Department for Environment Food & Rural Affairs

Plant Pest Factsheet

Guava root-knot nematode

Meloidogyne enterolobii

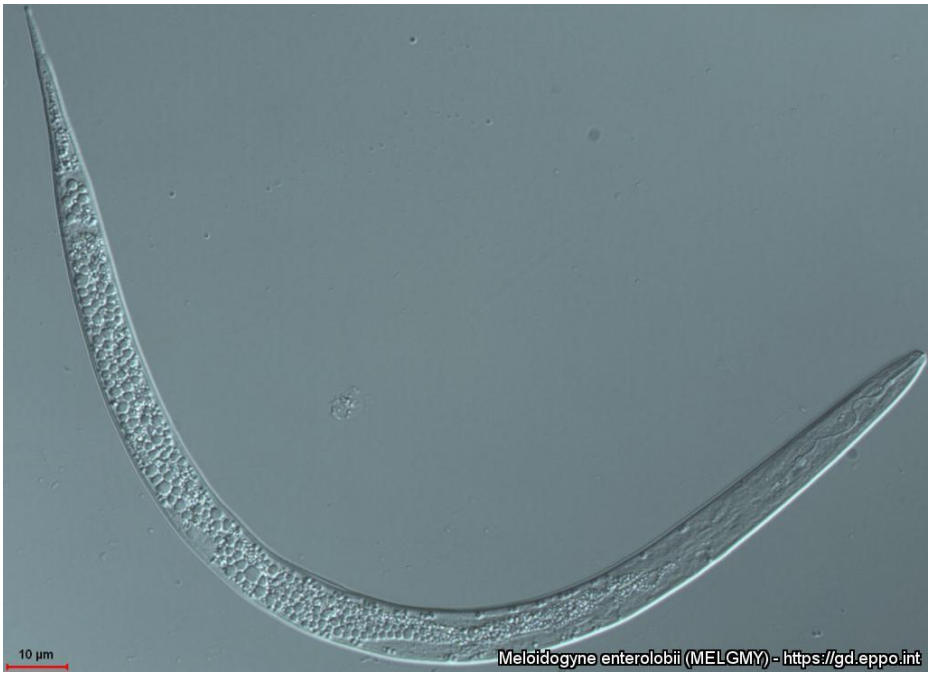

Figure 1. An infective juvenile of *Meloidogyne enterolobii*. Dr Sebastian Kiewnick, Agroscope Changins-Wädenswill Research Station (CH) (EPPO Images).

Background

Meloidogyne enterolobii (Yang & Eisenback, 1983) is a root-knot nematode which was first described from Hainan Island, China. There has been confusion over the identity of *M. enterolobii*, as it was previously misidentified as *Meloidogyne incognita* (southern root-knot nematode). A further finding described as *Meloidogyne mayaguensis* on *Solanum melongena* (aubergine) was thought to be a new species which resembled *M. enterolobii*, however this has now been confirmed as the same species and is now a synonym. Since its description *M. enterolobii* has been reported from every continent except Antarctica. This nematode is known to feed on a wide range of economically important crops and wild plant species. *Meloidogyne enterolobii* is primarily a tropical/subtropical species, but it

could pose a threat to protected cultivation in the UK. As a result of this threat, *M*. *enterolobii* was listed as a provisional quarantine pest in GB legislation in 2022. The symptoms caused by *M*. *enterolobii* infestation are similar to those caused by many root-knot nematodes, including stunting, galling of roots, malformation and yield losses. However, when present in low numbers, symptoms may not be apparent or, when present, symptoms could be confused with those caused by other pests and pathogens.

There have been numerous interceptions of *M*. *enterolobii* in the UK from Argentina, China, Gambia, Ghana, India, Indonesia, Ivory Coast, Malaysia, Singapore, Sri Lanka, Thailand and the USA. Most interceptions have been made on *Ipomoea batatas* (sweet potato) from the USA and *Chlorophytum* sp. (spider plant) from Malaysia and Singapore. Interceptions have also been made on *Crassula*, *Syzygium*, *Gardenia*, *Corchorus* and *Zingiber officinale* (ginger).

Geographical Distribution

Meloidogyne enterolobii is not present in the UK. It has been reported from Europe: Portugal and Switzerland (under protection cultivation only); Africa: Benin, Burkina Faso, Cote d'Ivoire, Democratic Republic of the Congo, Kenya, Malawi, Mozambique, Niger, Nigeria, Senegal, South Africa and Togo; Asia: China, India, Taiwan, Thailand and Vietnam; North America: Costa Rica, Cuba, Guadeloupe, Guatemala, Martinique, Mexico, Puerto Rico, Trinidad and Tobago, and USA; South America: Brazil and Venezuela; and Oceania: Australia.

Initially it was believed that *M*. *enterolobii* would be restricted to tropical areas. However additional findings outside these regions imply that other areas may be at risk including subtropical areas and areas with Mediterranean-like climates as well as protected environments. It is considered that establishment outside protected environments in the UK is unlikely.

The first European outbreak of *M*. *enterolobii* was detected in southern France associated with a tomato crop growing in a poly tunnel in 2002. The population has now been declared eradicated in France. In 2008 *M*. *enterolobii* was reported from two commercial greenhouses in cucumber and tomato crops in Switzerland where it is still present and under containment. In 2018 *M*. *enterolobii* was found in Coimbra District, Portugal infesting *Physalis peruviana* (Cape gooseberry) from a private garden; surveys are ongoing.

Host Plants

Meloidogyne enterolobii has a wide host range of both herbaceous and woody plants.

The main hosts include *Coffea arabica* (coffee), *Gossypium hirsutum* (cotton), ***Cucumis sativus*** (cucumber), ***Solanum melongena*** (aubergine), *Psidium guajava* (guava), *Carica payaya* (papaya), ***Capsicum annum*** (pepper), *Glycine max* (soybean), *Ipomoea batatas* (sweet potato), *Nicotiana tabacum* (tobacco), ***Solanum lycopersicum*** (tomato), *Solanum*

tuberosum (potato) and *Citrullus lanatus* (watermelon). The hosts in bold are thought to be the most at risk in the UK, as they are primarily grown under protection for commercial purposes. Due to the wide host range of other *Meloidogyne* spp. the possibility of new hosts cannot be ruled out.

Description

Meloidogyne enterolobii is a microscopic nematode and similar to many other species of root-knot nematodes. The physical appearance of *M*. *enterolobii* most closely resembles *M*. *incognita*, *M*. *arenaria* and *M*. *javanica* which are tropical root-knot nematodes.

Eggs are very small, approximately 0.09 mm long and 0.04 mm wide and are contained as a mass within a gelatinous matrix. Infective juveniles are worm-like in shape and around 0.02 mm wide and up to 0.7 mm in length (Figure 1). Males are also worm-like in shape but are longer, up to 2 mm in length and 0.04 mm wide. Adult females are usually embedded within plant roots or tubers and therefore immobile. Females are pearly white, pear-shaped, and are up to 1.3 mm long and 0.7 mm wide (Figure 2).

Figure 2. Two adult female *Meloidogyne enterolobii*. Dr. Weimin Ye Agronomic Division North Carolina Department of Agriculture & Consumer Services Raleigh, NC, USA (EPPO Images).

Biology

Typical of other root-knot nematodes, *M*. *enterolobii* is an endoparasite (living as a parasite inside its host) and completes its lifecycle within 4-5 weeks in favourable conditions.

All root-knot nematodes have an embryonic stage, four juvenile stages and an adult stage. Within the egg, the first juvenile stage moults to form the second juvenile stage, and this second juvenile then hatches from the egg. The hatching of the egg is dependent on soil conditions: temperature and moisture. Second stage juvenile nematodes are the infective stage and gather at the plant's region of cell elongation just behind the root tip. This accumulation of nematodes even occurs on plants which are resistant to root-knot

nematodes. They are also attracted to other growing root tips, points where lateral roots emerge, and invasion sites of other juveniles. Upon entering the plant root at these invasion sites, juveniles move within the root start feeding on root cells and stimulate feeding site formation. These feeding sites are generally known as giant cells which provide nematodes with nutrition by diverting plant metabolites.

As giant cells form, the surrounding root tissue gives rise to a gall in which the developing juvenile is embedded within and can no longer move. The root tip may enlarge, and root growth often stops for a short period. After further feeding, the juveniles swell to become more sausage shaped, moult three times and become adults. Eggs are laid by adult females in a gelatinous sac near the root surface. It has been reported that females can produce about 500 eggs on *Ipomoea batatas* (sweet potato). Several generations can occur in a growing season, although reproduction can occur without males.

Figure 3. Gall formation on roots of tomato caused by infestation of *Meloidogyne enterolobii*. Image courtesy of Fera Science Ltd.

Dispersal and Detection

The classic symptoms of infestation by *M*. *enterolobii* are gall formations on roots which can be large and high in number (Figure 3). Above ground symptoms are also typical of other root-knot nematodes and plants which have a malfunctioning root system, including stunting, wilting and chlorosis of leaves. In terms of commerically grown crops, infestation by *M. enterolobii* can result in both a reduction in yield and quality. If a host plant is exhibiting the symptoms described, a number of pest and disease species could be responsbile. Therefore a comprehensive laboratory diagnosis is required.

The natural spread of *M*. *enterolobii* is very limited. Dispersal occurs by movement of infective juveniles which can only move tens of centimetres per year. Consequently, the primary means of dispersal is human assisted movement through the trade of infested

plants, cuttings, non-hosts with soil attached, commodities with soils attached, equipment and irrigation water.

Economic Impact

Economic impacts of *M*. *enterolobii* are widely reported, particularly associated with tropical crops. Significant damage has been reported in guava where *M. enterolobii* has gained its common name the guava root-knot nematode. In Brazil it has resulted in losses of 61 million US dollars and losses of thousands of jobs. Severe outbreaks of *M. enterolobii* in sweet potato crops have also been reported from the USA which supports the frequent UK interceptions of this pest on imported sweet potato from the USA (Figure 4). For crops of more relevance to the UK, yield losses of 65% have been reported for tomato and significant damage has been reported for cucumber and pepper.

Figure 4. *Meloidogyne enterolobii* damage on *Ipomoea batatas* (sweet potato). Image courtesy of Fera Science Ltd.

Pest Management and Reporting

Host crops grown under protection are most at risk from this pest and especially those grown in soil. Therefore, the sampling of growing media in protected environments for plant-parasitic nematodes is important. Inert growing media such as rockwool or coir is unlikely to harbour *M. enterolobii*, therefore where growing practices use hydroponic systems the risk is somewhat mitigated. Although, if infected plants or cuttings are introduced in the system there is still a risk that the pest could potentially spread through irrigation water to non-hydroponic systems. Control strategies based on the growing of non-hosts or resistant (trap) crops (or cultivars) in a crop rotation system may be effective. When non-hosts are grown the nematode fails to complete a lifecycle which reduces population levels. Effective weed control is essential to the success of any crop rotation, as

the presence of weed hosts in the field can result in the development of high populations of root-knot nematodes despite the less favourable nature of the crop.

Meloidogyne enterolobii can reproduce on hosts which carry resistances genes which were thought to confer resistance to root-knot nematodes, and therefore this is not an effective means of controlling *M*. *enterolobii*.

An important component of cultural control is to minimize root-knot nematode movement between planting sites or into new production areas (e.g. sanitation). This may be achieved by:

i. removal/destruction of infested plant material prior to replanting a site;

ii. inspection and use of certified nematode free plants from reliable nurseries;

iii. cleaning of farm implements, machinery, footwear and

iv. heat treatment of potentially infected plant material (e.g. roots, tubers etc).

Suspected outbreaks of ***Meloidogyne enterolobii*** or any other non-native plant pest should be reported to the relevant authority:

For **England and Wales**, contact your local **APHA Plant Health and Seeds Inspector** or the **PHSI Headquarters**, York.

Tel: 0300 1000 313 (please select option 3 when calling)

Email: planthealth.info@apha.gov.uk

For horticultural crops in **Scotland**, contact the **Scottish Government's Horticulture and Marketing Unit:**

Email: hort.marketing@gov.scot

For agricultural crops in **Scotland**, contact your local **RPID officer**: Web site: http://www.gov.scot/Topics/farmingrural/Agriculture/AOcontacts/contacts

Email: potatoexports@sasa.gov.scot

For **Northern Ireland**, contact the **DAERA Plant Health Inspection Branch:**

Tel: 0300 200 7847 Email: planthealth@daera-ni.gov.uk

Web: https://www.daera-ni.gov.uk/topics/plant-and-tree-health

For additional information on UK Plant Health please see:

https://planthealthportal.defra.gov.uk/pests-and-diseases/uk-plant-health-risk-register/

https://planthealthportal.defra.gov.uk/

https://www.gov.uk/plant-health-controls

http://www.gov.scot/Topics/farmingrural/Agriculture/plant/PlantHealth/PlantDiseases

https://www.daera-ni.gov.uk

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