

## Gremmeniella (Scleroderris) Disease of Conifers



Figure 1. Mortality in a red pine plantation caused by *Gremmeniella abietina*.

The fungus *Gremmeniella abietina* (Lagerb.) Morelet causes a serious disease of evergreen trees, principally pines. In North America the disease, commonly known as Scleroderris canker or Gremmeniella canker, has been associated with extensive planting failures (Fig. 1) since the 1950s. Dying trees had a very characteristic appearance (Fig. 2 and 3), but it was difficult to implicate the fungus because the dying trees were frequently affected by other damaging agents such as frost, drought or poor planting procedures. In 1964, after extensive investigations, the causal agent, then known as *Scleroderris lagerbergii* Gremmen, was identified. Previous to this, the disease was known variously as "X disease of pine" and "Jones' disease".

In eastern Canada and the northeastern and central United States, regeneration size red pine has suffered the greatest damage. In Canada the planting of red pine in the northern part of its range has been largely curtailed because of the disease. Jack pine and Scots pine may also be seriously damaged, but these species appear to be more resistant to the disease than red pine. Eastern white pine is seldom affected, and while Austrian pine is susceptible to the disease, plantations of this species are uncommon. Black spruce and white spruce infected with the fungus occur at several locations in the Laurentide Provincial Park in Quebec, but the potential of the disease on spruce is not yet clear.

In western Canada, lodgepole pine, ponderosa pine and whitebark pine are hosts for the disease which was first detected in Jasper National Park, Alberta in 1974. Evidence indicates that the fungus has been present at least since 1968. The disease is known to occur at only a few scattered locations in Alberta and British Columbia, and to date, impact on the western forests has been negligible.



Figure 2. Foliar symptoms on red pine affected by the European race of *Gremmeniella abietina*. Symptoms for the North American race are the same except that only one year's growth is affected.



(a)



(b)

Figure 3. Stem canker caused by the North American race of *Gremmeniella abietina* (a) before and (b) after bark removal to show green stain and pattern of dead wood.

*Gremmeniella* also occurs in Europe and Asia where the disease is referred to as top killing of pine, bud drought and Brunchorstia dieback. The names reflect a different disease character and it is now clear that at least two immunologically distinct races of the fungus exist, a North American race and a European race.

Over the years, the North American race, which commonly causes basal stem cankers, has been active in Canada. The European race, which more typically causes a dieback disease, is now established in North America in the pine plantations of New York and Vermont. In 1978 infection by this race was detected in Quebec in an isolated red pine plantation just 2 km north of the New York border. This plantation was immediately put in quarantine and sanitized by destroying all in-

fectured material. American reports of damage to the end of 1977 indicate that 10 000 hectares of pine plantations have been affected, including 1 000 hectares of complete mortality. The European race is especially damaging to our native red pine (Fig. 4), and appears to be more virulent than the North American race to Austrian, Scots and white pine. This virulence is indicated by extensive mortality of seedlings and juvenile trees, and the common occurrence of dieback on larger trees of these species growing in New York.



Figure 4. Red pine plantation in New York devastated by the European race of *Gremmeniella abietina*.

Diseases caused by the two races are compared in Table 1. Mortality caused by the North American race results either from massive shoot dieback when trees are small or from stem girdling by cankers that form where the fungus grows into the mainstem from branch infections. Mortality resulting from massive shoot blight is typical for trees of all sizes affected by the European race.

Table 1. Disease characters for the European and the North American races of *Gremmeniella abietina*

European Race	North American Race
1. Needle bases turn red or yellow (Fig. 2) in May or June.	1. Same.
2. All needles on infected branches turn brown in summer.	2. Same.
3. Entire branches may be killed in a single year.	3. One internode is killed per year, from tip toward mainstem.
4. Tree dies when all or most of the crown has been killed.	4. Fungus grows along branch to mainstem which is girdled or cankered (Fig. 3). Massive shoot mortality kills only small trees.
5. Bright green stain may occur just beneath bark on killed stems.	5. Same.
6. Infected branches are found 20 metres or more above ground.	6. Infection seldom occurs more than 2 metres above ground.
7. Mature trees are killed in 2 to 4 years.	7. Damage is confined to lower crown of mature trees.
8. Trees do not exhibit basal mainstem cankers.	8. Trees may bear basal mainstem cankers (Fig. 3) up to 2 metres long.
9. Cuplike fruiting structures (Fig. 6) are rare.	9. Cuplike fruiting structures (Fig. 6) are abundant.
10. Pine, spruce, larch and Douglas-fir are affected.	10. Pine and possibly spruce are affected.

While branch cankers result from infection by both races, basal stem cankers (Fig. 3) are typical for only the North American race.

The disease is spread by two types of minute fungal spores. Conidiospores are produced in small, round structures called pycnidia (Fig. 5), that form at the base of dead needles or on small twigs. Ascospores form in small cup-shaped fruiting bodies called apothecia (Fig. 6), that form on the bark about a year after underlying tissue

dies. Cool and moist weather conditions favor sporulation, infection, and the colonization of host tissue. Most foliar symptom expression (Fig. 2) occurs in the spring following infection. Delayed symptom expression makes diagnosis of infection on nursery stock difficult because diseased seedlings may look healthy at shipping time.

Scientists in the United States have mounted a massive research effort to understand and control the European dieback disease. One study involves testing disease resistance and a number of Canadian selections are included. Research in Canada, however, remains confined to laboratories as a precaution against entry. It is unlikely that our research efforts will be expanded unless the disease becomes established here.



Figure 5. Conidiospore producing pycnidia of *Gremmeniella abietina* fruiting on the bark of a dead twig.



Figure 6. Ascospore producing apothecial stage of *Gremmeniella abietina* on a dead red pine twig.

Both Canadian and American authorities have imposed quarantines to impede the spread of the disease. In the United States shipment of material capable of harboring *Gremmeniella* from affected areas is prohibited. The Canadian quarantine<sup>1</sup> screens the importation of susceptible host materials from all parts of the world where the European race exists. This quarantine reduces the risk of accidental introduction, and, it is hoped, will provide the time needed to develop disease controls.

Several methods for the control of the disease caused by the North American race are recommended. Fungicides may be used in tree nurseries, and effective sanitation procedures are available for use in forest and Christmas tree plantations. For specific information or recommendations, contact staff of the forest research centre nearest you. These centres, operated by the Canadian Forestry Service, are listed on the following page.

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<sup>1</sup>Quarantine circular 16C - Agriculture Canada

Pacific Forest Research Centre  
Canadian Forestry Service  
506 West Burnside Road  
VICTORIA, British Columbia  
V8Z 1M5  
Phone: (604) 388-3811

Northern Forest Research Centre  
Canadian Forestry Service  
5320 - 122 Street  
EDMONTON, Alberta  
T6H 3S5  
Phone: (403) 435-7210

Great Lakes Forest Research Centre  
Canadian Forestry Service  
P.O. Box 490, 1219 Queen St. E.  
SAULT STE. MARIE, Ontario  
P6A 5M7  
Phone: (705) 949-9461

Laurentian Forest Research Centre  
Canadian Forestry Service  
P.O. Box 3800, 1080 Route du  
Vallon  
STE-FOY, Quebec  
G1V 4C7  
Phone: (418) 694-3957

Maritimes Forest Research Centre  
Canadian Forestry Service  
P.O. Box 4000  
College Hill  
FREDERICTON, New Brunswick  
E3B 5P7  
Phone: (506) 452-3500

Newfoundland Forest Research  
Centre  
Canadian Forestry Service  
Building 304, Pleasantville  
P.O. Box 6028  
ST. JOHN'S, Newfoundland  
A1C 5X8  
Phone: (709) 737-4683

(Figure 4 courtesy of D. Skilling, USDA Forest Service, St. Paul, Minn.)

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