



FOREST RESEARCH REPORT

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The Cost and Productivity of Four Selective Methods of Applying Herbicide to Hardwood Sprouts

Introduction

Broadcast¹ (ground or aerial) applications of herbicides are often the prescribed treatment for controlling competition in plantations or naturally regenerated cutovers. In Nova Scotia this has been the primary method used to control competing vegetation on forest land. However, there are circumstances where treatments other than broadcast can be efficient and economical. For example, selective² treatments can be used in situations where competition consists primarily of scattered patches of sprouting hardwoods.

The advantages of selective treatments over broadcast treatments include:

- treatment of target species only,
- reduced spray drift,
- reduced quantity of spray solution applied and
- treatment of areas not possible by broadcast methods.

The purpose of this report is to compare the labour costs and productivity of basal, ground, and foliar selective-methods of herbicide treatment.

¹ Treatment of the entire area with herbicide

² Treatment of individual trees

Site Description

Five sites with predominantly maple (*Acer* sp.) sprout competition were selected for the trial. The sites are located at Glencoe and Cameron Settlement, Guysborough Co.; Big Marsh, Antigonish Co.; Sucker Lake, Colchester Co.; and Frog Lake, Kings Co. (Figure 1).

Four of the sites were clearcuts (Glencoe, Cameron Settlement, Big Marsh and Sucker Lake); all had predominantly red maple (*Acer rubrum* L.) competition except Sucker Lake which was mostly sugar maple (*Acer saccharum* Marsh). The fifth site, Frog Lake, was a clearcut that had received shelterwood treatments during the previous 10 year period. The main competing species at this site

was sugar maple.

At the time of the herbicide treatment, the maple sprouts on the clear-cut sites averaged 1.6 m in height and the density of maple stumps ranged from 291 to 1410 per hectare. The average number of sprouts per stump varied from 10 - 33. On the shelterwood site, there was an average of 10 sprouts per stump and 890 stumps/ha with the maple sprouts varying in height from 3 to 6 m (Table 1).

Each of the sites had a relatively flat terrain with little accumulation of slash or other obstacles, such as rocks and wet areas that would hinder ground spray operations or worker movement.

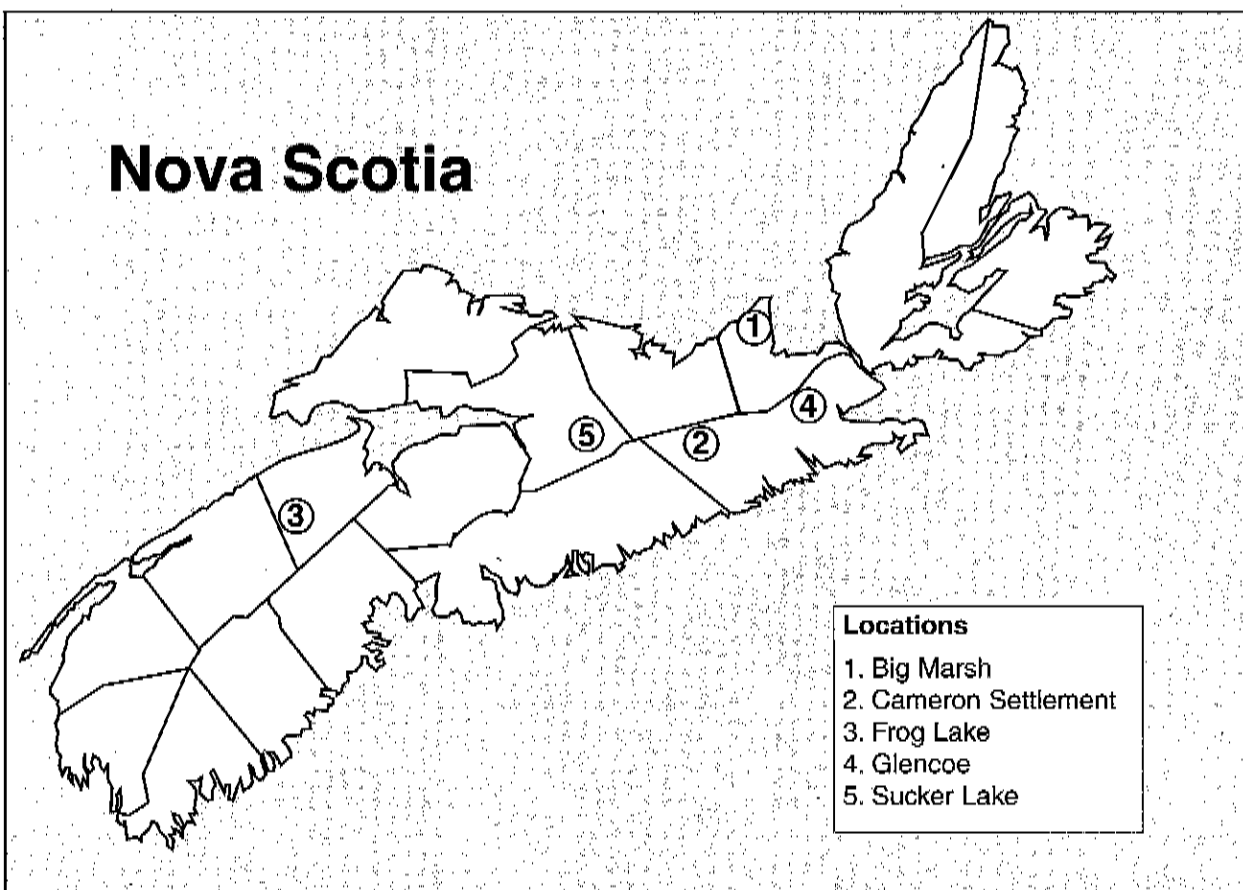


Figure 1. Selective herbicide-application trial locations.

Table 1. Pre-treatment site conditions by location.

Location	Previous Treatment	Date Harvested	Date Treated	Total Area Treated (ha)	Average Block Size (ha)	Target Species ¹			Distance ² (m)
						Stumps/Ha	Height (m)	Stems/Stump	
Big Marsh	Clear Cut	1991	1993	1.2	0.20	1088	1.6	33	82
Cameron Sett.	Clear Cut	1991	1993	1.3	0.21	291	1.6	23	105
Frog Lake	Shelterwood	1980-90 ³	1993	9.9	1.65	890	3.0-6.0	10	135
Glencoe	Clear Cut	1991	1992	1.7	0.34	1410	1.6	10	120
Sucker Lake	Clear Cut	1992	1994	1.1	0.18	383	1.6	14	60

¹ Only maples (*Acer* sp.) were treated. Predominantly red maple sprouts at all sites except Sucker Lake and Frog Lake, where sugar maple predominated.

² Average distance to the back of each site.

³ Hardwood shelterwood performed over a 10 year period. Final cut 1990.

Methods

Each location was divided into 7 blocks. Six blocks were treated and one left untreated as a control. Treatments were randomly assigned to blocks.

Spray operations were carried out between May 1992 and November 1994 by the

Research Section of the Dept. of Natural Resources. All spraying was performed from the ground. A pump action, back pack sprayer was used for the foliar and basal applications, while a Spot-Gun was used for the ground applications.

Treatments

The treatments were grouped by application method as follows:

- 1) The **Basal 1-sided** method, involved applying Release® to the bark using the one-sided stream-line method with a solid cone nozzle. The chemical was sprayed in a 5cm swath to one side of all sprouts at a height of 30 to 50cm. The product was applied until the bark was wet. When optimum amounts of solution are sprayed, the treated zone widens to encircle the sprout.
- 2) With the **Basal 2-sided** method, Weedone® was applied using the same equipment.

The entire perimeter of the lower 30 cm was sprayed until wet including the root collar, exposed roots and sprout stems.

All basal treatments were applied between November and December after leaf-fall.

- 3) The **Ground** method involved applying a specific volume of Velpar®L using a Spot Gun. One shot of undiluted product was applied for each centimetre of stump diameter. The shots were spread evenly around the base of the stumps approximately 50 cm from the root collar. Applications took place in May, after the soil had thawed.

RELEASE® TRADEMARK OF DOWELANCO, WEEDONE® TRADEMARK OF RHONE-POULENC NEDERLAND B.V
VELPAR®L TRADEMARK OF DU PONT CANADA INC.

4) The **Foliar** method consisted of applying Release® or Vision® using a flat fan nozzle. The foliage was thoroughly covered but

not to the point of dripping. Foliage treatments were applied during August and September.

Results & Discussion

Most of the blocks were treated using either the 1 - sided Basal method (12 blocks) or the Foliar method (10 blocks). Three blocks were treated with the Ground and 2 - sided Basal methods (Table 2).

Average labour cost, productivity and sample size for each application method are shown in

Table 2 and listed by individual block in Appendix I. Cost and productivity comparisons can not be made from these tables because of the varying density of stumps treated in each block. In order to make comparisons, regression equations were derived relating productivity and cost to the density of treated stumps.

Table 2. Productivity and cost of 4 selective herbicide treatments by method of application.

Method of Application	Number of Blocks (#)	Stumps/Ha	Average Treatment Time		Average Chemical Applied		Actual Labour Cost ¹	
			sec/stump	hrs/ha	ml/stump	l/ha	cents/stump	\$/ha
Basal 1-side	12	877	17.3	3.8	5.3	4.3	7	57
Basal 2-sides	3	731	36.6	5.7	42.1	23.2	15	86
Ground	3	1107	26.8	5.8	17.9	14.6	11	86
Foliar	10	664	33.8	5.2	6.3	3.5	14	78

¹ Labour costs were assumed to be \$15/productive-hour.

Application Productivity and Labour Cost

Application time in hours/hectare was related to density of stumps/hectare for each of the four application methods (1-sided Basal, 2-sided Basal, Ground and Foliar). In all cases, application time increased with the number of stumps treated per hectare but at a decreasing rate (Figure 2). Labour costs were subsequently derived by applying an

hourly wage of \$15 per productive hour.

The Basal 1-sided method resulted in the highest productivity (Table 3); approximately 50% higher than the Foliar method. Although the sample sizes for the other treatments were minimal (3 blocks), it appears that the Basal 2-sided and Ground treatments have roughly the same productivity as the Foliar method.

The predicted productivity for treating

1,000 stumps per hectare is 1.5, 1.0, 1.0 and 0.9 hectares per day, respectively for the single-sided Basal, Ground, Foliar and double-

sided Basal methods. In terms of labour cost this is equivalent to \$62, \$88, \$95 and \$104 per hectare (table 3).

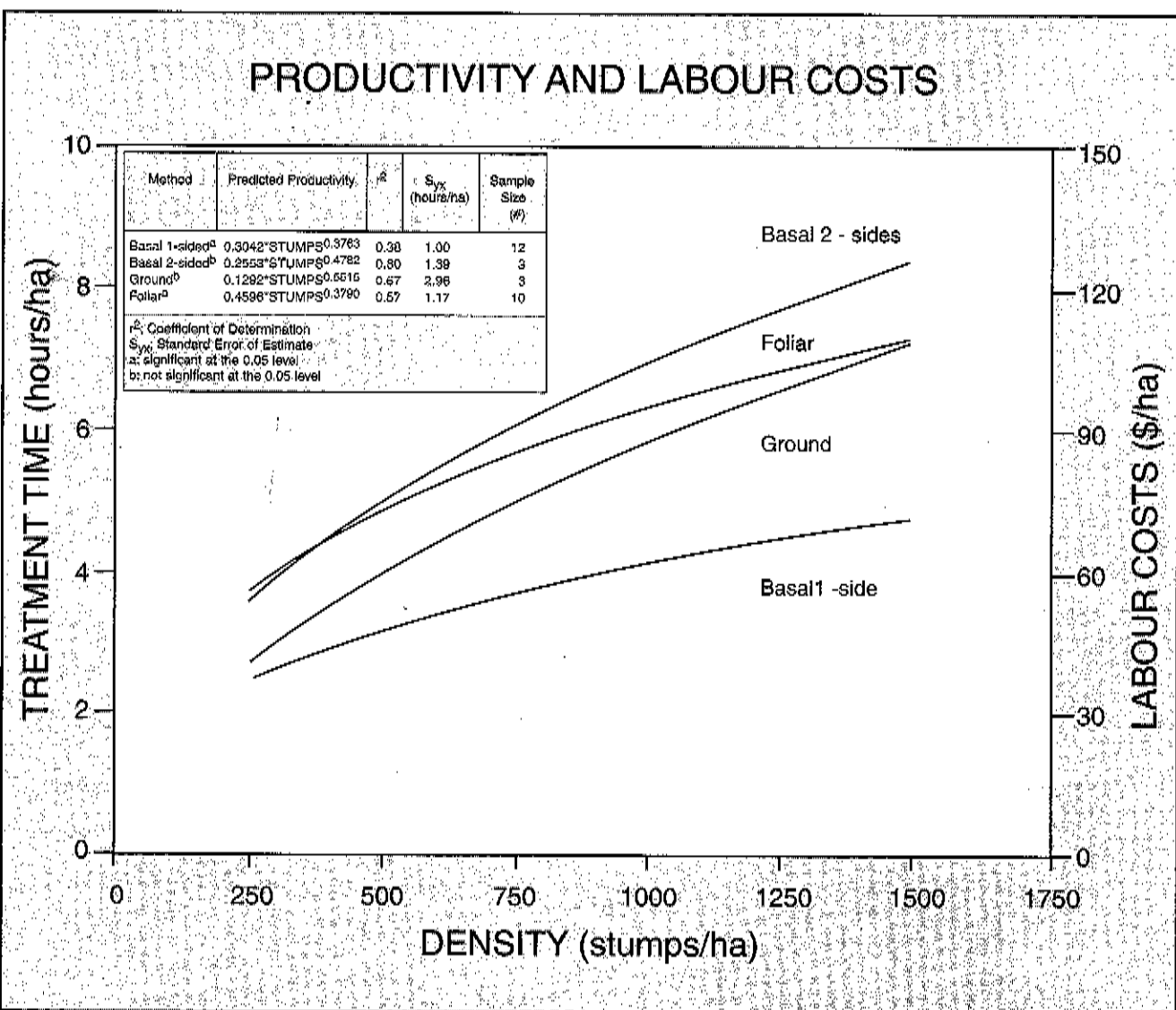


Figure 2. Predicted productivity (hours/ha) and labour costs (\$/ha) for 4 selective methods of applying herbicide.

Table 3. Predicted productivity and labour costs by density of treated stumps for 4 selective methods of applying herbicide.

Treated Stumps (#/ha)	Basal 1-sided		Basal 2-sided		Ground		Foliar	
	Prod ¹ (ha/day)	Cost ² (\$/ha)	Prod (ha/day)	Cost (\$/ha)	Prod (ha/day)	Cost (\$/ha)	Prod (ha/day)	Cost (\$/ha)
250	2.5	36.4	1.7	53.7	2.2	40.7	1.6	56.0
500	1.9	47.3	1.2	74.9	1.5	59.7	1.2	72.6
750	1.6	55.1	1.0	90.8	1.2	74.6	1.1	84.8
1000	1.5	61.5	0.9	104.1	1.0	87.5	1.0	94.5
1250	1.3	66.8	0.8	116.0	0.9	98.9	0.9	102.9
1500	1.3	71.6	0.7	126.5	0.8	109.4	0.8	110.3

¹ Prod = predicted productivity expressed in hectares per day based on productivity equations (hours/ha) (Figure 2) converted to ha/day by assuming a 6 productive hour work day.

² Cost, expressed in \$/ha, determined by multiplying productivity in (hr/ha) by the labour rate (\$15/productive-hour).

Summary

The following are the results of a trial which compares the labour cost and productivity of 4 selective herbicide application methods (Basal 1-side, Basal 2-side, Ground and Foliar) to control maple sprouts. All values are based on treating 1000 stumps/ha.

1) The quickest and least costly method of applying herbicide was the basal 1-sided treatment at 4.1 hours/ha (\$62/ha). Based on

a 6 productive hour work day, a worker could be expected to treat 1.5 ha/day.

- 2) The remaining treatments were roughly 50% less productive. Estimated productivity, cost and daily production for these treatments are:
- Ground: 5.8 hrs/ha; \$88/ha and 1.0 ha/day
 - Foliar: 6.3 hrs/ha; \$95/ha and 1.0 ha/day
 - Basal 2-sided; 6.9 hrs/ha; \$104/ha and 0.9 ha/day.

Appendix I. Herbicide Treatments, Site Characteristics, Productivity and Costs by Location and Block.

Location	Block	Area (hectares)	Method	Product	Rate ¹	Stumps (#)	Product Applied (litres)	Labour ² (hours)	Stumps/ Stump	Stumps/Ha	Product Applied m ² /stump	Product Applied l/ha	Productivity seconds/ stump	Productivity hrs/ha	Labour Costs cents/ stump	Labour Costs \$/ha	
Big Marsh	1	0.20	Ground	Velpar	1.5 ml. product	316	3.75	1.92	35	1560	11.87	18.75	21.9	9.60	9	144	
	2	0.19	Foliar	Vision	2%, solution	195	1.00	1.55	30	1026	5.13	5.26	28.6	8.16	12	122	
	3	0.20	Foliar	Release	3%, solution	155	0.90	1.25	25	775	5.81	4.50	29.0	6.25	12	94	
	4	0.20	Basal 2-sides	Weedone	pre-mixed	136	4.70	0.93	35	680	34.56	23.50	24.6	4.65	10	70	
	5			CONTROL													
	6	0.21	Basal 1-side	Release	30%, diesel oil	238	1.20	0.92	35	1133	5.04	5.71	13.9	4.38	6	66	
	7	0.22	Basal 1-side	Release	20%, diesel oil	294	0.93	0.95	40	1336	3.16	4.23	11.5	4.32	5	65	
Cameron Settlement	1	0.36	Ground	Velpar	2.5 ml. product	65	1.90	0.83	20	181	29.17	5.28	46.0	2.31	19	35	
	2	0.17	Foliar	Vision	2%, solution	54	0.30	0.70	25	318	5.56	1.76	46.7	4.12	19	62	
	3	0.17	Foliar	Release	3%, solution	86	0.45	0.73	23	388	6.82	2.65	39.8	4.29	17	65	
	4	0.18	Basal 2-sides	Weedone	pre-mixed	45	3.10	0.77	24	250	68.89	17.22	61.6	4.28	26	64	
	5	0.19	Basal 1-side	Release	30%, diesel oil	63	0.40	0.47	25	332	6.35	2.11	26.9	2.47	11	37	
	6	0.19	Basal 1-side	Weedone	pre-mixed	52	1.30	0.48	22	274	24.96	6.84	33.5	2.54	14	38	
	7			CONTROL													
Frog lake	1	2.78	Basal 1-side	Release	30%, diesel oil	3058	16.80	13.92	10	1100	5.49	6.04	16.4	5.01	7	75	
	2	0.84	Basal 1-side	Release	30%, mineral oil	689	5.70	3.95	6	820	8.28	6.79	20.6	4.70	9	71	
	3			CONTROL													
	4	3.98	Basal 1-side	Release	30%, diesel oil	3303	23.20	20.10	10	830	7.92	5.83	21.9	5.05	9	76	
	5	0.38	Basal 1-side	Release	20%, diesel oil	354	1.24	2.12	16	932	3.50	3.26	21.6	5.58	9	84	
	6	1.02	Basal 1-side	Release	30%, mineral oil	1040	5.40	3.33	10	1020	5.19	5.29	11.5	3.26	5	49	
	7	0.87	Basal 1-side	Release	20%, diesel oil	557	2.04	2.90	7	640	3.66	2.34	18.7	3.33	8	50	
Glencoe	2	0.25	Basal 1-side	Release	30%, diesel oil	393	1.20	0.83	10	1578	3.05	4.82	7.6	3.33	3	50	
	3	0.26	Basal 2-sides	Weedone	pre-mixed	323	7.40	2.12	11	1262	22.91	28.91	23.6	8.28	10	124	
	4	0.36	Ground	Velpar	1.5 ml. product	559	7.10	1.92	10	1561	12.70	19.83	12.4	5.36	5	80	
	5	0.37	Foliar	Release	3%, solution	516	1.47	1.92	13	1398	2.85	3.98	13.4	5.20	6	78	
Sucker Lake	7	0.43	Foliar	Vision	2%, solution	542	1.96	3.17	7	1249	3.62	4.52	21.1	7.30	9	110	
	1	0.15	Foliar	Vision	3%, solution	64	0.48	0.83	9	438	7.50	3.28	46.7	5.68	19	85	
	2	0.16	Foliar	Release	3%, solution	41	0.23	0.49	14	256	5.63	1.44	43.0	3.06	18	46	
	3	0.18	Foliar	Vision	5%, solution	68	0.90	0.80	12	377	13.26	5.00	42.4	4.44	18	67	
	4	0.17	Foliar	Release	5%, solution	73	0.53	0.56	14	419	7.16	3.00	27.6	3.21	11	48	
	5	0.21	Basal 1-side	Release	30%, diesel oil	88	0.69	0.45	16	413	7.97	3.29	18.4	2.11	8	32	
	6	0.21	Basal 1-side	Release	20%, diesel oil	82	0.40	0.42	15	394	4.88	1.92	18.4	2.02	8	30	
7			CONTROL														

¹ The Weedone treatments were pre-mixed. All foliar applications were mixed with water, and all Release basal treatments were mixed with either diesel or mineral oil. The Velpar treatments were applied as 1.5 or 2.5 ml of undiluted product per cm of stump diameter.

² Productive time (in hours) required to treat each block.

³ Labour rate is assumed to be \$15/productive hour.

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