

EFFECT OF PRUNING SEVERITY ON THE ANNUAL GROWTH OF HYBRID POPLAR

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Summary

Hybrid poplar (clone OP-367) planted at 14-ft by 14-ft spacing was submitted to 5 pruning treatments. Pruning treatments consist of the rate at which the side branches are removed from the tree to achieve an 18-ft branch-free stem. Starting with a 6-ft (from ground) pruned trunk, 3-year-old trees are pruned to 18 ft in either 3, 4, or 5 years. Starting in March 2000, the side branches on the trunk were pruned to a height of 6, 9, or 12 ft. In subsequent years, the trees were pruned in 3-ft increments annually. A check treatment where trees were pruned only to 6 ft was included. In 2004 the percentage of the total tree height that was pruned ranged from 12 percent for the check treatment to 35 percent. Stem volume growth in 2004 and over the previous 5 seasons was not affected by pruning up to 23 percent of the total tree height.

Introduction

With reductions in timber supplies from Pacific Northwest public lands, sawmills and timber products companies are searching for alternatives. Hybrid poplar wood has proven to have desirable characteristics for many timber products. Growers in Malheur County, Oregon have made experimental plantings of hybrid poplar and demonstrated that the clone OP-367 (hybrid of *Populus deltoides* x *P. nigra*) performs well on alkaline soils for at least 7 years of growth. Research at the Malheur Experiment Station during 1997-1999 determined optimum irrigation criteria and water application rates for the first 3 years (Shock et al. 2002).

Pruning the side branches of trees allows the early formation of clear, knot-free wood in the trunk and increases the trees' value as saw logs and peeler logs. The amount of live crown removed might have an effect on tree growth. More severe pruning might improve the efficiency of the pruning operation (fewer pruning operations to reach the final pruning height), but could reduce growth excessively. The timing of pruning could also affect the amount of epicormic sprouting (sprouts forming on pruned stem) during the season, wound healing, and insect damage at wound sites. The objective of this study was to evaluate the effect of pruning severity and timing on tree growth and health.

Materials And Methods

The trial is being conducted on a Nyssa-Malheur silt loam (bench soil) with 6 percent slope at the Malheur Experiment Station. The soil had a pH of 8.1 and 0.8 percent organic matter. The field had been planted to wheat for the 2 years prior to 1997 and before that to alfalfa. Hybrid poplar sticks, cultivar OP-367, were planted on April 25, 1997 on a 14-ft by 14-ft spacing. The field was used for irrigation management research (Shock et al. 2002) and groundcover research (Feibert et al. 2000) from 1997 through 1999. All side branches on the lower 6 ft of all trees had been pruned in February 1999.

In March 2000, the field was divided into 20 plots that were 6 rows wide and 7 trees long. The plots were allocated to five irrigation treatments that consisted of microsprinkler irrigation with three irrigation intensities and drip irrigation. The microsprinkler-irrigated plots used the existing irrigation system. For the drip-irrigated plots, either one or two drip tapes (Nelson Pathfinder, Nelson Irrigation Corp., Walla Walla, WA) were laid along the tree row in early May 2000. The management of the irrigation trial is discussed in an accompanying article (see "Micro-irrigation Alternatives for Hybrid Poplar Production, 2004 Trial" in this report).

For the pruning study, only plots in the two wetter microsprinkler-irrigated treatments and the drip-irrigated treatments were used. The trees in the two wetter microsprinkler-irrigated treatments and the drip-irrigated treatments averaged 26 ft in height and 4.2 inches diameter at breast height (DBH) in March 2000. The middle 2 rows in each irrigation plot were assigned to pruning treatment 3 (Table 1). The remaining 2 pairs of border rows in each plot were randomly assigned to pruning treatments 2, 4, and 5. The pruning treatments were replicated eight times. The trees in treatments 2, 3, and 4 were pruned on March 27, 2000; March 14, 2001; March 12, 2002; March 12, 2003; and March 19, 2004. Trees in treatment 5 were pruned on May 16, 2000; May 21, 2001; May 15, 2002; and May 14, 2003. Trees were pruned by cutting all the side branches up to the specified height on the trunk, measured from ground level. The side branches were cut using loppers and pole saws. An additional 4 plots, in which the trees would remain pruned only to 6 ft, were selected for a check treatment (treatment 1).

The five central trees in the middle two rows and the five central trees in each inside row of each border pair in each plot were measured monthly for DBH and height. Trunk volumes were calculated for each of the measured trees in each plot using an equation developed for poplars that uses tree height and DBH (Browne 1962). Growth increments for height, DBH, and stem volume for 2004 were calculated as the difference in the respective parameter between October 2003 and October 2004. Growth increments for the five seasons (2000-2004) were calculated as the difference in the respective parameter between October 1999 and October 2004. Regression analyses were run for the percent of total tree height that was pruned trunk against tree growth. The maximum percent of total trunk height pruned that would not reduce tree growth was calculated by the first derivative (maximum = $-b/2c$) of the regression equation $Y = a + b \cdot X + c \cdot X^2$, where Y is the trunk volume increment and X is the percent of the total height pruned.

Results and Discussion

In 2004, the trees in the least intensive pruning treatment (treatment 2) were pruned to 18-ft height, completing the pruning treatments. In October 2004 the trees in the least severe pruning treatment (treatment 2) averaged 65.2 ft in height and 9.3 inches DBH. In 2003 the percentage of the total tree height that was pruned ranged from 12 percent for the check treatment to 35 percent for treatment 5 (Table 1). The differences in the percentage of the total tree height that was pruned trunk between treatments 2, 3, 4, and 5 was not significant in 2004, as all trees in these treatments were branch-free to 18 ft.

Tree growth increased, reached a maximum, and then decreased with increasing pruning severity, both in 2004 and over the 4 years (Figs. 1 and 2). The response of tree growth to pruning suggests that pruning up to a certain severity is beneficial for tree growth. Pruning removes branches from the lower canopy that might not contribute much to the photosynthetic capacity of the tree due to shading. Pruning also changes the trunk shape, with greater diameter growth occurring higher on the trunk than in unpruned trees. The maximum trunk volume growth was achieved by limiting the length of pruned stem to 22 percent of the total tree height in 2004 and to 23 percent of the total tree height over the 4 years. Future tree measurements will determine if trees subjected to the most severe pruning will eventually reach the same size as less severely pruned trees. Tree growth reductions that occurred when trunks were pruned above 25 percent of total tree height, as shown in this study, are inconsistent with the Oregon State University Extension recommendation to limit pruning to 50 percent of total height (Hibbs 1996).

Lower intensity pruning might increase pruning costs, because there will be more pruning events before an 18-ft branch-free trunk is achieved than with higher intensity pruning. Lower intensity pruning will also result in larger branches being pruned, which increases labor costs and results in less clear wood.

References

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Shock, C.C., E.B.G. Feibert, M. Seddigh, and L.D. Saunders. 2002. Water requirements and growth of irrigated hybrid poplar in a semi-arid environment in eastern Oregon. Western J. of Applied Forestry 17:46-53.

Table 1. Poplar pruning treatments and actual percentage of total height pruned (percentage of total height that is branch-free stem after pruning) in successive years. The amount of sprouting for trees pruned in winter is compared to spring. Trees were planted in April 1997, Malheur Experiment Station, Oregon State University, Ontario, OR.

Treatment	Pruning height* (ft from ground)						Actual percentage of total tree height that was pruned trunk in March				
	1999	2000	2001	2002	2003	2004	2000	2001	2002	2003	2004
1 Check	6	6	6	6	6	6	24.3	15.7	13.7	12.9	11.7
2	6	6	9	12	15	18	22.2	22.9	26.1	28.1	30.5
3	6	9	12	15	18	18	33.7	29.3	32.0	35.3	32.2
4	6	12	15	18	18	18	47.3	39.4	35.2	33.5	30.0
5 [†]	6	9	12	15	18	18	33.7	31.5	34.8	38.7	35.0
LSD (0.05)							2.7	2.1	3.5	3.0	3.4

*Trunk height to which all side branches were removed in March of the respective year.

[†] Pruned in May. All others were pruned when trees were dormant.



Figure 1. Poplar tree annual growth increment in 2004 in response to pruning severity, Malheur Experiment Station, Oregon State University, Ontario, OR.

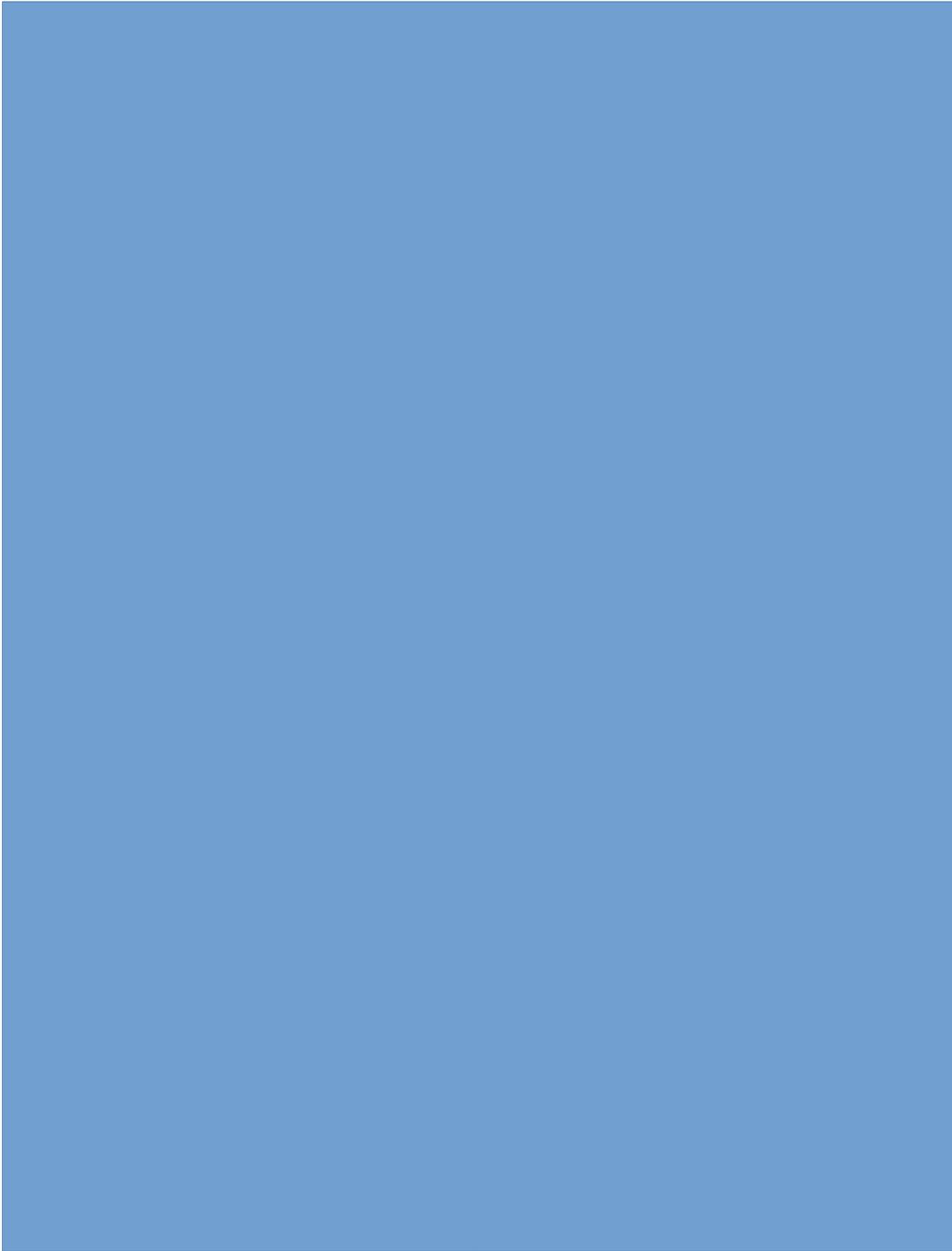


Figure 2. Poplar tree 5-year (2000-2004) growth in response to pruning severity, Malheur Experiment Station, Oregon State University, Ontario, OR.