Management of Plant-parasitic Nematodes on Turfgrass in Northern California

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Abstract

***Anguina pacificae* (Cid del Prado Vera and Maggenti, Tylenchida, Anguinidae), was found on *Poa* (L., Cyperales, Poaceae) greens in all golf courses (12) surveyed in Monterey, San Francisco, and San Mateo counties. For two additional courses with bentgrass greens, *A. pacificae* was not found on the greens but was present in surrounding areas. The 14 courses surveyed also had abundant populations of spiral nematode (*Helicotylenchus* sp., Steiner, Tylenchida, Hoplolaimidae), 13 had ring nematode (*Criconemella* sp., Hofmänner and Manzel, Tylenchida, Criconematidae), and 9 had root-knot nematode (*Meloiodogyne* sp., Goeldi, Tylenchida, Heteroderidae). Juveniles of *A. pacificae* in water were found to be very sensitive to heat. The following temperatures ^{o}C-times were required for mortality: 43.3-15, 44.4-9, 45.6-6, 46.7-5, 47.8-4, 48.9-3, 50-2.5, 51.1-2, and 52.8-2.**

INTRODUCTION

In 1982, from San Francisco, San Mateo, and Monterey counties of California, *Anguina pacificae* was identified from *Poa annua* (L., Cyperales, Poaceae) galls located at the bases of stems. Dissected galls contained a central cavity with 2 - 8 adult nematodes (females and males) and hundreds of larval stages and eggs (Cid del Prado Vera and Maggenti, 1984). Since this finding, *A. pacificae* has been considered to be the primary nematode causing problems on coastal golf courses in Northern California.

The organophosphate nematicide Nemacur (fenamiphos) has been used in the management of *A.pacificae* and other nematodes on turfgrass in California (Winterlin et al., 1986). Recently, the nematode problem has become increasingly more noticeable both on courses that have used Nemacur and on those that have not.

To further development of environmentally sensitive programs for nematode management, a survey was conducted to determine the distribution of *A. pacificae* and other nematodes on coastal golf courses in Northern California.

Heat treatments have been used successfully to manage nematodes in a variety of situations (Qiu et al., 1993). To evaluate the potential of using heat for managing *A. pacificae*, the heat sensitivity of juveniles in water was examined at several temperatures.

MATERIALS AND METHODS

To survey for nematodes, one or more cores were taken with a cup cutter from at least one green on 14 golf courses in Monterey, San Francisco and San Mateo counties. Nematodes were extracted from soil around roots via elutriation followed by sugar centrifugation (Byrd et al., 1976) and from roots via Baermann funnel extraction (Ayoub, 1977). Galls were individually removed from the cores and dissected.

A. pacificae juveniles dissected from galls were placed in 0.25-ml water in micro-centrifuge tubes (50 nematodes / tube, 3 replicates per treatment). Tubes were capped and placed into hot water treatment baths at various temperatures. At specified intervals, tubes were removed, nematodes were rinsed into petri dishes, and survivors counted. The greatest temperature-time interval required to kill nematodes in all three replicates was used as the criterion of mortality.

RESULTS AND DISCUSSION

A. pacificae was found on *Poa* greens in all golf courses (12) surveyed in Monterey, San Francisco, and San Mateo counties (Table 1). For two additional courses with bentgrass greens (Lake Merced and Presidio), *A. pacificae* was not found on the greens but was present in surrounding areas. In addition, all courses surveyed also had abundant populations of spiral nematode (*Helicotylenchus* sp.), 13 had ring nematode (*Criconemella* sp.), and 9 had root-knot nematode (*Meloiodogyne* sp.) (Table 1). Other nematodes found occasionally and in lower populations were: needle (*Longidorus* sp., Micoletzky, Dorylaimida, Longidoridae), pin (*Paratylenchus* sp., Micoletzky, Tylenchida, Tylenchulidae), stubby root (*Trichodorus* sp., Cobb, Triplonchida, Trichodoridae), sheath (*Hemicycliophora* sp., de Man, Tylenchida, Criconematidae), lesion (*Pratylenchus* sp., Filipjev, Tylenchida, Pratylenchidae), and cyst (*Heterodera* sp., Schmidt, Tylenchida, Heteroderidae). These findings indicate that although *A. pacificae* is widespread in coastal Northern California golf courses, there is potential for other nematodes to be causing problems as well.

When sampled at 50-mm increments to 150-mm, nematodes were abundant at all depths (data not shown). This indicated that although the galls of *A. pacificae* were located close to the surface, methods to kill populations of other nematodes will need to be effective to greater depths. Although they were not alive, *Anguina*, spiral and ring nematodes were recovered from a water sample taken from a pipe draining a green, indicating the ability of nematodes to move in drainage systems.

The following temperatures C-times were required for mortality: 43.3-15, 44.4-9, 45.6-6, 46.7-5, 47.8-4, 48.9-3, 50-2.5, 51.1-2, and 52.8-2. This relationship can be described by the curve: $y = 8E+30x-14.62^{-14.62}$, $R^2 = 0.9617$ where y = min of exposure and x = temperature. Further work will be required to determine if a temperature-time combination could be found that will be lethal to nematodes but not to *P. annua*.

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Tables

Table 1. Populations of various nematodes found on golf courses in Northern California.

Golf Course	Nematodes per liter of soil		
	Spiral	Ring	Root-knot
Bayonet	6,200	50	150
Cypress Point	22,500	4.200	300
Del Monte	9,600	38,400	650
Lake Merced	13,260	10	0
Monterey Peninsula	90,240	12,000	0
Northwood	5,760	9,120	1,450
Olympic Club	6,857	1,600	29,400
Pacific Grove	3,600	1,800	0
Pebble Beach	4,200	33,000	50
Poppy Hills	12,900	1,800	1,200
Presidio	9,200	0	0
Quail Lodge	9,600	27,900	0
San Francisco	4,114	2,229	350
Spyglass	600	1,350	50