Journal of Plantation Crops 2026, 54(2): 94-99
https://doi.org/10.25081/jpc.2026.v54.i2.10060

Research Article

Crop-specific distribution intensity and farmer-participatory integrated management of root-knot nematodes (*Meloidogyne* spp.) in coconut-based cropping system

K. M. Anes[1]*, Merin Babu[1], A. Josephrajkumar[1], H. Kesavakumar[2], Jilu V. Sajan[1], P. Anithakumari[1]

[1]*ICAR-Central Plantation Crops Research Institute, Regional Station, Kayamkulam-690533, Keralam*
[2]*ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram-695017, Keralam*

(Received: July 20, 2026; Revised: September 13, 2026; Accepted: September 15, 2026)
*Corresponding author: K. M. Anes, E-mail: aneskm@gmail.com

Abstract

Root-knot nematodes (*Meloidogyne* spp.) are hidden enemies of crops and often-overlooked pests that cause severe yield losses in diverse crops. A survey was conducted in Alappuzha district, Kerala, to assess the crop-specific occurrence and distribution of root-knot nematodes (RKN) in coconut intercrops, including vegetables, fruits, tubers, and spice crops. The results revealed RKN infestation across all sampled regions, with varying severity among crops. Elephant foot yam, ginger, and papaya were the most severely affected (gall index 3–5), whereas cassava and arrowroot showed only mild infestation (gall index 1). Molecular characterization confirmed *Meloidogyne incognita* and *M. javanica* as the predominant RKN species, with 99.15–100% sequence identity to reference 28S rRNA sequences. The invasive root-knot nematode *Meloidogyne enterolobii* was also detected in some samples, *viz.,* guava, West Indian cherry, star apple, and tomato. Farmer-participatory integrated nematode management strategies—including field sanitation, the use of nematode-free planting materials, crop rotation with less-preferred hosts such as cassava, together with the application of *Trichoderma harzianum* and *Pochonia chlamydosporia*-enriched organic amendments—resulted in a 52%–78% reduction in RKN infestation in the demonstration plots. These validated integrated management practices enhanced awareness among farmers, facilitated cross-learning among stakeholders, and promoted sustainable nematode management in coconut-based cropping systems.

Keywords: Root-knot nematode, *Meloidogyne* spp., Plant parasitic nematode, Integrated management, Crop rotation, Biocontrol

Introduction

Root-knot nematodes (*Meloidogyne* spp.) are among the most damaging plant-parasitic nematodes worldwide, infesting thousands of crops and causing substantial yield losses (Karssen & Moens, 2006). These obligate endoparasites have a wide host range, including weeds, and thrive in diverse agroecosystems. *Meloidogyne incognita* and *M. javanica* are the most widely distributed root-knot nematode species in India, infesting numerous agricultural, horticultural and plantation crops (Khan *et al.,* 2006). Owing to the polyphagous nature, high virulence and ability to overcome host resistance genes, the invasive root-knot nematode *Meloidogyne enterolobii* (Yang & Eisenback, 1983) is threatening the agri-production systems worldwide (Kiewnick *et al.,* 2009; Castagnone-Sereno, 2012). *Meloidogyne enterolobii* was first reported in India from Tamil Nadu in 2016 (Poornima *et al.,* 2016) and later in Kerala (Anes *et al.,* 2023). Its aggressive reproductive potential and wide host range pose serious biosecurity threats in terms of incursion potential in different crops. In Kerala, severe RKN damage is frequently observed in coconut intercrops, especially in the sandy soils of coastal belts (Anes *et al.,* 2021). Coconut-based cropping systems, designed to maximize farm income and climate resilience, rely on intercropping with vegetables, fruits, spices, and tuber crops. However, the prevalence of pests and diseases, particularly nematodes, is a major limiting factor. In this context, the present study was conducted to assess the occurrence and distribution of RKN in coconut intercrops in Alappuzha district, Kerala as well as to validate farmer-participatory integrated nematode management strategies under field conditions.

Materials and methods

Survey and collection of samples

Root and tuber samples were collected from different intercrops *viz.,* vegetables, fruits, tubers, and spices grown in coconut-based systems across Kayamkulam, Pathiyoor, Devikulangara, Vallikunnam, Cherthala, and Krishnapuram regions of Alappuzha district. The collected roots and tubers were gently washed, and the extent of gall formation was visually assessed. Gall severity was scored using a modified 1–5 gall index scale based on Hussey and Janssen (2002): 1 = ≤20% roots galled; 2 = 21–40%; 3 = 41–60%; 4 = 61–80%; and 5 = ≥81% of the root/tuber area galled. Adult females were separated from infested root/tuber tissues under a stereomicroscope (Leica Wild M3Z) and hand-picked for DNA extraction, while the perineal patterns of adult females and the morphological characteristics of juveniles were also examined for species identification.

Molecular characterization

Genomic DNA was extracted from single females using the cetyltrimethylammonium bromide (CTAB) method. PCR amplification of the D2–D3 expansion region of the 28S rRNA gene was performed using primers D2a and D3b (De Ley *et al.,* 1999). PCR products were purified and sequenced (Biokart India Pvt. Ltd., Bengaluru). The 28S rRNA gene sequences under study were subjected to BLAST analysis using the National Center for Biotechnology Information (NCBI) database to identify homologous sequences (Altschul *et al.,* 1990). Additionally,

species-specific SCAR markers (Long *et al.,* 2006) were used to confirm the identity of *M. enterolobii*.

Integrated Nematode Management (INM)

Awareness programmes, diagnostic field visits, and farmer training programmes were conducted to sensitise farmers to the impact of nematode infestation in different intercrops in coconut-based systems and to familiarise them with available management options. Farmer-participatory demonstration trials were established in one farmer's field each at Pathiyoor and Krishnapuram under the ICAR–Farmer FIRST Programme. The INM package included field sanitation, the use of nematode-free planting materials, crop rotation with cassava as a less-preferred host, and the application of *Trichoderma harzianum* (CPT28) and *Pochonia chlamydosporia* (CPP1) enriched neem cake and organic manures. The effectiveness of the interventions was evaluated by comparing gall indices recorded before intervention with those recorded during the first and second years after intervention.

Statistical analysis

Root-knot nematode infestation was assessed using a 1–5 gall index scale and observations were recorded from ten randomly selected plants for each crop at each surveyed location. Mean gall index and standard error (SE) were calculated and expressed as mean±SE. The level of infestation was categorised based on the mean gall index as follows: 1.0–1.9 = low infestation, 2.0–2.9 = moderate infestation, 3.0–3.9 = heavy infestation, and 4.0–5.0 = severe infestation. For the farmer-participatory integrated nematode management trials, the percentage reduction in gall index was calculated based on the difference between the pre-intervention and post-intervention gall indices relative to the pre-intervention value. Statistical analyses were performed using standard statistical procedures (Gomez & Gomez, 1984).

Results

Distribution of root-knot nematodes in coconut intercrops

Root-knot nematode (RKN) infestation was prevalent in all coconut-based intercropping systems surveyed, though severity varied across crops and locations (Table 1). Among the intercrops in coconut-based systems, elephant foot yam exhibited the highest mean gall index (3.4-5.0), indicating severe infestation. Ginger and papaya also recorded high infestation levels (3.4 to 4.5), with severe gall formation, stunting, and yellowing of foliage. Turmeric exhibited moderate to heavy galling (2.3-3.3), while colocasia showed low to moderate infestation (1.3-2.6). In contrast, cassava consistently showed low infestation levels (1.1-1.4) across all villages, indicating relatively low susceptibility to RKN infestation. Arrowroot, although less frequently sampled, also showed minimal gall formation (1.2). Molecular characterization indicated the predominance of *Meloidogyne incognita* and *M. javanica* in most samples,

Table 1: Severity of root-knot nematode (*Meloidogyne* spp.) infestation in coconut intercrops at selected locations in Alappuzha district, Kerala

S. No.	Location	Crop	Gall index[1] (Mean±SE)	Remarks (level of infestation)
1	Kayamkulam	Ginger	4.3±0.15	Severe
2		Turmeric	3.1±0.10	Heavy
3		Papaya	3.4±0.16	Heavy
4		Okra	4.2±0.13	Severe
5		Colocasia	2.6±0.16	Moderate
6		Arrowroot	1.2±0.13	Low
7		Cassava	1.1±0.10	Low
8	Pathiyoor	Elephant foot yam	5.0±0.00	Severe
9		Brinjal	3.3±0.15	Heavy
10		Turmeric	3.3±0.15	Heavy
11		Ginger	4.2±0.13	Severe
12		Cassava	1.3±0.15	Low
13	Devikulangara	Elephant foot yam	4.4±0.16	Severe
14		Colocasia	2.4±0.16	Moderate
15		Cassava	1.4±0.16	Low
16	Vallikunnam	Elephant foot yam	3.4±0.16	Heavy
17		Ginger	4.0±0.00	Severe
18		Turmeric	2.3±0.15	Moderate
19		Cassava	1.2±0.13	Low
20	Cherthala	Brinjal	2.5±0.17	Moderate
21		Ginger	3.6±0.16	Heavy
22		Elephant foot yam	3.4±0.16	Heavy
23		Colocasia	1.3±0.15	Low
24		Cassava	1.1±0.10	Low
25	Krishnapuram	Elephant foot yam	5.0±0.00	Severe
26		Ginger	3.4±0.22	Heavy
27		Turmeric	3.2±0.13	Heavy
28		Papaya	4.5±0.17	Severe
29		Brinjal	2.4±0.16	Moderate
30		Cassava	1.2±0.13	Low

[1]Gall index scale: 1 = ≤20%; 2=21–40%; 3=41–60%; 4=61–80%; 5 = ≥81% galling of roots; Gall index values represent the mean of 10 observations

exhibiting 99.15-100% sequence identity in the 28S rRNA gene region with corresponding sequences available in GenBank. The invasive RKN, *M. enterolobii* (GenBank acc. no. OP935640 and OP923224) was previously detected in guava plants at Kayamkulam, marking the first record of this invasive species in Kerala (Anes *et al.,* 2023). Subsequently, it was detected in guava from other locations as well as in West Indian cherry, star apple, and tomato (Figure 1), indicating its occurrence across multiple host species.

Symptom expression

The impact of RKN infestation on crop health was evident from visible symptoms including gall formation, stunting, and foliar yellowing. In ginger and turmeric, nematode infestation was associated with severe root galling and swelling of rhizomes (Figure 2), which may predispose the plants to secondary rhizome-rot pathogens and contribute to reductions in marketable yield. Elephant foot yam corms developed large, rounded galls that compromised marketability and storage quality, and may have predisposed the corms to secondary fungal infections and rotting during storage (Figure 3). In papaya, root galling was associated with severe stunting, premature leaf yellowing and inadequate fruit setting. These characteristic symptoms were observed in association with nematode infestation, highlighting the potential economic significance of RKN in these coconut-based intercropping systems and its possible impact on market returns.

Farmer-participatory integrated nematode management

Farmer-participatory demonstrations of integrated nematode management practices resulted in a substantial reduction in root-knot nematode infestation in the demonstration plots over the two-year study period (Table 2). At Pathiyoor, the gall index of elephant foot yam decreased from 5.0 before intervention to 1.3 during first year and remained relatively low (2.1) during the second year, corresponding to reductions of 74.0% and 58.0%, respectively. Similarly, ginger and turmeric exhibited marked reductions in galling, with reductions of 52.4%–73.8% and 63.6%–69.7%, respectively, over the two years. A comparable trend was observed at Krishnapuram, where the gall index of elephant foot yam decreased from 5.0 to 1.1 during the first year and remained low (2.0) during the second year, representing reductions of 78.0% and 60.0%, respectively. In ginger and turmeric, gall indices decreased from 3.4 and 3.2 before intervention to 1.1 and 1.0, respectively, during the first year and remained at low levels (1.1–1.3) during the second year. Across locations, the mean reduction in gall index during the first year was 76.0% in elephant foot yam, 66.2% in turmeric and 60.0% in ginger. During the second year, the corresponding reductions were 59.0%, 67.7% and 67.8%, respectively. Overall, the integrated nematode management interventions resulted in average reductions of 67.4% and 64.8% in gall index during the first and second years, respectively, reducing infestation from severe or heavy to moderate or low levels and demonstrating the effectiveness of the management strategy under farmer-field conditions.

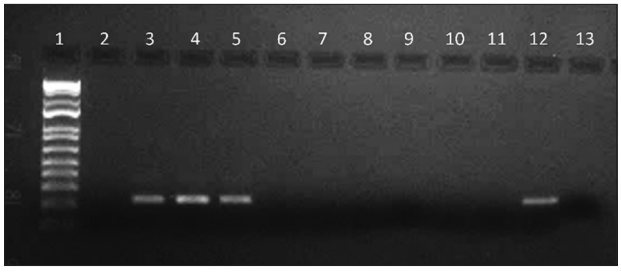


Figure 1: Agarose gel electrophoresis of PCR-amplified product using the *Meloidogyne enterolobii*-specific SCAR marker. Lane 1 - 1kb DNA ladder; lane 2 - no-template control; lane 3 – RKN from star apple; lane 4 - RKN from West Indian cherry; lane 5 – RKN from tomato; lanes 6 to 11 & 13 RKN from other crops; lane 12 – RKN from guava

Discussion

The survey clearly established that RKNs are widely prevalent in coconut-based intercropping systems in coastal belts of Kerala, with varying levels of host susceptibility. The high infestation observed in elephant foot yam, ginger, and papaya corroborates earlier findings that these crops serve as good hosts for *Meloidogyne* spp. (Rajendran & Mathew, 1999; Nagesh & Reddy, 2005; Mohandas *et al.,* 2018), thereby potentially contributing to nematode build-up in intercropped systems. Conversely, cassava and arrowroot showed low galling, supporting their potential role as relatively poor hosts in crop rotation programmes. These crops may therefore be considered for inclusion in crop rotation programmes in RKN-endemic areas of coconut-based systems.

The detection of *M. enterolobii* from guava and other horticultural crops is particularly significant. Since *M. enterolobii* is recognised globally for its aggressiveness, high virulence, wide host range, and ability to overcome resistance (Castagnone-Sereno, 2012; Onkendi *et al.,* 2014), its detection in coconut-based cropping systems in Kerala not only extends its known geographical distribution but also necessitates strict quarantine vigilance. Invasions of *M. enterolobii* have caused substantial yield losses in guava and other horticultural crops in other parts of India (Ghule *et al.,* 2020), and its spread in coconut-based systems could adversely affect established intercropping models if left unchecked. As non-native pests, including nematodes, cause a shift in the native fauna with competitive displacement, their entry into a new region is always viewed as detrimental, causing biodiversity decline and setbacks to economic livelihood. Despite the existence of quarantine regulations, the high demand for planting materials across the country, coupled with inadequate awareness among some private nurseries, may facilitate the movement of nematode-infested planting materials, thereby contributing to the introduction and spread of destructive nematode species such as *M. enterolobii* (Poornima & Walia, 2021). This underscores the need for continued quarantine surveillance and the development and adoption of resistant or tolerant varieties to withstand nematode feeding pressure. Adequate sensitisation and preparedness among different

Table 2: Reduction in root-knot nematode gall index following farmer-participatory integrated nematode management in coconut intercrops

S. No.	Village/ Farmer	Crop	Before intervention Gall inde× [1](Mean±SE)	After one year		After two years	
				Gall index[1] (Mean±SE)	Reduction (%)	Gall index[1] (Mean±SE)	Reduction (%)
1	Pathiyoor Farmer 1	Elephant foot yam	5.0±0.00 (Severe)	1.3±0.15 (Low)	74.0	2.1±0.23 (Moderate)	58.0
		Ginger	4.2±0.13 (Severe)	2.0±0.26 (Moderate)	52.4	1.1±0.10 (Low)	73.8
		Turmeric	3.3±0.15 (Heavy)	1.2±0.13 (Low)	63.6	1.0±0.00 (Low)	69.7
2	Krishnapuram Farmer 2	Elephant foot yam	5.0±0.00 (Severe)	1.1±0.10 (Low)	78.0	2.0±0.21 (Moderate)	60.0
		Ginger	3.4±0.22 (Heavy)	1.1±0.10 (Low)	67.6	1.3±0.15 (Low)	61.8
		Turmeric	3.2±0.13 (Heavy)	1.0±0.00 (Low)	68.8	1.1±0.10 (Low)	65.6

[1]Gall index scale: 1 = ≤20%; 2=21–40%; 3=41–60%; 4=61–80%; 5 = ≥81% galling of roots; Gall index values represent the mean of 10 observations

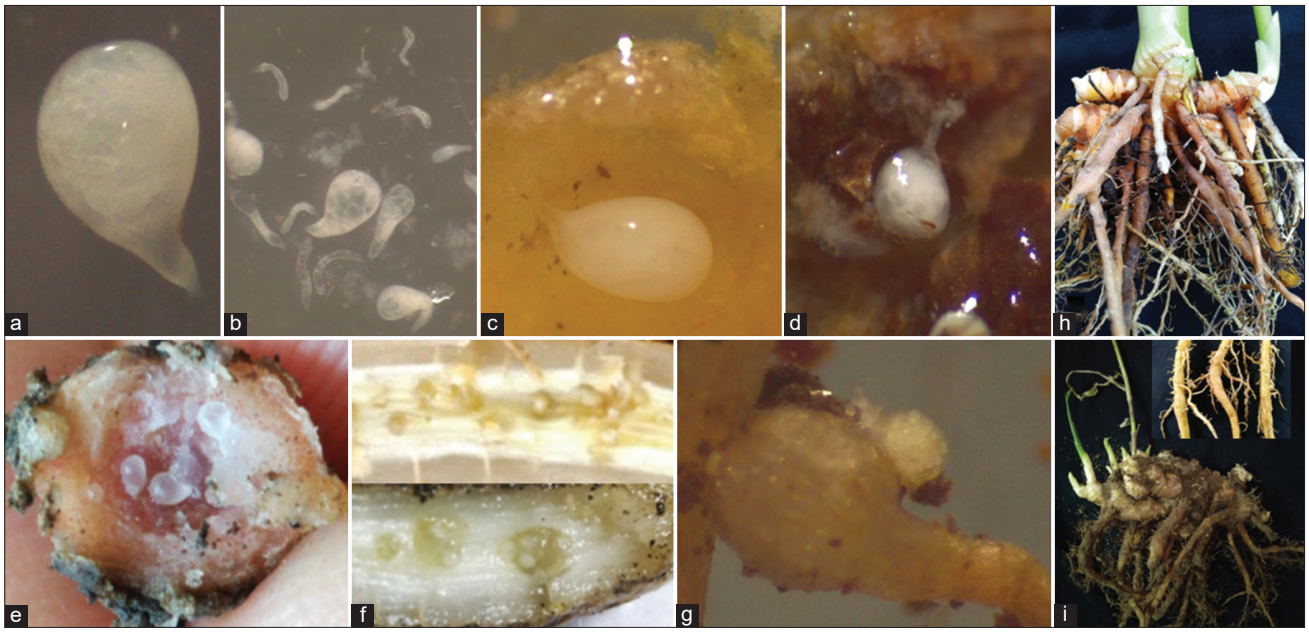


Figure 2: a) Adult female of root-knot nematode (RKN), b) Developmental stages of RKN, c) Adult female inside turmeric root, d) Adult female inside guava root, e) Adult females inside elephant foot yam, f) Adult females and egg masses inside ginger root, g) Gall with egg mass on the feeder root of papaya, h) Symptoms of RKN infestation in turmeric and i) Symptoms of RKN infestation in ginger

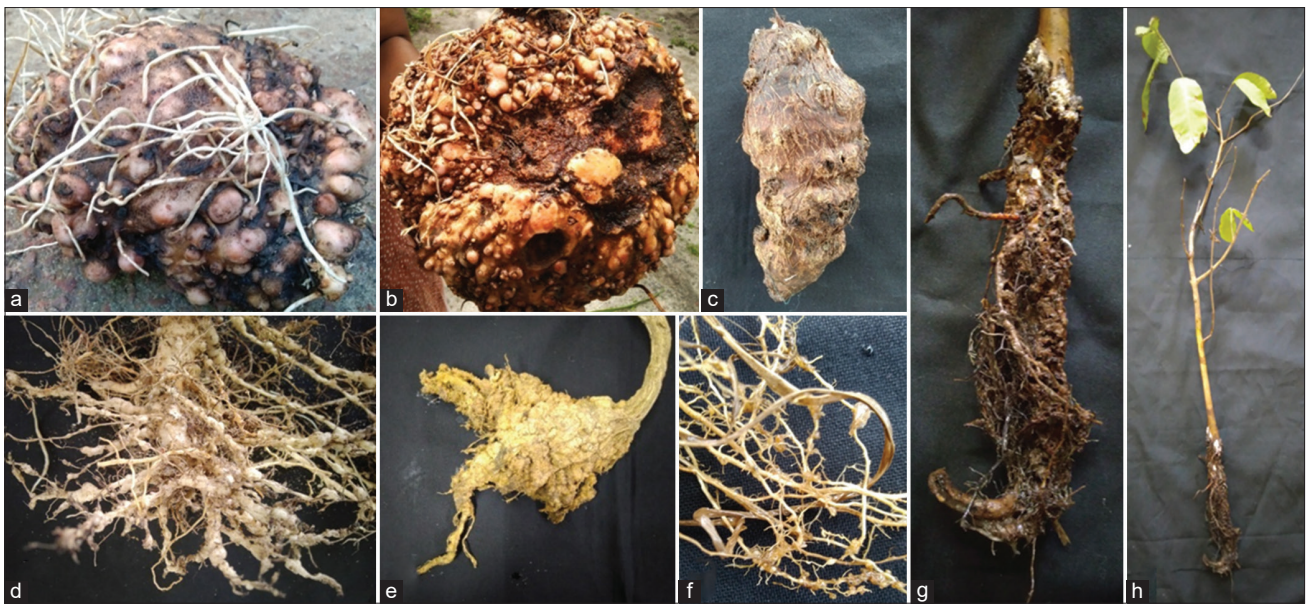


Figure 3: a, b) Root-knot nematode (RKN) infestation in elephant foot yam, c) RKN infestation in colocasia, d) RKN infestation in okra, e) RKN infestation in bitter gourd, f) RKN infestation in little millet, g & h) RKN infestation in guava

stakeholders are key components of strategies to contain the further spread of nematode infestation.

The farmer-participatory management trials demonstrated that nematode problems, though largely

hidden beneath the soil, can be effectively addressed through integrated and preventive strategies. The combination of clean planting materials, soil amendments, bioagents, and field sanitation resulted in substantial reductions in gall index, with reductions of up to 78% recorded in farmer fields. Several strategies have been evolved to manage the problem of RKN through cultural, chemical as well as biological means. The efficacy of *T. harzianum* in suppressing the nematode population with direct application and culture filtrates have been documented (Prasad & Anes, 2008). Crop rotation is an important cultural practice for the management of plant-parasitic nematodes. It involves the systematic alternation of susceptible crops with resistant, tolerant, poor-host or non-host crops in a given field. Such rotations help reduce nematode population densities by interrupting their life cycle and limiting opportunities for reproduction. The effectiveness of crop rotation largely depends on the inclusion of crops that exhibit high levels of resistance or are less-preferred hosts to the nematode species prevalent in the field. Several workers have reported field demonstrations in which integrated approaches combining organic amendments, bioagents such as *Paecilomyces lilacinus* and *P. chlamydosporia*, and improved crop management significantly suppressed RKN incidence (Siddiqui & Mahmood, 1996; Jonathan & Rajendran, 2000; Mohandas *et al.,* 2017).

The participatory mode of implementation under the ICAR–Farmer FIRST Programme not only reduced nematode infestation but also facilitated farmer involvement and technology adoption. Farmers also reported noticeable improvements in plant vigour, rhizome yield, and storage quality, highlighting the economic benefits of the approach. Similar success of participatory nematode management has been reported in perennial and plantation-based cropping systems elsewhere (Sikora & Fernandez, 2005; Bridge & Starr, 2007; Coyne *et al.,* 2018; Desaeger *et al.,* 2020). Community-level participation and coordinated management may also help reduce the risk of re-infestation from untreated neighbouring fields, which is a common challenge in nematode management.

Conclusion

Root-knot nematodes are an important production constraint in coconut-based intercropping systems of Kerala, particularly in sandy soils. The detection of the invasive *M. enterolobii* highlights a serious biosecurity concern and underscores the need for continued surveillance, preparedness, and awareness among stakeholders. The systematic adoption of integrated nematode management practices, including the use of nematode-free planting materials, field sanitation, organic amendments enriched with bioagents, and crop rotation, effectively reduced RKN infestation levels under farmer-field conditions. Farmer-participatory approaches further supported knowledge sharing and technology adoption. Continued surveillance and wider adoption of integrated management practices are essential for the sustainable management of RKN in coconut-based intercropping systems.

References

Altschul, S. F., Gish, W., Miller, W., Myers, E. W., & Lipman, D. J. (1990). Basic local alignment search tool. *Journal of Molecular Biology, 215*(3), 403-410. https://doi.org/10.1016/S0022-2836(05)80360-2

Anes, K. M., Arsha, G. M., & Josephrajkumar, A. (2021). Nematodes as an enemy and friend in coconut-based cropping system. *Indian Coconut Journal, 63*(12), 21-25.

Anes, K. M., Merin Babu, & Josephrajkumar, A. (2023). Root-knot nematode, *Meloidogyne enterolobii* Yang and Eisenback, 1983 infecting guava intercropped with coconut plantation in Kerala, India. *Indian Journal of Nematology, 53*(1), 15-20.

Bridge, J., & Starr, J. L. (2007). *Plant Nematodes of Agricultural Importance: A Colour Handbook*. (1st ed). CRC Press. https://doi.org/10.1201/b15142

Castagnone-Sereno, P. (2012). *Meloidogyne enterolobii* (*M. mayaguensis*): profile of an emerging, highly pathogenic root-knot nematode species. *Nematology, 14*(2), 133-138. https://doi.org/10.1163/156854111X601650

Coyne, D. L., Cortada, L., Dalzell, J. J., Claudius-Cole, A. O., Haukeland, S., Luambano, N., & Talwana, H. (2018). Plant-parasitic nematodes and food security in Sub-Saharan Africa. *Annual Review of Phytopathology, 56*, 381-403. https://doi.org/10.1146/annurev-phyto-080417-045833

De Ley, P., Felix, M. A., Frisse, L. M., Nadler, S. A., Sternberg, P. W., & Thomas, W. K. (1999). Molecular and morphological characterisation of two reproductively isolated species with mirror-image anatomy (Nematoda: Cephalobidae). *Nematology, 1*, 591-612.

Desaeger, J., Wram, C., & Zasada, I. (2020). New reduced-risk agricultural nematicides—rethinking nematode management in modern agriculture. *Annual Review of Phytopathology, 58*, 253-282. https://doi.org/10.21307/jofnem-2020-091

Ghule, T. M., Phani, V., Somvanshi, V. S., Patil, M., Bhattacharyya, S., & Khan, M. R. (2020). Further observations on *Meloidogyne enterolobii* (Nematoda: Meloidogynidae) infecting guava (*Psidium guajava*) in India. *Journal of Nematology, 52*, 1-9. https://doi.org/10.21307/jofnem-2020-120

Gomez, K. A., & Gomez, A. A. (1984). *Statistical Procedures for Agricultural Research*. (2nd ed.). John Wiley & Sons.

Hussey, R. S., & Janssen, G. J. W. (2002). Root-knot nematodes: *Meloidogyne* species. In J. L. Starr, R. Cook & J. Bridge (Eds.), *Plant Resistance to Parasitic Nematodes* (pp. 43-70). CAB International. https://doi.org/10.1079/9780851994666.0043

Jonathan, E. I., & Rajendran, G. (2000). Assessment of avoidable yield loss in banana due to root-knot nematode *Meloidogyne incognita*. *Indian Journal of Nematology, 30*, 162-164.

Karssen, G., & Moens, M. (2006). Root-knot nematodes. In R. N. Perry & M. Moens (Eds.), *Plant Nematology* (pp. 59-90). CABI International. https://doi.org/10.1079/9781845930561.0059

Khan, M. R., Pal, S., & Jairajpuri, M. S. (2006). Occurrence of root-knot nematodes on various crops in India. *Indian Journal of Nematology, 36*, 248-252.

Kiewnick, S., Dessimoz, M., & Franck, L. (2009). Effects of the Mi-1 and N root-knot nematode-resistance gene on infection and reproduction of *Meloidogyne enterolobii* on tomato and pepper cultivars. *Journal of Nematology, 41*, 134-139.

Long, H., Liu, H., & Xu, J. H. (2006). Development of a PCR diagnostic for the root-knot nematode *Meloidogyne enterolobii*. *Acta Phytopathologica Sinica, 36*, 109-115.

Mohandas, C., Anil, S. R., & Kumar, A. (2018). Status of root-knot nematodes in tropical tuber crops. *Journal of Root Crops, 44*, 3-12.

Mohandas, C., Rajasekharan, P. E., Radhakrishnan, N. V., & Anil, S. R. (2017). Integrated nematode management in tuber crops. *Indian Journal of Nematology, 47*, 65-72.

Nagesh, M., & Reddy, P. P. (2005). Integrated nematode management in spices. *Indian Journal of Nematology, 35*, 1-9.

Onkendi, E. M., Kariuki, G. M., Marais, M., & Moleleki, L. N. (2014). The threat of root-knot nematodes (*Meloidogyne enterolobii*) in Africa: a review. *Plant Pathology, 63*(4), 727-737. https://doi.org/10.1111/ppa.12202

Poornima, K., & Walia, R. K. (2021). Horticultural nurseries and nematode dissemination. *Current Science*, *120*(2), 278-284.

Poornima, K., Suresh, P., Kalaiarasan, P., Subramanian, S., & Ramaraju, K. (2016). Root-knot nematode, *Meloidogyne enterolobii* in guava (*Psidium guajava* L.): a new record from India. *Madras Agricultural Journal, 103*, 359-365.

Prasad, D., & Anes, K. M. (2008). Effect of metabolites of *Trichoderma harzianum* and *T. viride* on plant growth and *Meloidogyne incognita* on okra. *Annals of Plant Protection Sciences, 16*, 461-465.

Rajendran, G., & Mathew, C. 1999. Root-knot nematode, *Meloidogyne incognita* infestation on Amorphophallus. *Journal of Tropical Agriculture, 37*, 61-63.

Siddiqui, Z. A., & Mahmood, I. (1996). Biological control of plant parasitic nematodes by fungi. *Bioresource Technology, 58*(3), 229-239. https://doi.org/10.1016/S0960-8524(96)00122-8

Sikora, R. A., & Fernandez, E. (2005). Nematode parasites of vegetables. In M. Luc, R. A. Sikora and J. Bridge, (Eds.), *Plant Parasitic Nematodes in Subtropical and Tropical Agriculture* (pp. 319-392). CABI Publishing.

Yang, B., & Eisenback, J. D. (1983). *Meloidogyne enterolobii* n. sp. (Meloidogynidae), a root-knot nematode parasitizing pacara earpod tree in China. *Journal of Nematology, 15*(3), 381-391.