

FOREST RESEARCH REPORT

No. 56 February, 1995

TOLERANCE OF PLANTATION SEEDLINGS TO HEXAZINONE

Introduction

Hexazinone (Velpar[®]L¹) is a herbicide used to control weeds prior to establishment of softwood plantations. Its main mode of action is through root uptake and subsequent translocation, although contact damage may occur as a result of absorption by foliage (duPont, n.d.). To be effective, it must be carried by rainfall into the rooting zone where it can be taken up by growing roots. This process is

restricted when hexazinone is adsorbed in soils with high levels of clay and/or organic matter. In Nova Scotia, Velpar[®]L is generally applied at least 2 weeks before planting to avoid crop damage. The results of a study undertaken to determine the applicability of this 2 week guideline for different softwood species and soil characteristics are reported below.

Methods

This trial encompasses 5 different sites (Figure 1), treated with Velpar[®]L. In 1987, trials were established at Morton Road, an old field site located on Bridgewater² soil; and Stanburne, a softwood cutover on Wolfville soil. Trials at Mount Thom

(Kirkhill Soil) and Devon (Wolfville Soil) were established in 1988 on old field sites. The fifth trial was located in Delaney Settlement, in 1989, on a softwood cutover underlain by Folly soil (Table 1).

Treatments were replicated 3 times at all

¹ Velpar[®]L is a registered trademark of duPont Canada Inc. It is a liquid formulation containing 240 grams active ingredient of hexazinone per litre. The recommended application rate for forestry purposes is 8.3 l/ha.

² Soil classification from the Nova Scotia Department of Agriculture and Marketing and Agriculture Canada joint soil survey reports.

Nova Scotia



Locations
 1. Morton Road
 2. Stanburne
 3. Mount Thom
 4. Devon
 5. Delaney Settlement

Figure 1. Location of trial plantations.

resinosa Ait.)] were planted on each planting date in a randomly assigned plot (Figure 2). The spruce planting stock was grown as multipots, while the balsam fir and red pine were bareroot stock. The planting dates ranged from 6 days prior to and 146 days following hexazinone application (Appendix I).

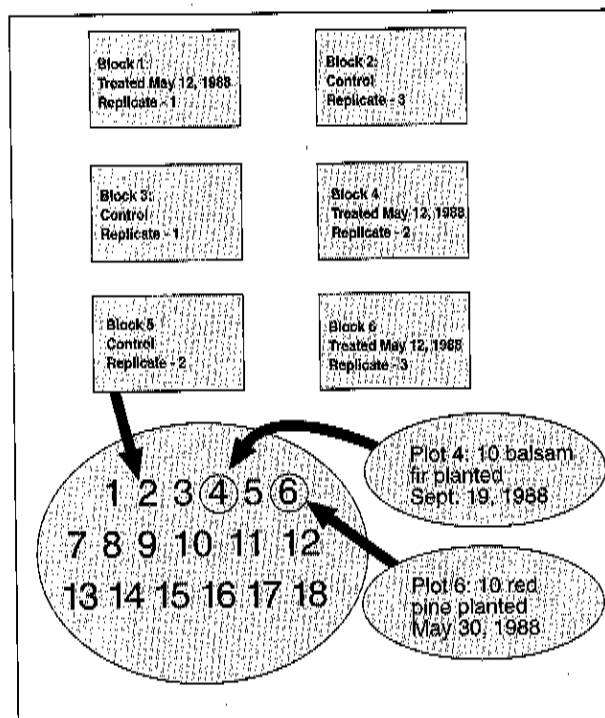


Figure 2. Example of block and plot layout for Mount Thom trial.

sites, except for Stanburne (1 replication). Treatment levels varied by site and ranged from 0 to 14 litres (150 - 300 l/ha total solution) of Velpar®L per hectare (Appendix I). Application was by CO₂ sprayer, equipped with a 3.2 metre boom and agricultural flat fan nozzles. Within each treatment block, 10 trees of each species, [red spruce (*Picea rubens* Sarg.), black spruce (*Picea mariana* (Mill.) B.S.P.), white spruce (*Picea glauca* (Moench) Voss), Norway spruce (*Picea abies* (L.) Karst.), balsam fir (*Abies balsamea* (L.) Mill.) and red pine (*Pinus*

Table 1. Description of experimental sites.

Location	Year Established	County	Site History	LFH ¹ (cm)	Rooting Zone ²					Soil Series	Rooting Depth (cm)
					Sand (%)	Silt (%)	Clay (%)	OM (%)	Texture		
Morton Road	1987	Lunenburg	Old Field	3	57	38	5	5.2	Silty Sand (Coarse)	Bridgewater	51
Stanburne	1987	Lunenburg	Softwood Cutover	3	43	46	11	4.3	Loam (Medium)	Wolfville	41
Mount Thom	1988	Pictou	Old Field	3	37	54	9	6.6	Silt Loam (Medium)	Kirkhill	64
Devon	1988	Halifax	Old Field	5	47	43	10	4.7	Loam (Medium)	Wolfville	43
Delaney Settlement	1989	Colchester	Softwood Cutover	3	39	48	13	4.5	Loam (Medlum)	Folly	41

¹Depth of LFH Litter, Fermentation, and Humus layer overtopping the mineral soil. (sampled in 1994).

²Top 15 cm was considered the rooting zone for planted seedlings (samples taken in 1994). Measurements based on analysis performed by the Nova Scotia Department of Agriculture and Marketing.

Data Collection

The planted trees were evaluated for survival, damage and growth in the fall of the year following treatment. Growth measurements included crop tree height, leader growth and root collar diameter. Evaluation also included

examination of shoots and buds for visual evidence of herbicide damage or abnormal growth, general vigour and an assessment of competing vegetation. In addition, precipitation records at the closest weather recording station were collected from Environment Canada (Appendix II).

Results

Survival

Morton Road and Stanburne

At Morton Road and Stanburne, trees were planted on three dates in 1987; six days prior to and 13 and 146 days following the Velpar®L treatment on May 13. At these sites, Velpar®L was applied at several rates; 4, 6 and 8 l/ha (Morton Road) and, 4, 6, 8 and 14 l/ha (Stanburne). Survival was not affected, except at the Morton road site (old field) where it was 23 and 12% less than in the controls for the seedlings sprayed 6 days after planting at the 4 and 8 l/ha rates respectively (Table 2, Appendix III). Inexplainably, at the 6 l/ha rate, there was virtually no difference between survival in the treated and control plots. At Stanburne (softwood cutover) there was no significant reduction in survival in the treated plots for any of the treatment dates, even at the 14 l/ha rate.

Mount Thom and Devon

At the Mount Thom and Devon sites (both old fields), only one rate of Velpar®L was applied (8 l/ha) on May 12 and May 11, 1988 respectively. Both sites were planted on three dates: 1 or 2 days before, and approximately 3 and 10 weeks following treatment. At Mount Thom, survival was 27% less than the control in plots, sprayed 1 day after planting and 12%

less for seedlings planted 18 days after spraying (Table 2). At Devon, survival in the treated plots was not significantly different than the controls, regardless of treatment date.

Delaney Settlement

At Delaney, a softwood cutover, seedlings were planted on 8 dates. The first planting date was on the afternoon of May 15, 1989, following a morning application of Velpar®L. The other planting dates were from 14 to 133 days later. Velpar®L was applied at one rate, 8 l/ha. In order to reduce the effects of varying competition on survival, both the control and treated plots were hand weeded during the summer of the year following treatment. Inspection of Table 2 indicates that survival in treated plots was not significantly less than in corresponding controls for any of the planting dates.

All Sites

Survival by Species

Statistical and graphical analyses (Appendices IIIb to IIIg, Figure 3) indicate that none of the species planted in this study were consistently more susceptible to Velpar®L damage.

Damage and Growth

Although some initial browning of treated

Table 2. Survival comparisons between control blocks and those treated with 8 l/ha of Velpar®L (all species).

Location	Day ¹	Survival ² (%)			Significance ³
		Control	Treated	Difference	
Morton Road	-6	73	61	-12	9*
	13	60	65	5	53
	146	87	81	-6	12
Stanburne	-6	60	65	5	42
	13	68	80	12	47
	146	85	90	5	35
Mount Thom	-2	81	54	-27	5**
	18	90	78	-12	5**
	130	82	82	0	100
Devon	-1	72	71	-1	72
	19	65	74	9	25
	131	79	78	-1	92
Delaney Settlement	0	89	89	0	75
	14	90	91	1	40
	28	86	89	3	20
	42	87	89	2	42
	91	79	87	8	3**
	105	82	85	3	28
	119	74	83	9	12
	133	72	76	4	60

¹ Number of days between planting seedlings and Velpar®L application (before (-) or after (+)).

² Survival measured in the fall of the year following establishment.

³ The level of significance is the probability that the null hypothesis "no differences in survival between control and treated blocks" is incorrectly rejected. Tested using the paired Wilcoxon procedure (paired by species), using Z test statistic.

* Significant at the 10% level

** Significant at the 5% level

Difference (%) between survival in treated versus control plots
 (+) Survival in treated plots greater than in control
 (-) Survival in treated plots less than in control

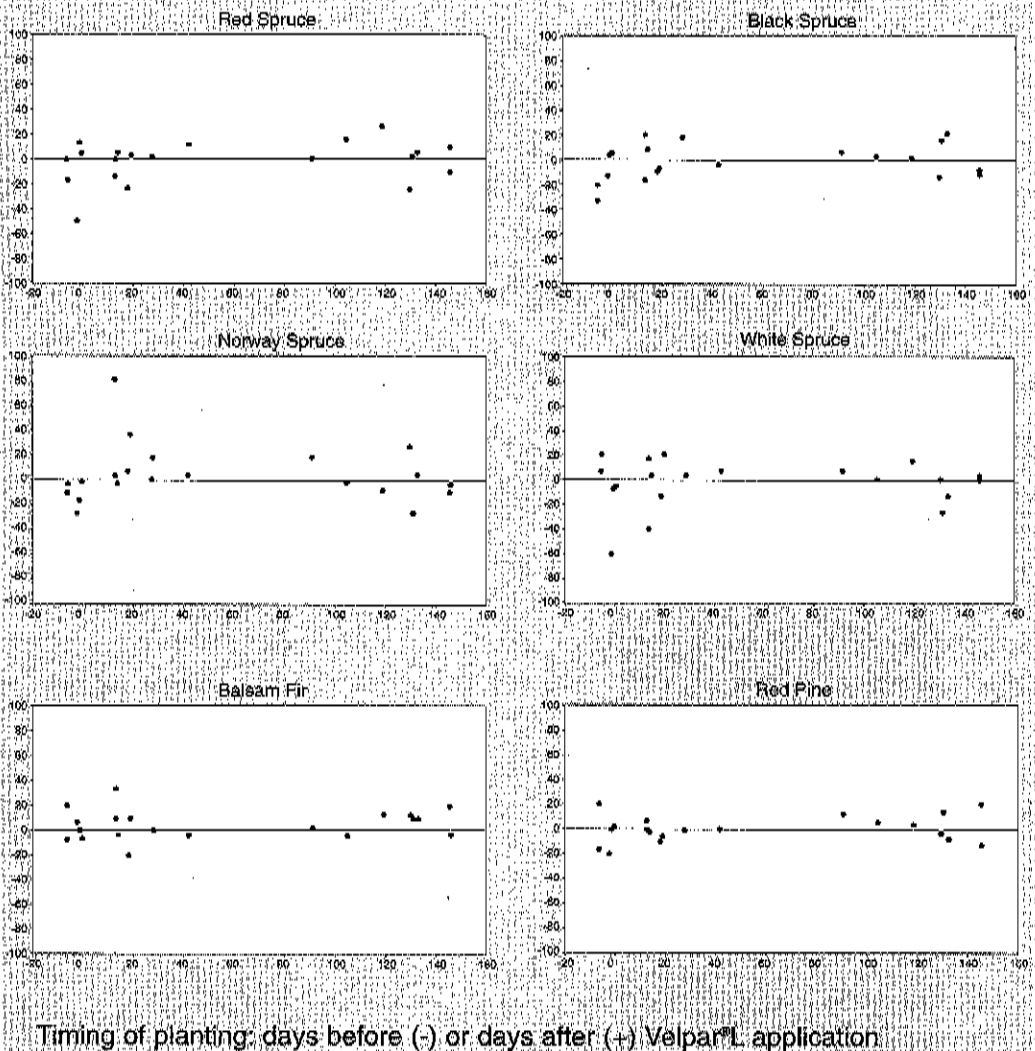


Figure 3. Effect of Velpar®L application on average survival by species (all locations).

tree foliage occurred, no foliage or bud damage was noted in the fall of the year after planting. In addition, no differences in vigour, browsing, total height, leader growth and root collar diameter were noted at that time.

Texture and Organic Matter

Dupont, (1991) reported that hexazinone effi-

cacy may be reduced in soils with fine textures and/or high organic matter (OM) content. In contrast, other studies have shown that sites with higher levels of OM in the soil portion of the rooting zone have incurred increased crop damage and target species control (Minogue, et al. 1988; Sampson, G. (pers. comm. Oct/94³). In our study, the highest levels of crop damage occurred on sites with the

³ Mr. G. Sampson, Associate Professor at Nova Scotia Agricultural College, Truro.

highest OM content in the rooting zone (6.6% at Mount Thom and 5.2% at Morton Road). It is noteworthy that the Morton Road site also contained the highest content of sand (57%) and the lowest amount of clay (5%) (Table 1).

It is also noteworthy that survival was not adversely affected at either of the sites originating from softwood cutovers. The reduced crop damage may be associated with the unincorporated organic layers lying on top of the mineral soil at these sites.

Summary and Conclusion

In a series of trials designed to determine the effects of hexazinone on planted red spruce, white spruce, black spruce, Norway spruce, balsam fir and red pine, planted prior to and following treatment, the following results were noted:

- 1) Significantly higher mortality in herbicide treated plots occurred at 2 of the 5 test sites, Mount Thom and Morton Road, which are both old fields. The Mount Thom site contained the highest level of organic matter (OM), while the Morton Road site contained the second highest level of OM, the highest amount of sand, and the lowest clay content of the five sites investigated.
- 2) At these two locations, the highest mortality increase (27% & 12%) occurred when the seedlings were oversprayed with Velpar shortly after planting (6 days after at Morton

Road and 2 days after at Mount Thom).

- 3) At Mount Thom, mortality increases also occurred when seedlings were planted 18 days after spraying.
- 4) No significant increases in crop mortality were detected in the sprayed plots located in softwood cutovers (Stanburne and Delaney Settlement).
- 5) None of the species planted (red spruce, black spruce, white spruce, Norway spruce, balsam fir or red pine) sustained consistently higher levels of mortality in the treated plots at any of the locations or on any of the planting dates.
- 6) Insufficient information exists, at this time, to shorten the recommended 2 week delay between Velpar®L application and planting.

Literature Cited

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Appendix I. Treatment descriptions and timing by site.

Location	Blocks (#)	Plots (#)	Species (#)	Velpar [®] L (l/ha)	Treatment Date	Plant Date	Assessment Date
Morton Road, Lunenburg County (10 trees/plot)	12	18	6	Control (0) 4 6 8	May 13, 1987	May 7 May 26 Oct 6	Sept 1988
(Total Solution = 267 litres/ha)							
Stanburne, Lunenburg County (10 trees/plot)	5	18	6	Control (0) 4 6 8 14	May 13, 1987	May 7 May 26 Oct 6	Oct 1988
(Total Solution = 267 litres/ha)							
Mount Thom, Pictou County (10 trees/plot)	6	18	6	Control (0) 8	May 12, 1988	May 10 May 30 Sept 19	Oct 1989
(Total Solution = 300 litres/ha)							
Devon, Halifax County (10 trees/plot)	6	18	6	Control (0) 8	May 11, 1988	May 10 May 30 Sept 19	Nov 1989
(Total Solution = 300 litres/ha)							
Delaney Settlement, Colchester County (20 trees/plot)	6	48	6	Control (0) 8	May 15, 1989 (am)	May 15, (pm) May 29 June 12 June 26 Aug 14 Aug 28 Sept 11 Sept 25	Oct 1990
(Total Solution = 150 litres/ha)							

Appendix II. Precipitation by day and location based on the closest Department of Environment recording station.

Day	Morton Road (Springfield)		Stanburne (Springfield)		Mount Thom (Truro)		Devon (Halifax Airport)		Delaney (Truro)	
	Treatment	Rain (mm)	Treatment	Rain (mm)	Treatment	Rain (mm)	Treatment	Rain (mm)	Treatment	Rain (mm)
-12		0.4		0.4		-		-		nil
-11		nil		nil		0.4		-		nil
-10		trace		trace		trace		0.8		nil
-9		0.6		0.6		18.2		1.4		48.0
-8		12.8		12.8		nil		14.1		17.0
-7		15.6		15.6		nil		1.6		33.8
-6	Plant	0.6	Plant	0.6		nil		nil		23.8
-5		2.0		2.0		nil		nil		1.2
-4		nil		nil		nil		nil		nil
-3		nil		nil		nil		nil		nil
-2		nil		nil	Plant	nil		nil		2.2
-1		5.4		5.4		0.6	Plant	trace		3.8
0	Velpar®L	nil	Velpar®L	nil	Velpar®L	trace	Velpar®L	trace	Velpar®L(am)	trace
									Plant (pm)	-
1		trace		trace		trace		2.0		nil
2		1.8		1.8		nil		nil		nil
3		0.4		0.4		nil		0.6		nil
4		nil		nil		2.8		nil		nil
5		nil		nil		6.4		3.3		nil
6		trace		trace		trace		5.2		nil
7		nil		nil		nil		0.2		nil
8		nil		nil		1.8		trace		nil
9		13.4		13.4		0.2		0.3		14.2
10		1.8		1.8		nil		trace		4.8
11		0.8		0.8		nil		nil		4.6
12		nil		nil		5.2		nil		4.4
13	Plant	nil	Plant	nil		5.4		0.8		2.0
14		2.8		2.8		2.4		7.6	Plant	nil
15		0.6		0.6		0.5		7.4		0.2
16		nil		nil		nil		nil		nil
17		8.8		8.8		nil		nil		2.4
18		5.8		5.8	Plant	nil		trace		6.4
19		-		-		10.6	Plant	nil		nil
20		-		-		-		7.4		4.6

Number of days before (-) or after (+) Velpar®L treatment.

Appendix IIIa. Survival, Discolouration and Leader Growth by location and treatment in the fall of the year following establishment. (ALL SPECIES)

Location	Day ¹	Velpar ² L (litres/hectare)				
		Control	4	6	8	14
Survival (%)						
Morton Road	-6	73	50	74	61	
	13	60	58	71	65	
	146	87	86	82	82	
Stanburne	-6	60	87	67	65	68
	13	68	92	85	80	87
	146	85	88	88	90	90
Mount Thom	-2	82			54	
	18	90			78	
	130	82			82	
Devon	-1	72			71	
	19	65			74	
	131	79			78	
Delaney	0	89			89	
	14	90			91	
	28	86			89	
	42	87			89	
	91	79			87	
	105	82			86	
	119	74			83	
133	72			76		
Foliage Discolouration²						
Morton Road	-6	6.6	7.3	7.7	7.1	
	13	6.4	7.5	7.5	7.4	
	146	6.5	7.6	7.7	7.6	
Stanburne	-6	8.7	8.4	8.1	8.4	8.4
	13	7.2	8.7	8.8	8.7	8.6
	146	8.4	8.5	8.8	8.3	8.4
Mount Thom	-2	Not Available				
	18	Not Available				
	130	Not Available				
Devon	-1	5.3			5.8	
	19	5.5			5.5	
	131	5.4			5.2	
Delaney	0	8.6			8.8	
	14	8.8			8.8	
	28	8.7			8.6	
	42	8.6			8.7	
	91	8.4			8.5	
	105	8.5			8.6	
	119	8.3			8.3	
133	8.2			8.1		
Leader Growth (mm)						
Morton Road	-6	40	57	63	58	
	13	37	65	75	64	
	146	45	52	54	56	
Stanburne	-6	63	116	85	87	73
	13	68	98	97	98	97
	146	61	56	74	65	60
Mount Thom	-2	59			76	
	18	64			84	
	130	58			61	
Devon	-1	39			55	
	19	38			54	
	131	67			47	
Delaney	0	109			111	
	14	102			95	
	28	89			90	
	42	76			82	
	91	93			85	
	105	86			82	
	119	71			72	
133	64			62		

¹ Day: Number of days seedlings planted before (-) or after (+) hexazinone application.
² Discolouration rating from 1 = severe to 9 = none. In control plots, competition sometimes resulted in more discolouration (yellowing) than the herbicide may have caused in the treated plots.

Appendix IIIb. Survival, Discolouration and Leader Growth by location and treatment for RED SPRUCE in the fall of the year following establishment.

Location	Day ¹	Velpar [®] L (litres/hectare)				
		Control	4	6	8	14
Survival (%)						
Morton Road	-6	50	20	67	33	
	13	57	27	43	43	
	146	53	67	50	43	
Stanburne	-6	60	100	80	60	50
	13	90	90	100	90	90
	146	80	100	80	90	80
Mount Thom	-2	77			27	
	18	100			77	
	130	83			60	
Devon	-1	37			50	
	19	37			40	
	131	57			60	
Delaney	0	77			82	
	14	80			85	
	28	77			78	
	42	73			85	
	91	93			95	
	105	82			98	
	119	67			93	
	133	60			67	
Foliage Discolouration²						
Morton Road	-6	5.3	6.4	7.1	6.5	
	13	5.5	6.0	5.5	7.2	
	146	5.1	6.9	6.5	6.1	
Stanburne	-6	8.3	8.1	7.9	7.5	8.2
	13	8.3	9.0	9.0	9.0	8.4
	146	7.8	9.0	8.4	8.7	7.8
Mount Thom	-2	Not Available				
	18	Not Available				
	130	Not Available				
Devon	-1	4.5			4.6	
	19	5.0			4.9	
	131	5.4			5.0	
Delaney	0	8.1			8.5	
	14	8.7			8.8	
	28	8.8			8.2	
	42	8.1			8.1	
	91	8.2			8.4	
	105	8.4			8.7	
	119	8.2			8.8	
	133	8.1			8.3	
Leader Growth (mm)						
Morton Road	-6	21	29	41	40	
	13	21	41	37	50	
	146	31	42	34	46	
Stanburne	-6	63	80	49	70	54
	13	63	83	96	83	82
	146	41	73	49	54	50
Mount Thom	-2	38			27	
	18	56			72	
	130	20			38	
Devon	-2	25			38	
	19	27			36	
	131	67			54	
Delaney	0	57			60	
	14	47			64	
	28	61			45	
	42	44			49	
	91	80			91	
	105	91			96	
	119	51			66	
	133	46			51	

¹ Day: Number of days seedlings planted before (-) or after (+) hexazinone application.

² Discolouration: a rating from 1 = severe to 9 = none. In control plots, competition sometimes resulted in more discolouration (yellowing) than the herbicide may have caused in the treated plots.

Appendix IIIc. Survival, Discolouration and Leader Growth by location and treatment for BLACK SPRUCE in the fall of the year following establishment.

Location	Day ¹	Velpar ² L (litres/hectare)				
		Control	4	6	8	14
Survival (%)						
Morton Road	-6	73	47	73	40	
	13	67	90	93	50	
	146	83	80	87	77	
Stanburne	-6	60	90	60	40	40
	13	70	90	90	90	80
	146	90	100	80	80	80
Mount Thom	-2	63			50	
	18	80			70	
	130	73			60	
Devon	-1	60			63	
	19	63			57	
	131	63			80	
Delaney	0	77			82	
	14	77			85	
	28	68			87	
	42	68			65	
	91	83			90	
	105	83			87	
	119	70			72	
133	60			82		
Foliage Discolouration²						
Morton Road	-6	6.2	8.3	7.6	7.0	
	13	6.2	7.5	8.0	4.9	
	146	7.3	7.3	7.7	6.8	
Stanburne	-6	9.0	8.4	9.0	8.0	9.0
	13	8.1	8.3	9.0	9.0	8.4
	146	8.8	8.4	8.6	7.6	8.4
Mount Thom	-2	Not Available				
	18	Not Available				
	130	Not Available				
Devon	-1	4.9			5.8	
	19	5.6			5.0	
	131	4.8			5.0	
Delaney	0	8.9			8.8	
	14	8.1			8.8	
	28	8.3			7.8	
	42	8.5			8.8	
	91	8.1			8.8	
	105	8.9			8.6	
	119	8.3			8.7	
133	8.7			8.0		
Leader Growth (mm)						
Morton Road	-6	36	64	62	59	
	13	33	109	100	43	
	146	41	36	45	46	
Stanburne	-6	95	146	78	65	93
	13	151	144	188	131	168
	146	62	47	51	50	78
Mount Thom	-2	56			61	
	18	64			114	
	130	80			86	
Devon	-1	32			65	
	19	33			58	
	131	28			37	
Delaney	0	103			85	
	14	81			78	
	28	65			82	
	42	64			72	
	91	122			117	
	105	116			100	
	119	87			91	
133	90			89		

¹ Day: Number of days seedlings planted before (-) or after (+) hexazinone application.

² Discolouration: a rating from 1 = severe to 9 = none. In control plots, competition sometimes resulted in more discolouration (yellowing) than the herbicide may have caused in the treated plots.

Appendix III d. Survival, Discolouration and Leader Growth by location and treatment for WHITE SPRUCE in the fall of the year following establishment.

Location	Day ¹	Valpar ² (litres/hectare)				
		Control	4	6	8	14
Survival (%)						
Morton Road	-6	63	47	73	70	
	13	57	60	57	73	
	146	93	100	100	97	
Stanburne	-6	70	80	90	90	90
	13	100	90	90	80	90
	146	100	90	90	100	100
Mount Thom	-2	97			37	
	18	97			83	
	130	97			97	
Devon	-1	67			60	
	19	63			83	
	131	100			73	
Delaney	0	90			85	
	14	88			92	
	28	80			83	
	42	85			92	
	91	90			97	
	105	92			92	
	119	72			87	
	133	65			52	
Foliage Discolouration²						
Morton Road	-6	6.1	7.6	7.1	7.3	
	13	6.7	7.7	7.4	8.3	
	146	6.4	8.0	8.1	8.3	
Stanburne	-6	8.7	8.5	8.8	8.6	8.9
	13	9.0	8.3	9.0	8.0	8.8
	146	8.2	7.9	9.0	7.8	8.8
Mount Thom	-2	Not Available				
	18	Not Available				
	130	Not Available				
Devon	-1	5.3			5.4	
	19	5.2			5.5	
	131	4.8			4.8	
Delaney	0	8.3			8.6	
	14	9.0			8.8	
	28	8.9			8.8	
	42	8.8			8.7	
	91	9.0			8.7	
	105	8.2			8.8	
	119	7.9			7.8	
	133	8.3			7.7	
Leader Growth (mm)						
Morton Road	-6	25	41	39	28	
	13	14	42	43	50	
	146	47	61	57	58	
Stanburne	-6	47	66	69	53	34
	13	64	62	57	48	71
	146	73	80	59	58	63
Mount Thom	-2	50			51	
	18	56			52	
	130	58			58	
Devon	-1	27			47	
	19	29			50	
	131	55			46	
Delaney	0	80			47	
	14	63			66	
	28	64			55	
	42	52			65	
	91	106			80	
	105	84			85	
	119	56			58	
	133	52			42	

¹ Day: Number of days seedlings planted before (-) or after (+) hexazinone application.

² Discolouration: a rating from 1 = severe to 9 = none. In control plots, competition sometimes resulted in more discolouration (yellowing) than the herbicide may have caused in the treated plots.

Appendix IIIe. Survival, Discolouration and Leader Growth by location and treatment for Velpar[®] L in the fall of the year following establishment.

Location	Day ¹	Velpar [®] L (litres/hectare)				
		Control	4	6	8	14
Survival (%)						
Morton Road	-6	90	70	67	87	
	13	63	57	77	67	
	146	100	90	90	97	
Stanburne	-6	60	70	60	50	70
	13	10	100	100	90	90
	146	100	70	100	90	90
Mount Thom	-2	90			63	
	18	77			83	
	130	63			90	
Devon	-1	73			57	
	19	40			77	
	131	80			53	
Delaney	0.5	97			95	
	14	97			93	
	28	93			93	
	42	95			98	
	91	68			77	
	105	68			67	
	119	62			53	
	133	62			67	
Foliage Discolouration²						
Morton Road	-6	6.7	7.3	7.3	7.7	
	13	6.7	8.0	7.7	7.1	
	146	5.8	7.4	8.1	8.0	
Stanburne	-6	8.5	7.9	8.2	8.6	6.7
	13	-	8.8	8.6	8.8	8.0
	146	8.6	9.0	9.0	8.0	7.7
Mount Thom	-2	Not Available				
	18	Not Available				
	130	Not Available				
Devon	-1	5.2			5.8	
	19	4.8			4.8	
	131	5.1			5.2	
Delaney	0	8.8			8.9	
	14	8.9			8.9	
	28	8.4			9.0	
	42	8.5			8.7	
	91	8.4			8.8	
	105	8.5			8.2	
	119	8.7			8.1	
	133	8.6			8.0	
Leader Growth (mm)						
Morton Road	-6	41	55	49	39	
	13	41	64	47	61	
	146	59	59	84	79	
Stanburne	-6	67	66	47	78	37
	13	-	84	57	98	58
	146	99	49	149	82	59
Mount Thom	-2	48			79	
	18	75			52	
	130	40			59	
Devon	-1	39			44	
	19	25			56	
	131	82			55	
Delaney	0	129			110	
	14	109			87	
	28	106			103	
	42	93			106	
	91	52			69	
	105	54			60	
	119	67			45	
	133	52			46	

¹ Day: Number of days seedlings planted before (-) or after (+) hexazinone application.

² Discolouration: a rating from 1 = severe to 9 = none. In control plots, competition sometimes resulted in more discolouration (yellowing) than the herbicide may have caused in the treated plots.

Appendix IIIf. Survival, Discolouration and Leader Growth by location and treatment for RED PINE in the fall of the year following establishment.

Location	Day ¹	Velpar [®] L (litres/hectare)				
		Control	4	6	8	14
Survival (%)						
Morton Road	-6	87	73	93	70	
	13	87	77	100	93	
	146	100	93	77	87	
Stanburne	-6	80	100	90	100	100
	13	90	100	80	90	90
	146	60	70	80	80	100
Mount Thom	-2	97			77	
	18	100			90	
	130	100			97	
Devon	-1	97			97	
	19	97			90	
	131	87			100	
Delaney	0	97			98	
	14	100			98	
	28	100			98	
	42	100			100	
	91	58			70	
	105	82			87	
	119	93			97	
133	97			88		
Foliage Discolouration²						
Morton Road	-6	8.6	8.5	9.0	6.0	
	13	8.6	8.4	9.0	9.0	
	146	7.7	8.6	8.8	8.4	
Stanburne	-6	9.0	9.0	9.0	9.0	9.0
	13	9.0	9.0	9.0	9.0	9.0
	146	9.0	7.9	9.0	9.0	9.0
Mount Thom	-2	Not Available				
	18	Not Available				
	130	Not Available				
Devon	-1	7.7			7.3	
	19	7.4			6.0	
	131	7.5			6.3	
Delaney	0	9.0			8.9	
	14	8.9			9.0	
	28	8.6			8.8	
	42	9.0			9.0	
	91	8.5			8.0	
	105	8.9			8.5	
	119	8.3			8.6	
133	7.8			8.7		
Leader Growth (mm)						
Morton Road	-6	88	107	135	97	
	13	90	99	166	133	
	146	45	49	56	53	
Stanburne	-6	59	231	203	184	165
	13	90	160	126	154	148
	146	45	41	60	70	45
Mount Thom	-2	129			190	
	18	102			158	
	130	90			76	
Devon	-1	88			65	
	19	89			72	
	131	78			61	
Delaney	0	150			226	
	14	200			183	
	28	153			150	
	42	109			110	
	91	74			49	
	105	66			61	
	119	81			76	
133	81			77		

¹ Day: Number of days seedlings planted before (-) or after (+) hexazinone application.

² Discolouration: a rating from 1 = severe to 9 = none. In control plots, competition sometimes resulted in more discolouration (yellowing) than the herbicide may have caused in the treated plots.

Appendix IIIg. Survival, Discolouration and Leader Growth by location and treatment for BALSAM FIR in the fall of the year following establishment.

Location	Day ¹	Velpar ² L (litres/hectare)				
		Control	4	6	8	14
Survival (%)						
Morton Road	-6	73	43	73	67	
	13	30	37	57	63	
	146	93	87	90	87	
Stanburne	-6	30	80	20	50	60
	13	50	80	50	60	80
	146	80	100	100	100	90
Mount Thom	-2	67			73	
	18	87			67	
	130	77			90	
Devon	-1	100			100	
	19	90			100	
	131	90			100	
Delaney	0	100			93	
	14	98			95	
	28	95			95	
	42	100			97	
	91	93			95	
	105	87			83	
	119	83			97	
	133	88			98	
Foliage Discolouration²						
Morton Road	-6	7.0	5.4	8.0	8.1	
	13	4.8	7.3	7.7	7.9	
	146	6.7	7.4	8.0	8.0	
Stanburne	-6	8.7	8.5	6.5	8.8	8.5
	13	8.8	9.0	8.0	8.2	8.9
	146	7.9	9.0	8.5	8.8	9.0
Mount Thom	-2	Not Available				
	18	Not Available				
	130	Not Available				
Devon	-1	4.5			6.0	
	19	5.0			6.6	
	131	4.9			4.8	
Delaney	0	8.8			9.0	
	14	8.8			8.7	
	28	8.9			8.8	
	42	8.6			8.5	
	91	8.3			8.6	
	105	8.4			8.5	
	119	8.3			7.9	
	133	7.5			7.9	
Leader Growth (mm)						
Morton Road	-6	29	44	49	87	
	13	25	38	61	49	
	146	45	65	51	55	
Stanburne	-6	50	109	65	70	53
	13	40	53	60	72	58
	146	48	45	78	77	67
Mount Thom	-2	34			48	
	18	35			57	
	130	57			50	
Devon	-1	23			54	
	19	25			50	
	131	90			29	
Delaney	0	137			139	
	14	112			91	
	28	83			106	
	42	95			88	
	91	120			104	
	105	101			89	
	119	82			95	
	133	64			65	

¹ Day: Number of days seedlings planted before (-) or after (+) hexazinone application.

² Discolouration: a rating from 1 = severe to 9 = none. In control plots, competition sometimes resulted in more discolouration (yellowing) than the herbicide may have caused in the treated plots.