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Branching Out

from the Canadian Forest Service - Laurentian Forestry Centre

White Pine Blister Rust: Knowledge, Control and Innovation

What is the major threat hanging over eastern white pine? White pine blister rust, which is caused by an exotic fungus, has been present in North America since the beginning of the 20th century. By drawing on the substantial knowledge available on the causal pathogen and the disease cycle, Canadian Forest Service (CFS) researchers have developed methods for detecting and controlling the disease in nurseries and plantations.

The essential link between *Ribes* spp. and blister rust

In the fall, the causal fungus (*Cronartium ribicola*), which is present on *Ribes* spp. (currants/gooseberries), infects pine needles, which become covered with yellow spots the following spring. The fungus spreads toward the branches and the trunk, eventually giving rise to a canker that may initially appear as a swelling. In mid-summer, about two or three years after infection, orange pustules form on the canker and produce an exudate containing a first type of spores that attract insects. The fertilized spores induce the formation of white blisters the following spring. At maturity, these blisters burst and discharge orange spores that are dispersed by the wind over long distances, eventually infecting the leaves of *Ribes* species. In late summer or early fall, filamentous fruiting bodies develop on the underside of the leaves of this host. Unlike the spores produced on pine, the spores released from these fruiting bodies are transported only over short distances; these spores infect the needles of eastern white pine.

Orange blisters on a branch. Photo: NRCan

Orange fruiting bodies on *Ribes*. Photo: NRCan

The cankers that form on white pines are perennial and enlarge from year to year. The pathogen spreads radially, producing fruiting bodies on the margins of the canker, which eventually girdles and kills the infected part of the tree. Tree mortality occurs when a canker girdles the main stem.

Careful selection of planting sites

Cool, moist conditions are required for the production of rust spores on *Ribes* species that can infect eastern white pine. The risk of rust infection can be reduced by selecting sites with well-drained soil, located on upper slopes or with a southern exposure. Flat, well-aerated sites that are exposed to air currents favouring rapid evaporation of morning dew also are suitable sites.

At the same time, it is important to avoid sites such as wet hollows, lower slopes with a northern exposure, and small clearings surrounded by mature forest. In general, sites where *Ribes* species are abundant should be avoided. During site preparation work, harvest residues should not be windrowed because this technique promotes the growth of *Ribes*.

Inspection and pruning to the rescue

White pine blister rust is widespread across Canada, and is particularly common in plantations. For example, in 2010, 68% of Quebec's eastern white pine plantations were found to be infected. It is therefore important to monitor the plantation following reforestation with eastern white pine in order to control the disease.

Healthy white pine, white pine killed recently by rust, and white pine killed a few months earlier. Photo: NRCan

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Orange blisters on a branch.
Photo: NRCan

Increasing resistance through hybridization

Breeding research aimed at increasing white pine resistance to blister rust has been carried out for more than half a century in Ontario and Quebec. A number of hybridization experiments with five-needle pines (including crosses between *Pinus wallichiana* and eastern white pine) have made it possible to induce blister rust resistance in eastern white pine. Other characteristics, such as cold hardiness, have also been studied in the hybrids.

CFS researchers recommend inspecting the plantation for signs of blister rust when the trees reach their sixth year. The inspection should be carried out in May or June, which is when infected needles turn red. If the plantation is established in a high rust hazard zone, the inspection can be carried out earlier. The goal is to determine the rate of infection and, if necessary, to recommend a suitable pruning height. If the rate of infection rises above 8%, systematic pruning of lower branches is recommended to limit the spread of the disease (see *Branching Out* Nos. 67 and 74). Pruned branches can be left on the ground because the fungus can only persist on living material and cannot spread from pine to pine. Trees with an infected bole should be felled.

Planting blister rust-free seedlings: it's not that simple!

Although using blister rust-free planting stock may seem like a straightforward way to prevent the spread of the disease, the solution is not that simple. White pine blister rust spreads slowly in host tissues: it takes at least two years for signs and symptoms to appear.

Every year, some 2 million eastern white pine seedlings are produced for reforestation use in Quebec. Although nurseries implement preventive measures, an outbreak could occur and infected seedlings could be delivered and planted without anyone knowing since they would be asymptomatic at that time.

CFS researchers have developed a test that can be used to detect blister rust in pine tissues before the symptoms have a chance to appear. This test, which is based on the DNA fingerprint of the causal pathogen, was introduced in 2011 and it has been used ever since to support the issuance of phytosanitary certificates for white pine seedlings produced at six forest nurseries in Quebec.

Photo: NRCan

Useful links

Controlling white pine blister rust:
http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/32509.pdf

Trees, insects and diseases of Canada's forests:
https://tidcf.nrcan.gc.ca

Infected needles.
Photo: NRCan

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