

CAPS Datasheets provide pest-specific information to support planning and completing early detection surveys.

## ***Heterodera ciceri***

### **Scientific Name**

*Heterodera ciceri* Vovlas, Greco & Di Vito, 1985

### **Synonym(s):**

none

### **Common Name**

Chickpea cyst nematode

### **Type of Pest**

Nematode

### **Taxonomic Position**

**Class:** Chromadorea, **Order:** Rhabditida, **Family:** Heteroderidae

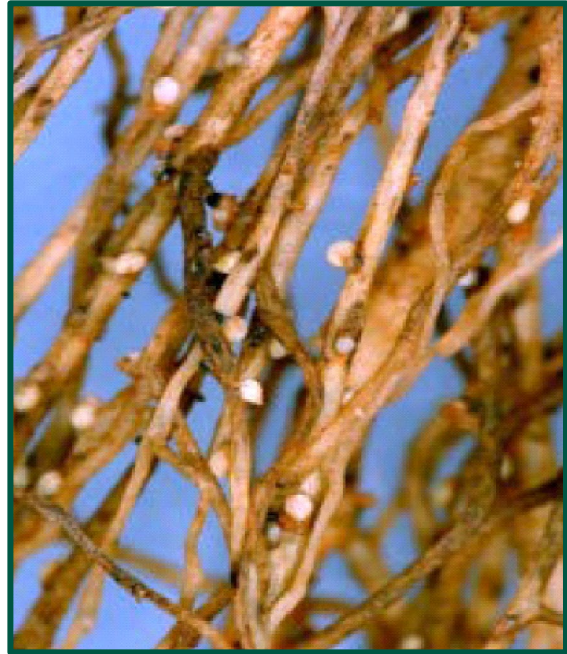
### **Pest Recognition**

*This section describes characteristics of the organism and symptoms that will help surveyors recognize possible infestations/infections in the field, select survey sites, and collect symptomatic material. For descriptions of diagnostic features, see the Identification/Diagnostic resources on the AMPS pest page on the CAPS Resource and Collaboration website.*

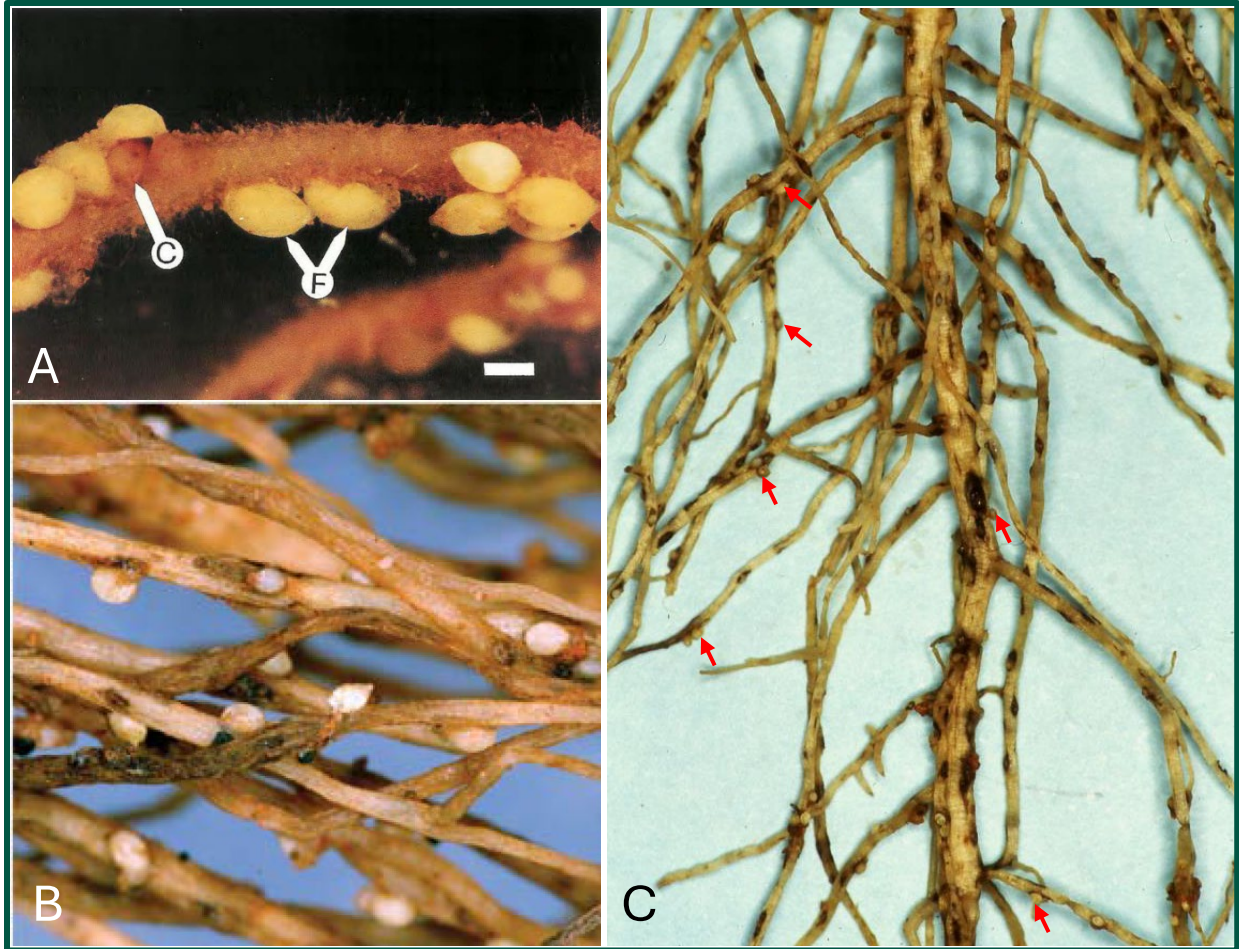
### **Pest Description**

*Heterodera ciceri* adults and juveniles are tiny, with only mature females and cysts visible to the naked eye. Identification requires lab-based microscopy or biochemical and molecular methods (Clapp et al., 2000).

Adult females: Adult females are opaque white, turning yellow and then yellowish-brown as they mature. They are lemon-shaped, with an average length of approximately 773  $\mu\text{m}$  and a width of 451  $\mu\text{m}$  (Figs. 2 & 3) (Kaloshian et al., 1986; Vovlas et al., 1985). Once attached to roots, adult females no longer migrate through soil.



**Figure 1.** *Heterodera ciceri* cysts in chickpea roots (Source: Zwart et al., 2019; originally from ICARDA)



**Figure 2.** Symptoms and signs of chickpea nematodes: *Heterodera ciceri* in lentil root (C = cyst, F = gravid females, scale bar = 450  $\mu$ m) (A); *Heterodera ciceri* females in chickpea roots (B); and *Heterodera ciceri* females (red arrows) and symptoms on chickpea roots (C) (Source: (A): Vovlas & Di Vito, 1985; (B) & (C): Nicola Greco, CNR - Institute of Plant Protection, Bari, Italy).

**Cysts:** Cysts, the dead bodies of mature females, contain viable eggs. Cysts are typically yellow to dark brown, lemon-shaped with a distinct neck, averaging 796  $\mu$ m in length and 115  $\mu$ m in width (Fig. 2) (Vovlas et al., 1985).

**Adult males:** Males are slender and vermiform (wormlike in shape), typically white in color, and average approximately 1,308  $\mu$ m long and about 30  $\mu$ m wide (Vovlas et al., 1985). Adult males are migratory in soil and not visible without microscopy.

**Juveniles:** Second stage juveniles (J2s) are slender, vermiform, and motile. They are not visible without microscopy. They hatch from eggs within cysts and migrate through soil to penetrate host roots. J2s typically measure 440 to 585  $\mu$ m in length and possess a robust stylet or feeding structure (27 to 30  $\mu$ m), four lateral field incisures (lines on the cuticle that allow for flexibility), and a distinct tail with a hyaline terminus (CABI, 2010; Vovlas et al., 1985). Additional juvenile stages (J3 and J4) develop inside root tissues (Kaloshian et al., 1986).

## **Symptoms**

There are no specific above-ground symptoms in plants infected by *H. ciceri*. Plants with severely infected roots are stunted initially, have pale green leaves that become chlorotic yellow, senesce earlier, and have fewer flowers and pods (Greco et al., 1988). If the infection is severe, the pods contain few or no seeds (Greco et al., 1988). In fields, poor and patchy plant growth is apparent in small, circular areas (Fig. 3) (Briar et al., 2023).

The roots of infected plants are underdeveloped, missing nitrogen-fixing nodules, and have cysts of adult female nematodes. The cysts are the primary diagnostic indicators of infection and are typically found on older plants (Fig. 2) (Greco et al., 1988; Greco et al., 1992b). Younger females are white or yellow and can be seen on infected plants before they become cysts, typically appearing at the flowering to early podding stage (Fig. 2A) (Zwart et al., 2019). Severely infected chickpea roots show small black necrotic spots caused by juvenile entry (Fig. 2C).



**Figure 3.** Patchy fields of chickpea damaged by *Heterodera ciceri* (Source: Nicola Greco, CNR - Institute of Plant Protection, Bari, Italy).

## **Easily Mistaken Species**

*Heterodera ciceri* is morphologically similar to *Heterodera trifolii*, *H. schachtii*, *H. rosii*, and *H. daverti* (Vovlas et al., 1985).

*Heterodera trifolii* attacks legumes and carnation (UC Davis, 2023) and is present in 15 U.S. states including Georgia, Pennsylvania, and Wisconsin (Prevalent Nematodes Project, 2025; Wang and Riggs, 1999).

*Heterodera schachtii* primarily infects sugar beet and has been found in 17 states, including Washington, Oregon, Utah, and Idaho (Hafez, 1998).

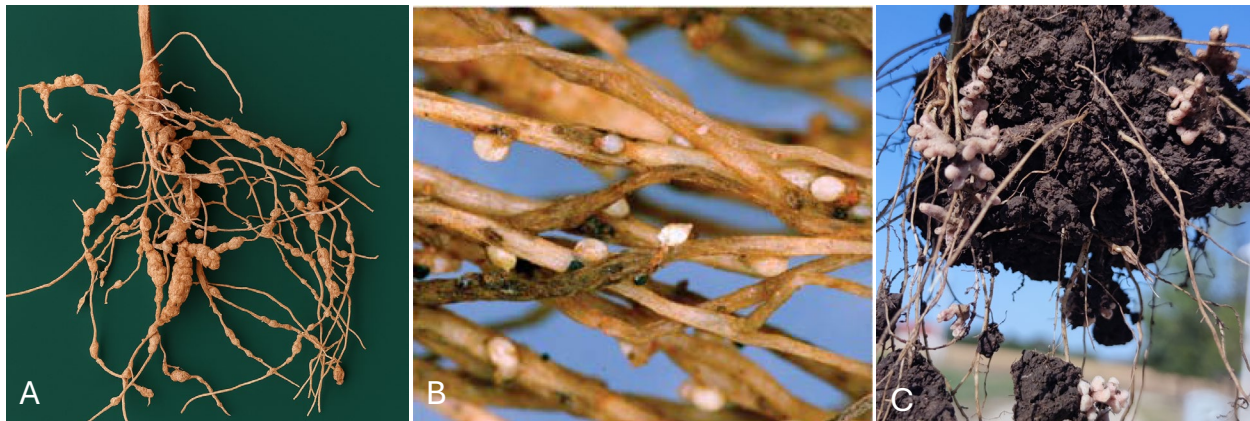
*Heterodera rosii* usually parasitizes dicotyledons, with curled dock (*Rumex crispus* L.) being the type-host and most efficient species for forming cysts (Duggan and Brennan, 1966). *Heterodera daverti* targets clover species (*Trifolium* spp.) (UC Davis, 2023). There is no evidence that *H. rosii* and *H. daverti* are present in the United States.

Keys to differentiate *H. ciceri* from similar species using light or scanning electron microscopy (SEM) can be found in Vovlas et al. (1985) and Greco et al. (1992b).

### Commonly Encountered Non-targets

The approved survey method for *H. ciceri* is soil and tissue sampling. Commonly encountered non-target species include *Ditylenchus dipsaci*, *Heterodera trifolii*, *H. glycines*, *Meloidogyne arenaria*, *M. incognita*, *M. javanica*, *Pratylenchus neglectus*, *P. penetrans*, and *P. thornei* (Faske et al., 2023; Greco et al., 1984; Starr et al., 2002).

Galled roots caused by *M. incognita* are markedly swollen and deformed, often appearing fused along the root. Mature *H. ciceri* females are typically scattered on chickpea roots and do not cause root swelling (Zwart et al., 2019). Healthy nodules formed by nitrogen-fixing bacteria are clustered and white to purple in color (Živanov and Nikolić, 2025) (Fig. 4).



**Figure 4.** Comparative root structures in chickpea: Galled roots caused by *Meloidogyne incognita* (A); Cysts caused by *Heterodera ciceri* (B); Healthy nodules (C) (Source: (A): P. Castillo, 2008; (B): N. Greco, 2021 & (C): D. Živanov and N. Nikolić, 2025).

The above-ground symptoms caused by *H. ciceri* are similar to those resulting from nutrient deficiencies, inadequate soil moisture, or damage from other pathogens (Castillo et al., 2008).

### Biology and Ecology

The life cycle of *H. ciceri* includes an egg stage, four juvenile stages (J1 to J4), and an adult stage. It takes approximately 48 days at 68 °F to complete the life cycle (Kaloshian et al., 1986). First-stage juveniles (J1s) live inside the egg as they grow. Second-stage juveniles (J2s) hatch from eggs within cysts, migrate through the soil (usually just a few inches or so), and penetrate host roots. Upon entry, they induce the formation of feeding structures (syncytia) in the root tissue and become sedentary. While inside roots, they progress through three successive molts, growing from third- and fourth-stage juveniles to adults (Greco et al., 1992b). Swollen adult females rupture root tissues and protrude from the root surface, while adult males become migratory again. Direct observations of mating for this species are limited, but it is presumed that, like other *Heterodera* species, motile *H. ciceri* males fertilize sedentary females externally before cyst formation (Green and Plumb, 1970; Jayaprakash and Rao, 1982). After

death, females transform into cysts, each containing an average of 256 eggs (Kaloshian et al., 1986). Cysts containing viable eggs can persist in the soil for years when hosts are unavailable or environmental conditions are unfavorable (Huston et al., 2024; UC Davis, 2023).

*Heterodera ciceri* completes one generation per growing season (univoltine) and is estimated to require 382 to 640 degree-days (°F) above 50 °F to fully develop (Greco et al., 1988; Kaloshian et al., 1986). Degree-day requirements have only been assessed for chickpea.

The optimum soil temperatures for *H. ciceri* development ranges from 68 to 77 °F. Development does not occur below 50 °F, although J2s can invade roots in temperatures as low as 46 °F (Kaloshian et al., 1986).

### Known Vectors (or associated insects)

This species is not a known vector, is not known to be vectored, and does not have any associated organisms.

### Known Hosts

*Heterodera ciceri* infects chickpea (*Cicer arietinum*) and several other legumes, including garden pea (*Pisum sativum*), grasspea (*Lathyrus sativus*), and lentil (*Lens culinaris*) (Greco, 2021; Greco et al., 1992b).

*The host list below includes cultivated and wild plants that 1) are infected by the pest under natural conditions, 2) are frequently described as major, primary, or preferred hosts, and 3) have primary evidence for feeding and damage documented in the literature. Plants are highlighted in bold if they are commercially produced and the pest causes economically significant damage.*

**Table 1.** Preferred hosts of *Heterodera ciceri*.

Scientific Name	Common Name	Presence in the US*	Type/Use	Reference
<b><i>Cicer arietinum</i></b>	chickpea	Present	Cultivated/wild	(Greco et al., 1992b)
<i>Lathyrus sativus</i>	grass pea	Present	Cultivated/wild	(Greco et al., 1992b)
<i>Lens culinaris</i>	lentil	Present	Cultivated/wild	(Greco et al., 1992b)
<i>Pisum sativum</i>	garden pea	Present	Cultivated	(Greco et al., 1992b)

\*Presence in the United States confirmed by PLANTS database (<https://plants.usda.gov/>).

## Known Distribution

**Table 2.** Countries where *Heterodera ciceri* is known to occur.

Region/Continent	Country	Reference
Middle East	Jordan	(Di Vito et al., 1994)
Middle East	Lebanon	(Di Vito et al., 2001)
Middle East	Syria	(Greco et al., 1992a)
Middle East	Turkey	(Di Vito et al., 2001)

## Pest Importance

*Heterodera ciceri* is a destructive pest of chickpea and lentil in the Middle East (Greco et al., 1988; Vovlas et al., 1985). Heavily infected plants produce pods with small and unmarketable seeds that have greatly reduced protein content (Di Vito et al., 1988). Chickpea yield losses can occur at densities above 1 egg/g soil (Greco, 2021).

In 2024, approximately 1.4 million acres of chickpeas and 4.0 million acres of lentils were planted in the United States, with a total value of approximately \$200 million and \$300 million, respectively. Idaho, Montana, and Washington are the major chickpea- and lentil-producing states in the United States (USDA-NASS, 2024a; USDA-NASS, 2024b).

*Heterodera ciceri* is listed as a harmful organism in Brazil (USDA-PCIT, 2025). There may be trade implications with this country if this pest becomes established in the United States.

## Pathway

*Heterodera ciceri* spreads into new areas through the movement of infected plant material (primarily roots) and cyst-contaminated soil. Contaminated soil may be carried on machinery, animals, boots, or moved by water or wind (Camacho et al., 2025). Greco et al. (1992b) suggested that increased movement of machinery and personnel between the United States and the Middle East could increase the likelihood of introduction of the pest.

*Use the PPQ Commodity Import and Export manuals listed below to determine 1) if host plants or material are allowed to enter the United States from countries where the organism is present and 2) what phytosanitary measures (e.g., inspections, phytosanitary certificates, post entry quarantines, mandatory treatments) are in use. These manuals are updated regularly.*

[Agricultural Commodity Import Requirements \(ACIR\) manual](#): ACIR provides a single source to search for and retrieve entry requirements for imported commodities.

## Potential Distribution within the United States

*Heterodera ciceri* likely has the potential to establish across much of the United States, given the widespread availability of conducive climates and host crops. However, survey efforts are likely to be most effective in regions where chickpea, lentil, and pea, are grown at commercial scale.

Based on the known distribution of this pest and comparing those climates to plant hardiness zones (Takeuchi et al., 2023), we expect that *H. ciceri* could establish in plant hardiness zones 6 to 10. These zones correspond to a wide portion of the continental United States. Recent assessments in California indicate that *H. ciceri* could establish in the state in any compatible climates where suitable hosts are grown (CDFA, 2024). Similarly, Greco et al. (1992b) emphasized that the soil conditions and climate of Florida could support *H. ciceri* development and reproduction; despite having relatively few hosts present in the state.

Chickpeas and lentils are grown commercially in Idaho, Montana, North Dakota, and Washington, with a small amount of chickpea production in California (USDA-NASS, 2024a). Dry peas are grown in Montana and North Dakota, with a small amount of production in Idaho, Nebraska, and Washington (USDA-NASS, 2024b). Garden pea commercial production occurs primarily in Minnesota, Washington, Wisconsin, Oregon, and New York (USDA-NASS, 2022). Additionally, garden peas are common in home gardens in nearly every state of the United States. California, Florida, Idaho, Minnesota, New York, Oregon, Washington, and Wisconsin are at the greatest risk because they have a suitable climate and are producers of chickpea, lentil, and pea.

## Survey and Key Diagnostics

### **Approved Methods for Pest Surveillance\*:**

For the current approved methods and guidance for survey and identification, see Approved Methods for Pest Surveillance (AMPS) pest page on the CAPS Resource and Collaboration website, at <https://approvedmethods.ceris.purdue.edu/>.

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## Versions

**July 2016:** Datasheet completed (Version 1)

**December 2025:** Datasheet revised and transferred to the current template (Version 2)

- Added **Pest Recognition** section
- Added **Easily Mistaken Species** section
- Added **Commonly Encountered Non-targets** section
- Updated **Biology & Ecology** section
- Updated **Known Hosts** section
- Updated **Pest Importance** section
- Updated **Pathogens or Associated Organisms Vectored** section
- Updated **Known Distribution** section
- Updated **Pathway** section
- Updated **Potential Distribution within the United States** section
- Updated guidance for **Approved Methods** section