Fertilization of Western Hemlock Seedlings
(Tsuga heterophylla (Raf.) Sarg.) at Time of Planting
to Reduce Competition by Salal (Gaultheria shallon Pursh)

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Establishment Report
SX Trial
August 1986
1.0 Introduction

Competition for nutrients and light (and perhaps allelopathic effects) by salal (*Gaultheria shallon* Pursh) is a serious problem in the northern Vancouver Island area, reducing the growth of plantations. On most sites in this area salal is present prior to harvesting. In the harvesting process very little is destroyed. Slashburning is the most frequently used method of reducing the salal, but the effectiveness lasts only approximately five years, depending on the intensity of the burn. If by this time the plantation crowns have not closed, salal invades quickly and reduces tree growth.

Herbicides are being tested for efficacy against salal, however, currently in B.C. there is no registered herbicide that has been found to be effective against salal. Also, the strong lobby against herbicide application in forestry, may prevent its use in many areas.

Fertilization at time of planting has been tried in previous studies to accelerate seedling growth during the first few years. The intention is that the crowns of the seedlings will close and shade out the salal before it becomes established at the level where it diminishes seedling growth.

2.0 Objectives

To quantify the effect of fertilization with Osmocote at time of planting upon western hemlock seedling survival, growth, and nutrition, and upon salal growth and vigor on sites that have been burned, and burned and spot scarified.
3.0 Methods of Investigation

3.1 Literature Review

The first phase of the study was to carry out a literature review on previous salal studies and on studies involving fertilization at time of planting.

3.2 Experimental Design

The study was laid out as three separate experiments due to the variability of ecosystems, aspect and accessibility by the spot scarifier. Each plot contained 53 or 35 seedlings, depending on the size of the area treated by the spot scarifier. The number of seedlings and replications for each treatment is as follows:

Experiment 1: Unscarified, South Aspect

<table>
<thead>
<tr>
<th>treatment</th>
<th># trees</th>
<th># replications</th>
<th>total trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>53</td>
<td>4</td>
<td>212</td>
</tr>
<tr>
<td>2. Osmocote 1 dibble</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>3. Osmocote 1 broadcast</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>4. Osmocote 2 dibble</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>5. Osmocote 2 broadcast</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>6. Complete</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
</tbody>
</table>

Experiment 2: Scarified, North Aspect

<table>
<thead>
<tr>
<th>treatment</th>
<th># trees</th>
<th># replications</th>
<th>total trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>35</td>
<td>3</td>
<td>105</td>
</tr>
<tr>
<td>4. Osmocote 2 dibble</td>
<td>35</td>
<td>3</td>
<td>105</td>
</tr>
<tr>
<td>5. Osmocote 2 broadcast</td>
<td>35</td>
<td>3</td>
<td>105</td>
</tr>
</tbody>
</table>
Experiment 3: Scarified, South Aspect

<table>
<thead>
<tr>
<th>treatment</th>
<th># trees</th>
<th># replications</th>
<th>total trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>2. Osmocote 1 dibble</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>3. Osmocote 1 broadcast</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>4. Osmocote 2 dibble</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>5. Osmocote 2 broadcast</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>6. Complete</td>
<td>53</td>
<td>2</td>
<td>106</td>
</tr>
</tbody>
</table>

3.3 Description of treatments

After harvesting the site was slashburned and a portion of the site was subsequently scarified using a John Deere backhoe 660. Due to the large amount of slash remaining on the site the backhoe could create only 800 planting spots per hectare. The site was then planted using 1 + 0 western hemlock seedlings. Seedlings used in the scarified area were only those which had been planted in mineral soil prepared by the backhoe.

The plots were randomly located on the site with a minimum buffer strip of 8 meters between them. The six treatments were then randomly allocated to the twelve plots. The fertilizer Osmocote contains N, P and K in the proportions 17-7-12, respectively. The six treatments are:

1. Control
   Seedlings in the control plots were not treated.

2. Osmocote 1 dibble
   A dibble planting tool was used to make a hole 7.5 cm upslope from the seedlings so that the groundwater would wash the fertilizer toward the roots. 29.41 grams of Osmocote (to provide 5 g N) were then placed in the hole and covered with soil.

3. Osmocote 1 broadcast
   29.41 grams of Osmocote were spread around the seedling within a radius of 30 cm, such that the Osmocote did not come in contact with the seedling stem.
4. Osmocote 2 dibble

58.82 grams of Osmocote (to provide 10 g N) were placed in a dibble hole using the method described in 2.

5. Osmocote 2 broadcast

58.82 grams of Osmocote were spread around the seedling using the method described in 3.

6. Complete

58.82 grams of Osmocote were mixed with 3.617 grams of dolomite lime, 5.550 grams of Potassium sulfate and 0.42 grams of Frit 503 (containing micronutrients: iron, zinc, manganese, copper, boron and molybdenum), and applied using the method described in 2.

3.4 Site Selection

The site was selected to meet the following criteria:
- a homogenous area large enough to accommodate the trial layout.

3.5 Description of Site

The study area is located approximately 20 km northeast of Port Hardy at an elevation of less than 100 m a.s.l. The site is in the Hypermaritime Coastal Western Hemlock Subzone (CWHi1).

The area is on a glaciofluvial terrace overlying basal till. Soils are predominantly loamy sand underlain by compacted sand at around 0.6 m below the surface. The humus form is a Lignohumimor, varying in depth between 1 and 30 cm.

The plots were restricted to the upper slope and mid-slope topographic positions as these are the most prone to salal domination.
4.0 Measures and Records

Assessment will be carried out to monitor the effect and the duration of the effect of the different fertilization treatments on seedling growth. The information collected at each assessment includes:

- seedling diameter
- seedling height
- crown diameter
- form (crooked, forked or straight)
- vigor (dead, poor, fair, good)
- shade (whether the seedling is being shaded or not)
- percent cover of salal (within a 50 cm radius around the seedling)
- mean height of salal (mean height of the salal within the 50 cm radius)
- minimum distance of salal from seedling
- maximum distance of salal from seedling (to a maximum of 50 cm)
- percent of seedling overtopped by salal
- percent cover of deer fern (within a 50 cm radius around the seedling)
- mean height of deer fern (mean height of the deer fern within the 50 cm radius)
- minimum distance of deer fern from seedling
- maximum distance of deer fern from seedling (to a maximum of 50 cm)
- percent of seedling overtopped by deer fern
- name of 3rd species present within the 50 cm radius around the seedling
- percent cover of the 3rd species (within the 50 cm radius)
- mean height of the 3rd species (within the 50 cm radius)
- minimum distance of the 3rd species from the seedling
- maximum distance of the 3rd species from the seedling (to a maximum of 50 cm)
- percent of seedling overtopped by the 3rd species
- name of 4th species present within the 50 cm radius around the seedling
- percent cover of the 4th species (within the 50 cm radius)
- mean height of the 4th species (within the 50 cm radius)
- minimum distance of the 4th species from the seedling
- maximum distance of the 4th species from the seedling (to a maximum of 50 cm)
- percent of seedling overtopped by the 4th species.

Foliage samples were also collected of the current year's growth. These samples will be analyzed for:

- Nitrogen
- Potassium
- Calcium
- Magnesium
- Phosphorus
- Sulphur
- $SO_4^-$
- Copper
- Iron
- Manganese
- Boron
- Aluminum
- Sodium
- Active Iron
- Zinc
- weight per 100 needles
5.0 Data Analysis

An analysis of variance will be carried out to test for significant differences in diameter and height growth between the different treatments.

The ANOVA will be as follows:

**Experiment 1**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>14 (each the 5 treatments have 2 replicates; control has 4 replicates)</td>
</tr>
<tr>
<td>T</td>
<td>53</td>
</tr>
</tbody>
</table>

**Experiment 2**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>9</td>
</tr>
<tr>
<td>T</td>
<td>35</td>
</tr>
</tbody>
</table>

**Experiment 3**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>12 (2 replications)</td>
</tr>
<tr>
<td>T</td>
<td>53</td>
</tr>
</tbody>
</table>

Where:  
F = Fertilizer  
P = Plot  
T = Trees  
Interactions are:  P(F)  
T(P*F)
Contrasts will be used to determine:

1. If there is a difference between applying 29.41 g Osmocote and 58.82 g Osmocote, using both application methods (dibble & broadcast)
   i.e. 29.41 g dibble vs 58.82 g dibble
   29.41 g broadcast vs 58.82 g broadcast

2. If there is any difference between applying the same amount of Osmocote, using the two application methods
   i.e. 29.41 g dibble vs 29.41 g broadcast
   58.82 g dibble vs 58.82 g broadcast

3. If there is any difference between applying 58.82 g Osmocote using both application methods and applying the complete fertilization treatment
   i.e. 58.82 g dibble (Osmocote) vs 58.82 g complete
   58.82 g broadcast (Osmocote) vs 58.82 g complete

4. If there is a difference between the control (untreated) and the fertilized treatments.

A subjective comparison of the results will be made between the performance of the fertilizers on both the north and south aspects; and between their performance on the scarified and unscarified areas.

In the case of the foliage samples, the 53 samples collected from each plot (in experiments 1 and 3) and the 35 samples (in experiment 2) were combined into a single sample per plot. Descriptive statistics will be used to indicate differences in the chemical values.

The data collected for salal, deer fern and two other competing species will be assigned competition indices which will be correlated with seedling height and diameter growth.
6.0 Roles and Responsibilities

The trial was established with the following personnel:

- F.C. Nuszdorfer, Research Ecologist, Ministry of Forests, Vancouver Forest Region
- K.L. Nuszdorfer, Assistant Research Ecologist, Ministry of Forests, Vancouver Forest Region
- Ministry of Forests, Port McNeill District staff

Tasks will be carried out as follows:

<table>
<thead>
<tr>
<th>Task</th>
<th>Time</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Selection</td>
<td>Spring 1985</td>
<td>F. Nuszdorfer, Port McNeill District staff</td>
</tr>
<tr>
<td>Trial Establishment</td>
<td>Spring 1985</td>
<td>F. Nuszdorfer, K. Nuszdorfer Port McNeill District staff</td>
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<tr>
<td>Field Assessment</td>
<td>Spring 1985</td>
<td>F. Nuszdorfer, K. Nuszdorfer Port McNeill District staff</td>
</tr>
<tr>
<td>(all years)</td>
<td>(initial assessment)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fall 1985</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fall 1986</td>
<td></td>
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<td></td>
<td>Fall 1987</td>
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<tr>
<td></td>
<td>Fall 1989</td>
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<tr>
<td>Data Analysis</td>
<td>after each assessment</td>
<td>K. Nuszdorfer</td>
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<tr>
<td>Progress Report</td>
<td>after each assessment</td>
<td>F. Nuszdorfer, K. Nuszdorfer</td>
</tr>
<tr>
<td>Final Report</td>
<td>after 5th assessment</td>
<td>F. Nuszdorfer, K. Nuszdorfer</td>
</tr>
<tr>
<td>- experiments 2 &amp; 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- experiment 1</td>
<td>after 2nd assessment</td>
<td></td>
</tr>
</tbody>
</table>
Fertilization of HW Seedlings at Time of Planting to Reduce Competition by Salal

Officer I/C: K.L. Nuszuorfer

Location: 20 KM Northeast of Port Hardy

Region/District: Vancouver/Port McNeill

Objective: To quantify the effect of fertilization with osmocote at time of planting upon HW seedling survival growth, and nutrition, and upon salal growth and vigor on site that have been burned and spot scarified.

Progress: First and second growing season assessments completed.

Next Scheduled Assessment/Treatment: Third assessment Fall 1987

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Research Branch - Victoria

Incomplete Abandoned

Delay in planting, lack of cold storage facilities and poor planting quality resulted in poor survival of seedlings.

April 1987