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 are being submitted to five 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 stem, 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 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 is included. In 2003 the percentage of the total tree height that was pruned stem ranged from 13 percent for the check treatment to 34 percent. Stem volume growth in 2003 and over the previous four seasons was not affected by pruning up to 25 percent of the total tree height. Another treatment compares the effect of pruning during tree dormancy to pruning after growth has resumed. There was no significant difference in epicormic sprouting between trees pruned while dormant and trees pruned after bud break.

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 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 of the side branches of trees allows the early formation of clear, knot-free wood in the stem 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 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 8.1 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 six rows wide and seven 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 Mircro-irrigation Alternatives for Hybrid Poplar Production, 2003 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 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, March 14, 2001, March 12, 2002, and March 12, 2003. 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 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).

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. 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) that 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 2003 were calculated as the difference in the respective parameter between October 2002 and October 2003. Growth increments for the four seasons (2000-2003) were calculated as the difference in the respective parameter between October 1999 and October 2003. Regression analyses were run for the percent of total tree height that was pruned stem against tree growth. 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 $Y = a + b \cdot X + c \cdot X^2$, where Y is the stem volume increment and X is the percent of the total height pruned.

Results and Discussion

In October 2003 the trees in the least severe pruning treatment (treatment 2) averaged 58 ft in height and 8.4 inches DBH. In 2003 the percentage of the total tree height that was pruned stem ranged from 13 percent for the check treatment to 34 percent for treatment 4 (Table 1).

Tree growth increased, reached a maximum, and then decreased with increasing pruning severity, both in 2003 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 stem shape, with greater diameter growth occurring higher on the stem than in unpruned trees. The maximum stem volume growth was achieved by limiting the length of pruned stem to 25 percent of the total tree height, both in 2003 and over the 4 years. Tree growth reductions with stems pruned above 25 percent of total tree height in this study are inconsistent with the Oregon State University Extension recommendation to limit pruning to 50 percent of total height (Hibbs 1996).

There was no significant difference in the number of sprouts and sprout weight between the trees pruned in March and trees pruned in May (Table 1). There was no significant difference in growth between trees pruned in March and trees pruned in May.

References

Browne, J.E. 1962. Standard cubic-foot volume tables for the commercial tree species of British Columbia. British Columbia Forest Service, Forest Surveys and Inventory Division, Victoria, B.C.

Feibert, E.B.G., C.C. Shock, and L.D. Saunders. 2000. Groundcovers for hybrid poplar establishment, 1997-1999. Oregon State University Agricultural Experiment Station Special Report 1015:94-103.

Hibbs, D.E. 1996. Managing hardwood stands for timber production. The Woodland Workbook, Oregon State University Extension Service, Oregon State University, Corvallis.

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 poplar pruning treatments and actual percentage of total height pruned (percentage of total height that is branch-free stem after pruning) in 2003. 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 stem in March				No. of sprouts	Sprout weight	Time to prune sprouts
	1999	2000	2001	2002	2003	2004	2000	2001	2002	2003	#/acre	lb/acre	man-hours/ acre
1 Check	6	6	6	6	6	6	24.3	15.7	13.7	12.9			
2	6	6	9	12	15	18	22.2	22.9	26.1	28.1			
3	6	9	12	15	18	18	33.7	29.3	32.0	35.3	3,923	193.3	6.5
4	6	12	15	18	18	18	47.3	39.4	35.2	33.5			
5‡	6	9	12	15	18	18	33.7	31.5	34.8	38.7	2,956	123.3	4.9
LSD (0.05)							2.7	2.1	3.5	3.0	NS	NS	NS

*Stem height to which all side branches were removed in March of the respective year.
‡ Pruned in May. All others pruned when trees were dormant.

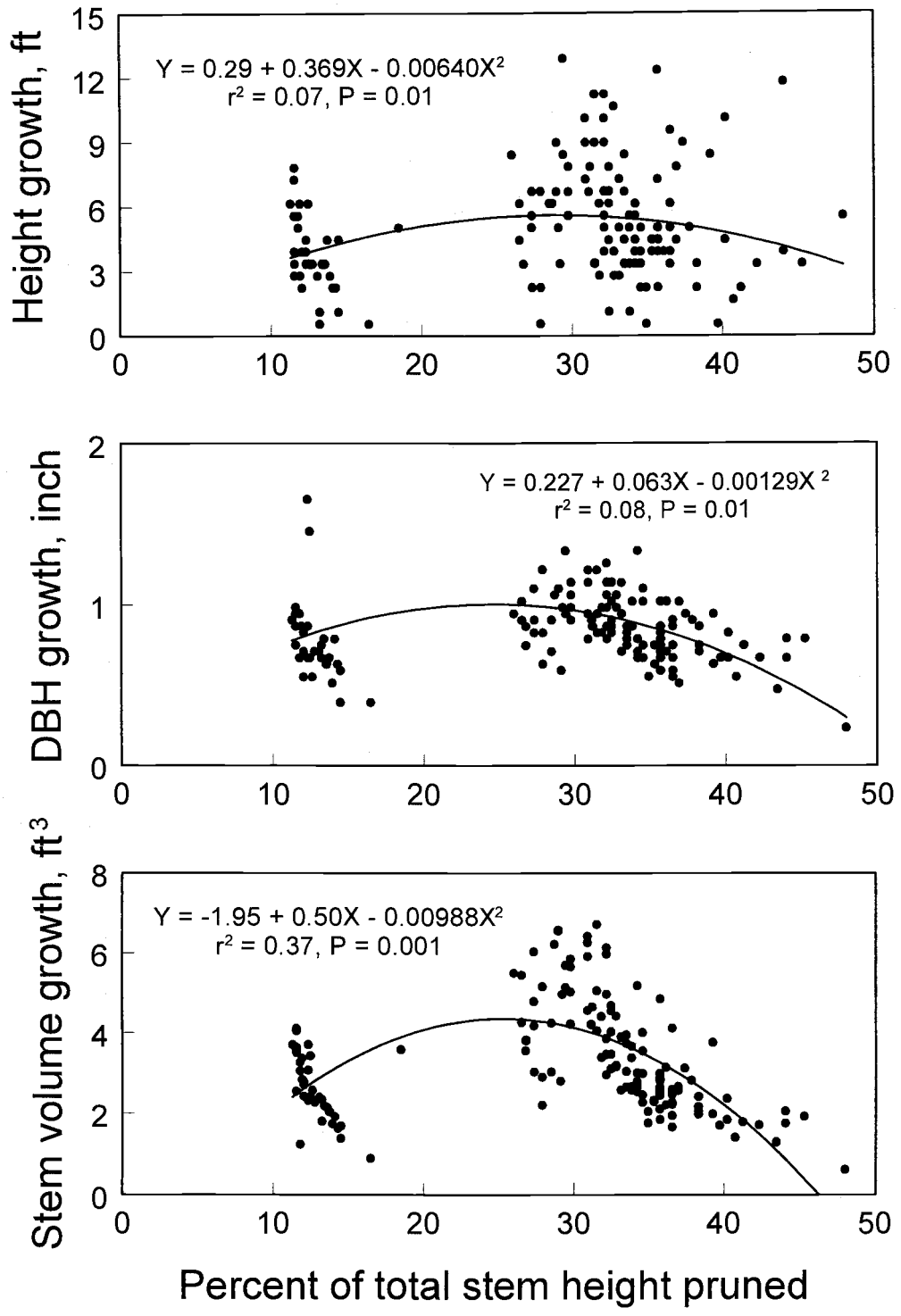

Figure 1. Poplar tree growth in 2003 in response to pruning severity, Malheur Experiment Station, Oregon State University, Ontario, OR.

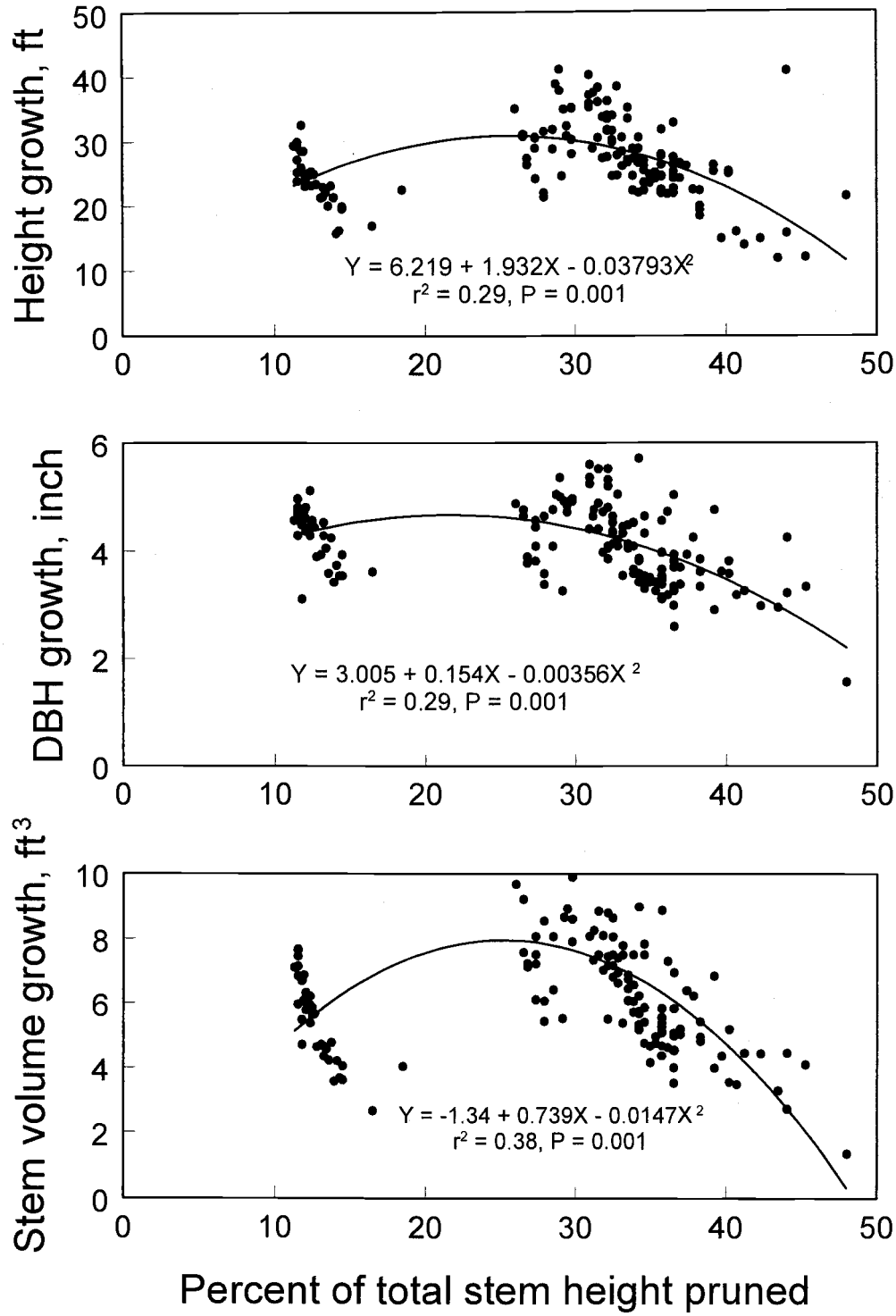

Figure 2. Poplar tree 4-year (2000-2003) growth in response to pruning severity, Malheur Experiment Station, Oregon State University, Ontario, OR.