

California Pest Rating Proposal for

Meloidogyne artiellia Franklin (1961) British root-knot nematode

Pest Rating: A

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

Comment Period: 05/07/2024 – 06/21/2024

Initiating Event:

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

History & Status:

Background:

Meloidogyne spp. are obligate, sedentary endoparasites that feed within host plant roots. *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 range from common to rare. Some are not seen unless the population is subjected to environmental stress; in their absence, females reproduce through parthenogenesis.

Eggs hatch in the soil and vermiform juveniles swim to new roots. 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 that hatch from eggs and migrate in rhizosphere soil to 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 males and completing the life cycle.

The feeding site inside the root 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 for growth. 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 juvenile establishes a feeding site, it develops into an adult female which, for perhaps six to eight weeks, deposits eggs into a gelatinous matrix (the egg mass) on the root (Perry and Moens, 2013; Mitkowski and Abawi, 2003; Sasser and Carter, 1985).

Meloidogyne artiellia was first reported from cabbage in England (Franklin, 1961), and re-described by Esser et al. (1976). Today, *M. artiellia* is mainly distributed in Mediterranean countries, but it has been found in limited areas of Northern Europe, Russia, and China. Investigations on the host range of this root-knot nematode done by Di Vito et al., (1985) indicated that, with a few exceptions, it reproduces well on cereals in addition to plants in the families Cruciferae and Leguminosae. Studies by DeVito and Greco (1988a) showed the most favorable temperatures for development were 20-25°C, males were present, and the second stage juveniles survived hot dry summer months coiled, in anhydrobiosis. These nematodes have only one generation per year in the Mediterranean Basin (Castillo et al., 2008). There was a fear that this nematode would be introduced into the United States (particularly to Florida) as machinery with soil and personnel returned from the Persian Gulf at the conclusion of the Gulf War conflicts (Greco et al., 1992).

Hosts: Apium graveolens (celery), *Artemisia* (wormwoods), *Avena sativa* (oat), *Brassica campestris* (field mustard), *B. oleracea* var. *botrytis* (cauliflower), *B. oleracea* var. *capitata* (cabbage), *B. oleracea* var. *gemmifera* (Brussels sprouts), *B. napus* (canola), *B. rapa* (turnip), *Cicer arietinum* (chickpea), *Cucumis melo* (cantaloupe), *Hedysarum coronarium* (french honeysuckle), *Hordeum vulgare* (barley), *Lathyrus cicera* (flat-podded vetchling), *Lathyrus sativus* (grass pea), *Lens culinaris* (lentil), *Medicago lupulina* (black medic), *M. rigidula* (medic), *M. sativa* (alfalfa), *Nasturtium fontanum* (watercress), *Phaseolus vulgaris* (bean), *Pisum sativum* (pea), *Raphanus sativus* (radish), *Solanum lycopersicum* (tomato), *Sorghum vulgare* (sorghum), *Spinacia oleracea* (spinach), *Trifolium incarnatum* (crimson clover), *T. pratense* (red clover), *T. repens* (white clover), *Triticosecale* sp. (triticale), *Triticum aestivum* (wheat), *T. turgidum* subsp. *durum* (durum wheat), *T. vulgare* (common wheat), *Vicia articulata* (oneflowered vetch), *Vicia faba* (fava bean), *V. narbonensis* (French vetch), *V. sativa* (common vetch), *Vicia* sp. (vetch), and *V. villosa* (hairy vetch) (Nemaplex, 2010; CABI 2024).

Symptoms: Aboveground symptoms of root knot nematodes are not very specific. Root galls formed by *M. artiellia* are small but often covered with large egg masses. They can be difficult to detect on the plant roots. There can be a proliferation of lateral roots. Infected plants can have chlorotic leaves and poor growth in patches (Greco et al., 1992). Depending on the level of root infection, infection can limit water uptake and cause physiological problems for the plant during periods of high water demand, usually at the end of the crop cycle. Infested plants may appear wilted under hot and sunny conditions and symptoms may not be apparent until plants reach later stages of growth. In wheat, spikes are sparse and reduced in size, and in chickpeas, pods are few, small, or without seeds (Greco et al., 1992),

and a reduction of the protein content of chickpea seeds has been documented (DiVito and Greco, 1988b).

Fusarium wilt caused by *Fusarium oxysporum* f. sp. *ciceris* is an important soil-borne disease in chickpea production, and management of this disease is achieved mainly using resistant cultivars. Co-infection of resistant chickpea plants by *Fusarium* and *Meloidogyne artiellia* causes breakdown of the resistance, limiting the efficacy of resistant varieties in the control of Fusarium wilt (Palomares-Rius et al., 2011).

Transmission: Natural dispersal is very slow in fields and is mainly accomplished plant-to-plant through root networks in the soil (Perry et al., 2009). Run-off water from infested fields can infest other fields, and the nematodes are moved with the soil and water. Long-distance movement is via propagative material (seedlings, tubers, etc.), soil adhering to machinery, equipment, or people, tilling by the contaminated machinery, and using the water from contaminated ditches for irrigation (Been and Schomaker, 2006).

Damage Potential: This nematode is a damaging pest of cereals and leguminous crops in Mediterranean countries. Damage caused by *M. artiellia* can be severe and cause complete crop failure in heavily infested fields. Chickpeas are severely damaged, especially if grown in rotation with another important host such as wheat (DiVito and Greco, 1988b, 1988c).

Worldwide Distribution: Africa: *Algeria, Morocco, Tunisia*. Asia: *China, Israel, Syria, Turkey*. Europe: *Belgium, France, Greece, Italy, Russia, Spain, and the United Kingdom* (CABI, 2024)

Official Control: *Meloidogyne artiellia* is on the USDA PCIT's harmful organisms list for Honduras, Indonesia, and Timor-Leste (USDA PCIT 2024).

California Distribution: none

California Interceptions: none

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

Consequences of Introduction:

- 1) Climate/Host Interaction:** This nematode is widely distributed in Mediterranean countries that share climates that are similar to California's. It is likely to survive wherever its hosts 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.**
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2) Known Pest Host Range: The host range includes plants in several families.

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: There is usually one generation per year in areas with hot dry summers. Artificial spread is important as root knot nematodes move with contaminated 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: Damage can be direct, from nematode feeding and gall formation on the roots, or indirect, as plants become more susceptible to attack from other types of pathogens. They can be moved with irrigation water.

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

Economic Impact: A, 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: 3

- 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: This nematode parasitizes many genera, some of which are represented by California natives, including *Artemisia*, *Vicia*, *Hordeum*, *Lathyrus*, and *Vicia*. These are potential hosts of this nematode. Cultural practices which involve movement of large amounts of soil can spread this nematode.

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

Environmental Impact: A, E

- 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: 3

- 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 artiellia*: High

Add up the total score and include it here. **13**

- 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 'not established'.

Score: 0

-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 = 13

Uncertainty:

Distinguishing between the species of *Meloidogyne* is often difficult and many species can co-occur. Cultural management techniques such as crop rotation and trap cropping, rely on knowing the species present in a field. The ability to analyze DNA has progressively led to more advanced and accurate methods of species identification and this is likely to continue to improve in the future (Chitambar et al., 2018).

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Meloidogyne artiellia* is **A**.

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Responsible Party:

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***Comment Period: 05/07/2024 – 06/21/2024**

***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[[@](mailto:permits@cdfa.ca.gov)]cdfa.ca.gov.

Comment Format:

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