CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

# California Pest Rating Proposal for

## *Meloidogyne arenaria* (Neal) Chitwood, 1949

## Peanut root-knot nematode

**Current Pest Rating: C**

**Proposed Pest Rating: C**

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

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**Comment Period: 06/07/2022 through 07/22/2022**

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## Initiating Event:

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

## History & Status:

**Background:** Root-knot nematodes (*Meloidogyne* spp.) were first reported in California by E. A. Bessey in 1911. They are the most extensively studied genus in the state with six species of significant economic concern: *M. arenaria, M. chitwoodi, M. hapla, M. incognita, M. javanica*, and *M. naasi* (Chitambar, 2018). Important agronomic hosts of *M. arenaria* in California are alfalfa, apple, grape, nectarine, peach, plum, prune, beans (dry), broccoli, cabbage, cauliflower, carrots, lettuce, cucurbits, sugar beet, wheat, barley, and potato (Siddiqui et al., 1973). *Meloidogyne* species occur in a wide range of soil textures, but they appear to predominate in coarse-textured sandy and sandy loam soils where plant damage is often accentuated in sandy patches or streaks within a field (Chitambar et al., 2018).

Females of *M. arenaria* reproduce by mitotic parthenogenesis; as soon as they are mature adults, they begin producing eggs. The eggs develop into a vermiform first-stage juvenile that undergoes one molt into a second-stage juvenile while still in the egg. The second-stage juvenile hatches and moves freely in the soil, penetrating plant roots just behind the root cap. They migrate intercellularly in the root and establish a feeding site within the vascular cylinder. As it feeds, the nematode induces a giant cell system in the roots. The female juvenile loses her mobility and begins to increase in girth as she feeds. She becomes flask-shaped and molts three times without additional feeding, maturing into a saccate

adult. Male second-stage juveniles undergo a metamorphosis during the third molt into an elongated vermiform fourth stage. The fourth-stage juvenile male remains enclosed in the cuticle of the second and third stages where he molts again to form an adult vermiform male. The male escapes from the cuticles and the root system. He moves freely in the soil, not feeding, mating with mature adult females. However, males serve no reproductive function in this species as the eggs are produced by parthenogenesis (Triantaphyllou and Hirschmann, 1960).

Resistant cultivars of some *Meloidogyne*-susceptible crops are available including for tomato, cotton, cowpea, lima bean, and sweet potato. Tomato cultivars are available with the Mi gene that are resistant to *M. arenaria, M. incognita,* and *M. javanica* but not to *M. hapla* (Ho et al. 1992). Mi-mediated resistance is characterized by a localized necrosis of host cells near the invading nematode that begins about 12 h after infestation occurs. The presence of resistance breaking nematode populations is a major loss of a very environmentally safe and effective control method. The length of generations of *M. arenaria* are greatly affected by temperature. At very high temperatures (>29°C), the life cycle takes approximately 3 weeks, but at very cool temperatures it can be extended to 2-3 months.

*Hosts:* The host range of *M. arenaria* is extremely large and includes members from many plant families including monocotyledons, dicotyledons, and herbaceous and woody plants. This root-knot species parasitizes most of the major food crops (vegetables, fruit trees, brambles, and vines) and ornamental plants grown in tropical, subtropical, and temperate climates (CABI, 2022). Three races have described as follows: race 1 reproduces on peanut but not tomato, race 2 reproduces on tomato but not peanut, and race 3 reproduces on tomato and peppers, but not on peanut (López-Pérez et al., 2011). Populations able to overcome *Meloidogyne* resistance in grape rootstocks are often identified as *M*. *arenaria* (Anwar et al., 2000).

*Symptoms*: The characteristic aboveground symptoms of *Meloidogyne* infestation include stunting, loss of quantity and quality of yield, wilting during hot periods of the day, and increased susceptibility to foliage diseases and vascular wilts. These symptoms alone are not diagnostic. In contrast, mild infections can stimulate an increase in growth and yield.

Belowground, *Meloidogyne* infection causes both a decrease in the size of the root system and the development of macroscopic root galls. Depending upon the host and the number of nematodes present, galls vary in size from minute to extremely large. On peanuts, *M. arenaria* causes large galls on roots, pegs, pods, and runners and reduces plant growth. Galls on trees and vines, are typically smaller than those on annual crops. In some cases, infections may cause an aesthetic problem rather than growth reduction. In carrots, for example, an early attack on the developing tap root can cause disfiguration through galling and splitting of the tap root, rendering the plant unmarketable (McKenry and Roberts 1985). Heavily infected roots are often badly discolored and rotted due to the invasion of roots by fungi such as *Rhizoctonia, Fusarium* and *Pythium* which cause rotting and breakdown of galled tissue, and by bacteria (Starr et al., 1996). *Fusarium oxysporum* infects wilt-resistant tobacco in presence of *M*. *arenaria*. Similar increase in wilt incidence occurs in watermelon and tomato (Francl and Wheeler, 1993).

*Transmission*: Infected roots, bare root propagative material, and anything that moves soil including containers, tools, equipment, machinery, irrigation water, and people can move this nematode. Long distance spread is with contaminated nursery stock (Chitambar et al., 2018).

*Damage Potential: Meloidogyne arenaria* is an economically important plant pathogenic nematode that parasitizes thousands of plant species worldwide. It is a pest of major food crops and significantly reduces the quantity and quality of food and fiber when populations are large. The average loss caused by root-knot nematodes is thought to be around 5%; however, in some fields the loss can be complete. Often the damage caused by these nematodes is overlooked or blamed on other agronomic problems and there can be mixed infections with multiple *Meloidogyne* species (Chitambar et al., 2018). The root system of the affected plants is stunted, and plants are often prone to increases in the susceptibility to, and severity of, soilborne fungal and bacterial diseases (Starr et al., 2002).

**Worldwide Distribution**: This nematode is cosmopolitan in tropical, subtropical, and temperate climates where the average temperature in the warmest month is 36°C or lower and the average temperature in the coldest month is at lowest 3°C. The principal limiting factor in the distribution of *M. arenaria* seems to be an average temperature in the coldest month above 3°C (Taylor et al., 1982).

**Official Control:** *Meloidogyne arenaria* is on the USDA PCIT's harmful organism list for Canada, Honduras, Jordan, and Panama. It is on EPPO's A2 list for Jordan and is a regulated non-quarantine pest in the United Kingdom.

**California Distribution**: Official detections have been made in Fresno, Kern, Los Angeles, Madera, Riverside, Sacramento, San Bernardino, San Mateo, Siskiyou, Sonoma counties.

**California Interceptions:** Interceptions have been made on incoming shipments of philodendrons from Texas and Florida.

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

## Consequences of Introduction:

1) **Climate/Host Interaction:** This nematode is sensitive to cold soil temperatures but can survive in most areas of the state appropriate for agriculture.

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

   **Score**: **2**

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

2) **Known Pest Host Range:** This is a highly polyphagous nematode.

Evaluate the host range of the pest.

**Score: 3**

- 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:** This nematode can reproduce without males, and a single female can produce hundreds of eggs. Their movement through soil is limited but move easily with contaminated planting stock and soils.

Evaluate the natural and artificial dispersal potential of the pest.

**Score: 3**

- 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:** Root knot nematodes reduce the size and the health of plant root systems. They do with direct damage to crops such as peanuts, potatoes, and carrots, and increase the susceptibility of their hosts to other pathogens. *Meloidogyne arenaria* is a quarantine pest in multiple countries.

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

**Economic Impact: A, B, C, G**

A. The pest could lower crop yield.
B. The pest could lower crop value (includes increasing crop production costs).
C. The pest could trigger the loss of markets (includes 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 has such a large host range that many native and naturalized hosts could be parasitized. Once established in a home or urban garden, or ornamental planting, it will be difficult or impossible to eradicate.

Evaluate the environmental impact of the pest to 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 arenaria:* High

Add up the total score and include it here. 14
-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.

There are extensive records at CDFA and in Nemabase of this nematode as widespread in the San Joaquin and Sacramento valleys, southern California, and the north coast.

***Evaluation is 'high'***.

**Score: -3**
-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 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* ***= 11***

## Uncertainty:

In the past, *Meloidogyne* species could not always separated based on the lack of distinguishing characters, especially for juveniles. It is possible that some records of *Meloidogyne* spp. would today be confirmed as *M. arenaria*.

## Conclusion and Rating Justification:

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

## References:

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USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Meloidogyne arenaria*. Accessed 5/12/2022

## Responsible Party:

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## *Comment Period: 06/07/2022 through 07/22/2022

## *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.

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## Comment Format:

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

**Example Comment:**

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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.

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**Proposed Pest Rating: C**