Herbicide Monitoring Note

Sixth year measurement of herbicide treatment effects on plant communities: Manning Diversified Forest Products L3- Blocks 110, 113 and 114

Phil Comeau

Centre for Enhanced Forest Management, Department of Renewable Resources, University of Alberta
email: phil.comeau@ualberta.ca; phone: (780) 492-1879

December 23, 2003

Introduction

A herbicide monitoring program was initiated in Alberta in 1996 to provide data on the effects of operational herbicide treatments on plant community composition and diversity. Monitoring installations comprised of paired plots were established in numerous selected cutblocks, with one of the plots left untreated and the other receiving operational herbicide treatment. Between 1996 and 1999, a total of 54 monitoring installations were established in Alberta, with 49 of them involving the application of glyphosate herbicide. Following a review of this protocol in 2001, collection of fifth year data from selected installations and other sites using a revised protocol was recommended.

This note summarizes results from measurements collected in three blocks where portions of blocks had been left unsprayed (these blocks were not part of the original set of monitoring installations, but were considered to be excellent candidate sites for assessment). Sprayed and unsprayed portions of the block had similar soil characteristics, slope, and aspect and were considered to be similar in prespray conditions. Measurements were completed in late July of 2003.

Site Description

These 3 blocks have elevations of: block 110 – 773 m; block 113 – 768 m; and block 114 – 738 m. All 3 blocks were located northwest of Manning, Alberta in the Central Mixedwoods Ecological Subregion, and were classified as being a low-bush cranberry (d) ecosite (Beckingham and Archibald 1996). Soil moisture regime is mesic and soil nutrient regime is medium.

These blocks were clearcut and ripped in the winter of 1995/1996. PSB410 1+0 white spruce were planted on all blocks in the spring of 1996. The treated portions of each block received an aerial broadcast application of glyphosate herbicide at a rate of 6 l/ha (2.1 kg a.i./ha) with a total spray volume of 50 l/ha during late summer of 1997.

Methods

Within each of the untreated and treated areas, vegetation assessments (% cover and modal height estimates for each plant species) were completed in 25 subplots established at 6 m intervals on a 5 plot x 5 plot grid system (with all plots located at least 15 m from treatment plot boundaries). Within each 2 m x 2 m meter subplot visual estimates of percent cover and modal height of each species were recorded by layer.

Four 3.99 m radius subplots were established within both the treated and untreated areas to document total stocking, by tree species. These were centered on subplots 7, 9, 17 and 19. Height, leader length, groundline diameter, and dbh were measured for 4 healthy pine and 4 healthy aspen in each subplot.

Data were analyzed using Analysis of Variance as, treating the 3 locations as blocks in a randomized block design. Having only 3 replicate blocks limits the power of this analysis. Further analysis is planned using data from sites assessed in 2002, 2003 and 2004 upon completion of measurement in 2004.

Results

In the untreated plots *Populus tremuloides* dominates the tall shrub (B1) layer. In block 114 *Populus balsamifera* had higher cover than *P. tremuloides. Rubus idaeus, Rosa acicularis, Linnaea borealis, Cornus canadensis, Epilobium angustifolium, Mertensia paniculata,* and *Rubus pubescens* were common in both treated and untreated plots. Cover of the tall shrub layer and total cover were significantly reduced by herbicide treatment (Table 1). Herb layer cover and *Epilobium angustifolium* cover were significantly greater in the herbicide treatment compared to the untreated.

Richness (number of species) in the B1 layer was lower in the herbicide treatment than in the untreated (Table 2). However, herb layer and total richness was higher in the herbicide treatment than in the intreated, and richness of the low shrub and grass layers were notsignificantly affected by treatment.

Total deciduous density, aspen height and aspen diameter (gld) were significantly lower in treated than in untreated plots (Table 3). Height and gld of planted spruce were significantly larger and hdr was significantly lower in treated than in untreated plots. No differences in total spruce stocking were evident between treated and untreated.

Acknowledgements

Financial support for completion of this study was provided by the Alberta Herbicide Task Force. I am grateful to Susan Hill and Annette Potvin for assistance with field data collection and data entry and to Steve Blanton for assistance with site selection.

References:

Beckingham, J.D. and Archibald, J.H.. 1996. Field guide to ecosites of northern Alberta. Canadian Forest Service, Northern Forestry Centre. Special Report 5.

Table 1. Comparison of vegetation cover between treated and untreated six years after herbicide treatment (Layers: B1=tall shrubs (>2 m); B2=low shrubs; C1=forbs and herbs; C2=grasses, sedges and rushes) (* = significant at 0.10; ** = significant at 0.05).

Plot	110	113	114	mean	110	113	114	mean	p
	untreated				treated				
B1	35	29	15	26.3	3	8	5	5.3	0.0262**
B2	18	26	34	26.0	20	20	7	15.7	0.1781
C1	20	21	12	17.7	33	32	28	31.0	0.0145**
C2	1	7	10	6.0	9	7	6.5	7.5	0.6149
Total	74	83	71	76	65	67	45	59.0	0.0976*
Picea glauca	1.6	3.7	2	2.4	2.4	4.2	4.1	3.6	0.2623
Populus tremuloides	30	17.7	2.8	16.8	0.4	0.4	0	0.3	0.1029
Rosa acicularis	0.9	12.2	18.9	10.7	2.3	3.1	0.4	1.9	0.1756
Rubus idaeus	4.9	6.1	5.8	5.6	11.2	9.6	2.5	7.8	0.4669
Epilobium angustifolium	3.6	4.9	3.9	4.1	16.4	18.3	15.2	16.6	0.0002**
Calamagrostis canadensis	0.2	5.3	7.4	4.3	5.8	6.8	6	6.2	0.4286

Table 2. Effects of treatment on plant community richness six years after herbicide treatment. (Layers: B1=tall shrubs (>2 m); B2=low shrubs; C1=forbs and herbs; C2=grasses, sedges and rushes) (* = significant at 0.10; ** = significant at 0.05).

Plot:	110	113	114	mean	110	113	114	mean	p
	untreated				treated				
B1	6	6	7	6.3	3	6	3	4.0	0.0913*
B2	15	12	14	13.7	13	12	14	13.0	0.5614
C1	16	20	20	18.7	28	27	36	30.3	0.0207**
C2	6	2	4	4.0	6	2	7	5.0	0.6291
TOTAL	43	40	45	42.7	50	47	60	52.3	0.0823*

Table 3. Tree growth responses and stocking 6 years after treatment (* = significant at 0.10; ** = significant at 0.05)..

Species	Response variable	Untreated				Treated				Pr>t
		110	113	114	mean	110	113	114	mean	
Aw	Height (cm)	460	450	367	447	164	179		174	0.0050**
	GLD (cm)	5.4	5.4	4.9	5.4	1.9	3.1		2.7	0.0104**
	HDR	86.8	84.2	79.3	85.1	86.5	59.4		69.2	0.3808
Sw	Height (cm)	151	179	160	164	181	196	195	191	0.0477**
	Leader (cm/y)	16.6	24.7	19.8	20.3	23.2	18.0	26.4	22.6	0.5509
	GLD (cm)	2.4	2.7	2.5	2.6	3.5	3.8	3.7	3.7	0.0007**
	HDR	64.2	67.1	63.0	64.8	51.6	53.8	52.9	52.8	0.0010**
Deciduous	Trees/ha	24693	6448	9597	13580	800	1150	150	700	0.0844*
Conifer	Trees/ha	2450	1950	1950	2116	2249	1650	1600	1833	0.3486

Herbicide Monitoring Note

Fifth year remeasurement of Millar Western Installation #2 (W9-L4)

Phil Comeau and Melanie Kalischuk

Centre for Enhanced Forest Management, Department of Renewable Resources, University of Alberta
email: phil.comeau@ualberta.ca; phone: (780) 492-1879

March 15, 2003

Introduction

A herbicide monitoring program was initiated in Alberta in 1996 to provide data on the effects of operational herbicide treatments on plant community composition and diversity. Monitoring installations comprised of paired plots were established in numerous selected cutblocks, with one of the plots left untreated and the other receiving operational herbicide treatment. Between 1996 and 1999, a total of 54 monitoring installations were established in Alberta, with 49 of them involving the application of glyphosate herbicide. Following a review of this protocol in 2001, collection of fifth year data from selected installations using a revised protocol was recommended.

This note summarizes results from remeasurement of Millar Western Installation #2, License W9-L4, Block 53 located near Whitecourt, Alberta, during August of 2002.

Site Description

This installation is located in the Lower Foothills Ecological Subregion, and was classified as being a low-bush cranberry (e) ecosite (Beckingham et al. 1996). The site has a south aspect, a 6 to10% slope and gently rolling topography. Soil parent is a well-drained glacio-lacustrine deposit with 15-18% coarse fragments and a clay loam texture below a SiL/L surface horizon. Soil moisture regime is mesic and soil nutrient regime is medium.

This site was clearcut harvested in the fall of 1992, planted with lodgepole pine (410A 1+0) in the summer of 1995 and spring of 1996. The treated portion of the block received an aerial broadcast application of glyphosate herbicide on September 9 1997 at a rate of 6 l/ha (2.1 kg a.i./ha) with a total spray volume of 50 l/ha.

Methods

Within each of the untreated and treated areas, vegetation assessments (% cover and modal height estimates for each plant species) were completed in 25 subplots established at 6 m intervals on a 5 plot x 5 plot grid system (with all plots located at least 15 m from treatment plot boundaries). Within each 2 m x 2 m meter subplot visual estimates of percent cover and modal height of each species were recorded by layer. In addition, four 3.99 m radius subplots were established within each plot to evaluate cover and densities of tree species.

Height, leader length, groundline diameter, and dbh were measured for 16 healthy planted conifer seedlings and 16 healthy aspen in each plot. Eight of the conifers and eight of the aspen were cut at the base and diameter increment and age of the conifers were determined from discs taken at 30 cm height.

Data are analyzed using t-tests to compare treated and untreated plots. While these results provide an indication of treatment effects, it is important to recognize that this approach results in pseudoreplication, with subplots that are nested within treatment plots not truly representing a replicated sample.

Results

In 2002, the most abundant species in both treated and untreated areas was bluejoint reedgrass and fireweed. In addition, green alder has a 15% cover in the untreated area and was about the same height as the aspen. The treated area had significantly (a=0.05) lower cover of aspen, alder, and bluejoint reedgrass than the untreated (Table 1). Fireweed cover was similar in both treated and untreated. Herbicide treatment resulted in a significant reduction in cover of the shrub (B) layer, the grass (C1) layer and in total cover. In contrast, cover of the herbaceous (C1) layer was significantly higher in the treated than in the untreated.

Species richness for the C layer and for all layers combined is significantly higher in the treated than in the untreated (Table 2). Values of the Shannon diversity index are higher in the untreated than in the treated for the tree (A) layer, but are lower in the untreated for the B, C, and total layers. These results indicate a reduction in plant community diversity in the tree layer, coupled with an increase in diversity in the shrub and herb layers, which results in an overall increase in diversity for the entire plant community.

Aspen height, GLD, and leader length are significantly (a=0.05) smaller in the treated compared to the untreated (Table 3). Aspen (deciduous) density was significantly lower in the treated (949.8) than in the untreated (11,547.7) (p=0.0064). Differences in pine height, leader length, and GLD are not significant. However, height:diameter ratio is significantly smaller for the pine in the treated (hdr=41.7) compared to the untreated (hdr=63.1) ($p<0.001$).

References:

Beckingham, J.D., Corns, I.G.W. and Archibald, J.H. 1996. Field guide to ecosites of west-central Alberta. Canadian Forest Service, Northern Forestry Centre, Edmonton. Special Report 9.

Table 1. Comparison of vegetation cover between treated and untreated five years after herbicide treatment. (Layers: A=tree; B=shrubs; B1=shrubs >1.3 m; C=herbs, forbs, grasses, sedges and rushes; C1=forbs and herbs; C2=grasses, sedges and rushes)

Layer or species	**Treated**		**Untreated**		**Pr>t**
	Mean	standard deviation	mean	standard deviation	
A	17.64	2.35	23.48	2.16	0.0735
B	19.36	2.46	35.00	2.45	<0.001
B1	2.88	0.93	18.16	3.03	<0.001
C	55.84	3.57	54.16	2.38	0.6972
C1	35.80	2.98	24.72	1.97	0.0032
C2	20.04	1.70	29.44	2.12	0.0011
Total	92.84	5.14	112.64	3.14	0.0019
Populus tremuloides	1.24	1.01	12.88	1.74	<0.001
Alnus crispa	0	0	14.8	2.72	<0.001
Epilobium angustifolium	11.68	9.91	12.32	7.75	0.800
Calamagrostis canadensis	18.68	8.44	29.16	11.05	<0.001

Table 2. Effects of treatment on plant community diversity five years after herbicide treatment. (Layers: A=tree, B=shrub, C=herbs, forbs, grasses, sedges and rushes).

Measure	**Layer**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Richness	A	1.96	0.93	2.20	0.82	0.3384
	B	7.08	2.00	6.60	1.73	0.3687
	C	13.56	3.57	8.12	3.11	<0.001
	Total	22.60	4.39	16.92	3.72	<0.001
Shannon Index	A	0.2955	0.2771	0.6130	0.3081	<0.001
	B	1.7066	0.3020	1.4026	0.3482	0.0018
	C	1.9410	0.3193	1.3035	0.3573	<0.001
	Total	2.4576	0.0561	2.1581	0.0536	<0.001

Table 3. Tree growth responses and stocking 5 years after treatment.

Species	**Response variable**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Aw	height (cm)	122.7	56.9	312.4	46.9	<0.001
	leader (cm/y)	16.4	15.0	40.2	11.1	<0.001
	GLD (mm)	20.57	10.64	39.12	6.53	<0.001
	diameter* increment 2002 (mm/y)	1.59	0.44	1.74	0.21	0.770
Pl	height (cm)	178.2	31.0	179.2	37.5	0.935
	leader (cm/y)	41.2	6.7	38.4	8.8	0.333
	GLD (mm)	43.3	7. 6	29.2	7.6	0.368
	hdr	41.7	6.4	63.1	11.7	<0.001
	diameter* increment 2002 (mm/y)	0.97	0.09	1.12	0.33	0.669
Deciduous	Trees/ha	949.8	1111.8	11547.7	5064.9	0.0064
Conifer	Trees/ha	7748.4	6338.8	4749.0	3681.2	0.444

*Diameter increment was measured at 30 cm height.

Herbicide Monitoring Note

Fifth year remeasurement of Alberta Plywood Installation #1 (S4-L32)

Phil Comeau and Melanie Kalischuk

Centre for Enhanced Forest Management, Department of Renewable Resources, University of Alberta
email: phil.comeau@ualberta.ca; phone: (780) 492-1879

March 15, 2003

Introduction

A herbicide monitoring program was initiated in Alberta in 1996 to provide data on the effects of operational herbicide treatments on plant community composition and diversity. Monitoring installations comprised of paired plots were established in numerous selected cutblocks, with one of the plots left untreated and the other receiving operational herbicide treatment. Between 1996 and 1999, a total of 54 monitoring installations were established in Alberta, with 49 of them involving the application of glyphosate herbicide. Following a review of this protocol in 2001, collection of fifth year data from selected installations using a revised protocol was recommended.

This note summarizes results from remeasurement of Alberta Plywood Installation #1, (S4-L32), located in the Marten Hills near Slave Lake, Alberta during July and August of 2002.

Site Description

This installation is located in the Central Mixedwoods Ecological Subregion, and was classified as being a low-bush cranberry (d) ecosite (Beckingham and Archibald 1996). The site has a southeastern aspect and a slope between 5 and 8%. Parent material is a well drained glacial till deposit with 5% cobbles and a sandy loam soil texture. Soil moisture regime is submesic and soil nutrient regime is medium. The paired plots are separated by approximately 100 meter horizontal distance and 17 m elevation. The treated plot (block 35) treated area is located at an upper slope position with a convex surface topography. The treated area (block 28) is located at a middle to upper slope position with straight/flat surface topography.

This site was clearcut in the winter of 1993, disk trenched and planted with white spruce in the spring of 1994. The treated portion of the block received an aerial broadcast application of glyphosate herbicide at a rate of 6 l/ha (2.1 kg a.i./ha) with a total spray volume of 50 l/ha on September 10th, 1997. As a result of winter desiccation injury, the treated area had an additional planting treatment (spruce) in the summer of 1998. (It was possible to differentiate between the stock types and the 1994 stock was used for conifer growth response measurements.)

Methods

Within each of the untreated and treated areas, vegetation assessments (% cover and modal height estimates for each plant species) were completed in 25 subplots established at 10 m intervals on a 5 plot x 5 plot grid system (with all plots located at least 15 m from treatment plot boundaries). Within each 2 m x 2 m meter subplot visual estimates of percent cover and modal height of each species were recorded by layer. In addition, four 3.99 m radius subplots were established within each plot to evaluate cover and densities of tree species.

Height, leader length, groundline diameter, and dbh were measured for 16 healthy planted conifer seedlings and 16 healthy aspen in each plot. Eight of the conifers and eight of the aspen were cut at the base and diameter increment and age of the conifers were determined from discs taken at 30 cm height.

Data are analyzed using t-tests to compare treated and untreated plots. While these results provide an indication of treatment effects, it is important to recognize that this approach results in pseudoreplication, with subplots that are nested within treatment plots not truly representing a replicated sample.

Results

In 2002, bluejoint reedgrass was a major species in both treated (23.8% cover) and untreated (27.6% cover) plots, with no significant treatment effect being evident after 5 years (Table 1). At this site, herbicide treatment resulted in a significant decrease in tree cover ($p<0.0001$), associated with a significant ($p<0.0001$) reduction in aspen cover. Fireweed cover is significantly higher in the treated compared to the untreated ($p=0.0052$).

Herbicide treatment resulted in small but significant reductions in the number of species (species richness) in each layer (Table 2). Diversity, measured using the Shannon index, was reduced for each of the individual layers. However, when all layers were combined, these reductions are no longer statistically significant.

Aspen height, leader length, and GLD were reduced significantly by the herbicide treatment (Table 3). In addition, the average number of aspen stems per hectare was reduced from 22,295 in the untreated to 449 in the treated plot. Spruce height, leader length, GLD and diameter increment were all significantly larger in the treated compared to the untreated. In addition, height:diameter ratio of spruce is significantly lower in the treated compared to the treated plot ($p=0.0004$).

References:

Beckingham, J.D. and Archibald, J.H.. 1996. Field guide to ecosites of northern Alberta. Canadian Forest Service, Northern Forestry Centre. Special Report 5.

Table 1. Comparison of vegetation cover between treated and untreated five years after herbicide treatment. (Layers: A=tree; B=shrubs; B1=shrubs >1.3 m; C=herbs, forbs, grasses, sedges and rushes; C1=forbs and herbs; C2=grasses, sedges and rushes)

Layer or species	**Treated**		**Untreated**		**Pr>t**
	mean	standard deviation	mean	standard deviation	
A	4.92	1.31	39.48	2.47	<0.001
B	21.84	2.13	21.72	2.01	0.967
C	43.92	3.92	40.72	2.09	0.475
C1	19.00	3.27	12.84	0.95	0.077
C2	24.92	2.74	27.88	1.63	0.359
Total	70.68	4.95	101.92	3.99	<0.001
Populus tremuloides	0.36	0.26	31.24	2.41	<0.001
Epilobium angustifolium	11.28	6.36	1.68	1.16	0.0052
Calamagrostis canadensis	23.80	13.45	27.56	8.18	0.238
Carex spp.	0.88	1.13	0.32	0.48	0.03

Table 2. Effects of treatment on plant community diversity five years after herbicide treatment. (Layers A=tree, B=shrub, C=herbs and grasses).

Measure	**Layer**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Richness	A	1.36	1.29	2.68	0.99	<0.001
	B	3.76	1.16	5.68	1.52	<0.001
	C	7.48	2.96	10.28	2.98	0.0017
	Total	12.60	3.99	18.64	4.04	<0.001
Shannon Index	A	0.1629	0.1536	0.4036	0.2825	<0.001
	B	0.634	0.768	1.4536	0.2993	<0.001
	C	0.9898	0.2464	1.2703	0.2705	<0.001
	Total	1.7866	0.07528	2.9611	0.9391	0.219

Table 3. Tree growth responses and stocking 5 years after treatment.

Species	**Response variable**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Aw	height (cm)	160.4	60.2	574.3	113.7	<0.001
	leader (cm/y)	32.4	18.5	56.3	7.9	<0.001
	GLD (mm)	17.3	7.3	54.0	9.3	<0.001
	diameter* increment 2002 (mm/y)	2.4	0.3	1.1	0.2	0.004
Sw	height (cm)	192.8	45.6	126.9	30.4	<0.001
	leader (cm/y)	35.7	8.2	19.8	6.6	<0.001
	GLD (mm)	34.9	10.1	17.9	5.5	<0.001
	hdr	57.0	8.9	72.7	13.0	<0.001
	diameter* increment 2002 (mm/y)	1.9	0.3	0.5	0.1	<0.001
Deciduous	Trees/ha	449.0	660.7	22295.5	4659.5	<0.001
Conifer	Trees/ha	2499.5	2175.2	1049.8	619.0	0.2471

*Diameter increment was measured at 30 cm height.

Herbicide Monitoring Note

Fifth year remeasurement of Blue Ridge Lumber #3 (License SH370 Block 7)

Phil Comeau

Centre for Enhanced Forest Management, Department of Renewable Resources, University of Alberta
email: phil.comeau@ualberta.ca; phone: (780) 492-1879

December 23, 2003

Introduction

A herbicide monitoring program was initiated in Alberta in 1996 to provide data on the effects of operational herbicide treatments on plant community composition and diversity. Monitoring installations comprised of paired plots were established in numerous selected cutblocks, with one of the plots left untreated and the other receiving operational herbicide treatment. Between 1996 and 1999, a total of 54 monitoring installations were established in Alberta, with 49 of them involving the application of glyphosate herbicide. Following a review of this protocol in 2001, collection of fifth year data from selected installations using a revised protocol was recommended.

This note summarizes results from remeasurement of Blue Ridge Lumber Installation #3, (License SH370 Block 7), Alberta, during July of 2003.

Site Description

This installation is located in the Lower Foothills Ecological Subregion, at an elevation of 883 m and was classified as a d ecosite (Beckingham et al. 1996). This site occupies a lower slope position, and has level surface topography. Soil moisture regime is mesic and soil nutrient regime is medium.

This site was clearcut in the summer of 1995, and planted with bareroot lodgeopole pine in 1996. The treated portion of the block received and an aerial broadcast application of glyphosate herbicide at a rate of 6 l/ha (2.1 kg a.i./ha) with a total spray volume of 50 l/ha on August 24th 1998.

Methods

Within each of the untreated and treated areas, vegetation assessments (% cover and modal height estimates for each plant species) were completed in 25 subplots established at 6 m intervals on a 5 plot x 5 plot grid system (with all plots located at least 15 m from treatment plot boundaries). Within each 2 m x 2 m meter subplot visual estimates of percent cover and modal height of each species were recorded by layer.

Four 3.99 m radius subplots were established within both the treated and untreated areas to document total stocking, by tree species. These were centered on subplots 7, 9, 17 and 19. Height, leader length, groundline diameter, and dbh were measured for 4 healthy pine and 4 healthy aspen in each subplot.

Due to the lack of replication, and the small size of the subplots used, vegetation data have not been analyzed statistically. Tree data were analyzed using t-tests to compare treated and untreated plots. While these results provide an indication of treatment effects, it is important to recognize that this approach results in pseudoreplication, with subplots that are nested within treatment plots not truly representing a replicated sample.

Results

In 2003, the deciduous canopy in the untreated plot was comprised of trembling aspen and a minor component of balsam poplar with a total cover of 33% (Table 1). Herbicide treatment resulted in 0% aspen cover at age 5. Major species in both the untreated and treated plots were *Rosa acicularis, Epilobium angustifolium, Equisetum pratense, Rubus pubescens*, and *Calamagrostis canadensis*. The herbicide treatment appears to have resulted in a decrease in tall shrub, low shrub, grass and total cover (Table 1). Cover of aspen and *Calamagrostis canadensis* are lower in the treated, compared to the treated.

Treated plots had only a slight reduction in species richness in the tall shrub layer and for all layers combined than the untreated plots. This reflects the absence of aspen and balsam poplar from the treated plots. However, for the low shrub, herbaceous and grass layers, richness is the same for both treated and untreated.

Deciduous density was significantly higher in the untreated compared to the treated (Table 2). A minor deciduous component is still present in the stand and will likely lead to development of a stand which resembles the original stand prior to harvest. For lodgepole pine, treated plots had significantly higher conifer (pine) density and groundline diameter than untreated. Height:diameter ratio of lodgepole pine was also significantly smaller in treated plots than in untreated. However, height and leader length of lodgepole pine did not differ significantly between treated and untreated.

More detailed statistical analysis will be completed utilizing data from several sites measured in 2002, 2003 and 2004 following sampling of additional sites in 2004.

Acknowledgements

Financial support for completion of this study was provided by the Alberta Herbicide Task Force. I am grateful to Susan Hill and Annette Potvin for assistance with field data collection and data entry.

References:

Beckingham, J.D., Corns, I.G.W. and Archibald, J.H. 1996. Field guide to ecosites of west-central Alberta. Canadian Forest Service, Northern Forestry Centre, Edmonton. Special Report 9.

Table 1. Vegetation cover and richness (number of species) in treated and untreated portions of the block six years after herbicide treatment. (Layers: B1=tall shrubs (>2 m); B2=low shrubs; C1=forbs and herbs; C2=grasses, sedges and rushes)

Layer or species	**Treated**	**Untreated**	**Treated**	**Untreated**
	Cover	Cover	Richness	Richness
B1	5.3	32.8	1	3
B2	5.8	12.3	16	16
C1	37	34.1	24	24
C2	26	35.6	5	5
Total	74	115	46	48
Pinus contorta (B1)	5	3		
Populus tremuloides (B1)	0	27		
Epilobium angustifolium	6	9		
Calamagrostis canadensis	17	32		
Elymus innovatus	7	4		

Table 2. Tree growth responses and stocking 6 years after treatment (trees are 14 years old or less in 2003). Comparison utilized a paired t-test. (.*=significant at 0.10; **=significant at 0.05)

Species	**Response variable**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Aw	Height (cm)	.		236	28	
	Leader (cm/y)	.		22.4	3.0	
	GLD (cm)	.		3.5	0.5	
	HDR	.		67.3	7.1	
Pl	Height (cm)	172	19	159	14	0.3317
	Leader (cm/y)	30.6	4.4	26.1	1.5	0.1019
	GLD (cm)	4.4	0.3	3.0	0.3	0.0006**
	HDR	39.0	2.7	53.6	3.4	0.0005**
Deciduous	Trees/ha	150	100	9798	2565	0.0003**
Conifer	Trees/ha	1600	566	950	300	0.0886*

Herbicide Monitoring Note

Fifth year remeasurement of Blue Ridge Lumber Installation #2, JC-130

Phil Comeau and Melanie Kalischuk

Centre for Enhanced Forest Management, Department of Renewable Resources, University of Alberta
email: phil.comeau@ualberta.ca; phone: (780) 492-1879

March 15, 2003

Introduction

A herbicide monitoring program was initiated in Alberta in 1996 to provide data on the effects of operational herbicide treatments on plant community composition and diversity. Monitoring installations comprised of paired plots were established in numerous selected cutblocks, with one of the plots left untreated and the other receiving operational herbicide treatment. Between 1996 and 1999, a total of 54 monitoring installations were established in Alberta, with 49 of them involving the application of glyphosate herbicide. Following a review of this protocol in 2001, collection of fifth year data from selected installations using a revised protocol was recommended.

This note summarizes results from remeasurement of Blue Ridge Lumber Installation #2, JC-130, Block 75, located near Whitecourt, Alberta, during August of 2002.

Site Description

This installation is located in the Lower Foothills Ecological Subregion, and was classified as being a low-bush cranberry (e) ecosite (Beckingham et al. 1996). This site occupies a middle slope position, has benchy/rolling surface topography, a slope gradient between 4 and 9% and a SW facing aspect. The parent material is a moderately well drained glacial till deposit with clay loam (CL) textured soil below a silt loam (SiL) surface. Soil moisture regime is mesic and soil nutrient regime is medium.

This site was clearcut in the fall of 1995, power disc-trenched in 1996, and planted with white spruce (p+1.5) in the spring of 1996. The treated portion of the block received and an aerial broadcast application of glyphosate herbicide at a rate of 6 l/ha (2.1 kg a.i./ha) with a total spray volume of 50 l/ha on September 3rd 1997.

Methods

Within each of the untreated and treated areas, vegetation assessments (% cover and modal height estimates for each plant species) were completed in 25 subplots established at 6 m intervals on a 5 plot x 5 plot grid system (with all plots located at least 15 m from treatment plot boundaries). Within each 2 m x 2 m meter subplot visual estimates of percent cover and modal height of each species were recorded by layer. In addition, four 3.99 m radius subplots were established within each plot to evaluate cover and densities of tree species.

Height, leader length, groundline diameter, and dbh were measured for 16 healthy planted conifer seedlings and 16 healthy aspen in each plot. Eight of the conifers and eight of the aspen were cut at the base and diameter increment and age of the conifers were determined from discs taken at 30 cm height.

Data were analyzed using t-tests to compare treated and untreated plots. While these results provide an indication of treatment effects, it is important to recognize that this approach results in pseudoreplication, with subplots that are nested within treatment plots not truly representing a replicated sample.

Results

In 2002, the deciduous canopy in the untreated plot was a mixture of balsam popular and trembling aspen with a total cover of 16%. Major species in both the untreated and treated plots (n having very similar cover) were: *Lonicera involucrata, Rosa acicularis, Rubus idaeus, Aster* species*, Fragaria vesca,* and *Calamagrostis canadensis*. *Elymus innovatus* was one species found in the treated plot but not in the untreated.

Total cover and cover of the tree (A) and shrub (B) layers was significantly lower in the treated than in the untreated plots (Table 1). Cover of the herb layer was slightly larger in the treated than in the untreated, but the difference was marginally non-significant (P=0.0746). The major effect of treatment appears to have been a reduction in deciduous cover due to effective control of aspen and balsam poplar.

Treatment resulted in a significant ($p<0.0001$) reduction in richness and in the Shannon Diversity Index for the tree layer (Table 2). Marginally non-significant differences ($0.05<p<0.10$) were found for B layer richness, and for both Richness and the Shannon Index for all layers combined (Total).

The treated plot has significantly lower aspen height ($p<0.0001$) and GLD ($p<0.0001$) and has significantly fewer deciduous per hectare ($p=0.004$) than the untreated (Table 3). While lodgepole pine height and GLD do not differ significantly between treated and untreated current height growth (leader length) was significantly greater and height:diameter ratio (hdr) was significantly lower in the treated compared to the untreated. This suggests that while effects of competition may not have been substantial, the effects of competition or other differences are beginning to occur, as reflected in differences in current growth rates. Deciduous cover in the untreated area was somewhat patchy and it is possible that competitive effects are only beginning to be noticeable.

References:

Beckingham, J.D., Corns, I.G.W. and Archibald, J.H. 1996. Field guide to ecosites of west-central Alberta. Canadian Forest Service, Northern Forestry Centre, Edmonton. Special Report 9.

Table 1. Comparison of vegetation cover between treated and untreated five years after herbicide treatment. (Layers: A=tree; B=shrubs; C=herbs, forbs, grasses, sedges and rushes; C1=forbs and herbs; C2=grasses, sedges and rushes)

Layer or species	**Treated**		**Untreated**		**Pr>t**
	mean	standard deviation	mean	standard deviation	
A	6.60	0.99	23.60	2.29	<0.0001
B	18.12	2.81	25.04	1.65	0.0390
C	51.4	3.25	42.96	3.30	0.0746
C1	31.88	2.48	27.44	1.79	0.1526
C2	19.52	2.29	15.52	2.76	0.2704
Total	76.12	4.18	91.60	4.79	0.0185
Populus (tremuloides + balsamifera)	0.16	0.12	15.80	2.46	<0.001
Epilobium angustifolium	1.84	2.12	1.75	2.541	0.8996
Calamagrostis canadensis	10.52	10.697	13.84	13.76	0.3457

Table 2. Effects of treatment on plant community diversity five years after herbicide treatment. (Layers A=tree, B=shrub, C=herbs and grasses).

Measure	**Layer**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Richness	A	1.68	0.75	2.96	0.61	<0.0001
	B	4.80	1.12	5.52	1.71	0.084
	C	13.84	3.24	13.88	3.06	0.964
	Total	20.32	18.64	22.36	3.76	0.061
Shannon Index	A	0.379	0.3421	0.861	0.213	<0.0001
	B	1.315	0.2742	1.394	0.411	0.428
	C	2.014	0.2722	2.090	0.406	0.441
	Total	2.449	0.04624	2.577	0.046	0.056

Table 3. Tree growth responses and stocking 5 years after treatment.

Species	**Response variable**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Aw	height (cm)	83.3	31.9	182.31	39.9	<0.0001
	leader (cm/y)	20.2	16.3	31.4	14.8	0.063
	GLD (mm)	14.62	4.46	23.5	5.7	<0.0001
	diameter* increment 2002 (mm/y)	1.51	0.31	0.94	0.09	0.096
Sw	height (cm)	163.9	29.1	167.7	40.3	0.761
	leader (cm/y)	39.7	12.6	27.8	9.5	0.005
	GLD (mm)	35.9	11.6	30.4	7.5	0.118
	hdr	47.3	7.6	56.4	12.9	0.020
	diameter* increment 2002 (mm/y)	1.57	0.19	1.13	0.12	0.068
Deciduous	Trees/ha	1049.8	443.4	20196.0	8594.4	0.004
Conifer	Trees/ha	1949.6	680.6	1549.7	412.3	0.354

*Diameter increment was measured at 30 cm height.

Herbicide Monitoring Note

Fifth year remeasurement of Sundance #2, R4-L54 Block 144064

Phil Comeau

Centre for Enhanced Forest Management, Department of Renewable Resources, University of Alberta
email: phil.comeau@ualberta.ca; phone: (780) 492-1879

December 23, 2003

Introduction

A herbicide monitoring program was initiated in Alberta in 1996 to provide data on the effects of operational herbicide treatments on plant community composition and diversity. Monitoring installations comprised of paired plots were established in numerous selected cutblocks, with one of the plots left untreated and the other receiving operational herbicide treatment. Between 1996 and 1999, a total of 54 monitoring installations were established in Alberta, with 49 of them involving the application of glyphosate herbicide. Following a review of this protocol in 2001, collection of fifth year data from selected installations using a revised protocol was recommended.

This note summarizes results from remeasurement of Sundance Installation #2, R4-L54 Block 144064 located near Edson, Alberta, during July of 2003.

Site Description

This installation is located in the Upper Foothills Ecological Subregion, at an elevation of 1192 m and was classified as an "e" ecosite (Beckingham et al. 1996). This site occupies an upper slope position, has benchy/rolling surface topography, a slope of less than 10 % and a S facing aspect. Soil moisture regime is mesic and soil nutrient regime is medium.

This site was clearcut in the summer of 1990, drag scarified in July of 1991, and regenerated naturally to lodgeopole pine. The treated portion of the block received and an aerial broadcast application of glyphosate herbicide at a rate of 6 l/ha (2.1 kg a.i./ha) with a total spray volume of 50 l/ha on September 8th 1997.

Methods

Within each of the untreated and treated areas, vegetation assessments (% cover and modal height estimates for each plant species) were completed in 25 subplots established at 6 m intervals on a 5 plot x 5 plot grid system (with all plots located at least 15 m from treatment plot boundaries). Within each 2 m x 2 m meter subplot visual estimates of percent cover and modal height of each species were recorded by layer.

Four 3.99 m radius subplots were established within both the treated and untreated areas to document total stocking, by tree species. These were centered on subplots 7, 9, 17 and 19. Height, leader length, groundline diameter, and dbh were measured for 4 healthy pine and 4 healthy aspen in each subplot.

Due to the lack of replication, and the small size of the subplots used, vegetation data have not been analyzed statistically. Tree data were analyzed using t-tests to compare treated and untreated plots. While these results provide an indication of treatment effects, it is important to recognize that this approach results in pseudoreplication, with subplots that are nested within treatment plots not truly representing a replicated sample.

Results

In 2003, the deciduous canopy in the untreated plot was comprised of trembling aspen with a total cover of 42.8%. Major species in both the untreated and treated plots were *Pinus contorta, Ledum groenlandicum, Linnaea borealis, Vaccinium myrtilloides*, and *Elymus innovatus*. The herbicide treatment appears to have resulted in a decrease in tall shrub, low shrub, and total cover (Table 1). Cover of aspen and *Elymus innovatus* are lower in the treated, compared to the treated. However, cover of lodgepole pine, *Epilobium angustifolium* and *Calamagrostis canadensis* are higher in the treated block.

Treated plots had substantially higher species richness in the herbaceous layers and for all layers combined than the untreated plots.

Aspen height and height:diameter ratio were found to be significantly higher in the untreated compared to the treated (Table 2). For lodgepole pine, treated plots had significantly higher leader length and groundline diameter than untreated. Height:diameter ratio of lodgepole pine was also significantly smaller in treated plots than in untreated.

More detailed statistical analysis will be completed utilizing data from several sites measured in 2002, 2003 and 2004 following sampling of additional sites in 2004.

Acknowledgements

Financial support for completion of this study was provided by the Alberta Herbicide Task Force. I am grateful to Susan Hill and Annette Potvin for assistance with field data collection and data entry.

References:

Beckingham, J.D., Corns, I.G.W. and Archibald, J.H. 1996. Field guide to ecosites of west-central Alberta. Canadian Forest Service, Northern Forestry Centre, Edmonton. Special Report 9.

Table 1. Vegetation cover and richness (number of species) in treated and untreated portions of the block six years after herbicide treatment. (Layers: B1=tall shrubs (>2 m); B2=low shrubs; C1=forbs and herbs; C2=grasses, sedges and rushes)

Layer or species	**Treated**	**Untreated**	**Treated**	**Untreated**
	Cover	Cover	Richness	Richness
B1	9.9	42.8	3	4
B2	28.3	44.1	13	13
C1	13.6	6.4	27	15
C2	12.1	8.3	5	4
Total	64	101.6	48	38
Pinus contorta (B1)	8.3	0.9		
Populus tremuloides (B1)	1.1	39.8		
Epilobium angustifolium	7.4	3.9		
Calamagrostis canadensis	5.1	0		
Elymus innovatus	5.4	7.7		

Table 2. Tree growth responses and stocking 6 years after treatment (trees are 14 years old or less in 2003). Comparison utilized a paired t-test. (.*=significant at 0.10; **=significant at 0.05)

Species	**Response variable**	**Treated**		**Untreated**		**Pr>t**
		mean	standard deviation	mean	standard deviation	
Aw	Height (cm)	283	25.5	438	82.4	0.069*
	Leader (cm/y)	25.4	4.80	34.1	5.64	0.140
	GLD (cm)	4.4	0.42	5.7	1.36	0.277
	HDR	67.4	2.40	77.9	6.10	0.088*
Pl	Height (cm)	283.2	51.9	153.8	88.5	0.450
	Leader (cm/y)	43.2	4.09	25.4	8.87	0.011**
	GLD (cm)	5.7	1.42	2.7	1.82	0.040**
	HDR	50.9	5.97	61.5	8.88	0.095*
Deciduous	Trees/ha	4198.75	3261.0	15545.5	12498.4	0.1294
Conifer	Trees/ha	3948.75	1472.8	2899.25	1762.2	0.3960