FRDA Research Memo

February 1994 Site Preparation No. 218

Mechanical Site Preparation and Seedling Establishment in the IDFdk, MSxk, and ESSFxc Subzones

by
W.R. Mitchell

INTRODUCTION

Mechanical site preparation is known to improve the survival and growth of seedlings on a wide range of sites. But the most suitable type of mechanical treatment for each site is not as well known.

Disc trenching has been used extensively in the southern interior of British Columbia as a site preparation treatment. After disc trenching, three planting positions (microsites) are available: trench, hinge, and berm (Figure 1). Experience in northern British Columbia suggests that the hinge and berm usually provide the best planting spots on many sites; however, the most suitable choice for conditions in the southern Interior is not well known.

This project was designed to assess the effects of:

1. three mechanical treatments (disc trenching, patch scarification, and ripping) on seedling survival, growth, and frost damage to seedlings in the three different subzones: IDFdk, MSxk, and ESSFxc; and

2. three microsite planting positions created by a disc trencher (trench, hinge, and berm), on seedlings' performance in three different subzones: IDFdk, MSxk and ESSFxc.

After 5 years, results indicate that the disc trencher and ripper/drag treatments generally provided the most favourable conditions for survival, growth, and protection from frost damage for seedlings on mesic and drier sites in the IDFdk, MSxk, and ESSFxc sites.

Results also indicate that the trench and hinge microsite planting positions (on disc trenched sites) provide suitable environments for seedling establishment on mesic and drier sites in the IDFdk and MSxk subzones. The hinge position is better on wetter sites in the MSxk subzone. The hinge and berm microsite planting positions provide better conditions on the ESSFxc sites.

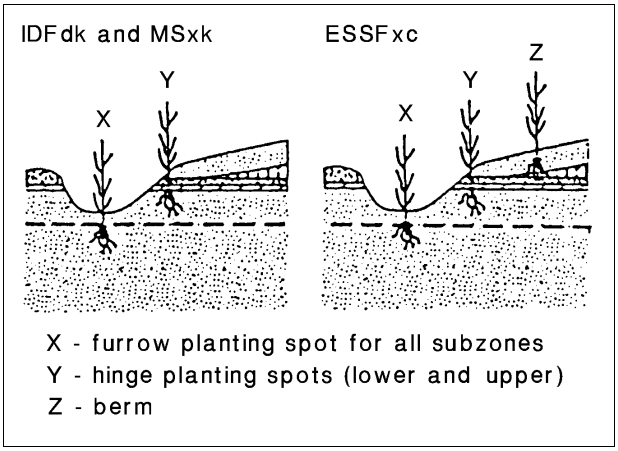

FIGURE 1. Microsite planting positions in the disc trencher treatment.

DESCRIPTION OF STUDY

The three study sites (Table 1) are grass-herb dominated backlog areas. Each site includes a research installation (Black and Mitchell,1990a,b. 1991,a,b.) where detailed microclimate and seedling response data are collected. Three common types of mechanical site preparation and one untreated control were located adjacent to

TABLE 1. Characteristics of the study area/sites

Biogeoclimatic zone	Location	Elevation (m)	Annual ppt. (mm)	Growing heat units (°C days)	Sites	
					Moisture regime	Dominant vegetation
IDFdk Interior Douglas-fir dry cool	Fehr Mountain	1200	430	1210	mesic to submesic	pinegrass
MSxk Montane spruce very dry cool	Paska Lake	1450	490	940	mesic	pinegrass, arctic lupine
ESSFxc Engelmann spruce Subalpine fir very dry cold	Tsintsunko Lake	1670	540	670	A - mesic to subhygic B - mesic	bluejoint bluejoint, pinegrass

the installations, and tested under operational conditions:

1. disc trenching (Donaren 280D or TTS 35)
2. patch scarification (Leno model 81)
3. ripping (two-shank ripper plus drag)
4. untreated control

In the spring of 1988, each treatment in the IDFdk subzone (including a control) was planted with lodgepole pine (Pl) and Douglas-fir (Fd). Engelmann spruce (Se) and Pl were planted in the MSxk and ESSFxc subzones. All seedlings were planted in the furrow (trench) for the main trial. In a subsidiary trial, seedlings were planted in the furrow and on the hinge at the IDFdk and MSxk study areas, and in the furrow, on the hinge, and on the berm at the ESSFxc sites

RESULTS

Results obtained after five growing seasons (1988 to 1992) provide information on initial seedling response or performance.

CONTROL

All treatments reduced the mortality of Se but not significantly for Fd. All treatments reduced the mortality of Pl at the IDFdk and ESSFxc-A sites.

The treatments improved the number of thrifty and fair seedlings of all species at all sites, except Pl at the MSxk site. The percentage of fair and thrifty seedlings was generally higher for Pl than for Fd or Se for all treatments (including the control), mainly because of the higher susceptibility of Fd and Se to frost damage (Figure 2).

Planting on the hinge and berm reduced Se and Pl mortality at the ESSFxc-A site, mainly because of less frost heaving and drowning during the spring of the first year.

Planting position had little effect on the percentage of thrifty and fair Fd and Pl seedlings at the IDFdk site. The hinge and berm positions at the MSxk and ESSFxc (A and B) sites had the largest amount of fair and thrifty Pl and Se seedlings. The condition of Pl was better than Fd at the IDFdk site and Se at the ESSFxc (A and B) sites, primarily because Pl is less susceptible to frost damage (Figure 3).

FROST DAMAGE

First-year frost damage to Pl was insignificant for all treatments and sites. Frost damage for Fd at the IDFdk site was the least for the ripper/drag and disc trencher treatments. All treatments (leno, disc trencher and ripper/drag) reduced frost damage to Se on the MSxk and ESSFxc sites, compared to the control (Figure 4).

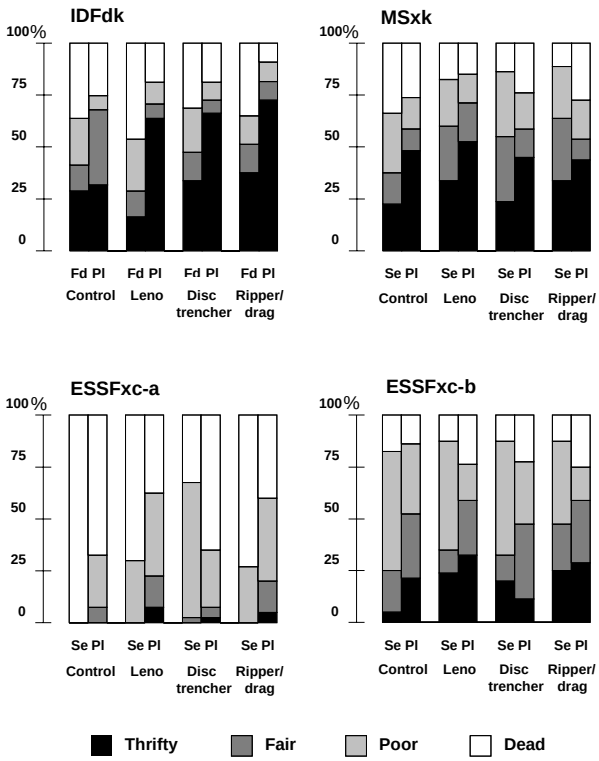

FIGURE 2. Seedling condition after 5 years, for species and treatments, on the IDFdk, MSxk, and ESSFxc sites.

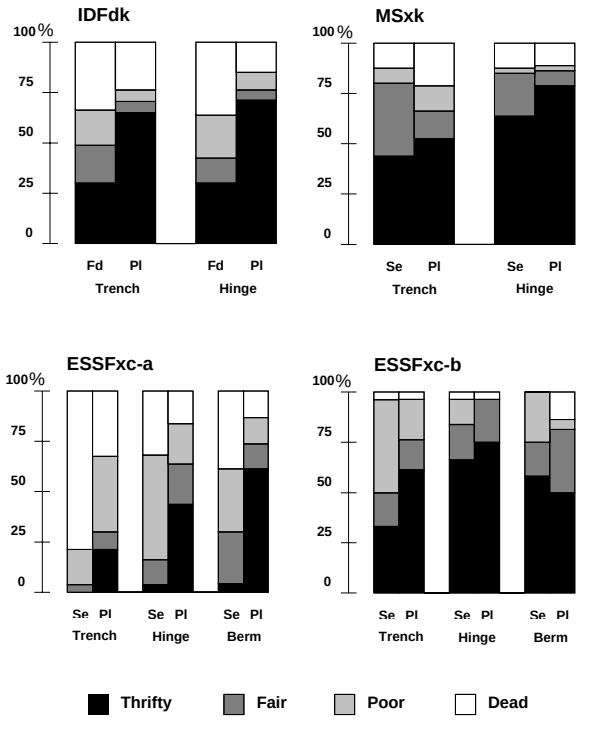

FIGURE 3. Seedling condition after 5 years, for species and planting position, on the IDFdk, MSxk, and ESSFxc sites.

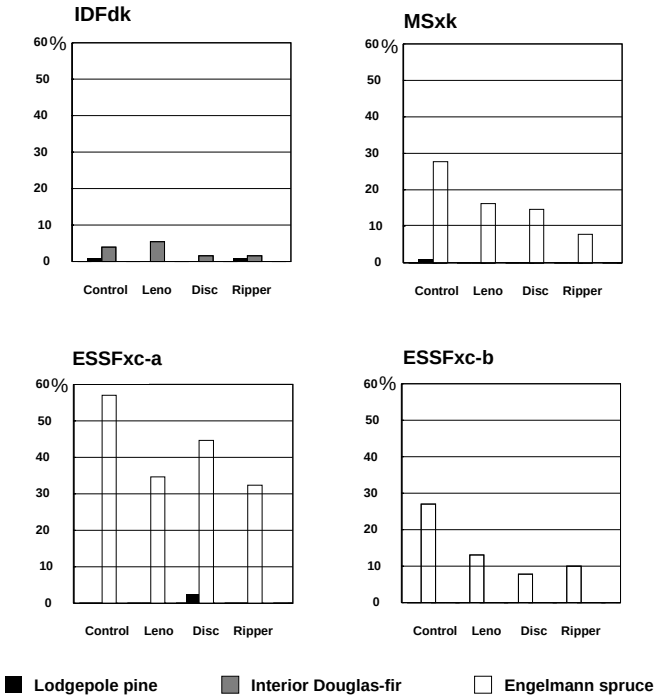

FIGURE 4. First-year frost damage for species and treatments, on the IDFdk, MSxk, and ESSFxc-A and ESSFxc-B sites.

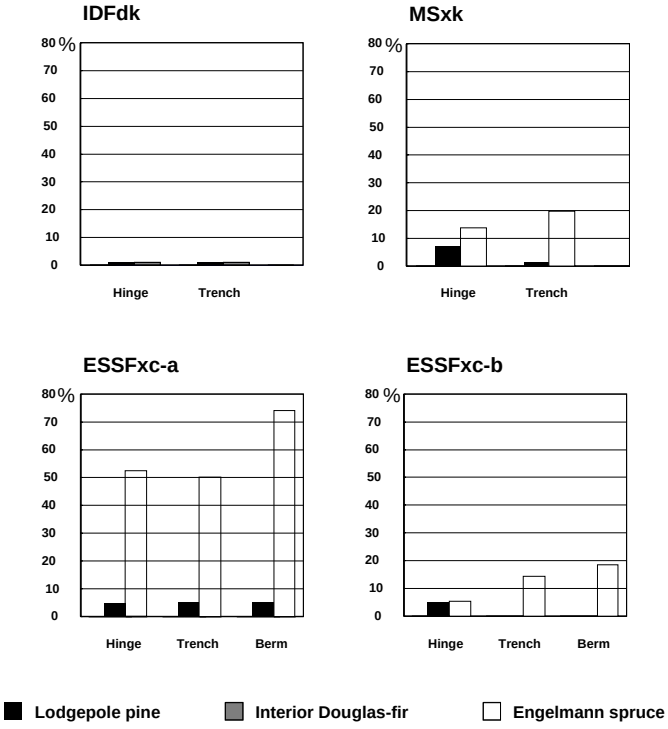

FIGURE 5. First-year frost damage for species, planting positions (berm, hinge, trench) for the IDFdk, MSxk, and ESSFxc-A and ESSFxc-B sites.

Planting position did not significantly affect Pl and Fd seedlings at the IDFdk site or the Pl seedlings at the ESSFxc-A site. Planting in the hinge was most effective in reducing frost damage to Se at the MSxk and ESSFxc-B sites; the trench and hinge planting positions were the most effective at the ESSFxc-A sites (Figure 5).

HEIGHT GROWTH

All treatments (leno, disc trencher and ripper/drag) significantly improved Pl height growth at the IDFdk and ESSFxc-A sites. Disc trencher and ripper/drag treatments improved Fd height growth at the IDFdk site. All treatments improved Se height growth at the MSxk and ESSFxc sites (A and B), with the exception of the leno at the ESSFxc-A site.

Se and Pl height growth at the ESSFxc-B was two to three times that of the ESSFxc-A site for all treatments (including the control), primarily because it is a steeper (5–25% gradient), warmer, mesic site and had very little frost damage, whereas the ESSFxc-A site is a flat, cold, air-ponding, frost-prone, subhygric site. Pl grew better than the other species at all sites and for all treatments. Most of the loss in height growth of Se, and to some extent for Fd, was due to periodic frost damage (Figure 6).

Seedling growth on the hinge was somewhat better at the IDFdk, MSxk, and ESSFxc-B sites. At the ESSFxc-A site, seedlings on the berm showed the best growth (Figure 7).

DIAMETER GROWTH

The effects of treatments on diameter growth are similar to height growth effects for Pl at the ESSFxc-A site. None of the treatments significantly affected the diameter growth of Se at this site (Figure 8).

The seedling root collar diameter growth was similar to the results for height growth at all four sites and in most of the planting positions. The exception was the hinge planting position at the IDFdk site, where there was less diameter growth of Pl (Figure 9).

CONCLUSIONS

The following conclusions are based on 5-year results and apply to mesic and submesic sites (medium to moderately fine textured) in the IDFdk and MSxk subzones, and mesic to subhygric sites (medium to moderately fine textured) in the ESSFxc subzone. The results of this study may also be applied to similar grass-herb dominated sites in other dry subzones in the southern Interior.

IDFdk Sites

The disc trencher and ripper/drag are the best treatments for Fd and Pl survival and height/diameter growth, and for protection from frost damage and winter desiccation.

Both disc trencher trench and hinge are suitable planting positions for Fd and Pl. No significant differences in seedling condition, frost damage, or height and diameter growth occurred after five growing seasons. The trench provides the best protection for sites where seedlings are subject to winter desiccation.

MSxk Sites

All treatments (leno, disc trencher and ripper/drag) reduced frost damage and improved seedling condition, survival, and height/diameter growth of Se. The treatment effects on Pl were insignificant.

Both the disc trencher trench and hinge are suitable planting positions for Se. No significant differences in seedling condition or height and diameter growth occurred after five growing seasons. The hinge position is somewhat better than the trench microsite for Pl seedling condition and height and diameter growth. On wetter sites, Se and Pl seedlings should be planted on the hinge to prevent frost heaving and drowning.

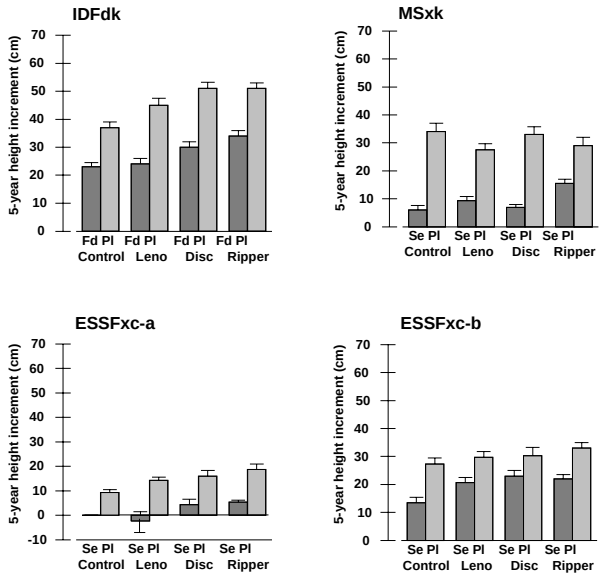

FIGURE 6. Height growth (increment in centimeters) after 5 years, for species and treatments in the IDFdk, MSxk, and ESSFxc sites.

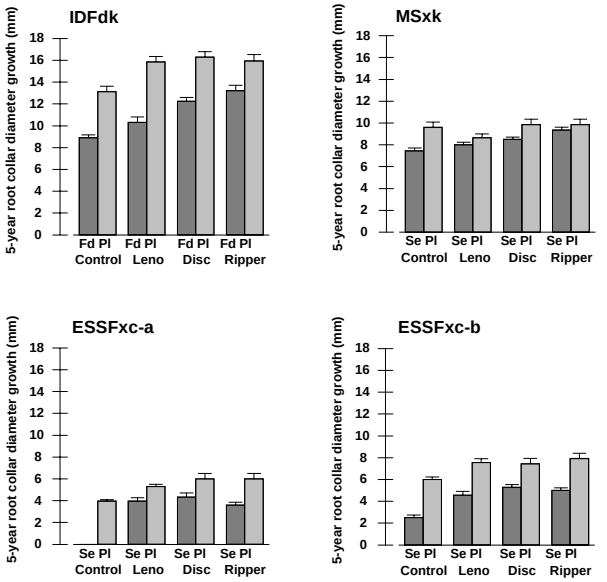

FIGURE 8. Diameter growth (increment in millimeters) after 5 years, for species and treatments at the IDFdk, MSxk, and ESSFxc sites.

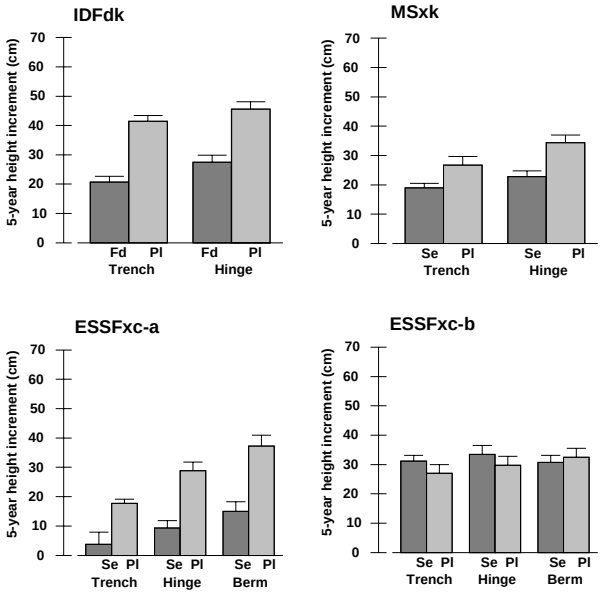

FIGURE 7. Height growth (increment in centimeters) after 5 years, for species and planting position in the IDFdk, MSxk, and ESSFxc sites.

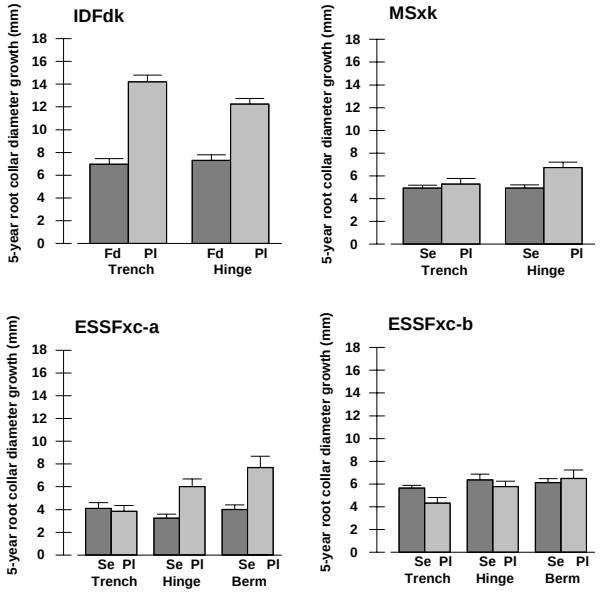

FIGURE 9. Diameter growth (increment in millimeters) after 5 years, for species and planting postions at the IDFdk, MSxk, and ESSFxc sites.

ESSFxc-Sites

On flat sites similar to ESSFxc-A:

Severe seedling frost damage and frost heaving are likely to occur, and any treatment that does not provide an elevated planting spot above ground level is susceptible to drowning.

Se and Pl seedling condition, survival, and height/diameter growth are all poor to very poor for all treatments (leno, disc trencher and ripper/drag) on this site. The disc trencher hinge and berm planting positions are the most suitable for Se and Pl seedling survival and height/diameter growth, and to prevent frost heaving and drowning. Two-year results on an adjacent research trial indicate mounding is probably the best site preparation treatment.

On sloping sites similar to ESSFxc-B:

Minor seedling frost damage and frost heaving occur. Drowning does not occur.

All treatments (leno, disc trencher, and ripper/drag) provide suitable environments for Se and Pl survival and growth.

All planting positions (trench, hinge, and berm) provide suitable environments for Se and Pl survival and height/diameter growth; however, the hinge is probably the best choice. Se performance is almost as good as Pl following mechanical site preparation; either species or mixtures of species can be planted.

REFERENCES

Black, A. and W.R. Mitchell. 1990a. Effect of site preparation treatments on seedling survival and growth in the IDF zone - FRDA project 3.02. For. Can. and B.C. Min. For. FRDA Memo no. 166.

_____. 1990b. Effect of site preparation treatments on seedling survival and growth in the MS zone - Southern Interior FRDA project 3.02. For. Can. and B.C. Min. For. FRDA Memo no. 167.

Black, T.A., R.S. Adams, R.L. Fleming, N.R. Eldridge, W.R. Mitchell and I.J. Simpson. 1991a. Effects of site preparation treatments on seedling survival and growth in the ESSF biogeoclimatic zone. For. Can. and B.C. Min. For. FRDA memo no. 177.

_____. 1991b. Reducing summer frost injury to seedlings in the Southern Interior. Project 3.02. For. Can. and B.C. Min. For. FRDA memo no. 181.

Contact:

Bob Mitchell
Regional Research Pedologist
(604) 828-4128

Alan Vyse
Forest Science Officer
(604) 828-4158

Kamloops Forest Region
515 Columbia St.
Kamloops, B.C.
V2C 2T7