# Nematodes in Strawberries on Prince Edward Island, Canada

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**ABSTRACT**

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The nematode fauna of strawberries was investigated on Prince Edward Island, Canada. Twenty-four genera and eight species of nematodes were identified. *Pratylenchus* spp. were the most numerous although the populations were much smaller than recorded from previous nematode surveys in other crops. *Meloidogyne* spp. and *Aphelenchoides* spp. were recovered infrequently from root and foliage samples, respectively. The cultivar Micmac did not respond to aldicarb treatments, and the cultivar Redcoat showed a yield increase only in the first year. The overall lack of yield response to aldicarb was presumed to be due to the absence of large populations of *P. penetrans*. Frequent cultivation and ample weed control the year before planting were considered the main reasons for the small nematode populations.

Previous investigations in eastern Canada showed that root-lesion nematodes (*Pratylenchus* spp.) are prevalent in strawberries (10,14) and their control with nematicides resulted in significant yield increases (5,13). Root-lesion nematodes occur in large numbers on Prince Edward Island (1,3) and are responsible for reduced yields in forage legumes and potatoes (2,9).

The objectives of this study were to record the nematodes present in strawberry plantings on Prince Edward Island, to determine the population levels of the common nematode genera, and to investigate the influence of *P. penetrans* (Cobb) on yield of strawberries.

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## MATERIALS AND METHODS

Ninety-nine soil and root samples were taken from 33 strawberry fields during harvest of the first fruiting year in July 1976. The soil type in all fields was a fine sandy loam (70% sand, 20% silt, and 10% clay, pH 5.5–6.0). Twenty soil cores (each 20 cm deep) taken at random from the vicinity of roots with a 25-mm-diameter soil probe from an area of 0.01 ha were combined to make one sample. Each sample was mixed thoroughly and screened through a sieve with 2-mm openings. Nematodes were extracted from each sample by placing 50 g of soil in a modified Baermann pan (11) and up to 10 g of fresh washed roots in a mist chamber (8). After 7 days at 20–25 C, nematodes that had emerged from soil and roots were counted with a stereo microscope and then preserved in 5% formalin. Fifty nematodes randomly selected from each sample were examined with a compound microscope for identification of genera and species. Numerical data were transformed to logarithms (7) for statistical analysis.

Strawberry cultivars were not identified in most of the fields sampled in 1976. Therefore, in 1977, population levels of *Pratylenchus* spp. in roots and soil were recorded for three cultivars (Redcoat, Veestar, and Vibrant) recommended for conditions on Prince Edward Island. Cavalier, an early-maturing cultivar, also was included. The numbers of foliar nematodes in foliage and soil (*Aphelenchoides* spp.) were noted. Five field sites were sampled for each cultivar. Soil type, dates, and sampling and extracting procedures were similar to those in the previous year. Three foliar samples, each consisting of foliage and a few berries collected from 20 random locations, were collected from each site. Foliar nematodes were extracted by placing 10 g of chopped tissue from each sample in a mist chamber for 7 days.

The effect of aldicarb on strawberry yields was investigated at Winsloe, Prince Edward Island. Preliminary examinations indicated that *P. penetrans* was the dominant plant-parasitic nematode. Certified plants of two cultivars, Micmac and Redcoat, were set out in adjacent 0.3-ha fields on 11 June 1978, spaced at 0.6 m in rows 1.4 m apart. Aldicarb 15G at 3.36 kg a.i./ha was incorporated along the row during planting at eight locations in each field. Each location, or plot, consisted of three contiguous rows of five plants each. An area of the same dimensions immediately adjacent to a treated plot served as a check plot. Mature fruit was harvested from the center row of each plot in 1979, 1980, and 1981. Soil samples for nematode analysis

were collected immediately before planting, and soil and root samples also were collected during July of 1978, 1979, 1980, and 1981. Foliage samples collected during July 1981 were examined for *Aphelenchoides* spp. Nematode sampling and extraction procedures were described before. Endosulfan and captan were applied for control of strawberry weevil and fruit rot, respectively, at rates outlined in the *Atlantic Provinces Strawberry Protection Guide*. Recommended cultural practices were followed. No irrigation was used, and in late fall, all plots were covered with straw mulch for winter protection.

## RESULTS

On the basis of 99 samples collected from 33 fields in July 1976, 24 genera and eight species of nematodes were identified from strawberry root and soil samples on Prince Edward Island: *Tylenchus* Bastian, *Tylenchorhynchus* Cobb, *T. dubius* (Bütschli) Filipjev, *Merlinius* Siddiqi, *Ditylenchus* Filipjev, *D. dipsaci* (Kühn) Filipjev, *Heterodera* A. Schmidt, *H. trifolii* Goffart, *Meloidogyne* Goeldi, *M. hapla* Chitwood, *Helicotylenchus* Steiner *Pratylenchus* Filipjev, *P. crenatus* Loof, *P. penetrans* (Cobb) Filipjev & Sch. Stek., *Paratylenchus* Micoletzky, *Aphelenchus* Bastian, *A. avenae* Bastian, *Aphelenchoides* Fischer, *Rhabditis* Dujardin, *Acrobeles* von Linstow, *Cephalobus* Bastian, *Eucephalobus* Steiner, *Cervidellus* Thorne, *Chiloplacus* Thorne, *Prismatolaimus* de Man, *Mononchus* Bastian, *Dorylaimus* Dujardin, *Mesodorylaimus* Andrassy, *Eudorylaimus* Andrassy, *Alaimus* de Man, *Xiphinema* Cobb, and *X. americanum* Cobb. The generic listings indicate that specific identifications were not attempted for all specimens.

*Pratylenchus* spp. was the dominant plant-parasitic genus and was found in 96 of 99 soil samples (Table 1). On the basis of the morphology of 500 randomly selected adult *Pratylenchus* spp., 255 (51%) were female *P. penetrans*, 82 (16%) were male *P. penetrans*, and 163 (33%) were female *P. crenatus*.

The numbers of *Pratylenchus* spp. were higher in roots of Cavalier and Veestar than in roots of Redcoat and Vibrant (Table 2). There were no differences among cultivars in population levels of *Aphelenchoides* spp. in soil, and nematode numbers were very low in foliage.

Aldicarb increased the marketable yield of Redcoat only in 1979, the first harvest year. This coincided with significant reductions in numbers of *P. penetrans* in aldicarb-treated roots in 1978 and 1979 (Table 3). Aldicarb did not significantly affect nematode populations or fruit yields in Redcoat during 1980 and 1981, and total yields over 3 yr were virtually the same for treated and untreated plots. Aldicarb did not influence yields or numbers of nematodes in Micmac. Analysis of variance on data combined from 1978–1981 indicated that soil and root samples from Redcoat harbored more *P. penetrans* than equivalent samples from Micmac (Table 3). Numbers of *Aphelenchoides* spp. were very low in soil samples from both cultivars and generally were not recovered from foliar samples.

**Table 1.** Predominant nematode genera recovered from strawberry roots and soil on Prince Edward Island, Canada

| Nematode genus | Number of samples with genus | Occurrence[a] (%) | Geometric mean[b] |
|---|---|---|---|
| Soil samples | | | |
| *Pratylenchus* spp. | 96 | 97 | 650 (800) |
| *Helicotylenchus* spp. | 33 | 33 | 9 (650) |
| *Paratylenchus* spp. | 32 | 32 | 8 (530) |
| *Tylenchorhynchus* spp. | 30 | 30 | 5 (210) |
| Root samples | | | |
| *Pratylenchus* spp. | 96 | 97 | 240 (280) |

[a] Based on 99 samples collected from 33 fields during July 1976.
[b] Population density of nematode genus per kilogram of dried soil or per gram of dried root, based on 99 samples and on number of samples with genus (in parentheses).

**Table 2.** Numbers of *Pratylenchus* spp. and *Aphelenchoides* spp. recovered from soil, roots, and foliage of four strawberry cultivars on Prince Edward Island, Canada

| | Number of *Pratylenchus* spp. | | Number of *Aphelenchoides* spp. | |
|---|---|---|---|---|
| Cultivar | Per kilogram of dry soil | Per gram of dry root | Per kilogram of dry soil | Per 10 g of fresh foliage |
| Cavalier | 1,360 a[y] | 850 a | ...[z] | ... |
| Redcoat | 620 ab | 150 b | 160 | 7 |
| Veestar | 470 ab | 900 a | 220 | 11 |
| Vibrant | 250 b | 320 b | 140 | 7 |

[y] Geometric means (based on 15 samples collected from five fields during July 1977) followed by different letters in a column are significantly different according to Duncan's multiple range test ($P = 0.05$); letters are omitted when no significant differences exist.
[z] Data not available.

**Table 3.** Effects of aldicarb[x] on marketable fruit yields and on numbers of *Pratylenchus penetrans* in roots and soil of Redcoat and Micmac strawberry cultivars

| | Redcoat | | Micmac | |
|---|---|---|---|---|
| Year[y] | Untreated | Treated | Untreated | Treated |
| | Marketable fruit yields (t/ha) | | | |
| 1979 | 10.9 a[z] | 13.9 b | 18.4 | 18.7 |
| 1980 | 24.2 | 23.7 | 36.9 | 35.1 |
| 1981 | 18.0 | 16.1 | 20.1 | 22.9 |
| | Number of nematodes per gram of dry root | | | |
| 1978 | 1,530 a | 220 b | 140 | 80 |
| 1979 | 490 a | 40 b | 100 | 70 |
| 1980 | 380 | 220 | 180 | 120 |
| 1981 | 1,060 | 830 | 30 | 30 |
| | Number of nematodes per gram of dry soil | | | |
| 1978 | 330 | 230 | 140 | 130 |
| 1979 | 660 | 630 | 380 | 220 |
| 1980 | 990 | 950 | 370 | 240 |
| 1981 | 3,120 | 1,320 | 770 | 540 |

[x] Aldicarb (15% granular at 3.36 kg a.i./ha) was incorporated along the row during planting in June 1978.
[y] Fruit yields are cumulative totals from plots harvested twice a week during late July to early August in each year; root and soil samples were collected during July in each year.
[z] Geometric means followed by different letters in a row for each cultivar are significantly different ($P = 0.05$) according to the $t$ test applied to paired values ($n = 8$); letters are omitted when no significant differences exist.

## DISCUSSION

The plant-parasitic nematode genera and species identified in the survey were recorded previously on Prince Edward Island (3,15). *Pratylenchus* spp., the dominant plant parasite, is usually considered an important pest in strawberries (4). However, the reduction in numbers of *P. penetrans* with aldicarb in the experimental plots only increased yields significantly in Redcoat in 1979. There was no effect on yield in 1980 and 1981, when aldicarb had deteriorated.

Furthermore, aldicarb did not influence yields of Micmac.

The overall lack of yield response in the aldicarb plots probably was due in part to the modest size of the root-lesion nematode population. The population density in experimental plots just before treatment in 1979 was only about 800 *P. penetrans* per kilogram of soil. This number is much lower than is usually found on Prince Edward Island (1,3) and may not have been large enough to affect yields. For example, Townshend (10) obtained reductions in foliage growth when at least 13,000 *P. penetrans* were added around strawberry roots in 1-L pots of soil.

The small size of nematode populations in experimental plots and commercial plantings in the survey was attributed ostensibly to recommended cultural practices in Atlantic Canada. Weeds, grasses, and legumes are often excellent hosts for root-lesion nematodes (12). Herbicide applications and proper cultivation before planting eliminate these hosts and substantially reduce the size of nematode populations (6). However, a nematicide treatment, preferably fumigation in the fall before planting (5), may be beneficial if nematode populations are large.

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