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The Impact Of Root-Knot Nematodes Infestation Studies On Some Turmeric Genotypes And Associated With Soil Quality Of Nizamabad District Of Telangana State Of India.

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Abstract

This study was conducted to assess the effect of soil quality and fertility in relations to root knot nematodes infestations on turmeric growing soils of Nizamabad district of Telangana sate during *kharif*, 2018. Twenty-eight surface soil samples representing seven turmeric (*Curcuma longa L.*) growing mandals of Nizamabad districts of Telangana namely Sirikonda, Armoor, Kammarpally, Velpur, Balkonda, Jakranpally and Dharpally. The soil texture varied from sandy loam to clay. This study indicates that turmeric crops grown in the selected localities with four major turmeric genotypes (Duggirala red, ACC-79, ACC-48 and Rajapuri). All the turmeric genotypes except ACC-79 were infested with root-knot nematodes occurrence in which almost all the roots have knot-like appearance was reported and also soil sampling revealed that crop showed the significant presence of *Meloidogyne* species as a pathogen. In all the turmeric growing soils, prominent disease symptoms were developed as gall formation in the root region and poor plant growth resulting crop yield loss to the farmers.

Keywords: *Turmeric Root knot nematode, Nizamabad, Meloidogyne species, soil quality and soil fertility.*

Introduction

India is called the "Spice Bowl of the World" as it cultivates 63 spices out of total 107 spices identified. Among the spices, turmeric *(Curcuma longa* L.) is one of the most important and ancient spice of India and also a traditional item of export. It is extensively used in the preparation of tasty curried dishes by all classes of people for its typical colour and flavour. It is used as a dye with varied application in drug and cosmetic industries. India is the largest producer of turmeric in the world accounting to 82 per cent of world turmeric production and 60 per cent of world export. In Telangana the major turmeric growing districts are Karimnagar and Nizamabad. Nizamabad is second largest producer of turmeric having an area of 11943 ha, with production of 97933 tons and productivity of 8200 kg/ha. The major varieties of turmeric cultivated in Nizamabad district are Duggirala red, ACC-79, ACC-48 and Rajapuri. The important soils prevailing in the district are black and red chalka (Sandy loams) soils covering 55% and 45% respectively of the total area. The blocks of Armoor, Bheemgal are predominantly dominated with red and red associated soils followed by black soils.

Root-knot nematode, Meloidogyne species is an important group of plant-parasitic nematode. Meloidogyne is an endo-parasitic nematode resides in almost all crops worldwide. These were recognized now a days as a major constraint in turmeric crop and it causing recognisable yield losses with infested plant parasitic nematodes and constitute the major pest crop all over the World. (Atkins *et al.,* 2003). Root-Knot nematodes are sedentary endoparasites (Crow, W.T. and Dunn, R.A 2009). These nematodes parasitise a wide variety of crops amounting to more than 2000 plant species most of which are higher plants (Karsen & Meons, 2006; Moens *et al.,* 2009). Root knot nematodes complete several generations in one cropping season and interfere with water and nutrient uptake by the host plant. The purpose of this study was to assess the effect of soil quality and fertility in relations to root-knot nematodes infestations on turmeric growing soils of Nizamabad district of Telangana sate.

Materials and methods

Location and description of the study area

The geographical area of the district is 4,288 square kilometres (1,656 sq mi) and it is located at 18°41′N 78°6′E. Nizamabad is bounded on the North by Nirmal district, on the East by Jagtial and Rajanna Sircilla district, on the South lies Kamareddy district, and on the West by Nanded district of Maharashtra State. The Godavari River enters into Telangana from Nizamabad district at Kandakurthi.

The climate is semi-arid which is comparatively equitable and although it is very hot in May with mercury rising up to 47^{o} C. The temperature dips to 5^{o}C in winters during the months of December and January. The mean maximum and minimum temperature vary from 38^{o}C to 25°C. Mean humidity varies from 64 per cent in July to 75 per cent in December. The mean annual rainfall is 900 mm of which 75 per cent is received during the southwest monsoon (June to September), 15 per cent during the northeast monsoon (October to December) and 10 per cent during the pre-monsoon period (March to May). The rainfall is highest

in the month of August. The major crops grown are rice, sugarcane, maize, turmeric, cotton, groundnut, sunflower and pulses etc.

Collection Methods used for soil sample analysis

The major turmeric growing villages from different mandals were selected. Surface soil samples (0-15 cm depth) from 28 turmeric growing villages of seven mandals. Soil samples and plant samples were collected from surveyed villages randomly from the fields. Soil sampling is done in the rhizosphere region at a depth of 0-15cm and collected samples were stored at 10-15℃ to avoid the decay and drying of specimens and 100 Rhizomes of the turmeric plants of each village were collected in polythene bags and neatly labelled. These were then brought to laboratory for examination. Upon arrival in laboratory, Soil samples were processed by Cobb's sieving and Decanting Method followed by modified Biermann's funnel Method (Cobb, 1918). These nematodes obtained were fixed in 4% formalin and stored in a glass vial. The number of samples positive to the nematode infection and % of infection is calculated. Plant-parasitic nematodes can be easily differentiated from free-living saprophytic nematodes with the presence of stylet in the head region. The nematode identification was mainly based on the morphology of adults and second stage juveniles (Eisenback, 1985). The fixed specimens were identified by making temporary mounts. Root samples were examined for overall root structure following the infection, presence of galls on roots. Numbers of gall in each root were counted. In order to count the number of egg masses on root surface, roots were washed clean in running tap water for 10-15 minutes, these were then immersed in aqueous solution of acid fuschin (875 ml of lactic acid, 63 ml glycerol, 62 ml of water and 0.1gm of acid fuschin) for 30 minutes and then washed with tap water to examine the stained egg masses. Initially number of egg masses in each root were counted, gall index 1 was on a scale of 0 to 5 (Taylor and Sasser, 1978), where 0 = no galls; 1 = 1 to 2; 2 = 3 to 10; 3 = 11 to 30; 4 = 31 to 100; and 5 = more than 100 galls.

Results

Occurrence and frequency of root-knot knot nematodes in turmeric

In the study area of turmeric growing soils of Nizamabad district in some patches all the villages found that the parasitic root-knot nematodes (*Meloidogyne spp*.) are damaging to turmeric majorly by feed on tender rhizomes, roots and base of pseudo stem causing stunting, chlorosis, poor tillering and necrosis of leaves are the common aerial symptoms. Characteristic root galls and lesions that lead to rotting are generally seen in rhizome roots. The infested rhizomes have brown, water-soaked areas in the outer tissues. Nematode infestation aggravates rhizome rot disease. Nematodes survive in soil and infected rhizomes as primary inoculum. Therefore, tissues from infected crops remaining in the field serve as a reservoir of the fungus. It spreads from infected plants or through soil.

Root knot nematodes were recorded in all the surveyed villages of Nizamabad district. Number of galls and gall index in roots of different turmeric varieties due to infection of *M.incognita* is shown in (Table 1 and 2). Among the four varieties (Duggirala red, ACC-79, ACC-48 and Rajapuri), the highest number of galls per root system was recorded in the variety Duggirala red in the range of 32-71 with gall index 4 of all villages and which is susceptible. The genotype ACC-79 found resistant with gall index 0. The ACC-48 turmeric genotype is in the

range of 15-25 with gall index 3 and which is found moderately resistant. The genotype Rajapuri is in the range of 32-41 with gall index 4 and which was found susceptible (Niranjan Prabhu *et al.*, 2017).

This study finds that the soil type has profound effect on the nematode reproduction facing greatest in coarsely textured sandy loam soils and least in more finely textured soils (Table 3 and 4). The soil of Nizamabad District are mostly Red, red associated soils and Black soils with sandy loam, sandy clay loam and clay and clay loam textured soils respectively. Therefore, soil type, moisture and temperature enhance the degree of Root knot nematode infestation and population size and Root sampled in selected location had significant amount of infection. Based on the observations made during the survey it can be concluded that the incidence of the root-knot nematode infection in four major turmeric genotypes (Duggirala red, ACC-79, ACC-48 and Rajapuri) as detailed below in selected villages.

This result in relation to soil texture has revealed that the numbers root-knots of nematode (galls) per turmeric root system are abundant in sandy loam to sandy clay loam soils (51-72) having larger populations of plant-parasitic nematodes than clay and clay loam soils (32-46) where there is more aeration and easy movement (Table 1 and 2). The penetrating capacity of nematodes was more in sandy loam soils (Nadakal. A.M, 1966). Increase in nematode numbers could be due to multiplication of the nematode as a result of continuous cultivation of turmeric without crop rotation and diversification (Kratochil *et al*., 2004). The intensity of Root knot nematode damage increased with the increase in the age of the plant. Extensive root galling was observed in Duggirala red turmeric genotype.

Host reaction

Among the four varieties studied, the turmeric cultivar ACC-79 was found immune to M. incognita, however the variety ACC-48 was found to be moderately resistant with gall index of 3 and Duggirala red and Rajapuri were found susceptible with the gall index of 4 (Niranjan Prabhu *et al.*, 2017).

Conclusion

The studied soils showed well developed structural variation and exhibited granular to sub angular blocky structure. The soil texture varied from sandy loam to clay. Results of this study indicates that selected turmeric genotype Duggirala red and Rajapuri were susceptible to root knot nematode infection. The genotype ACC-48 is Moderately resistant and ACC-79 is found to immune. The galling index indicates that the extent of damage is really a serious problem for turmeric growers. There is need for continued research in order to come up with cheap yet effective nematode management techniques. This may include screening various cultivars for resistance to various plant parasitic nematodes (PPN) with an aim of designing a proper nematode management strategy and promotes the plants to with stand unfavourable condition with better exploitation of nutrients and moisture.

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Table 1: Occurrence and distribution of root-knot nematode on each turmeric growing genotype in selected villages of Nizamabad district.

S.No	Mandals	Villages	Depth (cm)	Soil texture*	Village wise cultivated Turmeric genotypes				Turmeric genotypes wise Samples +ve and -ve for Root Knot Nematode (+ ve Positive; -ve negative; - Nil)				No of plants rhizome observed
					Duggirala red	ACC-79	ACC-48	Rajapuri	Duggirala red	ACC-79	ACC-48	Rajapuri	
1	Sirikonda	Nyavanandi	0-15	c	Duggirala red	-	-	-	+ve	-	-	-	100
		Gadkole	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Valgote	0-15	c	Duggirala red	-	-	-	+ve	-	-	-	100
		Kondur	0-15	c	Duggirala red	-	-	-	+ve	-	-	-	100
2	Armoor	Ankapoor	0-15	scl	Duggirala red	ACC-79	ACC-48	Rajapuri	+ve	-ve	+ve	+ve	100
		Govindpet	0-15	scl	Duggirala red	-	ACC-48	-	+ve	-	+ve	-	100
		Pipri	0-15	c	Duggirala red	ACC-79	ACC-48	Rajapuri	+ve	-ve	+ve	+ve	100
		Mamidipally	0-15	scl	Duggirala red	ACC-79	-	-	+ve	-ve	-	-	100
3	Kammarpally	Konapur	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Choutapally	0-15	scl	Duggirala red	-	-	Rajapuri	+ve	-	-	+ve	100
		Kammarpally	0-15	cl	Duggirala red	ACC-79	ACC-48	Rajapuri	+ve	-ve	+ve	+ve	100
		Narsapur	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
4	Velpur	Velpur	0-15	scl	Duggirala red	ACC-79	ACC-48	Rajapuri	+ve	-ve	+ve	+ve	100
		Kothapally	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Kuknoor	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Padgal	0-15	cl	Duggirala red	-	-	-	+ve	-	-	-	100
5	Balkonda	Balkonda	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Mendora	0-15	scl	Duggirala red	ACC-79	ACC-48	Rajapuri	+ve	-ve	+ve	+ve	100
		Bodepally	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Kothapalley	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
6	Jakranpally	Jakranpally	0-15	scl	Duggirala red	-	ACC-48	-	+ve	-	+ve	-	100
		Lakshamapur	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Brahmnapally	0-15	cl	Duggirala red	-	-	-	+ve	-	-	-	100
		Chintalur	0-15	scl	Duggirala red	-	-	-	+ve				100
7	Dharpally	Dharpally	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100
		Dubbaka	0-15	sl	Duggirala red	-	-	-	+ve	-	-	-	100
		Dammanapet	0-15	sl	Duggirala red	-	-	-	+ve	-	-	-	100
		Honnajipet	0-15	scl	Duggirala red	-	-	-	+ve	-	-	-	100

*Soil texture: ls – Loamy sand, sl- Sandy loam, scl –Sandy clay loam, sc- Sandy clay, cl- Clay loam and c- Clay

Table 2: Frequency of root-knot nematode on each turmeric growing genotype in selected villages of Nizamabad district

S.No	Mandals	Villages	Depth (cm)	Soil texture*	Root Galling index*				No. of galls/ root system				Host reaction			
					Duggirala red	ACC-79	ACC-48	Rajapuri	Duggirala red	ACC-79	ACC-48	Rajapuri	Duggirala red	ACC-79	ACC-48	Rajapuri
1	Sirikonda	Nyavanandi	0-15	c	4	-	-	-	33	-	-	-	Susceptible	-	-	-
		Gadkole	0-15	scl	4	-	-	-	60	-	-	-	Susceptible	-	-	-
		Valgote	0-15	c	4	-	-	-	40	-	-	-	Susceptible	-	-	-
		Kondur	0-15	c	4	-	-	-	39	-	-	-	Susceptible	-	-	-
2	Armoor	Ankapoor	0-15	scl	4	0	3	4	55	0	15	33	Susceptible	immune	Moderately resistant	Susceptible
		Govindpet	0-15	scl	4	-	3	-	51	-	25	-	Susceptible	-	Moderately resistant	-
		Pipri	0-15	c	4	0	3	4	32	0	19	36	Susceptible	immune	Moderately resistant	Susceptible
		Mamidipally	0-15	scl	4	0	-	-	53	0	-	-	Susceptible	immune	-	-
3	Kammarpally	Konapur	0-15	scl	4	-	-	-	56	-	-	-	Susceptible	-	-	-
		Choutapally	0-15	scl	4	-	-	4	60	-	-	41	Susceptible	-	-	Susceptible
		Kammarpally	0-15	cl	4	0	3	4	43	0	23	32	Susceptible	immune	Moderately resistant	Susceptible
		Narsapur	0-15	scl	4	-	-	-	60	-	-	-	Susceptible	-	-	-
4	Velpur	Velpur	0-15	scl	4	0	3	4	52	0	16	35	Susceptible	immune	Moderately resistant	Susceptible
		Kothapally	0-15	scl	4	-	-	-	61	-	-	-	Susceptible	-	-	Susceptible
		Kuknoor	0-15	scl	4	-	-	-	57	-	-	-	Susceptible	-	-	-
		Padgal	0-15	cl	4	-	-	-	45	-	-	-	Susceptible	-	-	-
5	Balkonda	Balkonda	0-15	scl	4	-	-	-	61	-	-	-	Susceptible	-	-	-
		Mendora	0-15	scl	4	0	3	4	58	0	18	39	Susceptible	immune	Moderately resistant	Susceptible
		Bodepally	0-15	scl	4	-	-	-	51	-	-	-	Susceptible	-	-	-
		Kothapalley	0-15	scl	4	-	-	-	52	-	-	-	Susceptible	-	-	-
6	Jakranpally	Jakranpally	0-15	scl	4	-	3	-	49	-	23	-	Susceptible	-	Moderately resistant	-
		Lakshamapur	0-15	scl	4	-	-	-	66	-	-	-	Susceptible	-	-	-
		Brahmnapally	0-15	cl	4	-	-	-	46	-	-	-	Susceptible	-	-	-
		Chintalur	0-15	scl	4	-	-	-	63	-	-	-	Susceptible	-	-	-
7	Dharpally	Dharpally	0-15	scl	4	-	-	-	58	-	-	-	Susceptible	-	-	-
		Dubbaka	0-15	sl	4	-	-	-	71	-	-	-	Susceptible	-	-	-
		Dammanapet	0-15	sl	4	-	-	-	68	-	-	-	Susceptible	-	-	-
		Honnajipet	0-15	scl	4	-	-	-	55	-	-	-	Susceptible	-	-	-

***Gall index: Gall index 1 was on a scale of 0 to 5; where 0 = no galls; 1 = 1 to 2; 2 = 3 to 10; 3 = 11 to 30; 4 = 31 to 100; and 5 = more than 100 galls.**

Root-knot Index for *Meloidogyne incognita*: Grade; Description; Reaction

0= No galls Immune; 1= 1 to 2 galls/ root system Highly resistant; 2 =3 to 10 galls/ root system Resistant; 3= 11 to 30 galls/ root system Moderately resistant; 4 =31 to 100 galls/ root system Susceptible; 5= >100 galls/ root system Highly susceptible.