

Distribution of Plant-Parasitic Nematodes in Quebec Apple Orchards

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ABSTRACT

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In a survey of apple orchards in southeastern Quebec in 1978, 351 soil samples were collected from 71 orchards in nine counties. Species in eight genera of plant-parasitic nematodes were found. Species of *Pratylenchus*, *Paratylenchus*, and *Xiphinema* were detected most frequently. *Pratylenchus penetrans* or *Pratylenchus crenatus* were found in all 71 orchards, at densities greater than 33/100 cm³ of soil in 58% of infested samples. *Xiphinema americanum* was found in 88% of the orchards.

Quebec is a major apple-growing province of Canada, producing about 110,000 metric tons annually on 8,000 ha. Most orchards are 20- to 30-yr-old trees on standard rootstocks such as *Malus robusta* 5 or seedlings (12). High density plantings on size-controlling rootstocks are gradually replacing the old orchards.

Apple trees with union necrosis and decline have been found in Quebec (13,14). A virus closely related to tobacco ringspot virus was isolated from affected trees, and *Xiphinema americanum*, a vector of this virus, was always present in the rhizosphere of those trees. Because of the potential for damage to new orchards by *Pratylenchus penetrans* (9) or by *X. americanum*, this survey was undertaken to determine their distribution and density in apple orchards of southern Quebec.

MATERIALS AND METHODS

During June and July 1978, 351 soil samples were taken from 71 apple orchards in nine counties (Fig. 1). The number of orchards sampled in each county was proportionate to the total orchards in the county.

Five 1-L samples of soil and roots were taken in each orchard, halfway between the trunk and the drip line of trees to a depth of 20 cm. The samples were kept at 10–20 C and processed within 7 days. For each soil sample, a 100 cm³ subsample was extracted for 7 days in a Baermann pan, 20 cm wide, and densities of plant parasitic nematodes were determined from the entire content of the pan. The nematodes from each sample were then killed in hot water and fixed in 2% formaldehyde. Specific identifications from glycerine or lactophenol mounts

were made by R. V. Anderson and B. A. Ebsary, Biosystematics Research Institute, Ottawa.

RESULTS

Species in eight genera of plant-parasitic nematodes were associated with apple tree rhizosphere in the soil samples (Table 1). Species of *Pratylenchus*, *Paratylenchus*, and *Xiphinema* were each detected in 78% or more of the orchards. Several genera were represented by two or more species in the same orchard. The frequency of occurrence and population densities of *Pratylenchus* spp. and *X. americanum* are shown in Table 2. *Pratylenchus penetrans* Filip and Stek or *Pratylenchus crenatus* Loof were present in all the orchards and in 38 and 47% of the samples, respectively. Of the samples infested with *Pratylenchus* spp., 58% had population densities greater than 33/100 cm³ of soil, 21% had 33–100/100 cm³, 15% had 100–300/100 cm³, and 6% had more than 300/100 cm³. *X. americanum* was found in 88% of the orchards and in

56% of the samples.

The pathogenicity to apple trees of several other nematodes found in this survey is doubtful. *Aphelenchus avenae*, *Paraphelenchus* sp., and *Ditylenchus* sp. are predominantly fungal feeders, and some migratory ectoparasites, *Aglenchus* sp., *Pseudhalenchus* sp., *Boleodorus thylactus*, and *Tylenchus* sp. are not considered pathogenic. Second-stage juveniles of *Meloidogyne* sp. and *Heterodera* sp. were found infrequently and in low numbers.

DISCUSSION

Several species of *Tylenchorhynchus*, *Helicotylenchus*, *Macroposthonia*, and *Paratylenchus* have not been pathogenic to apple trees although they are pathogenic to other fruit trees (3,4,6).

Pratylenchus penetrans is a major causal agent of nonspecific replant problems in apple orchards of Europe, North America, and Australia (2,5,7,9). In a study of nematodes in an apple orchard in Quebec, Ogiga and Estey (11) found that soil densities of *Pratylenchus* sp. were highest in June. Our survey was done mainly in June, but our extraction technique primarily measured nematodes from the soil, because nematodes from roots had only 7 days to leave the roots and move downward in the pan. Consequently our estimates of the population densities of *Pratylenchus* sp. in the roots and rhizosphere of apple trees are low. However, frequency and soil densities of *Pratylenchus* spp. populations

Table 1. Frequency and soil density of plant-parasitic nematodes from apple tree rhizosphere in Quebec

Nematode	Orchards infested (%)	No./100 cm ³ soil
<i>Heterodera</i> sp.	3	4
<i>Meloidogyne</i> sp.	21	25
<i>Tylenchorhynchus maximus</i>	32	17
<i>Helicotylenchus</i> spp.	54	36
<i>Helicotylenchus digonicus</i>	...	...
<i>Helicotylenchus platyurus</i>	...	...
<i>Macroposthonia</i> spp.	58	10
<i>Macroposthonia rusticum</i>	...	...
<i>Macroposthonia curvatum</i>	...	...
<i>Xiphinema americanum</i>	88	26
<i>Pratylenchus</i> spp.	78	32
<i>Pratylenchus microdorus</i>	...	...
<i>Pratylenchus projectus</i>	...	...
<i>Pratylenchus hamatus</i>	...	...
<i>Pratylenchus</i> spp.	100	91
<i>Pratylenchus penetrans</i>
<i>Pratylenchus crenatus</i>

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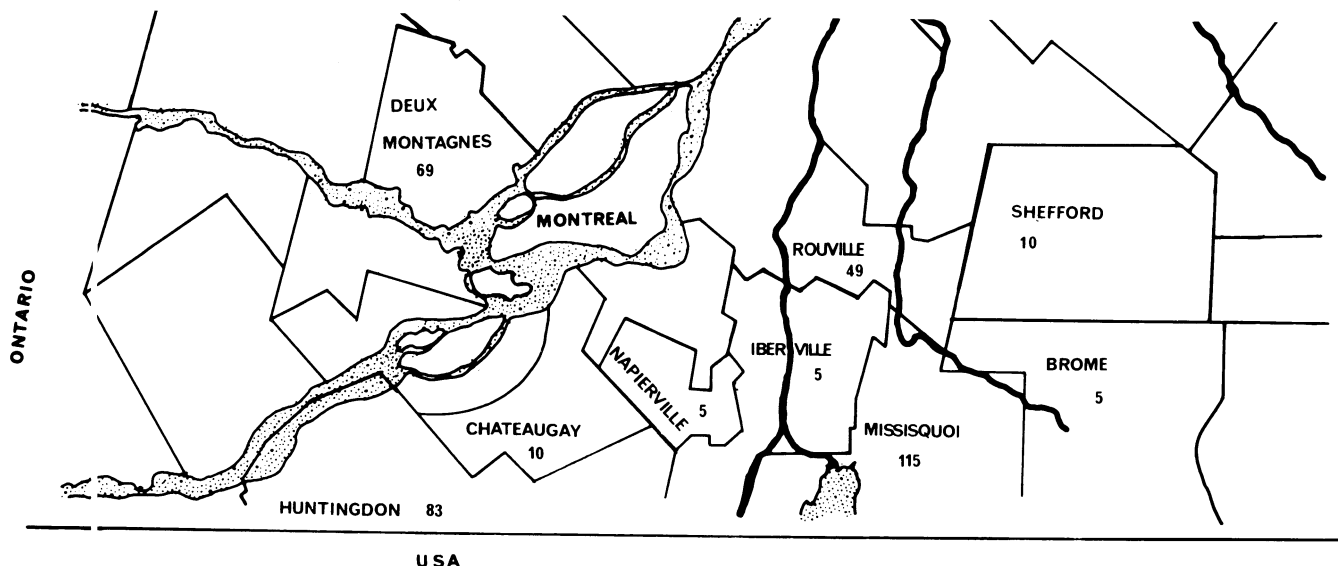


Fig. 1. Apple-producing counties of southeastern Quebec surveyed and numbers of soil samples taken in each county.

Table 2. Frequency and density of *Pratylenchus* spp. and *Xiphinema americanum* in Quebec apple orchards

County	Orchards sampled (no.)	<i>Pratylenchus</i> spp.		<i>Xiphinema americanum</i>	
		Samples infested (%)	No./100 cm ³ soil	Orchards infested (%)	No./100 cm ³ soil
Brome	1	80	213	100	73
Chateaugay	2	70	18	50	31
Deux Montagnes	14	81	105	78	16
Huntingdon	17	73	65	70	24
Iberville	1	100	45	100	32
Missisquoi	23	91	86	100	26
Napierville	1	80	81	100	10
Rouville	10	96	118	100	36
Shefford	2	100	113	100	23

are similar to those found in orchards of New York State where Braun et al (1) surveyed 40 apple orchards of the Hudson Valley during 1956-1965; all were infested with *Pratylenchus penetrans* or *Pratylenchus pratensis*. Of the 200 samples they examined, 82% contained an average *Pratylenchus* spp. density of 47/100 cm³ of soil. Parker and Mai (10), measuring the damage caused by *Pratylenchus penetrans* to apple trees in New York State 2 yr after fumigation, found densities of 300-4,000/g on roots but only 3-300/100 cm³ of soil.

There is no conclusive evidence that the densities of *Pratylenchus penetrans* found in Quebec lower the yield of mature trees, although soil fumigation in orchards with mature trees and comparable nematode densities increased growth and yield (1). There is definitive evidence, however, that relatively low densities of this nematode can severely retard the growth of seedlings and young trees. Hoestra and Oostenbrink (5) found a

highly significant negative correlation between *Pratylenchus penetrans* densities and shoot growth in field trials of young apple trees. Densities of 33/100 cm³ of soil reduced shoot growth by an average of 48%, and 330/100 cm³ reduced growth by 72%. Apple trees with apparent injury supported as many as 500 or more nematodes per gram of root, but the numbers of nematodes in the soil was often low.

Although the soil densities of *Pratylenchus penetrans* in Quebec apple orchards may only occasionally be injurious to mature trees, they could be very damaging to newly transplanted young trees. *X. americanum* is also a potentially damaging nematode because it is a vector of tobacco ringspot virus. Trees grafted on susceptible size-controlling rootstock may be damaged in the orchards where the nematode vector and virus are present.

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