A simple, effective tool for controlling white pine weevil and blister rust

ON NORWAY SPRUCE AND EASTERN WHITE PINE

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Issues

Due to increased reforestation with their favourite tree species and to foresters' limited knowledge of their biology, *white pine weevil*, in eastern white pine and Norway spruce plantations, and *white pine blister rust*, in white pine plantations, **have become the most serious pests** of plantations in Quebec.

Moreover, throughout the years, a number of Norway spruce and eastern white pine plantations were established on sites unsuited to their needs, thus allowing these two pests to cause severe damage.

In light of this situation, forest producers stopped using Norway spruce and eastern white pine for reforestation purposes, thereby forgoing the benefits offered by these two highly productive forest tree species.

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Norway spruce plantation that underwent weevil control for six years and now has a mean height of 6 m.

Fast-growing species

Eastern white pine

Norway spruce can produce yields of 200 to 300 solid m^3/ha in total volume over a period of 30 to 40 years. Some experts believe that, under optimal conditions, this species can produce more than 610 solid m^3/ha in total volume at age 60. Whatever the case may be, Norway spruce plantations yield exceeds on average the yields of all other spruce species native to eastern Canada, notwithstanding the damage caused by white pine weevil. The impact that weevil attacks have on plantation yields and on affected trees have therefore been exaggerated.

Under a Norway spruce breeding program, several superior fast-growing provenances have been identified for each of the three proposed reforestation zones in Quebec: the Appalachians, the Laurentians and the St. Lawrence Valley.

From the time of the first settlers, **eastern white pine** has been the most highly prized softwood species owing to the quality of its wood and its commercial value exceeding that of other softwoods. On good quality sites, white pine yields can exceed 250 solid m^3/ha at age 40.

In a context of intensive management, every means available should be used to improve plantation quality and minimize the damage associated with white pine weevil and white pine blister rust.

White pine weevil

Adult white pine weevil

Biology

White pine weevil is especially fond of **Norway spruce, followed by eastern white pine**. This insect may also attack **jack pine and black, white and red spruce**. In the adult stage, this small beetle is about 5 mm long. It is a native North American insect and it produces only one generation per year.

Weevil development

In spring, the adults emerge from their overwintering spot in the litter and make their way towards the highest point of young conifers, which is the terminal shoot. At this time of year, budbreak has not begun on the terminal shoot.

The females begin feeding under the bark and deposit their eggs there. The larvae feed and develop in this hiding place, eventually killing the previous year's shoot along with the current year's shoot (drooping shoot).

In July, larval development ends and the larvae pupate. New adults emerge from the terminal shoot by chewing a small circular hole about 2 mm in diameter in the bark. These exit holes are very easy to see. On average, about a dozen adults will emerge from a single shoot. This new generation feeds on the inner part of the tree bark and, in the fall, descends to the litter to overwinter under the snow cover. Some weevils live as long as three or four years, all the while continuing to reproduce and attack other terminal shoots.

Larvae inside a terminal shoot

Exit holes

Double terminal shoot

The result of weevil attacks

A severely attacked young tree will have a deformed stem, which reduces its commercial value as sawtimber. However, white pine weevil damage will not kill the tree.

Recent studies have shown that Norway spruce plantations can maintain good productivity in spite of weevil attacks owing to their fast growth.

However, the most deformed stems should be removed during the first thinning cuts.

Weevils are a problem in young plantations

A population of weevils that migrates into a new plantation develops slowly during the first five or six years, but then expands rapidly. **That is why we advise plantation owners to monitor young plantations carefully and to prune out and burn the first infested terminal shoots promptly. This intervention should take place at a time when field raspberries are just beginning to ripen, because the weevil larvae are still in the terminal shoot at this time of year.**

It is much easier to take action in a plantation where the infestation rate is below 1% than in a plantation with an infestation rate of over 10%. Given that adults can live for three to four years, it is important to keep the infestation level as low as possible.

Early intervention in young plantations is essential in order to:

> Keep the weevil population at a low infestation level;

> Ensure that fewer trees will be affected and fewer terminal shoots will need to be pruned;

> Keep the weevils from spreading to neighbouring plantations;

> Reduce the cost of control measures and carrying out work.

A simple weevil control method that produces good results

The method (see poster) was applied for seven consecutive years in Norway spruce plantations.

Fourteen plantations were treated, covering a total area of 33 ha and comprising nearly 75,000 trees. They were compared with six control plantations that received no treatment.

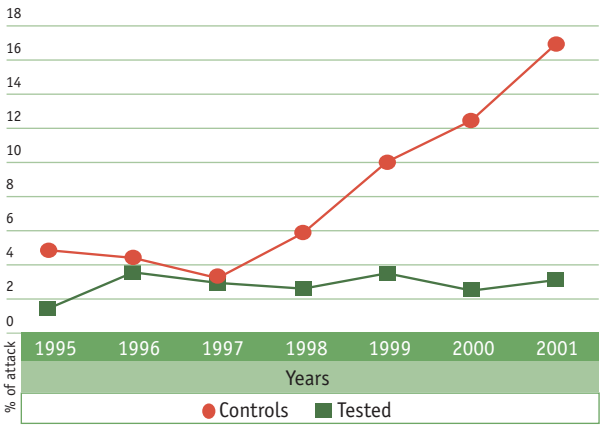
At the start of the trial, the rate of terminal shoot infestation in these plantations ranged from 1 to 8% and tree height ranged from 1 to 2 m.

Two persons did the work over a period of 10 days. After two weeks, a second intervention visit was made.

Annual control efforts made it possible to keep the infestation level below the 3% mark annually, which was much lower than in the control plantations.

Mean productivity was 3 hours/ha/person.

MEAN INFESTATION LEVELS WITH AND WITHOUT MECHANICAL TREATMENT IN THE MODERATE ZONE



Suggested pruning of attacked terminal shoot

NOTE

In untreated plantations with trees less than 5 m tall, the feasibility and cost of carrying out terminal shoot pruning work will depend on a combination of factors, such as:

> Ease of moving around in the plantation;

> Height of the trees;

> Infestation rate.

Note: Boulet, B. 1994. *Zones de susceptibilité aux attaques du charançon du pin blanc, (Peck), dans les plantations du Québec*. In R. Lavallée and G. Bonneau (eds.). *Compte rendu du Colloque sur le charançon du pin blanc tenu les 27 et 28 septembre 1994*. Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre, Sainte-Foy, Quebec.

A different approach

Mixed plantation of eastern white pine and Norway spruce

It was discovered that the white pine weevil preferentially attacks Norway spruce in mixed plantations of about 12 years old that have not previously undergone weevil control. For example, in the four plantations studied, white pine exhibited less damage than did Norway spruce.

Furthermore, weevil control measures applied in a mixed plantation helped to keep the damage inflicted on white pine at very low levels (see graphs opposite).

Mixed plantation

For more information

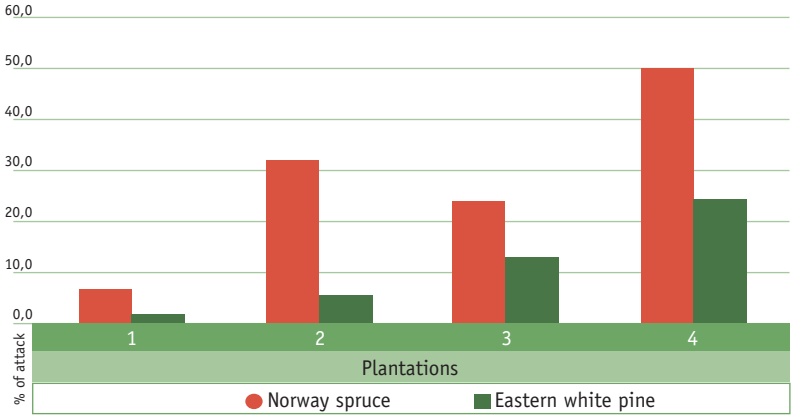
on the white pine weevil, visit this Web site:
www.pfc.cfs.nrcan.gc.ca/entomology/weevil/index_e.html

or contact:
Robert Lavallée at **robert.lavallee@nrcan.gc.ca**
or
Charles Coulombe at **charles.coulombe@nrcan.gc.ca**
or at: **(418) 648-7063**

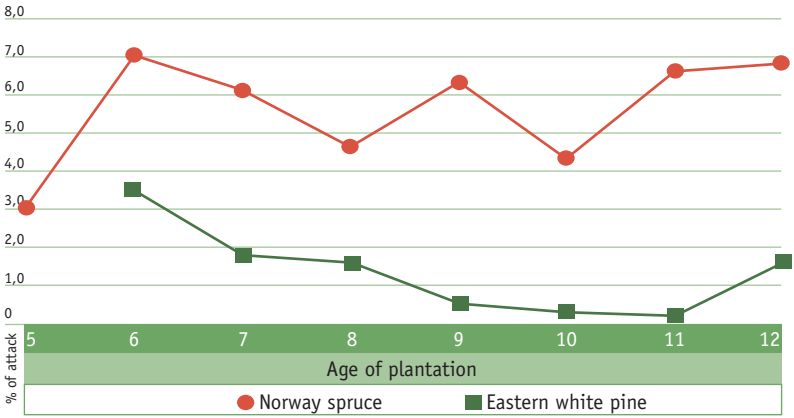
Pruning the infested terminal shoots

Affected terminal shoot (drooping shoot)

ANNUAL ATTACK RATE (%) OBSERVED IN 2002 IN FOUR UNTREATED MIXED PLANTATIONS



COMPARISON OF THE ANNUAL ATTACK RATE (%) IN NORWAY SPRUCE AND EASTERN WHITE PINE IN A MIXED PLANTATION THAT UNDERWENT CONTROL MEASURES FOR SEVEN CONSECUTIVE YEARS



White pine blister rust

Biology

White pine blister rust is a disease caused by *Cronartium ribicola*, an exotic fungal pathogen that was introduced into North America in the early 20th century and detected for the first time in Quebec in 1916.

To reproduce, this fungus needs an alternate host, specifically *Ribes* species such as currant and gooseberry. At the end of summer, it produces spores that can infect the needles of white pines. If the disease spreads to the bole, it will kill the tree.

Life cycle

Orange-coloured blisters full of spores on a lateral branch of white pine.

Spring

The infected parts of white pine, i.e. the branches, trunk or lower trunk, exhibit orange-coloured blisters.

These blisters are full of spores, called aeciospores, which are dispersed by the wind over **great distances** and germinate on the young leaves of currant and gooseberry plants.

A dead branch with reddish needles (often called "red flag") is a characteristic sign of the disease. By looking at the live portion of the branch, it is easy to identify the path followed by the attacking fungus.

End of summer and early fall

Spores (basidiospores) released from the alternate host's leaves are disseminated by the wind and eventually infect the needles of white pines **located nearby**.

The conditions favouring new infections of white pine needles are at least two weeks of temperatures below 20°C followed by a period of at least 48 hours of high humidity.

After this, the fungus grows in the bark of the twigs, branches and the trunk. Following an incubation period of one to three years, swellings appear on the affected parts.

Red currant bush

Blister rust hazard zones

Rust on a red currant leaf

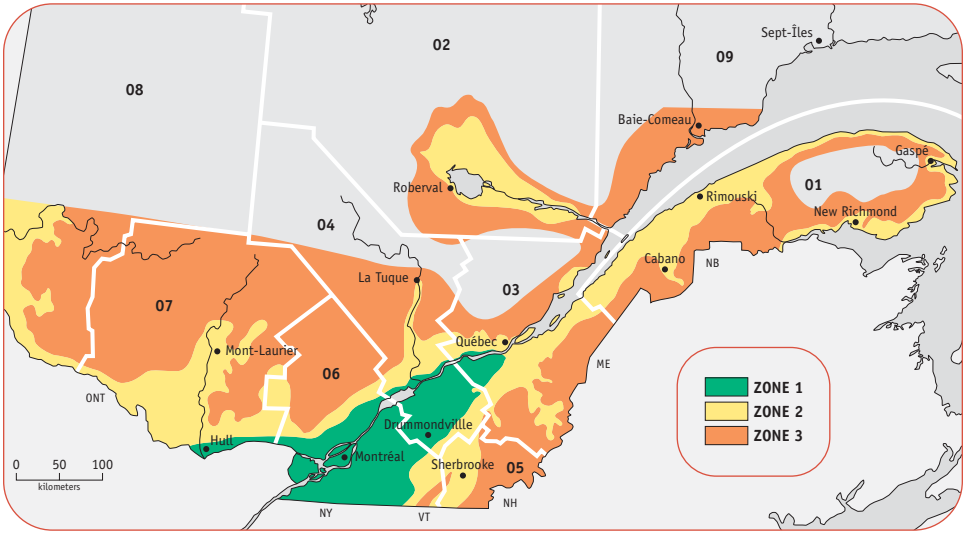
In Quebec, there are three blister rust hazard zones. These zones (see map below) take into account altitude, temperature and blister rust infection rates in eastern white pine as observed in plantations.

In all three zones there may be some plantations that are either barely affected by the disease or severely affected, owing to more or less conducive microclimatic conditions or owing to the presence or absence of *Ribes* species in the plantations.

Eastern white pine can escape blister rust infection only if the environmental factors are unfavourable to disease development.

Characteristic disease symptoms

MAP OF BLISTER RUST HAZARD ZONES[1]



1. Lavallée, A. 1986. Zones de vulnérabilité du pin blanc à la rouille vésiculeuse au Québec. For. Chron. 62: 24-28.

Site selection

Site selection is a determining factor in the success of an eastern white pine plantation!

What to look for

> Well-drained sites, such as hilltops, especially south-facing slopes.

> Flat, well-aerated sites where air currents favour rapid evaporation of morning dew.

> Systematic pruning should be carried out to keep the disease from spreading in the plantation.

What to avoid

> All topographic conditions and locations that favour persistent dew formation during cool, windless nights, in particular:

- Hollows or damp depressions;
- Lower slopes, especially those with a northern exposure;
- Small valleys or small openings surrounded by mature stands;

> Sites with dense vegetation where currant or gooseberry bushes (*Ribes*) form large colonies.

Systematic pruning of a young plantation in the Appalachians

Simple method for controlling white pine blister rust

Systematic pruning (see poster)

In contrast with **pathological pruning**, which involves removing only diseased branches, **systematic pruning** consists in cutting off all branches, whether healthy or diseased, up to a height prescribed by a forestry advisor.

This operation also allows the removal of branches that are likely to become infected.

Pruning of tree trunks also improves the quality of sawlogs.

Correct pruning

Incorrect pruning

How to prune

- When pruning branches, be sure to cut outside the branch collar swelling (1) near the trunk.
- If the work is done properly, the wound will form callus tissue quickly, preventing the entry of decay fungi (2) or the formation of a protruding stub (3).
- Suitable tools with a sharp cutting edge must be used in the pruning work.
- **NEVER USE A CHAIN SAW.**

NOTE

All the branches can be left on site, since there is no risk of other pines becoming infected.

The infection is not transmitted from one pine tree to another.

The fungus can exist only on living material.

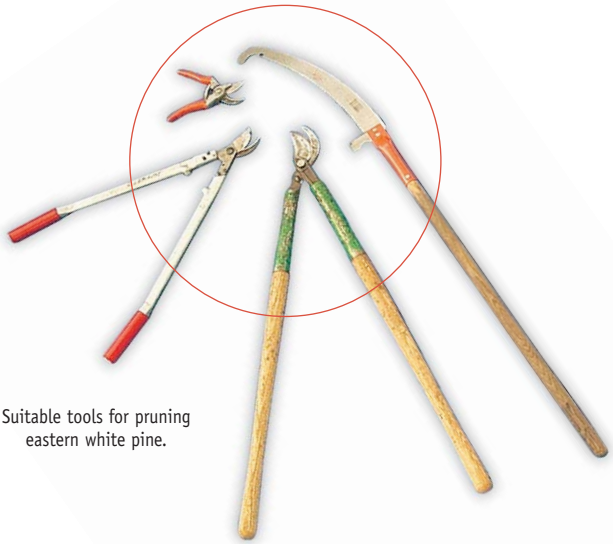
A diseased branch or tree can be cut and left on site.

When to prune

> Systematic pruning can be carried out any time, except during cold snaps; special care must be exercised when the sap is running in spring.

> Pathological pruning of infected trees can be done any time.

Pruning requires suitable tools with sharp cutting edges.



Suitable tools for pruning eastern white pine.

For more information on white pine blister rust, visit this Web site:
www.cfl.scf.rncan.gc.ca/imfec-idecf/maladies/indexmaladie.asp?ind=r

or contact:
Gaston Laflamme at **gaston.laflamme@nrcan.gc.ca**
or
Gilles Bélanger at **gilles.belanger@nrcan.gc.ca**
or at: **(418) 648-5512**

An ongoing experiment

Example of a mixed plantation in the Appalachians

Mixed plantation model: eastern white pine and Norway spruce

The objectives of the experiment are as follows:

> To obtain at least 600 white pines of sawtimber quality per hectare at harvest;

> To provide an initial source of income from Norway spruce harvested during commercial thinning.

Essential conditions for a healthy mixed plantation

> Strong interest in producing white pines of superior quality.

> Readiness to carry out monitoring and control operations on a regular basis for:

- **White pine weevil;**
- **White pine blister rust.**

> **Carry out plantation monitoring on a regular basis until the trees reach a height of 4 to 5 m (protection of the first 16-foot sawlog).**

Benefits of a mixed plantation

White pine weevil and white pine blister rust are two forest pests that plantation owners can control easily through appropriate interventions. If you are not planning to carry out monitoring in your plantations for these pests, your best bet is to reforest with other species.

> Norway spruce and white pine are two highly productive species;

> Although these two species are both subject to white pine weevil attack, Norway spruce is more susceptible than white pine (see graphs on page 7);

> Weevil attacks have a more severe impact on wood quality in white pine than in Norway spruce;

> A mixed plantation has fewer pines to prune.

> In this type of plantation, commercially valuable spruces can be harvested during the first thinning operation while maintaining the health of the white pines;

> If necessary, Norway spruce growing near poor quality pines can be preserved, enhancing residual stem quality in the plantation;

> A mixed plantation (white pine and Norway spruce) enhances forest biodiversity.

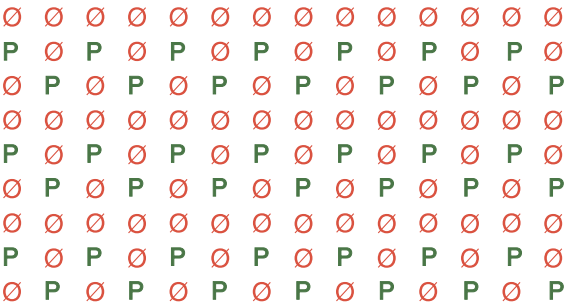
Example of a mixed plantation of white pine and Norway spruce in the Lower St. Lawrence Model Forest in spring 2004.

> Starting density: 2,500 seedlings/ha, with 2-m spacing between the seedlings and the rows.

> Reforestation with 1/3 eastern white pine and 2/3 Norway spruce in blocks with three rows, i.e. one row of Norway spruce and two mixed rows in which white pine and Norway spruce are alternated.

> During the first thinning operation, poor quality pines and spruces will be removed.

LAYOUT MODEL FOR A MIXED PLANTATION



Acknowledgments

We thank the staff of the Survey and Assessment Division (Forest Conservation Branch, Ministère des Ressources naturelles et de la Faune du Québec) for giving us access to the databases on reforestation and the annual plantation insect survey, as well as for their assistance in setting up training sessions.

ISBN 2-9808476-1-5
Legal Deposit – Bibliothèque nationale du Québec, 2004
Legal Deposit – Bibliothèque nationale du Canada, 2004

Simple steps for controlling the white pine weevil

Adults can live and lay eggs for 3 to 4 years.
Norway spruce plantations 3 to 12 years old must be inspected annually.
By destroying the infested terminal shoots, you can wipe out the current year's weevil generation.

1 When

should the infested leaders be pruned?

When wild raspberries are starting to ripen.

2 Inspection

Walk between the rows of trees in a systematic pattern, checking carefully.

If there are no rows, use a compass to map out 10-, 30- or 40-metre corridors, depending on whether 1, 2 or 3 people are conducting the inspection.

3 Pruning

Cut above the first whorl and leave the lateral branches intact.

Next year, remove one of the two laterals if they are in competition.

4 Disposal

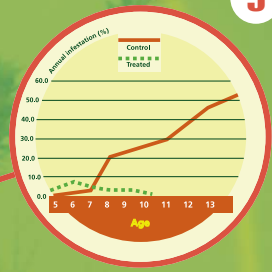
To save space in the pail and bag, remove the twigs from the leaders and the base of the uninfested leaders.

Promptly burn the leaders before the new adults emerge.

5 Results

Take action every year to **minimize** the number of affected trees **(green line)**.

In control plantations **(red line)**, the number of affected trees **increases** annually.



Worker productivity
at 1% infestation level = 0.5 hectare/hour/person

Recommandations

Take action **promptly every year**.

Re-visit the plantation after two weeks and follow the same procedures.

Use **good pruning shears**.

These guidelines also **apply** to **other tree species** susceptible to white pine weevil attack.

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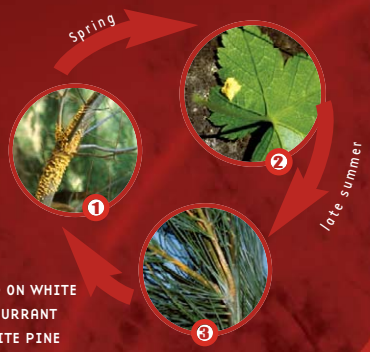
Controlling White Pine Blister Rust

White pine blister rust is an exotic disease introduced into North America in the early 1900s. In order to spread, this disease needs currant shrubs (*Ribes* spp.); it does not spread directly from pine to pine.



Life cycle

In spring, spores produced on white pine infect the foliage of currant shrubs. In late summer, white pine needles are infected with new spores produced on the foliage of currant shrubs. Small trees die when the disease reaches the trunk.

1 Inspection

Before any initiative to control blister rust is taken, the health of <u>young</u> plantations (6 to 12 years, depending on the region) needs to be assessed, preferably in spring (May-June) when blister rust is clearly visible.

2 Prescription

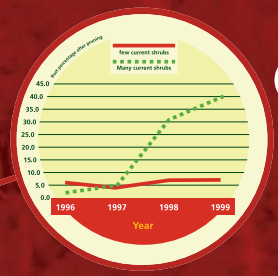
Following health assessment by a forestry adviser, a prescription is proposed if the number of infected trees warrants it. Intervention is not necessary when few stems are infected or when too many tree trunks are infected.

3 Pruning

Both infected and healthy branches are systematically pruned to a prescribed height.

Branch collars should not be damaged when cutting, but no stubs should be left.

Equipment: Well-sharpened pruning shears or handsaw. Axes or chain saws should not be used, so as not to damage the tender bark of white pine saplings. Work tools do not need to be sterilized.



5 Results

Blister rust can be controlled through pruning in young plantations when currant shrubs density near plantations is not too high.

Productivity
50-55 stems pruned per hour.

4 Disposal?

Branches do not need to be disposed of. They are left on site, because this blister rust fungus develops only in living tissue. Trees whose trunks are infected should be cut.

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