

**California Pest Rating Proposal for**  
***Cactodera cacti* (Filipjev & Schuurmans Stekhoven, 1941)**  
**Krall & Krall, 1978**

**Cactus cyst nematode**

**Current Pest Rating: none**

**Proposed Pest Rating: A**

Domain: Eukaryota, Kingdom: Metazoa,  
Phylum: Nematoda, Class: Secernentea,  
Order: Tylenchida, Family: Heteroderidae

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**Comment Period: 11/05/2021 through 12/20/2021**

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**Initiating Event:**

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

**History & Status:**

**Background:** Cyst nematodes are important pests that limit production of many plants. Cyst nematodes are biotrophic sedentary endoparasites that can establish prolonged parasitic interactions with their hosts. As second-stage juveniles, the females induce plants to form highly specialized nurse cells which sustain them through their lives. As adults they become sedentary, with most of their enlarged body protruding from the root surface, and their head embedding in the root. Extensive nematode feeding reduces root mass and saps plant nutrients and can result in greatly reduced crop yields. 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.

A cyst nematode was identified as the cause of decline symptoms on two types of cacti, *Discocactus akkermannii* and *Cereus speciosus*, by Adam (1932) in the Netherlands. At that time, it was thought to

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be *Heterodera schachtii*, the sugarbeet cyst nematode. Filipjev and Schuurmans Stekhoven (1941) named it as a separate species, *Heterodera cacti*. In 1978, Krall and Krall formed the genus *Cactodera* to accommodate *C. cacti* and other species. It was later reported from Central America and the most southern regions of North America in arid zones (Siddiqi, 2000). Today it is believed to have originated in Mexico (Krall and Krall, 1978) but there are records world wide. The cactus cyst nematode is distributed worldwide, mainly on plants of the family Cactaceae grown in greenhouses as ornamentals. There are twelve other species in *Cactodera*, and sequences from the ITS-rRNA gene are used for molecular diagnostics of *Cactodera* to species (Subbotin et al., 2010). The males and the juveniles are vermiform, and the female is a cyst; her body is lemon-shaped to almost spherical, pearly white, yellow, or golden, maturing to light brown, sometimes reddish brown.

**Hosts:** Hosts are mainly cacti and succulents, found in the families: Cactaceae and Euphorbiaceae. There are some reported hosts in Umbelliferae.

*Aporocactus flagelliformis* (rat-tail cactus), *Borzicactus trollii* (old man of the Andes), *Cereus* sp., *Cereus speciosus*, *Cereus xanthocarpus*, *Chamaecereus silvestri* (peanut cactus), *Coryphantha macrothela*, *Echinopsis aurea* (sea urchin cactus), *Echinopsis* sp., *Epiphyllum* (orchid cactus), *Ferocactus latispinus* (devil's tongue), *Ferocactus pilosus* (barrel cactus), *Ferocactus setispinus* (strawberry cactus), *Ferocactus* sp. (barrel cactus), *Gymnocalycium baldianum* (chin cactus), *G. denudatum* (spider cactus), *G. joossensianum* (chin cactus), *G. multiflorum* (chin cactus), *G. quehlianum* (chin cactus), *Lobivia pentlandii* (cob cactus), *Lobivia* sp., *Mammillaria longimamma*, *M. magnimamma*, *M. martinezii*, *M. parkinsonii*, *M. perbella*, *M. pringlei*, *M. prolifera*, *M. saetigera*, *M. sempervivi*, *M. sonorensis*, *Mammillaria* sp. (pincushion cactus), *M. spinosissima*, *M. winterae*, *M. woodsia*, *Nopalxochia ackermannii* (red orchid cactus), *Notocactus ottonis* (ball cactus), *Notocactus tabularis* (ball cactus), *Opuntia macdougaliana* (prickly pear), *Opuntia microdasys* (bunny-ears), *Opuntia pailana* (prickly pear), *Opuntia* sp. (prickly-pear) (Subbotin et al., 2010; Nemabase, 2010).

**Symptoms:** Infected plants develop branched roots and have an increased number of undersize rootlets or root reduction. Plants become reddish brown to yellow in color and can wilt and appear stunted. There is a reduction in flower production and shortening of the flowering period. Vegetative organs become flabby, and flower and stem jointing can be reduced (Mulk, 1977; Esser, 1992). There is often necrosis at the feeding sites, and this contributes to secondary root rotting, allowing other saprozoic nematodes and pathogenic fungi and bacteria access to wounded plant tissue (Haque and Khan, 2021).

**Transmission:** When the female dies, her skin becomes a protective cyst, containing her eggs, that is very resistant to environmental conditions. The cysts can survive for years in the soil without a host. Cyst nematodes can move easily with soil. Cactus cyst nematode is associated with unsanitary nursery practices, and nematodes are spread with growing media, tools, or watering. Shipping contaminated stock has moved the nematodes around the world in the nursery trades (Esser, 1992). It received a score of 10 out of 15 and a medium level rating of invasiveness by Haque and Khan (2021).

**Damage Potential:** Impacted hosts include *Opuntia* (prickly pear cactus), *Schlumbergia truncata* (Christmas cactus), and *Pitaya* (Dragon fruit) (Chan et al., 2016). Ornamental cacti and succulents are

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very sensitive to color changes, which can occur from cyst nematode damage. With high infection levels, some cactus hosts may die (Mulk, 1977; Esser, 1992). In China, one survey found 15% of greenhouse produced *Cereus jamacaru* with symptoms (Duan et al., 2012). Hamlen reported that the Christmas cactus (*Zygocactus truncatus*) was heavily infected in Florida, stunted with reddish stems that rendered them unsaleable (Hamlen, 1975). Cyst nematode infections often co-occur with other biotic diseases, mainly through the wounds associated with the penetration of the juveniles, but also as physiological changes in the host which increase susceptibility to secondary pathogens (Baldwin and Mundo-Ocampo, 1991).

**Worldwide Distribution:** All detections have come from greenhouses or botanical gardens except for one molecularly confirmed detection in a natural area in Brazil (Rebouças, 2017). Some older detections that used only morphology could be of this or other *Cactodera* spp.

**Europe:** *Austria, Belgium, Czechia, Denmark, Estonia, France, Germany, Hungary, Italy, Lithuania, Malta, The Netherlands, Poland, Portugal, Romania, Russia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Ukraine, Yugoslavia (former); Africa: Algeria; Asia: Armenia, China, Georgia, India, Iran, Israel, Japan, Kazakhstan, South Korea, Turkmenia, Uzbekistan, Vietnam; North America: Canada, USA (Arkansas, California, Colorado, Georgia, Florida, Idaho, Maryland, Michigan, Minnesota, New York), Mexico; South America and Caribbean: Argentina, Brazil, Cuba, Colombia; Oceania: Australia, New Zealand (CABI-ISC, 2021; Subbotin et al., 2021; Skantar et al., 2019)*

**Official Control:** *Cactodera cacti* is on the USDA PCIT's harmful organism list for Chile, Costa Rica, Israel, Nicaragua, and Thailand (USDA, 2021), and on the EPPO's A1 list for Argentina and Chile (EPPO, 2021).

**California Distribution:** There is one record of a detection in 1987 of *Cactodera* sp. from *Cotoneaster* sp. nursery stock in San Francisco County.

**California Interceptions:** There was one interception of *C. cacti* in Los Angeles county in 1998 on an incoming shipment of cacti nursery plants from Florida (PDR database).

The risk *Cactodera cacti* would pose to California is evaluated below.

## Consequences of Introduction:

- 1) Climate/Host Interaction:** This nematode species has been found almost exclusively in greenhouses and botanic gardens. It is likely to be found wherever its hosts can grow, but many of its hosts require protected culture in California.

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.**
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- High (3) likely to establish a widespread distribution in California.

- 2) Known Pest Host Range:** The host range includes multiple plant families, but the most important hosts are cacti and succulents.

Evaluate the host range of the pest.

**Score: 2**

- 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:** The nematode spreads mostly through the movement of cysts. They are spread with infected soil and water. Each cyst can contain hundreds of eggs.

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 is damaging to ornamental cacti grown in nurseries and gardens. It is a quarantine pest in several countries. The cysts can be spread through contaminated irrigation water. In Mexico, several states produce cacti for food, in the form of fruit and flattened stems (nopales). *Cactodera sp.* damage can reduce the profitability of these plants (Baldwin and Mundo-Ocampo, 1991). With water restrictions and drought conditions becoming very common in California, there is increased demand for xeriscaping with plants that are known or potential hosts of *C. cacti*.

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.**
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- 5) Environmental Impact:** There are many native cacti in California, and several are classified as rare (Calfora.org). This nematode has not been reported in the environment in California, but it could be introduced with infected nursery stock. Celery is a reported host in Florida (Langdon and Esser, 1969), and irrigated agriculture occupies large acreages in the southeast portion of the state in proximity to rare cacti. If it became established in residential properties or ornamental plantings, eradication would be nearly impossible (Chitambar et al., 2018).

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

**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 *Cactodera cacti*: Medium**

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 '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.
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-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:**

There are no molecularly confirmed identifications for *C. cacti* in California or Mexico, only diagnosis made on morphological approaches, which can easily mislead for the genus *Cactodera* (Dr. S. Subbotin, CDFA, *pers. comm.*).

### **Conclusion and Rating Justification:**

Based on the evidence provided above the proposed rating for *Cactodera cacti* is A.

### **References:**

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**Responsible Party:**

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**\*Comment Period: 11/05/2021 through 12/20/2021**

**\*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](mailto:permits[@]cdfa.ca.gov).

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**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.
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**Proposed Pest Rating: A**

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