FOREST PRACTICES

Harvesting and Silviculture Section

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SILVICULTURE NOTE 33

Lodgepole pine Survival and Growth 20 Years After Site Preparation at a Sub-boreal Site

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Summary

Twenty years after site preparation, lodgepole pine survival was high (≥ 80%) on mechanical site preparation (MSP) treatments, burned windrows, and in the untreated control. Significant treatment effects on pine height, diameter, and stem volume were present at all assessment dates. However, after 20 years, only the burned windrow treatment continued to show significant pine growth gains over the control. Of the mechanical treatments, coarse mixing (bedding plow) had the longest lasting effect on pine growth, improving it for at least 9 years. Planting at the disk trench hinge improved growth for at least 5 years. These data are potentially valuable for verifying growth and yield or carbon budgeting modelling tools. Full results are reported by Boateng et al. (2012).

Introduction

Mechanical site preparation (MSP) treatments have traditionally been applied in sub-boreal and boreal regions of B.C. to enhance conifer seedling survival and early growth. Many studies have shown these treatments can positively affect early conifer growth, but less information is available about longer term responses. According to modelling exercises, MSP also has the potential to reduce rotation length and benefit future timber supply. Long-term information about conifer responses to site preparation is therefore extremely valuable.

In the mid-1980s, a large research project was undertaken in boreal and sub-boreal B.C. to examine conifer responses to site preparation. In 1988, the Bednesti experiment was established to study lodgepole pine survival and growth following mixing, mounding, trenching, and scalping treatments and windrow burning. Survival and growth of pine were measured over a 20 year period, and these data can now help us answer the following questions:

1. Was site preparation necessary to ensure good lodgepole pine survival?
2. Which treatments enhanced growth the most?
3. How long did the growth responses last?

Site descriptions and methods

The Bednesti site is about 50 km west of Prince George, B.C. in the SBSdw3 biogeoclimatic variant (site series 01). It is at an elevation of 850 m on rolling terrain with slope of 0-15%. Soils are silty clay loam to sandy loam with 10-65% coarse fragment content and a rooting depth of 10-50 cm. The site was strip harvested in 1963-1964, with remaining strips removed in a second entry in 1971. The study was established in 1987 using a randomized complete block design. Treatments (Table 1) were installed in 1987 and planted with 1+0 lodgepole pine container stock in 1988. Height and diameter of lodgepole pine were measured repeatedly for 20 years, and stem volume was calculated using the formula for a cone.

Table 1. A summary of treatments applied at Bednesti

Treatment	Machinery	Description
Coarse mixing (CM)	Eden relief bedding plow	Continuous raised beds composed of coarse mixtures of mineral soil and forest floor materials. Seedlings were deeply planted in the loose material at the high point of the beds.
Bräcke mound (BM)	Bräcke mounder	20 L of subsoil dug from the adjacent screefed patch was manually added to the hinge position of standard Bräcke patches (BP). The mineral soil capping was 14 cm deep. Seedlings were deep-planted in the mound centre.
Bräcke patch (BP)	Bräcke mounder	Relatively deep scarified patches. Seedlings were planted at the hinge adjacent to the inverted forest floor at the highest location in the patch.
Plow-inverting (PI)	Double-bottom breaking plow pulled by D7 mover	Inverted furrow slices laid down in irregular berms. Material was loose even after over-winter settling. Seedlings were planted deeply into the loose berm material.
Burned windrows (BW)	None	Slash and some mineral soil were piled in long rows and burned. All fine and medium slash was fully consumed, leaving a thick ash layer over a 1-2 cm thick residue of burned mineral material. Seedlings were planted in well-burned microsites that were free of slash.
Disk trench hinge (DH)	TTS Delta disk trencher pulled by a rubber-tired skidder	Continuous, shallow, linear furrows with loosely mixed berms. Seedlings were planted to the root collar at the edge of the berm, close to the furrow.
Disc trench furrow (DF)	TTS Delta disc trencher pulled by a rubber-tired skidder	Continuous, shallow, linear furrows with loosely mixed berms. Seedlings were planted to the root collar in the exposed mineral soil at the bottom of the trench.
Wadell trench hinge (WH)	Silva Wadell cone scarifier	The powered cone created a shallow trench and an adjacent berm. Seedlings were planted through overturned forest floor material into mineral soil between the trench and the berm.
Untreated control (UC)	None	No site preparation, and therefore no soil exposure. Seedlings were planted with the root collar 1-2 cm below surface organic material.

Results

Survival

After 20 years, there were no significant treatment effects on lodgepole pine survival at Bednesti. Survival was 92% in the untreated control, 85-93% in the mechanical treatments, and 80% in the burned windrows (Figure 1). Early mortality in burned windrows may have been related to drought. Howver, by year 20, stem disease was the most common cause of lodgepole pine mortality in all treatments.

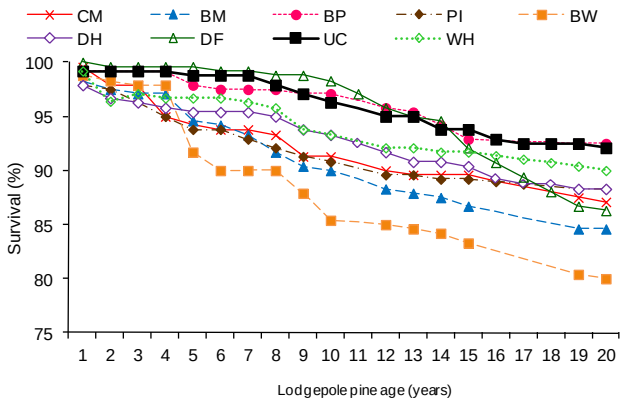

Figure 1. Twenty year lodgepole pine survival. CM=coarse mixing; BM=Bräcke mound; BP=Bräcke patch; PI=plow inverting; BW=burned windrows; DH=disk trench hinge; DF=disk trench furrow; UC=untreated control; WH=Waddell hinge

Growth

Significant treatment effects on height, diameter, and stem volume were present in years 5, 9, and 20. By year 20, only pine in the burned windrows exhibited growth gains over the untreated control (Table 2, Figure 2). Of the mechanical treatments, coarse mixing (bedding plow) continued to have a significant effect on pine growth for 9 years and the disk trench hinge for 5 years.

Stand-level lodgepole pine volume (m^3/ha) in year 20 was 1.9 times higher in burned windrows than in the untreated control (Figure 3). Although not statistically significant from the control, stand level volume in the coarse mixing and disk trench hinge treatments were 1.7 and 1.2 times greater than in the control.

Table 2. Treatments† resulting in significant ($p \leq 0.05$) growth increases over the untreated control.

	Year 5	Year 9	Year 20
Height	CM, BW, DH	CM, BW	none
Diameter	CM, BW, WH	CM, BW	BW
Stem volume	CM, BW	CM, BW	BW

†See Figure 1 for treatment abbreviations

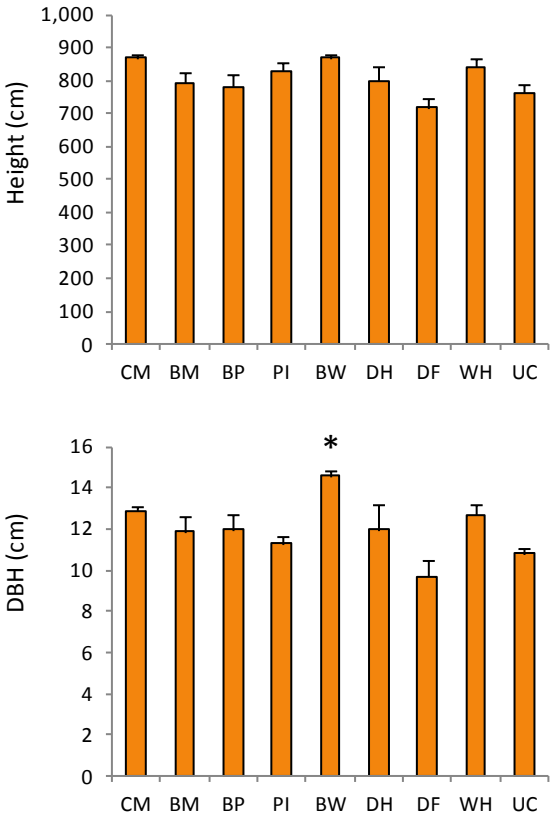

Figure 2. Year 20 lodgepole pine height and DBH. '*' indicates the treatment differs from UC ($p \leq 0.05$). Error bars are one standard error. See Figure 1 for treatment abbreviations.

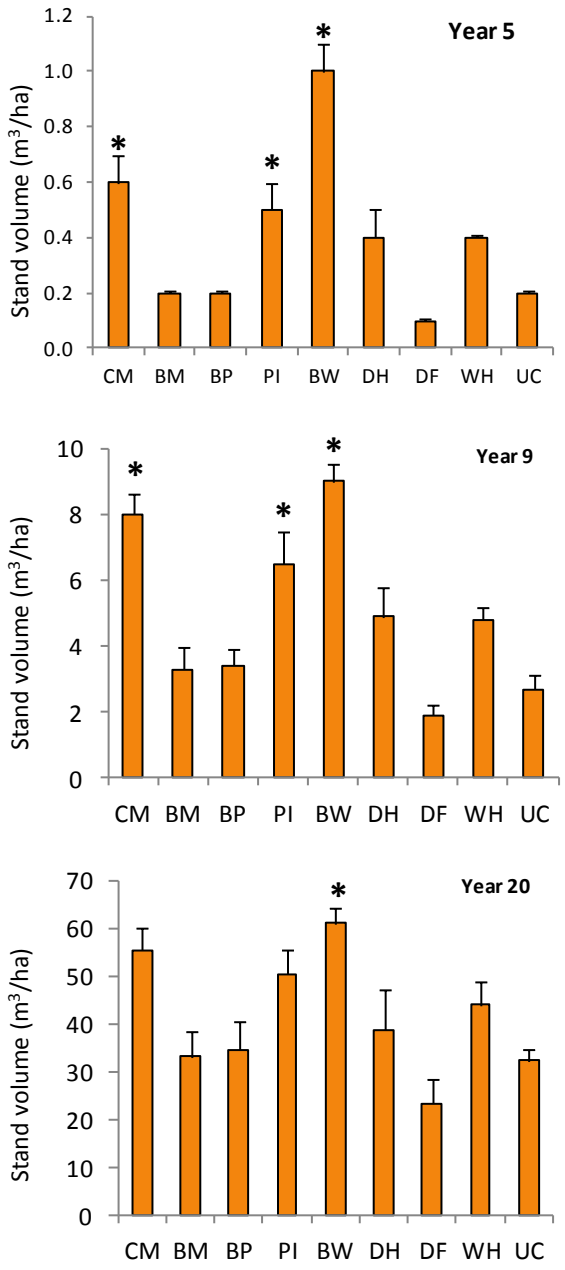

Figure 3. Pine stand volume (m^3/ha) in years 5, 9, and 20. '*' indicates the treatment differs from UC ($p \leq 0.05$). Error bars are one standard error. See Figure 1 for treatment abbreviations.

Interpretations

1. High survival in the control indicates that site preparation was not necessary to establish lodgepole pine container stock on this sub-boreal site. Stem disease is a potential problem at this site, and further work is underway to identify factors that may be influencing its presence.
2. Lodgepole pine were largest on burned windrows, probably because of long-term increases in soil pH and cation exchange capacity (Boateng et al. 2010). Windrow burning is a localized high severity treatment that affects only about 10% of cutblock area and it is important to recognize that broadcast burns are less intense and will not produce the same effect.
3. Of the mechanical treatments, coarse mixing by the bedding plow had the largest and longest lasting effect on lodgepole pine growth. This is probably because the treatment increased soil carbon and nitrogen for at least two decades (Boateng et al. 2010). Disk trenching, which is the most commonly used treatment in B.C., improved growth for between 5 and 9 years.

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