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Occurrence and Distribution of Plant Parasitic Nematodes in Mungbean in Jaipur District, Rajasthan, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Mungbean (*Vigna radiata* (L.) R. Wilczek) is one of the important pulse crops grown in India. Considering the economic importance of nematodes as disease causing organism of mungbean the present investigation was carried out to know the distribution of plant parasitic nematodes in mungbean crops in Jaipur district of Rajasthan.

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Methodology: A total 139 soil samples were collected from mungbean fields of 12 different localities in Jaipur district. The samples were processed using Cobb's sieving and decanting technique followed by Baermann's funnel technique and nematode population was counted in suspension and identified on the basis of their morphological characters.
Results: The samples were infected with mainly four genera of plant parasitic nematodes *i.e., Meloidogyne* spp.*, Helicotylenchus* spp.*, Pratylenchus* spp. and *Tylenchorhynchus* spp. *etc.* Out of 139 soil samples, 120 samples showed the presence of *Meloidogyne javanica* with 86.33 % occurrence, 18.82 % absolute density, 83.81 % relative density and 15.85 % prominence value and found most predominant in different surveyed localities in Jaipur district.

Keywords: Nematode; distribution; occurrence; mungbean, pulses.

1. INTRODUCTION

"Pulses are one of the important food crops grown globally for their higher protein content. Pulses improve soil fertility and physical structure and provide nutritious fodder for cattle feed" [1]. "All the pulses have the ability to fix nitrogen by association with rhizobium 58-109 kg/ha" [2]. "The pulse crops cover an area of about 30.73 million hectares with an annual production of 27.30 million tones and productivity is 888 kg/hectare" [3]. "India is one of the largest producers and consumers of pulses in the world. Although, is the largest pulse crop cultivating country in the World, pulses share to total food-grain production is only 9%" [3]. "Mungbean (*Vigna radiata* L. Wilczek) is one of India's important pulse crops, commonly known as green gram or mung, moong, mungo, golden gram" [4-7]. "In India, it is grown as pure, inter crop/mixed crop or as a relay crop in rice fallows during summer or spring season, in almost all parts of the country such as Orissa, Maharashtra, Andhra Pradesh, Rajasthan, Madhya Pradesh, Bihar, Karnataka, Assam and Uttar Pradesh" [8]. "Mung bean is an excellent source of:- low cost and high-quality protein" [9] The production of mung bean is limited by several constraints including pests and diseases. Among the various pest and diseases plant parasitic nematodes are one of the major constraints in reducing both the quality and quantity of the crops. Plant parasitic nematodes are termed as hidden enemies of plants.

"Among nematode diseases of pulse crops, root-knot nematodes (*Meloidogyne* spp.) are the common important group of plant parasitic disease caused by *M. incognita* and *M. javanica* on mung bean was first reported by Singh, 1972 in India. Avoidable losses under field conditions due to *M. javanica* in mung bean ranged from 42.1 to 93.4%" [10]. "Similarly, the yield loss of 18 to 65% due to *M. incognita* and 23 to 49% by *M. javanica* on mung bean have been reported from Uttar Pradesh" [11]. "Crop loss due to *M. incognita* in green gram has been reported 8.90%" by Khan et al. [12]. However, Jain et al. [13] reported *"Meloidogyne incognita, Meloidogyne Javanica, Heterodera cajani and Rotylenchulus reniformis* are the serious nematode pathogen attacking black gram and green gram inducing 8.90% yield loss with 162 million rupees as a monitory loss". "A significant reduction in plant growth, nodulation and nitrogen content of the shoot and root has been observed in mung beans infested with *M. incognita"* [14,15]. The infectivity and losses caused by root-knot nematodes in mungbean may vary due to location and regional differences in soil conditions and environmental variations.

Therefore, keeping the above aspects in view, the present investigation was planned to study the survey of plant parasitic nematodes on mungbean (*Vigna radiata* L. Wilczek) in Jaipur district of Rajasthan.

2. MATERIALS AND METHODS

I. Survey

Survey was conducted for the presence of root-knot nematode and other phytonematodes infesting mungbean from various localities in Jaipur district during August- September 2019.

II. Soil Sampling

A total 139 soil samples were collected from mungbean grown field in different localities of Jaipur district. The samples were collected with the help of khurpi from the feeder – root zone of plants at 6" to 9" depth. The samples were

brought to the laboratory in polythene bags, tied with rubber band and tagged with supporting information *viz.*-date of sampling, locality, host plant, temperature, soil type *etc.* soil samples were stored in refrigerator at about 10^{O}c. The samples were processed within a week.

III. Processing of Samples

To isolate the nematodes, each soil sample was processed by Cobb's sieving and decanting technique [16] followed by Baermann's funnel technique [17]

A 200cc soil sample was put in a bowl half filled with water and mixed thoroughly to make it homogenous and was left for 5 – 10 minutes to allow heavy particles to settle down at the bottom. The mixture was sieved into another bowl through a coarse sieve (16 mesh) to remove the debris and other undesirable particles. The suspension in the second bowl was then poured through sieves in a sequence, firstly 60 mesh followed by 100, 200 and 400 mesh sieves. The water flowing through 400 mesh sieve was allowed to run down and residue on the sieve was collected in a beaker. The process was repeated twice / thrice for complete recovery of nematodes.

The nematode suspension obtained by sieving was poured on wire gauge containing double layer tissue paper placed on Baermann funnel holding sufficient water in contact with the bottom of the gauge.

After 24 hrs the suspension was drawn in a beaker from the funnel and kept for some time to allow the nematode to settle down. The numbers of various plant parasitic nematode species were counted in 5 ml of suspension of each sample with the help of a counting dish under stereoscopic binocular microscope.

IV. Per Cent Occurrence

The frequency of occurrence % of the root-knot nematode in each locality was calculated by the following formula: -

(a) Percentage of occurrence = (Number of samples containing a species/ Total no. of samples collected) X 100

(b) Absolute density = (No. of individuals of a species in a sample / volume of sample) X 100

(c) Relative density = (No. of individuals of a species in a sample / Total of all individual in a sample) X 100

(d) Prominence value = (Absolute density X √Absolute frequency) /100

3. RESULTS

A survey was conducted to determine the distribution, % occurrence, % absolute density, % relative density and % prominence value of *Meloidogyne* spp. and other phytonematodes associated with mungbean in Jaipur district of Rajasthan. A total of 139 soil samples were collected from 12 different localities from mungbean fields (Tables 1,2). In this survey, a total of 139 soil samples were collected from 12 different localities from mungbean growing areas in Jaipur district in which all the samples were infected with plant parasitic nematodes. Mainly four genera of plant parasitic nematodes *i.e., Meloidogyne* spp.*, Pratylenchus* spp.*, Tylenchorhynchus* spp. and *Helicotylenchus* spp. *etc.* was found associated with mungbean in surveyed area (Tables 1,2). Out of 139 soil samples collected, 120 samples showed the presence of *Meloidogyne* spp. with 86.33 % occurrence, 18.82 % absolute density, 83.81 % relative density and 15.85 % prominence value in Jaipur district. (Table 1).

However, about presence of other phytonematodes, the *Helicotylenchus* spp. found in 90 samples with 64.74 % occurrence, 1.55 % absolute density, 6.93 % relative density and 1.0 % prominence value. Followed by *Pratylenchus* spp. found in 80 samples with 43.16 % occurrence, 1.37 % absolute density, 6.13 % relative density and 0.59 % prominence value. Whereas, The *Tylenchorhynchus* spp. found lowest in 57 samples with 41.0 % occurrence, 0.68 % absolute density, 3.04 % relative density and 0.27 % prominence value. (Table 1) Root knot nematode, *Meloidogyne* spp. (mix population of *M. javanica* and *M. incognita*) was found most predominant species in different surveyed localities of in Jaipur district.

Among all the nematodes only root-knot nematode, *Meloidogyne* spp. was found above or near the pathogenic level in mungbean in Jaipur district. Other phytonematodes were also present in low densities below the pathogenic or economic threshold level.

Table 1. Per cent occurrence of root-knot nematode and other phytonematodes associated with mungbean in Jaipur district

S. No.	Nematode spp.	Total Samples Collected	Samples Containing nematode spp.	Percent Occurrence	Total Population of nematode spp.	Total volume of sample	Total Population of Plant Parasitic Nematodes	Absolute Density	Relative Density	Prominence Value
1.	*Meloidogyne* spp.	139	120	86.33	5365	28495	6401	18.82	83.81	15.85
2.	*Pratylenchus* spp.		80	43.16	393			1.37	6.13	0.59
3.	*Tylenchorhynchus* spp.		57	41.00	195			0.68	3.04	0.27
4.	*Helicotylenchus* spp.		90	64.74	444			1.55	6.93	1.00

Table 2. Population studies of root-knot nematode and other phytonematodes associated with mungbean locality wise in Jaipur district

Locality	Nematode spp.	Total Samples Collected	Samples Containing nematode spp.	Percent Occurrence	Total Population of nematode spp.
L 1 Daulatpura	*Meloidogyne* spp.	15	14	93.33	641
	Pratylenchus spp.		11	73.33	49
	Tylenchorhynchus spp.		6	40.00	21
	Helicotylenchus spp.		11	73.33	66
L2 Rampura dabri	*Meloidogyne* spp.	12	12	100.00	599
	Pratylenchus spp.		8	66.66	51
	Tylenchorhynchus spp.		4	33.33	11
	Helicotylenchus spp.		9	75.00	53
L 3 Lalpura	*Meloidogyne* spp.	14	13	92.85	617
	Pratylenchus spp.		7	50.00	41
	Tylenchorhynchus spp.		5	35.71	19
	Helicotylenchus spp.		8	57.14	39
L 4 Sanganer	*Meloidogyne* spp.	14	12	85.71	533
	Pratylenchus spp.		8	57.14	38
	Tylenchorhynchus spp.		5	35.71	25
	Helicotylenchus spp.		6	42.85	57
L 5 Bassi	*Meloidogyne* spp.	12	9	75.00	382
	Pratylenchus spp.		7	58.33	18
	Tylenchorhynchus spp.		6	50.00	18
	Helicotylenchus spp.		5	41.66	28
L 6 Awandiya	*Meloidogyne* spp.	8	6	75.00	358
	Pratylenchus spp.		4	50.00	11

Locality	Nematode spp.	Total Samples Collected	Samples Containing nematode spp.	Percent Occurrence	Total Population of nematode spp.
	Tylenchorhynchus spp.		3	30.00	9
	Helicotylenchus spp.		7	87.50	23
L 7 Baseri	*Meloidogyne* spp.	10	10	100.00	454
	Pratylenchus spp.		9	90.00	53
	Tylenchorhynchus spp.		5	50.00	22
	Helicotylenchus spp.		7	70.00	27
L 8 Goner	*Meloidogyne* spp.	6	5	83.33	207
	Pratylenchus spp.		2	33.33	7
	Tylenchorhynchus spp.		3	50.00	9
	Helicotylenchus spp.		4	66.66	23
L 9 Jamwa Ramgarh	*Meloidogyne* spp.	10	8	80.00	357
	Pratylenchus spp.		6	60.00	34
	Tylenchorhynchus spp.		5	50.00	19
	Helicotylenchus spp.		8	80.00	35
L10 Bobari	*Meloidogyne* spp.	15	13	86.66	506
	Pratylenchus spp.		7	46.66	44
	Tylenchorhynchus spp.		6	40.00	13
	Helicotylenchus spp.		12	80.00	47
L11 Kankata	*Meloidogyne* spp.	10	7	70.00	209
	Pratylenchus spp.		4	40.00	11
	Tylenchorhynchus spp.		4	40.00	16
	Helicotylenchus spp.		5	50.00	18
L12 Mandaliyn Meda	*Meloidogyne* spp.	13	11	84.61	502
	Pratylenchus spp.		7	53.84	36
	Tylenchorhynchus spp.		5	38.46	13
	Helicotylenchus spp.		8	61.53	28

4. DISCUSSION

The present study showed that among 139 soil samples collected from mungbean fields of 12 localities were infected with mainly four genera of plant parasitic nematodes *i.e., Meloidogyne* spp., *Pratylenchus* spp., *Tylenchorhynchus* spp. and *Helicotylenchus* spp. *etc.* Similarly, Mishra and Chakrabarti [18] reported "the association of root-knot nematode, cyst nematode, lesion nematode, reniform nematode and various ectoparasitic nematode groups with all the pulse crops in pulse producing areas of India". Ali and Sharma (2003) observed *Meloidogyne incognita* and *M. javanica* infestations in sandy soils under rainfed and irrigated situations of Jaipur, Jhunjhunu and Swai Madhopur and estimated 20-30% yield loss in chickpea, also reported *Heterodera swarupi, Pratylenchus thornei and Pratylenchus spp.*in Rajasthan, India. Ali et al. [19] observed 174 soil samples for studying the community analysis of plant parasitic nematodes associated with pulse crops (chickpea, lentil, pigeon pea, field pea) in district Hamirpur, Uttar Pradesh. The results showed the presence of *Hoplolaimus indicus, Tylenchorhynchus mashhoodi, Xiphinema americanum, Filenchus* spp. in collected soil samples. Roy et al. [20] conducted a survey in West Bengal and reported *R. reniformis, Meloidogyne, Tylenchorhynchus, Criconemoides, Helicotylenchus, Pratylenchus, Hoplolaimus* and *Hirschmanniella* associated with leguminous vegetable crops. Chandrawat et al. [21] collected 245 soil samples, among them *Hoplolaimus* spp. reported in 169 samples with 68.97% of occurrence, 15.61% population density and 129.61% prominence value in and around Udaipur. Chandrawat et al. [22] reported three known species of *Hoplolaimus* (Daday, 1905) nematode (*H. tylenchiformis, H. indicus* and *H. columbus*) were encountered in the rhizosphere of perennial ornamentals. Chandrawat et al. [23] surveyed "14 perennial ornamentals and found that *Hoplolaimus* spp. were associated with rose, duranta, china rose, crape jasmine, acalypha, croton, jasmine, ficus, thuja, bougainvillea, anthurium, and oleander. Among them maximum population was recovered from rose (106 per 200cc soil) followed by jasmine (60 per 200cc soil), crape jasmine (35 per 200cc soil)". Singh [24] reported "thirteen nematode genera (*Hoplolaimus, Tylenchorhynchus, Helicotylenchus, Tylenchus, Heterodera cajani, Pratylenchus, Basiria, Aphelenchus, Meloidogyne, Filenchus, Boleodorus, Rotylenchulus* and *Scutellonema*) associated with pigeon pea from Bundelkhand region of Utter Pradesh, India". Chandrawat et al. [25] find out "distribution and Community analysis (occurrence, population density and prominence value) of *Hoplolaimus* spp. found associated with perennial ornamentals. Results indicated that out of 14 perennial ornamentals surveyed, maximum 86.53% occurrence of *Hoplolaimus* spp. was recorded on rose, while highest population density & prominence values 29.87% & 211.22% were found on jasmine". Jena et al. [26] reported "the presence of *Meloidogyne incognita, Rotylenchulus reniformis, Hoplolaimus indicus*, *Helicotylenchus dihystera*, *Tylenchorhynchus mashhoodi*, *Hirschmanniella oryzae*, Dorylaimids *and* Rhabditids exhibiting varying population densities with green gram in coastal districts of Odisha" [27].

5. CONCLUSION

In the present study root-knot nematode (*Meloidogyne javanica*) was found the only prominent economically important plant parasitic nematode genera above the economic threshold level affecting mungbean in Jaipur districts. This might be due to polyphagous nature of the nematode or the favourable environmental condition of this area or availability of light sandy soil which is most the favourable for growth and development of root-knot nematode, *Meloidogyne* spp.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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