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# Survey of Entomopathogenic Nematodes on Golf Courses in Ontario and Québec, Canada

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## Introduction

In Canada, new legislation on pesticide use forces the implementation of integrated pest management (IPM) and development of new alternative methods to control turfgrass pests. In Québec, all golf courses must submit a pesticide reduction plan to the Québec Ministry of Environment in 2006 (1). Currently, the golf course industry in Ontario is launching a new IPM Accreditation Program (2).

With this new reality for turfgrass managers, biological control agents such as entomopathogenic nematodes provide a potential alternative for reducing some well-targeted insect pests. In Canada, only few indigenous entomopathogenic nematode species were isolated: Bélair *et al.* (1984) (3) found *Steinernema carpocapsae* in Québec; Mracek and Webster (1993) (4) isolated *Steinernema feltiae* in British Columbia, Alberta and Yukon; Stock *et al.* (2000) (5) found *Steinernema kraussei* in British Columbia and Alberta.

## Objective

Survey for indigenous entomopathogenic nematodes on golf courses in Ontario and Québec.

## Material and Methods

A survey of 38 golf courses (19 in Ontario; 19 in Québec) located in different agroclimatic areas was carried out during Fall 2002 and 2003 in Québec and Ontario, respectively (Figure 3). Three holes (greens, fairways and roughs) were selected based on their historic insect damage on each golf course. Soil samples were collected using a soil probe to a depth of 0-15 cm on greens, fairways and roughs (Figure 1).

Entomopathogenic nematodes were isolated from soil (greens, fairways and roughs in Québec; roughs in Ontario) by using greater wax moth, *Galleria mellonella* L. (Lepidoptera: Pyralidae) larvae as bait according to the method of Bélair *et al.* (2001) (6) (Figure 2). In addition, soil samples from greens and fairways in Québec were screened with late instar of carrot weevil *Listronotus oregonensis* LeConte (Coleoptera: Curculionidae). For this screening, five plastic Solo Cup containers (30 cm<sup>3</sup>) were prepared by adding one carrot weevil larva and 15 cm<sup>3</sup> of soil. Containers were then closed and placed in the dark at 24°C during 10 days. Emerging nematodes were identified with both morphological and molecular criteria.

### On golf course



Figure 1. Soil sampling

### In laboratory



Figure 2. 'Galleria trap' bioassay

## Results and Discussion

ONTARIO		
Golf course	Location	Coordinates
1	Maple Leaf Golf & CC	45°21'N, 77°24'W
2	Gold CC	43°23'N, 80°25'W
3	Pelee Island Golf & CC	43°23'N, 80°25'W
4	Renfrew Golf Club	43°58'N, 80°26'W
5	Weston Golf & CC	43°57'N, 80°26'W
6	St. Thomas Golf & CC	42°46'N, 81°27'W
7	Donatville Golf Club	42°52'N, 80°28'W
8	The Brian Golf Club	44°18'N, 79°28'W
9	Big Red Point Golf & CC	44°17'N, 79°28'W
10	Jewel of the North Golf Resort	44°23'N, 81°16'W
11	Homes Point Golf Club	42°52'N, 81°16'W
12	Eric Simard Golf & CC	42°52'N, 81°20'W
QUÉBEC		
Golf course	Location	Coordinates
13	Maple Leaf Golf Club	45°21'N, 77°24'W
14	Maple Leaf Golf Club	45°21'N, 77°24'W
15	St-James Golf Club	46°17'N, 76°19'W
16	St-James Golf Club	46°17'N, 76°19'W
17	St-James Golf Club	46°17'N, 76°19'W
18	LaSalle Golf Club	43°54'N, 79°26'W
19	St-James Golf Club	46°17'N, 76°19'W
20	St-James Golf Club	46°17'N, 76°19'W
21	Bic Golf Club	46°22'N, 77°00'W
22	Chocoma Golf Club	46°23'N, 77°00'W
23	Hydrax Golf & CC	46°23'N, 77°00'W
24	St-James Golf Club	46°23'N, 77°00'W
25	Leval Golf Club	45°42'N, 77°15'W
26	Leval Golf Club	45°42'N, 77°15'W
27	Montréal CC	45°51'N, 72°57'W
28	Farnham Montebello Golf Club	45°59'N, 74°05'W
29	St-James Golf Club	46°17'N, 76°19'W
30	La Providence Golf Club	45°37'N, 72°57'W
31	Royal D'Ardenay Golf Club	45°37'N, 72°57'W
32	St-James Golf Club	46°17'N, 76°19'W
33	St-James Golf Club	46°17'N, 76°19'W
34	St-James Golf Club	46°17'N, 76°19'W
35	St-James Golf Club	46°17'N, 76°19'W
36	St-James Golf Club	46°17'N, 76°19'W
37	St-James Golf Club	46°17'N, 76°19'W
38	Wellesley Golf & CC	45°27'N, 74°05'W

**Steinernema carpocapsae**  
**Steinernema feltiae**  
**Steinernema kraussei**



Figure 3. Distribution of the 38 golf courses

- ★ *S. kraussei* was isolated for the first time in eastern Canada (Ile Bizard, Québec).
- ★ *S. feltiae* (4 isolates) was isolated for the first time in Québec (Bic and St-Liguori) and Ontario (Toronto and Renfrew).
- ★ *S. carpocapsae* (6 isolates) was isolated in Québec (St-Hyacinthe) and for the first time in Ontario (Toronto, Picton, Weston and Collingwood).
- ★ All indigenous nematodes were found on roughs of golf courses in Québec and Ontario.

No nematodes were isolated from greens and fairways in Québec when using a lepidoptera (*G. mellonella*) and a coleoptera (*L. oregonensis*) as bait. However, 4 and 6 indigenous nematodes were found on roughs of golf courses in Québec and Ontario, respectively. Our results suggest that habitats with a low pesticide input, as implemented in the rough areas, could harbor a greater biodiversity. A survey of other soil microorganisms such as fungi, bacteria, free-living and phytoparasitic nematodes on roughs, fairways and greens would be needed to support this hypothesis.

These indigenous isolates could be more adapted to climatic conditions prevailing on golf courses in eastern Canada. Ecological studies have demonstrated the importance of speciation and coevolution of organisms in relation to the potential of host infection. We are currently performing bioassays on different turfgrass insect pests.

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