EPPO Datasheet: *Meloidogyne enterolobii*

Last updated: 2020-09-11

IDENTITY

Preferred name: *Meloidogyne enterolobii*
Authority: Yang & Eisenback
Taxonomic position: Animalia: Nematoda: Chromadorea: Rhabditida: Meloidogynidae
Other scientific names: *Meloidogyne mayaguensis* Rammah & Hirschmann
Common names: guava root-knot nematode
view more common names online...
EPPO Categorization: A2 list
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EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: MELGMY

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Notes on taxonomy and nomenclature

Meloidogyne enterolobii was described by Yang & Eisenback (1983) from roots of pacara earpod trees (*Enterolobium contortisiliquum*), on Hainan Island in China. In 1988 Rammah and Hirschmann described *M. mayaguensis* from roots of eggplant (*Solanum melongen*a) from Puerto Rico and indicated that this new species 'superficially resembles *M. enterolobii*' but shows 'several distinct morphological features and a unique malate dehydrogenase pattern (N3c)'. Karssen *et al*. (2012) re-studied the holo- and paratypes of both species and confirmed *M. mayaguensis* as a junior synonym for *M. enterolobii.*

HOSTS

The root-knot nematode *Meloidogyne enterolobii* is polyphagous and has many host plants including cultivated crops and weeds. It infests herbaceous as well as woody plants. The main hosts of commercial importance include *Coffea arabica* (coffee) [it is noted that while coffee can be susceptible to some populations of *M. enterolobii*, it has been reported as resistant to other ones (see details in the control paragraph)], *Gossypium hirsutum* (cotton), *Cucumis sativus* (cucumber), *Solanum melongena* (eggplant), *Psidium guajava* (guava), *Carica papaya* (papaya), *Capsicum annuum* (pepper), *Solanum tuberosum* (potato), *Glycine max* (soybean), *Ipomoea batatas* (sweet potato), *Nicotiana tabacum* (tobacco), *Solanum lycopersicum* (tomato), and *Citrullus lanatus* (watermelon). For *G. hirsutum*, Brito *et al.* (2004) reported that four Florida isolates of *M. enterolobii* reproduced on this host, which confirmed the original description by Yang & Eisenback (1983). Recently this nematode was found infesting cotton under field conditions in North Carolina, USA (Ye *et al.*, 2013) and Brazil (Galbieri *et al*., 2020). While *C. papaya* has been found infested by *M. enterolobii* in the field (Lima *et al*., 2003; Souza *et al*., 2006; Brito *et al*., 2008), the cultivars Formosa and Papaya when inoculated with a nematode population collected from *P. guajava* were reported as non-hosts (Freitas *et al.*, 2017). The host status is determined by calculating the reproductive factor RF (RF = final population (Pf) / initial population (Pi); RF ? 1, good host; 0.1< RF <1.0, poor host; RF ? 0.1, non-host) (Sasser *et al*., 1984). It is expected that many more plant species will be hosts of *M. enterolobii* than currently known, since this is the case with other polyphagous *Meloidogyne* spp.

Some crops have been reported as non-hosts or poor hosts for *M. enterolobii*, including *Euterpe oleracea* (Assai palm), *Persea americana* (avocado), *Brassica oleracea* (cabbage), *Anacardium occidentale* (cashew), *Annona cherimola* (cherimoya) *Cocos nucifera* (coconut), *Allium sativum* (garlic), *Citrus* × *paradisi* (grapefruit), *Citrus limonia* (lemon 'Cravo'), *Citrus volkameriana* (lemon 'Volkameriano), *Zea mays* subsp. *mays* (maize), *Mangifera indica* (mango), *Olea europaea* (olive), most of the *Passiflora* spp. (passion fruit), *Arachis hypogaea* (peanut), *Citrus reticulata* (tangerine 'Cleopatra'), *Citrus trifoliata* (trifoliata), *Citrus* × *aurantium* (sour orange), *Averrhoa carambola* (starfruit), *Fragaria* × *ananassa* (strawberry), *Citrus sunki* (tangerine 'Sunki'), and *Allium fistulosum* (Welsh onion) (Rammah & Hirschmann, 1988; Guimaraes *et al*., 2003; Rodriguez *et al*., 2003; Brito *et al*., 2004;

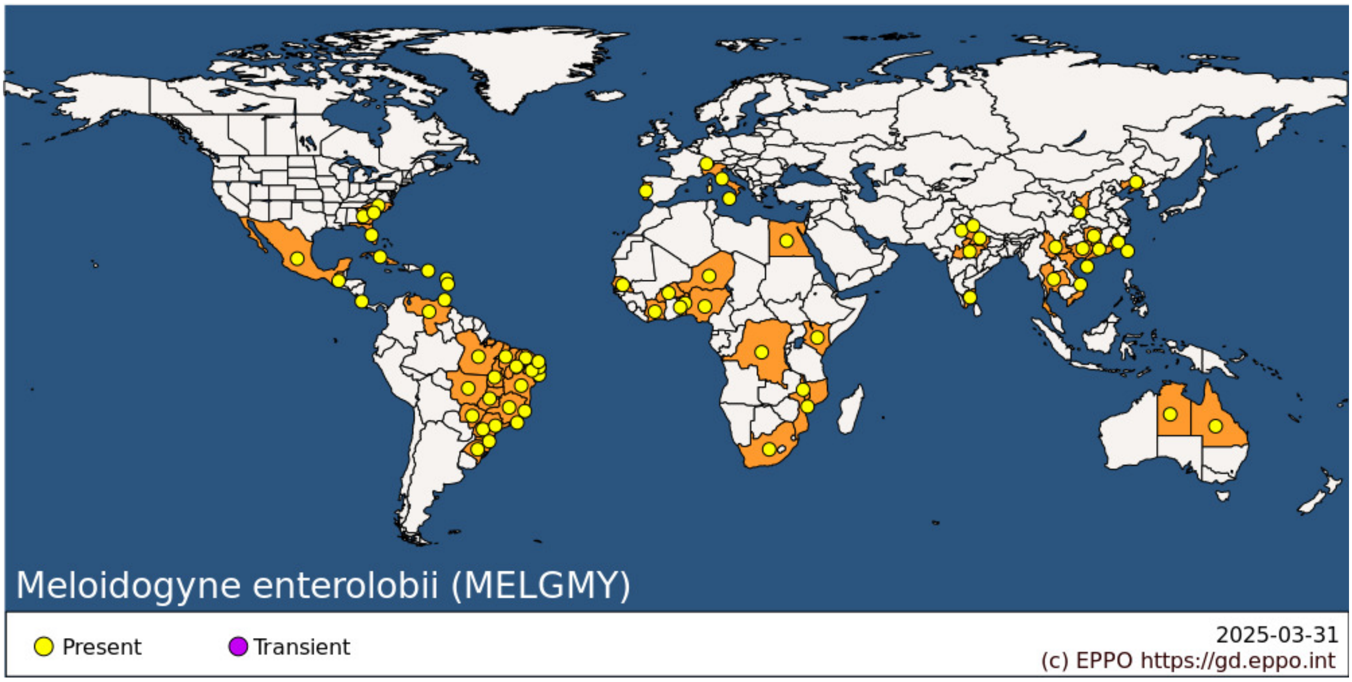
Bitencourt & Silva, 2010; Dias *et al.*, 2010a; Rosa *et al.*, 2012; Freitas *et al*., 2014; 2017).

Host list: *Abelmoschus esculentus*, *Acalypha australis*, *Ajuga reptans*, *Alysicarpus vaginalis*, *Amaranthus hybridus*, *Amaranthus tricolor*, *Angelonia angustifolia*, *Antirrhinum majus*, *Apium graveolens*, *Artocarpus heterophyllus*, *Basella alba*, *Beta vulgaris*, *Bidens pilosa*, *Brachychiton sp.*, *Brassica oleracea var. botrytis*, *Brugmansia hybrids*, *Brugmansia*, *Buddleia davidii*, *Camellia oleifera*, *Cannabis sativa*, *Capsicum annuum*, *Carica papaya*, *Caryopteris x clandonensis*, *Celosia argentea*, *Centrosema sp.*, *Cereus fernambucensis*, *Cereus hildmannianus*, *Citrullus lanatus*, *Citrus maxima*, *Coffea arabica*, *Coleus scutellarioides*, *Corchorus olitorius*, *Coriandrum sativum*, *Cucumis sativus*, *Cucurbita moschata*, *Daucus carota*, *Dioscorea rotundata*, *Elaeocarpus decipiens*, *Enterolobium contortisiliquum*, *Erechtites hieraciifolius*, *Eryngium foetidum*, *Euphorbia heterophylla var. cyathophora*, *Euphorbia prostrata*, *Euphorbia pulcherrima*, *Euphorbia punicea*, *Euphorbia tirucalli*, *Ficus sp.*, *Gardenia jasminoides*, *Glycine max*, *Gossypium hirsutum*, *Hydrocotyle bonariensis*, *Ipomoea batatas*, *Ixora chinensis*, *Jatropha urens*, *Lagerstroemia indica*, *Lampranthus sp.*, *Lantana camara*, *Lantana montevidensis*, *Ligustrum sp.*, *Luffa aegyptiaca*, *Malpighia emarginata*, *Malpighia glabra*, *Manihot esculenta*, *Maranta arundinacea*, *Melaleuca linearis*, *Melaleuca viminalis*, *Morella cerifera*, *Morinda citrifolia*, *Morus alba*, *Morus celtidifolia*, *Morus nigra*, *Morus*, *Musa sp.*, *Nicotiana tabacum*, *Ocimum basilicum*, *Oeceoclades maculata*, *Ormosia hosiei*, *Passiflora edulis*, *Passiflora mucronata*, *Paulownia elongata*, *Pentas lanceolata*, *Perilla frutescens var. crispa*, *Phaseolus vulgaris*, *Physalis peruviana*, *Platostoma palustre*, *Psidium guajava*, *Rosa sp.*, *Rotheca myricoides*, *Sageretia thea*, *Sageretia*, *Salix x pendulina f. salamonii*, *Samanea saman*, *Selenicereus costaricensis*, *Selenicereus megalanthus*, *Selenicereus*, *Senna alata*, *Senna occidentalis*, *Solandra maxima*, *Solanum americanum*, *Solanum lycopersicum*, *Solanum macrocarpon*, *Solanum melongena*, *Solanum nigrum*, *Solanum pseudocapsicum*, *Solanum quitoense*, *Solanum scabrum*, *Solanum tuberosum*, *Stenocereus queretaroensis*, *Syngonium sp.*, *Syzygium aromaticum*, *Syzygium*, *Talinum fruticosum*, *Tecoma capensis*, *Thunbergia sp.*, *Tibouchina sp.*, *Ulmus parvifolia*, *Zelkova serrata*, *Zelkova*, *Zingiber officinale*, *Ziziphus jujuba*

GEOGRAPHICAL DISTRIBUTION

M. enterolobii has been reported from several countries in North, Central and South America, Africa and Asia. Its present distribution in warmer climates suggests that this species will not survive outside greenhouses in northern countries of Europe, but it might be able to establish in the Mediterranean region. For Europe *M. enterolobii* was first recorded in a greenhouse in France (Blok *et al.*, 2002), but the pest is no longer present. It has also been reported from two greenhouses in Switzerland associated with severe damage on tomato and cucumber (Kiewnick *et al.*, 2008) and Portugal from some private gardens on *Cereus hildmannianus*, *Lampranthus* sp., *Physalis peruviana* and *Callistemon* sp. detected during a survey (Santos *et al.*, 2019).

M. enterolobii has been intercepted in EPPO countries such as the Netherlands, Germany and the UK several times in imported plant material (e.g. Cactaceae, *Syngonium* sp., *Ficus* sp., *Ligustrum* sp., *Brachychiton* sp., *Rosa* sp.) from Asia, South America and Africa.



EPPO Region: Italy (mainland, Sicilia), Portugal (mainland), Switzerland
Africa: Benin, Burkina Faso, Congo, The Democratic Republic of the, Cote d'Ivoire, Egypt, Kenya, Malawi, Mozambique, Niger, Nigeria, Senegal, South Africa, Togo
Asia: China (Fujian, Guangdong, Guangxi, Hainan, Hunan, Liaoning, Shaanxi, Yunnan), India (Haryana, Madhya Pradesh, Tamil Nadu, Uttarakhand, Uttar Pradesh), Taiwan, Thailand, Vietnam
North America: Mexico, United States of America (Florida, Georgia, North Carolina, South Carolina)
Central America and Caribbean: Costa Rica, Cuba, Guadeloupe, Guatemala, Martinique, Puerto Rico, Trinidad and Tobago
South America: Brazil (Alagoas, Bahia, Ceara, Espirito Santo, Goias, Maranhao, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Para, Paraiba, Parana, Pernambuco, Piaui, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Santa Catarina, Sao Paulo, Tocantins), Venezuela
Oceania: Australia (Northern Territory, Queensland)

BIOLOGY

M. enterolobii like other species of root-knot nematodes, is a sedentary endoparasite. Second-stage juveniles (J2) hatch from eggs in the soil or root debris and migrate towards the root tip of candidate host plants. Using their stylet or wounds, juveniles enter the unsuberized epidermal cells near the root tip and migrate within the cortical tissue until they initiate a permanent feeding site in close proximity to the vascular tissue. Juveniles soon lose their mobility and become sedentary. At the same time, feeding of the J2 on root cells induce those cells to differentiate into multinucleate nursing cells, so-called giant cells. The surrounding tissue starts to divide giving rise to a typical root gall or root-knot. During their further development juveniles swell to become sausage- shaped and undergo three moults before they reach adult stages. Adult females are pear-shaped and found almost completely embedded in the host tissue. Eggs are laid by the female in a gelatinous sac near the root surface (Moens *et al*., 2009). Adult males are vermiform and found free in the rhizosphere or near the protruding body of the female. As for other *Meloidogyne* species, reproduction is nearly almost always parthenogenetic. The life cycle of *M. enterolobii* takes 4–5 weeks under favorable conditions and it has been reported that on *I. batatas* females produce around 460–500 eggs per egg mass (Brito *et al*., 2020).

DETECTION AND IDENTIFICATION

Symptoms

M. enterolobii affects growth, yield, lifespan and tolerance to environmental stresses of infested plants. Typical above-ground symptoms include stunted growth, wilting and leaf yellowing. Typical root galls, which can be large and numerous, are found below-ground (Cetintas *et al.*, 2007). Overall, damage due to *M. enterolobii* may consist of reduced quantity and quality of yield. Plant infection with secondary plant pathogens may be enhanced following *M. enterolobii* infestation, as is described for *Fusarium solani* on guava (Gomes *et al.*, 2011).

Morphology

Second-stage juveniles are vermiform, annulated, tapering at both ends, 250–700 µm long, 12–18 µm wide, tail length 15–100 µm and hyaline tail part 5–30 µm in length (Yang & Eisenback, 1983; Rammah & Hirschmann, 1988). Females are characteristically globular to pear-shaped, pearly-white and sedentary. Their body is annulated, 400– 1300 µm long, 300–700 µm wide and shows lateral fields each with 4 incisures. The stylet is dorsally curved, 10– 25 µm long, with rounded to ovoid stylet knobs, set off to sloping posteriorly. The perineal pattern is round to ovoid; the arch is moderately high to high and usually rounded. The vermiform males are annulated, slightly tapering anteriorly, bluntly rounded posteriorly, 700–2000 µm long and 25–45 µm wide. The stylet is 13–30 µm long, with stylet knobs, variable in shape.

M. enterolobii closely resembles other tropical root-knot nematodes such as *M. incognita*, *M. arenaria* and *M. javanica*. In general, it can be separated from other species within the genus by perineal pattern shape, male and female stylet morphology; morphology of the male; body length and morphology of the lip region, as well as tail and hyaline tail part in second-stage juveniles according to EPPO Standard PM 7/103 (EPPO, 2016). The other two *Meloidogyne* species which are on the EPPO lists of pests recommended for regulation, namely *M. chitwoodi* and *M. fallax*, are usually not associated with *M. enterolobii* and can also be clearly distinguished by their demarcated hyaline tail end.

Detection and inspection methods

The presence of *M. enterolobii* in infested soil and planting material can be determined by sampling of suspected material and subsequent extraction of second-stage juveniles using standard methods described in the EPPO Standard PM 7/119 on Nematode Extraction (EPPO, 2013a). Root samples should also be collected, it is particularly necessary to extract females to aid species identification. Microscopic examination at 800–1000 times magnification is necessary for correct identification of the nematode species. Presence of males can assist in identification. However, as morphological characters of *M. enterolobii* are often similar to other *Meloidogyne* species, identification to species level is usually based on a combination of morphological/morphometrical characters and biochemical or molecular methods (isozyme electrophoresis, PCR or real-time PCR). For details see the EPPO Diagnostic Protocol (EPPO, 2016). The real-time-PCR protocol recommended for *M. enterolobii* identification has also been used successfully outside of the EPPO region by another Regulatory Agency to identify this nematode species on both regulatory and diagnostic samples (Moore *et al*., 2020a; 2020b).

Nematode populations in the soil tend to decline in the absence of a host (McSorley, 1998) and they reproduce better on good host. Therefore, detection of the nematodes through field inspection and soil sampling is more sensitive if done as close as possible to the time of harvest of a host crop, targeting particularly susceptible plants. It is imperative that samples collected are representative of the entire sampled field. When nematode densities are believed to be extremely low, a larger number of cores that comprise a sample may be needed, this is particularly important for samples taken for regulatory purposes.

PATHWAYS FOR MOVEMENT

As is the case for other plant-parasitic nematodes *M. enterolobii*'s own movement is limited at most to a few tens of centimetres in the soil. The main pathways for nematode dissemination are via infested planting material and soil, such as traded host plants for planting (including cuttings) with roots, non-host plants for planting with soil attached, other traded soil bearing products such as potatoes, soil attached to equipment and machinery, travelers, soil as such and irrigation water (EPPO, 2010).

PEST SIGNIFICANCE

Economic impact

M. enterolobii is considered as very damaging due to its virulence (Fargette 1987; Carneiro *et al*., 2006; Brito *et al*., 2007b; Cetintas *et al*., 2008; Kiewnick *et al*., 2009; Pinheiro *et al*., 2015), wide host range, high reproduction rate and induction of large galls (Castagnone-Sereno, 2012). Severe damage caused by *M. enterolobii* has been reported for several crops, including *Psidium guajava* in many parts of the world, particularly in Brazil, where it is widespread and reported to cause approximately 61 million USD in total economic loss and 3703 full - time jobs losses, and even plant death (Pereira *et al*., 2009); *S. lycopersicum* with yield loss up to 65% (Cetintas *et al*., 2007); *C. sativus* (Kiewnick *et al*., 2008), *C. lanatus* (Ramirez-Suarez *et al*., 2014), and *C. annuum* (Carneiro *et al*., 2006; Pinheiro *et al*., 2015). Most recently severe outbreaks of *M. enterolobii* have been observed in the major sweet potato producing states in the USA (Anonymous, 2017; Anonymous, 2018a; 2018b; Rutter *et al*., 2019). This nematode was reported causing severe yield and root quality reduction, and in at least one case, total crop loss (Anonymous, 2017). As a result, some states have imposed external quarantine for this nematode species. Compared with other root-knot nematode species, *M. enterolobii* displays virulence against several sources of root-knot nematode-resistance genes, which constitutes a challenge for its management particularly when dealing with a mixture of root-knot nematode species. For example, *M. enterolobii* develops on crop genotypes carrying resistance to the major species of *Meloidogyne,* including resistant cotton, sweet potato, tomatoes (*Mi-1*gene), potato (*Mh* gene), soybean (*Mir1* gene), bell pepper (*N* gene), sweet pepper (*Tabasco* gene) and cowpea (*Rk* gene) (summarized in Castagnone-Sereno, 2012). Similarly, *M. enterolobii* has been found inducing severe root galling, plant defoliation, yield losses and reduction of fruit quality on *Capsicum* rootstock 'Snooker' carrying the Me1 and Me3/Me7 genes (Pinheiro et al., 2015) in a commercial plastic house. In countries where *M. enterolobii* is regulated, traded plants and plant products infested with *M. enterolobii* may need to be destroyed.

Control

General management strategies for root-knot nematodes have been reviewed by Coyne *et al.* (2009) and Nyczepir & Thomas (2009). Taking into account the banning of most chemical nematicides, resistance, crop rotation and the use of non-host crops or black fallow, and good weed control are the most efficient methods for reducing *M. enterolobii* populations. Unfortunately, the list of non-host plants is limited, including cabbage, garlic, grapefruit, maize, peanut, sour orange and Welsh onion. Brito *et al.* (2007a) reported that two carrot cultivars and *Brassica oleracea* (collard) allowed very little or no nematode reproduction. Of various selections of *Phaseolus vulgaris*, *P. lunatus*, *Vigna radiata*, *V. unguiculata* and *Canavalia ensiformis* being tested for their susceptibility to *M. enterolobii* only *P. vulgaris* cv. Alabama was resistant (Crozzoli *et al*., 2011). Attempts to identify sources of resistance to this nematode species in tomato and pepper germplasms have failed. For instance, all 101 cultivated and wild tomato genotypes tested were susceptible (Silva *et al*., 2019), and none of the 24 pepper accessions were resistant (Soares *et al*., 2018). However, significant progress has been made and some resistance to *M. enterolobii* has been identified on sweet potato (Schwarz *et al*., 2020). Squash and lettuce showed some resistance towards *M. enterolobii* (Bitencourt & Silva, 2010) and eight genotypes of soybean turned out to be tolerant to *M. enterolobii* while 60 genotypes were susceptible (Dias *et al*., 2010b). Compared to annual crops, more sources of resistance towards *M. enterolobii* have been reported for perennial crops such as the *R Mia* resistance gene in *Prunus persica* (peach) rootstocks (Claverie *et al*., 2004; Nyczepir *et al*., 2008), the *Ma* gene in *Prunus cerasifera* (Myrobalan plum) (Rubio-Cabetas *et al*., 1999) and a newly detected resistance in the wild *Psidium guineense* was successfully used to develop a hybrid guava rootstock, 'BRS Guaraçá', which was released in 2018 (Castro, 2019; Costa *et al*., 2012; Souza *et al*., 2018). Although coffee has been reported as a host for *M. enterolobii* (Decker & Rodriguez Fuentes, 1989), all seven coffee cultivars tested with a nematode population initially isolated from guava were resistant (Alves *et al*., 2009). However, three out of seven coffee cultivars tested with another population originally collected from coffee in Costa Rica (Muniz *et al*., 2009) proved to be susceptible. Further studies are needed to clarify the genetic variability, if any, among populations of this nematode species collected from different host plants around the world.

Phytosanitary risk

With increased global trade, special attention should be given to the importation of plants for planting (e.g. seedlings and slips), plant products and soil from areas where *M. enterolobii* occurs. Reports of *M. enterolobii* in glasshouses in the EPPO region clearly demonstrate that it has the potential to enter Europe (Blok *et al*., 2002; Kiewnick *et al*., 2008). It also has been detected on several occasions in the USA during routine regulatory sampling at ornamental nurseries in Central and South Florida which has a comparable climate to Southern Europe (Brito *et al*., 2002; Brito *et al.*, 2010, Han *et al.*, 2012; Moore *et al*., 2020a; 2020b). It is very likely that this species can survive in the warmer parts of the EPPO region and in glasshouses throughout the EPPO region. In addition, this species was detected on roses (plants for planting) originating from China (see EPPO RS 2008/107), thus suggesting that it can also survive slightly cooler temperatures. As mentioned above *M. enterolobii* is highly virulent and produces more root galls than other root-knot nematodes, as the correlation between root galling and yield loss is well known (Ploeg & Phillips, 2001; Kim & Ferris, 2002), it is expected that *M. enterolobii* will cause yield losses similar to *M. incognita* and *M. javanica,* which are well established in large parts of the EPPO region. Once root-knot nematodes have been introduced, it is in general difficult to control or eradicate them.

PHYTOSANITARY MEASURES

Suggested phytosanitary measures are specified in the PRA performed by EPPO (EPPO, 2010); they are as follows. Rooted host plants for planting (with or without soil), non-host plants for planting with soil attached and plant products with soil attached should come from a pest free area, a pest free place of production or should be produced under protected cultivation. Alternatively, soil from non-host plants for planting or plant products should be removed. Soil as such should originate from a pest free area or a pest free place of production. Used machinery, equipment, vehicles, and passengers' shoes should be cleaned. Publicity would allow to enhance public awareness on *M. enterolobii* when travelling.

Measures similar to those recommended by EPPO to contain or eradicate *Meloidogyne chitwoodi* and *M. fallax* (EPPO, 2013b) would be relevant.

REFERENCES

Alves GCS, Almeida EJ & Santos JM (2009) Reacao de *Coffea* spp. a *Meloidogyne mayaguensis* (Reaction of *Coffea* spp. to *Meloidogyne mayaguensis*). *Nematologia Brasileira* **33**, 248–251.

Anonymous (2017) Agricultural Review. North Carolina Department of agriculture and consumer services. Public Affair Division. Raleigh, NC. Available at: https://www.ncagr.gov/paffairs/AgReview/articles/2017/June/NCDACS-warns-of-emerging-nematode.htm. Accessed July 13, 2020.

Anonymous (2018a) New crop pest identified in Louisiana. Department of agriculture and forestry. State of Louisiana. Baton Rouge, LA. Available at: http://www.ldaf.state.la.us/news/new-crop-pest-identified-in-louisiana/. Accessed July 13, 2020.

Anonymous (2018b) Declaration of emergency. Office of Agriculture and environmental sciences horticulture and quarantine. Department of Agriculture and forestry. State of Louisiana. Baton Rouge, LA. Available at: https://www.doa.la.gov/osr/EMR/2019/1906EMR020.pdf. Accessed July 13, 2020.

Bitencourt NV & Silva GS (2010) Reproducao de *Meloidogyne enterolobii* em olericolas (Reproduction of *Meloidogyne enterolobii* on vegetables). *Nematologia Brasileira* **34**, 181–183.

Blok VC, Wishart J, Fargette M, Berthier K & Phillips MS (2002) Mitochondrial differences distinguishing *Meloidogyne mayaguensis* from the other major species of tropical root-knot nematodes. *Nematology* **4**, 773–781.

Brito J, Inserra R, Lehman P & Dixon W (2002) The root-knot nematode, *Meloidogyne mayaguensis* Rammah & Hirschmann, 1988 (Nematoda, Tylenchida). Pest Alert. FDACS-P-01643. Available at: https://www.fdacs.gov/content/download/66978/file/Pest%20Alert%20-%20Meloidogyne%20mayaguensis%20-%20Root%20Knot%20Nematode.pdf. Accessed July 13, 2020.

Brito JA, Powers TO, Mullin PG, Inserra RN & Dickson DW (2004) Morphological and molecular characterization of *Meloidogyne mayaguensis* isolates from Florida. *Journal of Nematology* **36**, 232– 240.

Brito JA, Stanley JD, Mendes ML, Cetintas R & Dickson DW (2007a) Host status of selected cultivated plants to *Meloidogyne mayaguensis* in Florida. *Nematropica* **37**, 65–71.

Brito JA, Stanley JD, Kaur R, Cetintas R, Di Vito M, Thies JA & Dickson WD (2007b) Effects of the *Mi-1*, *N*, and *Tabasco* genes on infection and reproduction of *Meloidogyne mayaguensis* on tomato and pepper genotypes. *Journal of Nematology* **39**, 327-332.

Brito JA, Kaur R, Cetintas R, Stanley JD, Mendes ML, McAvoy EJ, Powers TO & Dickson DW (2008) Identification and isozyme characterization of *Meloidogyne* spp. infecting horticultural and agronomic drops, and weeds in Florida. *Nematology* **10**, 757-766.

Brito JA, Kaur R, Cetintas R, Stanley JD, Mendes ML, Powers TO & Dickson DW (2010) *Meloidogyne* spp. infecting ornamental plants in Florida. *Nematropica* **40**, 87-103.

Brito JB, Desaeger J & Dickson DW (2020) Reproduction of *Meloidogyne enterolobii* on selected root-knot nematode resistant sweetpotato (*Ipomoea batatas*) cultivars. *Journal of Nematology* **52**, e2020-63

Carneiro RMDG, Ameira MRA, Braga RS, Almeira CA & Gioria R (2006) Primeiro registro de *Meloidogyne enterolobii* parasitando plants de tomate e pimentao resistentes a meloidogynose no estado de Sao Paulo. *Nematologia Brasileira* **30**, 81 – 86.

Castagnone-Sereno P (2012) *Meloidognye enterolobii* (= *M. mayaguensis*): profile of an emerging, highly pathogenic, root-knot nematode species. *Nematology***14**, 133–138.

Castro JMC (2019) *Meloidogyne enterolobii* e sua evolucao nos cultivos brasileiros (*Meloidogyne enterolobii* and its evolution in Brazilian crops). *Informe Agropecuario* **40,** 41-48.

Cetintas R, Kaur R, Brito JA, Mendes ML, Nyczepir AP & Dickson DW (2007) Pathogenicity and reproductive potential of *Meloidogyne mayaguensis* and *M. floridensis* compared with three common *Meloidogyne* spp. *Nematropica* **37**, 21–31.

Cetintas R, Brito JA & Dickson WD (2008) Virulence of four Florida isolates of *Meloidogyne mayaguensis* to selected soybean genotypes. *Nematropica* **38**, 127-135.

Claverie M, Bosselut N, Lecouls AC, Voisin R, Lafargue B, Poizat C, Kleinhentz M, Laigret F, Dirlewanger E & Esmenjaud D(2004) Location of independent root-knot nematode resistance genes in plum and peach. *Theoretical and Applied Genetics* **108**, 765–773.

Crozzoli R, Seguro M, Perichi G & Perez D (2011) Respuesta de selecciones de leguminosas a *Meloidogyne incognita* y *Meloidogyne enterolobii* (Nematoda; Meloidogynidae) (Response of selections of legumes to *Meloidogyne incognita* and *Meloidogyne enterolobii* (Nematoda; Meloidogynidae)). *Fitopatologia Venezolana* **24**, 56–57.

Costa SR, Santos CAF, Castro JMC (2012) Assessing *Psidium guajava* x *P. guineense* hybrids tolerance to *Meloidogyne enterolobii. Acta Horticulturae* v1. No. **959,** 59-65. Presented at the III International Sympo-sium on Guava and other Myrtaceae. April 23, 2012, Petrolina, Brazil.

Coyne DL, Fourie HH & Moens M (2009) Current and future management strategies in resource-poor farming. In: *Root-Knot Nematodes* (Ed. Perry RN, Moens M & Starr JK), pp. 444–475. CAB International, Wallingford (UK).

Decker H & Rodriguez Fuentes ME (1989) U€ ber das Auftreten des Wurzelgallenematoden *Meloidogyne mayaguensis* an *Coffea arabica* in Kuba (The occurrence of root gall nematodes *Meloidogyne mayaguensis* on *Coffea arabica* in Cuba). *Wissenschaftliche Zeitschrift der Wilhelm-Pieck Universita€t Rostock, Naturwissenschaftliche Reihe* **38**, 32–34.

Dias WP, Freitas VM, Ribeiro NR, Moita AW & Carneiro RMDG (2010a) Reacao de genotipos de milho a *Meloidogyne mayaguensis* e *M. ethiopica* (Reaction of corn genotypes to *Meloidogyne mayaguensis* and *M. ethiopica*). *Nematologia Brasileira* **34**, 98–105.

Dias WP, Freitas VM, Ribeiro NR, Moita AW, Homechin M, Parpinelli NMB & Carneiro RMDG(2010b) Reacao de genotipos de soja a *Meloidogyne enterolobii* e *M. ethiopica* (Reaction of soybean genotypes to *Meloidogyne enterolobii* and *M. ethiopica*. *Nematologia Brasileira* **34**, 220–225.

EPPO (2010) Pest Risk Analysis for *Meloidogyne enterolobii*. Document 10-16243. Paris. Available at https://gd.eppo.int/taxon/MELGMY/documents

EPPO (2013a) EPPO Standard PM 7/119 Nematode extraction. *EPPO Bulletin* **43**, 471–495. Available at https://gd.eppo.int/standards/PM7/

EPPO (2013b) EPPO Standard PM 9/17 *Meloidogyne chitwoodi* and *Meloidogyne fallax*. *EPPO Bulletin* 43, 527–533. Available at https://gd.eppo.int/standards/PM9/

EPPO (2016) EPPO Standard PM 7/103(2)*Meloidogyne enterolobii*. *EPPO Bulletin* **46**, 190–201. Available at https://gd.eppo.int/standards/PM7/

Fargette M (1987) Use of the esterase phenotypes in the taxonomy of the genus *Meloidogyne*. 1. Stability of the esterase phenotype. *Revue de Nématologie* **10,** 39-43.

Freitas VM, Correa VR, Carneiro MDG, Silva JG, Gomes CB, Mattos JK, Somavilla L & Carneiro RMDG (2014) Host status of fruit plants to *Meloidogyne enterolobii*. *Journal of Nematology* **46,** 165.

Freitas VM, Silva JG, Gomes CB, Castro JMC, Correa VR & Carneiro RMDG (2017) Host status of selected cultivated fruit crops to *Meloidogyne enterolobii*. *European Journal of Plant Pathology* **148**, 307-319.

Galbieri R, Daivs RF, Scoz LB, Belot JL & Skantar AM. (2020) First report of *Meloidogyne enterolobii* on cotton in Brazil. https://apsjournals.apsnet.org/doi/10.1094/PDIS-02-20-0365-PDN

Gomes VM, Souza RM & Mussi-Dias V (2011) Guava decline: a complex disease involving *Meloidogyne mayaguensis* and *Fusarium solani*. *Journal of Phytopathology* **159**, 45–50.

Guimaraes LMP, Moura RM & Pedrosa EMR (2003) Parasitismo de *Meloidogyne mayaguensis* em diferentes especies botanicas (*Meloidogyne mayaguensis* parasitism on different plant species). *Nematologia Brasileira* **27**, 139–145.

Han H, Brito JA & Dickson DW (2012) First report of *Meloidogyne enterolobii* infecting *Euphorbia punicea* in Florida. *Plant Disease* **96**, 1706.

Karssen G, Liao JL, Kan Z, van Heese E & den Nijs L (2012) On the species status of the root-knot nematode *Meloidogyne mayaguensis* Rammah & Hirschmann, 1988. *ZooKeys* **181**, 67–77.

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

Kiewnick S, Karssen G, Brito JA, Oggenfuss M & Frey JE (2008) First report of root-knot nematode *Meloidogyne enterolobii* on tomato and cucumber in Switzerland. *Plant Disease* **92**, 1370.

Kim DG & Ferris H (2002) Relationship between crop losses and initial population densities of *Meloidogyne arenaria* in winter-grown oriental melon in Korea. *Journal of Nematology* **34,** 43-49.

Lima IM, Dolinski CM & Souza RM (2003) Dispersao de *Meloidogyne mayaguensis* em goiabais de Sao Joao da Barra e relato de novos hospedeiros dentre plantas invasoras e cultivadas (Dispersal of *Meloidogyne mayaguensis* in guava orchards in the city of Sao Joao da Barra, Brazil, and new hosts amongst cultivated plant species and weeds. *Nematologia Brasileira* **27,** 257-258.

Moens, M, Perry RN & Starr JL (2009) *Meloidogyne* species. In: *Root-knot nematodes* (Ed. Perry RN, Moens M & Starr JL), pp. 1-17. CAB International, Wallingford (UK).

Moore MR, Brito JB, Qiu S, Roberts CG & Combee LA (2020a) First report of *Meloidogyne enterolobii* infecting Japanese blue berry tree (*Elaeocarpus decipiens*) in Florida, USA. *Journal of Nematology* **52**:e2020-05.

Moore MR, Brito JB, Qiu S, Roberts CG & Combee LA (2020b) First Report of root-knot nematodes (*Meloidogyne* species) infecting Chinese elm tree (*Ulmus parvifolia*) in Florida, USA. *Journal of Nematology* **52**:e2020-49.

McSorley R (1998) Population dynamics. In: *Plant and Nematode Interactions* (Ed. Barker KR, Pederson GA & Windham GL), pp. 109-133. American Society of Agronomy, Madison, WI, USA.

Muniz MS, Campo VP, Moita AW, Goncalves W, Almeira MRA, Souza FR & Carneiro RMDG (2009) Reaction of coffee genotypes to different populations of *Meloidogyne* spp.: detection of a naturally virulent *M. exigua* population. *Tropical Plant Pathology* **34,** 370-378.

Nyczepir AP, Brito JA, Dickson DW & Beckman TG (2008) Host status of selected peach rootstocks to *Meloidogyne mayaguensis*. *HortScience* **43**, 804–806.

Nyczepir AP & Thomas SH (2009) Current and future management strategies in intensive crop production systems. In: *Root-Knot Nematodes* (Ed. Perry RN, Moens M & Starr JK), pp. 412–443. CAB International, Wallingford (UK).

Pereira FOM, Souza RM, Souza PM, Dolinske C & Santos GK (2009) Estimativa do impacto economico e social direto de *Meloidogyne mayaguensis* na cultura da goiaba no Brasil (Estimate of the economic and social impact of *Meloidogyne mayaguensis* onto the guava crop on Brazil). *Nematologia Brasileira* **33,** 176 -181.

Pinheiro JB, Boiteux LS, Almeida MRA, Pereira RB, Galhardo LCS & Carneiro RMDG (2015) First report of *Meloidogyne enterolobii* in *Capsicum* rootstocks carrying the *Me1* and *Me3*/*Me7* genes in central Brazil. *Nematropica* **45,** 184 – 188.

Ploeg A & Phillips MS (2001) Damage to melon (*Cucumis melo* L.) cv. Durango by *Meloidogyne incognita* in southern California. *Nematology* **3,** 151–157.

Ramirez-Suarez A, Rosas-Hernandez L, Alcasio S & Powers TO (2014) First report of the root-knot nematode *Meloidogyne enterolobii*, parasitizing watermelon from Veracruz, Mexico. *Plant Disease* **98**, 428.

Rammah A & Hirschmann H (1988) *Meloidogyne mayaguensis* n.sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. *Journal of Nematology* **20**, 58–69.

Rodriguez MG, Sanchez L & Rowe J (2003) Host status of agriculturally important plant families to the root-knot nematode *Meloidogyne mayaguensis* in Cuba. *Nematropica* **33**, 125–130.

Rosa JMO, Westerich JN & Wilcken SRS (2012) Reacao de hibridos e cultivares de milho a *Meloidogyne enterolobii* e *M. javanica* (Reaction of maize hybrids and cultivars to *Meloidogyne enterolobii* and *M. javanica*). *Nematologia Brasileira* **36**, 9–14.

Rubio-Cabetas MJ, Minot JC, Voisin R, Esmentjaud D, Salesses G & Bonnet A (1999) Resistance response of the *Ma* genes from 'Myrobalan' plum to *Meloidogyne hapla* and *M. mayaguensis*. *HortScience* **34**, 1266–1268.

Rutter WB, Skantar AM, Handoo, ZA, Muller JD, Aultman SP & Agudelo P (2019). *Meloidogyne enterolobii* found infecting root-knot nematode resistant sweetpotato in South Carolina, United States. *Plant Disease* **103,** 775.

Santos D, Abrantes I & Maleita C (2019) The quarantine root-knot nematode *Meloidogyne enterolobii* – a potential threat to Portugal and Europe. *Plant Pathology* **68,** 1607-1615.

Sasser JN, Carter CC & Hartman KM (1984) Standardization of host suitability studies and reporting of resistance to root-knot nematodes. North Carolina State University Graphics, Raleigh, NC, USA.

Schwarz T, Li C, Ye W & Davis E (2020). Distribution of *Meloidogyne enterolobii* in Eastern Northern North Carolina and comparison of four isolates. *Plant Health Progress* **21**, 91-96.

Silva AJ, Oliveira GHF, Pastoriza RJG, Maranhão EHA (*in memoriam*), Pedrosa EMR, Maranhão SRVL, Boiteux LS, Pinheiro JB & Carvalho Filho JLS (2019) Search for sources of resistance to *Meloidogyne enterolobii* in commercial and wild tomatoes. *Horticultura Brasileira* **37**, 188-198.

Soares RS, Silva EHC, Vidal RL, Cabdido WS, Franco CA, Reifschbeider FJB & Braz LT (2018) Response of *Capsicum annuum* L. var. *annuum* genotypes to root-knot nematode infection. *Chilean Journal of Agricultural Research* **78,** 78 – 85.

Souza RRC, Santos CAF, Costa SR (2018) Field resistance to *Meloidogyne enterolobii* in a *Psidium guajava* × *P. guineense* hybrid and its compatibility as guava rootstock. *Fruits* **73,** 118-124

Souza RM, Nogueira MS, Lima IM, Melarto M & Dolinski CM (2006) Manejo de nematoides das galhas da goiabeira em Sao Joao da Barra (RJ) e relato de novos hospedeiros, *Nematologia Brasileira* **30,** 165-169

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

Ye WM, Koenning SR, Zhuo K & Liao JL (2013) First report of *Meloidogyne enterolobii* on cotton and soybean in North Carolina, United States. *Plant Disease* **97**, 1262.

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