CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Hirschmanniella diversa Sher 1968

Current Pest Rating: Q

Proposed Pest Rating: C

Comment Period: 09/04/2019 through 10/19/2019

Initiating Event:

On May 5, 2016, a San Bernardino County agricultural inspector submitted root samples from an incoming nursery shipment from Florida under the California burrowing and reniform nematode state exterior quarantine. This quarantine requires Florida shippers to protect their plants from burrowing, reniform, and guava root-knot nematodes and has an annual survey of nursery stock at origin. The shipment contained multiple types of aquatic plants and was received by a nursery in Upland, California that specializes in water gardens. Twelve tropical waterlily plants (*Nymphaea* x 'Plum Crazy') were received under a valid Florida nematode certificate and sampled as per protocol. On May 17, 2016, CDFA Nematologist Ke Dong identified *Hirschmanniella* sp. and asked for an additional sample. The second sample was collected on May 18, 2016, and on May 23, 2016, the nematode was determined to be *H. diversa*, and it was assigned a temporary Q rating. On April 26, 2017, 10 tropical waterlily plants (5 *Nymphaea* x "blue spider" and 5 *Nymphaea* x "Evelyn Randig") were received at the same nursery from the same Florida shipper and were sampled by a county agricultural inspector. On May 9, 2017, CDFA Nematologist Ke Dong identified *H. diversa* from the second shipment of waterlily plants. Herein is proposed an official and permanent State rating for this nematode species.

History & Status:

Background: *Hirschmanniella* is a nematode genus in the family Pratylenchidae (Nematoda: Tylenchida) with 29 species of migratory root endoparasites that are uniquely adapted to aquatic environments (Khun et al., 2015; Jeger et al., 2018). Most are reported from tropical areas, and their main hosts are monocotyledonous aquatic plants; collectively they are called rice root nematodes. *Hirschmanniella diversa* was described by Sher in 1968 in his revision of the genus and was first described as a pathogen of lotus (*Nelumbium nelumbo* [=*Nelumbo nucidera*]) isolated from rhizomes and soil in Oahu, Hawaii (Sher, 1968). Some species in this genus are important pests of irrigated, lowland, and deepwater rice (Jeger et al., 2018). Although *Hirschmanniella diversa* has been found in

rice roots, it has not been reported to cause economic damage to this crop (Bridge et al., 2005; Koyama et al., 2013; Peng et al., 2018; Uematsu et al., 2016).

Symptoms: There are no easily identifiable above-ground symptoms of damage from this nematode in the field. Reduction of plant growth occurs especially if plants are attacked in the early stages. Yellowing of plants is occasionally observed and flowering can be delayed. Roots invaded by *H. diversa* turn yellowish brown and rot (Peng et al., 2018). On lotus roots, various life stages of this nematode were present in the root cortex cells, which were reduced in size (Koyama et al., 2013; Uematsu et al, 2016).

Transmission: The nematodes are spread with irrigation water and soil attached to tools, shoes, and machinery. Spread can also occur when seedlings are transplanted (Bridge et al., 2005).

Damage Potential: The economic threshold level for lotus was estimated as ten individuals of *H. diversa* per 100 g fresh soil with the Baermann method and 50 individuals in 100 g oven-dried soil with real-time PCR (Koyama et al., 2013). The damage potential to waterlily has not been researched.

Worldwide Distribution: *Hirschmanniella diversa* has been reported in North America: *United States* (Hawaii), Asia: *China, Japan*, and *Vietnam* (Jeger et al., 2018; Koyama et al., 2013; Sher, 1968; Chong Bin et al., 2001; Hu, et. al., 2014; Sun et al., 2013; Wu et al., 1995)

Official Control: *Hirschmanniella diversa* is on the harmful organism list for the Republic of Korea (PExD, 2019) and the genus *Hirschmanniella* is on the EPPO A1 list for Turkey (added in 2016).

California Distribution: none

California Interceptions: In San Bernardino County, twice from Florida nursery stock, see "initiating events".

The risk *Hirschmaniella diversa* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This is a tropical nematode adapted to aquatic environments, there would not be many suitable habitats in California.

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

   Score: **1**

   - **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 published host range is primarily lotus but there are mentions of its detection in rice roots and it has been detected in waterlily by CDFA.

Evaluate the host range of the pest.

Score: 1

- **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:** It is not known to be seed borne but could spread with movement of infested nursery stock, soil, or water. The length of the life cycle is unknown, but it could be as short as 1 month and a 10 fold increase in number of individuals per generation is possible (Jeger et al., 2018).

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:** Economic impact can be serious on lotus. Although the species has been observed in rice roots, economic damage to rice has not been quantified.

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

Economic Impact: A, 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:** none are anticipated

Environmental Impact: Low

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: 1
- **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 *Hirschmanniella diversa* is Low (7)*:*

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:

Evaluation is 'Not Established'. There has been only incursions from Florida with waterlily nursery stock (Chitambar et al., 2018)

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:

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 7***

Uncertainty: none

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Hirschmanniella diversa* is C.**

References:

Bridge, J., Plowright, R. A., and Peng, D. 2005. Nematode parasites of rice. In: Luc, M., Sikora, R. A., and Bridge, J. (Eds.). Plant parasitic nematodes in subtropical and tropical agriculture, 2nd Edition. CABI publishing, Wallingford, Oxfordshire, England. Pp. 87-130.

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

Chong Bin, L., Qi, Y-H., Ke, Q. X. and Shun, Q. M. 2001. Incidence of *Hirshmanniella diversa* in *Nelumbo nucifera* Gaertn and its infection pattern. Plant Protection, 27, 26-27.

Hu, X. Q., Yu, M., Lin, L., Wang, Y., and Yu, S. 2004. Species and distribution of rice root nematode in Yunnan Province, China. Agricultural Sciences in China 2004: 3, 8, pp 598-603.

Jeger, M., Bragard, C., Caffier, D., Candresse, T., Chatzivassiliou, E., Dehnen-Schumutz, K., Gilioli, G., Gregoire, J-C., Anton, J., Miret, J., MacLeod, A., Navajas Navaro, M., Parnell, S., Potting, R., Rafoss, T., Rossi. V., Urek, G., Van Bruggen, A., Van der Wef, W., West, J., Winter, S., Kaluski, T., and Niefe, B. 2018. Pest categorization of *Hirschmanniella* spp. ESFA Journal.

Khun, K., Decraemer, W., Couvreur, M., Karssen, G., Steel, H., and Bert, W. 2015. Deceptive morphological variation in *Hirschmanniella mucronate* (Nematoda: Pratylenchidae) and a polytomous key to the genus. Nematology, 17, 377-400.

Koyama, Y., Thar, S. Y., Kizaki, C., Toyota, K., Sawada, E., and Abe, E. 2013. Development of specific primers to *Hirschmanniella* spp. causing damage to lotus and their economic threshold level in Tokushima prefecture in Japan. Nematology V 15: 7. Pp 851-855.

Peng, D., Gaur, H. S., and Bridge, J. Nematode parasites of rice. In: Sikoru, R. A., Coyne, D., Hallmann, J., and Timper, P. Eds. 2018. Plant parasitic nematodes in subtropical and tropical agriculture. 3rd Ed. CABI publishing, Wallingford, Oxfordshire, England Pg 120-163.

Sher, S. A. Revision of the genus *Hirschmanniella* Luc & Goodey, 1963 (Nematoda: Tylenchoidea). Nematologica Vol 14, No. 2, pp 243-275

Sun, X. T., Hu, C. Z., Jiang, Q., Chen, Y. Y., Cui, R. Q. 2013. Morphological identification of six rice root nematodes in Jiangxi Province. Acta Agriculturae Universitatis Jiangxiensis, 35, 6, pp 179-182

Uematsu, S., Yabu, T., Yao, M., Kurihara, T., and Koga, H. 2019. Light and scanning electron microscopy of the Indian lotus roots invaded by *Hirschmanniella diversa*. Nematological Research Vol. 46, Issue 2. Pages 79-82.

USDA-PExD- Phytosanitary export Database Harmful Organism Reports. *Hirschmanniella*. Accessed 8/21/19

Wu, H., Yang, R., and Yilin, X. 1995. The identification and distribution of rice root nematode (*Hirschmanniella* spp.) in Anhui Province. Journal of Anhui Agricultural University. Vol. 22

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, California Department of Food and Agriculture, 204 West Oak Ave, Lompoc, CA 93436. Phone: 805-736-8050, plant.health[@]cdfa.ca.gov.

***Comment Period: 09/04/2019 through 10/19/2019**

***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 plant.health[@]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
