

Pacific Shoot-Gall Nematode *Anguina pacifica* (Cid Del Prado Vera and Maggenti, 1984) (Nematoda: Rhabditida: Anguinidae)¹

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The Featured Creatures collection provides in-depth profiles of insects, nematodes, arachnids and other organisms relevant to Florida. These profiles are intended for the use of interested laypersons with some knowledge of biology as well as academic audiences.

Introduction

The nematode *Anguina pacifica*, commonly known as the Pacific shoot-gall nematode (Figure 1), is a major pathogen on annual bluegrass (*Poa annua*) in the Pacific region of the United States (McClure et al., 2008; Westerdahl et al., 2004). The family Anguinidae is made up of both fungal feeding nematodes and plant parasitic nematodes. Plant-parasitic genera in the Anguinidae include certain species of *Anguina*, *Subanguina*, and *Ditylenchus*. Unlike most other plant-parasitic nematodes, many species in this family feed on, and cause malformation of, aboveground plant parts (seeds, stems, etc.). Notable turfgrass pests in this group are the root gall nematode (*Subanguina radicola*), the bentgrass nematode (*Anguina agrostis*) and the Pacific shoot-gall nematode *Anguina pacifica*. *Anguina pacifica* feeds on the stem of *Poa annua*, causing stem galls. *Anguina pacifica* is primarily an issue on golf courses where *Poa* is used as a turfgrass for putting greens, primarily in northern coastal California and Ireland. They cause chlorotic and

necrotic spots that coalesce and enlarge over time, creating an inconsistent and unsightly putting surface (Figures 5 and 6).



Figure 1. A second-stage juvenile Pacific Shoot-gall nematode *Anguina pacifica*.

Credits: C. L. Kammerer, University of Florida

1. This document is EENY-785, one of a series of the Entomology and Nematology Department, UF/IFAS Extension. Original publication date April 2022. Visit the EDIS website at <https://edis.ifas.ufl.edu> for the currently supported version of this publication. This document is also available on the Featured Creatures website at <http://entnemdept.ufl.edu/creatures/>.
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Distribution

Anguina pacifica has a limited distribution, favoring damp, cooler climates with temperatures around 12°C to 14°C (53°F to 57°F). *Anguina pacifica* was first reported in northern California in close proximity to the Pacific coast (Cid Del Prado Vera and Maggenti, 1984). Subsequent surveys have found them only in golf courses in a narrow band along California's northern Pacific coast. The first, and so far only, confirmed report of *Anguina pacifica* outside of North America is in Ireland (Fleming et al., 2015). It is believed that *Anguina pacifica* was introduced to Ireland from California on contaminated golf course equipment.

Life Cycle and Biology

The life cycle of *Anguina pacifica* was thoroughly documented by McClure et al. (2008), which is the source for most of the information below. The second-stage juvenile (J2) of *Anguina pacifica* (Figure 1) is the life stage that hatches from the egg and is the infective stage. The J2 crawl up the stem of the bluegrass plant in a film of water; this is thought to be one of the reasons this nematode is prevalent in damp regions. The J2 then enter the leaf sheath, and crawl downward within the sheath to the stem base or crown. Generally multiple nematodes enter a single crown. They enter the crown tissue and manipulate the plant cells in a way that a gall starts to form around them as they feed. Within the gall the nematodes molt into third-stage juveniles, then fourth-stage juveniles, and finally into adults. Because *Anguina pacifica* reproduces sexually by amphimixis, adults are either male or female and both sexes are required for reproduction to occur. While only one male and one female adult would be needed for reproduction, it has been noted that multiple adults of both sexes have been found in a single gall. After mating, the female *Anguina pacifica* (Figure 2) begins laying eggs, usually 1000 or more, within the gall. As the eggs hatch, the gall will contain eggs, juveniles, and adults at the same time (Figure 3). After 36 days or so post infection the females die, leaving eggs and juveniles behind. Around 80 days after infection the gall begins to rot and the J2 leave the gall to search for a new host. As the gall rots, the aboveground portion of the plant dies, causing chlorotic and later necrotic patches on the turf surface (Figure 6). When there is a lack of water, J2 are able to enter an anhydrobiotic state until sufficient moisture is present to resume nematode activity. In anhydrobiosis the nematodes can remain in a state of dormancy for up to 17 months and be readily moved on contaminated equipment.



Figure 2. An adult female *Anguina pacifica* with eggs.
Credits: A. Habtweld, University of Florida

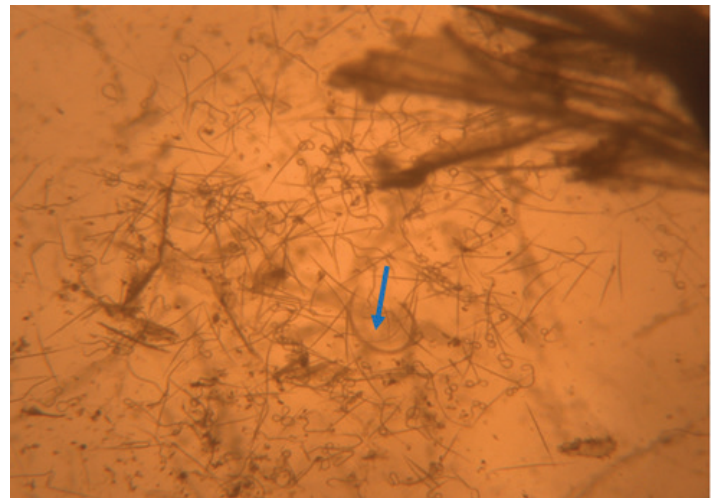


Figure 3. Contents from ruptured *Anguina pacifica* gall including juveniles and adults. The blue arrow points to an adult. All the smaller nematodes present are juveniles.

Credits: C. L. Kammerer, University of Florida

Symptoms and Diagnosis

The major indicator of *Anguina pacifica* on an individual plant is an enlarged crown or gall (Figures 4 and 5). The most characteristic turf symptom of *Anguina pacifica* are yellow patches that vary in size and shape (Figure 6). These patches will eventually become brown in color (Figure 7). Over time these patches coalesce and become larger. These larger patches can culminate in an uneven putting surface caused by a loss of turf (Fleming et al., 2015).

The easiest and most accurate way to diagnose *Anguina pacifica* is to look for stem galls on symptomatic plant tissue, and then mechanically rupture the galls and look for the nematodes within (Figures 3 and 4). For general *Anguina pacifica* assessment, pre-infective J2 can be found in soil and be detected in a typical soil nematode assay. However, for more accurate population density assessment, the [UF Nematode Assay Lab](#) recommends incubating turf plugs using a modified Baermann bowl extraction method.



Figure 4. Visible swelling in the crown of *Poa annua* indicating a gall caused by *Anguina pacificae*.

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Figure 5. Galls present on cores from *Poa annua* putting greens. Red arrow points to gall on crown.

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Figure 6. Yellow patches characteristic of *Anguina pacificae* on *Poa annua*.

Credits: M. M. Mahady, Mark M. Mahady and Associates, Inc.



Figure 7. With advanced-stage damage caused by *Anguina pacificae* patches become necrotic.

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Hosts

The primary host to *Anguina pacificae* is *Poa annua*, although it can also infect *Agrostus stolonifera* to a lesser extent (McClure et al., 2008; Fleming et al., 2015).

Importance

In coastal California and parts of Ireland, this nematode is the primary nematode concern for turfgrass managers. While *Anguina pacificae* has a very narrow host range made up almost exclusively of *Poa annua*, its effect on annual bluegrass putting greens can be devastating. Where available, nematicides used to manage *Anguina pacificae* are expensive, but revenue losses as golfers choose to play on other courses with better greens are even more costly. Severe infestation can cause golf greens to become unplayable, leading golf courses to renovate and regrass the greens, costing millions of dollars in renovation costs and revenue losses during the renovation process. While *Anguina pacificae* is not known to occur in Florida, its primary host, annual bluegrass, is commonly used as a winter overseed on golf greens in this state. If *Anguina pacificae* became established in Florida it could potentially cause damage to overseeded golf greens under certain conditions, but not likely to the severity as in locations where annual bluegrass is the primary grass year-round.

Morphology

Adult *Anguina pacificae* are roughly 1.4–2.5 mm in length for females and 1.2–1.8 mm in length for males. The body of adults (Figure 8) is much thicker than that of the slender juveniles. A small median bulb is present behind the esophageal lumen which is connected to the feeding part of this nematode, the stylet, but is often difficult to see. *Anguina pacificae* is armed with a slender stylet with knobs and weakly defined cephalic framework (Figure 9). At the rear caudal end of the female, the vulva is situated close

to the tail (Figure 10) (Cid Del Prado Vera and Maggenti, 1984). Annulations are present on the end of the tail (Fleming et al., 2015). These annulations are especially prominent on second stage juveniles. Second-stage juveniles recovered from soil samples are thin, have a small, weak stylet more typical of fungal-feeding than plant-parasitic nematodes, and poorly developed esophageal region (Figure 11).

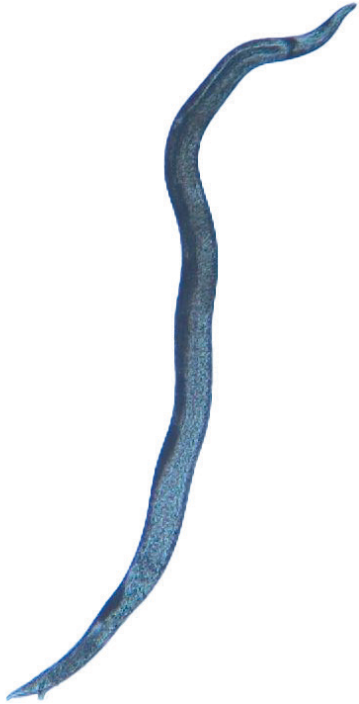


Figure 8. An adult (male) *Anguina pacifica*. The body of the adult is much thicker than that of the juvenile.
Credits: undefined

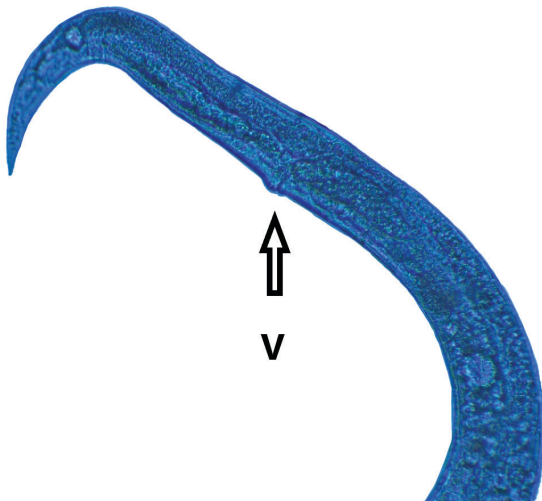


Figure 9. The vulva (V) of the female *Anguina pacifica* is located anteriorly, near the tail (T) of the nematode.
Credits: A. Habteweld, University of Florida

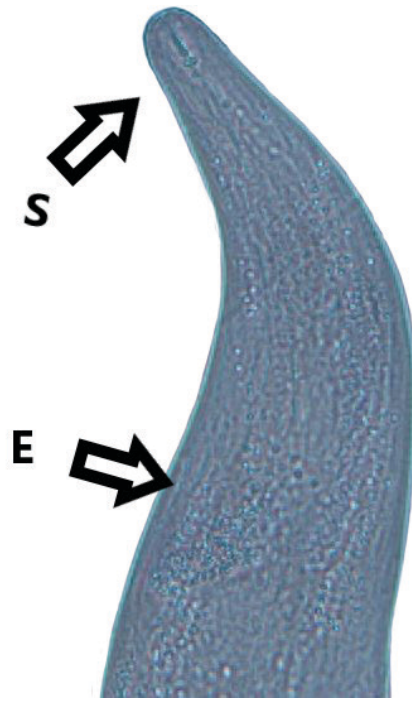


Figure 10. The stylet (S) of *Anguina pacifica* is small and has knobs at the base. Esophageal (E) features lack definition on *Anguina pacifica*.
Credits: C. L. Kammerer, University of Florida

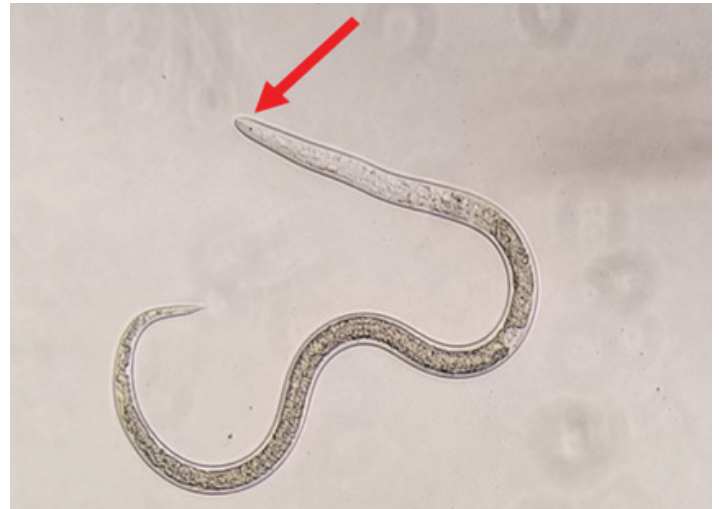


Figure 11. Red arrow pointing to anterior of *Anguina pacifica* juvenile. Note the small stylet with knobs (arrow), and poorly lack of esophageal definition. The juveniles are much slimmer than the adults.
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Management

As with many other pathogens, the management of this pest includes both cultural practices as well as chemical controls. Due to this nematode's ability to survive without moisture via anhydrobiosis, contaminated equipment poses a serious risk of spreading *Anguina pacifica*. Ensuring that all equipment is properly cleaned prior to use and after use is crucial. Chemical control is an effective method to reduce the low population density of *Anguina pacifica* and to reduce plant damage. Fluopyram (Petelewicz et al., 2020)

and abamectin (Orlinski et al., 2021) have been shown to be effective for managing *Anguina pacifica* and reducing its damage on *Poa* golf greens (Figure 12). The botanical pesticide azadirachtin has shown some activity against *Anguina pacifica* in some trials (McClure and Schmitt, 2012), but not others (Petelewicz et al., 2020). Novel methods of controlling nematodes may also be implemented in the future. White creamy bacteria inside *Anguina pacifica* galls has been inhibiting the developmental cycle of the nematode (McClure et al., 2008).



Figure 12. *Poa annua* green affected by *Anguina pacifica* with fluopyram treated plot showing visible green-up compared to control. Credits: M. M. Mahady, Mark M. Mahady and Associates, Inc.

Resources

Cid Del Prado Vera I, Maggenti AR. 1984. A new gall-forming species of *Anguina* Scopoli, 1777 (Nemata: Anguinidae) on bluegrass, *Poa annua* L., from the coast of California. *Journal of Nematology* 16(4): 386–392.

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