ABUNDANCE OF PHYTOPARASITIC ROOT NEMATODES ASSOCIATED WITH TOMATO (*SOLANUM LYCOPERSICUM MILL.*) IN 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 act as the best source of vitamin A, Vitamin D and also have 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 result 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 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., *Globodera* Spp., *Paratrichodors minor*, *Helicotylenchus dihystera*, *Pratylenchus* spp. and *Rotylenchus buxophilus* from selected study plots of Nirgudi, Bhosga, Bhosga Tanda, Gobbur, Sannur, Nadikur and Khanadal. The results suggest that *Meloidogyne* sps and *Paratrichodors minor* were most commonly recorded. The highest abundance of these nematodes recrded in Nirgudi region and in Nandikur region population of these root nematodes is least abundant.

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

Introduction:

India is a major agriculture and horticulture-based country of the world. A total of 15% of 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, 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 second position in tomato production with yearly production of 21.24 million tons followed by USA, Turkey and Egypt. Major tomato tomato producing states of India are Madhya Pradesh, Karnataka, Andhra Pradesh, Telangana and Gujarat among which 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, 8).** Nematodes peculiarly *Meloidogyne* spp. are the most frequently observed and damaging plant-parasitic nematodes in vegetable production.

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).** 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 several 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 by Decraemer and Hunt previously viewed as non-damaging, but later they became 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 towards the decomposition of organic materials and thus increase fertility, while many others are parasitic pests.

However, they can successfully survive a wide range of geo-physico-chemical conditions. In unfavourable 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 juveniles of these nematodes can also survive unfavourable 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, 9)**. Most nematodes affect a variety of crops 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 act as parasites of many vegetable crops including tomato. Some entomopathogenic nematode species like *Steinernema*, *Heterorhabditis*, *Neosteinernema*, etc., acts as predators of important pets in agriculture and have been used in the successful management of many economically important insect pests **(18).**

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 as a result of which crop yields are greatly affected reducing quantity and quality of crops on field, orchard, home garden and greenhouse **(19, 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 of the District throughout which tomato crop is grown as an important vegetable crop. As there is a 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.

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

Months	**Temperature Maximum ()**	**Temperature Minimum ()**	**Rainfall (mm)**	
			Maximum	**Minimum**
January	34	15	0	0

February	36	17	0	0
March	40	20	5.8	1
April	42	23	5.6	10.3
May	43	25	13.6	1.9
June	38	23	39.4	1.5
July	35	22	18.7	1.1
August	37	22	18	1.4
September	39	21	34.2	1.2
October	36	21	54.6	1
November	33	17	6.56	0
December	31	16	4.9	0

Table1. Temperature and Rainfall during the study year 2021

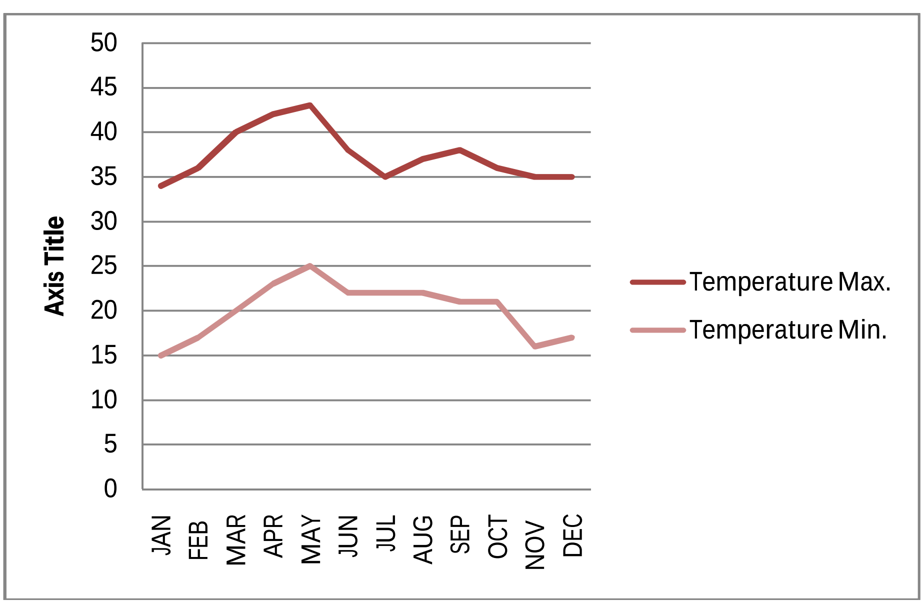

Fig.1 Temperature during the study year 2021

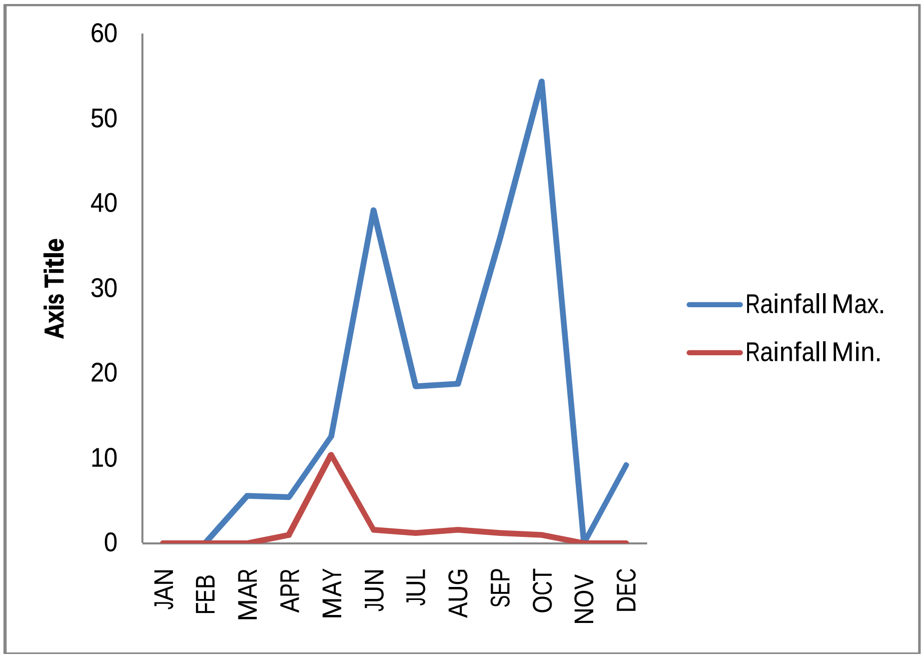

Fig.2 Rainfall data during the study year 2021

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 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 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.
- 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 pan 2 is poured into the Sieves on top of the sieve with the sieve of 175 micro pore sizes on 100 micro pore sizes. The catch is immediately washed into a plastic pan with little tap water.
- Decanted the suspension in a sieve of 385 micro pore 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 analysis process.

  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 and identification 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 dihystera

Paratrichodorus Minor

***Pratylenchus* spp**

Rotylenchus buxophilous

Plate 6: Different species of root nematodes isolated and identified in selected study plots of Kalaburagi

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., *Heterodera Globodera* spp., *Helicotylenchus dihystera*, *Pratylenchus* spp., *Paratrichodorus minor*, and *Rotylenchus buxophilous.* The abundance of different root nematodes is shown in Table 1 and 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. (Fig.3).

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

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

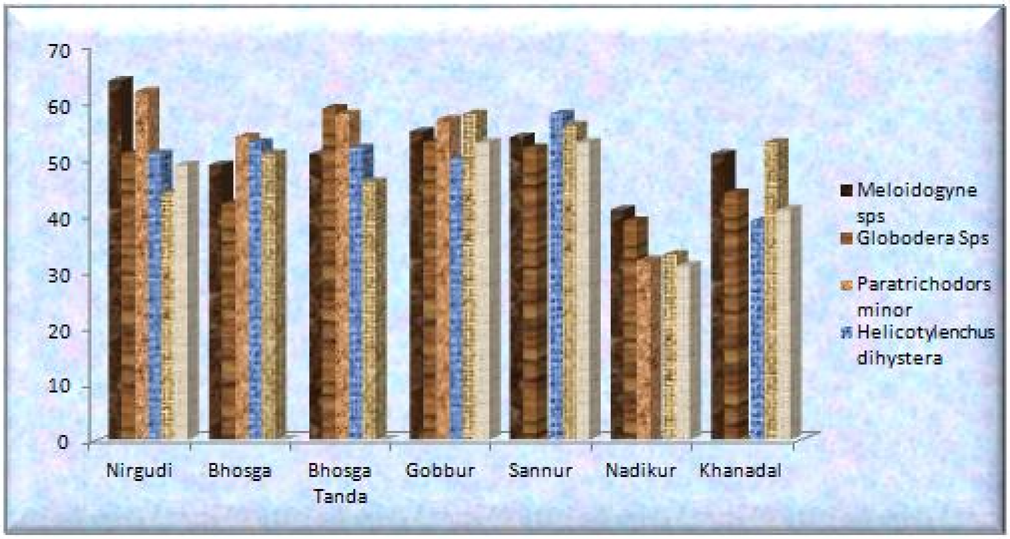

Fig 3. The abundance of different root nematode species in the selected study Plots of Kalaburagi

Meloidogyne spp. being the uttermost dominant genera which has been isolated followed by the *Paratrichodors minor* and *Globodera* spp. in 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-stage juveniles of *Meloidogyne* spp. whereas in Nandikur plots least population of *Meloidogyne* spp was recorded. *Rotylenchus buxophilus* population density is recoreded comparatively less in Nandikur plots of Kalaburagi District whereas in Bhosga and Bhosga tanda study plots *Rotylenchus buxophilus* is not recorded. *Paratrichodors minor* population is not recorded in Sannur and Nandikur study plots however, the other nematodes genera were adequate in number in soil rhizosphere.

The results from the present survey suggests that abundant population of root-knot nematodes including *Meloidogyne* spp., *Paratrichodors minor*, *Globodera* spp. and *Pratylenchus* spp. 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 population of nematodes 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 nearby 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 selected study area. Agricultural escalation is mainly due to soil disruption by reduced tillage, organic applications, fertilizers and heavy pesticide spraying mainly induce deterioration of nematode abundance, richness and diversity (Kimenju *et al.,* 2009; Yeates, 1999).

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).

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. followed by *Paratrichodors minor* and *Globodera* spp. 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 dihystera* 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 factors like soil, intercropping, monocropping and pesticide usage. There is an urgent need to increase awareness in tomato growers about damage caued by these nematodes and prevention measures of these damaging nematode pests should be done crop rotation, biocontrol and other scientific methods by which high yield of tomato can be achieved by farmers.

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