

Unreplicated responses of Douglas-fir and the *Willow* complex to foliar glyphosate treatment in the IDF zone

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INTRODUCTION

This report describes trends in conifer and vegetation responses to foliar glyphosate treatment of the *Willow* complex, a common vegetation community on logged sites in the southern interior of B.C. [Click here](#) for a description of the *Willow* complex.

The results presented here are for only one site. The treatment was not adequately replicated to allow analysis of variance to be completed (a minimum of three replicate sites is required), therefore we can only report trends in responses to the brushing treatment. The reader is cautioned that these results cannot be directly extrapolated to other sites because of the inadequate replication. Nevertheless, the trends in conifer and vegetation responses to foliar glyphosate treatment presented here can provide general information about the effectiveness of this treatment. It is important to understand that brushing outcomes on individual sites may differ from the results presented here.

STUDY AREA

Table 1. Characteristics of the study site

Location	Nicoamen River (Boston Bar)
BEC unit	IDFdk2/01
Elevation (m)	1080
Slope/aspect	27%/East
Soil texture	Sandy loam
Logging history	Clearcut 1977-78
Site preparation	Broadcast burn 1978
Regeneration	Fd planted 1984 (8 years-old when brushed)
Brushing treatment	Foliar glyphosate spray 1992

RESULTS

Table 2. A summary of Douglas-fir responses

Was there an improvement ¹ in conifer performance after brushing?	
Survival	No
Vigour	No
Stem diameter ²	No
Height	No
Leader length	No

1 Based on visual examination of survival and vigour trends and t-test comparisons for diameter, height, and leader length.

2 Stem diameter was measured at the root collar.

14 YEAR DOUGLAS-FIR RESPONSES

Douglas-fir survival and vigour

- Fourteen years after glyphosate treatment, when Douglas-fir trees were 22 years-old, survival was lower in the treated area (86%) than the control (97%) (Figure 1).
- *Armillaria* root disease caused 4 and 11% mortality in the control and treatment, respectively.
- Seedling vigour improved over time (25% of seedlings were of good vigour before treatment compared to 95% 14 years later). Vigour trends were similar in the treatment and control.

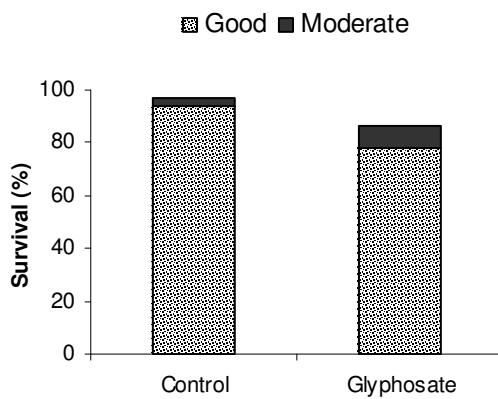


Figure 1. A comparison of 22 year-old Douglas-fir survival and vigour in the control and treatment, 14 years after glyphosate application.

Douglas-fir growth

- Stem diameter and total height of Douglas-fir were slightly greater in the control than the treatment before brushing and this trend lasted for the rest of the measurement period (until 14 years after brushing) (Table 3).
- Height growth was moderate (15-30 cm/year in the first 5 years after brushing), but by year 14 trees were growing vigorously (55 cm/year).

Table 3. Douglas-fir responses

Response variable (cm)	Pre-treatment		1 st year response		3 rd year response		5 th year response		14 th year response	
	C ¹	T	C	T	C	T	C	T	C	T
Diameter ²	3.0	2.6	3.5	3.1	4.3	4.1	5.5	5.0	11.5	10.5
Height	91	84	151	132	214	173	247	201	672	591
Leader length	22	18	25	25	30	21	15	13	56	54

1 C = Control; T = Treatment

2 Stem diameter was measured at the root collar.

Douglas-fir competitive status

- One year after treatment, 70% of Douglas-fir were free of vegetation in the treatment compared with 28% in the control (Figure 2).
- After 5 years, trees in the control were also outgrowing vegetation (Figure 3). After 14 years, 97% of Douglas-fir were free of vegetation in both the treatment and control (Figure 2).

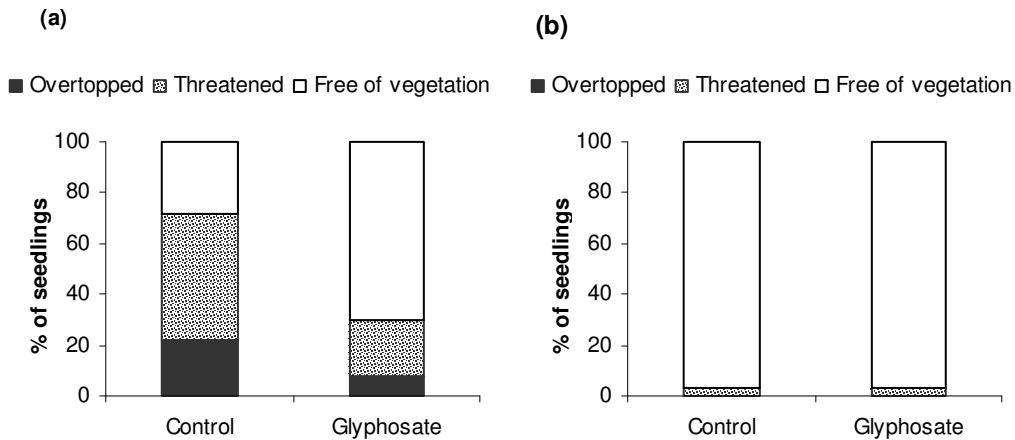


Figure 2. A comparison of Douglas-fir competitive status in the control and treatment (a) 1 and (b) 14 years after glyphosate application.

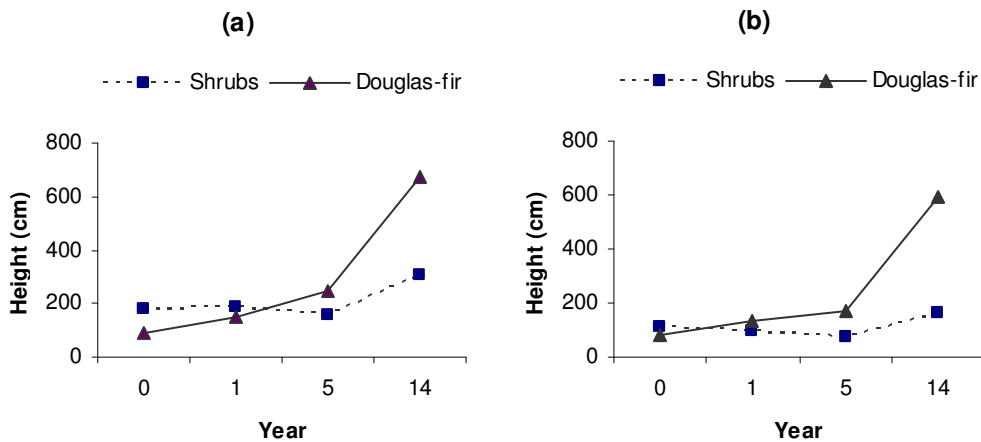


Figure 3. A comparison of the height of shrubs and Douglas-fir from pre-treatment (year 0) to 14 years after brushing, in (a) the control and (b) the glyphosate treatment.

Conifer stocking

- Tree density on the treated and control plots was close to the target stocking standard (1200 well-spaced trees/ha) throughout the measurement period (Table 4). Douglas-fir was the dominant species, but minor amounts of lodgepole pine, spruce, and subalpine fir were also present. Broadleaf trees were uncommon.

- The low density of well-spaced Douglas-fir in the control in year 5 reflects the high incidence of defoliated, chlorotic trees that year.
- The total number of stems per hectare gradually increased over time, presumably as small seedlings reached the minimum tally size. By year 14, both the treatment and control plots had about 1100 free-growing trees/ha, the majority of which were Douglas-fir.

Table 4. Conifer stocking in the treated area and control

	Pre-treatment		5 years post-treatment		14 years post-treatment	
	C	T	C	T	C	T
Total stems/ha	2006	2094	2289	2328	2567	2433
Total Douglas-fir/ha	1972	2022	2089	2100	2361	2177
WS stems/ha	928	933	589	911	1167	1117
WS Douglas-fir/ha	911	883	483	878	1167	1107
FG stems/ha	0	0	11	6	1122	1100
FG Douglas-fir/ha	0	0	11	6	1122	1090

WS = well-spaced; FG = free-growing

VEGETATION RESPONSE

- Before treatment, the dominant non-crop species on the site were willow (15% cover, 330 cm tall) and Sitka alder (10% cover; 170 cm tall). Pinegrass was the most abundant understory plant (45% cover).
- Willow and alder were damaged by glyphosate, which reduced their cover to 7% and 4%, respectively, in the first year after treatment. Forty-five percent of treated willow stems and 68% of treated alder died within one year of treatment. Five years after treatment, the proportion of dead plants had increased to 68% for willow and 97% for alder.
- In the control, alder and willow steadily decreased in vigour over time, and 14 years after the study was started, 73% of alder and 90% of willow stems had senesced and died.
- Glyphosate also reduced the height and cover of pinegrass for 5 years.

PRELIMINARY MANAGEMENT IMPLICATIONS

- The brushing treatment provided no benefit to the Douglas-fir. Survival, vigour, and growth were good without treatment. In fact, Douglas-fir survival was lower where glyphosate was applied than in the adjacent control because of the higher incidence of *Armillaria* root rot in the treatment.
- By year 14, both the treatment and control had at least 1100 free-growing trees/ha. Free-growing status may have been attained earlier, but the site was not monitored between years 5 and 14.
- Foliar glyphosate application killed most of the alder on the site but was less effective against willow (two-thirds of treated tagged willow stems were killed). By the end of our study much of the untreated alder and willow in the control had died due to senescence.
- Readers are reminded that information reported here is based on results from only one site and responses on individual sites may vary considerably.