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Nine-year response of lodgepole pine and the *Dry Alder* Complex to chemical and manual release treatments on an ICHmk1 site near Kelowna

by

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Programs to manage competing vegetation in the southern interior of British Columbia have grown steadily for more than a decade, in spite of a lack of information about the effects of the various treatments on individual vegetation communities. In order to justify the expenditure, it is necessary to maximize the benefits to conifers while minimizing negative effects on other resource values such as wildlife, range, biodiversity, and long-term site productivity. To this end, a research trial was established in the Kamloops Forest Region to study the effects of broadcast ground foliar applications of glyphosate at 3 L/ha (1.07 kg ai/ha) and 6 L/ha (2.14 kg ai/ha), and of manual cutting on lodgepole pine seedlings and the *Dry Alder* Complex.

This trial is located in the Penticton Forest District between Mission and Belgo Creeks, approximately 40 km east of Kelowna. It occurs on a submesic site within the ICHmk1–site series 03–04, at an elevation of 1320 m. The site was logged between 1981 and 1982, and it regenerated naturally to lodgepole pine. When this trial was established in 1986, pine seedlings were 40 cm tall with 1 cm stem diameters. Sitka alder was 142 cm tall with 23% cover, and fireweed was 50 cm tall with 11% cover.

Glyphosate treatments were applied between 05:30 and 09:30 hr on August 22 and 23 1986, under clear skies with a wind speed less than 3 km/hr. Glyphosate was mixed with water and delivered at a rate of 100 L/ha under low pressure using hand-pump back-pack sprayers. Manual cutting was done once on June 12 1986, using hand-held shears. All woody vegetation, excluding conifers, was cut at the root collar.

SITKA ALDER AND FIREWEED RESPONSES

Manual cutting had the most severe and long-lasting impact on Sitka alder, followed by treatment with glyphosate at 6 L/ha (Table 1). Glyphosate at 3 L/ha caused some reductions in height and cover of Sitka alder, but they were not significant compared to the control. Manual cutting reduced Sitka alder height to less than 20 cm for 3 years, and after 9 years it was still only 62 cm tall. Glyphosate applied at 6 L/ha reduced alder height to less than 70 cm for 3 years, but by 1995 it had recovered to the same height as the control, which averaged 190 cm. By 1995, cover of Sitka alder in manually cut plots was still less than 3% compared to 15% in plots treated with glyphosate at 6 L/ha, 18% in plots treated with glyphosate at 3 L/ha, and 22% in the control.

TABLE 1. Number of years required for target vegetation to recover to control levels

	Manual cut	Glyphosate 6 L/ha	Glyphosate 3 L/ha
Sitka alder			
Height	>9	>3 but <9	1
Cover	>9	>3 but <9	1
Fireweed			
Height	0	2	2
Cover	0	2	1

The two levels of glyphosate application reduced height and cover of fireweed for 1–2 years following treatment, but manual cutting had no effect.

A competition index (CI), calculated as

CI=((Alder height x cover)+
(Fireweed height x cover))/100

was significantly reduced for at least 3 years following treatment with glyphosate at 6 L/ha, and at least 9 years by manual cutting, mainly as a result of the effect of those treatments on Sitka alder (Figure 1).

LODGEPOLE PINE RESPONSE

Stem diameter of lodgepole pine seedlings increased over control levels within 2 years of all three release treatments, but height did not increase until 5–9 years after treatment. Nine years after treatment, stem diameter had increased to 6.7 cm in the control and 7.5 cm in the three release treatments (Figure 2). Likewise, seedling height had increased to 425 cm tall in the control and 455–468 cm tall in the three release treatments. There were no significant differences in seedling height or stem diameter among the three release treatments. However, stem volume in the 6 L/ha glyphosate treatment was estimated to be 25 and 45% greater than in the manual cutting treatment and control, respectively.

Lodgepole pine overtopped neighbouring vegetation immediately following manual cutting, within 2 years following application of glyphosate at 6 L/ha, within 3 years following application of glyphosate at 3 L/ha, and within 4 years in the control (Figure 3).

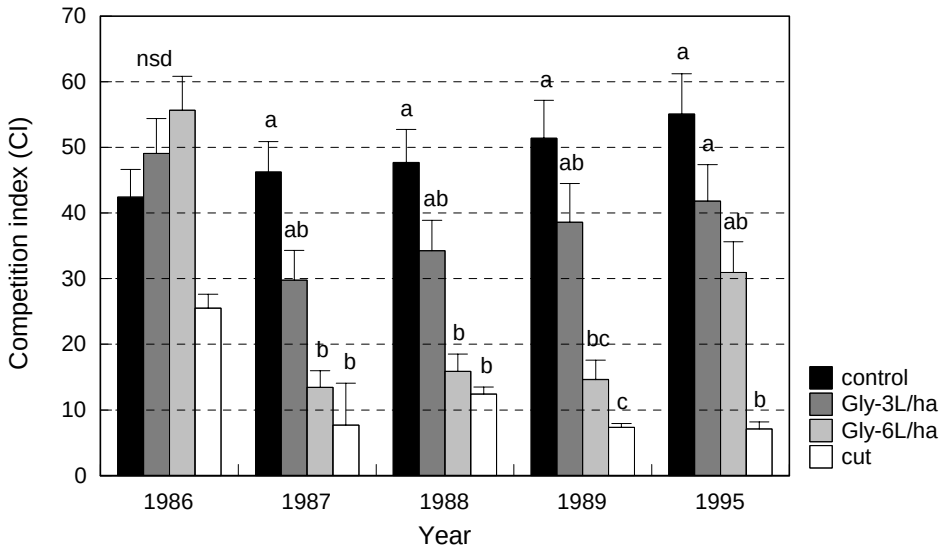

FIGURE 1. Competition index (CI) from 1986 to 1995. Treatments with the same letters within a single year are not significantly different from one another; nsd=no significant difference; error bars are one standard error.

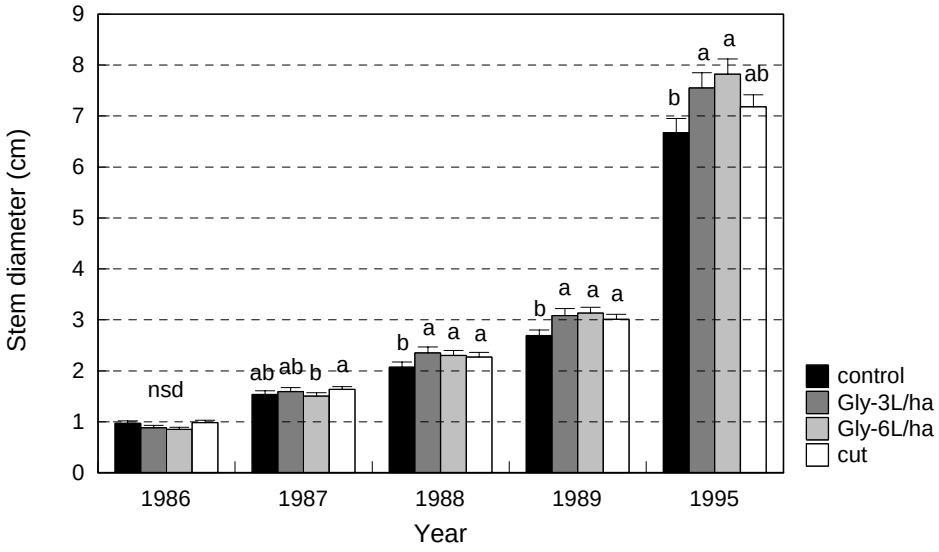

FIGURE 2. Lodgepole pine stem diameter from 1986 to 1995. Treatments with the same letters within a single year are not significantly different from one another; nsd=no significant difference; error bars are one standard error.

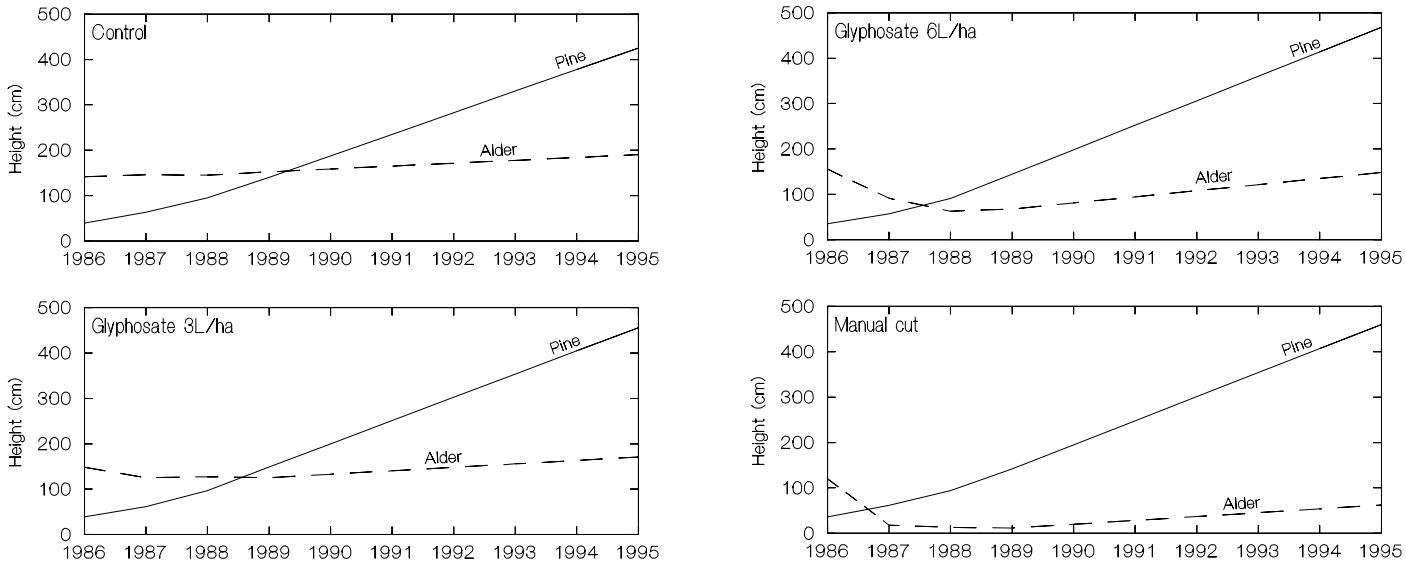

FIGURE 3. Comparison of height growth between lodgepole pine and Sitka alder.

SPECIES DIVERSITY

Percent cover of all vascular plant species was recorded in each treatment plot in 1995. Species richness (total number of species present) was lower in the manual cutting treatment than in the control, but species diversity (Simpson's and Shannon's diversity indices, both of which combine measures of richness and abundance) did not differ among any treatments. The abundance of the shrubs *Vaccinium* spp. and *Symphoricarpos albus* were somewhat reduced following glyphosate treatments, but results were inconsistent between rates of application.

INTERPRETATIONS AND RECOMMENDATIONS

1. All three release treatments resulted in increases over control levels in lodgepole pine stem diameter after 2 years, and in height after 5–9 years. Although reduction in height of Sitka alder was greater as a result of manual cutting and glyphosate at 6 L/ha than as a result of glyphosate at 3 L/ha, seedling response was not correspondingly greater in the higher-impact treatments. This suggests that the availability of soil resources was limiting to seedlings, as was light availability.

2. Reductions in Sitka alder cover from 22% in the control to 15–18% following application of glyphosate at 3 L/ha were sufficient to allow growth responses of lodgepole pine seedlings. This supports and helps refine the estimate of a 10–35% competition threshold for Sitka alder (Simard 1990) at which seedlings may benefit from the nitrogen fixing ability of alder, but above which seedlings are negatively affected by competition for resources.

3. Lodgepole pine was shorter than Sitka alder when the trial was initiated, but was taller in all treatments, including the control, within 5 years of treatment. Although treatment accelerated dominance by lodgepole pine, it was not necessary to achieve free-growing status within the recommended assessment period (British Columbia Ministry of Forests 1995).

4. Diversity of vascular plant species was unaffected by treatment. However, species richness was lower following manual cutting than in the control, possibly due to soil and micro-environment changes associated with Sitka alder reduction. Glyphosate treatments appeared to reduce the abundance of some berry-producing shrub species, but the effects were too variable to draw conclusions.

British Columbia Ministry of Forests. 1995. Establishment to free growing guidebook, Kamloops Forest Region. *In* Forest Practices Code of British Columbia. Province of British Columbia.

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