of plant parasitic nematodes were done by determining absolute frequency (AF), relative frequency (RF), density (D), relative density (RD) and prominence value (PV) using the following formulae [8].

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

$$\text{Relative Frequency} = \frac{\text{Frequency of the species}}{\quad} \times 100$$

$$\text{Density} = \frac{\text{Sum of frequencies of all the species}}{\text{Number of individuals of a species counted in all samples}}$$
$$\text{Total number of samples collected}$$

$$\text{Relative density} = \frac{\text{Mean density of the species}}{\text{Sum of mean density of all nematode species}} \times 100$$

$$\text{Prominence value} = \text{Density} \times \sqrt{\text{Absolute frequency}}$$

3. RESULTS AND DISCUSSION

In the present investigation seven species of plant parasitic nematodes *viz*., *Meloidogyne* sp, *Helicotylenchus dihystera*, *Hoplolaimus indicus.*, *Tylenchorhynchus leviterminalis*., *Xiphinema* sp., *Tylenchulus semipenetrans* and *Pratylenchus* sp. were found to be associated with different production blocks (fruit, vegetable, floriculture blocks) of Horticultural Orchard of Biswanath College of Agriculture (Table 1,2&3). Among the plant parasitic nematodes *H. dihystera*, *H. indicus* and *T. leviterminalis* was recorded in all the samples of different production block. *T. semipenetrans* was recorded only in the sample of Assam lemon block, likewise *Pratylenchus* sp. was recorded only in Banana block. In Assam, during the survey programme from the rhizosphere of different vegetable and pulse crops five different plant parasitic nematodes viz., *Meloidogyne incognita, H. dihystera, Hoplolaimus* sp., *Tylenchorhynchus* sp. and *Rotylenchulus reniformis* were recorded [9]. From the rhizosphere of banana in Assam *H. dihystera*, *M. incognita*, *Hoplolaimus* sp. and *T. leviterminalis* were also previously recorded [10]. Survey of tuberose fields of Kamrup, Morigaon and Jorhat district of Assam revealed seven different genera of plant parasitic nematodes *viz*., *M. incognita*, *Helicotylenchus* spp., *Hoplolaimus* spp., *Tylenchorhynchus* spp., *Pratylenchus* spp., *R. reniformis* and criconematids [11].

Analysis of nematode communities revealed that, in fruit block 100% absolute frequency was recorded in case of *H. dihystera*, *H. indicus* and *T. leviterminalis*. In banana cultivation of North Bank Plain Zone of Assam 100% absolute frequency was previously recorded in case of *H. dihystera* [12]. *H. dihystera* had the highest density (245.33) followed by *T. leviterminalis*(140.33). Among the community of plant parasitic nematodes, *H. dihystera* was found to be most prominent with highest prominence value (2453.40) and *Pratylenchus* sp. was the least prominent (4.82) in fruit block. In vegetable and floriculture block 100% absolute

frequency was recorded in case of *H. dihystera*, *H. indicuas*, *Meloidogyne* sp. and *T. leviterminalis*. In floriculture block *H. dihystera* was found to be most prominent (1970) and *H. indicus* was the least prominent (1193). Similarly, in vegetable block *H. dihystera* was found to be most prominent (2530) and *Xiphinema* sp. was the least prominent (521.77).

Table1: Population of plant parasitic nematodes in different fruit block

Fruit ~~Crop~~ block	Nematode Population (200 cc soil)							Total
	Meloidogyne sp.(J_2)	*Helicotylenus dihystera*	*Hoplolaimus indicus*	*Pratylenchus sp.*	*Tylenchorhynchus leviterminalis*	*Tylenchulus semipenetrans*	*Xiphinema* sp.	
Litchi	126	275	136	-	185	-	60	782
Banana	130	300	144	45	180	-	66	865
Guava	190	260	156	-	120	-	-	726
Assam Lemon	-	156	50	-	96	150	-	452
Apple ber	124	231	106	-	139	-	56	656
Minor fruit	100	250	50	-	122	-	-	522

Table2: Population of plant parasitic nematodes in different floriculture bock

floriculture~~Crop~~ block	Nematode Population (200 cc soil)				
	Meloidogyne sp.(J_2)	*Helicotylenus dihystera*	*Hoplolaimus indicus*	*Tylenchorhynchus leviterminalis*	Total
Gerbera	155	208	141	149	653
Tuberose	180	195	108	168	651
Gladiolus	132	188	109	153	582

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Table3: Population of plant parasitic nematodes in different vegetable and spice block

vegetable and spice ~~Crop~~ block	Nematode Population (200 cc soil)

	Meloidogyne sp.(J_2)	*Helicotylenus dihystera*	*Hoplolaimus indicus*	*Tylenchorhynchus leviterminalis*	*Xiphinema* sp.	Total
Okra	216	334	150	149	84	933
Ridgegourd	181	267	120	173	67	808
Dolicosh bean	136	200	180	110	90	716
Turmeric	105	211	98	145	-	559

Table 4: Community analysis of plant parasitic nematodes associated with different production block

Production block	Nematodes	AF (%)	RF (%)	D	RD (%)	PV
Fruit block	*Meloidogyne* sp.	83.33	17.86	111.66	16.74	1019.29
	Helicotylenchus dihystera	100	21.43	245.33	36.77	2453.30
	Hoplolaimus indicus	100	21.43	107	16.04	1070
	Tylenchorhynchus leviterminalis	100	21.43	140.33	21.03	1403.30
	Tylenchulus semipenetrans	16.66	3.57	25	3.75	102.04
	Pratylenchus sp.	16.66	3.57	7.5	1.12	4.82
	Xiphinema sp.	50	10.71	30.33	4.55	214.47
Floriculture block	*Meloidogyne* sp.	100	25	155.67	24.76	1556.70
	Helicotylenchus dihystera	100	25	197.00	31.34	1997.00
	Hoplolaimus indicus	100	25	119.33	18.98	1193.30
	Tylenchorhynchus leviterminalis	100	25	156.67	24.92	1566.70
Vegetable and Spice block	*Meloidogyne* sp.	100	21.05	159.5	21.15	1595
	Helicotylenchus dihystera	100	21.05	253	33.55	2530
	Hoplolaimus indicus	100	21.05	137	18.17	1370
	Tylenchorhynchus leviterminalis	100	21.05	144.25	19.13	1442.5
	Xiphinema sp.	75	15.79	60.25	7.99	521.77

Add legends; AF=Absolute Frequency, RF= Relative Frequency

4. CONCLUSION

The present analysis of the community structure of the plant parasitic nematode indicated that *H. dihystera*, *H. indicus*, *T. leviterminalis* and *Meloidogyne* sp. were found in almost all the production block. These nematodes may involve in all sorts of interaction with other ~~disease causing~~disease-causing organisms like fungi, bacteria and viruses and resulting in forming disease complexes, in which they may play the role of incitant, aggravator, vector and predisposer of plants to secondary attack by other pathogenic organisms. Therefore, intensive study regarding management aspects of these nematodes is very essential to reduce the yield losses caused by them in horticultural crops.

5. FUTURE SCOPE

In future an extensive survey of plant parasitic nematodes associated with horticultural crops popularly grown in Assam and adjoining North Eastern states is very essential to know the emerging nematode pest status as well as distribution pattern and community structure of plant parasitic nematodes.

REFERENCES

1. Anupriya, P., Anita, B., Kalaiarasan, P., & Karthikeyan, G. (2019). Population dynamics and community analysis of plant parasitic nematodes associated with carrot, potato and garlic in the Nilgiris district, Tamil Nadu. *J. Ento. Zool. Stud.*,**7**, 627-630.
2. Arun, A., Shanthi, A., Poornima, K., & Arumugam, ~~T.(~~T. (2019). Occurrence and distribution of plant parasitic nematodes in cabbage growing regions of Tamil Nadu. *Ann. Pl. Protec. Sci*., 27, 289-294.
3. ~~Kumar,V.~~Kumar, V., Khan, M.R. & Walia, R.K.(2020). Crop loss estimations due to plant parasitic nematodes in major crops in India. *Natl. Acad. Sci. Lett.* https://doi.org/10.1007/s40009-020-00895-2.
4. Mahalik, J.K.& Sahoo, ~~N.K.(~~N.K. (2017). Occurrence, distribution and community analysis of plant parasitic nematodes associated with okra in Odisha, India. *Ann. Pl. Protec. Sci*., 25(1), 210-214.
5. Patasani, ~~JitendraJ.~~, Mahalik, J.K., Sahoo, N.K.& Samal, ~~B.K.(~~B.K. (2019). Survey of nematodes associated with flowering plants in Khordha district, Odisha. *Ann. Pl. Protec. Sci*., 27(1), 166-169.
6. Sreeja, P. & Kurien, ~~SusannammaS.~~ (2017). Community structure of plant parasitic nematodes in polyhouse vegetables in Kerala. *Ann. Pl. Protec. Sci*., 25(2), 389-393.
7. Christie, J.R., & Perry, ~~V.G.(~~V.G. (1951). Removing nematodes from soil. *Proc. Helminth. Soc. Wash*., 18, 106-108.
8. Norton, D.C. (1978). Ecology of Plant Parasitic Nematodes. John Willey and Sons, NewYork. pp. 268.
9. Neog, P.P., Kalita, M.K., &Borah, D. (2015). Root-knot and other nematodes infestation on crops of Assam. *Ann. Pl. Protec. Sci*., 23, 194-196.
10. Deuri, A.& Das, D. (2013~~).Effect~~). Effect of some abiotic factors on population dynamics of plant parasitic nematodes around banana rhizosphere. ~~In :~~In: *Abstracts.* National

Seminar on Climate Change and Climate Resillent Agriculture, March 18-19, B. N. College of Agriculture, Biswanath Chariali, Assam. p. 49.
11. Chetia, A., Borah, A., & Mahanta, ~~B.(~~B. (2022). Plant parasitic nematodes associated with tuberose growing areas of Kamrup, Morigaon and Jorhat district of Assam. *The Pharma Innovation Journal*, SP-11(3), 942-945.
12. Neog, ~~P.P.(~~P.P. (2021). Community analysis of plant parasitic nematodes associated with ~~banana(~~banana (*Musa* Spp.) cultivation in north bank plain agro-climatic zone of Assam. *Crop Res*.56(1&2), 20-22.