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 five 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 stem, the 3-year-old trees are being pruned to 18 ft in either 3, 4, or 5 years. Starting in March 2000, the side branches on the stem were pruned to a height of 9, 12, or 15 ft. In subsequent years, the trees were pruned in 3 ft increments annually. A check treatment where trees were pruned only to 6 ft is included. Another treatment compares the effect of pruning during tree dormancy to pruning after growth has resumed. In 2001 the treatments ranged in pruning severity from 17 to 45 percent of total tree height. Stem volume growth in 2001 was not affected by pruning up to 24 percent of the total tree height for trees undamaged by leafhoppers. Leafhopper damage exacerbated the negative effects of pruning on tree growth.

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 have made experimental plantings of hybrid poplar and demonstrated that the clone OP-367 (hybrid of *Populus deltoides x Populus nigra*) performs well on alkaline soils for at least 4 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 of the side branches of trees allows the early formation of clear, knot-free wood in the stem and increases their value as saw logs and peeler logs. The amount of live crown removed in 1 year 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 sprouting 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 was conducted on a Nyssa-Malheur silt loam (bench soil) with 6 percent slope at the Malheur Experiment Station. The soil had a pH of 8.2 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. The field was marked using a tractor, and a solid-set sprinkler system was installed prior to planting. 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 six rows wide and seven trees long. The plots were allocated to five irrigation treatments that consisted of microsprinkler irrigation with 3 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 report.

For the pruning study, only plots in the two wetter microsprinkler-irrigated treatments and the drip irrigated treatments were used. The middle two 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 and March 14, 2001. Trees in treatment 5 were pruned on May 16, 2000 and May 21, 2001. Trees were pruned by cutting all the side branches up to the specified height measured from ground level. The side branches were cut using loppers and pole saws. An additional four plots, in which the trees would remain pruned only to 6 ft, were selected for a check treatment (treatment 1).

In 1999, a leafhopper infestation in part of the field resulted in damage to the terminal shoots, resulting in the tree canopy having a bushy or witches-broom appearance by the end of the season in 1999. The leafhoppers were controlled in 2000 and 2001, but damage symptoms persisted through 2001. Since tree growth response to pruning could be influenced by the leafhopper damage, all trees were rated for the degree of damage. Leafhopper damage was evaluated subjectively as the degree to which the tree canopy had a witches-broom appearance (flat top) as opposed to a more conical shape in undamaged trees. Leafhopper damage was evaluated in October each year.

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 diameter at breast height (DBH) and height. Stem 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). The trees were observed for insect damage at pruning cuts. Sprouts (epicormic branches) formed during the season on the pruned length of the

stem of trees in treatments 3 and 5 were counted, cut, and weighed on February 26, 2002. The amount of time to remove the sprouts in each plot of treatments 3 and 5 was recorded. Growth increments for height, DBH, and stem volume for 2001 were calculated as the difference in the respective parameter between October 2000 and October 2001. Growth increments for the combined 2000 and 2001 seasons were calculated as the difference in the respective parameter between October 1999 and October 2001. Regression analyses for the effects of leafhopper damage on tree growth were run for damaged and undamaged trees separately. The maximum percent of total stem height pruned that would not reduce tree growth was calculated by the first derivative (maximum = -b/2c) of the regression equation $Y = a + b \bullet X + c \bullet X^2$, where Y is the stem volume increment and X is the percent of the total height pruned.

Results and Discussion

The percentage of the total height pruned in 2001 for trees undamaged by leafhopper feeding averaged from 15 percent for the check treatment to 39 percent for treatment 4 (Table 1). The percentage of the total height pruned in 2001 for trees damaged by leafhopper feeding averaged from 20 percent for the check treatment to 55 percent for treatment 4.

Height increment in 2001 and 2000-2001 for the trees undamaged by leafhoppers was not very responsive to pruning. (Fig. 1 and 2). Diameter at breast height increment for the undamaged trees showed a negative linear response to pruning severity (Fig. 1 and 2). Calculated from the regression equations, stem volume increment for the undamaged trees was not reduced until the height pruned exceeded 24 percent of total height in 2001 and 2000-2001. Future monitoring of tree growth will help determine whether, once pruning ceases, stem volume increments for pruned trees would approach that of unpruned trees.

Leafhopper damage exacerbated the negative effects of pruning on tree growth. Height increment for the damaged trees in 2001 was not responsive to pruning (Fig. 1). Height increment for the damaged trees in 2000-2001 showed a negative response to pruning severity (Fig. 2). Diameter at breast height increment for the undamaged and damaged trees showed similar negative linear responses to pruning severity. However, at the same pruning severity, DBH increment was smaller for the damaged trees than for the undamaged trees (Fig. 1 and 2).

While stem volume increment for the undamaged trees was reduced when pruning severity exceeded 24 percent of the total height, any level of pruning to the leafhopper damaged trees reduced stem volume increment.

The substantial effects of pruning severity on tree growth for the trees undamaged by leafhopper feeding contradicts the Oregon State University Extension recommendation to limit pruning to 50 percent of total height (Hibbs 1996).

Sprouting was substantially lower for the trees pruned in May than in March when the

trees were dormant (Table 1). Pruning in May, after the trees had resumed growth, resulted in fewer sprouts, less total sprout weight, and less time to remove the sprouts.

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. Current and intended future poplar pruning trial treatments and actual percentage of total height pruned (percentage of total height that is branch-free stem after pruning) in 2001 for trees undamaged and damaged by leafhopper feeding. 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 stem height pruned		Number of sprouts	Sprout weight	Time to prune sprouts†
	1999	2000	2001	2002	2003	2004	undamaged	damaged	#/acre	lb/acre	hours/acre
1 Check	6	6	6	6	6	6	15.7	19.8			
2	6	6	9	12	15	18	22.9	31.6			
3	6	9	12	15	18	18	29.3	41.2	4,806	366.1	5.8
4	6	12	15	18	18	18	39.4	55.0			
5‡	6	9	12	15	18	18	31.5	39.1	739	24.5	1.0
LSD (0.05)							2.1	7.4	1,347	123.2	2.6

*Stem height to which all side branches were removed.
†One person.
‡ Pruned in May. All others pruned when trees were dormant.

Figure 1. Poplar tree 2001 growth increment response to pruning severity for trees undamaged (Y_1, continuous line, •) and damaged (Y_2, dashed line, +) by leafhoppers. Malheur Experiment Station, Oregon State University, Ontario, OR.

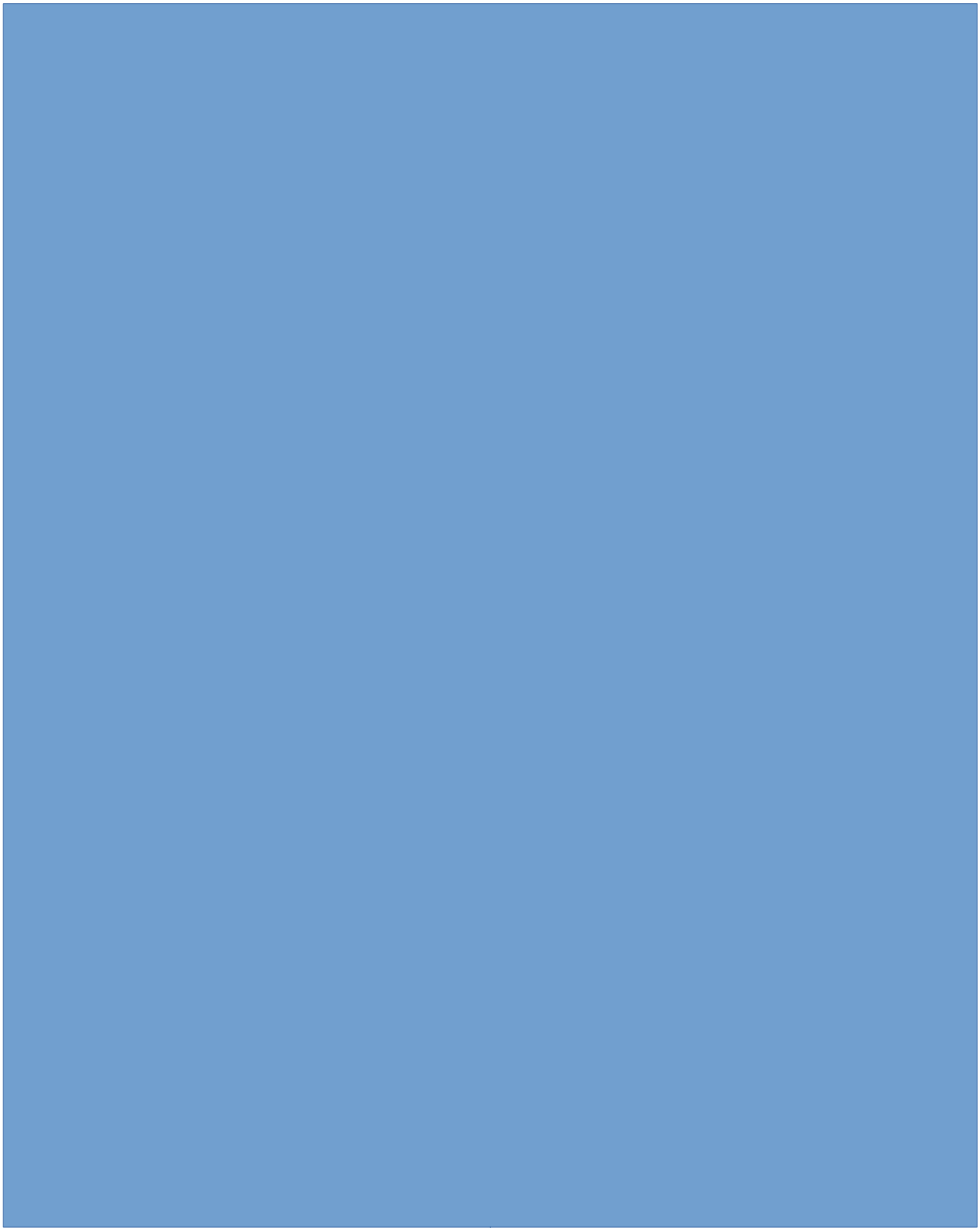

Figure 2. Poplar tree 2 year (2000-2001) growth increment response to pruning severity for trees undamaged (Y_1, continuous line, •) and damaged (Y_2, dashed line, +) by leafhoppers. Malheur Experiment Station, Oregon State University, Ontario, OR.