California Pest Rating Profile for

Heterodera fici Kirjanova, 1954

Fig cyst nematode

Pest Rating: C

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

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Comment Period: 02/23/2022 through 04/09/2022

Initiating Event:

This pathogen has not been through the pest rating system. The risk to California from *Heterodera fici* is described herein and a permanent rating is proposed.

History & Status:

Background: The name "Mission" was given to dark purple figs that were introduced to the New World by Spanish and Portuguese missionaries and spread from San Diego up the coast to Ventura, Santa Clara, and Sonoma beginning in the 1790s. Fig trees have tremendous longevity; some trees that were planted at the onset of California's commercial fig production are still bearing fruit today, over 100 years later. 100 percent of the dried figs and 98 percent of the fresh figs grown commercially in the U.S. are from California. Figs are mostly grown in the San Joaquin Valley, where there are hot, dry summers and cool, wet winters.

California figs have two harvest seasons. The first crop is small, maturing in late June. The second crop ripens later in the summer and produces upwards of 90% of the total crop. Figs were last reported in the California Ag stats review in 2017-18 with 6700 bearing acres, 31,200 tons of fruit, and a value of $28.5 million, mostly in and around the cities of Madera, Fresno, and Merced.

The fig cyst nematode, *Heterodera fici*, was first described by Kirjanova (1954) from roots of *Ficus elastica* that had been imported into Russia from China. Surveys have shown that this nematode is widely distributed in natural conditions in Mediterranean countries and southwestern Asia where it infects field grown figs, and in many countries that grow *Ficus* spp. as ornamentals.

The first detections of *Heterodera fici* in the United States occurred when it was detected in *Ficus elastica* (rubber fig) showing poor growth in a nursery at San Bernardino in 1954, and in field-grown *Ficus carica* (commercial fig), in Yolo County in 1955. The nematode was soon found by survey in six nurseries in Southern California. The host range appears to be restricted to the genus *Ficus*. Fig cyst nematode pathogenicity in commercial cultivars of fig has not been determined (Sher and Raski 1956).

Heterodera fici is a sedentary endoparasite. After emerging from the egg, the J2s penetrate fig feeder roots, become sedentary, swell, and establish a permanent feeding site in the root stele. Adult females are swollen and protrude with the posterior portions of their bodies external to the root. They produce eggs and later become cysts, each containing 200-250 embryonated eggs. Males are sedentary in the juvenile stages, and become active after reaching maturity (Vovlas et al., 1989). This species was once in the *Schachtii* group because of the lemon shaped cysts, but now belongs to the *Humuli* group. It differs from other members of the *Humuli* group (*H. humuli, H. ripae, H. vallicola* and *H. litoralis*) by ambifenestrate rather than bifenestrate cysts and a longer vulval slit (43-48 vs <40 µm) (Subbotin et al., 2010).

Hosts: The host range of *H. fici* is restricted to the species of the genus *Ficus*: *F. australis, F. benghalensis*, *F. carica*, *F. elastica*, *F. lyrata*, and *F. rubiginosa* (Siddiqui et al., 1973; Subbotin et al., 2010).

Symptoms: Poor plant growth and leaf chlorosis have been reported for infected figs (Vovlas et al., 1989). These symptoms are non-diagnostic and easily confused with other diseases, caused by other nematode species, pathogens, or abiotic problems (Nemaplex, 2010).

Transmission: The main way *H. fici* spreads is as resistant cysts moving with soil. Thus, anything that moves soil short or long distances 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. Cysts can persist in dry soil for months to years, protecting the eggs, until there is adequate water for hatching. Leachates from fig roots stimulate egg hatch and emergence of juveniles from cysts when temperatures are above 10°C, with a maximum hatch at 20-25°C (Di Vito, 1986; Di Vito and Sasanelli, 1990). The life cycle from cyst to cyst on *F. carica* seedlings was completed in as little as two months (Di Vito, 1986).

Damage Potential: The potential pathogenicity of *H. fici* on fig seedlings was demonstrated in pot trials by Di Vito and Inserra (1982) who reported 30% death of plants with an initial nematode population of eight eggs and juveniles/cm^3 of soil, and 100% plant mortality with an initial nematode density of 64 eggs and juveniles/cm^3 of soil and higher. Field populations of *H. fici* generally do not appear to attain such damaging levels, the nematode can be considered a potential threat in fig nurseries, where fig

rootstocks are often grown from seeds. This nematode has caused considerable damage to potted plants of *F. elastica* (Scotto La Massèse et al., 1984; Narbaev and Sidikov, 1985). During a 1986 survey of a fruit orchard at Saryab, Quetta, Pakistan, *H. fici* was found heavily parasitizing the roots of *Ficus carica* plants, which were showing symptoms of retarded growth and yellowing of leaves (Maqbool et al., 1987). Damage is greater on smaller seedlings than on older plants (Di Vito and Inserra, 1982; Luc et al., 2005).

Worldwide Distribution: *Heterodera fici* is reported infesting common fig (*F. carica*) trees in several Mediterranean countries and southwest Asia. Infections of several ornamental fig species has been reported from many countries including: Europe: *Belarus, Belgium, Estonia, France, Germany, Greece, Hungary, Italy, The Netherlands, Norway, Poland, Portugal, Russia, Spain, Yugoslavia (former)*; Asia: *China, Georgia, Iran, Turkey, Uzbekistan*; Oceania: *Australia, New Zealand*; North America: *Canada, USA* (California, Florida, Louisiana, Maryland, Virginia); South America: *Brazil*; Africa: *Algeria, South Africa* (Subbotin et al., 2010; Sun et al., 2017).

Official Control: *Heterodera fici* is on the USDA PCIT's harmful organism list for Argentina, Chile, Egypt, Indonesia, Israel, Timor-Leste, and Turkey (USDA, 2022). It is on the EPPO's A1 list for Argentina, Chile, Egypt, A2 list for Turkey and a Quarantine pest in Israel, and Tunisia (EPPO, 2022).

California Distribution: There are official records for Fresno, San Bernardino, Santa Barbara, and Yolo counties, but it is likely more widespread as it has been present in some nurseries but not under regulation for 70+ years.

California Interceptions: None

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

Consequences of Introduction:

1) **Climate/Host Interaction:**

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 establish in a larger but limited part of California.**
- High (3) likely to establish a widespread distribution in California.

Risk is Medium (2) – Heterodera fici *is likely to be found where its hosts can grow. Many of the* Ficus *hosts are mainly grown as tropical indoor ornaments, common figs are grown for fruit along the coast and in the Central Valley.*

2) Known Pest Host Range:

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.

Risk is Low (1) – The host range is restricted to members of the genus Ficus.

3) Pest Reproductive Potential:

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.

Risk is High (3) –Long and short distance spread is mainly infected roots, bare root propagative plant materials, soil debris, run-off and irrigation water, cultivation tools, equipment and human activity that can move soils from infested to non-infested sites.

4) Economic Impact:

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

Economic Impact: C, 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.

Risk is Medium (2) – Yield reductions have not been widely reported. Heterodera fici *is a quarantine pest. The nematodes can be spread with anything that moves soil or water.*

5) **Environmental Impact:**

Evaluate the environmental impact of the pest to California using the criteria below

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.

Risk is Medium (2) – An impact on the natural environment is not likely as the host range is restricted to *Ficus,* which has no native members in California. However, the infestations of this root lesion nematode could affect home/urban gardening.

Consequences of Introduction to California for *Heterodera fici:*

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 'medium'.

Score: -2

-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.

Evaluation is Medium (-2) – There are records in Southern California, Yolo County and Santa Barbara County. There are no official records from the San Joaquin Valley which is the main area where figs are grown commercially.

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* ***= 8***

Uncertainty:

None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Heterodera fici* is C.

References:

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***Comment Period: 02/23/2022 through 04/09/2022**

***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.

Pest Rating: C