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# Diagnosis of *Peltamigratus christiei*, a Plant-Parasitic Nematode Associated with Warm-Season Turgrasses in the Southern United States

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## Introduction

Various turfgrass species are used as ground cover for residential, commercial, right-of-way, and recreational purposes in the southern United States. Increases in population density and urbanization in the South have led to an increase in both warm-season turfgrass use and its importance as a horticultural commodity. In many southern states, turfgrass and related industries are significant contributors to local and regional economies. The increasing importance of turfgrass has led to greater emphasis on diagnosis and management of turfgrass pests, including plant-parasitic nematodes. Turfgrass samples comprise more than 90% of the diagnostic samples evaluated in the University of Florida Nematode Assay Laboratory.

Plant-parasitic nematodes are common and destructive pests of both warm- and cool-season turfgrasses. The most common warm-season grasses in the southern United States include bermudagrass (*Cynodon dactylon*), St. Augustinegrass (*Stenotaphrum secundatum*), bahiagrass (*Paspalum notatum*), centipedegrass *(Eremochloa ophiuroides*), and zoysiagrass (*Zoysia* spp.). These grasses are often found growing on sandy soils favoring damaging populations of plant-parasitic nematodes. The population diversity and distribution of plant-parasitic nematodes in numerous turfgrass ecosystems have been characterized (5,8,13,15,16). In these studies, nematodes from the genera *Belonolaimus, Mesocriconema, Helicotylenchus, Hemicycliophora, Hoplolaimus, Paratrichodorus, Pratylenchus, Meloidogyne, Trichodorus*, and *Tylenchorhynchus* were associated with both warm- and cool-season grasses. *Belonolaimus longicaudatus* and *Hoplolaimus* spp. are among the most destructive turfgrass nematodes. In addition, *Meloidogyne* spp. can be destructive to various warm-season turfgrasses, such as bermudagrass, when grown on sandy soils.

*Peltamigratus christiei* (Fig. 1A and 1B) has been reported from Florida turfgrass ecosystems for many years (4) and is the only species of *Peltamigratus* reported parasitizing warm-season turfgrasses. Originally thought to be confined to tropical climates, the authors have recently identified *P. christiei* associated with bermudagrass in California, Mississippi, and Oklahoma. On some crops, *Peltamigratus* spp. can be easily mistaken for nematodes in the genera *Scutellonema* or *Aorolaimus*. However, on turf *P. christiei* is most often confused with the common turf parasites *Hoplolaimus* spp. and *Helicotylenchus* spp.

A B

Fig. 1. Female (A) and male (B) of *Peltamigratus christiei*.

When viewed under low magnification, *P. christiei* may be confused with other plant-parasitic nematodes, including *Hoplolaimus* spp. and *Helicotylenchus* spp. Correct diagnosis of this nematode is important, as its virulence is most likely different from nematodes in these other genera. Depending on the type of nematode for which it is mistaken, misidentification could result in an unnecessary nematicide application or lack of a nematicide application where it would be beneficial. The objective of this report is to describe *P. christiei* and the characteristics which can be used to readily distinguish it from *Hoplolaimus* spp. and *Helicotylenchus* spp. when examining nematode populations from warm-season turfgrasses. This article emphasizes features that can be observed with a dissecting, or low-magnification inverted microscope rather than those requiring the use of high resolution microscopy.

## Hosts

Bermudagrass (*Cynodon dactylon*), St. Augustinegrass (*Stenotaphrum secundatum*), bahiagrass (*Paspalum notatum*).

## Pathogen

*Peltamigratus christiei* (Golden and Taylor, 1956) Sher, 1964 (Nematoda: Hoplolaimidae);
syn. *Rotylenchus christiei* (Golden and Taylor, 1956),
*Scutellonema christiei* (Golden and Taylor) Andrassey, 1958,
*Aorolaimus christiei* (Golden and Taylor) Fortuner, 1987.

## Taxonomy

*Peltamigratus christiei* was first described by Golden and Taylor (4) as *Rotylenchus christiei*. Sher (10) later placed *R. christiei* in a new genus *Peltamigratus*. Fortuner (2) synonymized the genus *Peltamigratus* with *Aorolaimus*. However, Siddiqi (12) resurrected the genus *Peltamigratus*. In this paper, we retain the genus name *Peltamigratus* as in Siddiqi (12).

## Symptoms

No symptoms specific to *P. christiei* on turfgrasses have been described, but are probably typical to those caused by other ectoparasitic nematodes on turfgrasses. These include irregular patches of declining turf that exhibit wilting, chlorosis, thinning, or death (14). These symptoms have been observed in areas with high populations of *P. christiei* in the field (Fig. 2). Affected roots may appear abbreviated, darkened, or exhibit rotting.

Fig. 2. Irregular patches of declining turf in a St. Augustinegrass lawn associated with high (> 300/100 $cm^3$ of soil) population densities of *Peltamigratus christiei*.

## Host Range

*Cerothamnus* sp. (wax myrtle), *Crinum americanum* (swamp lily), *Cynodon dactylon* (bermudagrass), *Hibiscus cannabinus* (Indian hemp), *Paspalum notatum* (bahiagrass), *Paspalum vaginatum* (seashore paspalumgrass), *Quercus* sp. (oak), *Sabal* spp., *Stenotaphrum secundatum* (St. Augustinegrass), *Theobroma cacao* (cacoa).

## Geographic Distribution

California, Florida, Mississippi, and Oklahoma in the United States. *Peltamigratus christiei* has also been reported in Brazil (3).

## Pathogen Isolation

*Peltamigratus christiei* is primarily an ectoparasite of roots. Therefore, any of the common methods of extracting nematodes from soil (7) should be adequate for isolating *P. christiei*. The most common methods used by nematode diagnostic services are variations of sugar-flotation with centrifugation or Baermann funnel methods.

## Pathogen Identification

On turf, *P. christiei* is most commonly mistaken for nematodes in the genera *Hoplolaimus* and *Helicotylenchus*, which are widespread turfgrass parasites (Fig. 3). The most easily identifiable morphological features that distinguish *P. christiei* from nematodes in these genera are body size, body position when dead, vulval position, tail shape, and the presence of epiptygmata.

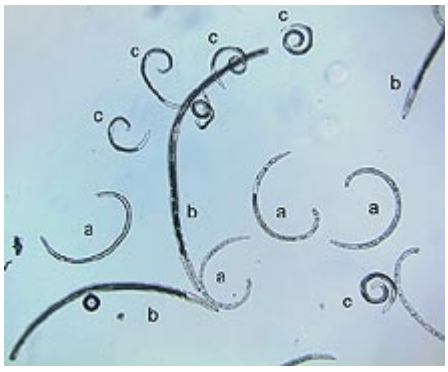


Fig. 3. *Peltamigratus christiei* (a), *Hoplolaimus galeatus* (b), and *Helicotylenchus pseudorobustus* (c).

The female body length of *P. christiei* is 0.67 to 0.87 mm (10). The female body length of *Hoplolaimus galeatus*, the most common species of lance nematode associated with turf, is 1.24 to 1.94 mm (9). The female body lengths of the two most commonly encountered *Helicotylenchus* spp. associated with turf in Florida, *H. pseudorobustus* and *H. dihystera*, are 0.60 to 0.82 mm, and 0.59 to 0.79 mm, respectively (11). Therefore, *P. christiei* is shorter than *Hoplolaimus* spp., but its range overlaps that of *Helicotylenchus* spp. (Fig. 3).

The vulval position of *P. christiei* is 53 to 58% of the body length from the anterior (4,10). The vulval position of *H. galeatus* is 52 to 60% from the anterior (9). *Helicotylenchus pseudorobustus* and *H. dihystera* have vulval positions of 59 to 64%, and 60 to 65%, respectively (11). Therefore, the vulval position of *P. christiei* is anterior to that of the *Helicotylenchus* spp. commonly found on turf, but not different from that of *H. galeatus*.

Death position can be very useful for distinguishing *P. christiei* from common *Hoplolaimus* spp. and *Helicotylenchus* spp. on turf. In death, the body position of *P. christiei* is usually a loose spiral or C shape (Fig. 4A). The head seldom overlaps the tail to form a complete spiral. In contrast, the death position of *H. pseudorobustus* and *H. dihystera* is usually a tight spiral, with the head generally overlapping the tail (Fig. 4B). The death position of *Hoplolaimus* spp. is more or less straight or slightly curved (Fig. 4C).


Fig. 4A. In death the body of female *Peltamigratus christiei* (a) is curved, but usually does not form a full spiral. Males (b) are often not curved when dead.

Fig. 4B. In death the bodies of the *Helicotylenchus* spp. common on turf usually form a full spiral with the head overlapping the tail at least once.

Fig. 4C. In death the body of *Hoplolaimus* spp. is usually straight or slightly curved.

Tail shape is also useful in distinguishing *P. christiei* from *Hoplolaimus* spp. and *Helicotylenchus* spp. on turf. The female tail of *P. christiei* is rounded and may be slightly asymmetrical (Fig. 5A). The female tail of *H. galeatus* is short and symmetrical (Fig. 5B). The female tails of *H. pseudorobustus* and *H. dihystera* are distinctly asymmetrical, being curved ventrally and often having a short terminal projection (Fig. 5C).

Fig. 5A. The female tail of *Peltamigratus christiei* is slightly asymmetrical and curved ventrally.

Fig. 5B. The female tail of *Hoplolaimus* spp. is symmetrical and bluntly rounded.

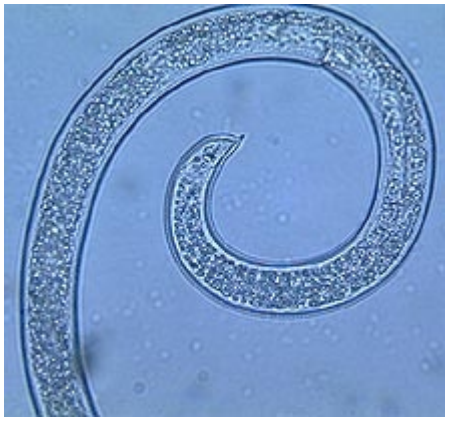

Fig. 5C. The female tail of the *Helicotylenchus* spp. common on turf is asymmetrical and curved ventrally, and often a terminal projection is present.

The most useful diagnostic tool for separating *P. christiei* from *Hoplolaimus* spp. and *Helicotylenchus* spp. on turf is the presence of epiptygmata. Epiptygmata are sclerotized projections surrounding the vulva of certain species of nematodes (Fig. 6). *Peltamigratus christiei* has two prominent epiptygmata that are easily observed with most microscopes (Fig. 7A). Some other species of *Peltamigratus* have only a single epiptygma. Epiptygmata are not present in *Hoplolaimus* spp. (Fig. 7B) or *Helicotylenchus* spp. (Fig. 7C).

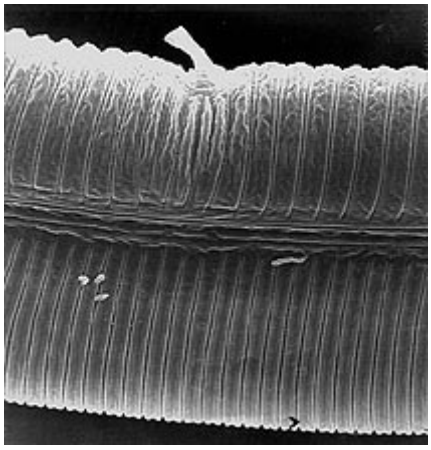

Fig. 6. Scanning electron micrograph of epiptygmata, sclerotized vulval projections, on a female *Peltamigratus christiei*. *Peltamigratus christiei* has two epiptygmata, some other species of *Peltamigratus* have only a single epiptygma (Photo courtesy of K. B. Nguyen).

Fig. 7A. Epiptygmata are easily seen surrounding the vulva of *Peltamigratus christiei*.

Fig. 7B. The vulva of *Hoplolaimus* spp. lacks epiptygmata.

Fig. 7C. The vulva of *Helicotylenchus* spp. lacks epiptygmata.

The intent of this paper is to help identify *P. christiei* from common nematodes found in turfgrass samples in the southern United States. On occasion, other nematodes also may be confused with *P. christiei*. *Scutellonema* spp. and *Aorolaimus* spp. very much resemble *P. christiei*, and females may be indistinguishable using low resolution microscopy. While there are no published reports of *Scutellonema* spp. parasitizing warm-season turfgrasses, they are occasionally found in turf samples submitted to the University of Florida Nematode Assay Laboratory. Since males are abundant in populations of *P. christiei*, the shape of the bursa (caudal alae) is a useful feature to separate it from species of *Scutellonema*. The bursa of *P. christiei* extends beyond the tail

tip when seen in lateral view (Fig. 8A). In many *Scutellonema* spp. males are rare. When *Scutellonema* males are present, the bursa does not extend beyond the tail tip when seen in lateral view (Fig. 8B). If observation at high magnification using oil immersion is possible, scutella (large phasmid) location is the primary feature used to separate the genera *Peltamigratus*, *Scutellonema*, and *Aorolaimus*. The scutella of *Scutellonema* are located near the anus and are nearly opposite each other on the nematode body. In *Peltamigratus* and *Aorolaimus* the scutella are anterior to the anus and not opposite each other. *Aorolaimus* has one scutella anterior and the other posterior to the vulva. *Peltamigratus* has both scutella posterior to the vulva. See Sher (9,10,11) for a detailed description of each genus.

Fig. 8A. The bursa of *P. christiei* extends beyond the tail tip in lateral view.

Fig. 8B. The bursa of *Scutellonema* spp. does not extend beyond tail tip in lateral view.

A general key to genera of plant-parasitic can be very helpful in diagnosing plant-parasitic nematodes. Mai et al. (6) has both pictorial and non-pictorial keys and is an excellent resource for nematode diagnostic laboratories. Keys specific to the Hoplolaiminae, the suborder containing all the genera dealt with in this paper (*Aorolaimus*, *Helicotylenchus*, *Hoplolaimus*, *Peltamigratus*, and *Scutellonema*), are found in Siddiqi (12). The most current key to species in the genera *Peltamigratus* and *Aorolaimus* is Baujard et al. (1).

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