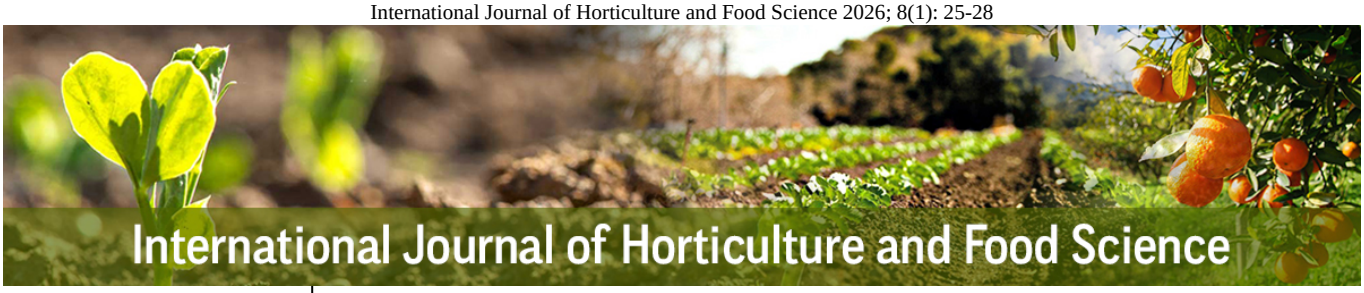

E-ISSN: 2663-1067
P-ISSN: 2663-1075
NAAS Rating (2026): 4.74
www.hortijournal.com
IJHFS 2026; 8(1): 25-28
Received: 10-10-2025
Accepted: 13-11-2025

Anil Kumar
Department of Nematology, CCS Haryana Agricultural University, Hisar, Haryana, India

Vinod Kumar
Department of Nematology, CCS Haryana Agricultural University, Hisar, Haryana, India

SS Mann
Department of Nematology, CCS Haryana Agricultural University, Hisar, Haryana, India

Priyanka Duggal
Department of Nematology, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Vinod Kumar*
Department of Nematology, CCS Haryana Agricultural University, Hisar, Haryana, India

Plant parasitic nematodes: A burning problem in protected cultivation systems in Haryana

Anil Kumar, Vinod Kumar, SS Mann, Priyanka Duggal

DOI: https://www.doi.org/10.33545/26631067.2026.v8.i1a.451

Abstract
Under varying climatic conditions, plant parasitic nematodes (PPNs) cause substantial economic damage to a wide variety of agricultural and horticultural crops. A survey of polyhouses in different districts of Haryana was conducted during 2020-25 to determine the incidence of important PPNs on vegetable crops mainly, cucumber, tomato, chili and bell peppers grown in protected conditions. In this respect, a total of 250 roots and rhizosphere soil samples were collected from the surveyed plants such as cucumber, tomato, chili and bell peppers from different districts (Jind, Kaithal, Bhiwani, Hisar, Fatehabad and Palwal). Soil and root samples were collected from each polyhouse and analyzed mainly for the presence of PPNs. Out of these, 178 samples were found infested withroot-knot nematodes (RKNs) with 71.2% frequency of occurrence. Frequency of occurrence of each species was highly variable from field to field. During the survey, different PPNs genera *viz.*, *Meloidogyne*, *Pratylenchus*, *Rotylenchulus*, *Hoplolaimus*, *Helicotylenchus*, *Tylenchorhynchus* were detected from soil samples. Based on incidence, population density and associated damage on affected crops, *M. incognita* was considered to be the most important parasites of the crops under local condition. The average population density range of RKN was recorded to be 70-670 J2s/200cc soil. The frequency of occurrence of *M. incognita* was 82.5% in Fatehabad, 73.3% in Jind, 70.0% in Hisar, 68.0% in Kaithal, 60.0% in Bhiwani and 50.0% in Palwal district, respectively.

Keywords: Incidence, *Meloidogyne incognita*, plant parasitic nematodes, protected cultivation, vegetable crops

1. Introduction
The adoption of protected cultivation techniques has significantly enhanced vegetable productivity in India, by offering numerous advantages such as extended growing seasons, increased yield and better control over environmental conditions. The most common crops cultivated in polyhouses include vegetables; mainly, tomato, cucumber, capsicums, green beans, beetroot, eggplant, lettuce, sweet peas, chilli, okra, spinach, spring onion, cabbage and chinese leek. Among fruits crops, strawberries, muskmelon, watermelon and grapes; and among ornamentals anthuriums, carnations, gerberas, gladioli, roses, chrysanthemums and orchids are common (Singh, 2016) [14]. Growing of crops in plastic greenhouses has reinvigorated farmers' interest in growing off-season or year-round crops for increased economic gains (Kumar *et al*., 2009) [11]. However, the ecological conditions created in protected houses are propitious to certain pests and diseases, which are not frequently confronted by crops grown in open field cultivation conditions (Sharma *et al*., 2009) [13].
Growing crops under protected cultivation has multifaceted benefits; however, the adoption of sequential cropping pattern in these closed structures has led to the prevalence of soil borne pathogens, plant parasitic nematodes (PPNs) and pest incidence, which became a major hindrance to the sustainable agriculture.
Among PPNs, such as root-knot nematodes (RKNs) and reniform nematodes, can survive in the congenial conditions of higher temperature and humidity present in the protected cultivation structures. The most widespread, economically important, and dominant group of PPNs are the RKNs (Kayani *et al*., 2012) [9].
In India, *Meloidogyne incognita* is the most frequently observed species among the genus followed by *M. javanica* and *M. arenaria* in vegetable cultivation. Moreover, *M. hapla* is known to infest vegetables crops grown in temperate hilly regions. Other PPNs genera also cause significant economic damages, although their impact is often underestimated due to

the indistinct symptoms exhibited by infested plants (Hallmann and Meressa, 2018) [5]. Nematode infestations can cause significant damage to the root systems of plants, leading to reduced water and nutrient uptake, stunted growth and lower yields and symptoms like chlorosis, wilting and stunting will appear after the significant damage. Besides the direct damage, RKNS act as predisposing agent for the entry of soil borne fungal and bacterial pathogens and aggravate the problem still further leading to development of disease complexes.

Prevalence and distribution of PPNs and ecological factors understanding the drivers of the distribution of PPNs community in an area and a specific crop are critical issues for the development of sustainable management strategies. Hence, a comprehensive survey was conducted to evaluate the diversity and distribution of PPNs in the soil rhizosphere of different crops in protected cultivation of different districts of Haryana.

Materials and Methods

A survey of polyhouses in different districts (Jind, Kaithal, Bhiwani, Hisar, Fatehabad and Palwal) of Haryana was conducted during 2020-25 to determine the incidence of important PPNs on vegetable crops mainly, cucumber, tomato, chili and bell peppers.In this respect, a total of 250 roots and rhizosphere soil samples were collected from the surveyed plants such as cucumber, tomato, chili and bell peppers. The samples were collected from individual fields from villages within tehsils (administrative subunit of a district) of each of the six districts. Soil and root samples were collected from each polyhouse and analyzed mainly for the presence of PPNs. These samples were collected from poorly growing plants which showed stunting and chlorosis symptoms on the foliage from a depth of 20-25 cm. Soil samples were collected in polythene bags, labeled, handled and refrigerated at 7-10 ^{0}C before processing. When the samples were being collected, the farmers and villagers were interviewed to collect data on previous crop history, cropping pattern, fertilizer, irrigation and pesticide inputs. Extraction of nematodes from soil samples was done by modified Cobb's sieving and decanting technique (Christie and Perry, 1951) [3]. Genera of important PPNs in the suspension were identified and counted under the stereo binocular microscope. Data on nematode population densities were analysed to assess the average density of each nematode species, and frequency of occurrence in each district. The severity of the infection was recorded on the basis of root-knot index (Table 1).

Table 1: Root-knot index (RKI) on 1-5 scale (Hartman and Sasser, 1985) [6]

No. of galls/plant	Root-knot index (RKI)
No galls	1.0
1-10 galls	2.0
11-30 galls	3.0
31-100 galls	4.0
More than 100 galls	5.0

Results and Discussion

During this study period from 2020 to 2025, it was observed that there is diversity of PPNs associate with crops grown in protected cultivation in different districts of Haryana region. The highest diversity was recorded of RKNs (*Meloidogyne* spp.) from all visited fields of the crops grown in protected cultivation. *Meloidogyne* was the most prevalent and dominant genus in both soil and roots, making them the most widespread nematode genus. A total of 250 soil and root samples were collected from crops grown in protected cultivation (Table 2). Out of these, 178 were found infested with *M. incognita* with 71.2% frequency of occurrence. The results revealed that out of 90 samples from Jind district, 66 were found infested with *M. incognita* with 73.3% frequency of occurrence and density range of 120-540 J2s/200 cc soil. In Fatehabad district, this nematode had 82.5% frequency of occurrence (33 out of 40 samples) with density range of 140-670 J2s/200 cc soil (Table 2). The highest number of RKNs was recovered from Fatehabad district which was identified as the most heavily infested (82.5% frequency of occurrence) followed by Jind district with 73.3% frequency of occurrence. The lowest RKN population was recovered from Palwal district (50.0% frequency of occurrence). Overall in five years surveyed data, a total 119 sample of crops grown in protected cultivation were found aboveeconomic threshold level (ETL) in different districts. During survey, it was observed that cucumber was found very susceptible to the RKN and when plants uprooted there showed innumerable knots on the root systems (Plate 1).

The average population of the RKNs was highest in Fatehabad district (140-670 J2s/200 cc soil) while minimum in Palwal district (70-295 J2s/200 cc soil). The *Tylenchorhynchus* sp. (41.5%) was very widespread and recorded in all the districts sampled.The results are also confirmed by Chandel *et al*., 2010 [2] who surveyed 214 greenhouses compromising of sweet pepper, carnation, cucurbits, tomato and cauliflower and found *M. incognita* to be predominant with a population range from 8-5604 J2s in soil and 15-4288 individuals/5 g of roots. Nine important PPNs genera *viz., Meloidogyne, Pratylenchus, Rotylenchulus, Hoplolaimus, Helicotylenchus* and *Tylenchorhynchus* was detected from soil samples. However, *M. incognita* was found to be the major PPN under protected conditions. Frequency of occurrence of RKN was recorded to be 63.1% and population density range was 30-10000 J2s/200cc soil (Patil *et al*., 2017) [12]. The prominence value was found maximum for RKN in all the vegetable crops *viz.,* tomato, capsicum and cucumber having 592.9, 223.4 and 910.6 J2s/200 cc, respectively. The data also revealed that *M. incognita* absolute frequency in tomato and tomato+capsicum mixed cropping was 100% and in cucumber was 92.9% (Kranti *et al*., 2023) [10].

A total of 40 polyhouses visited and collected 158 root and soil samples during 2 years survey. In results, it was keen observed that all samples of both soil and root were infected with *M. incognita.* After the examination of roots 40 to 142 galls/5 g roots and 26 to 135 egg masses/5 g root of cucumber found in polyhouses of different locations. It was also recorded that 100% occurrence with above ETL of RKN found in visited polyhouses (Bhati and Baheti, 2020) [1]. A survey conducted by Ismail *et al*., 2012 [8] to determine the incidence and distribution of *Meloidogyne* spp. infecting cucumber in open-field and plastic tunnel and found that two root-knot nematode species. *M. incognita* and *M. javanica* were found from 200 samples. *M. incognita* was predominantly found species compare to *M. javanica.*

Singh and Khanna [15] carried out survey about 81 polyhouses from 52 localities of different districts of Himachal Pradesh and reported that *M. incognita, M. hapla,*

Pratylenchus sp., *Helicotylenchus* spp., *Mesocriconema* sp., *Tylenchorhynchus* sp. and *Hoplolaimus* sp. are major PPNs of polyhouse. Out of these PPNs, *M. incognita* was found mostly followed by *Helicotylenchus dihystera*. Due to controlled environmental condition and continuous growing of susceptible crops, the RKNs (*Meloidogyne* spp.) has emerged as a major problem, most destructive, causing enormous yield loss and difficult to control. The population build-up is rapid in polyhouse and the nematode population reaches five to six times the threshold levels within 18-24 months, making protected cultivation a wasteful exercise. The micro-parasitic abundance in an agro ecosystem is directly linked to the degree of host damage and economic loss of the crops. Individual parasite, by their own accord inflicts minor damage that plants can withstand (Irvin *et al*., 2006) [7], although climate change and global warming seem to favor higher development of the poikilothermic parasites (Culos and Tyson, 2014) [4], as apprehensible for the PPNs. Moreover, warmer temperature changes the geographical distribution pattern of the nematodes. This creates the major problem of pest invasion into new areas, and also helps to grow minor pests as major ones for range expansion of the species.

Plate 1: Root-knot nematode infected cucumber roots collected from the farmer's polyhouse during the survey

Table 2: Occurrence and population status of root-knot nematode, *Meloidogyne incognita* on cucumber under protected cultivation in different districts of Haryana (2020-2025)

Districts	No. of cultivation units surveyed	No. of cultivation units infected	GPS information	Frequency of occurrence (%)	Density range (J2s/200 cc soil)	RKI	Nematode identified	Other PPNs associated with crop (%)
Jind	90	66	N29′169-29′558 E75′705-77′203	73.3	120-540	3.0-5.0	*Meloidogyne incognita*	*Pratylenchus* sp. (18.2), *Hoplolaimus* sp. (20.1), *Helicotylenchus* sp. (38.5), *Tylenchorhynchus* sp. (41.5)
Kaithal	75	51	N29′730-29′809 E76′629-77′009	68.0	95-310	2.0-4.0	—	—
Bhiwani	15	09	N28′818-28′968 E75′713-76′737	60.0	195-365	2.0-5.0	—	—
Hisar	20	14	N29′428-29′558 E76′157-76′203	70.0	145-345	3.0-5.0	—	—
Fatehabad	40	33	N29′537-29′538 E75′708-75′209	82.5	140-670	3.0-5.0	—	—
Palwal	10	05	N28′120-28′149 E77′018-77′305	50.0	70-295	2.0-5.0	—	—
Total	250	178*	—	71.2	70-670	2.0-5.0	—	—

Conclusion

In summarizing up of the findings of the survey concluded that *M. incognita* is a major key pest of protected cultivation in Haryana. It causes severe infection in polyhouses and cause great losses to cucumber. It was observed during survey that incidence of RKN fluctuates with the age of establishment of polyhouses structure. RKNs population increase with the increase the exposure of time of polyhouses and nematodes population found minimum in the newly established polyhouses. Therefore, additional research is required to identify the nematode species on molecular basis so that an appropriate and effective management plan may be developed to keep the PPN, population below the economic threshold and at a sustainable level.

Conflict of Interest

I declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgements

There are no acknowledgements to declare.

References

1. Bhati SS, Baheti BL. Occurrence and population status of root-knot nematode, *Meloidogyne incognita*, on cucumber under protected cultivation in Rajasthan. Journal of Entomology and Zoology Studies. 2020;8(4):1441-1444.
2. Chandel YS, Kumar S, Jain RK, Vashisth S. An analysis of nematode problem in greenhouse cultivation in Himachal Pradesh and avoidable losses due to *Meloidogyne incognita* in tomato. Indian Journal of Nematology. 2010;40(2):198-203.
3. Christie JR, Perry VG. Removing nematodes from soil. Proceedings of the Helminthological Society of Washington. 1951;18:106-108.
4. Culos GJ, Tyson RC. Response of poikilotherms to thermal aspects of climate change. Ecological Complexity. 2014;20:293-306.
5. Hallmann J, Meressa BH. Nematode parasites of vegetables. In: Sikora RA, Coyne D, Hallmann J, Timper P, editors. Plant parasitic nematodes in subtropical and tropical agriculture. Wallingford (UK): CABI; 2018. p. 346-410.
6. Hartman KM, Sasser JN. Identification of *Meloidogyne* species on the basis of differential host test and perineal-pattern morphology. In: Barker KR, Carter CC, Sasser JN, editors. Advanced treatise on *Meloidogyne*. Vol. II. Methodology. Raleigh (NC): North Carolina State University; 1985. p. 69-77.
7. Irvin NA, Scarratt SL, Wratten SD, Frampton CM, Chapman RB, Tylianakis JM. The effects of floral understoreys on parasitism of leafrollers (Lepidoptera: Tortricidae) on apples in New Zealand. Agricultural and Forest Entomology. 2006;8:25-34.
8. Ismail M, Anwar SA, Riaz A. Incidence of *Meloidogyne incognita* in cucumber fields. Pakistan Journal of Zoology. 2012;44:1383-1387.
9. Kayani MZ, Mukhtar T, Hussain MA, Haque MI, Perveen R. Incidence and severity of root-knot nematodes (*Meloidogyne* spp.) on cucumber in district Rawalpindi. Pakistan Journal of Phytopathology. 2012;24:122-128.
10. Kranti KVVS, Patil JA, Yadav S, Supriya P. Community analysis of plant parasitic nematodes infesting vegetable crops under polyhouse conditions. The Pharma Innovation Journal. 2023;12(6):1622-1626.
11. Kumar P, Khapte P, Saxena A, Kumar P. Evaluation of gynoecious cucumber (*Cucumis sativus*) hybrids for early summer. The Indian Journal of Agricultural Sciences. 2009;89:545-550.
12. Patil J, Kumar A, Goel SR. Incidence of plant parasitic nematodes associated with polyhouses under protected cultivation in Haryana. Environment and Ecology. 2017;35(3A):1870-1873.
13. Sharma H, Pankaj, Singh B. Protected cultivation and nematode problem. Journal of Nematology. 2009;39:1-8.
14. Singh B. New age protected cultivation (E-magazine). New Delhi: Indian Society of Protected Cultivation; 2016. p. 57.
15. Singh P, Khanna A. Incidence of phytoparasitic nematodes in vegetable crops grown under protected cultivation in Himachal Pradesh. International Journal of Science, Environment and Technology. 2015;4(6):1640-1646.