Distribution of Plant-Parasitic Nematodes in Putting Green Turfgrass in Washington

G. A. CHASTAGNER, Western Washington Research and Extension Center, Washington State University, Puyallup, WA 98371, and F. D. McELROY, Peninsu-LAB, 23976 N.E. Newellhurst Court, Kingston, WA 98346

ABSTRACT

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Seventy-two soil samples were collected during 1979 and 1980 in a survey of 30 putting greens located west and six located east of the Cascade Mountains. Species in 10 genera of plant-parasitic nematodes were found in the samples collected west of the Cascades and five genera were found in samples collected east of the Cascades. *Helicotylenchus pseudorobustus, Criconemella ornata, C. vandensis, C. rusium*, and *Paratylenchus nanus* were detected most frequently in samples from west of the Cascades. *C. ornata* and *Tylenchorhynchus maximus* were detected most frequently in samples from east of the Cascade Mountains. Higher populations of many species were associated with areas of poor-quality turf.

Loss of turf, particularly *Poa annua* L., frequently occurs during periods of elevated ambient temperatures in Washington. Many factors contribute to the development of stress and resulting loss of turf that occurs under such conditions. One such factor is root damage caused by plant-parasitic nematodes (10). Apt and Goss (1) found high populations in three genera of plant-parasitic nematodes in putting green turf near Seattle, WA, that showed a severe loss of vigor during the summer of 1958. High populations of *Helicotylenchus* spp. were associated with the loss of 75% of the turf on one green. More recently, high populations of plant-parasitic nematodes were associated with poor-quality turf in southern British Columbia (6).

Limited work has been done to determine the relative importance of nematodes on the maintenance of quality turf in Washington. During 1979 and 1980, we surveyed putting greens to determine the distribution and prevalence of plant-parasitic nematodes throughout Washington.

MATERIALS AND METHODS

Root and soil samples were obtained from six putting greens at four golf courses east of the Cascade Mountains and 29 putting greens at 11 golf courses west of the Cascade Mountains in Washington during July through September in 1979 and 1980. Samples were also collected from one green at a golf course in Portland, OR. Two samples were taken from each green, one from areas that showed good growth and one from areas where the turf showed poor growth or had a history of poor growth. Each sample consisted of 15 cores 1 cm in diameter by 8 cm long.

Samples were taken with a special probe (Fig. 1). The probe was constructed by welding a hollow-core aerating tine (1 × 10 cm) to a piece (4 × 7.5 cm) of 0.6-cm-thick steel that had a hole drilled through it to accommodate the tine. The tine extended 8 cm from the bottom of the piece of steel. One end of a metal rod (1.2 × 90 cm) was welded onto the other end of the flat stock. A rod (1.2 × 30 cm) was welded in "T" fashion to the other end of this rod to serve as a handle. A 0.5-kg coffee can into which a hole had been cut to accommodate the tine extending above the flat piece of steel was strapped to the metal rod (1.2 × 90 cm).

The sample probe works on the same principle as a turf Aerifier. As the tine is repeatedly pushed into the turf at different locations, the plugs are pushed into and retained in the can. When the required number of cores has been taken, the can is inverted over a polyethylene bag to collect the composite sample.

The origin of the design of this sampler is unknown. It was first introduced to the second author by Bob Wick, then Superintendent of the Capilano Golf and Country Club, Vancouver, BC, Canada. This sampler is especially useful in sampling golf greens for nematodes because numerous subsamples can be taken rapidly without destroying the playing surface or having to replace any plugs. The sample depth is adequate because previous studies have shown that the highest populations of nematodes on golf greens in the Pacific Northwest occur at 0–8 cm (F. D. McElroy, *unpublished*).

Samples were processed using the Jenkins centrifugal flotation method (7). Because of the high amount of organic matter, a 100-cm^2 subsample was the most efficient size in terms of processing time and sample readability. The nematodes from each sample were killed and fixed in hot 2% formaldehyde, then processed to glycerine by the Seinhorst rapid method (11).

RESULTS

Twelve species of plant-parasitic nematodes were found in the 30 greens sampled west of the Cascade Mountains (Table 1). *Helicotylenchus pseudorobustus* (Steiner) Golden, *Criconemella* spp., and *Paratylenchus nanus* Cobb were the most prevalent, occurring in 80, 67, and 60% of the samples, respectively. *C. ornata* Raski accounted for 60% of the three *Criconemella* spp. found and only one species occurred at any one course. *Pratylenchus crenatus* Loof., *Tylenchorhynchus dubius* Allen, and

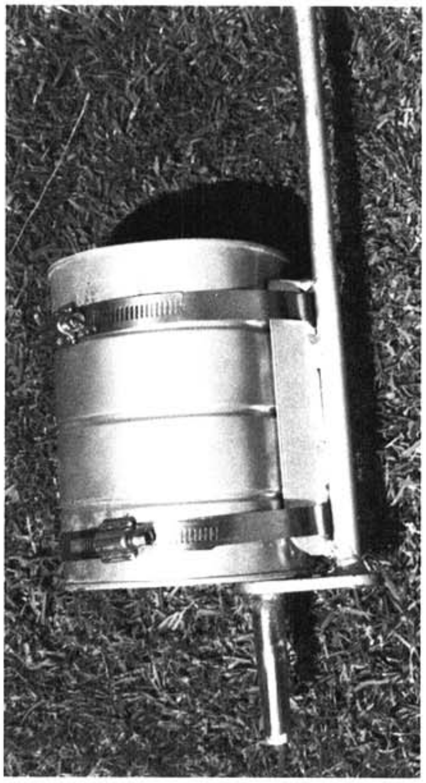

Fig. 1. Probe used for collecting 1-cm-diameter by 8-cm-long cores of turf and soil during nematode sampling.

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Longidorus elongatus (de Man) Thorne & Swanger were found in 43, 37, and 30% of the samples, respectively.

Four, nine, six, and two of the greens contained combinations of two, three, four, and five species, respectively, where populations were higher in the poor area compared with the good area. In five greens, only a single species had a higher population in the poor area, and in four of the greens, nematode populations were not higher in the poor areas.

Five species of plant-parasitic nematodes were found in the six sampled greens east of the Cascade Mountains (Table 2). *C. ornata* and *T. maximus* Allen occurred most frequently and were found in 83 and 50% of the samples,

Table 1. Populations of nematodes recovered from putting green turf located west of Cascade Mountains[a]

Site and sample	Condition[c]	Number of nematodes[b]/473 cm³ (pint) of soil									
		P.c.	C.[d]	T.d.	P.n.	T.	L.e.	H.p.	Ho.	He.	M.n.[e]
1-1	G	0	4,100 C.o.	0	0	70	0	38,900	0	0	0
	P	0	12,055 C.o.	0	0	1,100	70	23,300	0	370	0
2-1	G	400	0	0	0	0	0	35,000	0	0	600*
	P	900	400 C.o.	0	0	0	0	74,000	0	0	2,065*
2-2	G	30	0	0	0	0	0	25,500	0	0	0
	P	0	0	0	0	0	0	1,400	0	0	1,230*
3-1	G	70	270 C.o.	0	0	0	0	35	0	0	0
	P	30	540 C.o.	0	0	0	0	0	0	0	0
4-1	G	0	70 C.v.	0	2,000	0	0	22,000	170	0	0
	P	0	1,400 C.v.	0	2,760	0	70	159,300	200	0	0
4-2	G	0	2,430 C.v.	0	730	0	0	55,700	0	0	0
	P	0	10,920 C.v.	0	1,100	0	0	70,700	0	0	0
4-3	G	0	1,470 C.v.	400	0	0	0	1,400	0	0	0
	P	0	1,700 C.v.	2,470	0	0	130	179,300	0	0	0
5-1	G	135	0	0	90	0	0	0	0	0	*
	P	0	0	0	90	0	0	0	0	0	*
5-2	G	315	0	45	180	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0
5-3	G	225	0	0	950	0	0	0	0	0	*
	P	90	810 C.r.	0	2,390	0	0	0	0	0	*
6-1	G	0	0	0	90	0	0	855	0	0	0
	P	0	0	0	0	0	0	90	0	0	0
6-2	G	0	0	0	0	0	0	135	0	0	0
	P	0	0	0	0	0	0	0	0	0	0
6-3	G	0	0	0	0	0	0	0	0	0	0
	P	0	0	0	45	0	0	0	0	0	360L
6-4	G	0	0	0	0	0	0	810	0	0	0
	P	45	630 C.r.	0	45	0	90	180	0	0	0
6-5	G	0	2,520 C.r.	135	90	0	135	900	0	0	0
	P	0	3,600 C.r.	1,800	0	0	90	4,950	0	0	0
7-1	G	0	990 C.o.	0	0	0	0	360	0	0	0
	P	45	900 C.o.	45	0	0	135	540	0	0	0
7-2	G	0	855 C.o.	0	0	0	0	45	0	0	0
	P	0	855 C.o.	0	45	0	45	1,170	0	0	0
8-1	G	0	315 C.o.	360	270	0	0	225	0	0	0
	P	450	5,850 C.o.	0	450	0	0	3,600	0	0	0
9-1	G	0	450 C.o.	0	2,700	0	0	450	0	0	450L
	P	0	4,050 C.o.	5,850	1,800	0	0	3,150	0	0	450L
10-1	G	0	450 C.o.	0	0	0	0	2,700	0	0	0
	P	0	5,850 C.o.	0	0	0	45	4,050	0	0	0
10-2	G	0	135 C.o.	0	0	0	45	450	0	0	0
	P	0	1,350 C.o.	450	0	0	225	4,050	0	0	0
10-3	G	0	900 C.o.	0	0	0	0	3,600	0	0	0
	P	450	5,400 C.o.	0	0	0	0	8,100	0	0	0
10-4	G	0	900 C.o.	0	0	0	0	1,800	0	0	0
	P	0	6,750 C.o.	0	0	0	540	27,000	0	0	0
10-5	G	0	4,050 C.o.	0	0	0	0	5,400	0	0	0
	P	0	8,100 C.o.	0	0	0	0	4,050	0	0	0
11-1	G	450	0	0	3,150	0	0	0	0	0	0
	P	900	0	0	2,250	0	0	450	0	0	0
11-2	G	0	0	0	900	0	0	0	0	0	0
	P	0	0	0	450	0	0	16,650	0	0	0
11-3	G	900	0	225	450	0	0	0	0	0	0
	P	1,800	450 C.v.	0	1,800	0	0	0	0	0	0
11-4	G	0	0	0	450	0	0	0	0	0	0
	P	450	0	450	2,250	0	0	0	0	0	0
11-5	G	0	0	225	900	0	0	0	0	0	0
	P	0	0	2,250	450	0	0	15,300	0	0	0
12-1	G	0	2,250 C.r.	1,000	1,000	0	0	0	0	0	0
	P	0	1,250 C.r.	1,500	250	0	0	740	0	0	0

[a] Samples were collected from sites 1–4 and 5–12 during September 1979 and 29 July through 20 September 1980, respectively.
[b] P.c. = *Pratylenchus crenatus*, C. = *Criconemella* spp., T.d. = *Tylenchorhynchus ducuis*, P.n. = *Paratylenchus nanus*, T. = *Trichodorus* spp., L. e. = *Longidorus pseudorubustus*, Ho. = *Hoplolaimus* spp., He. = *Heterodera* spp., and M.n. = *Meloidogyne naasi*.
[c] Condition of turf samples: G = good, P = poor or had a history of being poor.
[d] *Criconemella* spp.: C.o. = *C. ornata*, C.v. = *C. vandensis*, C.r. = *C. rusium*.
[e] Specific identification was only made for samples with females: * = females present, L = larvae present.

respectively. Three greens contained a single parasitic species with a higher population in the poor area and one green contained two species with higher populations in the poor areas.

The predominant turfgrass present on all but one of the sampled greens was *P. annua*, and all of the greens, whether originally established on native soils or sand, were routinely being topdressed with sand.

DISCUSSION

The genera of plant-parasitic nematodes found in putting turf during this survey have been reported from turf previously (4,10). *H. pseudorobustus* was the most prevalent species found in the samples from west of the Cascades. Compared with samples collected west of the Cascades, fewer species of nematodes occurred in putting turf east of the Cascades. Of the 12 species found, only three were common to both east and west and only two were unique to the east. Populations of the nematodes found, except *C. ornata*, were also somewhat lower in turf east of the Cascades.

Although the number of sample sites east of the Cascades was relatively small compared with the number from the west, some reasons for species and population disparity can be suggested. Golf greens are intensively and rather uniformly managed, regardless of location. There appears to be no obvious correlation between species and population numbers and variety of turfgrass, soil type, or soil moisture because management practices tend to standardize these factors within certain limits.

The most unique variable over which golf course managers have little control is temperature. The climate west of the Cascades is moderated by the marine influences of the Pacific Ocean. East of the Cascades, this influence is blocked by the mountains, resulting in greater temperature extremes during both the winter and summer (5,9).

Temperature is a major environmental factor influencing the behavior of plant-parasitic nematodes (8). Each species has an optimal temperature at which it functions best, and at temperature extremes, activities such as movement, feeding, and reproduction are curtailed (12). Temperatures most favorable to high populations of nematodes feeding on grasses are dependent on seasonal preference of the particular nematode species (2). Temperature also determines distribution within the soil profile (3).

The greater extremes in temperature east of the Cascades may limit the diversity of species as well as be a determining factor in seasonal activity. Because nematode samples were collected at only one time during the year in eastern Washington, the full potential of the populations may not have been evaluated. Seasonal samplings from turfgrass in western Washington indicate there is seasonal variation in nematode populations, but even at the lowest point, populations were higher and diversity greater than those of eastern Washington.

High populations and the presence of several species of plant-parasitic nematodes associated with poor areas in putting turf, particularly west of the Cascades, indicates that nematodes may play a role in the ability of turf to withstand periods of temperature and moisture stress in Washington. However, data relating nematode population levels to damage needs to be developed before recommendations can be made regarding the benefits of controlling these pathogens on the overall maintenance of quality turf.

Table 2. Populations of nematodes recovered from putting green turf located east of Cascade Mountains[a]

Site and sample	Condition[c]	Numbers of nematodes[b]/473 cm³ (pint) of soil				
		P.c.	C.o.	T.m.	P.n.	H.p.
13-1	G	0	0	0	0	0
	P	0	0	0	0	0
14-1	G	0	100	0	0	0
	P	0	17,250	0	0	0
14-2	G	130	3,030	70	130	0
	P	0	7,725	0	0	0
15-1	G	0	1,170	0	0	830
	P	0	1,730	530	0	530
15-2	G	0	2,230	330	0	1,000
	P	200	500	0	0	800
16-1	G	0	0	0	1,600	0
	P	0	0	0	0	0

[a] Samples collected during July 1979.
[b] P.c. = *Pratylenchus crenatus*, C.o. = *Criconemella ornata*, T.m. = *Tylenchorhynchus maximus*, P.n. = *Paratylenchus nanus*, and H.p. = *Helicotylenchus pseudorubustus*.
[c] Condition of turf samples: G = good; P = poor or had a history of being poor.

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