

# Nematode pests of Coconut-based cropping system and their management

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## Abstract

The coconut tree originated from Southeast Asia and is considered Kalpavriksha – the ‘tree of heaven which means all the tree parts are useful. India is the leading producer of coconut in the global market. There are various pests which attack the coconut-based cropping system of which nematodes are also one of the serious pests. The nematodes which attack coconut-based cropping system are burrowing nematode- *Radopholus similis*, root-knot nematode- *Meloidogyne incognita*, and red-ring nematode- *Bursaphelenchus cocophilus*. These nematode pests are significant threats, affecting the root system and leading to poor growth, reduced yield, and in severe cases, plant death. Of these, red ring nematodes are not present in India. Effective management of nematodes in coconut-based cropping system is crucial to ensure healthy palms and sustainable yields.

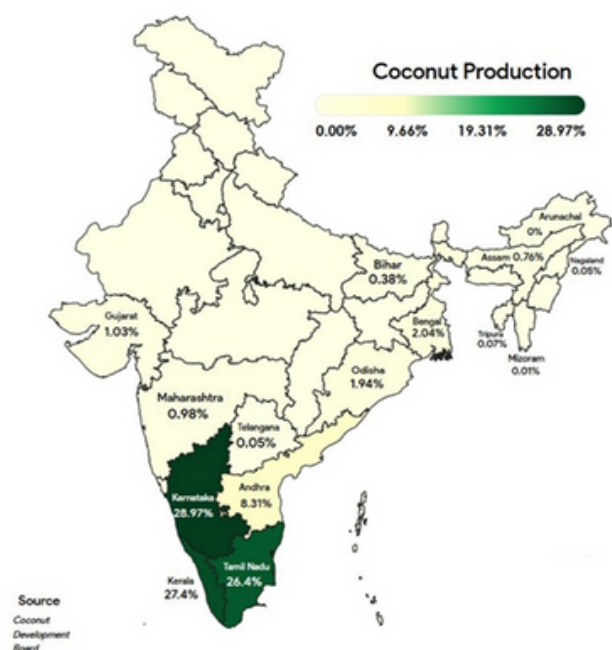
**Keywords:** Kalpavriksha, nematodes, quarantine, management

## Introduction

The coconut tree (*Cocos nucifera* L.) belongs to the family Arecaceae which is originated in Southeast Asia and transported to America and Africa through ocean currents and by voyagers. It grows well in tropical regions of temperatures around  $27 \pm 5^{\circ}\text{C}$  and does not survive temperatures below  $20^{\circ}\text{C}$ . India is the leading producer of coconut in the global market. From 2022 to 23 the production of coconut is 3.7K MT (Anonymous, 2022). Around 90% of the coconut products are produced in the four main southern states of India: Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh. In the order of production- Karnataka (28.97%) > Kerala (27.4%) > Tamil Nadu (26.4%) > Andhra Pradesh (8.31%) (Figure 1), Karnataka makes up the largest proportion of production in India as per data of CDB (Coconut Development Board), 2022-2023. The following crops, like black pepper, turmeric, betel vine, and ginger, are

planted as intercrops in coconut plantations. There are numerous pests and diseases of coconut-based cropping system of which nematodes are also one of the serious threats to the coconut plantations. The serious nematode pests of coconut-based cropping systems are the burrowing nematode, *Radopholus similis*, and the root-knot nematode, *Meloidogyne incognita* which are present in India (Anes et al., 2021). Another serious nematode pest is the red-ring nematode *Bursaphelenchus cocophilus* which is a quarantine pest, not present in India (Nisha et al., 2024).

the oesophagus which is degenerated and bursa covers two-third of the tail (Sekora and crow et al., 2012). It causes general nonspecific symptoms such as yellowing, stunting, reduction in the number and size of leaves and leaflets, delay in flowering, button shedding and yield reduction. Their infestation is more severe in the roots of nursery seedlings. They produce small, elongated, orange-coloured lesions on the creamy-white roots is the typical symptom (Figure 2). Burrowing nematode is a parasite of more than 300 plant species. It also infests major crops like banana, black pepper, betel vine, ginger, turmeric etc. This nematode also causes the toppling disease of banana.



**Fig. 1.** Coconut production in India 2022-23

### Burrowing nematode, *Radopholus similis*

It is the migratory endoparasite that completes its life cycle within 25 days inside the coconut roots (Geetha et al., 1991). All the larval stages and females are infective except males. The typical identification characters for *Radopholus similis* are the females with lip region sometimes set off and hemispherical, well-developed oesophagus with overlapping dorsally, vulva postmedian, gonads paired, outstretched, tail elongate conoid while the male has



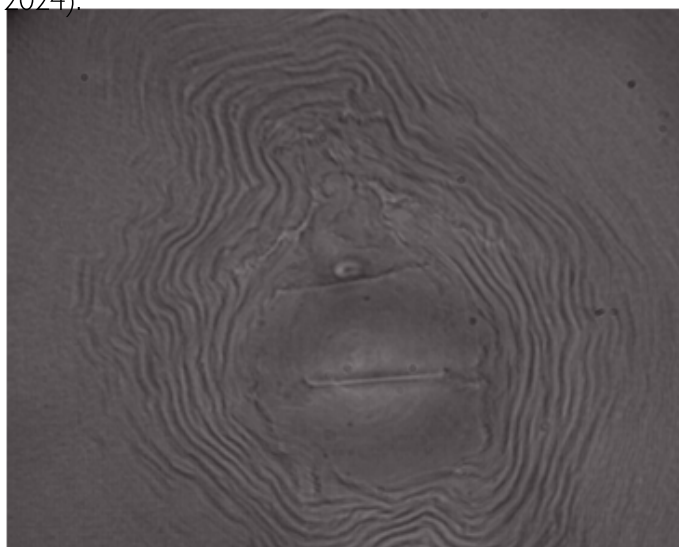
**Fig. 2.** Necrotic lesions caused by burrowing nematode in coconut root (from right to left) (Photograph by V.K. Sosamma.)

### Root-knot nematode, *Meloidogyne incognita*

It is a sedentary endoparasite with a broad host range. Its life cycle is completed within 24-30 days (Mhatre et al., 2020). This nematode causes damage to coconut-based cropping systems such as ginger, turmeric, black pepper, and betel vine which are planted as intercrops but not the main crop of coconut (Nampoothiri et al., 2019). The identification of this nematode is done based on examining the perineal pattern of melon-shaped females which has a high dorsal arch, no distinct lateral lines and punctations (Figure 3). Whereas in vermiform males bursa is absent, and second-stage juveniles have elongated conoid tail with pointed (Eisenback et al., 1985).



Symptoms include the formation of rounded or irregular galls in the roots and stunting and yellowing are above-ground symptoms caused by this nematode. This nematode infestation aggravates many other pathogens like *Phytophthora capsici* which causes slow decline or slow wilt in black pepper (Rai and Upadhyay et al., 2023), and *Fusarium oxysporum* in the roots of black pepper (Ramana et al., 1992). In turmeric this nematode acts as predisposer for secondary pathogen like *Pythium* sp. (Jalaluddin et al., 2024).



**Fig. 3.** Perineal pattern of *Meloidogyne incognita*

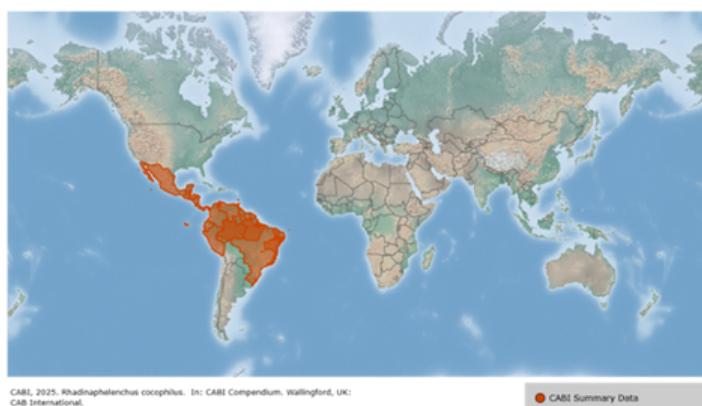
## Red-ring nematode, *Bursaphelenchus cocophilus*

It is the aerial plant parasite, transmitted by palm weevil (*Rhynchophorus palmarum* L.). Nematodes are injected into the tissues of young coconut palms aged 2.5 to 10 years by insects while depositing their eggs. Nematodes first occur intercellularly and later found in both intercellularly and intracellularly. Symptoms include initial chlorosis appearing in the older leaves, and premature shedding of nuts, in cross-section the stem appears orange to brick red colour ring of 2 to 4 cm wide (Figure 4). The disease-affected trees will not recover after attack by this nematode because there will be an imbalance in the water uptake by the plant (Griffith et al., 2018). It is a quarantine pest that occurs in the West Indies and Latin America, which is not present in India (Figure 5). The plant materials such as seed nuts, seedlings, pollens, and tissue cultures etc.,

where import is prohibited and are subjected to quarantine inspection.



**Fig. 4.** Red ring symptom caused by *Bursaphelenchus cocophilus* in cross-section. (Photograph by Society of Nematologists slide collection)



**Fig. 5.** Distribution map of *Bursaphelenchus cocophilus*

## Management

- Use of nematode-free planting materials from certified nurseries.
- Avoid planting intercrops such as banana, black pepper, turmeric, betel vine, and ginger in coconut plantations or nurseries.
- Remove the infected roots of the seedlings before planting.
- Use of less susceptible cultivars such as dwarf cultivars Kenthali and Klappawang, tolerant cultivar such as Indonesia 6 (VTL-11), Mahuva 8 and Andaman-5 (VTL-29e) and hybrids such as Java Giant x Malayan Dwarf Yellow, San Ramon x

SGangabondam, Kulasekharam Dwarf Yellow × Java Giant, Java Giant × Kulasekharam Dwarf Yellow, and Indonesia-6 (VTL-11) × Singapore (VTL 17) are resistant against *R. similis*. (Sosamma et al., 1980, 1988; Sosamma et al., 1984; Griffith et al., 2018).

- Growing antagonistic crops like marigold as intercropping or as border planting will reduce the nematode population.
- Incorporation of bioagents such as AMF (Arbuscular Mycorrhizal Fungi), *Pasteuria penetrans* and *Paecilomyces lilacinus* in potting mixture
- Application of organic amendments like neem cakes at 2-4 kg/palm/ year.
- Apply 3 kg of enriched FYM per pit before planting and apply at an interval period of six months and it is prepared by mixing with 2 kg of each of *Pseudomonas fluorescens* + *Trichoderma harzianum* + *Paecilomyces lilacinus* formulation under shade. It has to be covered with mulch and optimum moisture of 25 - 30% has to be maintained for a period of 15 days.

## Conclusion

The management of nematodes in coconut-based cropping system requires a holistic approach, balancing cultural, biological, and chemical methods. By adopting these integrated strategies, farmers can protect their coconut palms from nematodes, ensuring higher yields and long-term sustainability. Regular monitoring and adaptive management are key to keeping nematode infestations under control and maintaining the health of coconut plantations.

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