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First Report of *Meloidogyne incognita* Infecting Cocopeat-Grown Melon (*Cucumis melo* L.) in Bengkulu, Indonesia

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ABSTRACT: Cocopeat, a growing medium derived from coconut husk fibers, is valued for its high porosity, strong water retention, and support for healthy root development. However, its physical properties may also provide favorable conditions for plant-parasitic nematodes. This study reports, for the first time, the occurrence of *Meloidogyne incognita* in melon (*Cucumis melo* L.) cultivated in cocopeat in Bengkulu, Indonesia, and examines the susceptibility of this medium to infestation. Root samples were purposively collected from **six infected plants** showing stunted growth, wilting, and root galling. Adult female nematodes were extracted and identified morphologically through perineal pattern analysis. The diagnostic features, such as a tall, narrow dorsal arch, fine striae, and the absence of lateral lines, consistently matched those of *M. incognita*. Galls of varying sizes were observed in all samples, indicating different infection intensities. This finding suggests that the physical structure of cocopeat may facilitate nematode mobility and persistence across growth stages. The study highlights that cocopeat is not inherently nematode-free despite its agronomic advantages and should be managed through preventive strategies, including substrate sterilization, sanitation, and regular nematode monitoring.

Keywords: root-knot nematode infection, soilless cultivation, perineal pattern identification, growth substrate susceptibility

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INTRODUCTION

Cocopeat, produced from coconut husk fibers, is widely used in modern cultivation for its high water-holding capacity, porosity, and aeration that support root growth (Atikah et al., 2023; Rahman et al., 2024). Its lightweight fibers and good nutrient retention make it effective for plant growth, especially in intensive systems with controlled water and nutrient supply (Rajaseger et al., 2023). In practice, cocopeat is preferred for its cleanliness from soil-borne pathogens, ease of handling, and suitability as an alternative to mineral soil (Agung, 2023).

Although cocopeat is often assumed to be free from pathogens, this perception is not always accurate. During production, transport, or reuse, the material can become contaminated with plant-parasitic organisms. Untreated cocopeat may harbor harmful agents, including root-knot nematodes (*Meloidogyne* spp.) (Ploeg & Edwards, 2024). Its fine physical structure can create microenvironments that support the movement and survival of second-stage juveniles (J2), allowing them to persist, reproduce, and invade plant roots even in systems with precisely controlled water and nutrient delivery.

Meloidogyne infestations damage root tissues, disrupt water and nutrient transport, and induce aboveground symptoms such as chlorosis, stunted growth, and yield reduction (Diniz et al., 2016; Idhmida et al., 2024). These effects can be more severe in cocopeat-based cultivation, as roots rely entirely on this medium for structural support and nutrient distribution. Although perineal pattern identification of *Meloidogyne* species has been reported across various growing media, there is no published record of species infesting crops grown in cocopeat in Bengkulu.

Despite the widespread occurrence of root-knot nematodes in soil-grown melons and other soilless systems, no published record has documented their presence in cocopeat-grown crops in Bengkulu, Indonesia. This province has an expanding horticultural sector where soilless cultivation, including cocopeat-based systems, is increasingly used to support year-round melon production. The absence of local data creates uncertainty about the actual risk of nematode contamination in such systems. Therefore, this study provides the first report of *Meloidogyne incognita* infecting melon cultivated in cocopeat in Bengkulu and evaluates the medium's susceptibility to nematode infestation. The findings are expected to strengthen local diagnostic awareness and inform targeted nematode management strategies for cocopeat-based cultivation.

MATERIALS AND METHODS

Sampling Location

The study was conducted at a Toboponik melon cultivation site located in Lingkar Barat Ward, Ratu Samban Subdistrict, Bengkulu City (3°47'44" S, 102°15'35" E). Melons were grown in greenhouses using cocopeat as the sole growing medium under a hydroponic drip irrigation system. Root sampling was conducted purposively on three plants from each greenhouse exhibiting typical Meloidogyne-like symptoms, including stunted growth, crown wilting, and visible root galls, after the plants were gently uprooted. In total, six plants were collected, and each was treated as an independent sample.

Extraction of Nematodes from Roots

Root samples were gently washed under running water and placed in petri dishes containing approximately 20 mL of distilled water. Adult female nematodes were isolated by dissecting root tissues with a fine needle and tweezers under a stereomicroscope at 40× magnification. The isolated adult females were transferred into 2 mL microtubes containing sterile distilled water and stored at 4 °C for no longer than one week for further analysis. Perineal pattern preparations were made from 25 adult females per plant sample.

Identification of Meloidogyne Species Based on Perineal Pattern Characters

Identification of *Meloidogyne* species was carried out through perineal pattern examination of adult females, following the method described by Gilchrist-Saavedra et al. (1997). Adult female nematodes were placed on a clean microscope slide, and the anterior body region was excised to remove internal contents. The perineal region was then treated with 45% lactic acid to clear remaining tissues and transferred to another slide containing a drop of pure glycerin as the mounting medium. The specimen was positioned with the anterior edge facing upward, gently covered with a cover slip, and labeled. Species identification was performed using the key of Eisenback et al. (1981)and diagnostic features were photographed through the microscope eyepiece with a smartphone camera.

RESULTS AND DISCUSSION

Symptoms of Meloidogyne Attack

Figure 1 shows that infected plants grew more slowly than healthy ones, indicating early physiological stress associated with *Meloidogyne* infection. Although no severe chlorosis or wilting was observed during the study period, reduced vigor and uneven growth were apparent among infected plants.

Figure 1. Above-ground symptoms on the plant

These early symptoms often precede more visible effects, such as leaf yellowing or severe wilting, reported in other host systems (Diniz et al., 2016; Idhmida et al., 2024). Root examination revealed typical gall formations, a characteristic symptom of root-knot nematode infection. Galls ranged from small spherical nodules to large irregular swellings distributed along both primary and secondary roots (Figure 2a, 2b). Galls remained clearly visible even one week after plant removal (Figure 2c), indicating that nematode-induced tissue modification persists beyond active infection. The durability of these structures is attributed to permanent cellular changes, including the formation of giant cells, hyperplasia of surrounding tissues, and subsequent lignification and suberization of the cortical area (Cabrera et al., 2023; Sato et al., 2021). The durability of symptoms aligns with previous observations by Djamilah et al. (2023) in Bengkulu, where root galling remained distinguishable long after active infection had ceased.

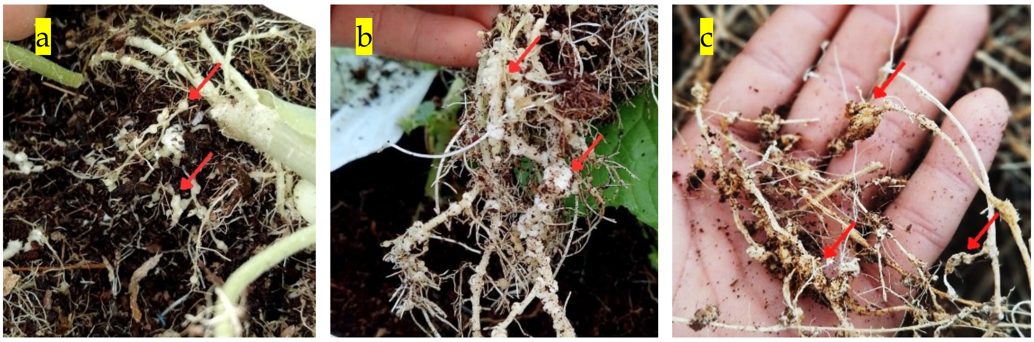

Figure 2. Root gall symptoms. (a) Active gall formation on primary roots of growing plants; (b) Galling observed on secondary roots; (c) Galls persisting one week after plant removal.

From a physiological perspective, these structural alterations disrupt water and nutrient flow, ultimately reducing plant vigor and yield potential (Assoumana et al., 2017). The persistence of galls after harvest highlights the importance of early detection and integrated management, as residual nematode structures may serve as inoculum for subsequent planting cycles.

Species Identification

Microscopic examination of perineal patterns in adult female nematodes revealed distinct morphological traits characteristic of *M. incognita*. Under light microscopy at **40× magnification, 25 adult females were examined from each of six infected plants (n = 150 in total)**. All specimens showed a tall, narrow dorsal arch with fine striae extending in straight (Figure 3a) or gently undulating (Figure 3b) formations. Lateral lines were absent, a consistent feature distinguishing *M. incognita* from closely related species such as *M. javanica* (Eisenback et al., 1981).

These morphological characteristics were uniform across all samples, indicating a stable population structure of *M. incognita* in the infected plants. The observed perineal patterns closely matched established diagnostic descriptions, reinforcing the accuracy of identification. Similar results have been reported in surveys from Sumatra (Hamidi et al. 2022), where *M. incognita* consistently lacks lateral lines and displays finely striated dorsal fields. The combination of these features, such as the absence of lateral lines, a tall, narrow dorsal arch, and a finely striated perineal field, provides definitive morphological evidence confirming *M. incognita* as the causal species of root-knot symptoms in the examined melon roots.

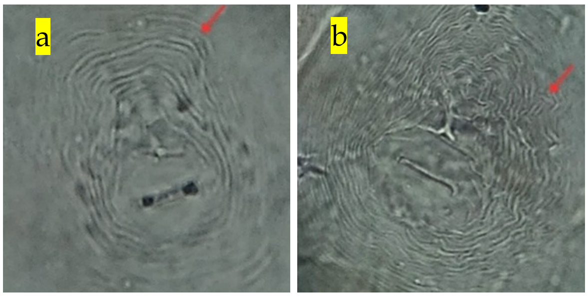

Figure 3. Perineal patterns of *M. incognita* from the study site. (a) Straight fine striae; (b) Gently undulating to zigzag formations.

Susceptibility of Cocopeat Media to *Meloidogyne* Infection

Cocopeat's high porosity and strong water retention (Al-Ajlouni et al., 2024) may inadvertently create a favorable microenvironment for the mobility and survival of second-stage juveniles (J2). These physical properties influence nematode dispersion and persistence, as observed in other moist, low-density substrates. For example, studies on entomopathogenic nematodes (EPNs) show that nematode movement depends on the presence of thin water films in pore spaces, while excessive or insufficient moisture restricts their locomotion. (Fatimah et al., 2025). The same principle applies to plant-parasitic nematodes in saturated environments, such as rice systems, where higher soil moisture levels correlate with greater nematode abundance. (Nisa et al., 2022). This analogy suggests that cocopeat, with its fine-fiber texture and high water retention, can maintain conditions conducive to nematode activity.

Although cocopeat is widely regarded as a clean and sustainable growing medium, its physical nature does not guarantee freedom from nematode infestation. Under favorable moisture conditions, J2 larvae may persist between cropping cycles and reinfect new seedlings if the medium is reused. Therefore, cocopeat-based cultivation systems should include preventive measures, such as pre-use sterilization, sanitizing tools and containers, and periodic monitoring for nematodes. These steps help preserve the agronomic benefits of cocopeat while minimizing the risk of nematode buildup in controlled cultivation environments.

CONCLUSION

This study reports the occurrence of *Meloidogyne incognita* infecting melon cultivated in cocopeat in Bengkulu, Indonesia. Identification based on perineal pattern morphology confirmed that the observed root galls were caused by *M. incognita* infestation. The results indicate that cocopeat, although widely valued for its agronomic benefits, can also serve as a favorable medium for root-knot nematode development.

SUGGESTION

These findings emphasize the need for preventive management of cocopeat, including substrate sterilization, sanitation, and periodic nematode monitoring, to minimize the risk of reinfestation in subsequent planting cycles. Given the preliminary nature of this report, further studies should include larger sample sizes across multiple cultivation sites to validate the extent of infestation. Research on the survival dynamics of *Meloidogyne incognita* in cocopeat under different moisture and nutrient conditions, as well as trials assessing pre-use treatments or nematode-suppressive amendments, would provide valuable guidance for sustainable management in hydroponic and semi-hydroponic systems.

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