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CONIFEROUS STANDS IN NOVA SCOTIA

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FREDERICTON, NEW BRUNSWICK
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INTRODUCTION

The Nova Scotia Department of Lands and Forests with interests in pruning coniferous stands is concerned about decay fungi entering the trees and offsetting any benefits of pruning. Accordingly, a preliminary examination of some pruned stands was conducted at Crowdis Mountain, North River Picnic site, and Kelly's Mountain, Victoria County, Nova Scotia, to determine the relationship between pruning and incidence of heart rot in young trees, particularly balsam fir, Abies balsamea (L.) Mill.

METHODS

Field Procedure

On September 15 and 16, 1965, five pruned balsam fir and three pruned white spruce [Picea glauca (Moench) Voss] trees were cut from the areas mentioned above. The bole, from ground level to living crown, was cut into 3 foot bolts, transported to the Forest Research Laboratory at Fredericton, New Brunswick, and stored at 35 F until it was dissected.

Description of Areas

Information regarding operations on the three sites was quite limited as the work was done over a period of several

years by a contractor or by displaced coal miners employed under a government works program.

(1) Crowdis Mountain

This area is the freehold property of Bowaters Mersey Paper Company Limited. It was hoped pruning would release an extensive balsam fir "thicket" where trees averaged 3 inches DBH and 15 feet high. Plans were that Christmas trees would be removed for a few years leaving the balance of the pruned trees for a future pulpwood crop.

Four balsam fir trees were randomly chosen from this area. Ring counts, with respect to pruning scars, showed that these trees were pruned approximately $3\frac{1}{2}$ years ago, that is about mid-growing season, 1962.

(2) North River Picnic Site

Here the white spruce and balsam fir trees average about 5 inches DBH and 30 feet in height. Numerous broken tops, probably the result of a winter storm, are on the ground beneath the pruned trees. Two trees, one balsam fir and one white spruce, were removed from this area. These trees appeared to have been pruned 7 years ago, that is, prior to the 1959 growing season. However, Mr. G. K. Ross, Forester at Truro, N. S., believes that the work was done by displaced miners using axes, while being taught proper cutting methods during the fall of either 1960 or 1961.

(3) Kelly's Mountain

This area consists of immature white spruce and balsam fir averaging 5 inches DBH and 30 feet in height. Two white spruce trees were cut from this stand. Ring counts indicate that pruning occurred prior to the 1959 growing season, but there is no record of pruning here before 1960.

Laboratory Procedure

Individual trees were removed from storage and dissected between September 21 and November 22, 1965. Wounded sections of each stem were sawn vertically, through their centres. Branch stubs were split through their centres to expose a side view of the branch. Within 24 hours of dissection two isolates were made from each of the following points: within each branch; beside each branch; and from wounded areas; (2% malt extract agar slants). To reduce the possibility of fungi being isolated from extensions of a decay pocket which originated from a different infection court all isolates were made near the annual ring representing the apparent year of pruning. Records were made of tree age at stump, diameter at breast height, branch diameter, height of branch above base, size and age of wounds, and signs of decay such as wood discoloration. The percentage decay for pulpwood utilization was estimated for the Crowdis Mountain balsam fir by comparing the actual volume of firm and unfirm decay with the total stem volume (calculated by Smalian's formula).

Cultures were first examined 17 to 20 days after inoculation. Decay causing fungi (Basidiomycetes) which could not be determined at that time were plated for identification.

RESULTS

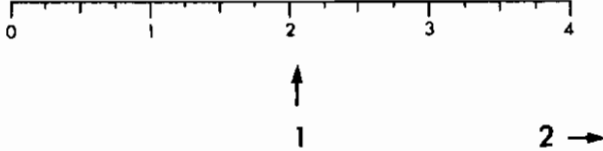
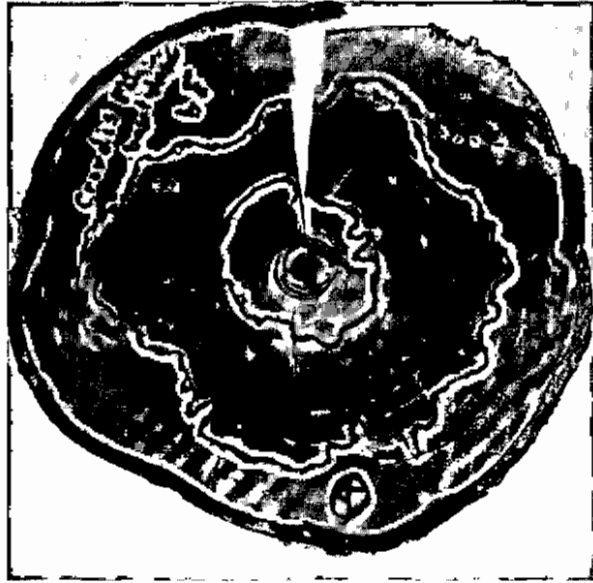
Balsam Fir

The one fir tree cut at North River had a buried leader which was over-grown about 28 years ago after being exposed for approximately 5 years. As it contained unfirm decay and was likely a major point of decay entry, the results for this tree are not averaged with those from Crowdis Mountain.

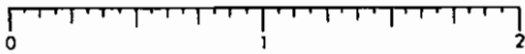
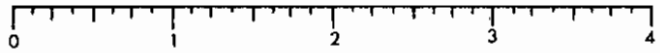
Table 1. Decay in Pruned Balsam Fir at Crowdis Mountain, N. S.

Tree	Stump age (years)	DBH (inch)	Decay %	No. pruned branches (not wounded)			No. measured wounds		Av. wound size (1.w/2 in. ²)
				Total	Dis-colored	With confirmed decay	Total	With confirmed decay	
C ₁	46	3.4	7.9	26	12	1	6	2	2.6
C ₂	16	2.9	3.1	11	7	1	6	1	2.2
C ₃	15	1.7	3.7	17	7	0	16	2	1.4
C ₄	35	3.0	19.2	20	8	2	11	10	2.5
Av.	28	2.75	8.5	18.5	8.5	1	9.8	3.8	2.2

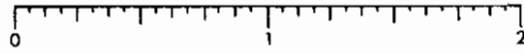
In this sample (Table 1) 34 (46%) of the 74 pruned, but otherwise unwounded branches, were distinctly discolored, suggesting incipient decay, but decay causing organisms were isolated



SCALES IN INCHES



3



4

from only 4 of these branches (5.4% of the total). Of the isolated Basidiomycetes, 12% originated within branches, 27% were from wood surrounding branch stubs, and 61% were from areas adjacent to wounded tissues. Decay causing fungi were isolated from 19 locations, of which 15 (79%) were associated with pruning wounds resulting from sapwood exposure. In other terms, 39 wounds were visible and were measured before dissection; 15 (39%) of these were decay entry courts (confirmed by isolation of decay organisms), but tissues adjacent to all wounds were discolored, suggestive of incipient decay. It appears that sapwood exposure during pruning operations provided the most serious entrance courts for decay causing fungi.

Several other observations were apparent. Branch diameter had little effect upon decay entry, for pruned branches as small as 0.3 inches in diameter gave isolates of decay organisms. At least two growing seasons were required, however,

Figures 1-4. Sections of a pruned balsam fir tree from Crowdis Mountain, N. S.

Figure 1. Basal disc showing the dark brown ring of decay.

Figure 2. Stem wound (4.0 x 1.0 inches) from which decay causing organisms were isolated.

Figure 3. Stem wound (2.0 x 0.8 inches) associated with a pruned branch (0.5 inch in diameter).

Figure 4. Section through wound and branch shown in Figure 3. Decay causing organisms were isolated from this section.

to heal over even the smallest infected branches. No correlation was found between branch decay and height of branch above the tree's base; this may be more significant in older trees where the basal branches have died slowly and naturally.

An examination of all branches or wounds from which decay fungi were isolated indicated that the branch was alive and/or living sapwood was exposed at the time of pruning.

Table 2. Frequency of Organisms Isolated from Pruned Balsam Fir at Crowdis Mountain and at the North River Picnic Site.

Organism	Crowdis Mt. trees 544 isolates Average	Range	North River tree 244 isolates (has a dead leader)
<u>Stereum sanguinolentum</u>	0.7%	0- 1.9%	2.5%
Unidentified Basidiomycetes	6.8	0.8-22.1	1.2
<u>Retinocyclus abietis</u>	6.4	2.3-11.8	9.8
Bacteria	32.0	19.1-54.7	6.2
Bacteria and Imperfects	8.3	4.5-13.6	0.8
Other Imperfects	6.2	1.3-10.5	2.5
No growth	38.8	26.7-47.5	76.2
Contaminated	0.8	0- 2.1	0.8

Decay producing Basidiomycetes were isolated in culture from wounds or pruned branches of all balsam fir trees examined (Table 2). The Basidiomycete occurring most frequently was Stereum sanguinolentum (Alb. and Schw. ex Fr.) Fr., the most destructive heart rot fungus of living conifers. The balance of the Basidiomycete cultures includes at least seven infrequently occurring fungi yet to be identified.

White Spruce

In general, sapwood wounds, regardless of size, were less important as decay entry courts in white spruce than in balsam fir (Table 3). All branches which were infection courts were living when pruned, varied in diameter from 0.5 to 1.2 inches, and required 2 to 3 years to heal over. The results with tree No. 2 from Kelly's Mountain are questionable because of the time between cutting and culturing (about 2 months). Although several of the wounds in this tree appeared to have decay, no Basidiomycete isolations were obtained.

Table 3. Decay in Pruned White Spruce at North River and Kelly's Mountain.

Tree	Stump age (yrs.)	DBH (inch)	Decay (approx.)	No. pruned branches (not wounded)			No. measured wounds		
				Total	Discolored	With confirmed decay	Total	With confirmed decay	Av. wound size (l.w/2 in. ²)
N ₁	40	4.8	5%	36	25	12	19	0	2.7
K ₁	42	5.5	pink stain only	41	11	0	9	1	2.5
K ₂	44	5.0	pink stain only	24	9	0?	7	0?	4.5

Examination of balsam fir (Table 2) and white spruce isolates showed white spruce to have a higher percentage (38.8% versus 68.5%) of isolates with no apparent growth. Similarly, the frequency of Retinocyclus abietis (Crouan)

Groves and Wells, a resin-inhabiting fungus, was greater in white spruce (12.6%) than in balsam fir (6.4%). Stereum sanguinolentum, the major Basidiomycete isolated from branches and wounds of spruce, occurred in 3.9% of the cultures. No bacteria were isolated from spruce, whereas 32% of the balsam fir isolates contained bacteria.

DISCUSSION

Because of the limited sampling, discussion is confined to the balsam fir at Crowdis Mountain. At present the problem here is of little economic importance because heart rot has little effect on the value of Christmas trees. A problem of considerable importance, however, is likely to appear when the remaining trees are harvested for pulp.

Davidson (1951), in a study of decay in unpruned balsam fir in the Green River Watershed, found no decay in trees under 40 years old. Smerlis (1961) in Quebec found decay in only 12.6% of the trees in a 46-55 year old balsam fir stand, and even then only 1.4% of the wood volume was decayed. By contrast, all pruned trees sampled at Crowdis Mountain had decay, and decay volume ranged from 3.1% to 19.2%. These trees average only 28 years of age. When they are mature the amount of decay is likely to be very significant in pulpwood, where both quantity and quality of pulp is reduced by decay.

Little information is available on allowable volumes of decay and its effect on pulp yield and quality. In general decayed wood is less dense than normal wood and gives a lower cellulose yield. Consequently, more decayed wood is required to produce the same amount of pulp. Moreover the pulp is darker, dirtier and weaker, and more cooking liquor is needed (Sheridan, 1958). According to Beath (1956) decayed wood should make up less than 5% of the wood being used at any one time for efficient operation of the modern high speed paper machines.

Storage of pruned pulpwood may also be a problem. Sapwood decay organisms became very active when our samples were removed from the coldroom. Sheridan (1958) believes shorter storage periods will be necessary as pulpwood may decompose faster following the introduction of fungi during pruning operations.

ACKNOWLEDGEMENTS

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