WOUND HEALING AND FUNGAL COLONIZATION IN STEMS OF YOUNG TREMBLING ASPEN AFTER THINNING AND PRUNING

by

G. A. STENEKER and R. E. WALL

NORTHERN FOREST RESEARCH CENTRE
INFORMATION REPORT NOR-X-37
JUNE 1972

CANADIAN FORESTRY SERVICE
DEPARTMENT OF THE ENVIRONMENT
5320 - 122 STREET
EDMONTON, ALBERTA, CANADA
T6H 3S5

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

WOUND HEALING AND FUNGAL COLONIZATION IN STEMS OF YOUNG TREMBLING ASPEN AFTER THINNING AND PRUNING

by

G. A. Steneker* and R. E. Wall**

ABSTRACT

Fifteen-year-old trembling aspen (Populus tremuloides Michx.) on unthinned and thinned (12 x 12 ft or 3.7 x 3.7 m spacing) 1/10-ac (0.04 ha) plots were pruned to a height of 10 ft (3.1 m) in September 1964 and April 1965. Pruned branch stubs on half of the trees were dressed with an asphalt-base paint immediately after pruning. After 5 years, living trees from each treatment were harvested. Thinning increased diameter increment by about 60% and also resulted in more rapid wound healing. In the unthinned plots, wound dressing resulted in somewhat slower wound healing and more extensive fungal colonization as indicated by isolations from pruning wounds. More organisms were isolated from pruned trees than from unpruned controls, the main isolates being a bacteria, a yeast, and Cytospora chyrsosperma (Pers.) Fr. Very little decay was detected and the fungi known to cause trunk rot in aspen were isolated in very few instances. The trunk rot fungus Peniophora polygonia Pers. ex Fr. (Bourd and Galz) was isolated from tissues adjacent to several wounds which had failed to heal over. Cankers developed around some of these wounds.

* Research Officer, Northern Forest Research Centre, Environment Canada, Edmonton, Alberta. T6H 3S5

** Research Scientist, Maritime Forest Research Centre, Environment Canada, Fredericton, New Brunswick.

INTRODUCTION

Cull studies in trembling aspen have provided good evidence that trunk rots are the principal cause of volume losses (Thomas, Etheridge, and Paul, 1960; Basham, 1958; Black and Kristapovich, 1954)* The fungi causing trunk rots are probably introduced through exposed wood tissue, particularly branch stubs (Schmitz and Jackson, 1927; Basham, 1958), although the possibility of infection through fresh wounds has been suggested (Manion and French, 1968). If infection through branch stubs is more prevalent, pruning of young trees should reduce infection by trunk-rot fungi at later stages. In addition, pruning should further improve the quality of the final product by providing wood with fewer knots. On the other hand, pruning exposes fresh wood tissue and thereby increases the danger of introducing decay organisms which may be capable of invading fresh wounds. Therefore pruning should be limited to vigorous, fast-growing trees with relatively small branches which would heal over rapidly (Hawley and Smith, 1954; Zeedyk and Hough, 1958; Stoeckeler and Arbogast, 1947; Mayer-Wegelin, 1936). The use of a dressing on the cut surface has been recommended (FAO, 1958), although the value of this practice is doubtful according to the results of Neely (1970).

The ultimate purpose of the experiment, initiated in 1964, was to determine whether through pruning the introduction into the aspen stem of trunk rot fungi can, as a result of the healing over of branch stubs, be

---

* Black, R. L. and P. J. Kristapovich. 1954. Decay of trembling aspen in Manitoba and Saskatchewan. Can. Dept. Agri. For. Path. Lab. Saskatoon, Interim report.

prevented or reduced. Furthermore, it was thought that the introduction of artificial changes as a result of branch removal might assist in obtaining a better understanding of the process of natural infection by trunk rot fungi. The present report deals with the initial healing process in pruning wounds and preliminary fungal colonization.

METHODS

A 15-year-old aspen stand along the south boundary of the Porcupine Forest Researve in western Manitoba was selected for treatment. The stand had developed on a moderately well-drained clay loam till. Adequate moisture is available throughout most of the growing season. Occasional mottling, as a sign of impeded drainage, may occur in the soil profile. Trees ranged up to 3 inches (7.5 cm) in diameter at breast height (d.b.h.) and 15 to 20 ft (5 to 6 m) in height. Twenty-four 1/10-ac (0.04 ha) sample plots were established within the stand, and in each plot 35 good quality, evenly spaced dominant and codominant trees were selected. These trees averaged 2.3 inches (5.8 cm) at d.b.h. On each plot the selected trees were assigned randomly to one of five treatments, thus providing seven replications per plot. The treatments were:

F: flush pruning in the fall (Sept.) of all branches to a height of 10 ft (3.1 m),

FD: as in F but dressing applied to wound surface,

S: flush pruning in the spring (April) to a height of 10 ft (3.1 m),

SD: as in S but dressing applied to wound surface,

C: unpruned controls.

Twelve plots were thinned to a spacing of about 12 x 12 ft, (3.7 x 3.7 m) by leaving only the 35 selected trees on the plot. The thinning was done to determine the effect of the anticipated increase in diameter increment on the rate of healing-over of pruned branch stubs. On the other 12 plots no trees were cut. Each treatment was therefore applied to 84 released and 84 unreleased trees. Figure 1, a and b, illustrates the pruned and control condition on thinned plots.

All branches to a height of 10 ft were cut flush with the stem, using a knife and hammer. Asphalt-base tree paint was applied immediately after pruning to FD and SD trees. The height and diameter of all sample trees and the size, height from the ground and status (dead or alive) of all pruned branches was recorded. The number and size range per tree of pruned branches was similar for the various treatments. Statistics for pruned branches in 1965, including all treatments, are shown in Table 1.

TABLE 1. NUMBER, SIZE, AND STATUS OF PRUNED BRANCHES AT TIME OF TREATMENT

Pruned branches per tree to height of 10 ft (3.1 m)							
number				diameter (inches)			
alive		dead		alive		dead	
range	average	range	average	range	average	range	average
0-7	0.25	6-31	18.0	.12-1.40 (.3-3.6cm)	.59 (15 cm)	.08-1.20 (0.2-3.0cm)	.32 (0.8cm)

Increment cores were taken at breast height from a number of trees to determine periodic diameter increment before thinning.

After five growing seasons, all living sample trees on three thinned and three unthinned plots were harvested. Height and diameter of each tree harvested were recorded. After the trees had been cut, several nodal sections, approximately 4 inches (1 dm) in length, were cut from that part of each stem between 4 and 8 ft (1.2 and 2.4 m) from ground level. These nodal sections were surface sterilized in 1% lysol solution and aseptically split parallel to a branch axis. Two isolations were made on 2% malt-extract agar from discolored or decayed wood immediately below the axil of each embedded branch stub. The longitudinal sections were then examined to provide measurements of branch size and rate of healing-over. The incidence of stains and decay was noted in each section, the tan or reddish-brown stain usually associated with branch

stubs being visually rated on a 0 to 5 scale (0 = no stain, 5 = intense reddish-brown stain).

RESULTS

Diameter Growth and Branch Healing

Increment core analyses indicated that thinned and unthinned trees of similar size in 1964 had comparable growth rates before treatment. Thinning resulted in an increase in diameter increment of about 60% (Table 2).

Examination of a random sample of pruned branch stubs of trees in thinned and unthinned plots indicated that it took 1 to 2 years longer for branch stubs of similar size to heal over on unthinned than on thinned plots (Table 3). Based on the examination on thinned plots of 65 branch stubs, ranging in diameter from 0.1 to 0.7 inches (0.3-1.8 cm), 8% of the stubs were still not closed over with wood after five growing seasons. For the unthinned plots this percentage was 35, based on the examination of 96 branch stubs with the same range in size. As expected, time required to heal over increased with increasing branch size.

Heavy mortality, particularly on the thinned plots, occurred among the study trees during the first 2 to 3 years after treatment (Table 4). Cankers associated with pruning wounds, particularly those that received a dressing, were observed on many of the dead and dying trees.

Microorganisms Associated with Pruning Wounds

In Tables 4, 5, 6 and 7 are summarized the defects associated with branch stubs and the results of isolations on malt-extract agar. As expected, no advanced decay was found in the young trees. Incipient decay, although difficult to detect, was observed in a few trees, mainly adjacent to open pruning wounds or around aged branch stubs in unpruned trees in unthinned plots (Table 6). Reddish brown stains were always present around healed-over branch stubs (Table 6). About 50% of the isolation attempts from stem tissue adjacent to embedded branch stubs or open pruning wounds resulted in sterile cultures. However, the proportion yielding microorganisms was greater in isolations from pruned than control trees (Table 4) and in isolations from open than healed-over pruning wounds (Table 6). Conversely, in unpruned controls the proportion of successful isolation attempts was greater in healed-over than exposed branch stubs (Table 6). As expected, nodes where cankers or incipient decay were observed gave rise to a greater number of positive isolations than apparently healthy stem sections (Table 7), but there appeared to be little association of stains with microorganisms.

All of the bacterial isolates produced slimy cream-colored colonies on malt-extract or peptone-dextrose agar and were ovoid to rod-shaped. Representative isolates were tentatively placed in the Agrobacterium chromobacter group (Hawirko, personal communication). These bacteria were slightly more prevalent in isolations from pruning wounds

which had not been treated than in wound-dressed trees (Table 4) and from tissue adjacent to small healed-over branch stubs with deep brown stain than from larger open pruning wounds with less stain (Tables 5, 6 and 7).

The yeast isolates closely resembled the bacterial isolates in culture and microscopically all appeared the same -- a small, budding imperfect yeast. Representative isolates had similar biochemical characteristics (Spencer, personal correspondence). This yeast was much more prevalent in isolations from pruned than control trees (Table 4) and like the bacteria, were more frequently associated with small healed-over branch stubs than the larger, slower healing branches (Table 5 and 6). The association with the two main types of stain was slight, and inconsistent vis-a-vis the controls and pruned trees (Table 7).

The main mycelial fungi isolated were Cytosporina acharii (Sacc) Grove and Cytospora chrysosperma (Pers.) Fr. C. acharii isolates arose mainly from trees with treated pruning wounds (Table 4), many of which were open at the time of harvest (Table 6) and had associated cankers (Table 7). It was not isolated from unpruned trees. Cytospora was likewise associated with large branches, open wounds and cankers but was more widespread in distribution, occurring for instance in wood adjacent to small healed-over branch stubs in unpruned trees (Table 6) and being especially prevalent in fall-pruned untreated trees (Table 4).

Basidiomycetes were isolated infrequently but those identified as such were those usually associated with poplar decay. Peniophora polygonia was isolated from decayed samples, mostly those with open pruning wounds (Table 6) and some detectable decay (Table 7). Polyporus adustus Willd.

ex Fr. was recovered from 2 trees in the same plot from wood adjacent to healed-over pruning wounds. Fomes igniarius var. populinus was isolated from decayed tissue adjacent to aged branch stubs in an unpruned tree (Table 5 and 6). None of the 28 basidiomycetes isolated came from tissues where yellow or yellow-green stain was observed (Table 7).

DISCUSSION

At the time of pruning, most of the branches had been dead for one or more years. Therefore, little difference was expected in the extent of colonization by preliminary invaders, mainly bacteria and yeasts between treated and untreated trees. The tendency in this study for a greater incidence of micro-organisms in pruned trees than in controls at first glance leaves the efficacy of the pruning treatment in doubt. Furthermore, treatment of pruning wounds with asphalt paint apparently did not help in reducing fungal colonization.

Although more rapid wound healing occurred on the thinned plots, trees on these plots showed no evidence of less fungal incidence than those on the unthinned plots, suggesting that wound healing was not sufficiently rapid to prevent fungal colonization in any of the treatments. Response to thinning was less than expected. Diameter growth data from other aspen stands of the same age and subjected to a similar thinning intensity as used here, showed growth increases up to 100% (Steneker and Jarvis, 1966). A heavy tent caterpillar (Malacosoma sp. attack

during the year of treatment, in combination with the sudden exposure of trees after thinning may have weakened tree vigor and thereby retarded wound healing. Under more favorable conditions it may be expected that a thinning intensity as applied here will hasten the healing-over process by 2 to 3 years.

Other than the slightly higher incidence of Cytospora in fall-pruned untreated trees, no apparent differences could be detected in the fungal colonization between fall and spring-pruned trees. The dormant season may not be (according to Borsdorf (1966), the best time for pruning. He suggests that poplars be pruned shortly after the growing season has started so that the healing over of branch stubs would start immediately and the chances of infection be reduced. Time of spore dispersal in relation to pruning time presumably also plays a role in the chances of pruning wounds to become infected but the few aspen-infecting fungi which have been investigated are known to produce spores throughout the frost-free season and sometimes beyond (Riley, 1952; Wood and French, 1961).

Attempts to relate the various pruning treatments and the incidence of microorganisms to the occurrence and intensity of stains were largely unsuccessful. Findings tend to support those of Sucoff et al. (1967) who artificially produced stains in aspen stem tissue and concluded that these stains are not due primarily to microorganisms.

Except for the wound invader, Cytosporina acharii, the organisms isolated from stem tissues coincided closely with those reported by Etheridge (1961). In his study infection by Cytospora and other fungi

imperfecti became evident 4 or more years after branch death and basidiomycetes were isolated from branches which had been dead for at least 8 years. The bulk of the branches on the stems sampled in this study have probably been dead 4 to 8 years, since only a small number were still living at time of pruning and the trees were only 15 to 20 years of age.

It is noteworthy that Fomes igniarius var. populinus was not found associated with open pruning wounds. Inoculum was undoubtedly present at the time of pruning since sporophores were present on older trees in the study area. Riley (1952) has also shown that the fungus produces basidiospores from early spring until late fall.

Recently killed lower branches of aspen were considered too dry for rapid fungal infection (Etheridge, 1961). It appears that as these dead branches age, infection gradually increases and a natural avenue to the central part of the stem is formed. Substances which selectively favor Fomes igniarius var. populinus are present in these slowly deteriorating process. Pruning, although it may result in more extensive colonization by primary invaders, should therefore facilitate escape from later invasion by trunk-rotting fungi as a result of more rapid healing-over of branch stubs.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. R. Hawirko of the University of Manitoba for identifying the bacteria, Dr. J. F. T. Spencer of the

National Research Council for examination of yeasts, and Drs. R. A. Shoemaker, K. A. Pirozynski and J. H. Ginns of the Canada Department of Agriculture for identifying the fungi.

REFERENCES

Basham, J. T. 1958. Decay of trembling aspen. Can. J. Bot. 36:491-505.

Borsdorf, W. 1966. The best time for pruning poplars. Forestry Abstracts 27:674 (Original in: Arch. Forstw. 15:153-167, 1966.)

Etheridge, D. E. 1961. Factors affecting branch infection in aspen. Can. J. Bot. 39:799-816.

Food and Agri. Organization, of the United Nations, 1958. Poplars in forestry and land use. Forestry and Forest Products Studies. No. 12. Rome. 511 pp.

Hawley, R.C., and D.M. Smith. 1954. The practice of silviculture. John Wiley and Sons Inc., N.Y. Chapman and Hall Ltd., London, 6th Ed., vii + 525 pp.

Manion, P. D., and D. W. French. 1968. Inoculation of living aspen trees with basidiospores of Fomes igniarius var. populinus. Phytopathology 58:1302-1304.

Mayer-Wegelin, H. 1936. Extracts from: Astung (Pruning). U.S.D.A. For. Service, Division of Silvics, Translation No. 264. (Translated from the German by C. P. de Blumenthal, 1936.)

Neely, D. 1970. Healing of wounds on trees. J. Amer. Soc. Hort. Sci. 95:536-540.

Riley, C. G. 1952. Studies in forest pathology IX. Fomes igniarius decay in poplar. Can. J. Bot. 30:710-734.

Schmitz, H., and W. R. Jackson. 1927. Heart rot of aspen with special reference to forest management in Minnesota. Univ. of Minn., Agric. Exp. Sta., Tech. Bull. 50.

Steneker, G. A., and J. M. Jarvis. 1966. Thinning in trembling aspen stands, Manitoba and Saskatchewan, Canada Dept. Forestry, Public No. 1140.

Stoeckeler, J. H., and C. F. Arbogast. 1947. Thinning and pruning of young second growth hardwoods in N. E. Wisconsin. Proc. Soc. Am. Foresters. p. 328.

Sucoff, E., H. Ratsch, and D. D. Hook. 1967. Early development of wound initiated discoloration in Populus tremuloides Michx. Can. J. Bot. 45:649-656.

Thomas, C. P., D. E. Etheridge, and G. Paul. 1960. Fungi and decay in aspen and balsam poplar in the Boreal Forest Region, Alberta. Can. J. Bot. 38:459-466.

Wall, R. E., and J. E. Kuntz. 1964. Water soluble substances in dead branches of aspen (Populus tremuloides Michx.) and their effects on Fomes igniarius. Can. J. Bot. 42:969-977.

Wood, F. A., and D. W. French. 1962. Ejection of ascospores by Hypoxylon pruinatum during the winter in Minnesota. Phytopathology 52(1):33.

Zeedyk, W. D., and A. F. Hough. 1958. Pruning alleghany hardwoods, U.S.D.A. For. Service, N.E. For. Exp. Sta., Sta. Pa. No. 102.

TABLE 2. PERIODIC BREAST HEIGHT-DIAMETER INCREMENT BY SIZE CLASS ON THINNED AND UNTHINNED PLOTS, 1965-1969

Treatment	Diameter class (") 1965	No. trees examined	Diameter increment 1965-1969
Not thinned	2 in (5.1 cm)	44	0.54 in (1.4 cm)
	3 " (7.6 cm)	15	0.71 " (1.8 cm)
Thinned	2 " (5.1 cm)	32	0.92 " (2.3 cm)
	3 " (7.6 cm)	12	1.00 " (2.5 cm)

TABLE 3. NUMBER OF CLOSED* AND OPEN BRANCH STUBS BY BRANCH SIZE ON THINNED AND UNTHINNED PLOTS 5 YEARS AFTER TREATMENT. (PRUNED TREES ONLY)

Branch diam. (")	UNTHINNED									THINNED									
	No. branches			%	No. yrs to close					No. branches			%	No. yrs to close					
	exam.	closed	open	open	1	2	3	4	5	exam.	closed	open	open	1	2	3	4	5	
0.15	3	3	-	0		1	2			1	1	-	0				1		
0.20	8	5	3	38			4	1		7	7	-	0.		3	2	2		
0.25	15	14	1	7			7	6	1	8	5	3	38		3	2			
0.30	8	5	3	38			2	2	1	11	10	1	9		1	6	3		
0.35	13	9	4	31			4	4	1	11	10	1	9		1	6	3		
0.40	10	5	5	50			1	3	1	12	12	-	0			4	6	2	
0.45	12	9	3	25			2	5	2	7	7	-	0			3	4		
0.50	9	5	4	44			1	3	1	6	6	-	0			3	3		
0.55	6	1	5	83				1		1	1	-	0				1		
0.60	5	3	2	40				2	1	-									
0.65	2	1	1	50					1	-									
0.70	5	2	3	60				1	1	1	1	-	0		1				
SUB TOTAL	96	62	34	35		1	23	28	10	65	60	5	8	-	9	26	23	2	

* Pruning wounds were considered closed when covered with at least 1 year wood growth.

TABLE 3. (continued)

Branch diam. (")	UNTHINNED No. branches exam.	closed	open	% open	No. yrs to close 1	2	3	4	5	THINNED No. branches exam.	closed	open	% open	No. yrs to close 1	2	3	4	5
0.75	7	2	5	71				1	1									
0.80	3	2	1	33				1	1									
0.85	4	-	4	100														
0.90	-	-	-															
0.95	-	-	-															
1.00	4	1	3	75					1									
1.05	—	—	—															
1.10	1	-	1	100														
1.15	1	-	1	100														
TOTAL	116	67	49	42	-	1	23	30	13	65	60	5	8	-	9	26	23	2
% OF TOTAL					0	1.5	34	45	19					0	15	43	38	3

TABLE 4. DEFECTS ASSOCIATED WITH TREATMENTS AND ORGANISMS ISOLATED FROM STEM TISSUE ADJACENT TO BRANCH STUBS 5 YEARS AFTER TREATMENT

ITEM	THINNED					UNTHINNED				
	F*	FD*	S*	SD*	CONTROL	F*	FD*	S*	SD*	CONTROL
Number of trees**	14	14	14	14	18	18	17	20	18	20
Number examined	83	73	81	79	106	108	102	117	103	110
% Healed over	88	89	98	82	7	72	58	87	75	10
% Nodes with Reddish-brown stain***	59	62	74	54	69	77	48	69	72	71
Yellow-green stain	8	25	41	24	21	23	25	30	31	29
Incipient decay	0	0	5	4	0	6	4	3	5	5
Cankers	0.	0	0	5	1	1	12	0	10	0

* F = pruned Sept. 1964, FD = as F plus wound dressing, S = pruned in April 1965, SD = as S plus wound dressing.

** Represents trees which survived out of the original 21 per treatment.

*** Branch pockets where stain in the adjacent sapwood equaled or exceeded a rating of 3 in a 0 to 5 rating system.

TABLE 4. (Continued)

ITEM	THINNED					UNTHINNED				
	F	FD	S	SD	CONTROL	F	FD	S	SD	CONTROL
% isolations yielding****										
Bacteria	13	9	17	9	10	19	3	16	9	15
Yeasts	29	28	22	23	11	9	12	8	19	2
Cytosporina acharii	0	1	1	7	0	4	13	3	9	0
Cytospora spp.	16	12	4	6	6	18	11	12	12	2
Phoma sp.	1	1	0	2	1	0	2	2	5	0
Peniophora polygonia	0	2	0	2	1	3	3	0	0	0
Polyporus adustus	0	0	0	0	0	0	0	1	0	0
Fomes igniarius var. *populinus*	0	0	0	0	0	0	0	0	0	2
Miscellaneous and unidentified	2	5	1	8	3	6	6	3	5	5
Sterile cultures	39	42	54	42	67	40	49	54	40	75

**** Number of isolations is twice the number of nodes examined (row 2).

TABLE 5. DEFECTS ASSOCIATED WITH PRUNED AND UNPRUNED BRANCH STUBS OF DIFFERENT DIAMETER IN THINNED AND UNTHINNED PLOTS AND ORGANISMS ISOLATED FROM STEM TISSUE ADJACENT TO BRANCH STUBS 5 YEARS AFTER TREATMENT

ITEM	PRUNED						UNPRUNED CONTROLS			
	Thinned			Unthinned			Thinned		Unthinned	
	<0.3"	0.3"-0.5"	>0.5"*	<0.3"	0.3-0.5"	>0.5"*	<0.3"	>0.3"	<0.3"	>0.3"*
Number examined	94	182	40	182	208	40	52	54	55	55
Mean height on tree (in)**	72	74	77	71	74	74	75	75	69	81
% Healed Over	94	88	83	93	64	35	14	0	20	0
% Nodes with Reddish brown stain***	66	61	60	78	60	53	71	67	69	73
Yellow-green stain	19	25	35	23	32	23	21	20	31	27
Incipient decay	4	2	0	2	4	23	0	0	2	7
Cankers	0	2	0	3	6	13	2	0	0	0

* Diameters of branches measured at location of pruning cut made 5 years previously or equivalent point in controls.

** Standard deviation 10 to 15 inches.

*** Staining intensity equal to or exceeding a rating of 3 in a 0 to 5 rating system.

TABLE 5. (Continued)

ITEM	PRUNED						UNPRUNED CONTROLS			
	Thinned			Unthinned			Thinned		Unthinned	
	<0.3"	0.3"-0.5"	>0.5"*	<0.3"	0.3-0.5"	>0.5"*	<0.3"	>0.3"	<0.3"	>0.3"*
% isolations yielding****										
Bacteria	17	11	9	16	9	6	8	12	15	14
Yeasts	40	20	13	14	11	4	12	10	3	1
Cytosporina acharii	2	2	1	4	8	13	0	0	0	0
Cytospora spp.	7	10	15	9	16	24	11	2	3	2
Phoma sp.	1	1	1	3	2	1	1	1	0	0
Peniophora polygonia	1	1	0	1	2	3	1	1	0	0
Polyporus adustus	0	0	0	1	0	0	0	0	0	0
Fomes igniarius var. *populinus*	0	0	0	0	0	0	0	0	3	1
Miscellaneous and unidentified	2	6	3	2	7	8	4	2	6	3
Sterile cultures	31	48	59	51	44	41	64	71	70	80

* Diameters of branches measured at location of pruning cut made 5 years previously or equivalent point in controls.

**** Number of isolations twice the number of specimens examined (row 1).

TABLE 6. DEFECTS ASSOCIATED WITH HEALED-OVER AND EXPOSED PRUNING WOUNDS AND UNPRUNED DEAD BRANCHES IN THINNED AND UNTHINNED PLOTS AND ORGANISMS ISOLATED FROM STEM TISSUE ADJACENT TO BRANCH STUBS 5 YEARS AFTER TREATMENT.

ITEM	PRUNED TREES				UNPRUNED CONTROLS			
	Thinned		Unthinned		Thinned		Unthinned	
	Healed Over	Open*	Healed Over	Open*	Healed Over	Exposed	Healed Over	Exposed
Number examined	283	34	317	112	7	99	11	99
% Nodes with Reddish brown stain**	66	32	74	53	86	68	82	70
Yellow-green stain	27	6	28	30	14	21	18	30
Incipient decay	2	12	3	13	0	0	9	4
Cankers	0	12	0	20	0	1	0	0
% Isolations yielding***								
Bacteria	13	4	14	5	7	10	50	9
Yeasts	27	9	14	6	21	16	5	2
Cytosporina acharii	1	10	4	17	0	0	0	0
Cytospora spp.	6	41	9	24	29	5	0	3
Phoma sp.	1	2	3	2	0	1	0	0

* Includes pruning wounds recently covered with callus growth.

** Branch pockets with stain equal or exceeding a rating of 3 in a 0 to 5 rating system.

*** Number of isolations twice the number of specimens examined (row 1).

TABLE 6. (Continued)

ITEM	PRUNED TREES				UNPRUNED CONTROLS			
	Thinned		Unthinned		Thinned		Unthinned	
	Healed Over	Open*	Healed Over	Open*	Healed Over	Exposed	Healed Over	Exposed
Peniophora polygonia	0	6	1	9	0	1	0	0
Polyporus adustus	0	0	1	0	0	0	0	0
Fomes igniarius var. *populinus*	0	0	0	0	0	0	9	1
Miscellaneous, mixed, and unidentified	3	13	3	12	0	3	0	5
Sterile cultures	48	15	52	25	43	68	36	79

* Includes pruning wounds recently covered with callus growth.

TABLE 7. ASSOCIATION AMONG DEFECTS IN STEM TISSUE ADJACENT TO BRANCH STUBS IN PRUNED AND CONTROL TREES AND THEIR ASSOCIATION WITH ORGANISMS ISOLATED 5 YEARS AFTER TREATMENT

ITEM	PRUNED TREES								UNPRUNED CONTROLS			
	Reddish-brown stain*		Yellow-green stain		Incipient decay		Cankers		Reddish-brown stain		Yellow-green stain	
	with	w/o	with	w/o	with	w/o	with	w/o	with	w/o	with	w/o
Number examined	486	260	199	547	30	716	27	719	151	65	54	162
% with Reddish-brown stain	-	-	53	70	57	66	33	66	-	-	74	66
Yellow-green stain	22	35	-	-	20	27	15	27	29	15	-	-
Incipient decay	3	5	3	4	-	-	15	4	3	2	2	3
Cankers	2	7	2	4	13	3	-	-	0	2	0	1
% Isolations yielding**												
Bacteria	13	8	9	12	13	12	6	12	14	8	18	10
Yeasts	20	13	12	19	8	18	0	18	5	9	10	5
Cytosporina acharii	4	7	4	5	3	5	28	4	0	0	0	0

* Branch pockets with stain equal or greater than or less than a rating of 3, respectively in a 0 to 5 rating system.

** Number of isolations twice the number of specimens examined.

TABLE 7. (Continued)

ITEM	PRUNED TREES								UNPRUNED CONTROLS			
	Reddish-brown stain*		Yellow-green stain		Incipient decay		Cankers		Reddish-brown stain		Yellow-green stain	
	with	w/o	with	w/o	with	w/o	with	w/o	with	w/o	with	w/o
Cytospora spp.	10	15	10	14	23	12	28	12	6	1	1	5
Phoma sp.	1	1	2	1	2	1	2	1	1	0	1	0
Peniophora polygonia	1	3	0	2	15	1	9	1	0	1	0	1
Polyporus adustus	0***	0	0	0***	0	0***	0	0***	0	0	0	0
Fomes igniarius var.populinus	0	0	0	0	0	0	0	0	1	1	0	1
Miscellaneous and unidentified	5	6	5	5	10	5	9	5	4	2	8	2
Sterile cultures	46	47	58	42	26	46	18	47	69	78	62	76

* Branch pockets with stain equal or greater than or less than a rating of 3, respectively in a 0 to 5 rating system.

*** Incidence of P. adustus less than 0.5%.

Figure 1a - Pruned stem from thinned plot showing callus formation around branch 2 years after pruning.

Figure 1b - Unpruned stem on thinned plot showing amount and size of branches.

Steneker, G. A., and R. E. Wall

1972. Wound healing and fungal colonization in stems of young trembling aspen after thinning and pruning.

Information Report NOR-X-37; 25 p.;
Northern Forest Research Centre,
Canadian Forestry Service,
Environment Canada,
Edmonton, Alberta.
T6H 3S5

Steneker, G. A., and R. E. Wall

1972. Wound healing and fungal colonization in stems of young trembling aspen after thinning and pruning.

Information Report NOR-X-37; 25 p.;
Northern Forest Research Centre,
Canadian Forestry Service,
Environment Canada,
Edmonton, Alberta.
T6H 3S5

Copies of this publication (if still in stock) may be obtained from:

Information Officer
Northern Forest Research Centre
Canadian Forestry Service,
Environment Canada
5320 - 122 Street
Edmonton, Alberta, Canada
T6H 3S5