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Spiral Nematode *Helicotylenchus* spp. (Nematoda: Chromodorea: Rhabditida: Hoplolaimidae)[1]

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Introduction

The common name spiral nematode is most often applied to nematodes in the genus *Helicotylenchus*, but it is also sometimes applied to other genera in the family Hoplolaimidae, including *Rotylenchus*, *Aorolaimus*, *Scutellonema*, and *Peltamigratus*. These are called spiral nematodes because their bodies tend to curl into a spiral when the nematodes are relaxed or dead (Figures 1 and 2). Spiral nematodes of the genus *Helicotylenchus* are among the most ubiquitous plant-parasitic nematodes worldwide. Dozens of *Helicotylenchus* spp. have been reported in Florida associated with various cultivated horticultural, agronomic, ornamental, and turfgrass plants, and from natural habitats.



Figure 1. The body of *Helicotylenchus* spp. and other spiral nematodes curve into a spiral when the nematode is dead or relaxed. This moving nematode is outstretched.
Credit: William T. Crow, UF/IFAS



Figure 2. The body of *Helicotylenchus* spp. and other spiral nematodes curve into a spiral when the nematode is dead or relaxed. These relaxed nematodes are curled into a spiral.
Credit: William T. Crow, UF/IFAS

Distribution

Helicotylenchus spp. are found in temperate and tropical regions on all continents (except Antarctica), on many islands, and throughout the United States. *Helicotylenchus* spp. can thrive in a wide range of soil types including heavy, sandy, and organic soils.

Life Cycle and Biology

Reproduction is highly variable among species of *Helicotylenchus*. Some species, like *Helicotylenchus muticinctus*, reproduce sexually and have males and females that mate. Some species are hermaphrodites that self-fertilize their own eggs without mating. Other species, like *Helicotylenchus pseudorobustus,* reproduce asexually by parthenogenesis, do not mate, and have only females. Females lay eggs individually in soil. Inside each egg a first-stage juvenile develops and then molts into a second-stage juvenile before hatching. After hatching, the second-stage juvenile must locate a host plant and begin feeding for further development. *Helicotylenchus* spp. typically feed on cortical cells of host roots. The nematode inserts its mouth-spear (stylet) into the epidermis and cortical cells and ingests the cellular

contents. In some cases, *Helicotylenchus pseudorobustus* induces development of a specialized "food cell" on which it feeds (Vovlas and Inserra 1985). This food cell in not larger than a typical cortical cell, but has denser cytoplasm and larger nucleus than a normal cell. *Helicotylenchus pseudorobustus* will generally stay in one location feeding on a single food cell, but can also move to a different location on the same or different root and induce a new food cell at the new location.

While generally considered an ectoparasite whose body remains outside of host tissue during feeding, occasionally *Helicotylenchus pseudorobustus* behaves as a semi-endoparasite and penetrates into the host root with its anterior body portion (head region). In contrast, *Helicotylenchus multicinctus* is a migratory endoparasite that enters completely into banana roots and moves in the lumen between cells, feeding on different cells as it migrates. After feeding, all *Helicotylenchus* spp. undergo three more molts into a third and fourth stage juvenile, and then into an adult. The various juvenile life stages of *Helicotylenchus* spp. look very similar to the adults, differing only in body size and lack of a developed reproductive system. Eggs of most species are deposited into the soil, although *Helicotylenchus multicinctus* lays eggs within banana roots.

Hosts

Helicotylenchus spp. have a wide host range including fruit crops, vegetables, agronomic crops, ornamental plants, forages, turfgrasses, weeds, and plants in natural habitats. With the exception of *Helicotylenchus multicinctus*, spiral nematodes are not considered important pests on most hosts. However, often their damage has not been well quantified or documented. Research has shown that some Florida crops, such as soybean, cotton, and corn are damaged by *Helicotylenchus pseudorobustus*. *Helicotylenchus multicinctus* is an important nematode pest of banana in Florida (McSorley and Parrado 1983), and worldwide (McSorley and Parrado 1986). *Helicotylenchus paxilli* has been demonstrated to reduce growth of bermudagrass and seashore paspalum used on Florida golf courses (Pang et al. 2011 and Pang et al. 2012).

Symptoms

The symptoms of *Helicotylenchus pseudorobustus* are more subtle than those of certain other nematodes such as root-knot or sting nematodes. Heavy infection by *Helicotylenchus* spp. can cause a reduction in the root system, leading to unhealthy plants. On turfgrasses, *Helicotylenchus paxilli* has been shown to reduce root length and cause thinning of turf. Generally, the turf decline will occur in patches (Figure 3) and is often accompanied by proliferation of weeds in the affected areas (Figure 4). *Helicotylenchus multicinctus* causes small necrotic lesions on roots, and with heavy infestation these lesions coalesce, leading to root necrosis and die-back of roots. Plant stunting and reduction in yield can result. Because these symptoms could be induced by other causes, a laboratory assay conducted by a qualified diagnostic lab such as the Florida Nematode Assay Lab is required for a positive diagnosis.



Figure 3. Seashore paspalum on a golf course fairway infested by *Helicotylenchus paxilli*. Nematode damage is visible as patches of declining turf.
Credit: William T. Crow, UF/IFAS



Figure 4. A seashore paspalum golf tee box infested with *Helicotylenchus paxilli*. Nematode damage results in thinning turf and proliferation of weeds.
Credit: William T. Crow, UF/IFAS

Identification

As previously described, the body of *Helicotylenchus* spp. forms a complete spiral when the nematode is dead or

relaxed. The vulva of the female is located around 2/3 of the nematode's body length from the anterior terminus (Figure 5). The tail is asymmetrical, being curved dorsally with a rounded projection in many species (Figure 6). The presence of males is a useful biological character to separate *Helicotylenchus multicinctus* from species that do not have males. A combination of morphological evaluation, morphometrics, and molecular phylogenetic inference should be used to accurately determine the species of an individual population (Subbotin et al. 2015).

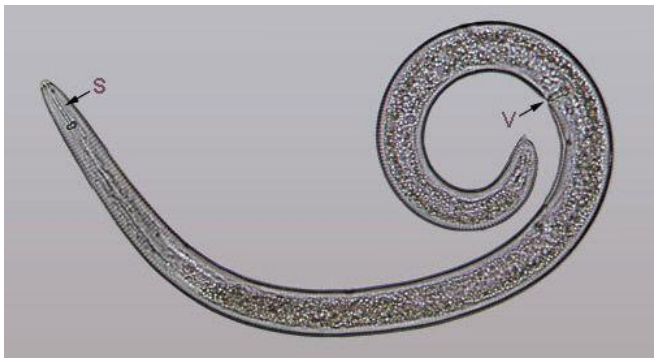


Figure 5. An adult *Helicotylenchus paxilli*. S = stylet (mouth spear) used for feeding. V = vulva, located around 60% of the body length from the anterior terminus.
Credit: William T. Crow, UF/IFAS

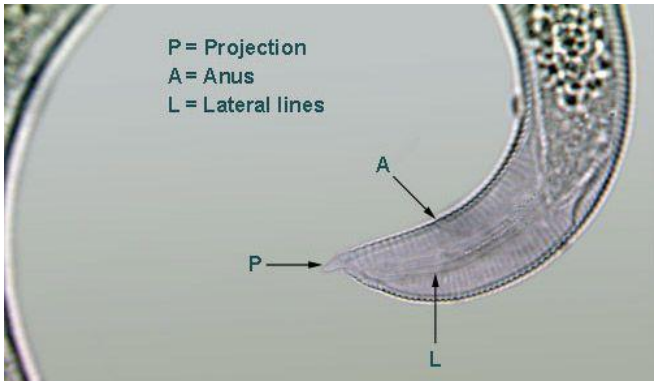


Figure 6. The tail of *Helicotylenchus pseudorobustus* is asymmetrical and has a projection on the end.
Credit: William T. Crow, UF/IFAS

Economic Importance

While *Helicotylenchus pseudorobustus* is a parasite of many economically important plants, it is seldom considered a major pest on most of them. In Florida, seashore paspalum, a turfgrass used in tropical and subtropical regions, is particularly susceptible to infestation by *Helicotylenchus paxilli*. On this grass, *Helicotylenchus paxilli* is among the most common nematodes requiring nematicide application in Florida. While banana is not an important commercial crop in Florida, *Helicotylenchus multicinctus* is damaging to banana grown for local fruit consumption and ornamental banana growing in nurseries and landscapes. Another species that is very common on many crops, ornamentals, and other cultivated and non-cultivated plants in Florida is *Helicotylenchus dihystera*. However, the damage induced by this nematode in Florida has not been assessed.

Management

The extensive host range of *Helicotylenchus* spp. makes management by use of crop rotation or cover crops very difficult. Because the body of *Helicotylenchus* spp. remains exposed in soil, it responds well to nematicides and bionematicides that are effective for management of other nematodes. On golf and sports turfgrasses, nematicides are applied for management of *Helicotylenchus paxilli* in Florida. Refer to Nematode Management for Golf Courses in Florida for current management recommendations on golf course turf. Sanitation, planting of nematode-free banana plants into non-infested soil, is currently the best control measure for *Helicotylenchus multicinctus* on banana in nurseries and landscapes.

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