

# Pathological Pruning: A Useful Tool in White Pine Blister Rust Control

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## ABSTRACT

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Paired-tree plots were used to determine the advantages of pathological pruning, in which all lower branches are removed from young eastern white pines (*Pinus strobus*), as opposed to removing only cankered branches. After 9 yr, pathological pruning was nearly three times more effective than canker pruning because many latent infections were removed, and the preventive effect has been significant. Pruning cankered branches only would have saved 10.7% of the pruned trees, and an additional 20.1% were saved by removing all lower branches. Pathological pruning eliminated latent infections on 13.9% of trees and prevented new infections on 6.2%. Total blister rust loss in the unpruned controls was 29.7% compared with only 7.4% in the pruned trees.

White pines (*Pinus strobus*) are among North America's most valuable tree species. White pine blister rust (*Cronartium ribicola* J. C. Fischer ex Rabenh.) has been the most serious disease of white pines since its accidental introduction into the United States.

Early blister rust control entailed eradication of alternate host (*Ribes* spp.) plants from white pine stands. Pruning of cankered branches was also early recognized as a control (2,3), but it was seldom used to supplement ribes eradication. Because moisture and temperature conditions favorable for rust inoculation occur most frequently near the ground (1,7), it has been suggested that early removal of the lowest living branches from young trees would produce reliable control (6). Stewart (4) pruned all branches from the lowest 2.1 m of saplings averaging 3.8 m tall. Weber (8) removed the lowest one or two whorls in each of four biennial prunings beginning 3 yr after planting and terminating when the trees averaged 2.7 m tall and were pruned to about 1.2 m. Stewart reported greater control benefits than that from pruning only cankered branches, but neither he nor Weber reported any other than therapeutic effects.

Because of these studies, "pathological pruning" (removal of the lowest 35-40% of the green limbs, up to 2.7 m high, from young white pines of 1.2-5.5 m height) was instituted in 1965 in the Lakes States as a blister rust control measure. This study was conducted from 1970 to 1979 to evaluate the effectiveness of the pathological pruning program in Wisconsin.

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## MATERIALS AND METHODS

In this study, 741 study plots were established in eight (Fig. 1) natural and planted areas representing all of Van Arsdel's four climatic hazard zones (5). Each plot consisted of two trees paired on the basis of similar size, vigor, exposure, and proximity to each other. Neither tree in a pair could have a bole infection, but either or both could have a prunable branch canker.

In the blister rust survey procedure and in this study, all cankers with the earliest visible bark symptoms, a yellowish discoloration, within 10 cm of the bole were considered not prunable; any tree with such a canker was considered fatally infected. Branch cankers with the proximal margin more than 10 cm and the center less than 45 cm from the bole were considered lethal and prunable cankers. Any canker that had its origin more than 45 cm from the bole was considered nonlethal because the branch and canker were likely to die before the fungus mycelium grew to the bole. Canker age was determined by dating the year of internode formation at the origin of the canker and considering that as the year of inoculation.

In each paired-tree plot, one tree was treated by pruning all lower branches, leaving the upper 60-65% of the green crown intact. This is a standard pruning guideline that will not depress the growth rate of the pruned trees. Branches were pruned flush with the bole, but no attempt was made to excise bark at the branch collar. The height to which the treated trees were pruned, the height to which each control would have been pruned, and the total height of each tree were recorded. The pruned trees averaged 3.3 m tall and were pruned up to 1.6 m. Controls averaged 3.1 m and could have been pruned up to 1.6 m. All computations are based on the number of lethally infected trees rather than on the total

number of cankers. Plots were first rechecked for new infection and canker development 3 yr after establishment and annually thereafter. This report covers the period 1970-1979, but the study is being continued.

## RESULTS

This study shows that pathological pruning does prevent blister rust infections (Table 1). Average annual incidence of lethal new rust infections has been 3.4 times greater in the controls

**Table 1.** Effect of pathological pruning for white pine blister rust control in Wisconsin, 1970-1979

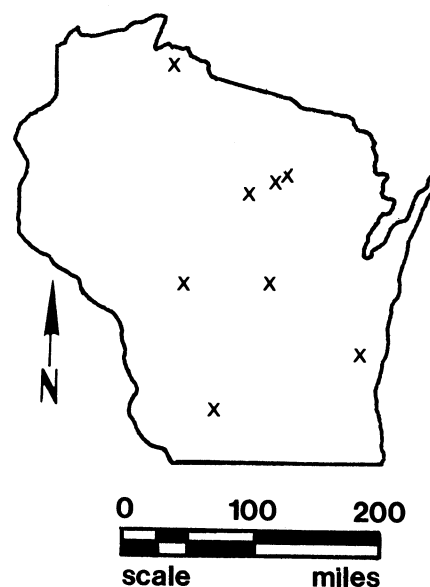
	Pruned		Not pruned	
	No.	%	No.	%
Trees	741	100	741	100
Trees with lethal cankers <sup>a</sup>	79	10.7	71	9.6
Trees with latent lethal infections <sup>b</sup>	38* <sup>c</sup>	5.1	103*	13.9
Trees becoming infected by 1979 <sup>d</sup>	17*	2.3	46*	6.2
Total lethally infected in 1979	55*	7.4	220*	29.7

<sup>a</sup> Cankers were removed from pruned trees at time of pruning.

<sup>b</sup> Therapeutic effect.

<sup>c</sup> \* = Significantly different (0.005 level) by chi square test from value on the same line.

<sup>d</sup> Preventive effect.



**Fig. 1.** Location of paired-tree plots used to evaluate pathological pruning for white pine blister rust control in Wisconsin.

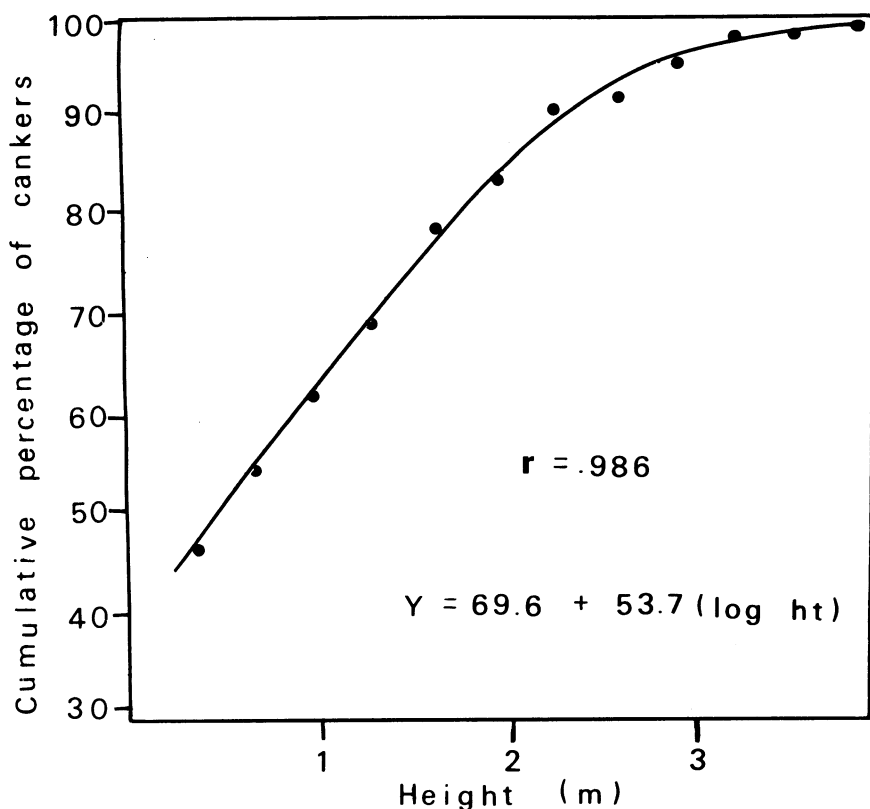


Fig. 2. Height of occurrence of first lethal blister rust cankers on white pines.

(1.2%) than in the pruned trees (0.3%). The results also showed that there were many latent infections present. When the study was established, latent infections on 103 controls and at least 38 pruned trees escaped detection. After eventual detection, the normal method of determining infection age indicated inoculation dates prior to pruning. Their removal was considered to be therapeutic. The benefit from removal of latent infections and the prevention of new infections exceeded that of removing observed cankers by more than 2 to 1. The total blister rust loss then was four times greater in the controls than in the pruned trees, with 220 pruned trees either dead or lethally infected and only 55 pruned trees similarly affected.

The study trees had grown to an average height of 7.7 m and could be pruned up to about 3.4 m in 1979. In spite of the increasing amount of foliage at

greater heights and some shading of lower branches, 90% of all lethal cankers found in this study occurred below 2 m and 96% were below 3 m (Fig. 2). Trees that had only nonlethal cankers occurred equally between pruned and not pruned (46 each), and the nonlethal cankers occurred at similar heights to lethal cankers.

Analysis using the chi square test shows that these differences in infection incidence between pruned and controls were significant at the 0.005 level.

#### DISCUSSION

There is currently no comprehensive integrated pest management strategy for blister rust control. This study shows that pathological pruning could be an important component in such a strategy for rust control in eastern white pine.

Pathological pruning could be the sole

control measure in low and medium climatic hazard zones (1,5) in situations where ribes eradication would be too expensive or where rust losses threaten to become limiting. In some stands in the medium hazard zones, pruning would give adequate control without ribes eradication. In some other stands, pruning could be used where ribes eradication has not provided desired control. This insufficient control might occur where ribes eradication was delayed too long after pine establishment, where eradication was poorly done, where excessive ribes regrowth occurred, or where favorable weather allowed long-range spread.

In areas with high climatic hazard, pruning could be used to supplement ribes eradication in all pine stands selected for protection. It could even be used to protect genetically resistant trees in the event that the resistance was overcome by races of the pathogen.

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