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Time and Size for Young Coastal Douglas-fir to Occlude after Pruning

A Stand Management Cooperative (SMC) research study at the University of Washington developed models of time and distance characteristics of occlusion after pruning young Douglas-fir. The sample consisted of five stands in British Columbia and eight stands in Oregon, These stands had a range of age at time of pruning of nine to 22 years. Dates of pruning varied from 1961-1986.Three dominant or co-dominant pruned trees in each stand were felled and a disk, centered on a pruned whorl, was taken from near the base, middle, and top of the pruned height.A total of 335 pruned branches were exposed by sawing through the disks as shown in Figure 1. Occlusion was segregated into two zones; zone A, which is from inside bark at the time of pruning to the end of the stub, and zone B, which may contain wood splinters, bark, and pitch pockets between the stub end and the onset of clear wood.

Variables Measured

All measurements in the models are expressed in millimeters; to convert to inches use 1 inch = 25.4 mm. For further detail see Petruncio, Briggs and Barbour 1997.

- AW — width of zone A or stub length
- RIB — distance from stem pith to the start zone A
- ROS — distance equal to the sum of RIB and AW. Doubling ROS will approximate diameter-over-stubs (DOS) for trees that are reasonably circular in cross section.
- ROO — distance from stem pith to end of zone B, defined as the point where lumber would qualify for C-Select or better lumber. Doubling ROO will approximate diameter-over-occlusion (DOO) if trees are reasonably circular in cross section.
- SDI — diameter of the pruned stub at its end
- RWAP — average ring width for the 10 years after pruning
- ABR — number of rings or years included in zones A and B
- CND — code indicating if a branch was alive (0) or dead (1) when pruned
- CUT — code indicating if a branch was pruned with a smooth (0) or non-smooth (1) cut

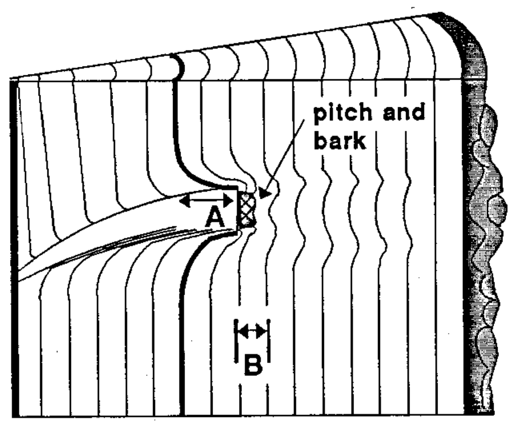

Figure 1. Pruned branches exposed by sawing through disks

Model # 1 could be used in planning before pruning or when diameter over stubs (DOS) was not measured during the pruning operation. Model # 2 is intended for situations where DOS was measured. Doubling the prediction from either model estimates the diameter that will be achieved before clear wood is produced. Model # 3 estimates the years it takes to occlude and may be useful in financial calculations.

Predictions from these models are for individual pruned branches, not for a tree. Applying them to data for branches from pruned whorls in a tree will provide estimates for ROO and ABR along the pruning lift. To use the models, estimate the diameter (SDI) of the branch being pruned and the stub length. At a minimum, the stub length (AW) will equal the bark thickness, although pruning methods that do not cut stubs flush with the bark and extend the distance due to nodal swelling may also need to be considered. A taper curve or some other method can be used to estimate radius-inside-bark (RIB) of the whorl at the time of pruning. If DOS is measured in the field, Model # 2 may be used where ROS = DOS / 2. A growth model or some other method can be used to estimate the 10-year growth after pruning and to express this in terms of average ring width (RWAP). When live branches are pruned using methods that leave smooth cuts, variables CND and CUT are zero. Table 1 presents predictions of ROO from Model # 1, where the range for each predictor is approximately one standard deviation from the respective mean and all values have been converted to inches.

Models for Radius-Over-Occlusion

(1) $$ROO = -3.7285 + 1.0528\,RIB + 0.9812\,AW + 0.7180\,RWAP + 0.1649\,SDI + 3.4512\,CND$$

r-squared = .98 s.e. = 5.4 mm

(2) $$ROO = -3.7088 + 1.0415\,ROS + 0.6744\,RWAP + 0.1549\,SDI + 3.4642\,CND$$

r-squared = .98 s.e. = 5.4 mm

Model for Years to Occlude

(3) $$ABR = 4.0970 + 0.0133\,RIB + 0.1430\,AW - 0.7024\,RWAP + 0.9458\,CND + 0.3326\,CUT$$

r-squared = .66 s.e. = 1.39 years

	RIB = 1.8 in (DIB = 3.6 in)		RIB = 4.4 in (DIB = 8.8 in)	
	AW = 0.4 in	AW = 1.3 in	AW = 0.4 in	AW= 1.3 in
RWAP = 0.1 in	2.3-2.4 in	3.2-3.4 in	5.1-5.2 in	6.0-6.1 in
RWAP = 0.3 in	2.4-2.5 in	3.4-3.5 in	5.2-5.3 in	6.1-6.2 in

Table 1. Predictions of ROO from Model #1

ROO values in each cell are for SDI = 0.4 - 1.1 in and assumes pruning live branches; add 0.1 in if pruning dead branches.

If a 0.4 inch diameter live branch is pruned on a stem cross-section with a radius of 1.8 inches (3.6 in. dib) and the distance from inside bark to the stub end is 1.3 inches and growth rings after pruning average 0.3 inches wide, then one can expect radius-over- occlusion to be 3.4 inches (DOO = 6.8 inches) before clear wood forms beyond zone B.

Recommendations and Study Limitations

- Prune young, small trees to minimize the distance and time for occlusion. Such trees tend to have thinner bark, smaller diameter branches, and live rather than dead branches—factors that reduce occlusion. The result will be a smaller defect core diameter and the potential for greater yield of clear products.
- Select trees that promise to have good growth after pruning or use growth enhancing treatments in concert with pruning.
- Have good quality control on pruning methods to eliminate unnecessary protrusion of stubs and prevent non-smooth cuts.
- Use caution pruning through branch collars and nodal swellings since research indicates that this increases attack by the Douglas-fir pitch moth.

The models developed in this study were limited by lack of information on stem, crown, and stand measures before and after pruning was conducted. Hence effects of stand density, crown removal and other important variables could not be included. The SMC recently initiated pruning trials in which these potentially important variables are being carefully monitored. Eventually refined models for predicting occlusion will be examined using data from these trials.

A common question associated with pruning is whether one should prune branches at the end of branch collars or cut through and remove branch collars. Literature (Helmers 1946, Childs and Wright 1956) indicates that wounding the branch collar promises faster occlusion even though it produces a larger wound. Also, cutting branch collars flush with the stem would reduce DOS. While these effects argue for cutting off the branch collars, one should proceed with caution with Douglas-fir since University of Washington research indicates that cutting through branch collars increases attack by the Douglas-fir pitch moth. Attack by this insect can produce defects that widen zone B and hence increase DOO and reduce potential yield of clear wood. The risk of attack by this insect also seems to be dependent on the season when the pruning is conducted.

References

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