

**California Pest Rating Proposal for**  
***Meloidogyne paranaensis* Carneiro et al. 1996**  
**Parana coffee root-knot nematode**

**Current Pest Rating: Q**

**Proposed Pest Rating: A**

Domain: Eukaryota, Kingdom: Metazoa,  
Phylum: Nematoda, Class: Chromadorea,  
Order Rhabditida, Family: Meloidogynidae

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**Comment Period: 12/01/2021 through 01/15/2022**

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**Initiating Event:**

In May 2021, a resident of San Diego County was shipped an uncertified *Caladium* sp. (elephant ear plant) by a resident of San Antonio, Texas. The shipment was in violation of quarantine codes and was intercepted at the USPS facility by a High-Risk Pest Exclusion dog and handler team. A sample of the roots and soil was collected and submitted to CDFA's Plant Pest Diagnostics Center at Meadowview. CDFA Nematologist Sergei Subbotin extracted juvenile nematodes from the sample and by using molecular markers identified them as *Meloidogyne paranaensis*. This was the first detection of *M. paranaensis* in the continental United States (it has been found in Hawaii), and the first report on *Caladium* spp. It was assigned a temporary Q rating. The risk to California from this nematode is described herein and a permanent rating is proposed.

**History & Status:**

**Background:** *Meloidogyne* spp. have the common name of root-knot nematodes. They are one of the most damaging and important groups of nematodes to agriculture. They are obligate, sedentary endoparasites that feed within host plant roots. Adult females embedded in host roots produce eggs within a mass either on the surface of, or within 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 where they reinfest the same roots they were originally associated with or are attracted to other nearby host roots. The J2s penetrate the host roots and establish a specialized feeding site or giant plant cells that are formed at the head end of the nematode in response to its feeding. They become sedentary while feeding at the specialized site,

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increase in size and undergo two more molts and non-feeding stages before developing into mature adult females or vermiform males and completing the life cycle.

*Meloidogyne paranaensis* was first named and described in 1996 in the state of Paraná, Brazil by Carneiro et al. Previously, it was identified as a pathotype of *M. incognita*, before it was elevated to a species. It was described as one of the most destructive root-knot species attacking coffee in the Americas and was estimated to account for half of all root knot infestations in that state.

**Hosts:** *Coffea arabica* (coffee) is the primary host. Other hosts are *Ageratum conyzoides* (billygoat-weed), *C. canephora* (robusta coffee), *Citrullus lanatus* (watermelon), *Eleusine indica* (Indian goosegrass), *Emilia sonchifolia* (lilac tasselflower), *Glycine max* (soybean), *Ilex paraguariensis* (yerba mate), *Impatiens balsamina* (garden balsam), *Nicotiana tabacum* (tobacco), and *Raphanus raphanistrum* (wild radish) (Subbotin et al., 2021). There are additional weeds that are susceptible under experimental inoculation (Monaco et al., 2008).

**Symptoms:** Above ground, coffee plants will show different levels of general decline, reduced growth, nutritional deficiency symptoms, with leaf chlorosis, defoliation, and dieback. *Meloidogyne paranaensis* does not produce the usual galls on the roots of coffee that are typical from root-knot nematodes. It produces a syndrome called ‘coffee corky-root disease’ with symptoms such as splitting and cracking of the cortical root tissue, especially on the taproot. Necrotic spots occur along the roots where the females are embedded, and nematode feeding probably causes the death of tissues around the giant cells (Carneiro et al., 1996; López-Lima et al., 2015).

**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.

**Damage Potential:** Arabica coffee is aggressively attacked by this nematode and as a result, plant growth is limited and yields are reduced as much as half when fields are infested (Carneiro et al., 1996; Ferraz, 2008). Coffee corky-root disease associated with root-knot nematode infection is a major concern for coffee production in Mexico where substantial losses are reported annually (López-Lima et al., 2015).

**Worldwide Distribution:** Central America and the Caribbean: *Costa Rica, Guatemala, Martinique.* Europe: *France.* North America: *Mexico, United States (Hawaii).* South America: *Brazil, Colombia* (CABI-CPC, 2021; Subbotin et al., 2021; Carneiro and Cofcewicz, 2008).

**Official Control:** *Meloidogyne paranaensis* is on the USDA PCIT’s harmful organism list for Nicaragua (USDA, 2021).

**California Distribution:** None

**California Interceptions:** There has been one interception on a *Caladium* plant destined for San Diego County. As this shipment was not manifested with a proof of origin, the plant materials may have

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originally come from South or Central America, where it is native and found in tropical forests (Subbotin and Burbridge, 2021).

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

### Consequences of Introduction:

- 1) Climate/Host Interaction:** This nematode is an obligate parasite, likely to survive wherever its hosts can grow. There are limited zones that can support coffee, but watermelon is grown widely.

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:** The primary host is coffee. Although coffee is not a widely planted or large economic crop for California, there are coffee farms in Santa Barbara and San Diego counties. Other hosts such as watermelon are widely planted, and wild radish is a nonnative but widely distributed weed along the coast and in the Central Valley.

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:** Root knot nematode females can produce hundreds of eggs. Dispersal depends on the movement of infested plants or soils.

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:** This nematode is reported as a serious pest in Central and South America. It could be spread by irrigation water. Once established in an area it would be extremely difficult to eradicate. This is a quarantine pest for Nicaragua.

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

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**Economic Impact: A, 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:** Detection in a nursery would trigger official programs.

Evaluate the environmental impact of the pest to 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: 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 paranaensis*: Medium**

Add up the total score and include it here. **12**

- 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

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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 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 = 12*

**Uncertainty:**

None

**Conclusion and Rating Justification:**

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

**References:**

CABI Crop Production Compendium 2021. *Meloidogyne paranaensis* (Parana coffee root-knot nematode) <https://www.cabi.org/cpc/datasheet/33251> Accessed 11/5/21

Carneiro, R. M. D. G., Carneiro, R. G., Abrantes I.M. O., de A. Santos, M.S.N., and Almeida, M. R. A. 1996. *Meloidogyne paranaensis* n. sp. (Nematoa: Meloidogynidae), a root-knot nematode parasitizing coffee in Brazil. *Journal of Nematology* 28:177-189.

Carneiro, R.M. and Cofcewicz, E.T., 2008. Taxonomy of coffee-parasitic root-knot nematodes, *Meloidogyne* spp. In *Plant-parasitic nematodes of coffee* (pp. 87-122). Springer, Dordrecht.

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Ferraz, L.C.C.B. 2008. Plant parasitic nematodes of coffee in Brazil. In: *Plant Parasitic Nematodes of Coffee* (Souza RM, Editor). New York, NY, USA: APS Press & Springer, 225-248.

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Subbotin, S. A., and Burbridge, J. 2020. Report of the Parana coffee root-knot nematode, *Meloidogyne paranaensis* (Tylenchida: Meloidogynidae) from *Caladium* sp. in the continental United States. *Journal of Nematology* (Submitted)

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PEXD) Harmful Organisms Database Report. Accessed 2/26/2021

### **Responsible Party:**

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 1220 N St Rm 221, Sacramento, CA 95814 Phone: (916) 654-1017, [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

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**\*Comment Period: 12/01/2021 through 01/15/2022**

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

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### **Comment Format:**

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- ❖ 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.

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**Proposed Pest Rating: A**

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