

Large Infection Center of Scleroderris Canker (European Race) in Quebec Province

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ABSTRACT

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Scleroderris canker was found in 163 plantations, primarily on red pine and occasionally on Scots pine, during a survey of 1,183 pine plantations in southwestern Quebec. The European race of *Gremmeniella abietina* was identified in 121 plantations and the North American race in 29. This is the second largest known outbreak of the European race in North America after that in New York State. Plantations varied in age from 6 to 24 yr; half of the diseased plantations were severely damaged. Both races were well mixed geographically, and no definite source of infection could be identified. The extensive presence of *G. abietina* (European race) in this region could not be explained. Jack pine was not affected by the disease.

Scleroderris canker of pine caused by *Gremmeniella abietina* (Lagerb.) Morelet is a relatively new disease in North America. Even though disease symptoms were noted in Michigan in 1951, the causal organism was not identified until 1964 (13). That same year, the fungus was isolated for the first time in the province of Quebec (18). The disease is now known throughout the province (4).

Pines, particularly red (*Pinus resinosa* Ait.) and jack (*P. banksiana* Lamb.), are common hosts of this pathogen. Until the mid-1970s, damage occurred mainly in nurseries and in plantations less than 10 yr old. In 1977, in northern New York State (16), several thousand hectares of red and Scots pine (*P. sylvestris* L.) plantations, some with trees 18 m high, were devastated by the disease. At about the same time, races of the causal organism were being differentiated through immunological reactions. A North American race was defined to encompass serologically related isolates from everywhere in America. Most of these were not able to infect shoots higher than 2 m from the ground, and only small trees were killed, generally by a girdling canker of the lower stem. As a counterpart, fungus isolates originating from New York State appeared closely related serologically to European isolates and unrelated to those found elsewhere in North America (2). Thus, the name European race was applied to serologically defined isolates originating from New York State and generally thought to be responsible for rapid spread of the

disease throughout the crowns of large pines that often resulted in mortality.

The European race of *G. abietina* was found for the first time in Canada in 1978 (3). The fungus was isolated from a 10-yr-old red pine plantation at Powerscourt, just a few kilometers north of the Quebec-New York State border. In 1979, during an intensive survey of pine plantations in Quebec, 10–15 km north of the New York, Vermont, and New Hampshire borders, we detected *G. abietina* in 22 plantations (6). Serological testing of isolates originating from this survey and from other scattered locations in the area revealed the presence of the European race in plantations of red pine, jack pine, and Scots pine (5). Immediate cutting and burning of all infected branches in these lightly infected plantations, with follow-up disease monitoring and sanitation measures when needed in the following years, apparently eradicated the disease in the area (7). The European race of the fungus also was detected at two locations in New Brunswick (10) and at one in Newfoundland (15) about the same time as the Quebec report.

In 1983, infected red pine plantations were localized in southwestern Quebec during a study of the epidemiology of Scleroderris canker. Eight isolates of *G. abietina* originating from eight plantations where symptoms above 2 m from the ground had been observed were tested for race identity. Six proved to be of the European race (8). Consequently, an intensive survey of all pine plantations in a relatively large area of southwestern Quebec was carried out during the 1984 field season to delimit and evaluate the extent of the European race infestation in the area. Results of this survey as well as a

discussion on disease behavior and symptom expression observed are presented in this article.

MATERIALS AND METHODS

Field survey. The survey area was located in southwestern Quebec, north of the Ottawa River, and included about 18,000 km² of agricultural and private or public woodlands. The area extended 150 km north of Hull and 100 km on each side, encompassing most of the catchments of the Gatineau, la Lièvre, and Rouge rivers (Fig. 1). The survey included all 6- to 30-yr-old pine plantations in the Ottawa region listed in the records of the Quebec Department of Energy and Resources as well as other nonlisted plantations found during the survey. Multiple-age plantations on a given lot were classified as one plantation.

For each plantation, the location, tree species, age, and estimated number of trees were noted. A random search (up to 0.5 hr) was carried out for disease symptoms. The following symptoms were recorded: 1) dead twigs on lower branches with or without needles still attached, 2) partly green needles with yellowing at the base that could easily be pulled out from the shoot (pull test), 3) greening of the cambium beneath diseased bark, and 4) Scleroderris cankers on lower stems. When symptoms were found, samples were collected and an estimate of the percentage of trees affected and disease severity was made. Three classes of severity were used: light (1–5% of the trees infected), moderate (6–25% with no mortality recorded), and severe (mortality present and/or more than 25% of the trees infected).

Laboratory study. All samples were examined under a stereoscopic microscope for pycnidia or apothecia. When these were not found, a search for cryptopycnidia in the bark was made (1). The disease was confirmed in a plantation only when fruiting bodies of the fungus were found on the sample; symptoms alone were not sufficient.

Isolates of the fungus, needed for race identification, were made from fruiting bodies of *G. abietina*. A culture medium composed of 2% malt, 2.5% agar-agar, and 5% V-8 juice was used. Cultures were incubated for 2 wk at 22–24 C, then purified before storage at 18 C.

Race identification of the isolates was made by C. E. Dorworth and C. Davis at the Great Lakes Forestry Centre, Canadian Forestry Service, using their standard immunoserological method (2). Race determination of only one isolate per infected plantation was done because the test is quite laborious.

RESULTS

About 10 million trees were surveyed in 1,183 plantations. Scleroderris canker, regardless of race, was found in 163 (13.8%) of the plantations. Among infected plantations, 157 were red pine, representing about 2 million trees. The other six plantations were Scots pine, representing about 60,000 trees. The disease was found throughout the area surveyed except in a portion west of Fort-Coulonge (Fig. 1). The low number of diseased plantations in the Maniwaki region, along the Gatineau Valley, is probably due to pruning the previous year. Estimates of disease severity showed that half of the diseased plantations were severely infected; some plantations had all trees infected and some were completely devastated with

more than 50% mortality. The other half were lightly infected.

Cultures of *G. abietina* from 121 plantations were identified as European race by their immunogenic reactions. This is 74% of all infected plantations compared with 18% (29 plantations) identified as North American race. Among the other 13 infected plantations (8%), five cultures did not react to the test and eight were lost through contamination. The European race affected five of six locations of Scots pine, the same proportion as with red pine.

DISCUSSION

This is the second largest outbreak of the European race of Scleroderris canker disease in North America; the first was in New York State (16). Similarities between both outbreaks are the presence of both races in the area and the predominance of the European over the North American race (17). There also are two major differences:

1. The trees killed in New York were older than those reported in Quebec. Diseased plantations in Quebec varied from 6 to 24 yr old (mean 12 ± 4 yr). In

New York, trees ranged from 35 to 50 yr old (14).

2. Contrary to the New York situation, apothecia and cankers were relatively common in Quebec in plantations where isolates of the fungus were identified as European race (16).

The difference in symptomatology between the two outbreaks may be explained by the frequent occurrence of the two races in the same plantations in Quebec.

The disease has been known to occur in southwestern Quebec since 1967, when it was first reported on both red and jack pine (12). Five years later, only a few infection centers were known along la Lièvre and Rouge rivers and only one along the Gatineau River (9). However, new infection centers have been discovered almost annually since 1974 (11).

Because the disease, particularly its European race, is widespread in this area, we looked for a possible source of infection for these plantations. The nursery that provided most seedlings planted in the area in the late 1950s and early 1960s has had no history of *G. abietina* until 1985. One other nursery

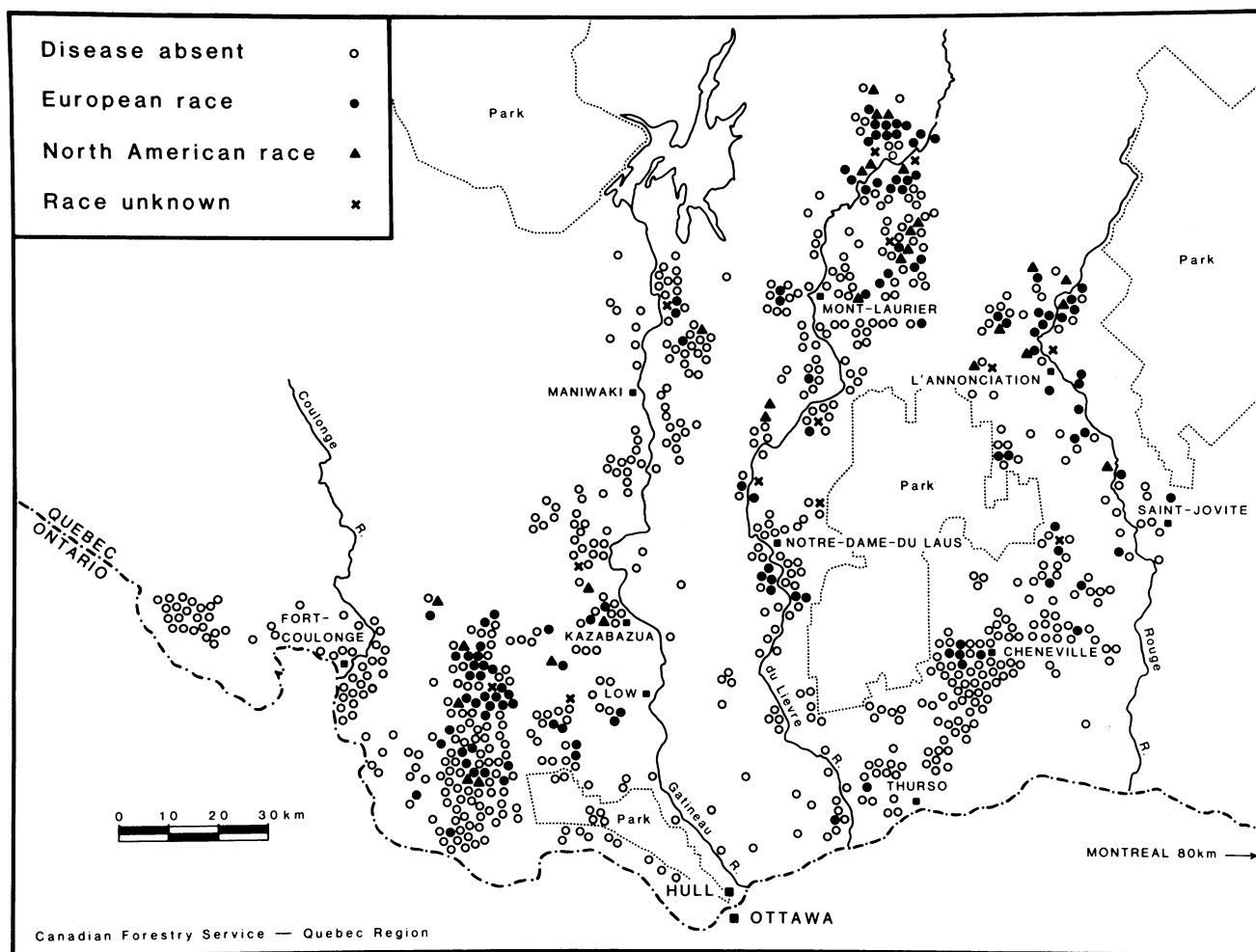


Fig. 1. Distribution of *Gremmeniella abietina* in southwestern Quebec in 1984. All infected pine plantations found are represented, but only about half of the healthy ones are shown where clusters of plantations occur.

known to have provided red pine seedlings for the region had an outbreak of *Scleroderris* canker in 1978, but these seedlings were destroyed and chemical control treatment was carried out from then on. If seedlings were brought into the area from other sources, their number was surely low. Thus, disease dispersal by nursery seedlings seems to be a remote possibility.

There also is the possibility that the sudden increase in disease frequency is due to a combination of favorable climatic conditions, the presence of numerous relatively young red pine plantations, and the proximity of a few known infection centers. We experienced a marked increase in reforestation in Quebec in the 1960s, with mostly red pine planted in this region. Also, the disease has been present in the area on red and jack pine since 1967 (12), and new infection centers have been discovered annually since 1974 (11).

The two races are well mixed geographically in this part of Quebec. The European race seemed to appear rapidly and simultaneously over a large area. No definite infection centers of the European race could be identified based on information from this intensive survey; in addition, this outbreak is located about 150 km northwest of the closest known European race-infected plantation. Therefore, we cannot explain the extensive presence of the European race

of the fungus over such a large area.

During this survey, jack pines of similar age growing naturally or planted in the area did not show disease symptoms. This area has now become a field laboratory to study the epidemiology and control technology of the disease as well as a testing ground for race evaluation.

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