

## Research

# Effects of *Tylenchulus semipenetrans* on Growth and Yield of Citrus Plants in Chhatrapati Sambhajnagar District, Maharashtra, India

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**DOI:** 10.62896/ijmsi.2.1.23

**Conflict of interest:** NIL

**Article History**

Received: 08/05/2026

Accepted: 10/06/2026

Published: 17/06/2026

**Abstract:**

*Tylenchulus semipenetrans* (N.A. Cobb) is one of the most economically important plant-parasitic nematodes affecting citrus cultivation worldwide. The present investigation was conducted to determine the influence of citrus nematode infestation on growth and yield parameters of citrus orchards in Chhatrapati Sambhajnagar district, Maharashtra, India. Soil and root samples were collected from selected citrus orchards and nematode populations were assessed. Growth characteristics including plant height, canopy spread, leaf size, root development, fruit size, fruit weight and yield were compared between infected and healthy orchards. Results revealed that heavily infested orchards showed significantly reduced vegetative growth and productivity. Infected orchards exhibited chlorosis, stunted growth, poor root development, reduced fruit size and premature fruit drop. Statistical analysis indicated a strong negative correlation between nematode population density and fruit yield ( $r = -0.92$ ). The study highlights the economic significance of *T. semipenetrans* and emphasizes the need for integrated nematode management strategies.

**Keywords:** Citrus nematode, *Tylenchulus semipenetrans*, Citrus orchards, Yield loss, Maharashtra, Plant parasitic nematodes.

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**Introduction**

Citrus is one of the most important fruit crops cultivated in India. Maharashtra contributes substantially to the national citrus production, especially sweet orange (*Citrus sinensis*). However, several pests and diseases reduce productivity. Among soil-borne pathogens, *Tylenchulus semipenetrans* is considered one of the most destructive nematodes causing "slow decline disease" in citrus (Duncan and Cohn, 1990).

The nematode attacks feeder roots and interferes with nutrient and water absorption. Symptoms include chlorosis, poor vigor, reduced root growth and significant yield reduction (Bridge and Starr, 2007). Yield losses ranging from 10–50% have been reported from different citrus-growing regions worldwide (O'Bannon, 1977).

The present study aimed to assess the impact of citrus nematode infestation on citrus growth and productivity in District Chhatrapati Sambhajnagar.

**Materials and Methods**

**Study Area**

The study was conducted in Paithan and Tehsils of Chhatrapati Sambhajnagar district during 2024–2025.

**Sampling**

Collection of soil samples with digging method through 20 to 30 cm deeper from the infected citrus orchards.

A total 20 orchards were surveyed.

- 10 Healthy Orchards
- 10 Infested Orchards

Five trees were randomly selected from each orchard.

**Nematode Extraction**

Nematodes were extracted using Cobb's sieving and decanting technique followed by Baermann funnel extraction (Cobb, 1918).

#### Parameters Recorded

1. Plant Height (m)
2. Canopy Diameter (m)
3. Leaf Area (cm<sup>2</sup>)
4. Root Biomass (kg)
5. Fruit Diameter (cm)

6. Fruit Weight (g)
7. Number of Fruits/Plant
8. Yield (kg/plant)

#### Statistical Analysis

Data were analysed using One-Way ANOVA and Student's t-test. Correlation analysis was performed to determine the relationship between nematode population density and yield.

### Results

**Table 1. Population Density of *T. semipenetrans* in Surveyed Citrus Orchards**

Citrus Orchard Category	Mean Nematode Population (J2/200 cc Soil)
Healthy	52 ± 12
Moderately Infested	875 ± 95
Heavily Infested	1850 ± 165

**Table 2. Effect on Vegetative Growth**

Parameter	Healthy Citrus Orchard	Infected Citrus Orchard	Reduction (%)
Plant Height (m)	4.82 ± 0.41	3.71 ± 0.38	23.0
Canopy Spread (m)	4.35 ± 0.29	3.02 ± 0.25	30.6
Leaf Area (cm <sup>2</sup> )	28.6 ± 2.4	18.4 ± 2.1	35.7
Root Biomass (kg)	7.9 ± 0.7	4.5 ± 0.5	43.0

ANOVA revealed significant differences ( $P < 0.05$ ) between healthy and infected orchards.

**Table 3. Effect on Fruit Characteristics**

Parameter	Healthy Citrus Orchard	Infected Citrus Orchard
Fruit Diameter (cm)	7.92 ± 0.35	6.11 ± 0.27
Fruit Weight (g)	182.5 ± 10.4	134.6 ± 8.7
Fruits per Plant	354 ± 21	246 ± 18

Fruit size and weight decreased significantly with increasing nematode population.

**Table 4. Yield Loss Assessment**

Orchard Type	Yield (kg/tree)
Healthy	64.8 ± 4.5
Moderately Infested	49.6 ± 3.9
Heavily Infested	34.2 ± 2.8

#### Percentage Yield Loss

Moderately infested orchard = 23.45%

Heavily infested orchard = 47.22%

**Table 5. Correlation between Nematode Population and Yield**

Variable	Correlation Coefficient (r)
Nematode Population vs. Yield	-0.92
Nematode Population vs. Root Biomass	-0.89
Nematode Population vs. Fruit Weight	-0.86

The correlation analysis demonstrated a strong negative relationship between nematode density and plant performance.

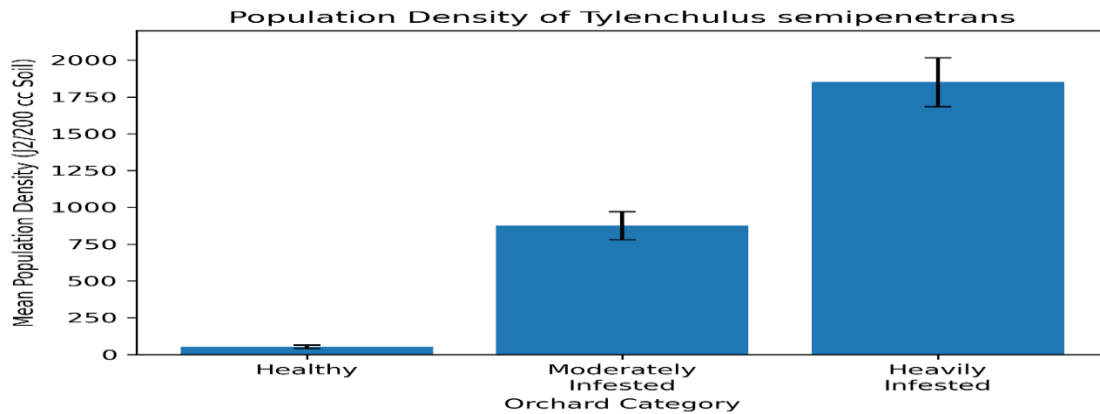
The survey revealed that *Tylenchulus semipenetrans* population density increased from 52 ± 12 J2/200 cc soil in healthy orchards to 875 ± 95 and 1850 ± 165 J2/200 cc soil in moderately and heavily infested

orchards, respectively. Nematode infestation significantly reduced vegetative growth parameters, including plant height (23.0%), canopy spread (30.6%), leaf area (35.7%), and root biomass (43.0%) compared to healthy orchards. Fruit characteristics were also adversely affected, with reductions in fruit diameter, fruit weight, and

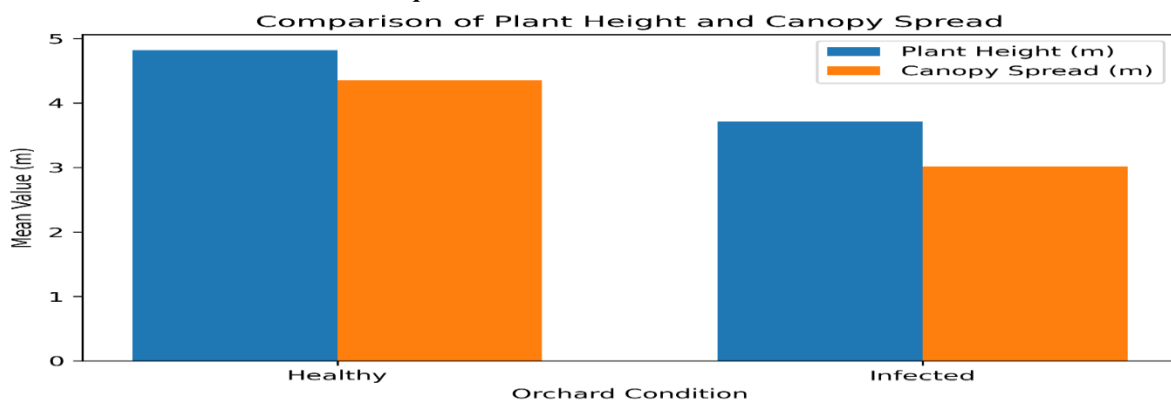
number of fruits per plant in infected orchards. Yield declined from  $64.8 \pm 4.5$  kg/tree in healthy orchards to  $49.6 \pm 3.9$  kg/tree and  $34.2 \pm 2.8$  kg/tree in moderately and heavily infested orchards, resulting in yield losses of 23.45% and 47.22%, respectively. Correlation analysis showed strong negative relationships between nematode population density

and yield ( $r = -0.92$ ), root biomass ( $r = -0.89$ ), and fruit weight ( $r = -0.86$ ), indicating that increasing nematode infestation severely affects citrus growth and productivity. ANOVA confirmed significant differences ( $P < 0.05$ ) between healthy and infected orchards.

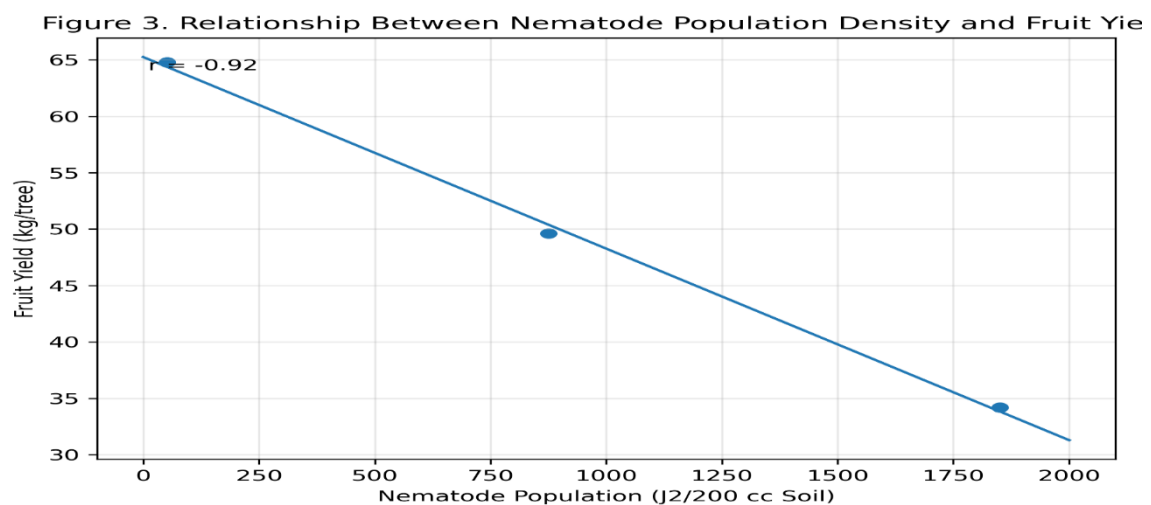
**Figure 1. Mean Population Density of *Tylenchulus semipenetrans* in Citrus Orchards**



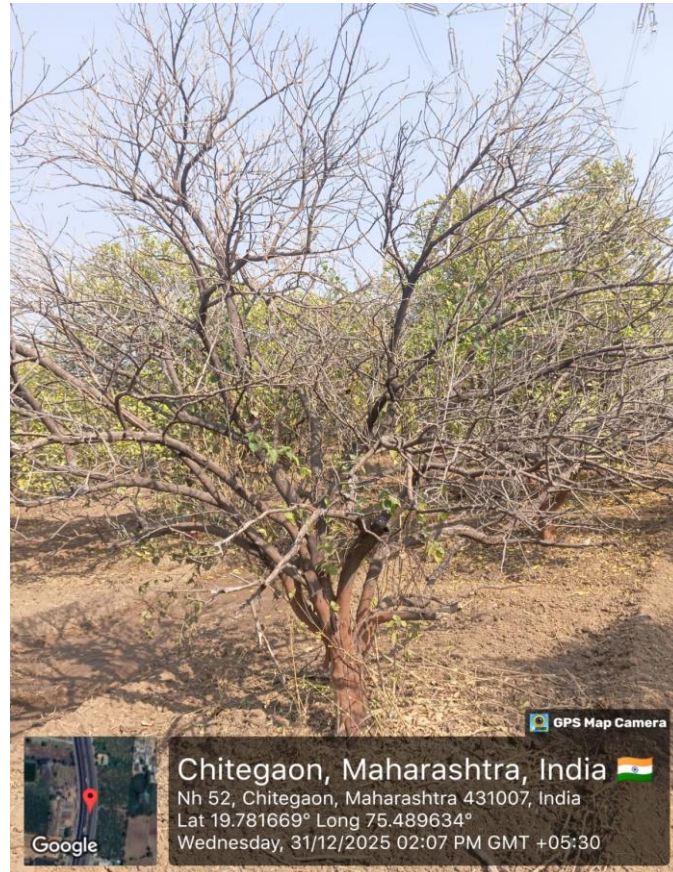
**Figure 2. Comparison of Mean Plant Height and Canopy Spread Between Healthy and *Tylenchulus semipenetrans*-Infected Citrus Orchards**



**Figure 3. Relationship between Nematode Population Density and Fruit Yield.**



**Figure 4. Symptoms Associated with *Tylenchulus semipenetrans* Infestation in Citrus Orchards**



### Discussion

The present study demonstrated that *Tylenchulus semipenetrans* significantly affects citrus growth and productivity. The nematode population was considerably higher in declining orchards than in healthy orchards.

Reductions in plant height, canopy spread and root biomass observed in this study agree with the findings of Duncan and Cohn (1990), who reported severe feeder root damage in infected citrus plants. Root impairment reduces nutrient and water uptake resulting in chlorosis and stunted growth.

The significant reduction in fruit size, fruit weight and yield supports previous reports by O'Bannon (1977), who documented economic losses associated with citrus nematode infestation. Similar findings were reported by Inserra et al. (1980), indicating that increasing nematode density directly affects citrus productivity.

The strong negative correlation ( $r = -0.92$ ) observed between nematode population and yield indicates that nematode density may serve as a useful predictor of economic damage. Integrated nematode management practices involving resistant rootstocks, organic amendments and biological control agents have been recommended to reduce losses (Akhtar and Malik, 2000).

### Conclusion

The survey clearly demonstrated that *Tylenchulus semipenetrans* is a major limiting factor in citrus production in Paithan and Chhatrapati Sambhajnagar district. Infested orchards exhibited poor vegetative growth, reduced root development, lower fruit quality and substantial yield loss. Yield reduction reached nearly 47% under heavy infestation. Therefore, regular monitoring of nematode populations and adoption of integrated management practices are essential for sustainable citrus production in Maharashtra.

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