California Pest Rating Proposal for

Hirschmanniella oryzae (van Breda de Haan, 1902) Luc & Goodey,1964
rice root nematode

Current Pest Rating: none

Proposed Pest Rating: A

Kingdom: Animalia, Phylum: Nematoda,
Class: Chromadorea, Order: Rhabditida,
Family: Pratylenchidae

Comment Period: 10/29/2024 through 12/13/2024

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from *Hirschmanniella oryzae* is described herein and a permanent rating is proposed.

History & Status:

Background:

Commercial rice production began in California in 1912. Rice production is concentrated in the Sacramento Valley, where about 95% of California rice is grown, with the balance grown in a few counties of the northern San Joaquin Valley. California mostly grows short and medium-grain Japonica-type rice, and rice is grown on 256K acres with a 2022 value of $752M (CDFA Ag Stats https://www.cdfa.ca.gov/Statistics/PDFs/2022-2023_california_agricultural_statistics_review.pdf).

Hirschmanniella are migratory endoparasites of roots. Generally, they can cause lesions in the root cortex while feeding with their stylets and can be classified as “lesion nematodes”. *Hirschmanniella* species are widespread and are mainly in tropical and subtropical areas (Asia, Africa, the Americas, Oceania). They are adapted to an aquatic environment, and some are marine species (Luc, 1987). This is rare among Tylenchid nematodes. Many of the 29 currently recognized *Hirschmanniella* species are associated with rice (Sturhan and Hallmann,2010; Khun et al., 2015).

Only a few *Hirschmanniella* species cause measurable yield losses, and these are of economic importance for rice: *H. oryzae, H. gracilis, H. imamuri, H. mucronata,* and *H. spinicaudata*. Among them, the most important is *H. oryzae* which is considered a key pest of rice in the Far East and tropical

countries (Bohra and Sultana, 2013). *Hirschmanniella belli* is established in California rice fields but is not considered very damaging and is C-rated (Martin, 2019; https://blogs.cdfa.ca.gov/Section3162/?p=6412).

On rice, it is common to detect several species of *Hirschmanniella*. There are several questionable or easily mistaken species in the genus. A study by Tandingan De Ley et al. (2007) on Californian *Hirschmanniella* suggests that this genus contains one or more complexes of species that are only slightly different by morphology.

Hosts: Abelmoschus esculentus (okra), *Aeschynomene afraspera*, *Amaranthus caudatus* (tassel flower), *Bolboschoenus maritimus* (salt marsh bulrush), *Chenopodiastrum murale* (nettle-leaved goosefoot), *C. album* (baconweed), *Cryptocoryne* (water trumpet), *Cyperus brevifolius* (umbrella sedge), *C. compressus* (annual sedge), *C. difformis* (smallflower umbrella-sedge), *C. elatus* (umbrella sedge), *C. haspan* (haspan flatsedge), *C. iria* (umbrella sedge), *C. pilosus* (umbrella sedge), *C. platystylis* (nutgrass), *C. procerus* (nutgrass), *C. pulcherrimus* (umbrella sedge), *C. rotundus* (nutgrass), *C. sanguinolentus* (purple-glume flat sedge), *Echinochloa colonum* (awnless barnyard grass), *E. crus-galli* (barnyardgrass), *E. glabrescens* (barnyardgrass), *Eleocharis spiralis, Eleusine indica* (finger millet), *Fimbristylis ferruginea* (rusty sedge), *F. globulosa, F. miliacea, F. quinquangularis* subsp. *quinquangularis* (lesser fimbristylis), *Gossypium hirsutum* (upland cotton), *Hydrolea zeylanica, Juncus* sp., *Kyllinga brevifolia* (shortleaf spikesedge), *K. monocephala* (rottboill), *Lepidium didymium* (lesser swinecress), *Leptochloa chinensis* (Chinese sprangletop), *Marsilea crenata* (nardoo), *M. minuta* (water clover), *Monochoria vaginalis*, *Oryza sativa* (Asian rice), *Panicum colonum, Paspalum commersonii, P. distichum knotgrass, P. scrobiculatum* (kodo millet), *Pennisetum typhoides* (pearl millet), *Pycreus sanguinolentus, Pontederia vaginalis* (oval-leafed pondweed), *Rotala rosea* (rosy rotala), *Rumex dentatus* (toothed dock), *Saccharum officinarum* (sugar cane), *Schoenoplectiella supina* (reclining club-rush), *Scirpus supinus/Bolboschoenus supinus, S. tuberosus/B. tuberosus* (brittle rush), *Sesbania rostrata, Sphenoclea zeylanica* (gooseweed), *Solanum lycopersicum* (tomato), *Triticum aestivum* (wheat), *Zea mays* (corn) (EFSA, 2018; Nemaplex 2010).

Symptoms: All stages (juvenile and adult) of *H. oryzae* migrate through the root cortex and feed on cells. There are no distinct above-ground symptoms of damage from *H. oryzae* in the field. Symptoms caused by this nematode may be confused with nutrient deficiencies or root damage from other pathogenic organisms. Symptoms of rice root nematode on rice are inhibiting growth, stunting, chlorosis, reduced tillering, and finally a reduction of grain yield (Babatola and Bridge, 1979; Prot, 1992). Roots invaded by *H. oryzae* may turn yellowish brown and rot, and a reduction of plant growth can occur, especially if plants are attacked in the early stages (Peng et al., 2018). The damage is most evident in soils with poor nutrient content, but it also depends on many other factors including tolerance of rice cultivars (Whitehead, 1998).

Transmission: Spread is mainly by people and with agronomic activities including long-distance movement of nematodes with irrigation water and soil attached to tools, shoes, and machinery. It is not associated with or spread by seed (Bridge et al., 2005).

Damage Potential: The nematodes produce cavities and channels through the cortex, which becomes necrotic for some distance into the root and is invaded by secondary pathogens, which increase necrosis. Yield losses caused by *Hirschmanniella* spp. are greater in poor soils. This species causes yield reduction of rice (Babatola and Bridge, 1979). The rice suffers retardation of growth, decrease in culm height, reduction in weight of dry matter, delayed tillering, fewer shoots, and discoloration of the older leaves (EFSA, 2018).

Worldwide Distribution: *Hirschmanniella oryzae* is widely distributed in major rice-growing areas of the world and is commonly found in tropical and subtropical regions. Africa: *Burkina Faso, Cote d'Ivoire, Egypt, Gambia, Ghana, Guinea, Madagascar, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone.* Asia: *Bangladesh, Cambodia, China, India, Indonesia, Iran, Japan, Korea, Republic, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam.* North America: *United States of America* (Arkansas, Florida, Louisiana, Texas). Central America: *Costa Rica, El Salvador*. South America: *Argentina, Brazil, Ecuador, Guyana, Venezuela.*

Official Control*: Hirschmanniella oryzae* is a regulated quarantine pest in the European Union (EPPO, 2024). It is on the USDA PCIT's harmful organisms list for Egypt, the European Union, Honduras, Indonesia, and Timor-Leste (USDA PCIT 2024).

California Distribution: none

California Interceptions: none

The risk that *Hirschmanniella oryzae* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This nematode is more common in damp paddy fields than in drained and dried fields. Weeds in and around rice paddies are important for its survival between crops.

   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 be established 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 includes plants in many families.

   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:** Rice root nematodes are not seed-borne. They spread with the movement of infested soil and water. Females produce hundreds of eggs and in ideal conditions, there can be three generations per year (Fortuner and Merny, 1979).

   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 has an economic impact on rice. It can be moved with water.

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

   Economic Impact: A, G
   A. The pest could lower crop yield.
   B. The pest could lower crop value (including increasing crop production costs).
   C. The pest could trigger the loss of markets (including 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 have been observed for other species of *Hirschmanniella* in California and none are anticipated.

   Evaluate the environmental impact of the pest on 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: 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 oryzae:* Medium

Add up the total score and include it here. **10**
-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 '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 the 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* ***= 10***

Uncertainty:

Symptoms caused by *H. oryzae* may be confused with symptoms of nutrient deficiency or other pathogenic organisms. Only a few species of the genus *Hirschmanniella* are economically important and accurate species identification is important. Identification of *Hirschmanniella* to species is extremely difficult due to huge intraspecific morphological variation (Sturhan and Hallmann, 2010) and can only be carried out by expert nematologists.

Conclusion and Rating Justification:

Based on the evidence provided above, the proposed rating for ***Hirschmanniella oryzae*** **is A.**

References:

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Responsible Party:

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*Comment Period: 10/29/2024 through 12/13/2024

*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.

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:

Contains inappropriate language that 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 that have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: A
