FIRST PROGRESS REPORT

SX85604V

OPERATIONAL CROP MANAGEMENT OF WESTERN HEMLOCK

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1.0 ABSTRACT

This document reports on initial treatment applications for SX85604V. The working plan for SX85604V outlines the three areas of western hemlock crop management activities for this trial,

FLOWER INDUCTION
POLLEN MANAGEMENT
CONE COLLECTION.

During the first season the flower induction studies were established and first treatments were applied. Procedures on 'How to Apply Gibberellic Acids' were written and are included in this progress report.

The next immediate activities required to continue SX85604V are noted.
2.0 FLOWER INDUCTION STUDIES

Three flower induction studies (A, B, C) were established on two sites in April, 1985.

The objective of Study A at Cobble Hill Clone Bank Block 2 is to study the effect of gibberellins (GA 4/7) applied with OPERATIONAL equipment on western hemlock crop production. Study C at CIP/Nootka seed orchard #36 in Saanich is similar to Study A.

Study B, at Cobble Hill Clone Bank Block is designed to determine the effect of GA 4/7 application on crop production of trees which have been top pruned.

Study trees for all sites were selected in the field and tagged in April and May, 1985.

Definitions - year of induction - year the trees were sprayed with GA 4/7 - year of crop production - year cones mature.

2.1 STUDY A

Cobble Hill, GA 4/7 treatment of untopped, fertilized clonal pairs

Fifteen matched clonal pairs of trees (30 ramets) were identified for inclusion in Study A. Treatment trees (T1) were previously labelled (Clone number and Topping Treatment) with a tag on a branch on the south side of each study tree. To facilitate identification during GA 4/7 application, all fifteen T1 trees were marked with yellow ribbon on the south side of each tree. The untreated (TO) trees were selected by visually matching tree height, diameter and crown form to each T1 ramet. The result is fifteen matched pairs of trees, each pair representing one clone for a total of 30 trees in Study A. The TO trees were marked with an orange label (denoting SX85604V, clone number, TO) and pink ribbon on a branch on the south side of the tree.
2.2 STUDY B

Cobble Hill, Topping treatment of GA 4/7 treated, and fertilized clonal triplets

The fifty-seven Study B trees (all included in E.P. 944.02) were previously labelled (Clone number and Topping Treatment) with a tag on a branch on the south side of each tree. Each ramet of the nineteen clones had previously received one of three top pruning treatments, P0, P1, and P2. To facilitate identification during GA 4/7 application, all fifty-seven trees were marked with yellow ribbon on the south side of each tree.

NOTE that fifteen of the 19 P0 trees in Study B are also the T1 trees in Study A.

2.3 STUDY C

CIP/Nootka Seed Orchard #36, GA 4/7 treatment of fertilized clonal pairs

Study C includes 24 clonal pairs of trees (48 ramets). The trees were selected from clones which had at least two healthy ramets capable of carrying a cone crop. The selection of the untreated (T0) and treatment (T1) ramets within a clone was randomly made by the flip of a coin. All 48 trees are labelled with an orange tag (denoting SX85604V, Clone number, and T (or C) on a branch on the south side of the tree. Only the T1 trees are flagged with pink ribbon.
2.4 MATERIALS & METHODS

2.41 Fertilization

All Study A & B trees were fertilized with 200 kg/ha nitrogen applied as granular calcium nitrate Ca(NO₃)₂ to the equivalent area of each tree crown diameter. Assuming a 3 metre average crown diameter (7.07 square metre area), each tree received approximately 900 grams Ca(NO₃)₂ 141 g nitrogen. Fertilizer was applied within a week of vegetative bud burst in May 1985.

All Study C trees were fertilized in April, 1985 prior to vegetative bud burst as part of the CIP/Nootka seed orchard management regime. Trees were fertilized with 200 kg/ha nitrogen applied as ammonium nitrate to the equivalent area of the crown diameter. The total fertilizer regime for the western hemlock orchard was

\[
\begin{align*}
N & \quad P & \quad K \\
200 & \quad 100 & \quad 100 \quad \text{kg/ha}
\end{align*}
\]

2.42 Application of GA 4/7

The T1 trees in Studies A & C and all Study B trees received GA 4/7 application as follows;

weekly application of 200 mg/l for 6 weeks commencing when 50% of the trees reached vegetative bud burst applied with a SOLO backpack sprayer.

A 1% stock solution of GA 4/7 was prepared according to the following 'recipe' for a total volume of 80 litres (l) of working solution;

\[
80 \, l \times 0.2 \, g/l = 16.0 \, g \quad \text{GA 4/7 mixed with (80 \, l \times 1.24 \, g/l)}
\]

99.2 g grams Aromox active surfactant. This was then mixed with

\[
80 \, l \times .01 \, \text{litres} = 0.8 \, l \, \text{of 95% Ethanol}
\]

The stock solution was stored in the refrigerator. Immediately prior to each GA 4/7 application the working solution was prepared by mixing the 1% stock solution with 99% distilled water (dH₂O).

In total 80.4 litres of working solution or 16.1 grams GA 4/7 were used for the 1985 applications:

<table>
<thead>
<tr>
<th>Study</th>
<th>Working Solution</th>
<th>GA 4/7</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>17.8 l</td>
<td>3.6 g</td>
</tr>
<tr>
<td>B</td>
<td>67.4 l</td>
<td>13.5 g</td>
</tr>
<tr>
<td>C</td>
<td>13.0 l</td>
<td>2.6 g</td>
</tr>
</tbody>
</table>

The amount used in Study A is included within Study B because the treatment trees are included in Study B.
The average shoot elongation at the time of each GA 4/7 application was measured for each treated tree. For consistency, the average shoot length was measured on the flagged branch of each tree.

### 2.5 DATA COLLECTION

Field data sheets for Studies A, B, and C are included in Appendix 1. Photographs of flower induction study trees are included in Appendix 2.

### 2.6 PRODUCTIVITY

#### 2.6.1 Time required to prepare stock solution

- Time required to calibrate and test equipment: 0.5 days

#### 2.6.2 Volume of GA 4/7 solution applied to individual trees per application

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of trees</th>
<th>Total volume</th>
<th>Volume per tree</th>
<th>Average tree height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobble Hill</td>
<td>57</td>
<td>11.2 l</td>
<td>200 ml</td>
<td>4.5 m</td>
</tr>
<tr>
<td>CIP/Nootka</td>
<td>24</td>
<td>2.2 l</td>
<td>90 ml</td>
<td>2.19 m</td>
</tr>
</tbody>
</table>

#### 2.6.3 Amount of GA 4/7 required per tree per application

1. Cobble Hill: 200 ml per tree @ 200 mg per l = 0.04 grams
2. CIP/Nootka: 90 ml per tree @ 200 mg per l = 0.02 grams

#### 2.6.4 Application time per treatment

1. Cobble Hill: 60 minutes for 57 trees = 1 minute per tree
2. CIP/Nootka: 20 minutes for 24 trees = 0.8 minutes per tree
3.0 HOW TO APPLY GIBBERELLIC ACIDS

prepared from contract by A.M. Colangell, University of Victoria.

3.1 Introduction

Recently, numerous studies have shown that exogenous applications of the less polar gibberellins (plant growth regulators), particularly GA 4/7 will promote flowering in many species of the Pinaceae. Western hemlock responds consistently to strobilus promotion, especially if used in conjunction with various cultural treatments including fertilization girdling, water and heat stress. It is currently believed that the high levels of GA 4/7 plus the cultural treatments may mimic the conditions required to achieve the appropriate balance of hormonal, nutritional and environmental factors required for cone bud initiation.

3.2 Preparation of Stock and Working Solutions

The amount of stock solution required can be determined by calibrating application equipment in the field. This should be done prior to first GA 4/7 application.

Foliar sprays of gibberellins can be applied by two methods, the Solo backpack or the UTV (ultra low volume) applicator. Stock solutions for both applicators can be made ahead of time and refrigerated. The working solution should be made immediately before use. The recipes given below can be adjusted for any concentration of GA 4/7.

a) Solo Backpack Applicator

For each litre of working solution required mix the stock solution as follows:

Stock Solution (20,000 mg/l for 200 mg/l working solution)

- 0.2 g GA 4/7
- 1.24 g Aromox C-12/W
- 10.0 ml 95% ethanol

If the final working solution is to equal 60 litres, then the above amounts are to be multiplied by 60, eg.

- 12 g GA 4/7
- 74.4 g Aromox C-12/W
- 600 ml 95% ethanol.
Mix the GA 4/7 and aromox into a thick paste. Slowly stir in the ethanol until completely dissolved. Store in fridge.

**Working Solution (200 mg/l)**

- 10 ml stock solution
- 990 ml distilled water (dH20)

Aromox is a detergent or surfactant which helps the GA 4/7 penetrate the waxy cuticle of the foliage.

b) ULV Sprayer

For each litre of working solution required mix the stock solution as follows:

**Stock Solution (160,000 mg/l for 1600 mg/l working solution)**

- 1.6 g Ga 4/7
- 1.24 g Aromox C-12/1
- 10 ml 95% ethanol

Mix as described above and store at 0-4°C.

**Working Solution (1600 mg/l)**

For each litre of working solution mix:

- 10 ml stock
- 20 ml Sunspray 6E horticultural oil
- 970 ml dH2O

Preheat distilled water to about 32°C. Add the oil to the stock solution and mix well. Slowly add the dH2O a few mLs at a time stirring constantly to keep GA 4/7 in solution. If GA 4/7 should come out of solution maintain at 32°C stirring continuously until redissolved.

Sunspray 6E-oil is added to the solution to keep it from evaporating off the foliage quickly.
3.3 Application of GA 4/7

The best time to spray is when it is cool and windless, usually at dawn or dusk. At this time the stomata will be open allowing another route into the foliage plus the evaporation rate is keep to a minimum. With the ULV it is critical that there be no wind as even a slight breeze will carry away the fine mist. Do not spray if it has recently rained and the foliage is still wet or if there is a possibility of rain for the next six to eight hours.

In order to determine the optimum time to start spraying western hemlock, bud swelling and shoot elongation is arbitrarily divided into four stages (Fig. 1). Stage one is the swollen bud. Stage two is defined by less that 50% of the new foliage through the bud scales. The stage three shoot is between 50% and completely emerged. The foliage of the completely emerged shoot tends to spread out. Stage four is the elongating shoot, and is defined by a length greater than one centimeter.

The optimum time to start spraying in relation to tree physiology and shoot elongation is when the new buds are visibly swollen and about 10% of the new shoots are starting to emerge through the bud scales, or somewhere between stages one and two. The swollen buds can remain at stage one for several weeks so it is best to wait until a few (10%) buds have proceeded to stage two before spraying. Continue spraying weekly until the new shoots are well into the phase of rapid elongation. In western hemlock this occurs when the distal shoots in the mid-crown are about 30-60 mm long, approximately four to six weeks after bud burst.

When spraying GA's wear coveralls to protect skin and clothing and a face mask to prevent inhaling the fine mist.
FIGURE 1

STAGES OF WESTERN HEMLOCK VEGETATIVE BUD BURST
3.4 REFERENCES


4.0 FUTURE ACTIVITIES

Section 7.0 of SX85604V Working Plan outlines the schedule of future activities. Immediate activities required to complete the 1985 field season are;

1) final shoot elongation measurements of all flower induction study trees

2) site and tree selection of 1986 flower induction study & cone collection trees.
APPENDICES
APPENDIX 1

SX05604V

HEIGHT & SHOOT ELONGATION MEASUREMENTS FOR 1985
GA 4/7 APPLICATION
APPENDIX 2

PHOTOGRAPHS OF 1985 SX85604V STUDY TREES