FRDA Memo No. 166

er 1990 Site Preparation

IDF Zone Seedling Survival and Growth after Site Preparation Treatments – Project 3.02

INTRODUCTION

This research memo reports the results of research conducted from 1986-1989 on the effects of site preparation treatments on seedling survival and growth in the Dry Cool Interior Douglas-fir (IDFdk) subzone. Results for seedlings planted in 1987 are presented since they illustrate trends obtained for plantings in all years. The research was carried out in a large cut block at an elevation of 1220 metres near Fehr Mountain (40 km west of Kamloops). The site is mainly level, with a few small drainage depressions. The dominant vegetation is pinegrass. The block was clearcut in 1982, scarified in 1984 with a ripper blade and planted with lodgepole pine (Pl) in the spring of 1985. Survival from this planting was 5% in the fall of 1985.

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 very 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. Herbicide (30 mL glyphosate [Roundup®] per 100 square metres) 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 removed the surface organic layer using a front-mounted blade on a crawler tractor. Ripping to a depth of 30 to 50 cm was done using 2 rear-mounted ripper shanks, with paths 20–40 cm apart.

In 1987 the study was expanded to include a ripped trench (TRH) treatment. Some results from this treatment are also included in this memo. The trenches were made using a ripper shank with a heavy steel drag. The trenches were 20 to 30 cm deep and 40 to 60 cm wide at the top, and required some additional shaping by hand using a spade.

The experimental plots were located in a fenced area which excluded livestock. In spring 1986, sites were prepared and 1+0 containerized Douglas-fir (Fd) and lodgepole pine seedlings were planted in the control and the 4 original treatments. In spring 1987, seedlings were planted in the control and 5 treatments prepared the previous fall, including the ripped trenching treatment (TRH). In spring 1988, seedlings were planted in the control and treatments prepared the previous fall. All seedlings were planted so that the top of the plug was slightly below the top of the uppermost mineral horizon.

Survival and growth data were measured at the end of the first, second and third growing seasons after planting.

RESULTS

Seedling Environment

Soil water deficits in the seedling root zone were observed in the control in all four years. All treatments helped to conserve soil water. Volumetric water content at the 19 cm depth in the control dropped to as low as 10% – well below the level where significant reductions in seedling growth are expected to occur. Volumetric water content at the 19 cm depth in the treatments stayed above 15%. Further details of the effects of the treatments on soil moisture have been reported in FRDA Memo No. 162.

Frost events were common throughout all the growing seasons, but were less severe in the mechanical site preparation treatments (SCP, RIP, TRH). For example, from June to August 1987, the SCP treatment had 2 severe frosts (air temperature at the 15 cm height less than -4°C) compared to 6 severe frosts in the control. Air temperatures below -4°C have been found to cause frost injury in many actively growing conifers. **Soil temperatures were higher in the mechanical treatments, with daily average 5 cm soil temperatures in the SCP and RIP treatments 2–6°C higher than in the control and herbicide treatments.**

Seedling Mortality

Figures 1 and 2 show the mortality, at the end of each of three growing seasons, of the Douglas-fir and lodgepole pine seedlings planted in 1987. Mortality occurring during the first and second winters have been included in the measurements at the end of the second and third growing seasons respectively.

Mortality of the Douglas-fir seedlings was much greater than that of the lodgepole pine. The lowest mortality of both species was observed in the trenching treatment followed closely by the ripping treatment. The highest mortality occurred in the control for lodgepole pine seedlings and in the herbicide treatment for Douglas-fir seedlings. These results were also obtained for the 1986 and 1988 plantings.

Few Douglas-fir seedlings died during the first growing season, but considerable mortality occurred during the

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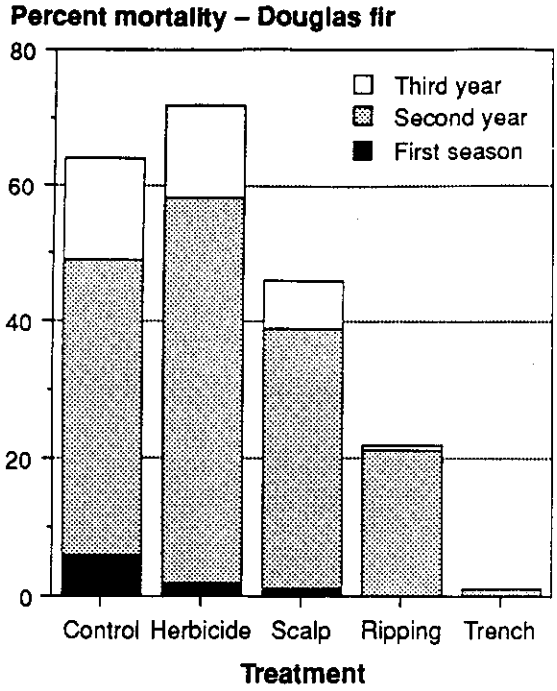

FIGURE 1. Mortality of Douglas-fir seedlings planted in 1987 (percent of planted seedlings) at the end of the 1st, 2nd and 3rd growing seasons after planting.

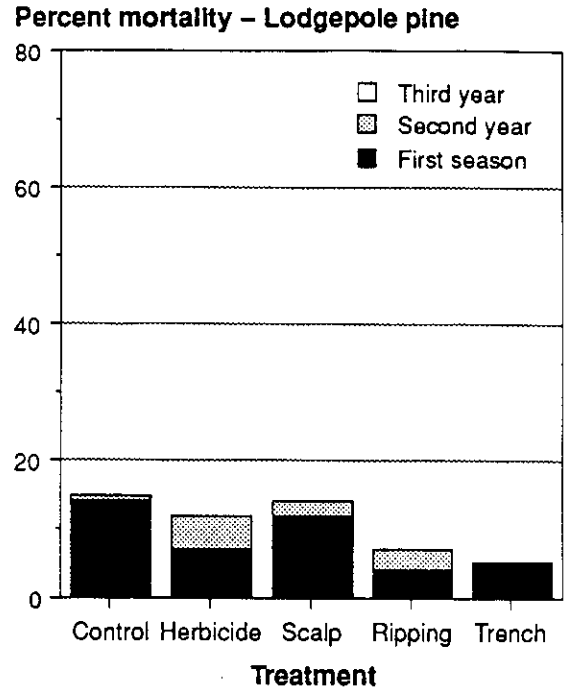

FIGURE 2. Mortality of lodgepole pine seedlings planted in 1987 (percent of planted seedlings) at the end of the 1st, 2nd and 3rd growing seasons after planting. (There was no mortality during the second winter and third growing season.)

first winter and the second growing season. Much less mortality occurred during the second winter and third growing season. Most lodgepole pine mortality occurred during the first growing season, and little mortality occurred subsequently. Similar results for both species were obtained for the first two years following the 1988 planting.

Seedling Growth

Figures 3, 4, 5 and 6 show height and diameter growth of the Douglas-fir and lodgepole pine seedlings during the first three years following planting in 1987. **Lodgepole pine seedlings grew better than Douglas-fir seedlings. The ripping treatment resulted in the best average height and diameter growth in both species over the three years. Seedlings in the control treatment grew the least. Seedling growth in the scalping and herbicide treatments was almost as good as that in the ripping treatment.** Seedling height and diameter growth in the trenching treatment was greater than in the control, but diameter growth was significantly less than in the other treatments.

INTERPRETATIONS

Seedling Mortality

1. Figure 1 indicates that the mortality of Douglas-fir seedlings growing in an exposed mineral surface is much lower than those growing in an undisturbed organic layer (i.e., the control and herbicide treatment). Frost intensity is greater in treatments with undisturbed surface organic horizons. **These results suggest that frost is a major cause of Douglas-fir mortality at this site.**
2. Measurements have shown that seedlings in trenches are covered in snow and are not exposed to the extremes in temperature, humidity, solar radiation, and windspeed that occur in the open. Douglas-fir mortality is much lower in the trenching treatment than in the ripping and scalping treatments. **This suggests that exposure during winter contributes to Douglas-fir mortality in the control and non-trenching treatments at this site.**
3. Lodgepole pine is much less susceptible to frost and winter damage than Douglas-fir. **The low mortality indicates that the critical values for frost and winter injury to lodgepole pine do not often occur at this site.**

Seedling Growth

1. **All treatments increased the diameter and height growth of both species because all treatments improved the root zone soil moisture regime.** The small differences in growth among the herbicide, scalping and ripping treatments show that the higher soil temperature in the mechanical site preparation treatments was not the main cause of better growth.
2. **Seedlings of both species planted in the trenching treatments grew less than those in the other treatments.** Measurements differed little in soil water deficit and soil temperature among the ripping, scalping, and trenching treatments; however, bulk density in the seedling root zone in the trenching treatment was higher than in the scalping and ripping treatments. High bulk density has the effect of increasing the

Douglas-fir

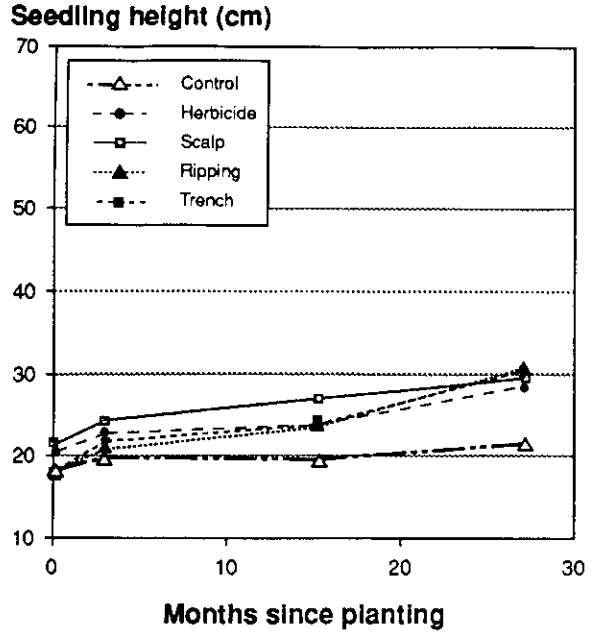

FIGURE 3. Average height (cm) of surviving Douglas-fir seedlings planted in 1987 at the end of the 1st, 2nd and 3rd growing seasons after planting.

Lodgepole pine

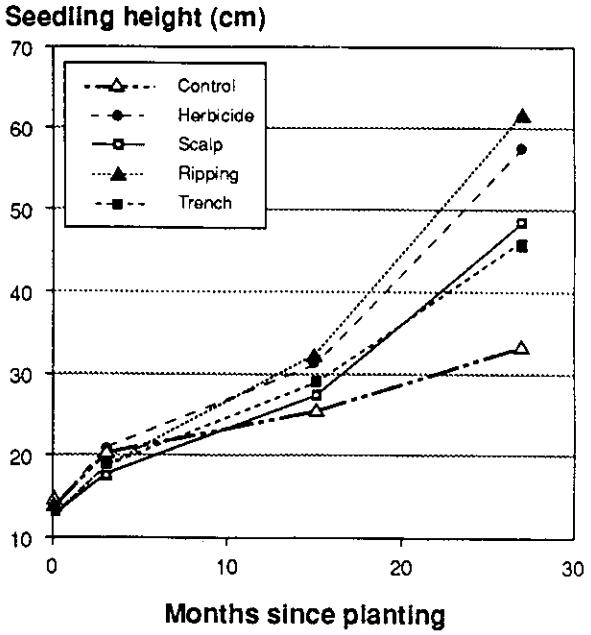

FIGURE 4. Average height (cm) of surviving lodgepole pine seedlings planted in 1987 at the end of the 1st, 2nd and 3rd growing seasons after planting.

Douglas-fir

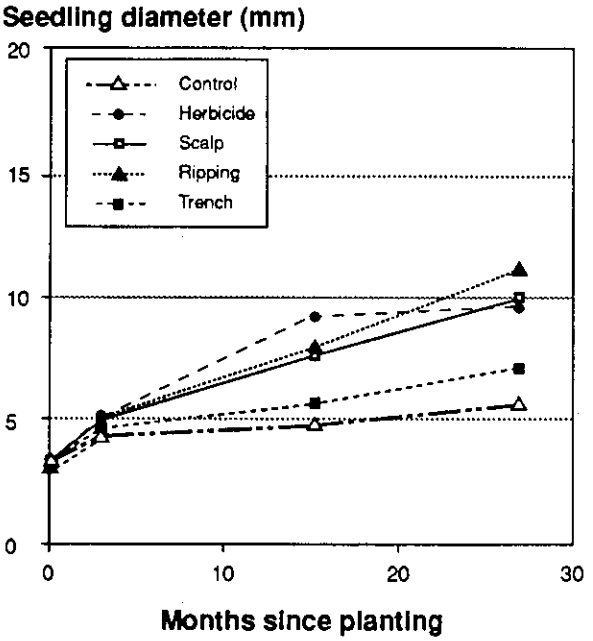

FIGURE 5. Average diameter (mm) of surviving Douglas-fir seedlings planted in 1987 at the end of the 1st, 2nd and 3rd growing seasons after planting.

Lodgepole pine

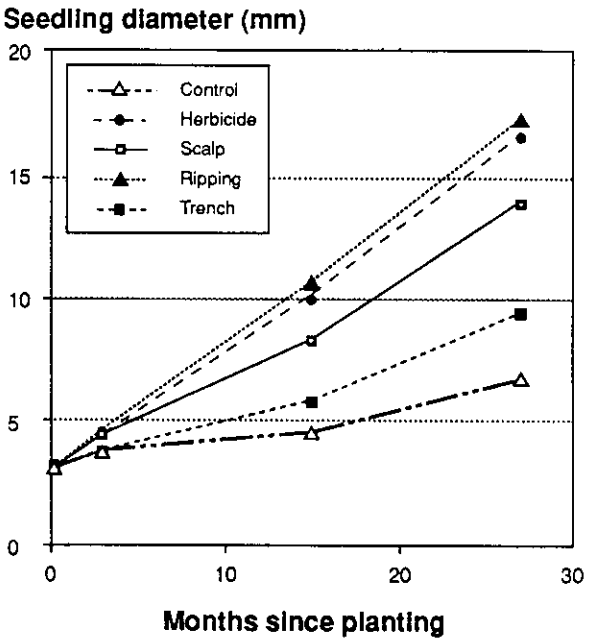

FIGURE 6. Average diameter (mm) of surviving lodgepole pine seedlings planted in 1987 at the end of the 1st, 2nd and 3rd growing seasons after planting.

resistance to root penetration and decreasing aeration. In addition, water logging in spring leads to poor aeration in the trenches and planting into a deeper soil horizon may reduce available nutrients.

CONCLUSIONS

1. **The mortality of Douglas-fir seedlings was much higher than that of lodgepole pine at this site.**
2. **The greatest proportion of Douglas-fir mortality occurred during the first winter and second growing season, while that of lodgepole pine occurred during the first growing season after planting.**
3. **For both species, mortality was greatly decreased by treatments in which the surface organic layer was removed (i.e., scalping, ripping and trenching).**
4. **For both species, all treatments (not just those in which the organic layer was removed) increased both height and diameter growth of surviving seedlings.**
5. **For both species, ripping resulted in the greatest growth in both height and diameter of surviving seedlings.**
6. **While mortality was lowest in the trenching treatment, growth was greater than in the control, but significantly less than in the other treatments.**
7. **Growth differences were consistent with differences in the soil moisture regime among treatments, while mortality was consistent with differences in frost severity and snow cover among treatments.**
8. **Differences in soil temperature among treatments did not appear to affect seedling growth at this site.**

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