

CENTRE FOR ENHANCED FOREST MANAGEMENT



ADVANCES IN FORESTRY RESEARCH

DEPARTMENT OF RENEWABLE RESOURCES

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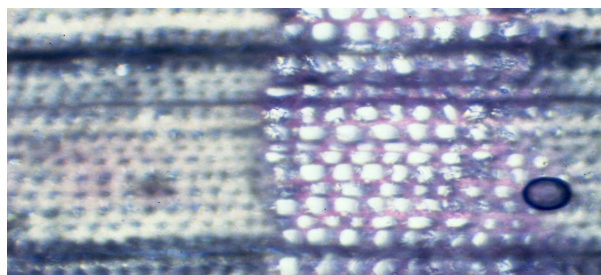


Self-pruning of lodgepole pine is caused by the tree gradually turning off its water supply to the lower branches

CLARK PROTZ, VICTOR LIEFFERS, AND ULDIS SILINS

Death and self-pruning of lower branches of trees affects canopy structure of the forest and the amount of clear wood contained in the trees. The current understanding of the cause of death of lower branches of trees in fully stocked stands is that there is insufficient light and photosynthesis at the branch to support its respiration demands. Recent understanding of the changes in size of tracheid and the amount of earlywood relative to latewood when trees are under competition suggest that there might be gradual reduction in water flow to lower branches.

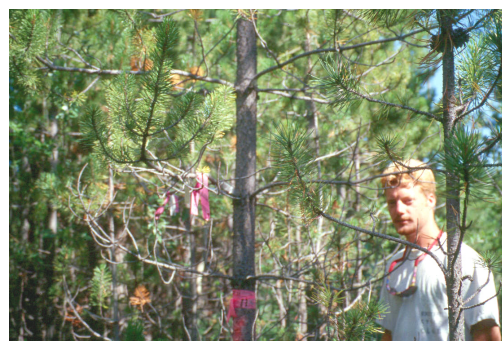
Several experiments were conducted on lower and upper branches of lodgepole pine from closed-canopy and open-grown conditions. Compared to upper branches, lower branches of shaded trees had reduced earlywood/latewood ratio, and reduced hydraulic conductivity in relation to leaf area. Foliage of lower branches of shaded trees was more likely to die if a fixed percentage of its xylem was damaged. The diameter of the tracheids of the lower branches was smaller than upper branches. All of these factors suggest that lower branches have reduced water flow to foliage.



Latewood and earlywood of lodgepole pine.

The explanation for the change in hydraulics for the lower branches is likely related to shading. As a branch gradually becomes more shaded, its buds become smaller and less able to produce the

hormones auxin. This results in a change in xylem structure that limits water flow.



Clark Protz taking branch measurements

Implications:

The gradual exclusion of water flow to lower branches is likely a mechanism to conserve water, reserving it for upper and better-illuminated branches. The gradual loss of hydraulic permeability of shaded lower branches will not be reversed quickly by thinning or other treatments. Branches would likely need several years of new xylem growth before regaining their hydraulic permeability. Early thinning treatments would therefore be needed to prevent deep stagnation of branches or if the branches were already stagnant, thinnings would need to be gradual. As there is likely a genetic basis for the changes in xylem structure, this might be considered in tree improvement programs.

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Further Information:

Protz, C.G., Silins, U. and Lieffers, V.J. 2000. Reduction in branch sapwood hydraulic permeability as a mechanism for crown recession in lodgepole pine. *Can. J. For. Res.* 30:1088-1095.

<http://www.rr2.ualberta.ca/research/EFM/>

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