Environment and Ecology 41 (1A) : 340—344, January–March 2023
ISSN 0970-0420

Survey of the Incidence of Root Knot Nematode, *Meloidogyne incognita*, Infesting Field Peas in Bihar

Vyamasani Shravani, Uma Shankar Singh

Received 29 September 2022, Accepted 12 December 2022, Published on 6 February 2023

ABSTRACT

The survey has conducted in the month of December-January 2020-21 to determine the incidence of root knot nematode, *Meloidogyne incognita* and other plant parasitic nematodes associated with the field pea crop in and around fields of Pusa, Dholi and Birauli areas of Bihar. The survey has done from eight places i.e., Pusa farm, Ladaura, Birauli Khurd, Birauli KVK, Dholi farm, Harpur Pusa, Pusa Mahamadpur Deopar and total 80 samples i.e., 10 from each location (approximately 1kg soil along with roots) were collected. The prominence value (PV), abundance and frequency of occurrence (%) was calculated. The plant parasitic nematodes associated with field pea in these areas are *M. incognita*, *M. javanica*, *Rotylenchulus* spp. *Haplolaimus* spp. and *Helicotylenchus* spp. respectively. Among them, only *Meloidogyne incognita*, *M. javanica* and *Rotylenchulus* spp. were recovered from the root samples. The frequency of occurrence of these nematodes ranging from 20 to 100%. The highest plant parasitic nematode population was recorded in Pusa farm (1768) from soil samples and least plant parasitic nematode population was observed in Pusa Mahamadpur Deopar (536), respectively. The root knot nematode, *M. incognita* was found to be abundant in all localities with mean population: 738.25; frequency of occurrence: 100%; relative frequency of occurrence: 28.36; Prominence value (PV) - 738.25 and is followed by *M. javanica*, *Rotylenchulus* spp, *Helicotylenchus* spp. and *Haplolaimus* spp. The population of *M. incognita* predominantly found in Birauli Khurd (974) and followed by Kalyanpur (849) and least population was observed in Pusa Mahamadpur Deopar (442). The frequency of occurrence of *M. incognita* was highest in Ladaura and Dholi areas of Bihar state i.e., 100% and least was observed in Birauli KVK i.e., 50%, respectively.

Keywords Prominence value, Abundance, Frequency of occurrence, *Meloidogyne incognita.*

Vyamasani Shravani[1]*
[1]PhD (Ag) in Department of Nematology, Tamil Nadu Agricultural University, Coimbatore 641003, India

Uma Shankar Singh[2]
[2]Professor Cum Chief Scientist, Department of Nematology, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar 848125, India

Email: shravanivyamasani1997@gmail.com
*Corresponding author

INTRODUCTION

Plant-parasitic nematodes, popularly known as "hidden foes to farmers", are a key limiting factor in crop productivity. The root knot nematode, *M. incognita*

is considered as the most destructive pathogen of vegetable crops worldwide (Jones *et al*. 2013). Root-knot nematode, *M. incognita* is a polyphagous and detrimental pest of field pea and has been observed to be a great obstacle to effective field pea production. It accounts for 40-45% loss in pea (Siddiqui *et al*. 2009). The most possible reason for their extremely wide spread distribution might be their vast host range, which includes weeds, the lack of awareness about nematodes to the growers, unintentional spread through the seedlings, farm implements and favourable climatic conditions for build-up of root knot nematode population. This study was conducted to identify the major nematode species associated with field pea in Pusa, Dholi and Birauli and surrounding areas of Bihar state as the increased knowledge of the occurrence and distribution of root knot nematodes is critical as resistant cultivars are considered one of the safest and most environmentally friendly non-chemical alternatives.

MATERIALS AND METHODS

The survey has conducted in the month of December-January 2020-21 to determine the incidence of root knot nematode, *Meloidogyne incognita* and other plant parasitic nematodes associated with the field pea crop in and around fields of Pusa, Dholi and Birauli areas of Bihar. The survey has done from eight places i.e., Pusa farm, Ladaura, Birauli Khurd, Birauli KVK, Dholi farm, Harpur Pusa, Pusa Mahamadpur Deopar and total 80 samples i.e., 10 from each location (approximately 1kg soil along with roots) were taken with the help of soil auger at a depth of about 10 to 15 inches. These soil and root samples were collected and stored in separate polythene bags, tightly sealed and labeled properly with the information about host, location and date of collection. These samples were stored in refrigerator at 8-10^{0}C till the nematodes were processed for extraction. The nematodes from these soil samples were extracted through Cobb's sieving and decanting method (Cobb 1918) and followed by Bearmann funnel method (Southey 1986). After 24 to 48 hrs, 10ml of sample transferred to counting dish from the nematode suspension and nematode population was counted by using Stereoscopic microscope and hand tally counter. This process was repeated at least ten times to get accurate population of nematodes. Thus, nematode population from soil samples was estimated and nematode species were identified later. The nematode population from root samples was estimated by washing the roots thoroughly to remove dirt and then stained with 0.1% acid fuchsin lacto phenol. The roots were transferred to plain lacto phenol after washing roots and left over night to remove extra stain from the roots. Then, next day the roots were examined under stereoscopic microscope i.e., roots become transparent and nematodes were stained red and clearly noticeable. Thus, nematode population was estimated in root samples. Later, average nematode population was enumerated in each locality. The associated plant parasitic nematodes were identified based on the morphological key of important genera (Bajaj *et al*. 2018).

Statistical analysis and data interpretation

The data collected were subjected to statistical analysis and data interpretation i.e., the nematode numbers were expressed as number of nematode per 200cc soil and 5g fresh root weight. The prominence value (PV), abundance and frequency of occurrence (%) was calculated according to Seid *et al*. 2015:

$$\text{Prominence value (pv)} = \text{mean population density} \times \sqrt{\text{absolute frequency of occurence}} \div 10$$

$$\text{Frequency of occurence (\%)} = \text{number of sites where a genus detected} \div \text{total number of sites sampled} \times 100$$

The genera were considered as 'widespread' if they occurred more than 30% of the sites.

Abundance- The mean number of individuals of a genus over the sampling sites where the genus was founded.

If a genus mean density was more than 10 individuals per 100g of root, then it was considered abundant (Talwana *et al*. 2008). The mean number of egg masses per gram of root, egg masses per egg, adult female nematodes per plant and root knot index (RKI) were estimated to determine whether the field pea plant in a particular locality is susceptible or resistant (Hartman and Sasser 1985). Thus, the abundance, frequency of occurrence of root knot nematode, *Meloidogyne incognita* was enumerated.

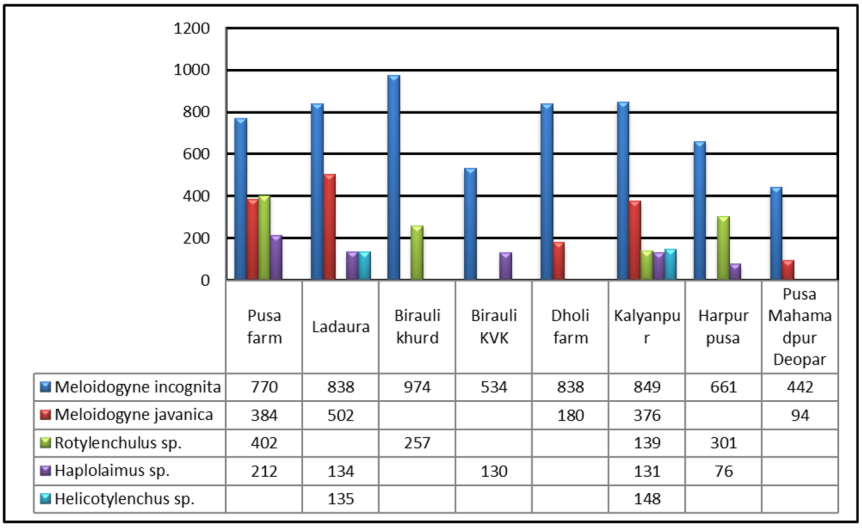

Fig. 1. Distribution of plant parasitic nematodes in field pea plots around Pusa, Dholi and Birauli areas of Bihar.

RESULTS AND DISCUSSION

The plant parasitic nematodes associated with field pea in these areas are *M. incognita*, *M. javanica*, *Rotylenchulus* spp., *Haplolaimus* spp. and *Helicotylenchus* spp., respectively. *Meloidogyne* spp. was identified based on the posterior cuticular pattern of adult females in which *M. incognita* has typical high dorsal arch with smooth to wavy striae. Whereas, in *M. javanica*, the dorsal arch is rounded with two distinct lateral lines. *Rotylenchulus* spp. was identified based on the kidney shape adult female and amphidelphic. *Haplolaimus* spp. contains strong body with robust stylet and has tulip shaped stylet knobs. The *Helicotylenchus* spp. were identified based on the shape acquired by the nematode body when heat relaxed i.e., spiral, vulva position is 2/3rd from anterior end of body and tail contains a short projection. Thus these species were identified based on key obtained from Bajaj *et al*. (2018). Among them, only *M. incognita*, *M. javanica* and *Rotylenchulus* spp. were recovered from the root samples (Table 1). All the nematodes mentioned were found to be prevalent in these localities with frequency of occurrence ranging from 20 to 100%. Fig. 1. represents that the highest plant parasitic nematode population was recorded in

Table 1. Occurrence of plant parasitic nematode genera in soil and root samples in and around Pusa, Dholi and Birauli areas of Bihar. + +: Present in both soil and root samples; +: Present in only soil sample.

Sl. No.	Location	*Meloidogyne incognita*	*M. javanica*	*Rotylenchulus* spp.	*Haplolaimus* spp.	*Helicotylenchus* spp.
1	Pusa farm	+ +	+ +	+ +	+	
2	Ladaura	+ +	+ +		+	+
3	Birauli Khurd	+ +		+ +		
4	Birauli KVK	+ +			+	
5	Dholi farm	+ +	+ +			
6	Kalyanpur	+ +	+ +	+ +	+	+
7	Harpur Pusa	+ +		+ +	+	
8	Pusa Mahamadpur Deopar	+ +	+ +			

Table 2. Frequency of occurrence of *M. incognita* in total samples.

Sl. No.	Location	Total number of soil (200cc) and root samples (5g) Collected	Infested	Frequency of occurrence of *Meloidogyne incognita* (%)
1	Pusa farm	10	8	80
2	Ladaura	10	10	100
3	Birauli Khurd	10	6	60
4	Birauli KVK	10	5	50
5	Dholi farm	10	10	100
6	Kalyanpur	10	7	70
7	Harpur Pusa	10	7	70
8	Pusa Mahamadpur Deopar	10	9	90

Table 3. Abundance, frequency of occurrence (FO) and prominence value (PV) of predominant plant parasitic nematodes recovered from soils and roots associated with field pea from in and around Pusa, Dholi and Birauli areas of Bihar.

Nematode genera	Soil (200cc) and Root (5g) samples		
	Abundance	FO (%)	PV
M. incognita	738.25	100	738.25
M. javanica	307.2	50	217.4
Rotylenchulus spp.	274.75	40	173.6
Haplolaimus spp.	136.6	50	96.5
Helicotylenchus spp.	141.5	20	63.2

Pusa farm (1768) from soil samples and least plant parasitic nematode population was observed in Pusa Mahamadpur Deopar (536), respectively. Based on frequency of occurrence, the sequence of genera detected in soil and root samples were arranged in descending order as *M. incognita* (100%), *M. javanica* (50%), *Haplolaimus* spp. (50%), *Rotylenchulus* spp. (40%) and *Helicotylenchus* spp. (20%). The frequency of occurrence of *M. incognita* was highest in Ladaura and Dholi areas of Bihar state i.e., 100% and least was observed in Birauli KVK i.e., 50%, respectively (Table 2). The root knot nematode, *M. incognita* was found to be abundant in all localities as it has highest mean population, frequency of occurrence, prominence value compared to them i.e., in soil and root samples- mean population: 738.25; frequency of occurrence: 100%; relative frequency of occurrence: 28.36; Prominence value (PV) - 738.25 and it is followed by *M. javanica*, *Rotylenchulus* spp., *Helicotylenchus* spp. and *Haplolaimus* spp. with mean population of 307.2, 274.75, 141.5 and 136.6 in soil samples, respectively. The frequency of Plant parasitic nematodes ranged from 20 to 100%, whereas frequency of occurrence of *M. incognita* ranged from 50 to 100%. Among population recovered from soil and root samples of eight localities, the population of *M. incognita* predominantly found in Birauli Khurd (974) and followed by Kalyanpur (849) and least population was observed in Pusa Mahamadpur Deopar (442) (Table 3).

Table 4. Root knot index of field pea crop infested with root knot nematode, *Meloidogyne incognita* in and around Pusa, Dholi and Birauli areas of Bihar.

Sl. No.	Location	No. of egg masses/ g of root	No. of eggs/ egg mass	No. of adult female nematodes/ plant	Root knot index (RKI)
1	Pusa farm	58	218.2	86.7	4
2	Ladaura	118.7	229.6	132.6	5
3	Birauli Khurd	108	227.7	110.3	5
4	Birauli KVK	37	195.6	40.3	4
5	Dholi farm	46	168.8	68.8	4
6	Kalyanpur	66	168.8	75.8	4
7	Harpur Pusa	18.6	214.1	27.8	3
8	Pusa Mahamadpur Deopar	12.57	215	22	3
	Mean	58.1	204.7	70.5	4

The mean number of egg masses per gram of root, number of eggs per egg mass, number of adult females per plant and root knot index (RKI) of root knot nematode, *M. incognita* was observed to be 58.1, 204.7, 70.5 and 4 as seen in Table 4, respectively. The number of egg masses per gram of root, number of eggs per egg mass, number of adult females per plant and root knot index (RKI) were found to be more in samples analyzed from Ladaura and Birauli Khurd areas of Bihar. The root knot index was found to be '5' in Ladaura and Birauli Khurd (highly susceptible), '4' in Pusa farm, Birauli KVK, Dholi farm, Kalyanpur (Susceptible), '3' in Harpur Pusa and Pusa Mahamadpur Deopar (moderately resistant). The mean root knot index (RKI) of all localities is '4' on the scale of 1 to 5 according to Hartman and Sasser (1985), which suggests that the field pea plants grown in these areas were shown susceptibility to root knot nematode, *Meloidogyne incognita*.

There were no reports on survey of incidence of root knot nematode, *Meloidogyne incognita* on field pea in Bihar state. Important phytonematodes that are known to infect field pea are *Meloidogyne incognita*, *M. arenaria*, *M. javanica*, *Heterodera goettingiana*, *H. schachtii* and *Rotylenchulus reniformis*. Upadhyay *et al*. 2019 investigated on occurrence of vermiform plant parasitic nematodes associated with field pea reported that the nematode genera associated with crop are *Haplolaimus* spp., *Helicotylenchus* spp., *Pratylenchus* spp., *Paratylenchus* spp., *Tylenchorhynchus* spp., *Paratrichodorus* spp. The results of this study agree with that of survey conducted by Anwar and Kenry (2010) from 2006-08 on sixteen major vegetable producing areas to identify the incidence and distribution of *M. incognita* and its reproduc-

tion on genotypes of vegetable crops in fields and greenhouses i.e., field pea crop was determined as susceptible variety with incidence of 10.7% of all fields surveyed and egg mass index as 4. Simona and Dass (2010) screened 55 varieties of field pea and reported that HUDP-15 is susceptible which has root knot index (RKI) as 4. Sharma *et al*. (2006) screened 23 selections of field pea against *Meloidogyne incognita* and among them HUDP-15 was determined as 'moderately susceptible'. The results are in agreement with the published reports and this study suggested that field pea crop shows susceptibility to root knot nematode, *Meloidogyne incognita* and the plant parasitic nematodes viz., *M. javanica*, *Rotylenchulus* spp., *Helicotylenchus* spp. and *Haplolaimus* spp.

CONCLUSION

The evidence in this study suggested that the root knot nematode, *Meloidogyne incognita* observed to be predominantly found in all localities surveyed. The other plant parasitic genera: *M. javanica*, *Rotylenchulus* spp., *Haplolaimus* spp. and *Helicotylenchus* spp. were also present in rhizhosphere of field pea crop. The mean root knot index (RKI) was recorded to be 4 on the scale of 1 to 5 according to Hartman and Sasser (1985), which suggested that the field pea plants grown in all localities were determined as susceptible to root knot nematode, *Meloidogyne incognita*.

REFERENCES

Anwar SA, McKenry MV (2010) Incidence and reproduction of *Meloidogyne incognita* on vegetable crop genotypes. *Pak J Zool*. 42(2): 135-141.

Bajaj HK, Kanwar RS, Gupta DC. (2018). Handbook of practical Nematology. Scientific Publishers, New Delhi, pp 47-63.

Cobb NA (1918) Estimating the nema population of soil, with special references to the sugarbeet and root-gall nemas, *Heterodera schachtii* Schmidt and *Heterodera radicicola* (Greef) Muller, with a description of *Tylencholaimus aequalis* n. spp. *Agric Tech Circular*. 1: 48.

Hartman KM, Sasser JN (1985) Identification of *Meloidogyne* species by differential host test and perineal-pattern morphology. An advanced treatise on Meloidogyne: Methodology. 2: 69-77.

Jones T, Haegeman A, Danchin EG, Gaur HS, Helder J, Jones MG, Kikuchi T, Manzanilla-López R, Palomares-Rius E, Wesemael WML, Perry RN (2013). Top 10 plant-parasitic nematodes in molecular plant pathology. *Mol PlPathol* 14 (9): 946-961.

Seid A, Goftishu M, Degebassa L, Mekete T (2015) Occurrence, distribution and abundance of plant-parasitic nematodes associated with khat (*Catha edulis* Forsk) in East Hararghe Zone, Ethiopia. *Nematropica* 45: 208-214.

Sharma A, Haseeb A, Abuzar S (2006) Screening of field pea (*Pisum sativum*) selections for their reactions to root-knot nematode (*Meloidogyne incognita*). *J Zhejiang Univ Sci B* 7(3): 209-214.

Siddiqui ZA, Qureshi A, Akhtar MS (2009) Biocontrol of root knot nematode, *Meloidogyne incognita* by *Pseudomonas* and *Bacillus* isolates on *Pisum sativum*. *Arch Phytopathol Pl Prot* 42: 1154-1164.

Simona LS, Dass S (2010) Screening of chickpea, field-pea, lentil and pigeonpea against root-knot nematode, *Meloidogyne incognita*. *Ind J Nematology* 40(2): 231-233.

Southey JF (1986) Laboratory Methods for Work with Plant and Soil Nematodes Her Majesty's Stationery Office. Technical Bulletin Ministry Agric, Fisheries Food, London, UK, pp 202.

Talwana HL, Butseya MM, Tusiime G (2008) Occurrence of plant-parasitic nematodes and factors that enhance population build-up in cereal-based cropping systems in Uganda. *Afr Crop Sci J* 16: 119-131.

Upadhaya A, Yan G, Pasche J, Kalil A (2019) Occurrence and distribution of vermiform plant-parasitic nematodes and the relationship with soil factors in field pea (*Pisum sativum*) in North Dakota, USA. *Nematology* 21(5): 445-457.