FRDA Memo

January 1991 Site Preparation No. 167

Effects of Site Preparation Treatments on Seedling Survival and Growth in the MS Zone — FRDA Project 3.02

INTRODUCTION

This research memo reports the results of research conducted over a 4-year period (1986–1989), examining the effects of site preparation treatments on seedling survival and growth in the Very Dry Cool Montane Spruce (MSxk) biogeoclimatic subzone. This work is part of Southern Interior FRDA Project 3.02. The research was carried out in a large cutblock at an elevation of 1450 m near Paska Lake (30 km SW of Kamloops). The slope is 3–5% with a southwest aspect. The dominant vegetation is pinegrass and arctic lupine. The site was clearcut in 1981 and received no subsequent silvicultural treatment.

TREATMENTS

The following four treatments were compared with a control (CTL, no site preparation): herbicide (HRB); herbicide plus shade cards (SHD); scalping (SCP); and scalping plus ripping (RIP). Results for the SHD treatment were similar to those of the HRB treatment and are not reported here. The treatments were applied uniformly to strips 12 m long by 3 m wide. Glyphosate (30 mL Roundup® per 100 m^2) was applied to the herbicide treatments 2 or 3 times during the growing season to eliminate competing vegetation. This was done during the first 2 years following planting; after this no attempt was made to control competing vegetation. Scalping with a front-mounted blade was used to remove the surface organic layer. Ripping to a depth of 30–50 cm was done with two rear-mounted ripper shanks, with paths 0.3–0.4 m apart.

In 1988, research on ripped trenches was started and some of the results are included here. The trenches were made with a ripper shank, fitted with a heavy steel drag. The trenches were 20–30 cm deep and 40–60 cm wide at the top in scalped and control strips described above, with two trenches per strip.

The experimental plots were located in a fenced area to prevent livestock damage. Engelmann spruce and lodgepole pine 1+0 PSB 211 stock was used in the study. In spring 1986, site preparation was completed and Engelmann spruce seedlings were planted; in springs 1987 and 1988, both Engelmann spruce and lodgepole pine seedlings were planted in similar experiments. All seedlings were planted so that the top of the plug was slightly below the top of the uppermost mineral horizon. Seedling survival and growth data have been measured at the end of the first, second, third and fourth growing seasons since planting.

RESULTS

Seedling Environment

No significant water deficits were observed during the growing season in any of the treatments at the site over the 4 years. In the same period, however, the control did show significant water deficits during the latter part of the growing season. Volumetric water content at the 19 cm depth in the treatments never fell below 21%, compared to 11% in the control. Significant reductions in seedling growth as a result of water stress are expected when soil moisture content drops below 15% (-0.2 MPa).

Although frost occurred during each growing season at this site, it seldom occurred in July and August, and was less severe in the mechanical site preparation treatments than in the control. For example, from June to August 1988, two severe frosts (air temperature at the 15 cm height less than -4°C) occurred in the scalping treatment compared to six in the control. All of these frosts occurred in June. Air temperatures below -4°C have been found to cause frost injury in many actively growing conifers. **Daily average growing season soil temperatures at the 5 cm depth were 3–6°C higher in the treatments than in the control.** Details of the microclimatic effects of the treatments are reported in FRDA Memos No. 152 and 181 (in press).

Seedling Mortality

Figure 1 shows the mortality of the Engelmann spruce seedlings planted in 1987, measured at the end of the first,

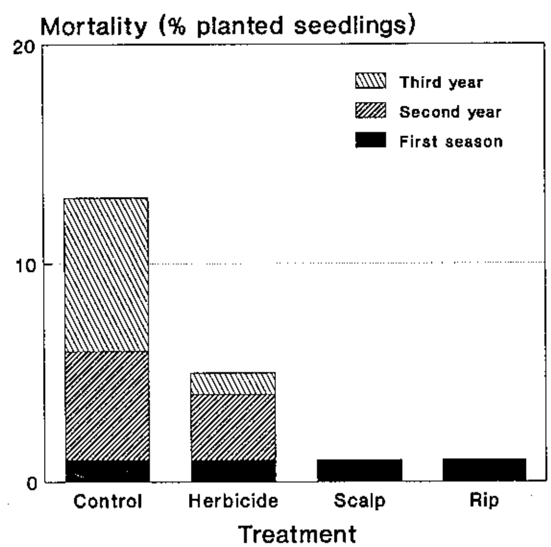

FIGURE 1. Mortality of Engelmann spruce seedlings planted in 1987 (percent of planted seedlings) at the end of the first, second, and third growing seasons since planting.

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second, and third growing seasons since planting. Mortality occurring during the first and second winters has been included in the measurements at the end of the second and third growing seasons, respectively.

Mortality of the Engelmann spruce seedlings at this site, which was generally low, was significantly lower than that at the FRDA 3.02 ESSFxc site. **Mortality of the Engelmann spruce seedlings planted in all years in the herbicide, scalping, and ripping treatments was less than that of the control seedlings.** The mechanical site preparation treatments (SCP and RIP) had especially low mortality. After two growing seasons, the seedlings planted in 1988 in trenching treatments had 9% mortality, which was similar to that of the control.

Spruce seedlings planted in 1987 in the scalping and ripping treatments had no further mortality after the first growing season. The seedlings planted in the control and herbicide treatments, however, had significant mortality over the first winter and second growing season. The control plot continued to undergo significant mortality over the second winter and third growing season. Similar results were also obtained for the 1986 and 1988 plantings.

Mortality of the lodgepole pine seedlings planted in 1987 averaged 5% after 3 years. Regardless of the treatment, lodgepole pine experienced only low mortality. Similar results were also obtained for the two trenching treatments after the first 2 years following the 1988 planting.

Seedling Growth

Both height and diameter growth of the Engelmann spruce and lodgepole pine seedlings during the first 3 years after planting in 1987 were very similar (Figures 2–5). **The ripping treatment resulted in the greatest average height and diameter growth in both species,** followed closely by the scalping and herbicide treatments. The control resulted in the least growth. Growth of the seedlings in the trenching treatment after two growing seasons was no greater than the control seedlings.

INTERPRETATIONS

The environmental conditions during the winter and growing seasons at this site are not extreme enough to cause much mortality to either species.

The herbicide, scalping, and ripping treatments all produce taller seedlings with greater stem diameters than does the control. The better growth in the treatments are likely the result of an improved soil water regime rather than an improved soil temperature regime. Because of the presence of an organic surface layer, the soil temperature in the herbicide treatments is very similar to that in the control. However, all treatments significantly reduce evaporative losses and therefore conserve soil water.

Over the first two growing seasons, the trenches do not increase seedling growth. This may be the result of the detrimental effects of planting the seedlings into a deeper soil horizon with high soil bulk density, reduced nutrient availability, and water logging during much of the first half of the growing season.

CONCLUSIONS

Several conclusions may be drawn from these research results:

1. **Mortality of Engelmann spruce and lodgepole pine seedlings at the MSxk site is low in both the control and treatments up to 4 years after planting.**
2. **For both species, growth differences between the treatment and control seedlings are not observed until the end of the second growing season.**
3. **For both species, the ripping treatment results in the greatest growth in height and diameter.**
4. **For both species, non-trench treatments (including those in which the organic layer is not removed) significantly increase height and diameter growth.**
5. **Growth increases in the treatments appear to be the result of improved soil moisture regime during the latter part of the growing season.**
6. **Differences in soil temperature among treatments do not appear to affect seedling growth at this site.**
7. **The trenching treatments do not improve the seedling growth of either species.**

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Engelmann spruce

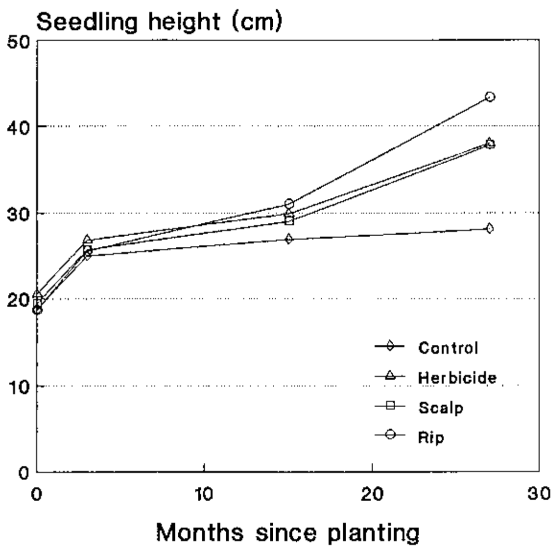

FIGURE 2. Average height of surviving Engelmann spruce seedlings at the end of the first, second, and third growing seasons since planting in spring 1987.

Lodgepole pine

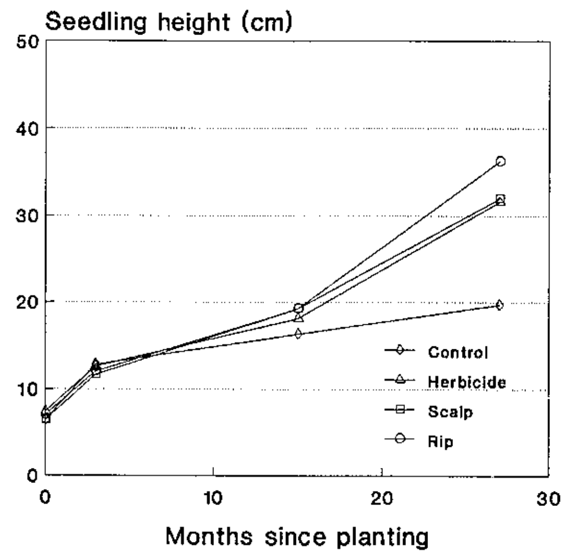

FIGURE 3. Average height of surviving lodgepole pine seedlings at the end of the first, second, and third growing seasons since planting in spring

Engelmann spruce

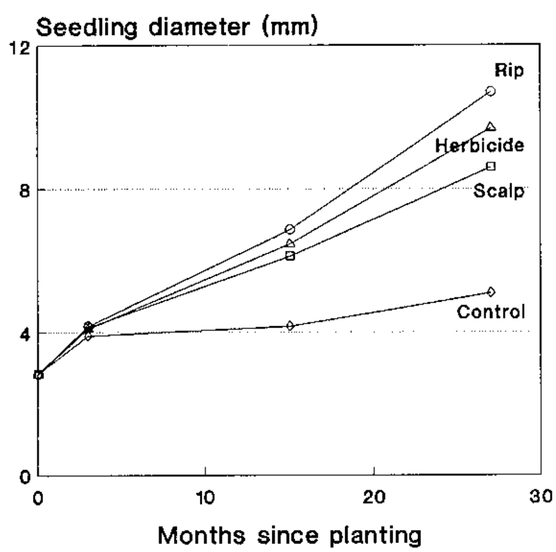

FIGURE 4. Average stem diameter of surviving Engelmann spruce seedlings at the end of the first, second, and third growing seasons since planting in spring 1987.

Lodgepole pine

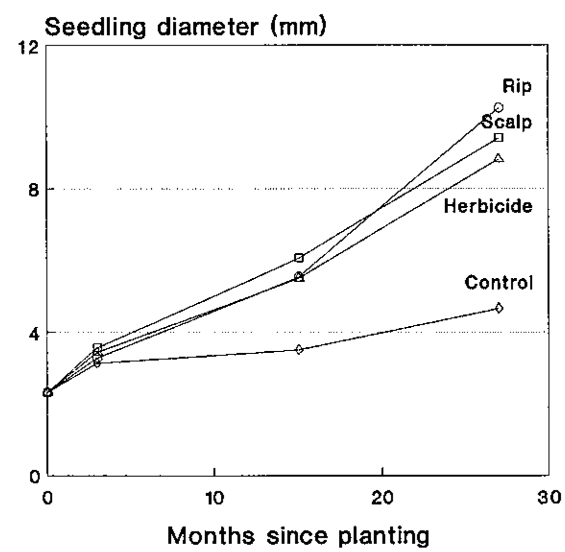

FIGURE 5. Average stem diameter of surviving lodgepole pine seedlings at the end of the first, second, and third growing seasons since planting in spring 1987.