

California Pest Rating Proposal for
***Meloidogyne hapla* Chitwood, 1949**
Northern Root-Knot Nematode

Current Pest Rating: C

Proposed Pest Rating: C

Comment Period: 12/17/2019 through 1/31/2020

Initiating Event:

On August 9, 2019, USDA-APHIS published a list of “Native and Naturalized Plant Pests Permitted by Regulation”. Interstate movement of these plant pests is no longer federally regulated within the 48 contiguous United States. There are 49 plant pathogens (bacteria, fungi, viruses, and nematodes) on this list. California may choose to continue to regulate movement of some or all these pathogens into and within the state. In order to assess the needs and potential requirements to issue a state permit, a formal risk analysis for the Northern Root-Knot nematode *Meloidogyne hapla* is given herein and a permanent pest rating is proposed.

History & Status:

Background: *Meloidogyne hapla* is a root-knot nematode in the family Meloidogynidae (Siddiqi, 2000). It was first described from the United States by Chitwood (1949) from New York on potatoes (*Solanum tuberosum*) and it has the common name “northern root-knot” because it commonly occurs in cooler environments. In the tropics it’s limited to cooler, higher elevations (Whitehead, 1969). Root-knot nematodes damage plants by attacking the root tips and causing the formation of swellings on the roots. The female lays approximately 500 eggs in a gelatinous substance which is released into the soil. The second-stage juvenile emerges from the egg. This is the only infective stage of the nematode and it enters the root and becomes a sedentary endoparasite. The nematodes feed on the plant cells by inserting a stylet and secreting saliva which stimulates plant cell enlargements and the “root-knots”. After multiple juvenile stages, the vermiform (worm-like) adult male emerges from the root and

becomes free-living in the soil while the female continues to grow in thickness and becomes pear shaped. Some populations have abundant males, others produce few or none. The female can produce eggs with or without fertilization.

Hosts: *Meloidogyne hapla* is an extremely polyphagous nematode and it attacks a wide variety of crops and weeds including nearly all temperate vegetables. There are records of this nematode on most of the higher plant families as it feeds on the roots of both herbaceous and woody plants. Most grasses and cereals appear to be non-hosts. (Goodey et al., 1965). In California, there are many records on alfalfa plus grapes, beans, potatoes, strawberries, tomatoes and walnuts (Nemabase, 2019).

Symptoms: Symptoms of *M. hapla* attack include a galling of the root system. Most of the galls are relatively small and subspherical, often with a proliferation of small roots at the site of the gall. This is a feature of *M. hapla*, and the galls that are induced by this nematode are usually smaller than those produced by *M. arenaria*, *M. incognita*, or *M. javanica*. In potato tubers, brown spots appear in the tubers after the females commence egg production. Severe attacks by *M. hapla* results in impaired root function and stunting of the above ground parts. The damage to the root system leads to a reduction in yield. Other symptoms include abnormal leaf colors and early senescing of leaves (CABI, 2019)

Transmission: Root-knot nematodes are spread primarily by water or by soil clinging to farm equipment or on infected propagating stock (i.e. potato tubers) transported into uninfested areas (Agrios, 2005).

Damage Potential: From their feeding, the nematodes take nutrients from the plants, but can also disfigure and reduce the value of root crops such as potatoes and carrots. When plants are infected at the seedling stage, losses are heavy and may result in complete destruction of the crop. Roots of trees are also attacked and develop galls. Infections of older plants may have only a small effect on yield or may reduce yields considerably (Agrios, 2005). The nematode has been associated increased severity of disease caused by other pathogens, including bacteria (such as *Pseudomonas caryophylli*) and fungi (such as *Fusarium*, *Rhizoctonia* and *Verticillium*) (Jacobsen et al., 1979; LaMondia, 1999; Irvine, 1964).

Worldwide Distribution: *Meloidogyne hapla* is widely distributed in temperate areas of Asia, Africa, North America, Central America, South America, Oceania and Europe, and at higher altitudes in the tropics (CABI-CPC).

Official Control: *Meloidogyne hapla* is on the harmful organism list for Canada, Dominican Republic, Guatemala, Honduras, Mexico, Nicaragua and Vietnam (USDA-APHIS, PCIT database). *Meloidogyne* spp are listed as pests of concern for onions grown in California for export seed

California Distribution: *Meloidogyne hapla* is widespread and has been detected in the following counties: Alameda, Butte, Fresno, Kern, Los Angeles, Mendocino, Merced, Monterey, Nevada, Riverside, Sacramento, San Bernardino, San Joaquin, Santa Barbara, Sacramento, Shasta, Solano, Tulare, Yolo and Yuba.

California Interceptions: *Meloidogyne hapla* has been intercepted in Fresno County on kiwi plants from New Zealand and in Butte County on peonies from Ohio.

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

Consequences of Introduction:

- 1) **Climate/Host Interaction:** *Meloidogyne hapla* is well adapted to the cooler parts of California and has many hosts that grow in temperate climates.

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 establish in a larger but limited part of California.
- **High (3) likely to establish a widespread distribution in California.**

- 2) **Known Pest Host Range:** *Meloidogyne hapla* is extremely polyphagous with more than 500 recorded hosts (Nemabase, 2010)

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:** The female *M. hapla* can produce hundreds of eggs with or without males. The eggs are released into the soil and can move with soil, water, or infected host plants.

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:** This nematode reduces yields as it interferes with the normal function of the plant root system which becomes impaired by root galls. It is especially damaging to root vegetables as it causes loss of yield and loss of quality to the underground plant parts.

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

Economic Impact: A, B, 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: 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:** *Meloidogyne hapla* has a very large host range that includes native plants. Individual fields can have very high nematode populations that prevent planting (Chitambar et al., 2018).

Environmental Impact: 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: 2

- 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 hapla* is 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.
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Evaluation is 'high'. This nematode is widespread in California (Nemabase, 2010).

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:

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = 13-3=10*

Uncertainty: None.

Conclusion and Rating Justification:

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

References:

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Responsible Party:

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***Comment Period: 12/17/2019 through 1/31/2020**

***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 [a] 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.

Proposed Pest Rating: C
