

FOREST RESEARCH REPORT

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The Effect of Various Cultural Treatments on the Growth and Quality of a Balsam Fir Christmas Tree Plantation

Introduction

The goal of Christmas tree growers is to produce quality trees for the least cost in the shortest period of time. Site preparation, fertilization, vegetation control and shearing are some of the cultural practices used by growers to

help achieve this goal. But, how many of these treatments are required to produce quality trees? To help answer this question for old field sites, a trial was established on Mount Thom, Pictou County in 1988.

Methods

Plantation Establishment and Treatment Description

The trial was established on an old-field at Mount Thom, Pictou County. This site is located on a Kirkhill soil (Webb, 1990), a

well drained, medium-textured, silt-loam of glacial till origin. The vegetation cover consisted of grass (*Gramineae* sp.) (100%¹), goldenrod (*Solidago* sp.) (60%) and strawberry (*Potentilla* sp.) (5%). The experimental area was divided into 8 blocks. All blocks were planted May 3, 1988, with

¹ %'s add to over 100% because of vegetation layering.

2+2² bare root balsam fir (*Abies balsamea* (L.) Mill.) at 1.8 X 1.8 m spacing. During the first 2 years, trees which died were replaced, however results in this report are based on the measurements of "original" trees planted in 1988. Shearing began when the trees reached 1.5 to 1.8 metres tall (Christmas Tree Council of N.S. *et al*, 1987): earlier if they started to lose their desired shape. Butt pruning, of approximately 30 cm, to the first good branch whorl was carried out when the trees had attained sufficient foliage³. Three cultural treatment regimes; Fertilizing (F), Herbiciding (H), and Liming (L) in various combinations were assigned to these blocks (Table 1).

Lime Treatment

Soil samples were collected and analyzed for pH to determine how much lime was

required to raise the pH to 6.0. The areas were then rotovated three times, with lime added after the second pass and mixed into the soil with the third rotovation. At this time a cover crop of bluegrass (*Poa pratensis* Linn.) and "Dutch White" clover (*Trifolium repens* Linn.) was established. This treatment was carried out during May 1987.

Herbicide Treatment

The herbicide treatment (H) consisted of an annual application from 1987 to 1994. All treatments were applied in bands along the planting rows. The first treatment was applied before planting, using Vision^{®4}, in the fall of 1987. Subsequently, Vision[®] was applied in 1988 and 1989, Simazine in 1990 and Velpar^{®L1} from 1991 to 1994. In addition, a treatment of Lontrel^{*4} was required in 1992. The untreated strips between the trees were mowed as required, sometimes as often as 3 times per year.

Fertilizer Treatment

Fertilizer (F) was applied in a ring beneath the outermost foliage (drip line) of each tree, beginning 2 years after planting. Initially, it was applied at 2 ounces per tree, but in 1991-92, the fertilizer dose was based on tree height and in 1993-94, on foliar analyses. Due to lower foliar nutrient levels, the unherbiced blocks received higher rates of fertilizer than herbiced blocks (Appendix D).

Table 1. Individual and combined treatments by block number.

Block	Treatment ¹			Code ²
	Fertilize	Herbicide	Lime	
1	✓	✓	✓	FHL
2	✓	✓		FH
3		✓	✓	HL
4		✓		H
5 and 6	✓			F
7 and 8				C

¹ For details of treatments and timing, see Appendix I.

² F = Fertilize, H = Herbicide, L = Lime, C = Control.

² 2+2 represents a 4 year old seedling which spent 2 years in a nursery seedbed followed by 2 years in a nursery transplant bed.

³ For a review of shearing techniques, the reader is directed to the video "Shearing Balsam Fir", available by advance request, from the Nova Scotia Department of Natural Resources Education and Publication Services, Truro, Nova Scotia.

⁴ Vision[®] is a registered trademark of Monsanto Company, Monsanto Canada Inc.
Velpar^{®L} is a registered trademark of E.I. duPont de Nemours & Co., du Pont Canada Inc.
Lontrel^{*} is a registered trademark of The Dow Elanco, Dow Chemical Canada Inc.

Data Collection

In 1992, 5 years following plantation establishment, measurements were carried out on unshaped trees in all treated blocks. Two sampling methods were used. First, the "original" unshaped trees were systematically sampled to determine total tree height, leader length and root collar diameter. Secondly, 5 to 10 "original" unshaped codominant trees were selected from each treatment and detailed measurements, relating to tree-foliage

density, were recorded to further identify treatment effects (Figure 1).

In 1994, seven years following establishment, another sample of "original" (shaped and unshaped) codominant trees was taken to estimate "years to harvest" and "potential density at harvest". In addition, photographs of trees of average height and crown volume were taken.

Current costs (1994) of each treatment and expected average revenues were provided by one of NSDNR's Christmas tree specialists.

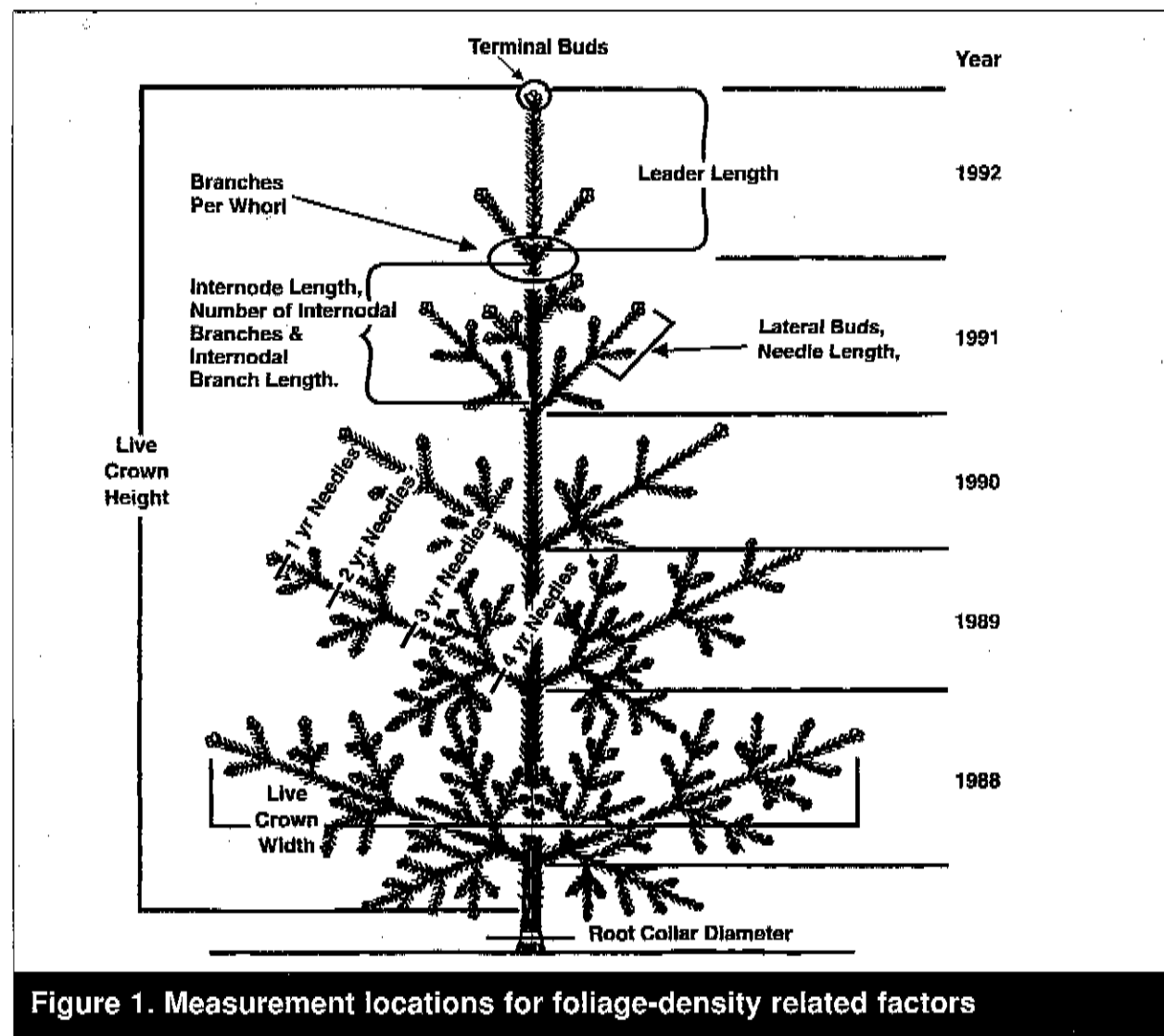


Figure 1. Measurement locations for foliage-density related factors

⁵ Foliage density at time of harvest and years to harvest were estimated by a Christmas tree specialist and a research technician.

Results

Five Years after Planting

Growth Comparison

Five years following planting, the total height, total leader length and root collar diameter of the unshaded trees generally fell into two groups. Trees in herbicided blocks (FHL, FH, HL, H) showed significantly greater growth than those not herbicided (F,C). Treatment with herbicides resulted in average total height, total leader lengths and root collar diameters, at least 40% greater than those in the fertilized block (F) and over 80% greater than in the control block (C)

(Table 2, Figure 2). For example, the average total height of trees receiving only herbicide (H) was 1.3 metres compared to 0.6 m for the control. The addition of lime (HL) and fertilizer (FHL and FH) did not significantly increase leader length, total height and root collar diameter (Table 2). Crown volume, on the other hand, was significantly affected by the addition of fertilizer in the herbicided blocks (Figure 2). The average crown volume of the herbicided and fertilized trees (FHL, FH) was roughly double that of trees which received only herbicide (HL, H) and 4 times that of non-herbicided trees (F, C) (0.87 vs 0.45 vs 0.19 m³).

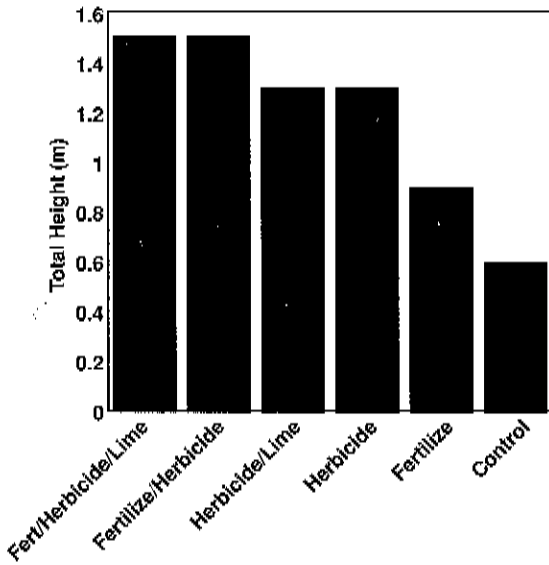
Table 2. Average total height, leader length, root collar diameter and crown volume of balsam fir by treatment, 5 years after planting¹.

Treatment	Code	1992 Total Height (m)	1992 Leader Length (cm)	1992 Root Collar Diameter (cm)	1992 Crown Volume (m ³)
Fertilize/Herbicide/Lime	FHL	1.5 _A *	47 _A	4.3 _B	0.93 _A
Fertilize/Herbicide	FH	1.5 _A	47 _A	5.0 _A	0.81 _A
Herbicide/Lime	HL	1.3 _{A,B}	45 _A	4.5 _{A,B}	0.45 _B
Herbicide	H	1.3 _{A,B,C}	51 _A	4.2 _{A,B}	0.45 _B
Fertilize	F	0.9 _{C,D}	32 _B	2.2 _C	0.23 _C
Control	C	0.6 _D	25 _C	1.7 _C	0.15 _C

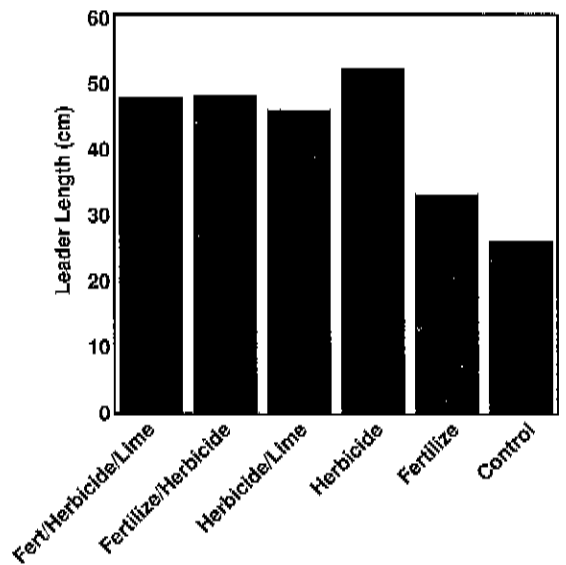
¹ Leader length, total height and root collar diameter based upon mechanically sampled tree measurements; crown volume based on subset of codominant trees.

*Subscripts A-D: Same letter, within a column, indicates averages are not significantly different at the 5% level based on the Student-Newman-Keuls multiple comparison test (Zar, 1974).

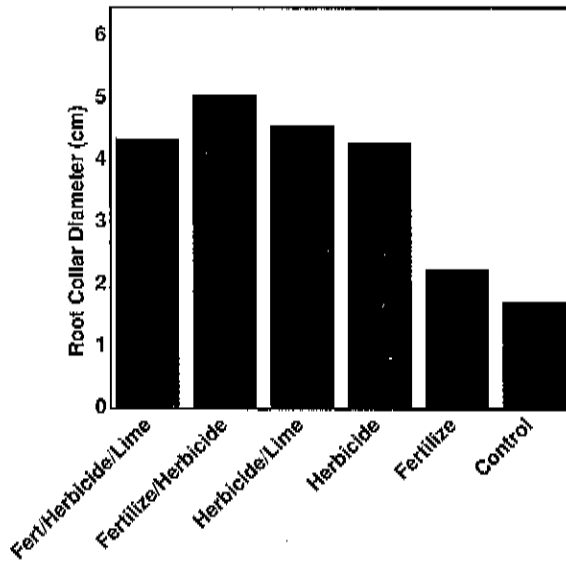
Total Height



Leader Length



Root Collar Diameter



Crown Volume

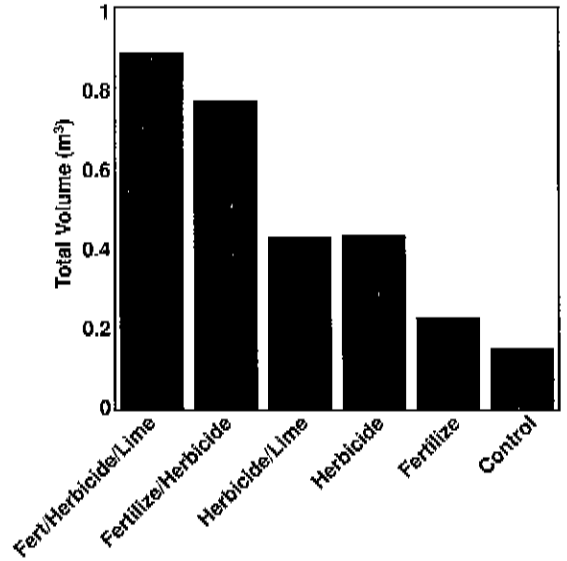


Figure 2. Effect of various combinations of treatments on the total height, leader length, root collar diameter and crown volume of balsam fir Christmas trees, five years following planting and before shearing.

Foliage Density Measures

The effects of herbiciding, fertilizing and liming on average internode length, internode branch length, branches per internode, and the number of lateral buds and terminal buds generally fell into 3 groups (Table 3). These measures were highest for trees that were both fertilized and herbicided (FHL, FH), intermediate for herbicided trees (HL, H), and lowest for non-herbicided trees (F, C). The lack of response in the fertilizer-only trees is attributed to competing vegetation, especially grass, taking up the fertilizer

instead of the crop trees. Expressed in terms of percent, trees that were both herbicided and fertilized had average internode lengths, branch lengths and number of internode branches 40-170% greater than for herbicided-only trees and 60-600% greater than non-herbicided trees. Adding lime to trees that were herbicided and fertilized, resulted in further gains but only in respect to internode length and number of branches per internode.

No significant differences were found between any of the treatments for number of branches per whorl, needle length and age of oldest needles retained by the tree.

Table 3. Effect of cultural treatments on various measures of foliage density of codominant balsam fir trees 5 years after planting.

Treatment	Code	1991 Internode Length (cm)	1991 Internode Branch Length (cm)	1991 Branches per Internode (#)	1992 Lateral Buds (#)	1992 Terminal Buds (#)	1991 Branches per Whorl (#)	Needle Length (mm)	Oldest Needles (yr)
Fertilize/Herbicide/Lime	FHL	49 _A *	46 _A	35 _A	5.0 _{A,B}	7.6 _A	3.9 _A	18.9 _A	3.0 _A
Fertilize/Herbicide	FH	41 _B	48 _A	23 _B	5.3 _A	7.9 _A	5.2 _A	18.7 _A	3.0 _A
Herbicide/Lime	HL	23 _C	31 _B	13 _C	4.6 _{A,B,C}	7.1 _{A,B}	3.9 _A	19.0 _A	3.2 _A
Herbicide	H	26 _C	33 _B	13 _C	4.7 _{A,B,C}	7.7 _A	3.6 _A	18.8 _A	3.0 _A
Fertilize	F	17 _{C,D}	28 _{B,C}	9 _C	4.2 _{B,C}	6.0 _{A,B}	4.0 _A	18.1 _A	3.0 _A
Control	C	10 _D	21 _C	5 _C	3.8 _C	5.1 _B	3.5 _A	18.5 _A	3.2 _A

*Subscripts A-D: Same letter, within a column, represents a homogeneous group where the populations are not significantly different, at the 5% level, based on the Student-Newman-Keuls multiple comparison test (Zar, 1974).

¹ Number of buds contained in the terminal bud unit, including terminal and subterminal buds

Seven Years after Planting

By 1994, seven years following planting, most trees receiving herbicide treatments had been sheared twice, while most trees in the fertilized only and the control treatments were not yet large enough for shearing.

Foliage Density

Foliage density, projected to time of harvest, was visually estimated in December of 1994. Sample co-dominant trees were categorized as having either light, medium, or heavy foliage density. Figure 3 illustrates the average foliage density by treatment. Trees receiving herbicide

(H, HL, FH, FHL) were projected to have the highest foliage densities with 78 to 100% graded as medium to heavy (Table 4, Figure 3). The addition of lime and fertilizer did not appear to further improve density. On the other end of the scale, all trees in the fertilized-only (F) and control (C) treatments were projected to have light foliage density.

The effect of the various treatments on average foliage density is illustrated in photographs taken in January of 1995, 7 years after planting (Figure 4). The pictures show the controls and "fertilize only" trees were the shortest and had the lowest foliage density while the herbicided and fertilized trees were the tallest and most dense.

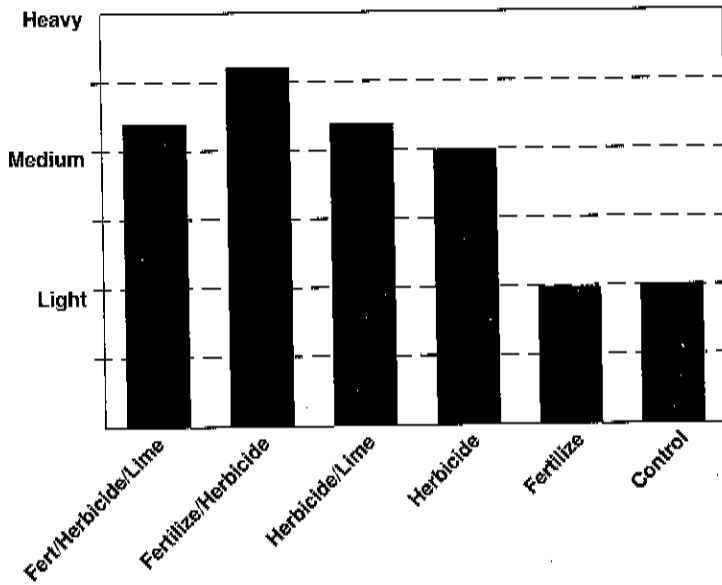
Table 4. Estimated¹ average foliage density and age at harvest.

Treatment	Code	% of Trees at Harvest				% of Trees Harvestable (6-8') by Rotation Age						Average Rotation Age (yrs)	
		Foliage Density				Rotation ² Age (years)							
		Light	Medium	Heavy	Medium + Heavy	8	9	10	11	12	13		
Fertilize/Herbicide/Lime	FHL	10	60	30	90	10	70	10	10				9.2
Fertilize/Herbicide	FH		44	56	100		56	44					9.4
Herbicide/Lime	HL	20	40	40	80			30	70				10.7
Herbicide	H	22	44	34	78				78	22			11.2
Fertilize	F	100			0					100			12.0
Control	C	100			0					88	12		12.1

¹Estimates based on examining trees 7 years after planting.

²Rotation age - estimated number of years (since planting), to reach a harvestable height of 6 - 8 feet.

Average Foliage Density



Average Harvest Age

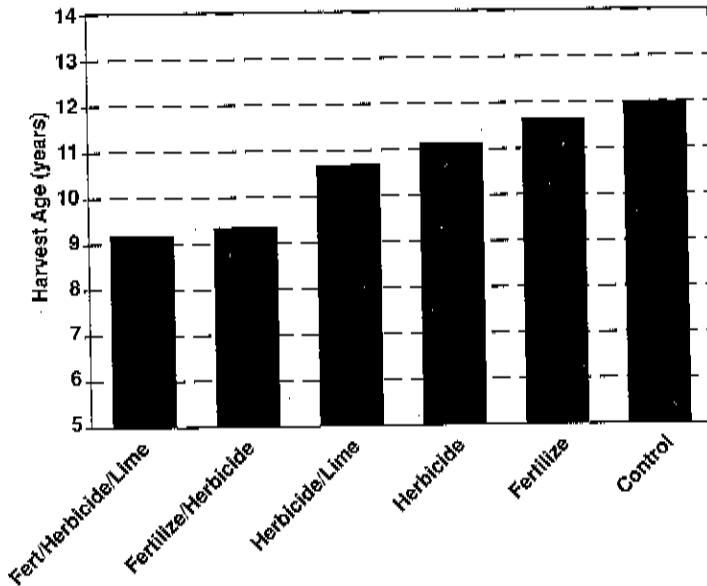


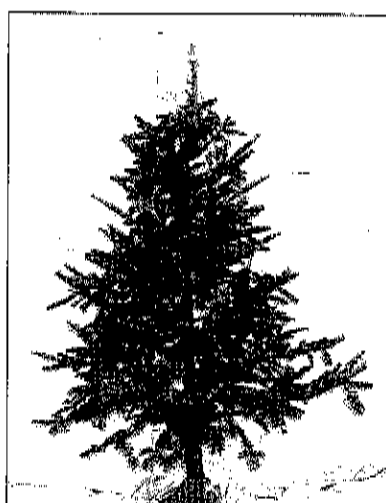
Figure 3. Estimated average foliage density and age at harvest. Estimates based on trees 7 years after planting. Harvest age is the estimated number of years (since planting), to reach a harvestable height of 6-8 feet.



Fertilize/Herbicide/Lime (FHL)	
Total height (1994)	1.85 m
Crown volume (1994)	0.86 m ³
Estimated foliage density	Heavy
Estimated harvest age (years)	9



Fertilizer/Herbicide (FH)	
Total height (1994)	1.75 m
Crown volume (1994)	0.62 m ³
Estimated foliage density	Heavy
Estimated harvest age (years)	10



Herbicide/Lime (HL)	
Total height (1994)	1.60 m
Crown volume (1994)	0.63 m ³
Estimated foliage density	Medium
Estimated harvest age (years)	10



Herbicide (H)	
Total height (1994)	1.40 m
Crown volume (1994)	0.51 m ³
Estimated foliage density	Medium
Estimated harvest age (years)	11



Fertilize (F)	
Total height (1994)	1.58 m
Crown volume (1994)	0.57 m ³
Estimated foliage density	Light
Estimated harvest age (years)	10



Control (C)	
Total height (1994)	1.35 m
Crown volume (1994)	0.38 m ³
Estimated foliage density	Light
Estimated harvest age (years)	12

Figure 4. Photographs, taken 7 years after planting, depicting average trees by treatment.

Years to Harvest

In addition to foliage density, an estimate was made of the number of years (since planting) to harvest based on a harvest height of 6 - 8 feet (Table 4 and Figure 3). All trees Fertilized and Herbicided (FHL, FH) are projected to be harvestable by 11 years, and over half of the trees by 9 years. All herbicided (HL, H) trees should be harvestable by 12 years with 75% ready for market by age 11. Trees which did not receive herbicide treatments (F,C) are projected to have the longest rotation at 12 to 13 years.

The addition of lime (FHL and HL) appears to slightly reduce the average rotation age and increase the portion of the trees harvestable at younger ages.

Costs and Revenues

All treatments carried out for this trial are documented by block number in Appendix I. The current (1994) treatment costs⁶ and sale revenues⁶ (Appendix II), are also included along with these same values discounted at 5%. Current net revenues, without discounting, ranged from \$1.15 per tree for trees Fertilized (F) to \$4.38 for trees Fertilized and Herbicided (FH).

To compare the before tax economic returns resulting from the treatments over time, the closing balance of a 14 year investment on one acre was examined (Appendix I). It was assumed that each treatment started with a bank account of \$4,000 and monies were taken from this account as treatments were carried out, and added as revenues accrued. The interest was calculated daily and the bank accounts were assumed to earn an annual rate of 5%. Figure 5 shows how each of the Christmas tree bank accounts would change over time. At the end of this time, a non

Christmas tree account would have a value of \$7,923. The only treatment with a lower return was the Fertilizer (F) block which was projected to earn \$7,792. The highest bank balances were achieved by treatments involving herbicide and fertilizer: \$10,579 (FHL) and \$11,636 (FH).

Another way to compare treatments is by looking at their Internal Rate of Return (Gunter *et al*, 1984) which is the interest rate at which one is indifferent between investing in a project and leaving one's money in the bank. Figure 6 shows the internal rate of return for each treatment, which uses the same parameters as the previous comparison, i.e. an opening bank account of \$4,000 dol-

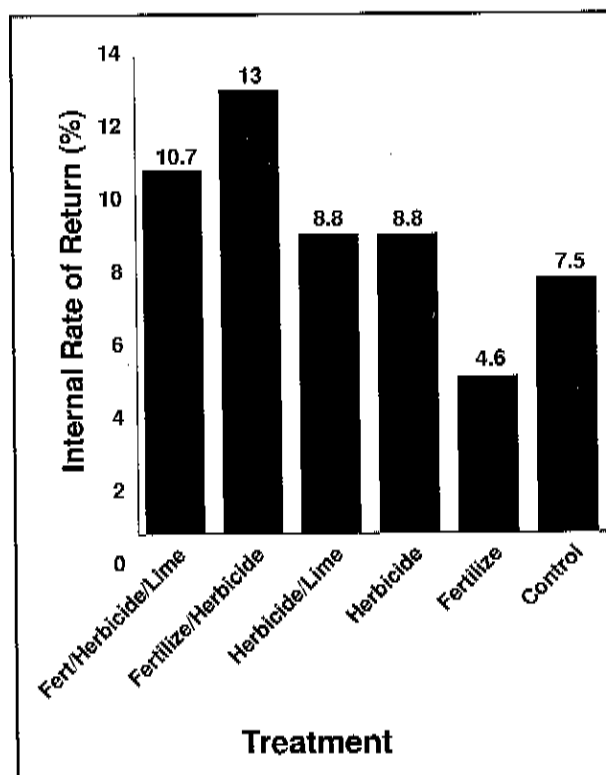


Figure 6. Internal Rate of Return based on a 14-year investment for 6 different treatment regimes.

⁶ Costs and revenues were obtained from various industry sources and are based primarily on cultivated natural stands rather than old field plantations. Costs not included were overhead, rental of land, cull trees, monitoring for pests, corrective pruning and soil/foliar analyses.

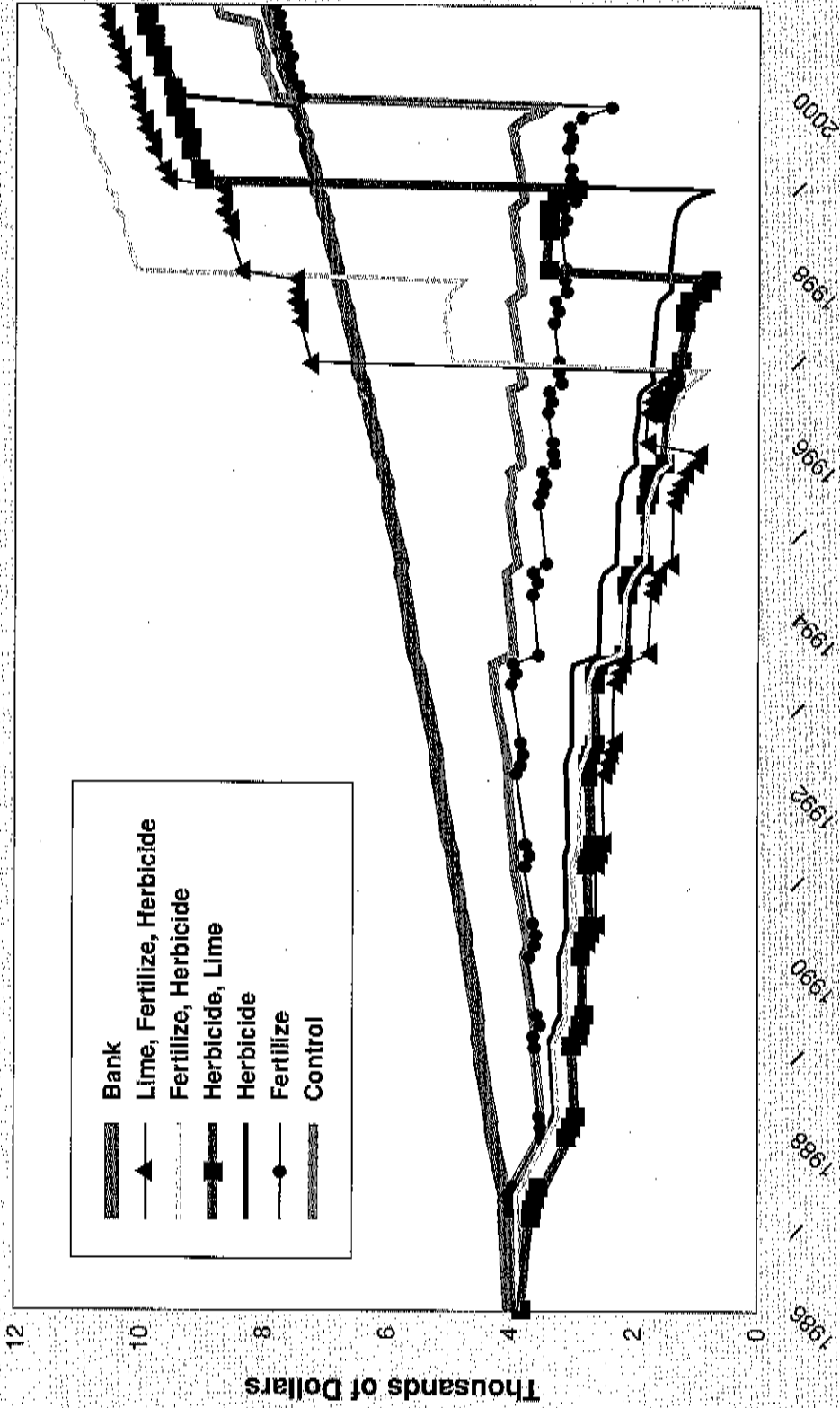


Figure 5. A comparison of the return on \$4,000 invested in a bank account versus Christmas trees grown according to six different treatment regimes, assuming an interest rate of 5%.

lars and a 14 year term. The treatments involving Herbicide and Fertilizer have the highest rates of return: 13% for the FH and 10.7% for the FHL. The Herbicide treatments

without fertilizer (HL,H) earned 8.8%, while the fertilizer-only and control earned the lowest internal return amounting to 4.6% (F) and 7.6% (C).

Conclusions and Summary

The major findings of a trial undertaken to determine the effects of individual and combined treatments of Fertilizer, Herbicide and Lime on the growth, quality and costs of producing balsam fir Christmas trees on an old-field site are as follows:

1. Vegetation management using herbicides reduced rotation age and increased height growth, foliage density, and internal rate of return.

Herbicided trees (HL,H) were (Table 5):

- 73% taller,
- 79% more frequently projected to have medium-heavy density foliage at rotation; had:
- 137% greater crown volume,
- 86% more branches per internode,
- 8% shorter rotation age, and had a
- 2.7% higher average internal rate of return

than trees not herbicided (F, C).

Table 5. Summary of average growth, foliage density, rotation ages and internal rate of return and their % increases by treatment.

Treatment	5-Years After Planting ¹						7-Years After Planting ²				Internal Rate of Return	
	Height		Crown Volume		Branches per Internode		Foliage Density ³		Rotation			
	m	% increase	m ³	% increase	#	% increase	%	% increase	years	% increase	Rate %	% increase
No Herbicide (F, C)	0.75	-	0.19	-	7	-	0	-	12.0	-	6.1	-
Herbicide (HL, H)	1.3	73	0.45	137	13	86	79	79	11.0	-8	8.8	2.7
Herbicide, Fertilizer (HFL, HF)	1.5	15	0.87	93	29	123	95	16	9.3	-15	11.8	3.0
Herbicide, Fertilizer & Lime (HFL) ⁴	1.5	0	0.93	15	35	52	90	-10	9.2	-2	10.7	-2.3

¹ Measurements taken before shearing.

² Projections based on 6' - 8' crop height (Table 4).

³ % of trees estimated to have medium to heavy foliage density at rotation (6 - 8' tall).

⁴ % difference is based on $\frac{HFL-HF}{HF} \times 100$.

HF

2. The addition of fertilizer further reduced rotation age and increased height growth, foliage density and internal rate of return. Herbicided and Fertilized trees (HFL, HF) were:
 - 15% taller,
 - 16% more frequently estimated to have medium-heavy density at rotation, had
 - 93% greater crown volume,
 - 123% more branches per internode,
 - 15% shorter rotation age, and had a
 - 3% higher average internal rate of return
 than herbicided trees (HL, H).
3. Although less dramatic, the incorporation of lime resulted in decreased rotation age and increased density. Herbicided, Fertilized and Limed trees (FHL) were:
 - 15% greater in crown volume, had
 - 52% more branches per internode, and a
 - 2% shorter rotation age,
 than fertilized and herbicided (F, H) trees.
4. Based on projections to rotation, the combination of herbicide and fertilizer was the most cost effective treatment in producing balsam fir Christmas trees in a plantation located on an old-field site at Mount Thom, Nova Scotia.

Literature Cited

- Christmas Tree Council of Nova Scotia, Canadian Forestry Service and Nova Scotia Department of Lands and Forests, 1987.** *Atlantic Canada Christmas tree growers manual.*
- Gunter, G.E. and H.L. Haney Jr. 1984.** *Essentials of Forestry Investment Analysis.* OSU Stores Inc., Corvallis, OR, 337 pp.
- Webb, K.D. 1990.** *Soils of Colchester County, Nova Scotia Report No. 19.* Nova Scotia Soil Survey. Research Branch, Agriculture Canada, Ottawa, Ont. 201 pp.
- Zar, J.H. 1974.** *Biostatistical analysis,* Prentice-Hall Inc. Englewood Cliffs, NJ, 620 pp.

Appendix I. Block 1 - Fertilizer/Herbicide/Lime - Description of the cultural treatments and their associated current and discounted costs and revenues, for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1987 (year 0)							
January 1	Roads	\$200.00	\$200.00				\$3,800.00
Early Spring	Soil samples sent for analysis.	nc					
May 20	Area rotovated with rotovator from tree breeding centre: 2.7 tons/acre lime plus magnesium applied after second pass and worked into soil on third pass.	\$180.00	\$177.00			71	\$3,691.00
May 21	15-5-5 plus magnesium @ 250 lbs/acre applied with cyclone seeder	\$46.00	\$45.00			1	\$3,646.00
May 21	Bluegrass and Dutch White Clover broadcast at 3 lbs/acre with cyclone seeder: cultivated area rolled.	\$64.00	\$63.00				\$3,582.00
August 25	Herbicide: Vision [®] @ 3.2 l/ha	\$100.00	\$97.00			46	\$3,528.00
	Total	\$590.00	\$590.00				
1988 (year 1)							
May 3	Planted balsam fir bareroot 2+2	\$570.00	\$534.00			121	\$3,079.00
June 3	Severe frost						
June 18	Herbicide with Vision [®] , at 1.5% solution (no foliage contact).	\$100.00	\$93.00			19	\$2,998.00
June-Aug	Mowed strips between rows.	\$75.00	\$70.00			11	\$2,934.00
	Total	\$745.00	\$677.27				
1989 (year 2)							
May 10	Fill planted with balsam fir bareroot 2+2.	\$57.00	\$51.00			119	\$2,996.00
June 15	Herbicide: Vision [®] @ label rate (no foliage contact)	\$100.00	\$89.00			15	\$2,911.00
June 15	Fertilizer	\$65.00	\$58.00				\$2,846.00
July 15	Mowed strips between rows.	\$75.00	\$66.00			11	\$2,782.00
	Total	\$297.00	\$245.45				
1990 (year 3)							
April 23	Herbicide: Simazine @ 7kg/ha	\$100.00	\$85.00			107	\$2,789.00
May 15	Fill planted balsam fir bareroot 2+3.	\$57.00	\$48.00			8	\$2,740.00
May 16	Fertilizer applied - 2.0 oz. 17-17-17 (not applied on newly planted trees).	\$65.00	\$55.00			1	\$2,676.00
June 25	Mowed strips between rows.	\$75.00	\$63.00			25	\$2,626.00
	Total	\$297.00	\$223.14				

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Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1991 (year 4)							
May 7	Herbicide: Velpar [®] L @ 5.0 l/ha.	\$100.00	\$81.00			102	\$2,628.00
May 15	Fertilizer applied rate of 2.0 ounces per tree and 1 ounce for every foot of tree over 2 feet, i.e. some trees received 4 ounces of 17-17-17.	\$65.00	\$53.00			3	\$2,566.00
July - early September	Mowed strips between rows.	\$75.00	\$60.00			27	\$2,518.00
November 20	Tipped a few trees that had excessive leader growth, these were not used in the study.	nc					
	Total	\$240.00	\$163.92				
1992 (year 5)							
May 11	Herbicide: Velpar [®] L @ 5.0 l/ha.	\$100.00	\$77.00			97	\$2,515.00
May 25	Fertilized - 17-17-17, 2 ounces per tree and 1 ounce per foot of tree height.	\$65.00	\$50.00			5	\$2,455.00
June 17	Treated all trees for aphids: Diazinon - label rates.	\$50.00	\$38.00			8	\$2,413.00
August 24	Herbicide: Lontrel* @ label rates (rotovated areas contained almost 100% Vetch).	nc					
June, July, August	Mowed strips between rows.	\$75.00	\$57.00			14	\$2,352.00
September	Foliage and soil samples were sent for analyses.	nc					
October 8	Sheared all trees with long leaders (tipped).	nc					
	Total	\$290.00	\$180.07				
1993 (year 6)							
May 11	Herbicide: Velpar [®] L @ 8.0 l/ha.	\$100.00	\$73.00			91	\$2,343.00
May 31	Applied fertilizer as prescribed by fall foliar analysis: 2 oz of 0-50-0	\$65.00	\$48.00			6	\$2,284.00
June, July, August	Mowed strips between rows.	\$75.00	\$54.00			19	\$2,228.00
October 20	Foliage and soil sample taken for analysis.	nc					
November 1	All appropriate trees were butt pruned and sheared.	\$450.00	\$322.00			28	\$1,806.00
	Total	\$690.00	\$497.00				

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Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1994 (year 7)							
May 11	Herbicide: Velpar [®] L @ 7.0 l/ha.	\$100.00	\$70.00			46	\$1,752.00
June 1	Applied fertilizer according to the 1993 foliar analysis results: 0-5-0 (4 ounces) 0-0-61 (2 ounces)	\$65.00	\$45.00			5	\$1,692.00
June-Aug	Mowed strips between rows.	\$75.00	\$52.00			14	\$1,631.00
August 17	Shearing, all blocks (Conventional methods)	\$200.00	\$138.00			4	\$1,435.00
	Total	\$440.00	\$305.00				
1995 (year 8) Estimates							
May 5	Herbicide	\$100.00	\$67.00			51	\$1,386.00
May 5	Insecticide	\$50.00	\$33.00				\$1,336.00
May 5	Fertilize	\$65.00	\$43.00				\$1,271.00
June-August	Mow 3 times	\$75.00	\$49.00			15	\$1,211.00
August 15	Shear	\$200.00	\$131.00			2	\$1,013.00
November 15	Harvest 10%	\$50.00	\$32.00			12	\$975.00
November 15	Sell 10%			\$867.50	\$562.57		\$1,843.00
	Total	\$540.00	\$355.00	\$867.50	\$562.57		
1996 (year 9) Estimates							
May 5	Herbicide	\$90.00	\$57.00			43	\$1,796.00
May 5	Fertilize	\$58.50	\$37.00				\$1,737.00
June-August	Mow 3 times	\$67.50	\$42.00			27	\$1,690.00
August 15	Shear	\$180.00	\$113.00			3	\$1,513.00
November 15	Harvest 70%	\$350.00	\$216.00			19	\$1,182.00
November 15	Sell 70%			\$6,072.50	\$3750.00		\$7,255.00
	Total	\$746.00	\$465.00	\$6,072.50	\$3750.00		
1997 (year 10) Estimates							
May 5	Herbicide	\$20.00	\$12.00			167	\$7,402.00
May 5	Fertilize	\$13.00	\$8.00				\$7,389.00
June-August	Mow 3 times	\$15.00	\$9.00			88	\$7,462.00
August 15	Shear	\$40.00	\$24.00			14	\$7,436.00
November 15	Harvest 10%	\$50.00	\$29.00			92	\$7,478.00
November 15	Sell 10%			\$867.50	\$510.20		\$8,345.00
	Total	\$138.00	\$82.00	\$867.50	\$510.20		
1998 (year 11) Estimates							
May 5	Herbicide	\$10.00	\$6.00			193	\$8,528.00
May 5	Fertilize	\$6.50	\$4.00				\$8,522.00
June-August	Mow 3 times	\$7.50	\$4.00			196	\$8,615.00
August 15	Shear	\$20.00	\$11.00			16	\$8,611.00
November 15	Harvest 10%	\$50.00	\$28.00			107	\$8,668.00
November 15	Sell 10%			\$867.50	\$485.91		\$9,535.00
	Total	\$94.00	\$53.00	\$867.50	\$485.91		
1999 (year 12) Estimates							
December 31	Bank Balance					539	\$10,074.00
2000 (year 13) Estimates							
December 31	Bank Balance					505	\$10,579.00
	Grand Total	\$5,107.00	\$3,968.00	\$8,675.00	\$5,308.69		

Appendix I. Block 2 - Fertilize and Herbicide - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1987 (year 0)							
Jan. 1, 1987	Roads	\$200.00	\$200.00				\$3,800.00
August 25	Herbicide: Vision® @ 3.2 l/ha.	\$100.00	\$97.00			122	\$3,822.00
	Total	\$300.00	\$297.00				
1988 (year 1)							
May 3	Planted balsam fir bareroot 2+2	\$570.00	\$534.00			131	\$3,383.00
June 3	Severe frost						
June 18	Herbicide: Vision® @ 1.5%.	\$100.00	\$93.00			21	\$3,304.00
July 15	Mowed strips between rows.	\$75.00	\$70.00			12	\$3,241.00
	Total	\$745.00	\$697.00				
1989 (year 2)							
May 10	Fill plant balsam fir bareroot 2+2.	\$57.00	\$51.00			132	\$3,316.00
June 15	Vision® treatment - shielded spray - 15-20% damage.	\$100.00	\$89.00			16	\$3,232.00
June 15	Fertilizer	\$65.00	\$58.00				\$3,167.00
July 15	Mowed strips between rows.	\$75.00	\$66.00			12	\$3,104.00
	Total	\$297.00	\$264.00				
1990 (year 3)							
April 23	Herbicide: Simazine @ 7 kg/ha.	\$100.00	\$85.00			120	\$3,124.00
May 15	Fill planted 500 Balsam fir bareroot 2+3.	\$57.00	\$48.00			9	\$3,076.00
May 16	Fertilizer applied - 2.0 oz 17-17-17 (not applied on newly planted trees).	\$65.00	\$55.00				\$3,011.00
July 25	Mowed strips between rows.	\$75.00	\$63.00			29	\$2,965.00
	Total	\$297.00	\$251.00				
1991 (year 4)							
May 7	Herbicide: Velpar® L @ 5.0 l/ha.	\$100.00	\$81.00			115	\$2,980.00
May 15	Fertilizer applied rate of 2.0 ounces per tree and 1 ounce for every foot of tree over 2 feet. i.e. some trees received 4 ounces of 17-17-17.	\$65.00	\$53.00			3	\$2,918.00
July - early September	Mowed strips between rows.	\$75.00	\$60.00			31	\$2,874.00
November 20	Corrective shearing; tipped a few trees that had excessive leader growth, these were not used in the study.	nc					
	Total	\$240.00	\$194.00				

Appendix I. Block 2 - Fertilize and Herbicide - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1992 (year 5)							
May 11	Herbicide: Velpar®L @ 5.0 l/ha.	\$100.00	\$77.00			111	\$2,885.00
May 25	Fertilized - 17-17-17, 2 ounces per tree and 1 ounce per foot of tree height.	\$65.00	\$50.00			5	\$2,825.00
June 17	Treated all trees for aphids: Diazinon - label rates.	\$50.00	\$38.00			9	\$2784..00
August 24	Lontrel® band for vetch control (nonrotovated areas contained 10% Vetch).	nc					
June, July, August	Mowed strips between rows.	\$75.00	\$57.00			17	\$2,726.00
September	Foliage and soil samples were sent for analyses.	nc					
October 8	Sheared all trees with long leaders (tipped).	nc					
	Total	\$290.00	\$222.00				
1993 (year 6)							
May 11	Herbicide: Velpar®L @ 8.0 l/ha.	\$100.00	\$73.00			105	\$2,731.00
May 31	Applied fertilizers as prescribed by fall foliar analysis: 4 oz of 0-50-0 and 2 oz of 0-0-61	\$65.00	\$48.00			7	\$2,673.00
June, July, August	Mowed with rotary mower.	\$75.00	\$54.00			23	\$2,621.00
October 20	Foliage and soil sample taken for analysis.	nc					
November 1	All appropriate trees were butt pruned and sheared.	\$450.00	\$322.00			32	\$2,203.00
	Total	\$690.00	\$497.00				
1994 (year 7)							
May 11	Herbicide: Velpar®L @ 7.0 l/ha.	\$100.00	\$70.00			57	\$2,160.00
June 1	Applied fertilizer according to the 1993 foliar analysis results: 0-0-61 (2 ounces)	\$65.00	\$45.00			6	\$2,101.00
July/August	Mowed strips between rows.	\$75.00	\$52.00			17	\$2,043.00
August 17	Shearing, all blocks (Conventional methods)	\$200.00	\$138.00			5	\$1,848.00
	Total	\$440.00	\$305.00				
1995 (year 8) Estimates							
May 5	Herbicide	\$100.00	\$67.00			65	\$1,813.00
May 5	Insecticide	\$50.00	\$33.00				\$1,763.00
May 5	Fertilize	\$65.00	\$43.00				\$1,698.00
August 1	Mow 3 times	\$75.00	\$49.00			20	\$1,643.00
August 15	Shear	\$200.00	\$131.00			3	\$1,446.00
	Total	\$490.00	\$323.00				
1996 (year 9) Estimates							
May 5	Herbicide	\$100.00	\$63.00			52	\$1,398.00
May 5	Fertilize	\$65.00	\$41.00				\$1,333.00
August 1	Mow 3 times	\$75.00	\$47.00			16	\$1,274.00
August 15	Shear	\$200.00	\$125.00			3	\$1,077.00
November 15	Harvest 44%	\$220.00	\$136.00			13	\$870.00
November 15	Sell 44%			\$4,114.00	\$2,540.55		\$4,984.00
	Total	\$660.00	\$412.00	\$4,114.00	\$2,540.55		

Appendix I. Block 2 - Fertilize and Herbicide - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1997 (year 10) Estimates							
May 5	Herbicide	\$56.00	\$22.00			135	\$5,063.00
May 5	Fertilize	\$36.00	\$22.00				\$5,027.00
August 1	Mow 3 times	\$42.00	\$25.00			59	\$5,044.00
August 15	Shear	\$112.00	\$67.00			10	\$4,942.00
November 15	Harvest 56%	\$280.00	\$147.00			91	\$4,753.00
November 15	Sell 56%			\$5,236.00	\$3,079.46		\$9,989.00
	Total	\$526.00	\$283.00	\$5,236.00	\$3,079.46		
1988 (year 11) Estimates							
December 31	Bank Balance					564	\$10,553.00
1999 (year 12) Estimates							
December 31	Bank Balance					528	\$11,081.00
2000 (year 13) Estimates							
December 31	Bank Balance					555	\$11,636.00
	Grand Total	\$4,925.00	\$3,745.00	\$9,350.00	\$5,620.01		

Appendix I. Block 3 - Barbeco and Lime - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1988 (year 1)							
January	Roads	\$200.00	\$200.00				\$3,800.00
Early Spring	Soil samples sent for analysis.	nc					
May 20	Area rotovated with rotovator from tree breeding centre: 2.7 tons/acre lime plus magnesium applied after second pass and worked into soil on third pass.	\$180.00	\$177.00			71	\$3,691.00
May 21	15-5-5 plus magnesium @ 250 lbs/acre applied with cyclone seeder	\$46.00	\$45.00			1	\$3,646.00
May 21	Bluegrass and Dutch White Clover broadcast at 3 lbs/acre with cyclone seeder; cultivated area rolled.	\$64.00	\$63.00				\$3,582.00
August 25	Herbicide: Vision [®] @ 3.2 l/ha.	\$100.00	\$97.00			46	\$3,528.00
	Total	\$590.00	\$582.00				
1988 (year 1)							
May 3	Planted balsam fir bareroot 2+2	\$570.00	\$534.00			121	\$3,079.00
June 3	Severe frost						
June 18	Herbicide: Vision [®] @ 1.5%.	\$100.00	\$93.00			19	\$2,998.00
June-Aug.	Mowed strips between rows	\$75.00	\$70.00			11	\$2,934.00
	Total	\$745.00	\$697.00				
1989 (year 2)							
May 10	Fill planted approximately 100 balsam fir bareroot 2+2.	\$57.00	\$51.00			119	\$2,996.00
June 15	Herbicide: Vision [®] treatment @ label rate.	\$100.00	\$89.00			15	\$2,911.00
July 15	Mowed strips between rows.	\$75.00	\$66.00			11	\$2,847.00
	Total	\$232.00	\$191.74				
1990 (year 3)							
April 23	Herbicide: Simazine @ 7 kg/ha.	\$100.00	\$85.00			110	\$2,857.00
May 15	Fill planted 500 Balsam fir bareroot 2+3.	\$57.00	\$48.00			8	\$2,808.00
July 25	Mowed strips between rows.	\$75.00	\$63.00			27	\$2,760.00
	Total	\$232.00	\$196.00				
1991 (year 4)							
May 7	Herbicide: Velpar [®] L @ 5.0 l/ha.	\$100.00	\$81.00			108	\$2,768.00
July - early September	Mowed strips between rows.	\$75.00	\$60.00			32	\$2,725.00
November 20	Corrective shearing; tipped a few trees that had excessive leader growth, these were not used in the study.	nc					
	Total	\$175.00	\$141.00				
1992 (year 5)							
May 11	Herbicide: Velpar [®] L @ 5.0 l/ha.	\$100.00	\$77.00			105	\$2,730.00
June 17	Treated all trees for aphids: Diazinon - label rates.	\$50.00	\$38.00			14	\$2,694.00
August 24	Herbicide: Lontrel [®] @ label rate (rotovated areas contained almost 100% Vetch).	nc					
June, July, August	Mowed strips between rows.	\$75.00	\$57.00			16	\$2,635.00
October 8	Sheared all trees with long leaders (tipped).	nc					
	Total	\$225.00	\$172.00				

Appendix I. Block 3 - Herbicide and Lime - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1993 (year 6)							
May 11	Herbicide: Velpar [®] L @ 8.0 l/ha.	\$100.00	\$73.00			101	\$2,636.00
June, July, August	Mowed strips between rows.	\$75.00	\$54.00			29	\$2,590.00
November 1	All appropriate trees were butt pruned and sheared.	\$450.00	\$322.00			33	\$2,173.00
	Total	\$625.00	\$449.00				
1994 (year 7)							
May 11	Herbicide: Velpar [®] L @ 7.0 l/ha.	\$100.00	\$70.00			56	\$2,129.00
June, July, August	Mowed strips between rows.	\$75.00	\$52.00			23	\$2,077.00
August 17	Shearing, all blocks (Conventional methods)	\$200.00	\$138.00			5	\$1,882.00
	Total	\$375.00	\$260.00				
1995 (year 8) Estimates							
May 5	Herbicide	\$100.00	\$67.00			66	\$1,848.00
May 5	Insecticide	\$50.00	\$33.00				\$1,798.00
August 1	Mow 3 times	\$75.00	\$49.00			22	\$1,745.00
August 15	Shear	\$200.00	\$131.00			3	\$1,548.00
	Total	\$425.00	\$280.00				
1996 (year 9) Estimates							
May 5	Herbicide	\$100.00	\$63.00			56	\$1,504.00
August 1	Mow 3 times	\$75.00	\$47.00			17	\$1,446.00
August 15	Shear	\$200.00	\$125.00			3	\$1,249.00
	Total	\$375.00	\$235.00				
1997 (year 10) Estimates							
May 5	Herbicide	\$100.00	\$60.00			45	\$1,194.00
August 1	Mow 3 times	\$75.00	\$45.00			14	\$1,133.00
August 15	Shear	\$200.00	\$119.00			2	\$935.00
November 15	Harvest 30%	\$150.00	\$88.00			12	\$797.00
November 15	Sell 30%			\$2,580.00	\$1,517.38		\$3,377.00
	Total	\$525.00	\$312.00	\$2,580.00	\$1,517.38		
1998 (year 11) Estimates							
May 5	Herbicide	\$70.00	\$40.00			78	\$3,385.00
August 1	Mow 3 times	\$52.50	\$30.00			39.5	\$3,372.00
August 15	Shear	\$140.00	\$79.00			7	\$3,239.00
November 15	Harvest 70%	\$350.00	\$196.00			40	\$2,929.00
November 15	Sell 70%			\$6,020.00	\$3,371.96		\$8,949.00
	Total	\$612.50	\$345.00	\$6,020.00	\$3,371.96		
1999 (year 12) Estimates							
December 31	Bank Balance					505	\$9,454.00
2000 (year 13) Estimates							
December 31	Bank Balance					474	\$9,928.00
	Grand Total	\$5,136.50	\$3,877.00	\$8,600.00	\$4,889.34		

Appendix I. Block 4 - Herbicide only - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1987 (year 0)							
January 1	Roads	\$200.00	\$200.00				\$3,800.00
August 25	Herbicide: Vision® @ 3.2 l/ha.	\$100.00	\$97.00			122	\$3,822.00
	Total	\$300.00	\$297.00				
1988 (year 1)							
May 3	Planted balsam fir bareroot 2+2	\$570.00	\$534.00			131	\$3,383.00
June 3	Severe frost						
June 18	Herbicide: Vision® @ 1.5%.	\$100.00	\$93.00			21	\$3,304.00
July 15	Mowed strips between rows.	\$75.00	\$70.00			12	\$3,241.00
	Total	\$745.00	\$697.00				
1989 (year 2)							
May 10	Fill planted approximately 100 balsam fir bareroot 2+2.	\$57.00	\$51.00			132	\$3,316.00
June 15	Herbicide: Vision® @ label rate.	\$100.00	\$89.00			16	\$3,232.00
July 15	Mowed strips between rows.	\$75.00	\$66.00			13	\$3,170.00
	Total	\$232.00	\$206.00				
1990 (year 3)							
April 23	Herbicide: Simazine @ 7 kg/ha.	\$100.00	\$85.00			121	\$3,191.00
May 15	Fill planted 500 balsam fir bareroot 2+3.	\$57.00	\$48.00			10	\$3,144.00
July 25	Mowed strips between rows.	\$75.00	\$63.00			30	\$3,099.00
	Total	\$232.00	\$196.00				
1991 (year 4)							
May 7	Herbicide: Velpar®L @ 5.0 l/ha.	\$100.00	\$81.00			121	\$3,120.00
July - early September	Mowed strips between rows.	\$75.00	\$60.00			36	\$3,081.00
November 20	Corrective shearing; tipped a few trees that had excessive leader growth, these were not used in the study.	nc					
	Total	\$175.00	\$141.00				
1992 (year 5)							
May 11	Herbicide: Velpar®L @ 5.0 l/ha.	\$100.00	\$77.00			119	\$3,100.00
June 17	Treated all trees for aphids: Diazinon - label rates.	\$50.00	\$38.00			15	\$3,065.00
August 24	Herbicide: Lontrel® @ label rate. (nonrotovated areas contained 10% Vetch)	nc					
June, July, August	Mowed strips between rows.	\$75.00	\$57.00			19	\$3,009.00
October 8	Sheared all trees with long leaders (tipped).	nc					
	Total	\$225.00	\$172.00				
1993 (year 6)							
May 11	Herbicide: Velpar®L @ 8.0 l/ha.	\$100.00	\$73.00			116	\$3,025.00
June, July, August	Mowed strips between rows.	\$75.00	\$54.00			33	\$2,983.00
November 1	All appropriate trees were butt pruned and sheared.	\$450.00	\$322.00			37	\$2,570.00
	Total	\$625.00	\$449.00				

Appendix I. Block 4 - Herbicide only - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1994 (year 7)							
May 11	Herbicide: Velpar ⁰⁰ L @ 7.0 l/ha.	\$100.00	\$70.00			66	\$2,536.00
July/August	Mowed strips between rows (2 times).	\$75.00	\$52.00			28	\$2,489.00
August 17	Shearing, all blocks (Conventional methods)	\$200.00	\$138.00			6	\$2,295.00
	Total	\$375.00	\$260.00				
1995 (year 8) Estimates							
May 5	Herbicide	\$100.00	\$67.00			81	\$2,276.00
May 5	Insecticide	\$50.00	\$33.00			0	\$2,226.00
August 1	Mow 3 times	\$75.00	\$49.00			26	\$2,177.00
August 15	Shear	\$200.00	\$131.00			5	\$1,982.00
	Total	\$425.00	\$280.00				
1996 (year 9) Estimates							
May 5	Herbicide	\$100.00	\$63.00			71	\$1,953.00
August 1	Mow 3 times	\$75.00	\$47.00			23	\$1,901.00
August 15	Shear	\$200.00	\$125.00			3	\$1,704.00
	Total	\$375.00	\$235.00				
1997 (year 10) Estimates							
May 5	Herbicide	\$100.00	\$60.00			61	\$1,665.00
August 1	Mow 3 times	\$75.00	\$45.00			20	\$1,610.00
August 15	Shear	\$200.00	\$119.00			3	\$1,413.00
	Total	\$375.00	\$224.00				
1998 (year 11) Estimates							
May 5	Herbicide	\$100.00	\$57.00			51	\$1,364.00
August 1	Mow 3 times	\$75.00	\$43.00			16	\$1,305.00
August 15	Shear	\$200.00	\$113.00			2	\$1,107.00
November 15	Harvest 78%	\$390.00	\$218.00			14	\$731.00
November 15	Sell 78%			\$6,540.30	\$3,663.39		\$7,271.00
	Total	\$765.00	\$431.00	\$6,540.30	\$3,663.39		
1999 (year 12) Estimates							
May 5	Herbicide	\$22.00	\$12.00			168	\$7,417.00
August 1	Mow 3 times	\$17.00	\$9.00			89	\$7,489.00
August 15	Shear	\$44.00	\$24.00			14	\$7,459.00
November 15	Harvest 22%	\$110.00	\$59.00			92	\$7,441.00
November 15	Sell 22%			\$1,844.70	\$984.06		\$9,286.00
	Total	\$193.00	\$104.00	\$1,844.70	\$984.06		
2000 (year 13) Estimates							
December 31	Bank Balance					525	\$9,811.00
	Grand Total	\$5,041.50	\$3,694.00	\$8,385.00	\$4,647.45		

Appendix I. Blocks 5 & 6 - Fertilize only - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1988 (year 1)							
January 1987	Roads	\$200.00	\$200.00				\$3,800.00
May 3, 1988	Planted balsam fir barroot 2+2	\$570.00	\$534.00			256	\$3,486.00
June 3	Severe frost	nc					
	Total	\$770.00	\$734.00				
1989 (year 2)							
May 10	Fill planted balsam fir barroot 2+2.	\$57.00	\$51.00			178	\$3,607.00
June 15	Fertilizer	\$65.00	\$58.00			17	\$3,559.00
	Total	\$122.00	\$109.00				
1990 (year 3)							
May 15	Fill planted balsam fir barroot 2+3.	\$57.00	\$48.00			163	\$3,665.00
May 16	Fertilizer applied - 2.0 oz 17-17-17 (not applied on newly planted trees).	\$65.00	\$55.00				\$3,600.00
	Total	\$122.00	\$103.00				
1991 (year 4)							
May 15	Fertilizer applied rate of 2.0 ounces per tree and 1 ounce for every foot of tree over 2 feet. i.e. some trees received 4 ounces of 17-17-17.	\$65.00	\$53.00			180	\$3,715.00
November 20	Corrective shearing; tipped a few trees that had excessive leader growth, these were not used in the study.	nc					
	Total	\$65.00	\$53.00				
1992 (year 5)							
May 25	Fertilized - 17-17-17, 2 ounces per tree and 1 ounce per foot of tree height.	\$65.00	\$50.00			191	\$3,841.00
June 17	Treated all trees for aphids: Diazinon - label rates.	\$50.00	\$38.00			12	\$3,803.00
September	Foliage and soil samples were sent for analyses.	nc					
October 8	Sheared all trees with long leaders (tipped).	nc					
	Total	\$115.00	\$88.00				
1993 (year 6)							
May 31	Applied fertilizers as prescribed by fall foliar analysis: Block 3: 3 oz of 20-5-5, Block 4: 2 oz of 0-50-0 and 2 oz of 0-0-61.	\$65.00	\$48.00			181	\$3,919.00
October 20	Foliage and soil sample taken for analysis.	nc					
November 1	All appropriate trees were butt pruned and sheared.	\$450.00	\$322.00			82	\$3,551.00
	Total	\$515.00	\$370.00				
1994 (year 7)							
June 1	Applied fertilizer according to the 1993 foliar analysis results: Block 3: 0-0-61 (2 ounces), Block 4: 3 oz of 20-5-5.	\$65.00	\$45.00			102	\$3,588.00
August 17	Shearing, all blocks (Conventional methods)	\$200.00	\$138.00			37	\$3,425.00
	Total	\$265.00	\$183.00				

Appendix I. Blocks 5 & 6 - Fertilize only - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1995 (year 8) Estimates							
May 5	Insecticide	\$50.00	\$33.00			121	\$3,496.00
May 5	Fertilize	\$65.00	\$43.00				\$3,431.00
August 15	Shear	\$200.00	\$131.00			-48	\$3,279.00
	Total	\$315.00	\$207.00				
1996 (year 9) Estimates							
May 5	Fertilize	\$65.00	\$41.00			117	\$3,331.00
August 15	Shear	\$200.00	\$125.00			46	\$3,177.00
	Total	\$265.00	\$166.00				
1997 (year 10) Estimates							
May 5	Fertilize	\$65.00	\$39.00			114	\$3,226.00
August 15	Shear	\$200.00	\$119.00			44	\$3,070.00
	Total	\$265.00	\$158.00				
1998 (year 11) Estimates							
May 5	Fertilize	\$65.00	\$37.00			110	\$3,115.00
August 15	Shear	\$200.00	\$113.00			43	\$2,958.00
	Total	\$265.00	\$150.00				
1999 (year 12) Estimates							
May 5	Fertilize	\$65.00	\$36.00			105	\$2,998.00
August 15	Shear	\$200.00	\$108.00			42	\$2,840.00
November 15	Harvest 100%	\$500.00	\$267.00			35	\$2,375.00
November 15	Sell 100%			\$5,000.00	\$2,667.27		\$7,375.00
	Total	\$765.00	\$411.00	\$5,000.00	\$2,667.27		
2000 (year 13) Estimates							
December 31	Bank Balance					417	\$7,792.00
	Grand Total	\$3,849.00	\$2,733.00	\$5,000.00	\$2,667.27		

Appendix I. Block 7 & 8 - Control - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1988 (year 1)							
Jan. 1, 1987	Roads	\$200.00	\$200.00				\$3,800.00
May 3, 1988	Planted balsam fir bareroot 2+2	\$570.00	\$534.00			256	\$3,486.00
June 3	Severe frost	nc					
	Total	\$770.00	\$734.00				
1989 (year 2)							
May 10	Fill planted approximately 100 balsam fir bareroot 2+2.	\$57.00	\$51.00			178	\$3,607.00
	Total	\$57.00	\$0.00				
1990 (year 3)							
May 15	Fill planted balsam fir bareroot 2+3.	\$57.00	\$48.00			183	\$3,733.00
	Total	\$57.00	\$41.00				
1991 (year 4)							
November 20	Corrective shearing; tipped a few trees that had excessive leader growth, these were not used in the study.	nc					
	Total						
1992 (year 5)							
June 17	Treated all trees for aphids; Diazinon - label rates.	\$50.00	\$38.00			401	\$4,084.00
October 8	Sheared all trees with long leaders (tipped).	nc					
	Total	\$50.00	\$30.00				
1993 (year 6)							
November 1	All appropriate trees were butt pruned and sheared.	\$450.00	\$322.00			284	\$3,918.00
	Total	\$450.00	\$235.00				
1994 (year 7)							
August 17	Shearing, all blocks (Conventional methods)	\$200.00	\$138.00			154	\$3,872.00
	Total	\$200.00	\$97.00				
1995 (year 8) Estimates							
May 5	Insecticide	\$50.00	\$33.00			137	\$3,959.00
August 15	Shear	\$200.00	\$131.00			55	\$3,814.00
	Total	\$250.00	\$164.00				
1996 (year 9) Estimates							
August 15	Shear	\$200.00	\$125.00			191	\$3,805.00
	Total	\$200.00	\$80.00				
1997 (year 10) Estimates							
August 15	Shear	\$200.00	\$119.00			190	\$3,795.00
	Total	\$200.00	\$73.00				
1998 (year 11) Estimates							
August 15	Shear	\$200.00	\$113.00			190	\$3,785.00
	Total	\$200.00	\$66.00				

Appendix I. Block 7 & 8 - Control - Description of the cultural treatments and their associated current and discounted costs and revenues for a Christmas tree plantation planted in an abandoned field in the spring of 1988.

Date	Activity	Cost		Revenue		Interest (\$)	\$4,000 Bank Account
		Current	Discounted (5%)	Current	Discounted (5%)		
1999 (year 12) Estimates							
August 15	Shear	\$200.00	\$108.00			189	\$3,774.00
November 15	Harvest 88%	\$440.00	\$235.00			47	\$3,381.00
November 15	Sell 88%			\$4,400.00	\$2,347.19		\$7,781.00
	Total	\$640.00	\$343.00	\$4,400.00	\$2,347.19		
2000 (year 13) Estimates							
August 14	Shear	\$24.00	\$12.34			289	\$8,046.00
November 14	Harvest 12%	\$60.00	\$30.00			100	\$8,086.00
November 14	Sell 12%			\$600.00	\$304.83		\$8,686.00
	Total	\$84.00	\$42.34	\$600.00	\$304.83		
December 31	Bank Balance					54	\$8,740.00
	Grand Total	\$3,158.00	\$2,239.00	\$5,000.00	\$2,652.03		

Appendix II. Estimated costs and revenues for the Mount Thom Christmas tree trial.

Treatment	Treatment Cost and Revenues (1994) For 1 Acre (1,000 trees)
Roads	\$0.20/tree * 1000
Rotovate	2 hours * \$25.00/hour
Lime (purchase + spread)	4.01 tons * \$26.15/ton
Rotovate (incorporation)	1 hour * \$25.00/hour
Cover crop seeding (purchase + spread + roll)	(1 hour * \$25.00/hour) + (\$2.60/lb * 15 lbs)
Fertilizer 25-5-5 at 250 lbs/acre	\$365.00/ton * 250 lbs
Herbicide application for rows	\$.10/tree * 1000
Stock acquisition: Balsam Fir	\$.45/tree * 1000
Planting	\$0.12/tree * 1000
Fill Plant (estimate 20%)	20% * 1000 trees * \$0.57/tree
Herbicide (all years)	\$0.10/tree * 1000 trees* each application
Fertilize (none first year)	\$0.0625/tree * 1000 trees* each application
Insecticide (estimate 2 times)	\$0.05/tree * 1000 trees* each application
Mowing (3 times/year)	\$25.00/acre * 3/year
Butt Pruning	\$0.25/tree * 1000 trees
Shearing (none first 5 years)	\$0.20/tree * each application
Harvest (Cut + drag)	\$0.50/tree * 1000
Revenue: Heavy	\$ 10.75
Medium	\$ 8.25
Light	\$ 5.00

¹Costs obtained from various industry sources.

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