The Development of Stain and Decay in Harvested Red Alder Logs

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INTRODUCTION

The objective of this study was to monitor the development of stain and fungal decay in alder logs harvested at four different times throughout the year.

Red alder is an important tree species in Pacific Coast forests. Although alder has historically been considered a "weed" species, there is increasing interest in managing red alder as a commercial crop because of its economic and ecological value. For example, alder can be grown as a high-value lumber crop with end uses in cabinets, furniture, etc. It is resistant to Phellinus root disease (Wallis 1976), and shows promise as an alternate species on infected Douglas-fir sites (Nelson et al. 1978). Alder is also capable of fixing atmospheric nitrogen and contributing to soil fertility.

While there is very little decay present in living alder trees (Allen 1993), defects are present in the form of loose knots (sometimes called black knot, the remnants of self-pruned branches), and stain. Two types of stain are associated with alder. The most common is a reddish discoloration that appears on freshly cut surfaces of alder wood. This discoloration can be reduced to produce a uniform white-ivory colour by utilizing appropriate kiln-drying procedures (Kozlik 1978). The second type is a more intense stain, formed in response to the growth of fungi in logs after harvest. This discoloration is initiated at the cut ends of harvested logs, and spreads into the wood over time, coincidental to the spread of fungal mycelium. This fungal-induced stain is more difficult to remove during drying, and results in a significant reduction in wood value. Most of the stain occurs in the butt log, which contains the most potentially knot-free wood, and is of the highest potential value. Therefore, degrade due to stain in this first log has a significant economic impact.

Study plots were established at Roger Creek, near Port Alberni, B.C. (Fig. 1), and in the Greater Victoria Watershed. The first harvest at each of these sites was conducted in March 1992 (referred to as spring harvest). Two or three trees were felled at each site, from which forty 1-m bolts

Figure 1. 50-year-old red alder stand near Port Alberni, B.C.
were cut. One end of each bolt was sealed with wax immediately after cutting to reduce moisture loss, and to prevent continued invasion of wood tissues by fungal spores. Twenty of the bolts were left at each site for storage under field conditions, and 20 were taken to an outside storage yard at the Pacific Forestry Centre in Victoria. At time intervals of 1, 2, 4, and 6 months after harvest, 5 bolts from each site/storage condition were dissected and assessed for moisture content, wood density, the development of stain, and the extent of fungal decay. This process was repeated with subsequent harvests initiated in June 1992 (summer), September 1992 (fall), and November 1992 (winter). In total, 320 bolts were dissected.

A second experiment was conducted to determine whether stain development could be stopped or slowed by applying wood preservatives to the cut ends of logs. Fifteen 1-m log bolts were cut and both ends of the bolts were treated with one of the following commercial preparations: creosote, copper naphthenate, zinc naphthenate, or powdered borax. Three logs were treated with each preservative, and three bolts were left as untreated controls. The experiment was repeated twice, once with trees cut in November 1992 and left for 8 months, and once with trees cut in March 1993 and left for 4 months. The logs were stored in natural alder stands, then dissected to determine the extent of stain development.

Figure 2. Stain development in 1-m red alder bolts stored at Port Alberni, the Victoria Watershed, and the Pacific Forestry Centre.

RESULTS

Fungal spores land on freshly exposed surfaces of alder logs almost immediately after the trees are cut down. As the spores germinate and grow into the wood, living cells in the wood respond and an intense red stain develops. The rate of stain development in the study bolts varied by season of harvest, and among storage sites (Fig. 2). In bolts cut in March, stain was present up to 10 cm from the cut end within 2 months and up to 70 cm within 4 months. Stain developed
more rapidly in bolts cut in June, with stain averaging 43 cm (Fig. 3) from the cut end of bolts within 2 months. (Fig. 2a, 2b). In contrast, bolts cut in September had a slower rate of stain development. Less than 20 cm of wood was stained after 6 months under field storage conditions, and about 55 cm was stained at 6 months when stored at the Forestry lab. Bolts cut in November showed virtually no stain formation in the first 4 months after harvest, and logs stored under field conditions showed less than 10 cm at 6 months. Logs cut in November and stored at the Pacific Forestry Centre lab showed greater staining, up to 63 cm.

Figure 3. Stain in alder bolts harvested in June and stored under field conditions. Staining averaged 43 cm after 2 months (A); after 4 months (B), the entire bolt was stained.

Fungi gained access to the wood through the cut ends of log bolts. Intact bark prevented fungal infection and subsequent stain formation. In bolts where bark pieces were missing, stain developed in wood adjacent to the exposed surfaces.

There was very little difference in stain development at any time of year between bolts stored at the Port Alberni and Victoria Watershed sites. However, stain development was more rapid in bolts stored at the Pacific Forestry Centre than those stored at either field location. The lab storage conditions were warmer and sunnier in all seasons, which resulted in increased drying rates, and contributed to faster fungal growth rates and more rapid staining.

No significant differences in wood density were found between stained and unstained wood at any time after harvest, suggesting that minimal degradation of wood structure occurred within the 6-month test period. These results, however, do not mean that wood structure and quality are unchanged. Further tests monitoring changes in wood strength must be conducted.

The tests of wood preservatives demonstrated that treatment of cut log ends with powdered borax significantly reduced the development of stain in winter-stored logs (Table 1). The other treatments provided no better protection from stain than in untreated logs.

Table 1. Development of stain in logs treated with wood preservatives and stored in field conditions

<table>
<thead>
<tr>
<th>Preservative</th>
<th>Winter storage</th>
<th>Summer storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borax</td>
<td>10.5 a</td>
<td>36 a</td>
</tr>
<tr>
<td>Creosote</td>
<td>34.7 b</td>
<td>50 b</td>
</tr>
<tr>
<td>Copper Naphthenate</td>
<td>36.8 b</td>
<td>49 b</td>
</tr>
<tr>
<td>Zinc Naphthenate</td>
<td>28.8 b</td>
<td>50 b</td>
</tr>
<tr>
<td>Untreated Control</td>
<td>43.3 b</td>
<td>50 b</td>
</tr>
</tbody>
</table>

* values followed by the same letter in a column are not significantly different (P<0.05 Sheffe's S test)

The wood preservative treatments were less effective on logs stored through the summer months. Initial fungal penetration of the wood was delayed, but once established, fungal growth and associated staining were rapid. As in the main experiment, wood moisture levels affected fungal growth rates. High winter moisture contents contributed to restricted stain development.
MANAGEMENT IMPLICATIONS

Log value losses due to stain degrade can be reduced through management of harvest schedules and by storing harvested logs under proper conditions. Most alder sawmill operators have learned from experience that logs should be processed as soon as possible after harvest to minimize staining. The results of this study clearly indicate that this policy should be followed, especially in the summer months when stain will penetrate as much as 70 cm within 2 months.

There is much less staining in logs harvested in the fall and winter. When these logs are stored under cool, moist conditions, they will develop minimal stain (less than 20 cm) and can be stored for periods up to 6 months. Logs stored in the open where snow does not accumulate and logs are warmed by the sun develop stain slightly faster and should be processed within 4 months. When possible, foresters might consider leaving harvested logs in the field and moving them to millyards just before milling.

Stain develops wherever fungi can gain access to, and grow in, alder wood. Therefore, when bark remains intact, stain forms only from the cut end of the log. When bark sections are removed, during falling or handling after harvest, wood tissues are exposed to fungal invasion and subsequent staining. Efforts should be made to minimize bark damage during harvesting operations, particularly during the summer months when stain development is rapid.

Preliminary experiments suggest that the treatment of freshly cut surfaces of alder logs with borax can slow the development of fungally induced stain. However, further tests must be conducted to determine the effectiveness of this method of stain control under varied field conditions.

Further study must also be directed at determining whether significant losses in wood strength and structure are associated with staining and the early stages of decay in red alder.

SUMMARY

The formation of stain that reduces wood quality occurs in alder in response to the invasion of wood tissues by decay fungi. Storing logs under conditions that inhibit fungal growth will result in less stain. The following guidelines should be considered:

1) When possible, schedule alder harvesting in the fall and winter.
2) Trees harvested between May and August should be processed within 1 month.
3) Trees harvested between September and January should be processed within 4–6 months.
4) Trees harvested between February and April should be processed within 2–3 months.
5) Minimize bark damage during harvest.
6) Store harvested trees in cool, moist conditions; shaded, but open to rain and snow.

REFERENCES


