

California Pest Rating Proposal for
***Aphelenchoides ritzemabosi* (Schwartz, 1911) Steiner & Buhrer, 1932**

Chrysanthemum foliar nematode

Current Pest Rating: C

Proposed Pest Rating: C

Kingdom: Animalia, Phylum: Nematoda, Class: Secernentea

Order: Tylenchida, Family: Aphelenchoididae

Comment Period: 3/13/2020 through 4/27/2020

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 Chrysanthemum foliar nematode, *Aphelenchoides ritzemabosi*, is given herein and a permanent pest rating is proposed.

History & Status:

Background: There are two important phytopathogenic genera in the nematode family Aphelenchoididae: *Aphelenchoides* (bud and leaf nematodes) and *Bursaphelenchus* (the pine wilt and red-ring nematodes). They survive inside the tissues of the plants they infect, and *Bursaphelenchus* also survives inside its insect vectors. They are unique among plant parasitic nematodes in that they seldom, if ever, enter the soil. The genus *Aphelenchoides* contains species that feed on plants, fungi, and insects, and the plant parasitic species have a very wide host range compared to other types of plant-pathogenic nematodes (Kohl, 2011).

Aphelenchoides ritzemabosi was first detected in chrysanthemums in the early 1890s, but it was confused with other nematodes with similar morphology until the species were separated by Schwartz

in 1911 (Goodey, 1933). The neotype for *A. ritzemabosi* was proposed by Allen (1952) from chrysanthemums collected in Redwood City, California. Now it is widespread in the United States, Europe and Asia as a pest of chrysanthemums and many other plants and seems well adapted to temperate climates.

Hosts: This nematode has an extensive host list with hundreds of species in dozens of families (CABI-CPC, 2010; CDFA PDR Database, 2020; Kohl, 2011).

Symptoms: On chrysanthemums, the nematodes can infest the stems, mainly in the axils or innermost parts of the buds (Kobayashi et al., 1971). Infested leaves become crinkled, deformed, and discolored. Black or brown areas are visible on the leaves. Initially, affected areas are wedge-shaped and bordered by the veins. Later, leaves dry, turn brown, and hang down from the stems. Generally, symptoms start on the older leaves and progress upward. Young leaves may be distorted without discoloration. Feeding within the bud may kill the growing point and prevent flowering. Bud feeding also can produce malformed leaves with rough brown scars. Affected ray flowers of chrysanthemums can fail to develop. Severely infected plants die without producing normal foliage and without marketable flowers (Pscheidt and Ocamb, 2020). In addition to direct killing of cells, the nematodes, through their secretions, cause several other symptoms, including shortening of the internodes, which results in a bushy appearance of the plant and failure of the shoot to grow (blindness).

On dry beans, plants develop numerous dark, angular lesions on leaves and occasionally superficial necrosis on the upper surfaces of the petioles (Franc et al., 1993). They also can develop angular leaf spots when nematodes enter through the leaf stomates and subsequent feeding leads to the breakdown of the leaf mesophyll. Larger leaf veins initially limit lesion expansion, but as the nematode populations increase, widespread necrosis can be seen crossing leaf veins (Franc et al., 1996).

Transmission: The nematode may live its entire life inside leaves or on the surfaces of the plant hosts. The female lays her eggs in the intercellular spaces of leaves. The eggs hatch and produce the four juvenile stages and adults all inside the leaf. The life cycle can be completed in as little as two weeks. They spread short distances by swimming when there is moisture on the leaves (from rain or irrigation) but they can also be splashed to new plants or to distant parts of the same plants by falling rain or overhead watering. The nematodes overwinter as adults in dead leaves or between the scales of buds of infected tissues. In the spring the nematodes become activated and feed ectoparasitically on the epidermal cells of the organs in their vicinity. Thus, stem areas, petioles, and leaves near infested buds show brown scars consisting of groups of cells killed by the nematodes. Adults and fourth-stage juveniles are able to overwinter in an anhydrobiotic state within dried plant tissue and can survive that way for up to three years (Daughtrey et al., 1995).

Damage Potential: *Aphelenchoides* spp. feed ectoparasitically and endoparasitically on aboveground plant parts. They can reach high populations and can result in severe losses. With low numbers they are asymptomatic and can spread undetected through vegetative propagation with cuttings from infected mother plants (Chitambar et al., 2018).

Aphelenchoides ritzemabosi is a major and widespread pest of chrysanthemum and many other ornamental hosts in Europe, North America, South Africa, New Zealand and Australia, and chrysanthemum is regarded as the major host in Europe (Juhl, 1978). Because ornamentals are sold for their aesthetic value, there is little to no tolerance for foliar or flower damage nematode feeding or the plant reaction to feeding (Horst and Nelson, 1997). On dry beans and alfalfa, the damage causes direct yield loss because photosynthetic leaf area is destroyed during nematode feeding and reproduction. *Aphelenchoides ritzemabosi* can occur sympatrically (two species in the same place) with *A. fragariae* (strawberry crimp nematode) on at least 28 hosts including strawberry, aster and begonia, and ferns (Siddiqi, 1974), and with *Ditylenchus dipsaci* (stem and bulb nematode) on alfalfa (Gray et al., 1994). A 1996 study in California (Chitambar et al.) showed that native bush lupins (*Lupinus arboreus*) shrubs growing along the coast in Sonoma county with symptoms of stunted shoots, crozier shaped curvatures of terminal shoots and buds, short internodal areas and rosetting of crinkled leaves with swollen stems were infected with both *Ditylenchus dipsaci* and *Aphelenchoides ritzemabosi*.

Several sanitary practices are used to control foliar nematodes. The leaves and stems of susceptible plants should be kept dry to prevent spread. Vegetative cuttings should be taken only from the tops of long, vigorous stems. Cuttings can be disinfested by dipping in hot water at 50°C for 5 minutes or at 44°C for 30 minutes. However, hot water treatment can negatively affect plant growth. There are miticides that can control this nematode on some hosts that can be used as sprays or drenches (Warfield et al., 2004). Infested plants should be rogued out. The reluctance of growers to rogue high value plants from greenhouses is a contributing factor in epidemics (Kohl, 2011).

Worldwide Distribution: Brazil, Bulgaria, Chile, China, Denmark, Fiji, Germany, Hungary, India, Iran, Ireland, Italy, Japan, Kazakhstan, Korea (Republic), Latvia, Mauritius, Mexico, New Zealand, Netherlands, Poland, Portugal, Russia, Serbia, South Africa, Spain, Switzerland, Ukraine, United Kingdom, United States of America (*California, Colorado, Florida, Wyoming*), Uzbekistan, Venezuela (CABI-CPC, 2020; Deimi et al, 2007).

Official Control: USDA PEXD Harmful organism list for China, Costa Rica, Cuba, Ecuador, Grenada, Guatemala, Honduras, India, Indonesia, Israel, Jordan, Mexico, Namibia, Nicaragua, Norway, Panama, Peru, South Africa, Svalbard and Jan Mayen, Taiwan, Timor-Leste, and Viet Nam. EPPO quarantine pest for Israel and Mexico, on the A1 List for Jordan (USDA PCIT, 2020; EPPO, 2020).

California Distribution: Detections in ornamental nurseries or with seed in Mendocino, San Luis Obispo, San Mateo, Santa Barbara, and Yolo counties.

California Interceptions: None.

The risk *Aphelenchoides ritzemabosi* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** *Aphelenchoides riztemabosi* is dependent on water for movement and dispersal. It is less likely to occur in the more arid parts of the state but conditions in greenhouses or other structures with higher humidity are ideal.

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

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 host range is extremely large including many ornamentals and vegetables plus alfalfa, berries, mint, tobacco, tomatoes, grasses, and beans.

Evaluate the host range of the pest. High

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 has a relatively short generation time when conditions are favorable and can survive for years in anhydrobiosis when conditions are unfavorable. It spreads with water.

Evaluate the natural and artificial dispersal potential of the pest. Medium

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 directly affects yield for greenhouse, field and orchard crops. It is on the harmful organism list for many countries.

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

Economic Impact: A, B, C, D, 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 is mainly a problem for greenhouse grown stock but there are few curative treatments making sanitation and prevention key programs for many crops.

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 *Aphelenchoides ritzemabosi*: 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 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 'high'. Detections have been made on the north coast, in the bay area and the central coast plus in the Sacramento valley over 40 years.

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.
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-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 = 12-3 =9*

Uncertainty:

None

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Aphelenchoides ritzemabosi* is C.**

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Responsible Party:

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***Comment Period: 3/13/2020 through 4/27/2020**

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

Proposed Pest Rating: C
