

# Impact of *Gremmeniella Abietina* in a Jack Pine Plantation

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*Infection by the fungus Gremmeniella abietina in a new jack pine plantation increased rapidly during the first 9 years, but tree mortality and main stem damage were negligible.*

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Red pine (*Pinus resinosa* Ait.) and jack pine (*P. banksiana* Lamb.) are the two species most often suitable for plantation establishment on sandy sites between approximately 44° N. latitude and the northern climatic limit of each species. Severity of the disease, known as scleroderris canker and caused by the fungus *Gremmeniella abietina*, (Lagerb.) Morelet, is strongly influenced by climate and site (2). Restriction of the North American race of *G. abietina* to areas north of approximately 44° N. latitude is often attributed to the pathogen's inability to grow at higher temperatures, but there is no specific proof for this claim. On the other hand, the pathogen definitely needs liquid water to produce infective spores, to disseminate the spores to new host trees, and to infect those trees (7, 8). The North American race of *G. abietina*, the only race known in Canada west of Quebec, infects pine tissues within 2 meters of the ground. This "safe height" is generally accepted (though prob-

ably conservative) as the point at which disease control operations, such as sanitation (3), are no longer required, except where it is desirable to reduce the amount of the pathogen in an area to protect newly planted stock nearby. Conversely, the European race of the fungus, which is currently found east of Ontario in Canada and in the Northeastern United States, kills tissues of various conifers at any height above the ground (9).

Earlier reports (1, 4) indicated that jack pine is less seriously damaged than red pine under the same conditions. This report outlines 9 years of observations in a 250,000-tree jack pine plantation, which replaced a red pine plantation that had suffered

over 95-percent mortality as a consequence of a *Gremmeniella abietina* epidemic.

## Procedures

In a 31-hectare red pine plantation near Searchmont, Ont. (46°20' N., 84°00' W.), adjacent to Perry Creek, more than 95 percent of the trees were killed by *G. abietina*; and the few that survived were stunted, deformed, and often cankered (fig. 1). In 1972, the area was replanted with 2+0 jack pine at 2- by 2-meter spacing. The average height of 50 randomly selected dominant trees exceeded 4 meters by the fall of 1981. Trees on this plain are subjected to severe climatic stresses



Figure 1.—Stunted, deformed, and often cankered red pine survivors of a *Gremmeniella abietina* epidemic.

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such as frequent droughts and an annual temperature range of approximately 80°C (-43° C to +38°C recorded (2), and freezing temperatures are encountered annually both in late spring and in early autumn.

An experimental block of 6.5 hectares occupying the southern end of the plantation was selected. Infected residual red pines were removed from the experimental area to reduce the intensive infection sources within the plantation. Most of the infections discussed here occurred when spores of *G. abietina* were blown into the experimental block.

Fifteen strip plots of one row each, three rows apart and 600 meters long, were marked with stakes at 50-meter intervals in the spring of 1973, 1 year after planting. Seedlings thereon were recorded as living or dead and with or without symptoms of infection by *G. abietina* (3). Beginning in 1979, the number of trees with clearly discernible basal stem cankers was recorded as well. A canker was defined as depressed area on the lower stem with or without dead bark and possibly with resin exudate and apothecia or pycnidia (spore-producing organs) of *G. abietina*. These are interpreted, through experience, as incipient chronic cankers, but with the understanding that cankers resulting from infection by *C. abietina* and by the rust fungus *Cronartium comptoniae* Arth. occasionally resemble one another at this stage of development. Recognizable

rust infections, most of which produced distinctive spores, were recorded on 5 percent of the seedlings the year after planting; these infections were probably carried in from the nursery. Trees recorded as dead were deleted from future records, a factor that explains what appears to be an increase over time in the percentage of healthy trees (table 1).

In total, 33.3 percent of the experimental area or 15 percent of the plantation proper, was examined annually, tree by tree. Examinations were continued for 9 years, by which time most of the surviving trees were more than 2 meters high and impending canopy closure

made it difficult to differentiate branches undergoing natural pruning from those dying from infection by *G. abietina*.

### Results and Conclusions

Basal stem cankers as long as 1.5 meters are found on red pine in *G. abietina* infection areas (5). Such prominent cankers have not yet been reported from older jack pine although cankers up to 0.5 meter long are routinely observed in younger plantations (fig. 2). *Gremmeniella abietina* was disseminated widely on the primary host, red pine, during the 1950's when postwar replant operations

**Table 1.**—Impact of *Gremmeniella abietina* on 37,500 trees of a 250,000-tree jack pine plantation during the first 9 years after planting<sup>1</sup>

Year	Tallied trees				
	Living, without <i>G. abietina</i> symptoms	Living, with <i>G. abietina</i> symptoms	Dead, with <i>G. abietina</i> symptoms	Dead from unknown causes	Living, with stem cankers <sup>1,2</sup>
			%		
1973	80.7	<0.1	0	19.3	0
1974	94.2	1.9	.0	3.9	0
1975	85.8	13.1	.5	.7	0
1976	84.8	13.7	.7	.9	0
1977	75.8	23.4	.8	.1	0
1978	30.7	69.1	.1	.1	0
1979	29.8	67.6	2.6	.1	12.5
1980	3.4	95.2	1.0	.4	17.9
1981	— <sup>3</sup>	— <sup>3</sup>	1.1	.3	15.6

<sup>1</sup>Dead trees were recorded once only, and this accounts for the apparent increase in percentage of trees living and exhibiting no symptoms of *G. abietina* infection, and the apparent decrease in live trees with stem cankers.

<sup>2</sup>1979 was the first year in which stem cankers were reliably discernible on living trees without dissecting the stems.

<sup>3</sup>Data are lacking for 1981 as it was no longer possible to record the cause of tree branch mortality dependably because of partial crown closure.



**Figure 2.**—Basal cankers caused by *Gremmeniella abietina* on stems of, left to right: a 14-year-old red pine, a 14-year-old jack pine, and a 24-year-old red pine.

reached their peak. The more resistant jack pine would then have been infected through natural spread of the pathogen. Future examinations will reveal whether the relatively small cankers now seen on young jack pine become covered or "heal" or continue to elongate as is the case with red pine (fig. 2).

Jack pine mortality as a consequence of infection by *G. abietina* is still within tolerable limits (table 1). Examination of other heavily infected jack pine plantations bearing trees twice the age of those described here leads us to believe that future mortality in the Perry Creek plantation will be slight. Although the percentage of trees infected is quite high, mortality has leveled off (table 1) and is confined mainly to trees badly damaged during the first

few years after planting.

Individual case studies in forest pathology are not ordinarily regarded too seriously because of the pronounced differences in the effects of site and climate on disease development in various areas. In the present case, however, the climatic extremes characteristic of the plantation area are such that we can regard this as an area of extreme environmental stress in which trees would be maximally predisposed to infection and damage by the pathogen. The fungus, by contrast, grows prolifically in the lowermost portions of the tree where snow cover is usually sufficient to prevent temperatures from dropping below the minimum for *G. abietina* growth (2). Therefore, as damage to jack pine was slight (table 1), we might

consider this species to have a relatively high field resistance to damage by *G. abietina*.

Earlier work by Mullin (6) showed the growth potential of jack pine to be superior to that of red pine on these poorer northern sites. There is little doubt that jack pine is to be preferred to red pine in northern Great Lakes reforestation work where the threat from *G. abietina* is pronounced and where it is difficult to correct problems with preexisting infections through sanitation work.

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