

California Pest Rating Proposal for

Xiphinema americanum Cobb, 1913

American dagger nematode

Current Pest Rating: C

Proposed Pest Rating: C

Kingdom: Animalia; Phylum: Nematoda; Class: Enoplea

Order: Dorylaimida; Superfamily: Dorylaimoidea;

Family: Longidoridae; Subfamily: Xiphineminae

Comment Period: 02/27/2020 through 04/12/2020

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 *Xiphinema americanum* is given herein and a permanent pest rating is proposed.

History & Status:

Background: *Xiphinema americanum* sensu lato (in the broad sense) is a migratory root ectoparasitic nematode that is widespread in North America (Robbins, 1993). This species inhabits the rhizosphere soils of host plants while feeding on roots. Eggs are laid singly in the soil and hatch in approximately one week. A population may be founded by a single larva. Once hatched, each larval stage must feed in order to molt and develop to the next stage. Larvae and adults feed by means of a long stylet that is used to penetrate the vascular tissue of roots. Males are very rare, and reproduction is apparently by parthenogenesis. The life cycle can take four years to complete (Halbrendt and Brown, 1992 and 1993).

The symptoms of plants in response to the feeding by *X. americanum* is like those caused by other migratory ectoparasitic nematodes of roots: Poor growth and/or stunting of the plant, yellowing or wilting of the foliage, and damaged/reduced root systems, including root necrosis, lack of feeder or secondary roots, and occasional tufts of stubby rootlets. *Xiphinema americanum* can be found feeding on many types of woody and herbaceous plants, including fruit trees and turf where, at high densities, they can cause considerable economic damage (Chitambar et al., 2018; Nemaplex, 2010, CABI CPC, 2020).

A small number of species of plant parasitic nematodes of the Longidoridae are vectors of plant viruses in the genus Nepovirus. *Xiphinema americanum* *sensu lato* transmits several important nepoviruses including Tobacco ringspot virus (Fulton, 1962), Tomato ringspot virus (Fulton, 1967), Cherry rasp leaf virus (Nyland et al., 1969), and Peach rosette mosaic virus (Klos et al., 1967). For a virus to be transmitted by a nematode, virus particles must be acquired and then retained in a specific area of the food canal. Virus transmission occurs when the retained virus particles are later disassociated and directly injected into plant root cells during nematode feeding (Wang et al., 2002). The viruses are not transmitted from the mother through the egg and are lost at molting such that the nematode must feed on an infected plant again to re-acquire the virus as it grows. Field evidence indicates that *X. americanum* has a long lifespan and a low reproduction rate (Jaffee et al., 1987) which makes it difficult for this nematode to maintain high populations in frequently tilled soils. It is mainly an economic problem on biennial and perennial crops rather than annual crops (McKenry and Anwar, 2006).

Hosts: Fruit trees, herbaceous ornamentals, woody plants, and turf. In California, there are hundreds of detections on fruit trees and vines including citrus, stone fruit, walnuts, and grapes plus perennial field crops such as turf and alfalfa (PDR Database, CDFA PDAS, 2020).

Symptoms: The symptoms of plants in response to the feeding by *X. americanum* is similar to those of other migratory ectoparasitic nematodes: Poor overall growth and/or stunting of the plant, yellowing or wilting of the foliage, and damaged/reduced root systems, including root necrosis, lack of feeder or secondary roots, and occasional tufts of stubby rootlets (Agrios, 2005).

Transmission: Infected rooted plants and soil, cultural practices that result in the movement of infected soil to clean, non-infected sites, infected nursery stock, and contaminated irrigation water.

Damage Potential: The nematode is most important as a vector of the American nepoviruses, which are important mainly on fruit crops. A strain of Tomato ringspot virus that causes peach yellow bud mosaic can debilitate and kill peach trees. On apples, the nematodes feed from outside the roots, but can reach the vascular tissues with their long stylets. They are capable of suppressing growth of young trees, but the major problem caused by them is transmission of Tomato ringspot virus, which causes apple union necrosis and decline. On raspberries, blueberries, and strawberries there is little direct damage from nematode feeding but the virus transmission can be significant (UC IPM, 2020; PNW Disease Control Handbook; 2020). Clean stock programs significantly reduce the incidence and spread of nepoviruses within California. (UC IPM, 2020; Pscheidt and Ocamb, 2019)

Worldwide Distribution: Canada: *Ontario, Québec*; United States of America: *Arkansas California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New York, North Carolina, North Dakota, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Virginia.*

Official Control: *Xiphinema americanum* is on the USDA PCIT PExD harmful organism lists for Chile (walnuts, stone fruit, and pears), and Morocco (grapes), and on the EPPO's A1 list for the European Union, Egypt, and Turkey, and on the quarantine list for Morocco and Israel.

California Distribution: Widespread statewide in more than 40 counties.

California Interceptions: Frequently intercepted at California border stations with incoming nursery stock and soil.

The risk *Xiphinema americanum* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** *Xiphinema americanum* can establish in cool to warm climates in a variety of soils from light to heavy (Lownsbery and Maggenti, 1963).

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:** *Xiphinema americanum* has a very large host range (Nemaplex, 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 Dispersal Potential:** The nematode's life cycle and increase are dependent on soil temperature and plant host. Long and short distance spread is mainly through infested soils accompanying plant stock, farm machinery, runoff and splash contaminated irrigation water, human and animal activity, and soil-contaminated clothing.

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:** Infestations of *Xiphinema americanum* could result in lowered crop yield and value, loss in market, and change in cultural practices to mitigate risk of spread to non-infested sites. The main economic damage is due to the ability of *X. americanum* to vector the economically important nepoviruses.

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

Economic Impact: A, B, C, E

- 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:** The impact of *Xiphinema americanum* on natural environments is not known. However, the infestations of the pest could affect cultural practices, home gardening, and ornamental plantings.

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 *Xiphinema americanum*: 14

Add up the total score and include it here.

- 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'. *Xiphinema americanum* is already distributed statewide

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 = 11*

Uncertainty:

The *Xiphinema americanum*-group is a large species complex containing more than 50 closely related nematode species. The species differentiation inside of the group is difficult because the species share many similar morphological characters. Correctly identifying these nematodes and being able to reliably distinguish between virus vector and non-virus vector species is very important to phytosanitary and regulatory programs. Using endosymbiotic bacteria in the genus *Xiphinematobacter* that are thought to be co-evolved with their hosts, Orlando et al. have proposed splitting the group into 17 species. The species they identify in California under the grouping of *X. americanum* sensu lato are *Xiphinema*

americanum sensu stricto, *X. californicum*, *X. pachtaicum*, *X. rivesi*, and two unidentified *Xiphinema* species (Orlando et al., 2016).

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Xiphinema americanum* is C.**

References:

Agrios, G. N. 2005. Plant Pathology, 5th Edition. Elsevier Academic Press. 922 pg

Chitambar, J. J., Westerdahl, B. B., and Subbotin, S. A. 2018. Plant Parasitic Nematodes in California Agriculture. In Subbotin, S., Chitambar J., (eds) Plant Parasitic Nematodes in Sustainable Agriculture of North America. Sustainability in Plant and Crop Protection. Springer, Cham.

EPPO Global Database. 2020. *Xiphinema americanum*. <https://gd.eppo.int/taxon/XIPHAA>. Accessed 1/29/2020

Fulton, J. P. 1962. Transmission of tobacco ringspot virus by *Xiphinema americanum*. (Abstr.) Phytopathology 52:375.

Fulton, J. P. 1967. Dual transmission of tobacco ringspot virus and tomato ringspot virus by *X. americanum*. Phytopathology 57:535-537

Halbrendt, J. M.; Brown, D. J. F. 1992. Morphometric evidence for three juvenile stages in some species of *Xiphinema americanum* sensu lato. Journal of Nematology 24: 305–309

Halbrendt, J. M.; Brown, D. J. F. 1993. Aspects of biology and development of *Xiphinema americanum* and related species. Journal of Nematology 25(3): 355–360

Jaffee, B. A.; Harrison, M. B.; Shaffer, R. L.; Strang, M. B. 1987. Seasonal population fluctuations of *Xiphinema americanum* and *Xiphinema rivesi* in New York and Pennsylvania orchards. Journal of Nematology 19: 369–378.

Klos, E. J., Fronek, F., Knierim, J. A., and Cation, D. 1967. Peach rosette mosaic transmission and control studies. Mich. Agric. Exp. Stn. Q. Bull. 49:287-293

Lownsbery, B. F., Maggenti, A. R. 1963. Some effects of soil temperature and soil moisture on population levels of *Xiphinema americanum*. Phytopathology 53: 667– 668.

McKenry, M. V. and Anwar, S. A. 2006. Nematode and grape rootstock interactions including an improved understanding of tolerance. Journal of Nematology 2006 Sep 38(3):312-8.

Nemaplex UC Davis Nemabase 2010. *Xiphinema americanum*. Accessed 1/29/20

Nyland, G., Lownsbery, B. F., Lowe, B. K., and Mitchell, J. F. 1969. The transmission of cherry rasp leaf virus by *Xiphinema americanum*. *Phytopathology* 59:1111-1112

Orlando, V., Chitambar, J. J., Dong, K., Chikhov, V. N., Mollov, D., Bert, W. and Subbotin, S. A. 2016. Molecular and morphological characterisation of *Xiphinema americanum*-group species (Nematoda: Dorylaimida) from California, USA, and other regions, and co-evolution of bacteria from the genus *Candidatus Xiphinematobacter* with nematodes. *Nematology* 18: 1015-1043.

Pscheidt, J.W., and Ocamb, C.M., senior editors. 2019. Pacific Northwest Plant Disease Management Handbook [online]. Corvallis, OR: Oregon State University. <http://pnwhandbooks.org/plantdisease> (accessed 29 January 2020).

Robbins, R. T. 1993. Distribution of *Xiphinema americanum* and related species in North America. *J. Nematol.* 25:344-348.

UC Statewide Integrated Pest Management Program. <http://ipm.ucanr.edu/index.html>. Accessed 29 January 2020.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PEXD) Harmful Organisms Database Report *Xiphinema americanum* Accessed 1/29/20.

Wang, S., Gergerich, R. C., Wickizer, S. L., and Kim, K. S. 2002. Localization of transmissible and nontransmissible viruses in the vector nematode *Xiphinema americanum*. *Phytopathology* 92:646-653.

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, California Department of Food and Agriculture, 204 West Oak Ave, Lompoc, CA. Phone: 805-736-8050, [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

***Comment Period: 02/27/2020 through 04/12/2020**

*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
