

Nine-year response of Douglas-fir and the *Mixed Hardwood-Shrub* Complex to chemical and manual release treatments on an ICHmw2 site near Salmon Arm

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. 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 Douglas-fir seedlings and the *Mixed Hardwood-Shrub* Complex.

This trial is located in the Salmon Arm Forest District at Larch Hills, about 22 km east of Salmon Arm. It occurs on a mesic site within the ICHmw2-site series 01, at an elevation of 950 m. The original hemlock/cedar stand was clearcut in 1978, followed by broadcast burning in 1980 and planting with 2+0 bareroot Douglas-fir in 1982. When this trial was established in 1986, Douglas-fir seedlings were 72 cm tall with 1.2 cm stem diameters, and were growing in association with a dense complex of paper birch, thimbleberry, and fireweed. Birch was 150 cm tall with 18% cover, thimbleberry was 60 cm tall with 29% cover, and fireweed was 109 cm tall with 18% cover.

All treatments were applied on September 4 1986, under slightly overcast skies with a wind speed of up to 8 km/hr. Glyphosate was

applied in mixture with water (mixture delivered at 50 L/ha) using hand-pump backpack sprayers. In the manual cutting treatment, all woody vegetation was cut at the root collar using circular brush saws.

BIRCH, THIMBLEBERRY, AND FIREWEED RESPONSES

Height and cover of birch were significantly reduced for 9 years by both levels of glyphosate application (Table 1), and Douglas-fir seedlings were released in the first year after treatment. Manual cutting significantly reduced height and cover of birch for 3 years, but sprouting was so vigorous that seedlings did not release. By 1995, birch cover in the control had increased to 40%, compared to 28% in manually cut plots. At the same time, it decreased to 15 and 7% in plots treated with 3 and 6 L/ha glyphosate, respectively.

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

	Glyphosate 3 L/ha	Glyphosate 6 L/ha	Manual cut
Birch	Height	>9	>9
	Cover	>9	>9
Thimbleberry	Height	>3 but <9	>3 but <9
	Cover	3	>3 but <9
Fireweed	Height	2	3
	Cover	0	2

Both levels of glyphosate reduced the height and cover of thimbleberry for 3 years, but manual cutting had no effect on the shrub. Fireweed height and cover were significantly reduced for 1–2 years following the glyphosate treatments, but actual reductions were small.

A competition index (CI), calculated as

$$CI = \frac{(\text{Birch height} \times \text{cover}) + (\text{Thimbleberry height} \times \text{cover}) + (\text{Fireweed height} \times \text{cover})}{100}$$

remained significantly reduced in the two glyphosate treatments after 9 years, mainly because of sustained reductions in height and cover of birch (Figure 1).

DOUGLAS-FIR RESPONSE

Within 2 years of treatment, stem diameter of Douglas-fir seedlings was significantly larger in both glyphosate treatments than in the control, and this difference was maintained through year 9 (Figure 2). Manual cutting had no significant effect on stem diameter. The height of Douglas-fir did not significantly increase relative to the control in any treatment during the 9 years of the trial, but differences may become more pronounced in the near future. In 1995, seedlings in the

control were 444 cm tall, compared to 519 cm tall in glyphosate at 6 L/ha plots, 508 cm tall in 3 L/ha plots, and 468 cm tall in manually cut plots (Figure 3).

The calculated stem volume of Douglas-fir seedlings in plots treated with glyphosate at 6 L/ha and 3 L/ha were 2.0 and 1.6 times greater than in the control, respectively, and this growth response to treatment may not yet be fully expressed.

SPECIES DIVERSITY

Percent cover of all vascular plant species was recorded in each treatment plot in 1995. There were no significant differences among treatments in species richness (total number of species present), nor in species diversity (Simpson's and Shannon's diversity indices, both of which combine measures of richness and abundance). However, there was a treatment effect on distribution of vegetation among different growth forms; glyphosate treatments had a lower proportion of broadleaves (mainly birch) and a higher proportion of herbs compared with the control and manual cutting treatment. The reduction in birch appears to have affected browse availability, since Douglas-fir was most heavily browsed in the glyphosate treatments.

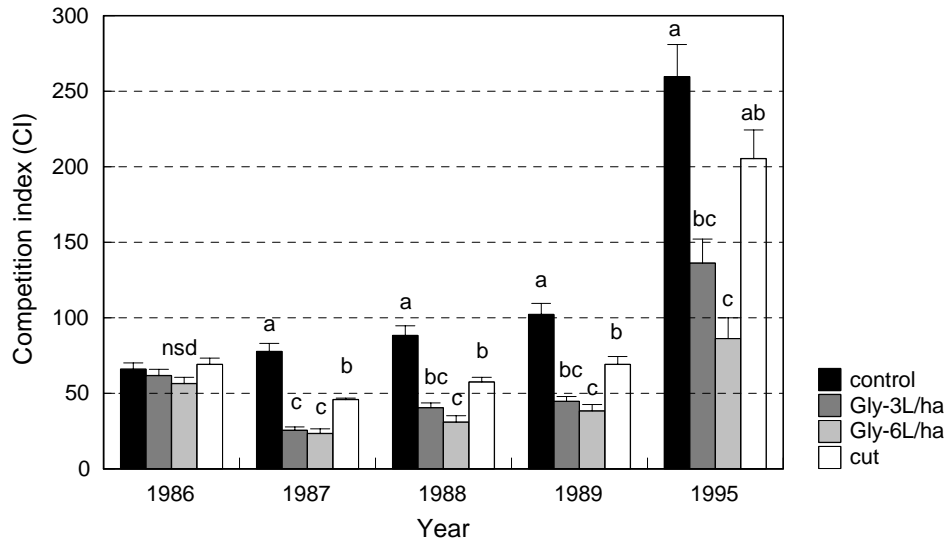


FIGURE 1. Competition index (CI) from 1986 to 1995. Treatments with the same letters within a single year are not significantly different from one another; nsd=no significant difference; error bars are one standard error.

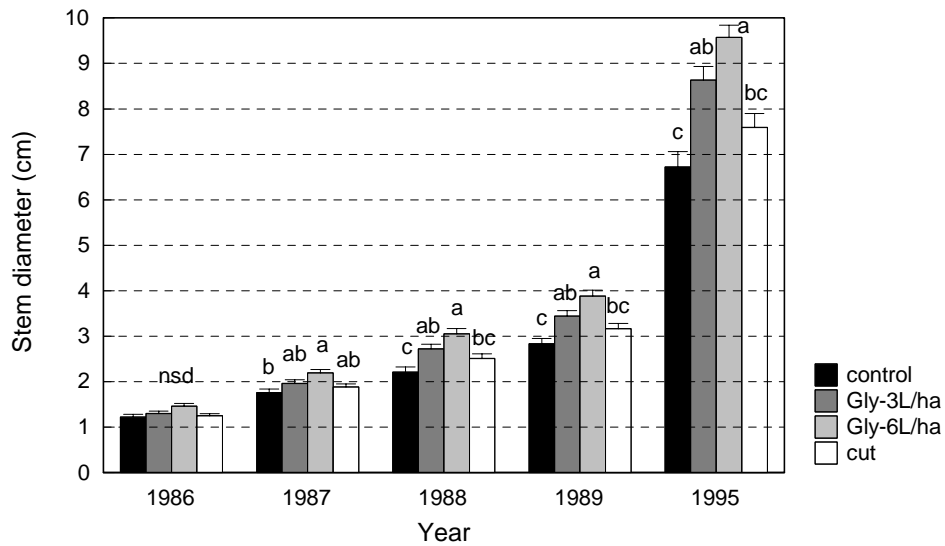


FIGURE 2. Douglas-fir stem diameter from 1986 to 1995. Treatments with the same letters within a single year are not significantly different from one another; nsd=no significant difference; error bars are one standard error.

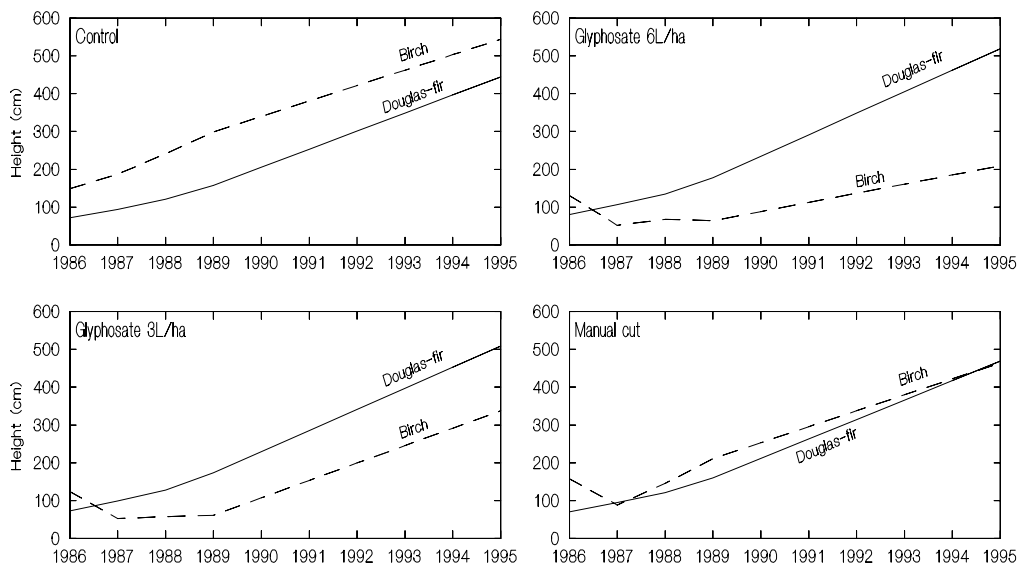


FIGURE 3. Comparison of height growth between Douglas-fir and birch from 1986 to 1995.

INTERPRETATIONS AND RECOMMENDATIONS

1. Reductions in the *Mixed Hardwood-Shrub* Complex that resulted from broadcast treatment with glyphosate improved Douglas-fir stem diameter growth; however, there was no apparent advantage to applying it at 6 L/ha rather than 3 L/ha.
2. Free-growing status of Douglas-fir was immediately improved by both glyphosate treatments. Most Douglas-fir were free-growing within a year following the 3 L/ha or 6 L/ha glyphosate treatments, whereas they remained overtopped in the control and were threatened in the manual treatment throughout the 9-year measurement period (Figure 3).
3. Neither the glyphosate nor manual cutting treatments affected species diversity or richness of vascular plants. However, community structure was altered by the glyphosate treatments due to the reduction in the proportion of birch and the increase in the proportion of herbaceous plants. Reductions in birch forage appeared to favour browsing of Douglas-fir by ungulates.
4. Birch is important as forage for wildlife, and current research also shows that its presence affects the incidence of root disease, improves long-term site productivity, and enhances biodiversity. Further research is needed to identify a competition threshold for birch, so that it need not be affected more than is necessary to ensure acceptable seedling growth.

ACKNOWLEDGEMENTS

This project was initiated by Ron Gray of the Kamloops Forest Region. The trial was installed by Suzanne Simard in 1986, monitored and reported on by Bryce Bancroft of Madrone Consultants Ltd. in 1987–1990, and monitored again by Silver Ring Forestry Ltd. in 1995. Data analysis was carried out by Jean Heineman and Don Sachs. This memo was reviewed by Ron Gray, Phil Comeau, and George Harper.

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