EFFECT OF PRUNING SEVERITY ON THE ANNUAL GROWTH OF HYBRID POPLAR THROUGH 2007

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Summary

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, if excessive, can reduce tree growth. 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 objective of this study was to evaluate the effect of pruning severity on tree growth.

Hybrid poplar (clone OP-367) planted at 14-ft by 14-ft spacing in 1997 was submitted to three pruning treatments. Pruning treatments consisted of the rate at which the side branches were 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 were either left unpruned (check) or 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 in all treatments had 3 ft of stem pruned yearly. At the start of the trial in 2000, the trees averaged 3.9 inches diameter at breast height and 29.7 ft tall. The average pruning intensities in 2000 ranged from 22 percent of the total stem that was pruned (for both the check and the least intensive pruning treatment) to 47 percent (most intensive treatment). Pruning to 18 ft was completed in 2004 for all treatments except the check. Stem volume growth in 2007 and over the previous seven seasons was not affected by the pruning treatments.

Introduction

With reductions in timber supplies from Pacific Northwest public lands, sawmills and timber products companies are searching for alternative sources of lumber. 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 12 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).

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 has a pH of 8.1 with 0.8 percent organic matter. The field had been planted to wheat for 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, 2007 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 middle 2 rows in each irrigation plot were assigned to pruning treatment 2 (Table 1). The remaining 2 pairs of border rows in each plot were randomly assigned to pruning treatments 1 and 3. The pruning treatments consisted of the height from the ground to which the stem was pruned. In the first year (2000), the trees in each treatment were pruned to different heights (intensities). Thereafter the trees in each treatment had 3 ft of stem pruned each year until the final pruned height of 18 ft was reached. An additional 4 plots, in which the trees would remain pruned only to 6 ft, were selected for the check treatment. The pruning treatments were replicated eight times. There was no significant difference between treatments in average diameter at breast height (DBH 4.5 ft from ground), height, or wood volume in the spring of 2000 (Table 3). The trees with pruning intensities 1, 2, and 3 were pruned on March 27, 2000; March 14, 2001; March 12, 2002; March 12, 2003; and March 19, 2004. All pruning treatments were completed in March of 2004. 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.

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 2007 were calculated as the difference in the respective parameter between October 2006 and October 2007. Growth increments for the eight seasons (2000-2007) were calculated as the difference in the respective parameter between October 1999 and October 2007.

Results and Discussion

The differences between treatments in the percentage of the tree stem that was pruned decreased over the years (Table 1). Starting in 2004, when the pruning treatments were completed, there was no difference in the percentage of the tree stem that was pruned between the three pruning treatments. The highest pruning intensity resulted in 47.3 percent of pruned stem in 2000, that declined to 21.4 percent of pruned stem by the fall of 2007. There was no significant difference between pruning treatments in wood volume growth in the years from 2000 to 2007 (Table 2). Wood volume growth from 2000 to 2007 was significantly lower for the unpruned check treatment. In the fall of 2007, the unpruned check treatment had lower height and wood volume than the pruned treatments (Table 3).

The lack of response of tree growth to pruning intensity in this study is consistent with the Oregon State University Extension recommendation to limit pruning to 50 percent of total height (Hibbs 1996). The greatest pruning intensity achieved in this study was 47 percent in 2000. The results of this study also agree with DeBell et al. (2002), who found that pruning three poplar clones to 50 percent of tree height once at age 1.5 years did not affect growth after 9 years. However, poplar grown on very wide spacing and kept pruned to one-third and one-half of tree height from years 2 through 8 showed reduced DBH from years 2 through 10 (Krinard 1985). Krinard maintained the same pruning intensity for 6 years, more intense than our study or that of DeBell et al. (2002).

The practical significance of this research is that the most severe pruning intensity used in this trial was easiest to establish and maintain. Pruning early in tree development avoids the need to cut larger diameter lateral branches in later years, which is a costly use of labor. Furthermore, the maintenance of 18 ft of tree trunk free of limbs for more years should enhance the quality of harvested lumber.

References

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Table 1. Poplar pruning treatments and actual percentage of total height that is branch-free stem after pruning in successive years. Trees were planted in April 1997, Malheur Experiment Station, Oregon State University, Ontario, OR.

Pruning intensity	Pruning height[a] (ft from ground)						Percentage of tree height that was pruned trunk in March							
	1999	2000	2001	2002	2003	2004	2000	2001	2002	2003	2004	2005	2006	2007
Check	6	6	6	6	6	6	24.3	15.7	13.7	12.9	11.7	10.9	9.9	9.7
1	6	6	9	12	15	18	22.2	22.9	26.1	28.1	30.5	27.7	25.6	23.2
2	6	9	12	15	18	18	33.7	29.3	32.0	35.3	29.9	29.9	25.2	23.2
3	6	12	15	18	18	18	47.3	39.4	35.2	33.5	30.0	27.5	25.5	21.4
LSD (0.05)							2.8	1.7	2.6	2.2	2.6	2.5	2.3	2.7

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

Table 2. Poplar wood volume annual growth increment for three pruning intensity treatments, Malheur Experiment Station, Oregon State University, Ontario, OR.

Pruning intensity	Growth increment								
	2000	2001	2002	2003	2004	2005	2006	2007	1999-2007
	ft^3/acre								
Check	321.3	365.4	266.3	301.6	460.7	395.8	271.4	437.4	2,842
1	369.3	379.0	397.4	552.4	571.3	413.7	523.6	778.8	3,985
2	360.1	414.5	356.4	542.4	570.3	541.1	478.8	741.7	4,005
3	318.9	423.5	328.1	547.8	529.7	473.8	479.6	958.7	4,060
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	1,028[a]

[a]Significant at 0.10 probability level.

Table 3. Poplar tree measurements before and 3 years after the end of pruning treatments, Malheur Experiment Station, Oregon State University, Ontario, OR.

Pruning intensity	November 1999			November 2007		
	DBH	Height	Volume	DBH	Height	Volume
	inch	feet	ft^3/acre	inch	feet	ft^3/acre
Check	3.6	27.7	167.3	10.1	63.1	3,009
1	4.3	30.5	242.6	11.0	78.0	4,228
2	3.8	30.0	196.6	10.5	78.6	4,202
3	3.7	29.1	172.3	10.2	79.3	4,232
LSD (0.05)	NS	NS	NS	NS	9.3	1026[a]

[a]Significant at 0.10 probability level.