

THE CHICKPEA CYST NEMATODE, *HETERODERA CICERI*

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INTRODUCTION: Several cyst-forming nematodes have been reported on legume crops from northern African countries and especially from those of the Middle East (11). *Heterodera ciceri* Vovlas, Greco and Di Vito is considered one of the most aggressive parasites to food legumes grown in parts of those geographical areas (10,11). The dramatic intensification in the movement of machinery and personnel among the United States and Middle Eastern countries during and after the Persian Gulf conflict has increased the probability of accidental introduction and spread of plant pests, including *H. ciceri*, among these countries. Cyst nematodes are more prone than other phytoparasitic nematodes to unintentional long distance transport because their resistant stages (cysts) tolerate long periods of desiccation and adhere to soil particles on vehicles and clothing. The purpose of this circular is to provide information about the morphology and biology of *H. ciceri*, in order to facilitate the detection of this pest in the unfortunate event of its accidental introduction into the United States and, in particular, Florida.

MORPHOLOGICAL CHARACTERS: *Heterodera ciceri* belongs to the large group of cyst-forming nematodes with major morphological characters similar to those of *H. schachtii* Schmidt. *Heterodera ciceri* has bullate cysts with a prominent underbridge and a vulval slit >35 µm long (13) (Fig. 1). *Heterodera ciceri* differs from other *Heterodera* species reported in Florida (1,2,5,8,9,14) as follows: *H. ciceri* cysts do have bullae (irregular globose bodies below the fenestra) (Fig. 1), whereas *H. cyperi* Golden et al. and *H. graminophila* Golden and Birchfield cysts do not. *Heterodera ciceri* cysts have a longer underbridge than that of *H. fici* Kirjanova, *H. glycines* Ichinoe, *H. schachtii* and *H. trifolii* Goffart (115-160 µm vs. <100 µm). *Heterodera ciceri* second-stage juveniles (J2) (Fig. 2) have a longer stylet than that of *H. fici*, *H. glycines* and *H. schachtii* J2 (27-30 µm vs. <26 µm). *Heterodera ciceri* differs from *H. leuceilyma* DiEduardo and Perry in having cysts with more numerous bullae.

Furthermore, *H. ciceri* J2 have four lines in the lateral field (Fig. 2), whereas *H. leuceilyma* J2 have three lines. *Heterodera ciceri* J2 differ from *H. trifolii* J2 in the number of lip annuli which are three in *H. ciceri* and 1 in *H. trifolii*.

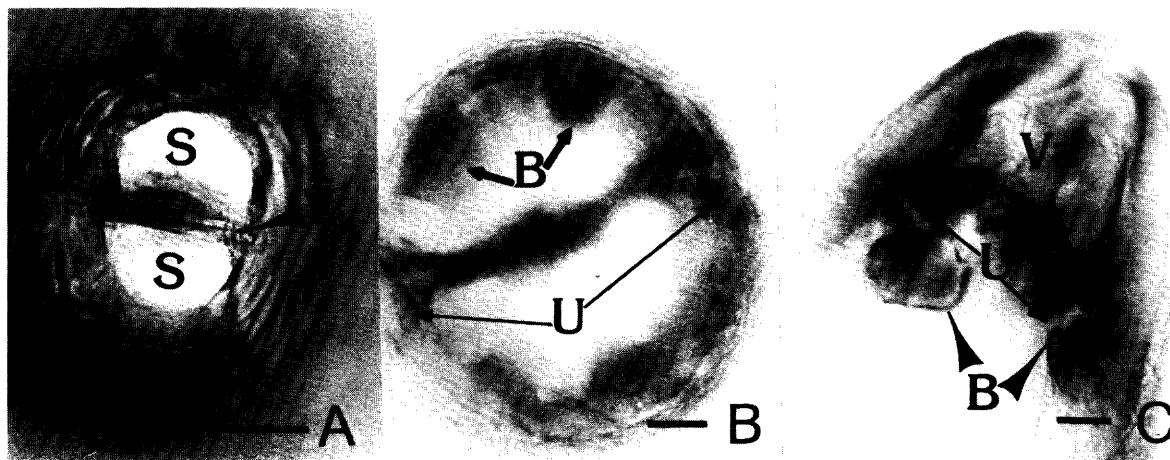


Fig. 1. Vulval cones of *Heterodera ciceri* cysts. A) End view of a vulval cone showing semifenestrae (S) and vulval slit (V). B) Underbridge (U) and bullae (B) below fenestra. C) Dorsal-ventral view of vulval cone showing vagina (Va), underbridge (U), and bullae (B). Scale bars = 20 µm.

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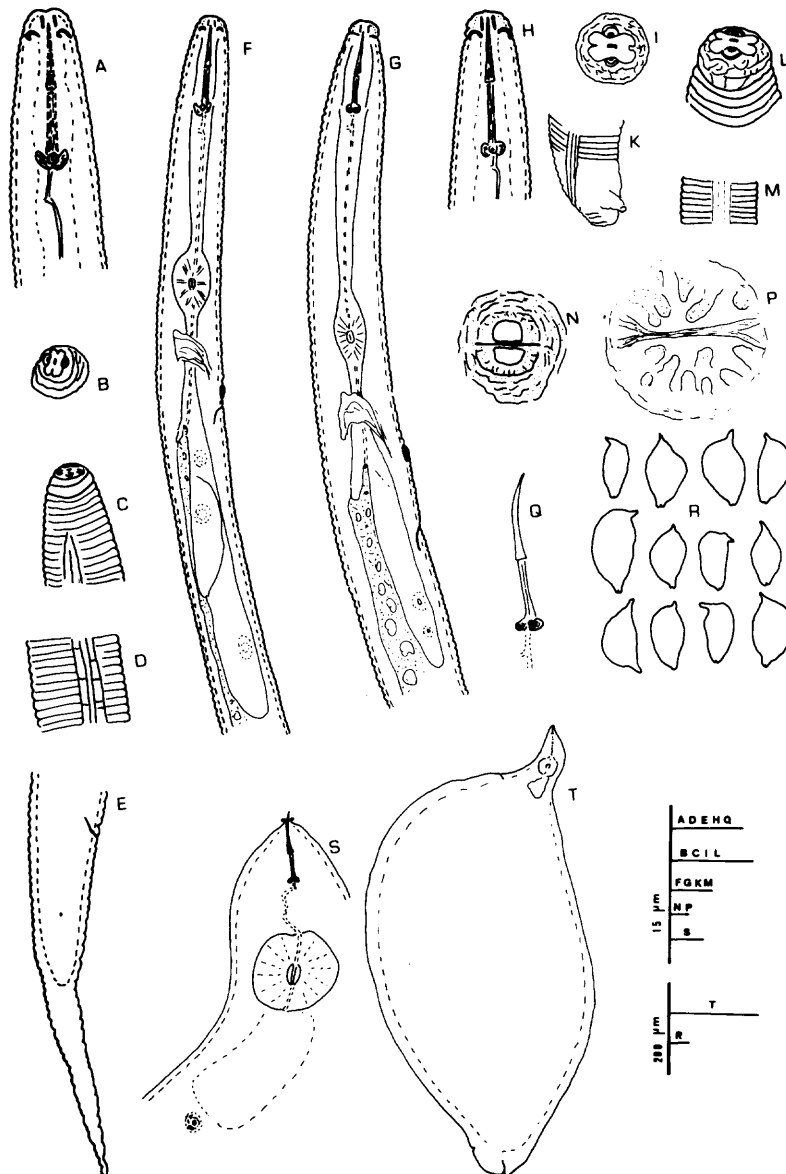


Fig. 2. *H. ciceri* from chickpea. A) Anterior end of J2. B, C) J2 lip pattern and profile. D) J2 lateral field at mid body. E) J2 tail. F, G) Oesophageal region of J2 and male, respectively. H) Anterior end of male. I, L) Lip pattern and profile of male. K) Male tail. M) Male lateral field at mid body. N) Semifenestrae and vulval slit of cyst. P) Bullae and underbridge of cyst. Q) Female stylet. R) Outline drawing of cysts. S) Anterior body portion of female. T) Outline drawing of gravid female, (13).

GEOGRAPHICAL DISTRIBUTION: *Heterodera ciceri* has been reported only in Syria (10,11). Information on the distribution of this nematode in other Middle Eastern countries is lacking.

HOST RANGE: *Heterodera ciceri* infects and damages leguminous crops such as chickpea (*Cicer arietinum*), garden pea (*Pisum sativum*), grasspea (*Lathyrus sativus*), and lentil (*Lens culinaris*). The nematode reproduces poorly on alfalfa (*Medicago sativa*), bean (*Phaseolus vulgaris*), broad bean (*Vicia faba*), crimson clover (*Trifolium incarnatum*), lupine (*Lupinus albus*), red clover (*Trifolium pratense*) and vetch (*Vicia sativa*). Very slight or no reproduction occurs on different soybean (*Glycine max*) cultivars. Outside the Leguminosae family, carnation (*Dianthus caryophyllus*) can allow development of a few females of *H. ciceri* (3).

BIOLOGY: *Heterodera ciceri* J2 emerge from the eggs inside the cysts, migrate through soil and penetrate host roots. Inside root tissues, J2 become sedentary and swollen and complete their development by feeding on specialized stelar cells. Swollen females rupture root tissues with the posterior portion of their bodies which then

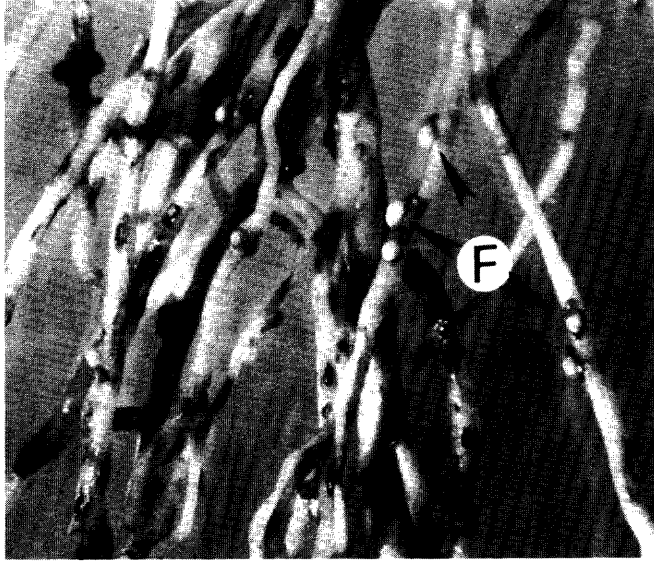


Fig. 3. Chickpea roots infected by *H. ciceri* females (F).

protrude from the root surface (Fig. 3). Females do not produce egg sacs. They retain eggs inside their bodies and may produce a gelatinous matrix without eggs. Gravid females die at the end of their life cycle and become cysts containing 200-300 eggs (7). On short-cycle leguminous crops such as chickpea, cysts are formed during plant podding stage by late spring (end of April or May) when roots are less receptive to nematode infection and development. Soil moisture shortage that occurs in Middle Eastern countries during this period also suppresses nematode infection. Therefore, on these crops, the nematode completes one generation per year (7). Field observations made in Syria indicate that *H. ciceri* females appear on chickpea roots at the end of April or by mid May on winter and spring-sown chickpea crops, respectively (4). *Heterodera ciceri* egg hatch and J2 root infection and development can occur at low soil temperatures such as 10 C (50 F). At 20 C (68 F) nematode development from J2 root invasion to the appearance of cysts is attained in 36 days. Vermiform males develop simultaneously with the females. Egg hatch and J2 root infection are suppressed by soil temperatures below 8 C (46 F) and at 30 C (86 F) or above (6,7).



Fig. 4. A large patch of stunted plants in a lentil field heavily infested by *H. ciceri*.

SYMPTOMS AND YIELD LOSSES: *Heterodera ciceri* is an aggressive parasite. Nematode-infected chickpea and lentil plants are stunted (Fig. 4), chlorotic and produce a few flowers and pods with small or no seeds. Infected roots are poorly developed and lack *Rhizobium* nodules (4). Chickpea yield is adversely affected by nematode soil populations exceeding 1 egg/cc soil. Yield losses of 20, 50 and 100% can be expected in chickpea fields infested with 8, 16 and 32 or more eggs/cc soil (4). Lentil is more tolerant to *H. ciceri* than chickpea. Nematode infection also suppresses protein content of both chickpea and lentil seeds (4).

CONTROL: *Heterodera ciceri* cysts can survive for many years in soil without a host. However, the number of viable eggs inside the cysts declines with time because of the adverse effects of several biological control agents. The average annual decline of *H. ciceri* eggs in the cysts maintained in soil without host plants is about 50% (4). Therefore, crop rotation with nonhost crops such as wheat or other cereals for 2-4 years is an effective cultural control practice in infested fields destined to low cash crops such as lentil or chickpea. Good nematode control can also be obtained with a 6-8 week soil solarization period. This method is, however, too costly for food legumes. So far no chickpea or lentil cultivars resistant to *H. ciceri* are available. Some resistance has been detected in *Cicer bijugum* (12).

SURVEY AND DETECTION: The outdoor climatic conditions of Florida are favorable to the establishment of *H. ciceri* because the optimal soil temperatures (20-25 C or 68-77 F) for nematode development and reproduction occur during the major part of the year in the Florida peninsula. In case of accidental introduction of *H. ciceri* into Florida, the nematode can become established on several legume crops such as garden pea, bean, clover and vetch that are commonly grown in the state. These crops, and especially garden pea, should be checked for patches of stunted plants with chlorotic leaves if a nematode problem is suspected. Soil and root samples from these suspect plants should be collected and analyzed for the presence of this parasite.

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