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Hypoxylon canker incidence on pruned and unpruned aspen¹

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This study was designed to measure the relation between the incidence of *Hypoxylon* canker, *Hypoxylon mammatum* Wahl. Mill., and the presence of branches on an aspen stem. Two test areas were established in sprout aspen stands in Minnesota and Wisconsin where paired sprouts were chosen for study. Limbs were pruned from the lower two-thirds of the stem of one member of each pair; the other was left unpruned. Pruning was continued during the study period to keep the lower two-thirds of the stem 'branch-free.' Pruned trees had less lower stem infection and more upper stem infection than unpruned trees. Results indicate that initial infection occurs on branches and the fungus then grows down the branch and into the stem.

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Cette étude avait pour but de déterminer l'incidence des branches sur le chancre hypoxylonien, *Hypoxylon mammatum* Wahl. Mill., chez le peuplier faux-tremble. Deux places d'études furent établies, l'une au Minnesota et l'autre au Wisconsin, dans des peuplements de peupliers où des drageons furent sélectionnés par groupes de deux. Un membre de chaque paire fut élagué sur les deux-tiers de la hauteur; l'autre fut laissé intact pour servir de témoin. L'élagage a été refait périodiquement pour prévenir le développement de nouvelles branches pendant la durée de l'étude. Dans la partie supérieure du tronc, les infections furent plus nombreuses chez les arbres élagués; dans la partie inférieure du tronc, les arbres témoins subirent plus d'infections. Ces résultats tendent à démontrer que le champignon infecte d'abord les branches et progresse ensuite jusqu'au tronc.

Introduction

Hypoxylon canker, caused by *Hypoxylon mammatum* Wahl. Mill., on quaking aspen, *Populus tremuloides* Michx., is commonly associated with branches or branch stubs (Baranyay 1967; Manion 1975), but the frequency and significance of this relation had not been measured. We designed a study to measure the relation between *Hypoxylon* canker incidence and the presence of branches on an aspen stem.

Methods

Two test areas were established in sprout aspen stands, the first in 1965 on the Pike Bay Experimental Forest on the Chippewa National Forest in Minnesota, and the second in 1966 on the Lakewood District of the Nicolet National Forest in Wisconsin. The Minnesota area contained 0.9- to

2.4-m-tall aspen sprouts that had developed following a clear-cut 3 years earlier. The sprouts in the Wisconsin area averaged 0.3 to 0.6 m taller.

Within these two areas, paired sprouts which were visually free of *Hypoxylon* infection were chosen for study. To ensure maximum survival, competing aspen suckers were removed. One randomly chosen member of each pair was pruned along the lower two-thirds of the stem with a small hand-saw. The other member of each pair was left unpruned. Pruning cuts were made close to the stem but with as little bark injury as possible. As trees increased in height during the study period, pruning was continued with a polesaw to keep the lower two-thirds of the stem 'branch-free.' Each year, after leaf fall, all trees were reexamined for evidence of *Hypoxylon* infection. Final examination was made in 1977.

Results

The proportion of study trees infected with *Hypoxylon* on the two areas was similar, 21% ($N = 154$) in Minnesota and 23% ($N = 200$) in Wisconsin. Fewer cankers developed on the lower two-thirds of the stems on pruned trees than on unpruned trees in both study areas (Table 1). The difference was significant for Minnesota but not for Wisconsin. On the other hand, more cankers developed in the tops of pruned trees in both areas than in the tops of unpruned trees, but the difference was statistically significant for Wisconsin only.

¹This article was written and prepared by U.S. Government employees on official time, and it is therefore in the public domain.

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TABLE 1. Number of *Hypoxylon* cankers on stems and branches of pruned and unpruned aspen trees

Infection	Minnesota		Wisconsin	
	Pruned (77 trees)	Unpruned (77 trees)	Pruned (100 trees)	Unpruned (100 trees)
Total cankers	12	22	24	25
Branch cankers	2	6	1	5
Stem cankers	10	16	23	20
Total upper stem cankers	7	2	12	2
Branch cankers	2	2	1	1
Stem cankers	5	0	11	1
Total lower stem cankers	5	20	12	23
Branch cankers	0	4	0	4
Stem cankers	5	16	12	19

Of the 69 stem cankers on the test trees, 41 were centered around dead branches or branch stubs. Origin of the remaining 28 cankers could not be determined. Various wounds and branch scars were present within some of these cankers; however, whether these were the points of entry for the fungus is questionable. In addition to stem infections, 14 cankers were observed on branches and 10 of these were centered around galls made by the beetle, *Saperda inornata* Say. On two trees the fungus had migrated down from a branch gall to the branch collar and almost into the main stem.

Discussion

These results suggest a relation between incidence of *Hypoxylon* canker infection and presence of aspen branches, perhaps indicating that conditions necessary for initial infection occur more often on branches than on the stem. Once established on a branch, however, the fungus may grow down into the main stem of the tree. A stem canker can develop from infected *S. inornata* branch galls (Anderson *et al.* 1976), which may explain the frequency of stem cankers around dead branch stubs. The origination of branch cankers at galls made by larvae of the beetle *S. inornata* verifies that such wounds are suitable sites for infection by *Hypoxylon*.

One problem inherent in studying *Hypoxylon* on aspen growing in a wild stand is that of detecting small cankers. A canker may not be readily visible until it is large, especially if it is high on a tree or on a small branch. It is difficult to determine the exact point of entry of the fungus for these large cankers. The breakage of healthy and infected branches further complicates identifying the origin of a canker. However, the number of small actively elongating cankers found on live branches and the number of

branches and branch stubs found associated with stem cankers are evidence that stem cankers can result from infected branches.

Presence of some infections on the lower stems of pruned trees suggests that not all main stem infections are associated with branches. However, some of these infections may have been latent when the test was established. Of the 17 cankers on pruned lower stems, 6 were centered around uncalloused pruning wounds and 6 developed around branch stubs that were not completely calloused before the first pruning. The other 5 could not be associated with any stem feature.

Why 16 of the 17 upper stem cankers occurred on pruned trees is unknown. On many of these trees, only the top portion of the tree was killed and a new leader took over.

The relation between canker incidence and branch distribution can explain an earlier report by Anderson and Anderson (1968) of greater incidence in thinned than in unthinned aspen stands. Trees in thinned or understocked stands have more branches which also persist longer, thus increasing the chance of being infected by *Hypoxylon*. The results also support silvicultural recommendations that encourage maintenance of fully stocked aspen stands as a means of minimizing the impact of *Hypoxylon* canker.

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