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GIS/GPS based survey on incidence and distribution of rice root-knot nematode (*Meloidogyne graminicola*) in Southern transition zone of Karnataka

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Abstract
A survey was conducted during *Kharif* -2016 in Southern transition zone districts of Karnataka to know the level of incidence and distribution of *Meloidogyne graminicola* with respect to soil types, types of cultivar, and geographical location. The survey indicated that, there is incidence of rice root- knot nematode in all the surveyed villages. But their level of incidence varies with respect to cultivar, soil type and geographical location. Maximum nematode population was found in Chikadadkatte of Davanagere district, Tuduru, Beguvalli, Hasudi of Shivamogga, Karagunda and Lakkavalli of Chickmagaluru district (586.33 to 841.00 J2/100 cc of soil) with root knot indices varying from 3 to 4. The lowest incidence was observed in Kumsi of Shivamogga and Vadeyarhatturu of Davanagere district. Interestingly it was observed that where the places recorded highest nematode population having sandy loam soil and Jyothi was predominant cultivated variety it is highly susceptible to rice root-knot nematode. *M. graminicola* is soil borne in nature it is adapted to congenial condition favored in these districts and continuous growing of susceptible cultivar Jyothi results in spreading throughout all rice growing areas of Southern transition zone districts

Keywords: *Meloidogyne graminicola*, Rice root-knot nematode, Rice, GIS/GPS

1. Introduction

Rice is one of the most important staple foods for more than half of the world's population [1]. And influences the livelihoods and economies of several billion people especially concentrated in Asia, Latin America, the Middle East, and the West Indies. [2] Describes the integral and vital role of rice as follows - "A key tenet of rice culture is that rice is a sacred food divinely given to humans that uniquely sustains the human body in a way that no other food can". It is cultivated in different agro climatic regions either as a sole crop (rain fed, irrigated or deep water) or as a major component in various cropping systems. Mono cropping of rice, year after year in some regions and cropping systems, involving different year specific crop sequences or fallow in a given area, create conditions congenial for plant parasitic nematodes. Of late, among the several biotic stresses, plant parasitic nematodes are gaining much importance. So far, 300 plant parasitic nematode species belonging to 35 genera have been reported infesting rice. Among them, *Meloidogyne graminicola* has become major production constraint both in nurseries and main fields. The yield loss due to this nematode varies from 17% to 80%. However, unfortunately, farmers and extension workers are unaware of the symptoms, damage and yield losses due to rice root -knot nematode as symptoms produced are non-specific and misdiagnosed [3]. Rice root-knot nematode, *M. graminicola* Golden and Birchfield 1965 has emerged as a pest of international importance [4]. In India, *M. graminicola* which was earlier found in West Bengal, Odisha, Assam, Kerala only, has also spread to newer areas of Uttar Pradesh, Delhi, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Tamil Nadu, Karnataka, and recently to Gujarat as per the reports from various co-operating centres of All India Coordinated Research Project (Nematodes) [5]. It is a serious problem in the nurseries and upland rice but has been found to be widespread in the deepwater and irrigated rice also in many states of India [6-8]. Rice root-knot nematode appeared in devastating form in parts of major rice growing areas of Shivamogga during 2001, which was a first report from Karnataka and subsequently, reported from Mandya district of the state [9]. Outbreak of root-knot nematode is also observed in Shivamogga, Karnataka [10].

Initially it was noticed only in aerobic condition. Since 2011, it has been observed in anaerobic condition also and appearing in all types of rice cultivating situations. [11] Observed the incidence and distribution of rice root-knot nematode in all the taluks of Shivamogga and Davanagere districts. In order to understand the distribution of rice root-knot nematode the present study was carried out and surveys were conducted in southern transition districts of Karnataka to know the distribution and incidence with respect to soil type, type of cultivar and geographical location.

2. Materials and Methods

2.1 Survey

Random Surveys were conducted in southern transition districts of Karnataka, *viz.,* Shivamogga, Davanagere and Chikamagaluru district of Karnataka to know the incidence of rice root-knot nematode.

2.2 Collection of sample

During the survey, rice plants in both nursery and main field showing uneven patches with yellowing, stunted growth, reduced tillering with galls on roots were observed. The plants in infested patches were dried up early. Such plants were selected for sampling.

2.3 Observations recorded

While collecting samples the following observations were recorded viz., soil type, cultivar, (GIS/GPS) Geographical information (using GPS Map camera- 1.4.0. android 3.0 and up JK. fantasy-GPS Map Camera). In each taluks, minimum of five villages are visited and root and soil samples were collected and analyzed in the lab to know the population of rice root-knot nematodes and root knot index. Root knot index was recorded according to the number of galls per root system in which 0 = No galls (Immune) 1 =1-2 galls / root system (Resistant), 2=3-10 galls/root system (Moderately resistant)3 = 11- 30 galls /root system (Moderately susceptible) 4=31-100 galls/root system (Susceptible) and 5 = >100 galls / root system (Highly susceptible) [12]. (Table.1)

Table 1: Root-Knot Index 0 to 5 scales for *Meloidogyne* spp

Grade	Description	Reaction
0	No galls	Immune
1	1-2 galls / root system	Resistant
2	3-10 galls / root system	Moderately resistant
3	11- 30 galls / root system	Moderately susceptible
4	31-100 galls / root system	Susceptible
5	>100 galls / root system	Highly susceptible

3. Results and Discussion

The survey revealed that, there is incidence of rice root-knot nematode in all the surveyed villages of southern transition district. But their level of incidence varies with respect to cultivar, soil type and geographical location. Maximum nematode population was found in Chickadadkatte (Latitude: 14°12' 06.6"N, Longitude: 75°67' 29.3"E) of Davanagere district, Tuduru (Latitude: 13°71' 54.9"N, Longitude: 75°37' 49.2"E), Beguvalli (Latitude: 13°70' 46.2"N, Longitude: 75°40' 24.2"E), Hasudi of Shivamogga, Karagunda (Latitude: 13°24' 85.2"N, Longitude: 76°20' 44.5"E) and Lakkavalli (Latitude: 13°69'86.9"N, Longitude: 75°54'43.0"E) of Chikmagaluru district recorded highest nematodes population ranging between 586.33 to 841.00 J2 / 100 cc of soil with root knot indices varying from 3 to 4. (Plate.1). The least incidence (210.56 and 240.66 J2 /100 cc of soil) was observed in Kumsi (Latitude: 14°05' 92.6" N, Longitude: 75°39' 10.3"E) of Shivamogga and Vadeyarhatturru (Latitude: 14°12' 48.1" N, Longitude: 75°63' 02.6"E) of Davanagere district population ranging between (210.56 J2 to 240.66 J2/100 of soil) with root knot index 1 (Table.2 and Figure. 1). Interestingly it was observed that where the places recorded highest nematode population having sandy loam soil and Jyothi was predominant cultivated variety it is highly susceptible to rice root-knot nematode. Whereas, the least nematode population observed in Kumsi of Shivamogga and Vadeyarhotturru of Davanagere district having clay loamy soil. The present investigations are in conformity with the findings of [13] found the incidence of root-knot nematode from all major rice growing districts of Karnataka but level of incidence differed from region to region. [14] Found greater damage to rice varieties in sandy soils than in clay soil. Larger nematode population densities observed in the fields with light soil as compared to heavy soil may be the result of better growth and multiplication of the nematodes favored by light soil [15]. Further, [16] surveyed for infestation of rice root-knot nematode (*M. graminicola*) fields located in the high Gangetic flood plain area of the Natore district in north-western Bangladesh and identified nearly two-thirds of the fields produced medium to severe root galling on rice seedlings. [17] Conducted survey on rice root-knot nematode associated with rice cultivar in Allahabad districts of Uttar Pradesh. Similar findings were also observed by [18, 19].

Plate 1: Rice Root knot nematode infected rice seedlings from different locations

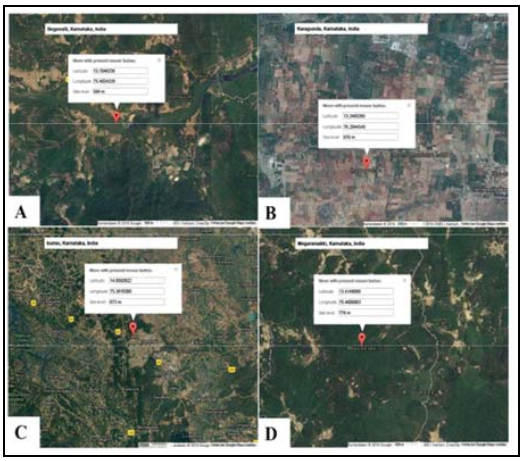

Fig 1: locations of rice root-knot nematode sampling site A) Beguvalli, B) Karagunda C) Kumsi D) Megaramakki

Table 1: Incidence of rice root-knot nematode in Southern transition district of Karnataka

District name	Taluk	Village name	Variety	Latitude/ Longitude	Soil type	RKI	Nematode population in soil (J2/100cc of soil)
Davanagere	Hannali	Chikadadkatte	Jyothi	14°12' 06.6"N 75°67' 29.3"E	Sandy loam	4	841.00
		Vadayarahatturu	Jyothi	14°12' 48.1"N 75°63' 02.6"E	Sandy loam	1	240.66
		Doddethinahalli	Sanna Akki	14°13' 82.8"N 75°59' 53.4"E	Sandy loam	2	324.60
	Davanagere	Malebennur	Jyothi	14°34' 98.8“N 75°74' 02.6“E	Sandy loam	1	273.25
		Chinnasamudra	Ankur sona	14°35'89.4"N 76°07'90.7"E	Sandy loam	1	244.52
		Dodderahalli	MTU 1001	14°23'94.2“N 75°60'36.1“E	Sandy loam	1	310.00
Shivamogga	Shivamogga	Kumsi	JJL	14°05' 92.6"N 75°39' 10.3"E	Clay loam	1	210.56
		Konehossur	Bhagyajyothi	14°10' 07.0"N 75°28' 75.4"E	Clay loam	1	286.33
		Gowthampura	JGL	14°15' 35.5"N 75°21' 72.5"E	Sandy loam	2	256.66
		Hosudi	Jyothi	13°92'19.8"N 75°64'50.3"E	Sandy loam	4	748.52
	Theerthahalli	Beguvalli	MTU 1001 Jyothi	13°70' 46.2"N 75°40' 24.2"E	Sandy loam	3	612.33
		Thuduru	Jyothi	13°71' 54.9"N 75°37' 49.2"E	Sandy loam	3	586.33
Chikmagaluru	N.R. Pura	Karagunda	Jyothi BPT Sona	13°24' 85.2"N 76°20' 44.5"E	Sandy loam	3	658.66
		Megaramakki	IET	13°41' 49.0"N 75°46' 06.9"E	Clay loam	2	354.65
	Tarikere	Doddakunduru	Jyothi	13°66'90.0"N 75°67'26.2"E	Sandy loam	1	310.25
		Lakkavalli	Jyothi	13°69'86.9"N 75°54'43.0"E	Sandy loam	3	586.33
		Rangenahalli	Jyothi	13°70'59.5"N 75°69'86.2"E	Sandy loam	1	342.66

4. Conclusion

The survey revealed that the incidence of *M. graminicola* varied from location to location, soil type and type of cultivar. *M. graminicola* is soil borne in nature it is adapted to congenial condition favored in these districts and continuous growing of susceptible cultivar Jyothi results in spreading throughout all rice growing areas of the Shivamogga, Davanagere and Chickmagaluru districts.

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