CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Meloidogyne graminis (Sledge & Golden) Whitehead 1968

Grass root-knot nematode

Pest Rating: C

Kingdom: Animalia, Phylum: Nematoda,
Class: Chromadorea, Order: Rhabditida,
Family: Meloidogynidae

Comment Period: 12/12/2024 through 01/26/2025

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from *Meloidogyne graminis* is described herein and a permanent rating is proposed.

History & Status:

Background:

Meloidogyne spp. are obligate, sedentary endoparasites that feed within host plant roots. The effect of root-knot nematodes on plants can be dramatic. As a result of their feeding, large galls or “knots” are formed on the root systems, which impairs the plant’s ability to take up water and nutrients from the soil (Chitambar et al., 2018).

Meloidogyne is a name of Greek origin, meaning "apple-shaped female". Adult females, globose and sedentary, are found embedded in their host’s roots. They produce eggs within a mass either on the surface of, or within roots. *Meloidogyne* spp. generally reproduce by mitotic parthenogenesis, meaning that males are not necessary and viable eggs can be produced by females alone in the absence of fertilization. Vermiform males are rare and are only found when the population is subjected to environmental stress. Eggs hatch in the soil and vermiform juveniles (mostly female sometimes male) swim to new roots (Mitkowski and Abawi, 2003).

The first stage juvenile develops within the egg and molts to develop into the second stage. The second-stage juveniles (J2) are the infective stage. They hatch from eggs and migrate in rhizosphere

soil to host roots, either the same roots they were originally associated with or other nearby host roots. The J2s penetrate the host roots and establish a specialized feeding site that is formed at the head end of the nematode in response to its feeding. They become sedentary while feeding at the specialized site, increasing in size and undergoing two more molts and non-feeding stages before developing into mature adult females or vermiform males and completing the life cycle.

The feeding site described above is a group of plant cells known as "giant cells", created when the nematode injects secretory proteins that stimulate changes within the parasitized cells. The injected cells rapidly become multinucleate when division occurs without cell wall formation. Giant cells can be very large and act as significant nutrient sinks, producing large amounts of proteins that the nematodes can use. Increases in the production of plant growth regulators from nematode feeding also play a role in this increase in cell size and division. Root cells next to the giant cells enlarge and divide rapidly, resulting in gall formation. Once a female establishes a feeding site as a juvenile, she permanently remains within the plant root, exuding her eggs out into the soil (Perry and Moens, 2013).

This nematode was first identified and described as the cause of St. Augustine grass decline in Florida in 1959 by E. B. Sledge. It resembled other root-knot nematodes (*Meloidogyne* spp.) but also shared some characteristics of cyst nematodes (*Heterodera* spp.). It was described as a new genus and species, *Hypsoperine graminis* (Sledge and Golden, 1964), and later referred to as the “pseudo-root knot nematode” (Esser and Langdon, 1965). Whitehead later synonymized the genus *Hypsoperine* with the genus *Meloidogyne* (Whitehead, 1968). Reproduction is by amphimixis when males are present, and by meiotic parthenogenesis when males are absent (Triantaphyllou, 1973). Today it is known for its ability to damage turf and has been collected across the southern United States, and in Hawaii and California.

Hosts: Meloidogyne graminis parasitizes grasses and cereals: *Agrostis stolonifera* (creeping bentgrass), *Cynodon dactylon* (Bermuda grass), *Cynodon transvaalensis* (Florida grass), *Cyperus esculentus* (yellow nutsedge), *Cyperus rotundus* (purple nutsedge), *Dactylis glomerata* (cat grass), *Digitaria sanguinalis* (hairy crabgrass), *Eremochloa ophiuroides* (centipede grass), *Hemarthria altissima* (limpo grass), *Hordeum vulgare* (barley), *Lolium arundinaceum* (tall fescue), *Paspalum notatum* (bahai grass), *Poa pratensis* (blue grass), *Sorghum bicolor* (sudangrass), *Stenotaphrum secundatum* (St. Augustine grass), *Triticum aestivum* (wheat), *Zea mays* (corn), *Zoysia japonica* (zoysia grass), *Zoysia matrella* (Manilagrass), *Zoysia* sp. (zoysia) (Nemaplex, 2010; Subbotin et al., 2021).

Symptoms: The adult females are sedentary endoparasites that establish feeding sites on plant roots. The body of the female grows and swells, causing extensive damage to the roots. The roots turn dark, the root cortex splits and the stele becomes exposed, dry, and brittle. Over time the cortex sloughs away. Galling is seen as an elongated swelling of infected adventitious roots that develop as a cluster of three to four clubs at each node. Nematode feeding halts root elongation and lateral root development is also suppressed. Infected root tips can curve into a “J” shape. The above-ground growth of the plants becomes chlorotic and stunted. Plants will eventually die (MacGowan, 1984).

Transmission: Meloidogyne graminis has a limited ability to move in the field. Only second-stage juveniles can move within the soil, and their range is typically restricted to a few tens of centimeters

per year at most. The most probable way for *M. graminis* to be introduced to a new area is through the transportation of infested or contaminated planting materials. Nematodes can easily be carried by infested host plants or host products such as bulbs or tubers. Additionally, the movement of non-host plants intended for planting, including seedling transplants or nursery stock, as well as non-host plant products such as bulbs, tubers, corms, and rhizomes, can contribute to the spread of *Meloidogyne* if they are contaminated with soil infested by the nematode. Other potential pathways for its spread include the movement of bulk soil and contaminated irrigation water. The infective juveniles of this nematode can survive for more than a year in the absence of host plants (Chitambar et al, 2018).

Damage Potential: Grass root-knot nematode feeding damage causes large circular areas of dead or dying grasses that may show chlorotic leaf margins (Grisham et al., 1974).

Worldwide Distribution: *Brazil, China, India, Libya, Germany, Malaysia, Netherlands, United States* (Alabama, Arizona, Arkansas, California, Florida, Georgia, Hawaii, Kansas, Maryland, Nevada, Northeastern states, North Carolina, South Carolina, Tennessee, Texas, and Virginia), *and Venezuela* (Subbotin et al., 2021).

Official Control*: Meloidogyne graminis* is on the USDA PCIT's harmful organisms list for Thailand (USDA PCIT 2024).

California Distribution: Imperial, Kern, Orange, Riverside, and San Diego counties (McClure et al., 2012; CDFA PDR Database, 2024).

California Interceptions: none

The risk that *Meloidogyne graminis* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** It is likely to survive wherever its hosts can grow.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   Score: **3**
   - Low (1) Not likely to establish in California; or likely to establish in very limited areas.
   - Medium (2) may be able to be established in a larger but limited part of California.
   - High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** The host range is mainly grasses plus nutsedges.

   Evaluate the host range of the pest.

   Score: 2
   - Low (1) has a very limited host range.
   - Medium (2) has a moderate host range.

- High (3) has a wide host range.

3) **Pest Reproductive Potential:** A single female nematode can produce hundreds of eggs in her lifetime. Root-knot nematodes do not have a high dispersal potential unless moved by people. They can be moved accidentally with infected plants, soil, and water.

   Evaluate the natural and artificial dispersal potential of the pest.

   Score: 2

   - Low (1) does not have high reproductive or dispersal potential.
   - Medium (2) has either high reproductive or dispersal potential.
   - High (3) has both high reproduction and dispersal potential.

4) **Economic Impact:** Populations of this nematode are the cause of turf grass decline. This can be damaging to golf courses and sports turf (McClure et al., 2012). They can be moved by water.

   Evaluate the economic impact of the pest on California using the criteria below.

   Economic Impact: B, G

   A. The pest could lower crop yield.
   B. The pest could lower crop value (including increasing crop production costs).
   C. The pest could trigger the loss of markets (including quarantines).
   D. The pest could negatively change normal cultural practices.
   E. The pest can vector, or is vectored, by another pestiferous organism.
   F. The organism is injurious or poisonous to agriculturally important animals.
   G. The organism can interfere with the delivery or supply of water for agricultural uses.

   Economic Impact Score: **2**

   - Low (1) causes 0 or 1 of these impacts.
   - Medium (2) causes 2 of these impacts.
   - High (3) causes 3 or more of these impacts.

5) **Environmental Impact:** None has been reported.

   Evaluate the environmental impact of the pest on California using the criteria below.

   Environmental Impact:

   A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
   B. The pest could directly affect threatened or endangered species.
   C. The pest could impact threatened or endangered species by disrupting critical habitats.
   D. The pest could trigger additional official or private treatment programs.
   E. The pest significantly impacts cultural practices, home/urban gardening, or ornamental plantings.

Environmental Impact Score: 1
- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Meloidogyne graminis:* Medium

Add up the total score and include it here. 10
-Low = 5-8 points
-Medium = 9-12 points
-High = 13-15 points

6) **Post-Entry Distribution and Survey Information**: Evaluate the known distribution in California. Only official records identified by a taxonomic expert and supported by voucher specimens deposited in natural history collections should be considered. Pest incursions that have been eradicated, are under eradication or have been delimited with no further detections should not be included.

Evaluation is "Medium".

Score: -2
-Not established (0) Pest never detected in California or known only from incursions.
-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).
-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.
-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) **The final score is** the consequences of the introduction score minus the post-entry distribution and survey information score: (Score)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 8***

Uncertainty:

None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Meloidogyne graminis* **is C.**

References:

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***Comment Period: 12/12/2024 through 01/26/2025**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.
- Comments may not be posted if they:

  Contain inappropriate language which is not germane to the pest rating proposal;

  Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

  Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

  Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.

- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Pest Rating: C