cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Heterodera ustinovi Kirjanova, 1969

Ustinov's grass cyst nematode

Current Pest Rating: none

Proposed Pest Rating: A

Kingdom: Animalia, Phylum: Nematoda,
Class: Secernentea, Subclass: Diplogasteria,
Order: Tylenchida, Superfamily: Tylenchoidea,
Family: Heteroderidae, Subfamily: Heteroderinae

Comment Period: 07/12/2021 through 08/26/2021

Initiating Event:

The USDA's Federal Interagency Committee on Invasive Terrestrial Animals and Pathogens (ITAP.gov) Subcommittee on Plant Pathogens has identified the worst plant pathogens that are either in the US and have potential for further spread or represent a new threat if introduced. *Heterodera ustinovi* is on their list. A pest risk assessment of this nematode is presented here, and a pest rating for California is proposed.

History & Status:

Background: Grass cyst nematodes are important pests that impact the health of wild grasses and limit production of grasses for uses such as golf courses. Extensive nematode feeding reduces root mass and saps plant nutrients and can result in greatly reduced crop yields. Cyst nematodes are biotrophic sedentary endoparasites that can establish prolonged parasitic interactions with their hosts. They are among the most challenging nematodes to control, because the "cyst" is the body of a dead female nematode containing hundreds of eggs. Cysts with viable eggs can persist in dry soil for years, where they remain relatively resistant to chemical and biological stresses. Cysts are easily moved with soil.

There are many closely related cyst nematodes in the genus *Heterodera* that are found in most regions of the world where small grains and grasses are grown. Using morphological and molecular

---

characteristics, the genus *Heterodera* has been divided into nine groups (Subbotin et al., 2010; Handoo and Subbotin, 2018). The Avenae group is one of the largest and contains species that parasitize monocots only. Subbotin et al. (2018) further categorized the Avenae group based on feeding preferences, subdividing them into species that feed on cultivated cereals versus forage or turf grasses. *Heterodera ustinovi*, together with *H. arenaria, H. pratensis, H. mani* and *H. aucklandica* are species known to feed on grasses exclusively.

A *Heterodera* sp. that differed from *H. avenae* was first reported by Ustinov and Zinojevi (1961) in Ukraine. Kirjanova (1969) named and described *H. ustinovi* based on the morphology of females and cysts from bentgrass, *Agrostis capillaries*. A *Heterodera* cyst nematode found parasitizing bentgrass was described from Northern Ireland as a separate species and named *H. iri* by Mathews (1971). Sturhan and Krall (2002) studied *H. ustinovi* and *H. iri* paratypes plus additional samples collected from the mountains in eastern Slovakia and concluded that the species were conspecific and synonymized *H. iri* with *H. ustinovi* (the later having seniority). This nematode has been found in several European countries and the United States (Subbotin et al., 2010; CABI-ISC, 2021).

Hosts: The original host from which this nematode was described is *Agrostis vulgaris* [*A. capillaris*], common or colonial bent grass. *Agrostis palustris*, creeping bentgrass, is also a reproductive host. (CABI-ISC, 2021).

Symptoms: The diagnostic symptoms of cyst nematodes are usually the presence of cysts on the roots, the proliferation of roots, and shallow, bushy root systems. Heavily colonized young plants are stunted, and their lower leaves are often chlorotic, forming pale green patches in the field. Mature plants are also stunted and have a reduced number of tillers. Their roots are shallow and have a “bushy-knotted” appearance, without necrosis or brown lesions. Plants produce smaller heads with shriveled seeds. (Smiley et al., 2017).

Transmission: Heterodera spp. overwinter inside the cysts and hatches to become the J1 while still inside the egg. Mobile, second-stage juveniles leave the cysts in the spring and burrow into the host roots just behind the growing point. They rest parallel to the main axis with their heads in the endodermis. The juveniles induce the formation of unique syncytial feeding structures as their sole nutrient resources within the vascular cylinder of the roots. After growing and molting, mobile, vermiform males are released back into the soil. The sedentary female matures and her body breaks through the root surface but remain attached to the root. Males mate with adult females on the root surface. Females can lay and release as many as 100 eggs into the soil. Near the end of her life, the female holds her eggs inside her body. The egg-filled female dies, and her body wall hardens to form a tough, leathery-skinned cyst around her eggs. The cysts are released into the soil as roots die (Willmott, 1972).

The main way this nematode spreads locally is as cysts in the soil. Thus, anything that moves soil is a potential pathway including agricultural equipment and containers, tools, vehicle tires, and workers clothing or boots. Adults, juveniles, eggs and cysts can be found in association with infected or contaminated planting stock. Cysts can also move in the soil with water from rainfall or irrigation. There are many examples of exotic nematodes accidentally transported in turf from turf farms (CABI-

ISC, 2021). *Heterodera* cysts can persist in dry soil for months to years, protecting the eggs, until there is adequate water for hatching (Smiley et al., 2017).

Damage Potential: Members of the *Heterodera* group Avenae are among the most important nematode pests that limit production of grasses and small grain cereals worldwide. Murdoch et al. (1978) collected *H. ustanovi* from five creeping bent grass golf greens in southeast New York. In Ohio, this nematode was identified from a bentgrass golf course sample that showed irregular patches of thinning, translucent leaves and reduced root systems (Joseph et al., 2018).

Worldwide Distribution: Belarus, Belgium, Estonia, Germany, Lithuania, Poland, Russia, Slovakia, UK, Ukraine, United States (*Connecticut, Massachusetts, Maine, Ohio, New Hampshire, New York, and Rhode Island*) (Subbotin et al., 2010; CABI-ISC, 2021).

Official Control: *Heterodera spp. are* on the EPPO's A1 list for Bahrain and Jordan (EPPO, 2021).

California Distribution: None

California Interceptions: None

The risk *Heterodera ustinovi* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** *Heterodera ustinovi* is likely to establish wherever its hosts can grow. Bentgrass is planted on golf courses, mainly in Coastal California. *Agrostis* spp. are found statewide

   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:** The natural host range is limited to *Agrostis* spp.

   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:** Tens to hundreds of eggs can be produced while the female is alive, with an additional ten to hundreds retained within her cyst after her death. For long and short distance

dispersal these nematodes are dependent on movements of cysts, cyst-infested soils, and cyst-infested seed lots.

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:** Infestations of grass cyst nematodes impact grass health directly from plant loss and shriveled, unmarketable seeds. Cysts in soil could be spread by movements of soil and irrigation water requiring changes in normal cultural practices. It is also a quarantine pest.

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:** Infestations of the grass cereal cyst nematode could significantly affect native *Agrostis* species, many of which are rated as rare (Calflora, 2021). It could also affect ornamental plantings.

Environmental Impact: A, 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: 3

- 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 *Heterodera ustinovi:* 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 'not established'. There have not been any detections in California

   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: (Score)

   Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 12***

Uncertainty:

None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Heterodera ustinovi*** is **A**.

References:

CABI Crop Production Compendium 2021. *Heterodera ustinovi* (grass cyst nematode) https://www.cabi.org/isc/datasheet/81305084 accessed 6/3/2021

Calflora: Information on California plants for education, research and conservation. [web application]. 2021. Berkeley, California: The Calflora Database [a non-profit organization]. Available: https://www.calflora.org/ (Accessed: Jun 04, 2021).

EPPO Global Database. 2021. *Heterodera ustinovi* https://gd.eppo.int/taxon/HETDIR. Accessed 2/10/2021.

Handoo, Z. A. 2002. A key and compendium to species of the *Heterodera avenae* group (Nematoda: Heteroderidae). J. Nematol. 34:250-262.

Handoo, Z.A. and Subbotin, S.A. 2018. Taxonomy, identification, and principal species. In: Perry, R.N., Moens, M. and Jones, J.T. (Eds). Cyst nematodes. Wallingford, UK, CAB International, pp. 365-397

Joseph, S., Akyazi, F., Habtewld, A., Mekete, T., Creswell, T., Ruhl, G. E., Faghihi, J. 2018. First report of cyst nematode (*Heterodera iri*) in Ohio. Plant Disease. 102 (5), 1042.

Mathews, H.J.P. 1971. Two new species of cyst nematode, *Heterodera mani* n. sp. and *H. iri* n. sp., from Northern Ireland. Nematologica 17, 553-565.

Kirjanova, E.S. 1969. On the structure of the subcrystalline layer of the nematode genus *Heterodera* (Nematoda: Heteroderidae) with a description of two new species. Parazitologiya 3, 81-91.

Murdoch, C. L., Tashiro, H., and Harrison, M. B., 1978. Plant-parasitic nematodes associated with golf putting-green turf in New York. Plant Disease Reporter, 62(1), 85-87.

Smiley, R.W., Dababat, A.A., Iqbal, S., Jones, M.G., Maafi, Z.T., Peng, D., Subbotin, S.A. and Waeyenberge, L., 2017. Cereal cyst nematodes: A complex and destructive group of *Heterodera* species. Plant Disease, 101(10), pp.1692-1720.

Sturhan, D. and Krall, E., 2002. *Heterodera iri* Mathews, 1971 a junior synonym of *H. ustinovi* Kirjanova, 1969. Russian Journal of Nematology, 10(1), pp.55-57.

Subbotin, S. A., Sturhan, D., Rumpenhorst, H. J., and Moens, M. 2003. Molecular and morphological characterisation of the *Heterodera avenae* complex species (Tylenchida: Heteroderidae). Nematology 5:515-538.

Subbotin, S.A. and Baldwin, J., 2010. Systematics of Cyst Nematodes (Nematoda: Heteroderinae), Part B. Brill.

Subbotin, S. A., Mundo-Ocampo, M. & Baldwin, J.G. 2010. Systematics of cyst nematodes (Nematoda: Heteroderinae). Nematology Monographs and Perspectives 8A (Series editors: Hunt, D.J. & Perry, R.N.). Leiden, The Netherlands, Brill.

Subbotin, S.A., Toumi, F., Elekçioğlu, I.H., Waeyenberge, L. and Maafi, Z.T., 2018. DNA barcoding, phylogeny and phylogeography of the cyst nematode species of the Avenae group from the genus *Heterodera* (Tylenchida: Heteroderidae). Nematology, 20(7), pp.671-702.

Ustinov, A. A. and Zinovjev, V. G. 1961. Plant parasitic nematodes in the Carpathian Mountains. Voprosy Fitogel'mintologii, Moscow, 199-212.

Willmott, S., 1972. Commonwealth Institute of Helminthology and. CIH descriptions of plant-parasitic nematodes. Commonwealth Agricultural Bureaux.

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFA/PHPPS ECOPERS, 2800 Gateway Oaks Suite 200, Sacramento, CA 95833 Phone: (916) 654-1017, permits[@]cdfa.ca.gov.

---

*Comment Period: 07/12/2021 through 08/26/2021

*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:

  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: A