

Response of Engelmann Spruce and the *Ericaceous Shrub* Complex to Glyphosate Treatment in the ESSF zone

INTRODUCTION

This report describes trends in conifer and vegetation responses to glyphosate treatment of the *Ericaceous Shrub* complex. This vegetation community is common on high elevation sites in southern interior BC which have been harvested with minimal ground disturbance. ([Complex description](#)).

The results presented here are from just two individual sites, which is insufficient replication to allow full statistical analysis of the data. For each site, t-tests have been carried out to determine if treatment responses are statistically different between brushed and untreated areas. However, because a full analysis of variance was not possible with just two sites, the reader is cautioned that results can not be directly extrapolated to other sites across the landscape. It is important to understand that brushing outcomes may differ on individual sites from the results presented here.

ABSTRACT

The following trends were identified following glyphosate treatment of the *Ericaceous Shrub* complex in the ESSFwc2 (wet cold) and ESSFwm (wet mild) subzones:

- Shrub cover was greatly reduced for at least 5 years but herbaceous vegetation recovered 1-3 years after treatment.
- Brushing reduced the percentage of seedlings that were overtopped by vegetation and shortened the time until seedlings were as tall as the vegetation. Seedlings reached vegetation height at age 6 and 13 in the brushed areas and are expected to reach this height 2 years later in the controls.
- Brushing did not affect the number of years to reach the required seedling height for free-growing. This occurred when the plantations were 8 and 14 years old.
- Even though brushing increased spruce height relative to the vegetation, seedling survival, vigour, and growth were not improved by the herbicide treatments, suggesting that light was not the most important factor limiting conifer performance.
- Spruce growth was slower in the ESSFwc2 subzone, where vegetation was tall and dense, than in the ESSFwm subzone where vegetation was shorter and more open.
- Spruce growth was slow regardless of whether brushing was done.

STUDY AREA

TABLE 1. Characteristics of sites where aerial glyphosate treatment was applied to the Ericaceous Shrub complex.

Location	Craigellachie 17 km Northeast of Malakwa	Glenogle Creek 38 km Northeast of Golden
BEC unit	ESSFwc2/04 (submesic)	ESSFwm/01 (mesic)
Climate	Wet cold	Wet mild
Slope/aspect	40% Northeast	55% North
Soil class/texture	Brunisol, sandy loam	Brunisol, silt loam
Logging history	Clearcut 1981	Clearcut 1982
Site preparation	“Hawk” power screefed	None
Regeneration	Se planted, 4 yrs old	Se planted, 3 yrs old
Seedling vigour	Mostly moderate, 20% poor	Mostly moderate, 25% poor
Seedling competitive status	Overtopped	Overtopped
Vegetation cover and height	97%, 120 cm	70%, 75 cm
Measurement years since brushing ¹	0, 1, 3, 5, 10	0, 1, 3, 5

¹ 0 = immediately prior to brushing, 1 = 1 year post-brushing. 3 = 3 years post-brushing. 5 = 5 years post-brushing. 10 = 10 years post-brushing.

VEGETATION RESPONSE

- Glyphosate significantly reduced shrub cover for 5-10 years (Figure 1).
- Herb cover was reduced for one year at Glenogle but recovered within one year of treatment at Craigellachie.
- Shrub height was significantly reduced for 5 years at both sites (Figure 2).
- Herb height was reduced for 5 years at Glenogle Creek and 1 year at Craigellachie.

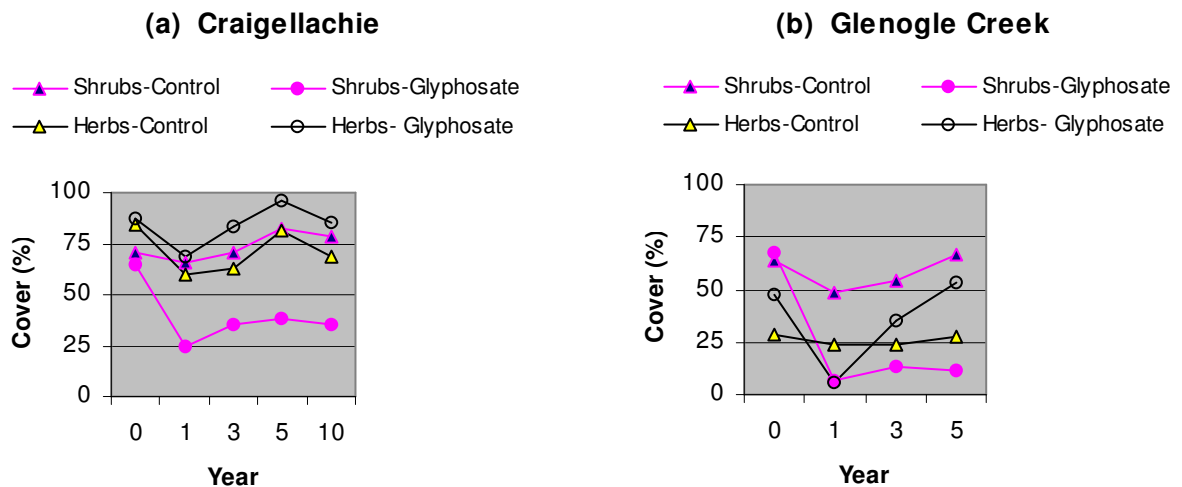


Figure 1. Vegetation cover at (a) Craigellachie and (b) Glenogle Creek.

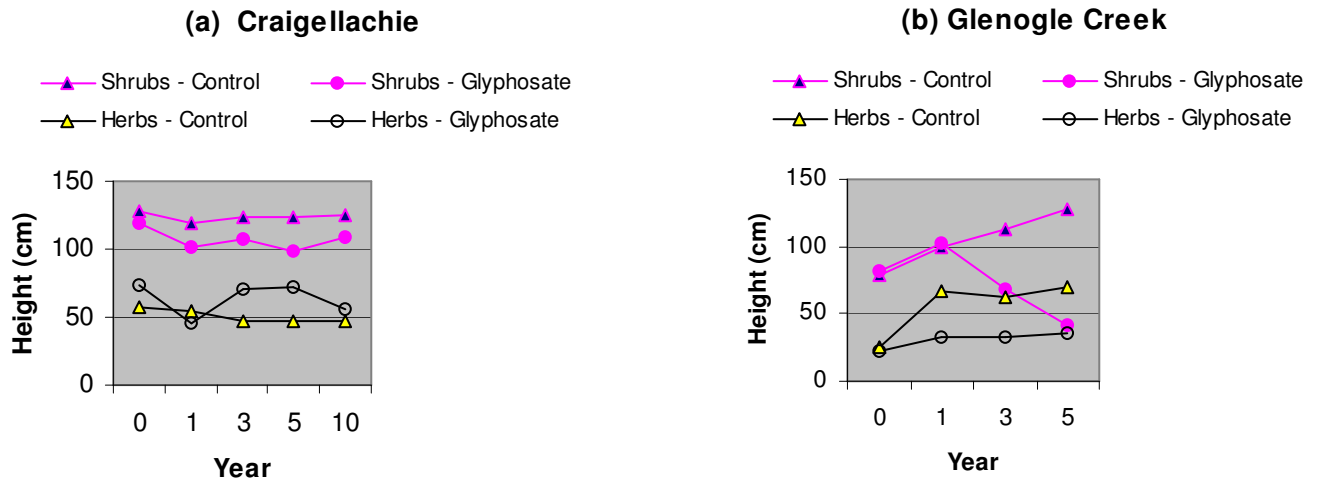


Figure 2. Vegetation height at (a) Craigellachie and (b) Glenogle Creek.

CONIFER RESPONSE

Engelmann spruce growth

- Root collar diameter and total height of spruce did not increase following glyphosate treatment (Table 2).
- Leader height significantly decreased one year after brushing, but recovered by year 3. At one site leader was significantly increased 5 years after brushing.
- Growth was slow throughout the measurement period.

Table 2. Engelmann spruce growth response to glyphosate treatment.

Response variable	Pre-treatment			1 st year response			3 rd year response			5 th year response			10 th year response		
	C ¹	T	Sig. ²	C	T	Sig.	C	T	Sig.	C	T	Sig.	C	T	Sig.
CRAIGELLACHIE															
Root collar diam (cm)	0.5	.0.5	ns	.0.8	0.7	s	1.00	0.9	ns	1.2	1.1	ns	1.7	2.2	ns
Total height (cm)	30	29	ns	38	36	ns	54	48	ns	68	63	ns	94	100	ns
Leader height (cm)	5	6	ns	8	6	s	7	6	ns	9	9	ns	7	9	ns
Survival (%)	100	100		100	89		94	86		92	19		83	67	
GLENOGLE CREEK															
Root collar diam (cm)	0.7	0.6	s	1.0	0.8	ns	1.1	1.1	ns	1.7	1.9	ns			
Total height (cm)	43	40	ns	58	51	s	74	64	s	102	101	ns			
Leader height (cm)				9	5	s	8	8	ns	9	14	s			
Survival (%)	100	100		100	100		97	97		94	92				

1 C = Control T = Treatment

2 s = Treatment and Control means significantly different at p = 0.05

ns = Treatment and Control means no significantly different at p = 0.05

Engelmann spruce survival and vigour

- Engelmann spruce survival and vigour were not improved by the glyphosate treatment.

- At Glenogle Creek, survival was excellent regardless of treatment and at Craigellachie survival was actually worse in the treated area than the control (Figure 3). The reason for this is unknown. Vegetation- and snow-press were the main causes of mortality regardless of whether brushing was done.
- At Craigellachie, seedling vigour declined over time, while at Glenogle it improved (data not shown).
- The difference in survival and vigour between the two sites may be related to differences in climate (temperature) and the height and cover of vegetation.

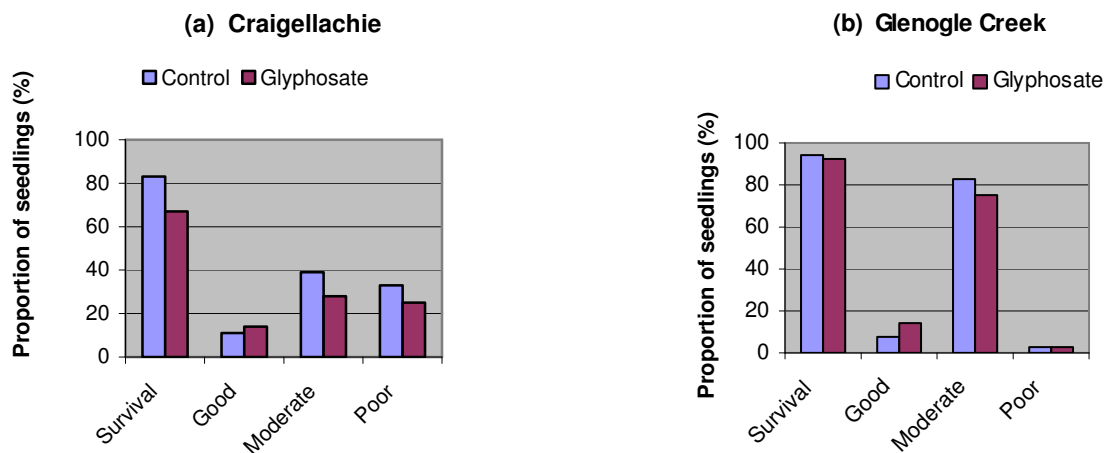


Figure 3. Engelmann spruce survival and vigour (a) 10 years after brushing at Craigellachie and (b) 5 years after brushing at Glenogle Creek.

Conifer stocking and free-growing

- Stocking surveys were done before brushing and 5 years afterward at Glenogle Creek, and before brushing and 5 and 10 years post-treatment at Craigellachie.
- The minimum stocking requirement was met on both sites before and after brushing (Table 3).
- Planted spruce reached the minimum height for free-growing (0.8 m) at the same time in the brushed and untreated areas (age 14 at Craigellachie and age 8 at Glenogle Creek).
- Spruce seedlings reached the height of vegetation sooner in the brushed areas than the controls (Figures 4 and 5). Seedlings in the brushed areas were as tall as the vegetation at age 13 at Craigellachie and age 6 at Glenogle Creek. It is estimated that seedlings will reach this height about 2 years later in the controls, which is still within the required time period for free-growing (20 years).
- Most of the free-growing trees were naturals.

Table 3. Conifer stocking.

	Pre-treatment		5 Years-post treatment		10 Years post-treatment	
	Control	Brushed	Control	Brushed	Control	Brushed
CRAIGELLACHIE						
Total conifers/ha	2000	1561	2356	2400	2783	3167
Well-spaced/ha	1167	1050	977	828	911	872
Free-growing/ha	50	44	144	122	339	283
GLENOGLE CR						
Total conifers/ha	6033	6750	9972	9844		
Well-spaced/ha	1200	1144	1194	1150		
Free-growing/ha	378	411	622	761		

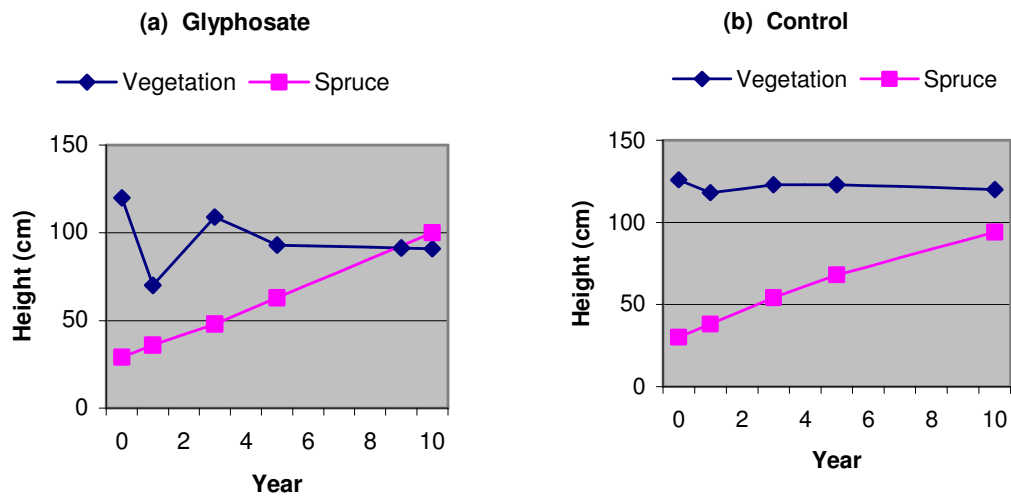


Figure 4. Height of Engelmann spruce and vegetation at Craigellachie (a) in the brushed area and (b) in the control.

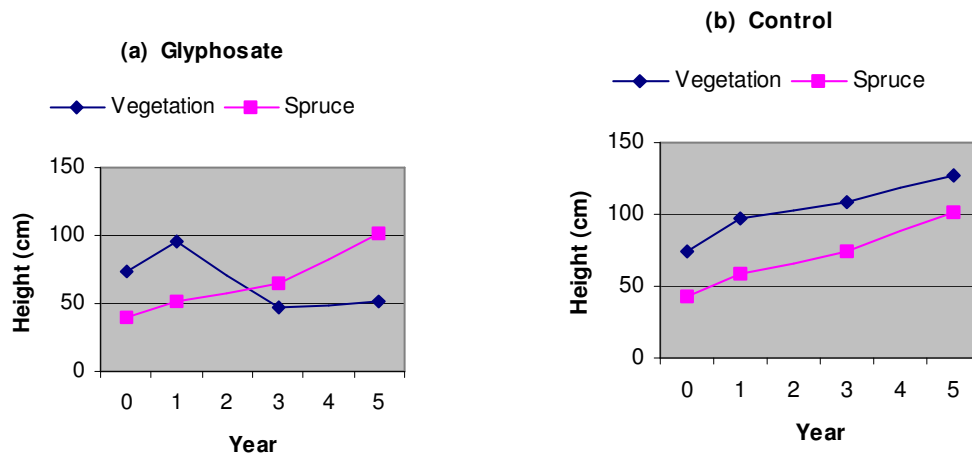


Figure 5. Height of Engelmann spruce and vegetation at Glenogle Creek (a) in the brushed area and (b) in the control.

PRELIMINARY MANAGEMENT IMPLICATIONS

- Vegetation competition is only one factor affecting plantation performance in the ESSF zone. Soil temperature, microsite conditions, timing of planting, and size and condition of the planted stock are some of the other factors that need to be considered.
- Our sites had variable survival rates, but glyphosate treatment consistently did not improve survival or vigour. However, other studies have found that manual cutting of the *Ericaceous Shrub* complex improved survival. Survival problems may be reduced by planting large stock immediately after disturbance.
- We found that Engelmann spruce growth was slow and that diameter and total height were not improved by glyphosate treatment, even though shrub abundance was greatly reduced. This suggests that vegetation competition was not the most important limitation to seedling growth.
- On our sites, brushing reduced the time to free-growing by approximately 2 years, but without treatment seedlings would still meet the free-growing requirements within the required time period. The reduced time to free-growing may not be significant enough to justify brushing.