

Original Research Article

THE ISOLATION AND IDENTIFICATION OF ROOT NEMATODES AFFECTING TOMATOES GROWN IN SOME SELECTED AREAS OF IN AND AROUND THE KALABURAGI, KARNATAKA, INDIA

ABSTRACT

Tomato (*Solanum lycopersicum* Mill.) is the most commonly grown prime vegetable crop in India and all around the world. Tomato is cultivated majorly in many states of the nation including Karnataka and plays an important role in the Indian economy. The ripe tomato fruits acts as the best source of vitamin A, and Vitamin D and also having various antioxidant properties. Tomato crop progressively gets infested by various diseases at different stages from vegetation up to fruiting. The diseases such as bacterial leaf spot, bacterial wilt, leaf curl, fruit canker and Septoria leaf spot are caused by different Bacteria, Viruses and Fungi. Nematodes also results in root-knot, stunting and fusarium wilt diseases which may reduce the crop yield and fruit quality. The present survey was carried out from June-June 2021 to November 2021 in selected tomato plots of Kalaburagi district to identify different species of root nematodes affecting tomato crop in the selected study area. According to the survey results a total of six species of root nematodes were isolated and identified namely *Meloidogyne* spp.s, *Globodera* spp.s, *Paratrichodors minor*, *Helicotylenchus dihystra*, *Pratylenchus* spp.s and *Rotylenchus buxophilus* from selected study plots of Nirgudi, Bhosga, Bhosga Tanda, Gobbur, Sannur, Nadikur and Khanadal. The results suggest that *Meloidogyne* spp.s and *Paratrichodors minor* were most commonly recorded. The Highest abundance of these nematodes is recorded in Nirgudi region and in Nandikur region population of these root nematodes is the least abundant.

Keywords: Tomato, Diseases, Nematodes, Abundance, Crop yield, Indian economy.

1. INTRODUCTION

India is a major agriculture and horticulture-based country of the world. A total of 15% of the India's national GDP is due to agriculture as well as horticulture contributes about 35% of total agriculture GDP (1) and (2). Worldwide, about 10% annual yield loss is recorded in various vegetable crops is mainly due to the infestation caused by root-knot nematodes (3) and (4) although more percent of yield loss has been recorded depending on various genera nematode species, locality, crop species and soil population level (5). India holds the second position in tomato production with a yearly production of 21.24 million tons followed by USA, Turkey and Egypt. In India Madhya Pradesh, Karnataka, Andhra Pradesh, Telangana and Gujarat are the top five tomato-producing states. Karnataka has an area of 63.73 thousand ha and annual production of about 2138.13 thousand tons with an average productivity of 33.55 tons/ha (6). Plant parasitic nematodes have been reported in many parts of the world and it was evident from the study that tree tomato is a suitable host to various

PPNs in tree tomato growing areas. (7) and (8). Nematodes peculiarly *Meloidogyne* spp. are the most frequently observed and damaging plant-parasitic nematodes in vegetable production.

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Nematodes are the most abundant organisms. Four of every five multicellular animals on our planet are nematodes (9). Nearly 90% of the multicellular animals on earth are nematodes (10, 11) and (14). Most of the soil nematodes are microscopic. However, their direct and indirect roles in a country's economy are massive. Plant parasitic nematodes cause immense yield losses to the vegetable crops worldwide (12). Among these parasitic nematodes, *Meloidogyne* spp. (Root-knot nematodes) is the most harmful and damaging nematode of global importance (13) and it is polyphagous. Nematode community structure can be used as a bioindicator in environmental monitoring (14). Although over 4,100 species of plant-parasitic nematodes have been identified, Decraemer and Hunt others, previously viewed as non-damaging, but later they are becoming pests as cropping patterns changed. In the food chain of the subterranean ecosystem, nematodes play a very important role. Many of them are bacterial and fungal feeders which contribute to the decomposition of organic materials and thus increase fertility, while many others are parasitic pests.

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However, they can successfully survive a wide range of geo-physico-chemical conditions. In unfavorable conditions, they can switch their food preference, a condition known as an omnivore. They can survive without any detectable metabolic activity (cryptobiosis) or simply they can lower their rate of metabolism (dormancy). The young ones (juveniles) of these nematodes can also survive unfavorable conditions through a kind of survival stage in which metabolic activities are suppressed (Dauer stages) and some species of root nematodes can survive complete dryness (15) and (9). Most nematodes affect a variety of crops through by feeding on or in plant roots, whilst a minority is aerial feeders. In addition to direct feeding and migration damage, nematode feeding facilitates subsequent infestation by secondary pathogens, such as fungi and bacteria causing huge losses to the farmers (16). The nematodes may be found in either free-living or parasitic forms of plants and animals (17) which acts as parasites of many vegetable crops including tomato. Some entomopathogenic nematodes species like *Steinernema*, *Heterorhabditis*, *Neosteinernema*, etc., acts as predators of important pests in agriculture and have been used in the successful management of many economically important insect pests (18).

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Nematodes are known for causing destructive diseases of crops as they have a wide range of feeding habits, constitute about 80% of all multicellular animals, attacking nearly every crop that is grown in the field and as a result crop yields are greatly affected reducing quantity and quality of crops on field, orchard, home garden and greenhouse (19) and (20). There is no plant on earth which is not infected by one or more species of nematodes. Plant-parasitic nematodes are usually shorter than 2 mm in length and less than 0.05 mm in Diameter and translucent, hence mostly microscopic. Most species of nematodes feed on roots and underground plant parts but a few also attacks the aerial plant parts. They may feed as ectoparasites, semi-endoparasites and endoparasites. According to the American Society of Phytopathology (APS), it is estimated that economic losses in the agricultural sector due to nematodes represent 14% of the worldwide crop yield losses, which is almost 125 billion dollars annually (21).

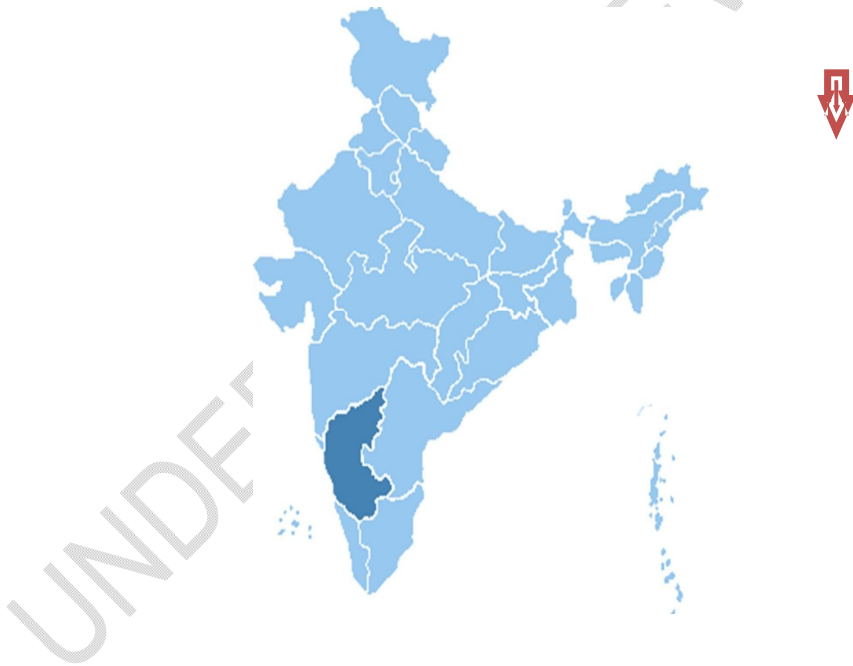
The selected study area of Kalaburagi District is one among of the areas throughout which tomato crop is grown as an important vegetable crop. As there is the least information available about root nematodes which are infesting tomato rhizosphere which results in loss of yield. There is a need

to study about these root knot nematodes which affects tomato crop the present study of isolation, identification and abundance was carried out in selected study sites in and around Kalaburagi.

2. MATERIAL AND METHODS

Study Area:

Kalaburagi district is situated in northern Karnataka between 76°.04' and 77°.42' East Longitude, and 17°.12' and 17°.46' North Latitude, covering an area of 10,951 km². The district is bounded on the west by Bijapur district and Solapur district of Maharashtra state, on the North by Bidar district and Osmanabad district of Maharashtra state, on the south by Yadgir district, and on the east by Ranga Reddy district and Medak district of Telangana state. The present study was undertaken in the 7 study plots of Kalaburagi during from June 2021 to November 2021. The study plots from where samples are collected include; Nirgudi, Bhosga, Bhosga Tanda, Gobbur, Sannur, Nadikur and Khanadal.



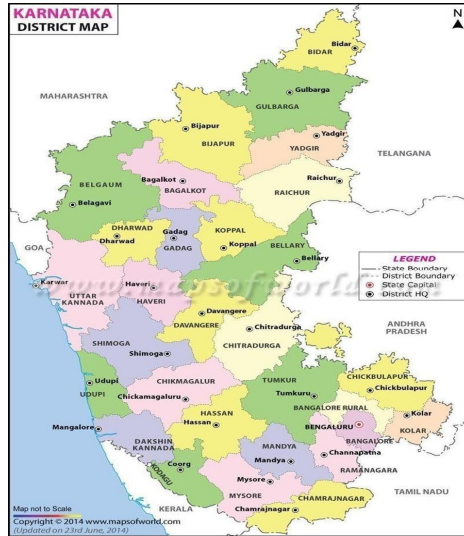


Plate-1

Plate-2

Plate (1) and (2): Map of Karnataka showing study area Kalaburagi



Plate (3): Map of study area Kalaburagi showing selected study plots in and around Kalaburagi

Environmental (weather) Factors in the Study Area of Kalaburagi:

The temperature and rainfall during the study period of 2019 ~~is are~~ recorded (Table 1). ~~A~~ ~~M~~maximum temperature of 43°C was recorded in ~~the month of~~ May 2021 and ~~a~~ minimum temperature of 15°C recorded was recorded in ~~the month of~~ November during ~~the~~ study period. The highest rainfall was recorded in ~~the month of~~ October (54.6 mm) and ~~the~~ lowest rainfall ~~was~~ recorded 10.3 mm in ~~the month of~~ May 2021. The same is represented in Fig. 1 and Fig2.

Table1. Temperature and Rainfall during the study year 2021

Months	Temperature Maximum (°C)	Temperature Minimum (°C)	Rainfall (mm)	
			Maximum	Minimum
January	34°C	15°C	0 mm	0 mm
February	36°C	17°C	0 mm	0 mm
March	40°C	20°C	5.8 mm	1 mm
April	42°C	23°C	5.6 mm	10.3 mm
May	43°C	25°C	13.6 mm	1.9 mm
June	38°C	23°C	39.4 mm	1.5 mm
July	35°C	22°C	18.7 mm	1.1 mm
August	37°C	22°C	18 mm	1.4 mm
September	39°C	21°C	34.2 mm	1.2 mm
October	36°C	21°C	54.6 mm	1 mm
November	33°C	17°C	6.56 mm	0 mm
December	31°C	16°C	4.9 mm	0 mm

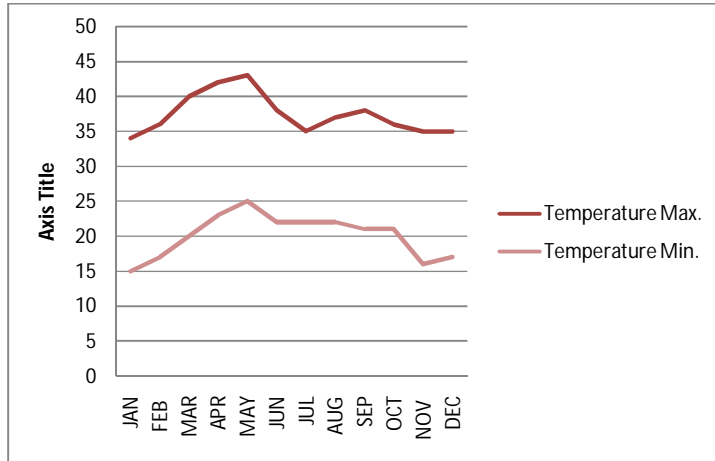


Fig.1 Temperature during the study year 2021

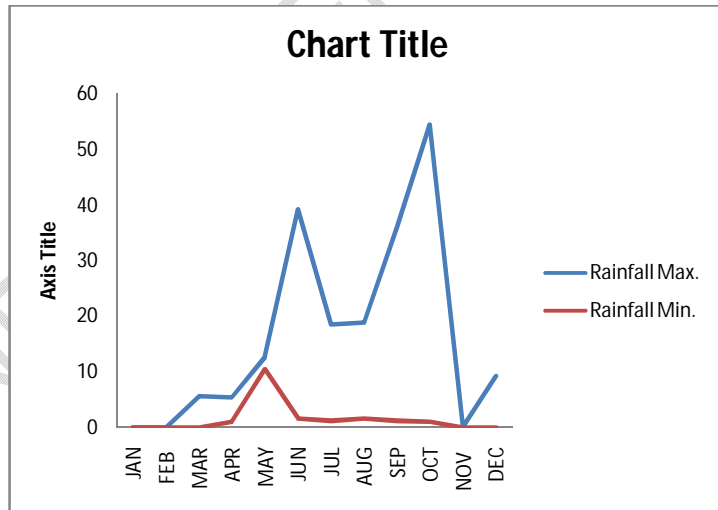


Fig.2 Rainfall data during the study year 2021

Methodology:

Sample collection:

Sample collection was carried out in the selected tomato farms by using the tools such as Hand trowel, shovel, bucket, Polythene bags, Paper tags, and Markers. A total of ten (10) plants were uprooted at from each plots randomly by digging to about 10cm deep below the soil surface. The soil samples thus collected were put in polythene bags separately and taken to the laboratory for analysis.

Extraction and Isolation of Nematodes:

The nematodes were extracted and isolated from the soil using sieving and decanting techniques method as described below.

- Firstly sieved the soil through a coarse sieve in order to remove root plants, leaves and stones.
 - After mixing the soil well, 250ml is placed in a plastic pan 1. Added 1000ml of water to cover and allow soaking. Later stirred the suspension for 15 seconds so that heavy soil particles get settled down at the bottom.
 - Decanted this muddy suspension into a plastic bowl.
 - Remaining The remaining soil was covered in a pan with enough water and stirring was repeated. The obtained supernatant was discharged into pan 2.
 - After 5 minutes in pan 2 is poured into the Sieves on top of the sieve with the sieve of 175 micropore sizes on 100 micropore sizes. The catch is immediately washed into a plastic pan with little tap water.
 - Decanted the suspension in a sieve of 385 micropore size on a double cotton wool filter paper with clamping the ring on the filter paper. The sieve is placed in a shallow tray filled with water. Use a watch glass.
 - The filter is placed in an extraction dish containing 100ml water.
 - The next day the filter is removed from the extraction dish and the final suspension containing the nematodes is ready for analyzing analysis.
- Used the aquarium pump to energize the nematode. Finally, the microscopic analysis was carried out.

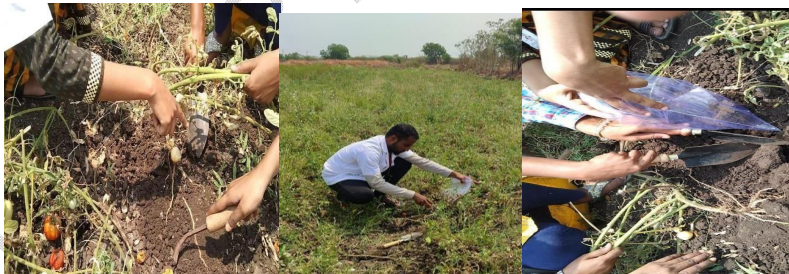


Plate 4 (A)

Plate 4 (B)

Plate 4 (C)

Plate 4 (A) to (C): Collection of root nematode samples from selected study plots



Plate 5 (A)

Plate 5 (B)

Plate 5 (C)



Plate 5 (D)

Plate 5 (E)

Plate 5 (F)



Plate 5 (G)

Plate 5 (A) to (G): Isolation of root nematodes

Identification:

The identification process of the nematode samples was carried out by nematologist Dr. Zaheer Ahmed of Krishi Vigyan Kendra (KVK), Kalaburgi. For identification also used an identification guide namely "Identification Guides for the most common Genera of plant-parasitic Nematodes" by Jonathan D. Eisenback.



Meloidogyne spp.



Globodera spp.



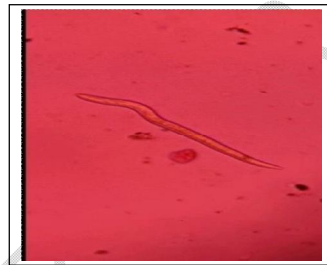
Helicotylenchus dihystra

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Paratrichodorus Minor



Pratylenchus spp.



Rotylenchus buxophilous

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Different species of root nematodes isolated and identified in selected study plots of Kalaburagi

3. RESULTS AND DISCUSSION

Results and Discussion:

According to the present study, a total of six crucial root-knot nematodes associated with tomato crop were isolated and identified from the selected study plots of Kalaburagi which includes *Meloidogyne* spp.s, *Heterodera* spp., *Globodera* spp.s, *Helicotylenchus dihystra*, *Pratylenchus* spp.s, *Paratrichodorus minor*, *Rotylenchus buxophilous*. The abundance of different root nematodes is shown in the Table 1 and the same is expressed in the graph below (Fig.3). The present survey revealed that the root nematode genera were spread across the tomato growing regions of the selected study area. (Figure 3).

Table 2.The abundance of different root nematode species in the selected study Plots of Kalaburagi

Name of the nematode species	Study plots of Kalaburagi						
	Nirgudi	Bhosga	Bhosga Tanda	Gobbur	Sannur	Nandikur	Khanadal
<i>Meloidogyne</i> spp.	64	49	51	55	54	41	51
<i>Globodera</i> spp.	51	42	59	53	52	39	44
<i>Paratrichodors minor</i>	62	54	58	57	--	32	--
<i>Helicotylenchus dihystra</i>	51	53	52	50	58	--	39
<i>Pratylenchus</i> spp.	44	51	46	58	56	33	53
<i>otylenchusbuxophilus</i>	49	--	--	53	53	31	41

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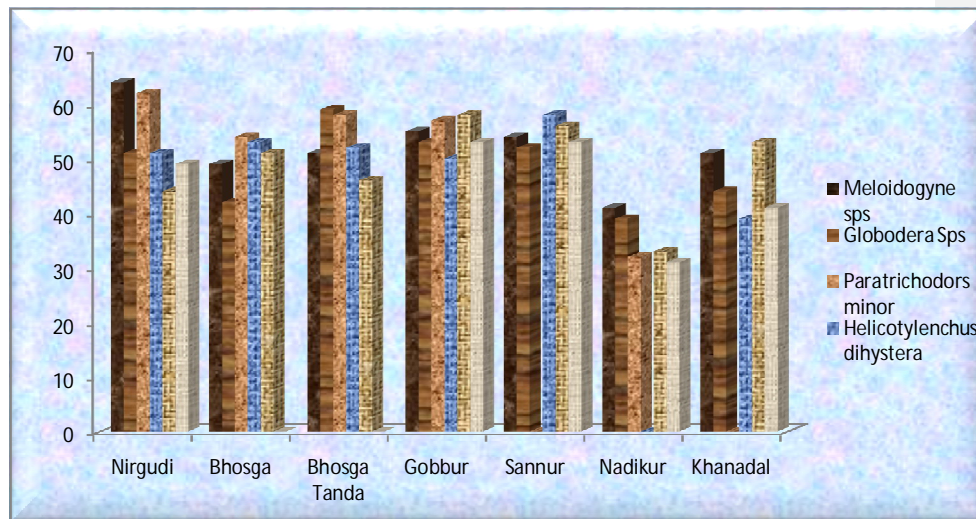


Fig 3. The abundance of different root nematode species in the selected study Plots of Kalaburagi

Meloidogyne sps. being the uttermost dominant genera which has been isolated followed by the *Paratrichodors minor* and *Globodera Sps.* in from all the study areas. The Results also (Table 2) suggests that important tomato growing areas i.e, Nirgudi, Gobbur and Sannur study plots of study area contains large densities of second-second-stage juveniles of *Meloidogynespp* whereas in Nandikur plots least population of *Meloidogynespp* was recorded. *Rotylenchusbuxophilus* population density is recorded comparatively less in Nandikur plots of Kalaburagi District where as, in Bhosga and Bhosgatanda study plots *Rotylenchusbuxophilus* not recorded. *Paratrichodors minor* population is not recorded in Sannur and Nandikur study plots however, the other nematodes genera were adequate in number in the soil rhizosphere.

The results from the present survey suggests that an abundant population of root-knot nematodes including *Meloidogynespp.s*, *Paratrichodors minor*, *Globodera Spp.s* and *Pratylenchus spp.s* were recorded in the cultivars of tomato rhizosphere of various study plots of Kalaburagi. This group of nematodes play an important role in essential soil processes (Neher 2001), however, the exact role of these nematodes in the crop production system is cabalistic. There was a remarkable difference in the abundance of root nematodes in the study plots of the selected study area Kalaburagi. Nirgudi and Gobbur recorded the highest number of root nematodes tomato rhizosphere. This drastic disparity in the nematode population in the rhizosphere of tomato is accredited to the divergent effects on nematode survival and multiplication.

Nematode genera diversity was generally low in both sannur and khandal plots. This could be attributed to the small parcels of land used by farmers and intensive intercropping of tomato with other vegetable plantations. The variation and reduced abundance of these root nematodes also due to the changing soil structure and also different pesticides which farmers used to practice in different plots of the selected study area. Agricultural escalation is mainly due to soil disruption by

reduced tillage, organic applications, fertilizers and heavy pesticide spraying mainly induces deterioration of nematode abundance, richness and their diversity (Kimenjue et al., 2009; Yeates, 1999).

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It was also noted during the survey that many farmers had previously grown susceptible crops on the farms where tree tomato were established. This could be the reason for high numbers of parasitic root-knot nematodes isolated from soil and roots. extended mono-cropping of susceptible crop plants which might be acting as host and may lead to plant parasitic nematodes build ups which causes serious crop damage (Bhan, et al., 2010).

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4. CONCLUSION

The present study disclosed that tomato rhizosphere is attacked by various root-knot nematode species in the selected study plots of Kalaburagi region. Results suggests that tomato crop in selected plots is extremely infested by the *Meloidogyne* spp.s followed by *Paratrichodors minor* and *Globodera* Spps. These nematodes may cause reduction in yield due to serious damage such as chlorosis and wilting. The findings also propose that population of nematode species which include *Rotylenchus buxophilus*, *Paratrichodors minor* and *Helicotylenchus dihystra* was not recorded in some study plots though they are abundant in other study plots. The difference in abundance of various nematodes may be due to many the factors like soil, intercropping, monocropping and pesticide usage. There is an urgent need to increase awareness in tomato growers about damage caused by these nematodes and prevention of these damaging pests should be done following crop rotation, biocontrol and other scientific methods by which high yield of tomato can be achieved by farmers.

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