SX89123Q

Evaluation and Comparison of Fertilization at Time of Planting and Effectiveness of "Ani-Pel Plus" as an Animal Repellant and Fertilizer

Interim Report

By

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Silviculture Branch

June 1991
TITLE: Evaluation and Comparison of Fertilization at Time of Planting and Effectiveness of "Ani-Pel Plus" as an Animal Repellant and Fertilizer

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Rainer Gruenhage  establishment and measurements
Colene Wood  establishment and measurements
Neil Hooker  measurements
Russ Warkman  measurements and photography
ABSTRACT

This trial was conducted to compare the benefits of fertilization at time of planting and the prevention of animal damage using the products Gromax\textsuperscript{R}, Ani-Pel Plus\textsuperscript{R}, and Ani-Spray\textsuperscript{R}. Four treatments were applied at the time of planting: a control, 1 package of Gromax Transplant 2, 2 packages of Gromax Transplant 2, and 1 tablet of Ani-Pel Plus with spraying using Ani-Spray. Each package (teabag) of Gromax Transplant 2 teabag contained 12 grams of fertilizer (12-5-8) and 3 grams of a hydrophilic gel. Each of the 4 treatments were applied to Douglas-fir (Pseudotsuga menziesii) 1+0 PSB 313A, Engelmann Spruce (Picea engelmannii) 1+0 PSB 313A, and interior lodgepole pine (Pinus contorta) 1+0 PSB 211A for a total of 12 different treatments. Two locations were established in the Salmon Arm District, at Tillis Landing.

After 2 growing seasons, significant differences were observed for all variables analyzed: survival, total height, height increment, total root collar diameter, root collar diameter increment, volume, and SR ratio.

With the results of both sites combined, Engelmann spruce fertilized with 1 and 2 teabags of Gromax performed significantly better than the Control and Ani-pel treated Engelmann spruce. In general, lodgepole pine and Douglas fir seedlings in both Gromax treatments also performed better than in the Control or Ani-Pel treatments.

Significant differences were observed between the 2 locations. Seedlings at Tillis Location 1 had higher survival and SR ratio and lower height increment and volume than at Tillis Location 2. At location 1, lodgepole pine seedlings fertilized with 1 and 2 teabags of Gromax had significantly larger height increments, root collar diameters, and root collar increments than the control. Seedlings fertilized with 2 teabags had significantly larger calculated volumes than the control. At location 2, lodgepole pine seedlings fertilized with 1 and 2 teabags of Gromax had significantly larger total heights, height increments, root collar diameters, root collar increments and calculated volumes than the control. In general, there were no statistically significant differences in seedling growth when one or two teabags of Gromax are used at either site. Seedling growth will be continued to be monitored.

More trials using Gromax teabags using different fertilizer formulations and concentrations should be carried out to determine the efficacy of the treatments on different locations and tree species.

\textsuperscript{R} Use of trade names does not constitute endorsement by the authors or the British Columbia Ministry of Forests. Similar results may be obtained with similar fertilizer formulations.
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INTRODUCTION

Research studies have indicated benefits due to fertilization at time of planting. This trial examines the benefits of adding pre-packaged slow release fertilizer at the time of planting, comparing the resultant survival and growth of outplanted seedlings. Three different tree species were assessed.

Previous trials applying fertilizer at time of planting have often shown inconsistent results (SX84115Q). The authors of this report believe that some poor results in previous trials may be attributed to: poor placement of fertilizer, and inconsistent amounts of fertilizer being applied to the seedlings by the planters. With pre-packaged fertilizer, the problem of inconsistent amounts of fertilizer being applied can be minimized. Proper placement of fertilizer will still be necessary.

This trial also examines the benefits of preventing animal damage to newly planted seedlings.

Products to be used in the study are the fertilizer "Gromax", the animal deterrent/fertilizer "Ani-Pel Plus", and the animal deterrent "Ani-Spray". This spray is designed for short term (3-6 months) protection from animal damage, until the tablet takes effect. "Gromax" is a trade name for the product distributed by Matrix Industries Inc. of Ladysmith, B.C. "Ani-Pel Plus" and "Ani-Spray" are trade names for the products distributed by T.S. Research Ltd. of Surrey, B.C.

This report summarizes the results after two growing seasons.
METHODS

The three stocktypes planted were:

1) Douglas fir (Fdi) 1+0 PSB 313A
2) Engelmann spruce (Se) 1+0 PSB 313A
3) lodgepole pine (Pli) 1+0 PSB 211A.

All stock was operationally grown and stored, with no special handling or treatments applied prior to outplanting.

The four treatments applied at the time of planting were:

<table>
<thead>
<tr>
<th>Treatment No.</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control. No other amendments.</td>
</tr>
<tr>
<td>2</td>
<td>1 package of Gromax Transplant 2 (12-5-8) fertilizer placed in planting hole. Each package or teabag contained 12 grams of 12-5-8 fertilizer and 3 grams of super absorbant gel</td>
</tr>
<tr>
<td>3</td>
<td>2 packages (&quot;teabags&quot;) of Gromax Transplant 2 (12-5-8) fertilizer placed in planting hole.</td>
</tr>
<tr>
<td>4</td>
<td>1 tablet of Ani-Pel Plus (18-6-12) placed in planting hole and seedling sprayed with Ani-Spray.</td>
</tr>
</tbody>
</table>

All four treatments were applied to each of the three species for a total of twelve different treatments.

This trial is located in the Salmon Arm District in Kamloops Region. Two trial locations were established at Tillis Landing; approximately 35 km northeast of Salmon Arm. This trial is in the ICH m1 subzone.

At each location each species and treatment combination was replicated four times. Each replication consisted of a row of 35 trees planted 2.0 metres apart.

Of the 35 seedlings in each row:

10 - were measured for height and calliper (#11-20)
25 - were measured for survival (#1-25)
10 - are available for destructive sampling (#26-35).

At each location 140 trees were planted for each treatment/species combination.
Each row was spaced 3.0 m apart. A total of 48 rows (4 treatments x 3 species x 4 replications) were established at each location.

A total of 1680 trees were planted at each location. A total of 3360 seedlings were planted in the two locations.

Seedlings were planted using a planting shovel. Gromax tea-bags or Ani-Pel tablets were placed in the planting hole, directly beside the plug. Ani-Spray was formulated and sprayed on the seedlings the day prior to planting. Survival, height and root collar diameter data were recorded at establishment and in the Fall of 1989 and 1990. Further assessments are scheduled for the Fall of 1991 and 1993. A Chi-square test or an analysis of variance was conducted on these variables to determine any significant differences between treatments.
# STOCK AND SITE DESCRIPTIONS
## FOR FERTILIZATION TRIAL SX89123Q

### STOCK DESCRIPTION

<table>
<thead>
<tr>
<th>Species</th>
<th>Fdi</th>
<th>Se</th>
<th>Pli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock Type</td>
<td>PSB 313A</td>
<td>PSB 313A</td>
<td>PSB211A</td>
</tr>
<tr>
<td>Seedlot</td>
<td>8144</td>
<td>8150</td>
<td>27028</td>
</tr>
<tr>
<td>Nursery</td>
<td>RC</td>
<td>DR</td>
<td>VR</td>
</tr>
<tr>
<td>Date Planted</td>
<td>stock planted May 29-June 3, 1989</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SITE DESCRIPTION

| Location | Tillis #1 | Tillis #2 |
| Mapsheet & Opening # | 82L085-4 | 82L085-5 |
| Former Stand Species | CHB83 | CHB83 |
| Biogeoclimatic Subzone | ICH m1 | ICH m1 |
| Ecosystem Association | SHG | M |
| Moisture Regime | 4-5 | 3-4 |
| Nutrient Regime | D | D |
| Soil Texture | L/CL 25% | L 30% |
| LFH Layers (cm) | 5 | 5 |
| Site Prep: Method | Broadcast | Broadcast |
| Burn | 1987 | 1987 |
| Site Prep: Year | 20% | 15% |
| Aspect | East | West |
RESULTS

For the variables:

1. survival,
2. height and height increment,
3. root collar diameter (RCD) and RCD increment,
4. stem volume, and
5. stem to RCD (SR) ratio,

graphs are presented of the results of the 12 treatments. These graphs are accompanied by summaries of the statistical analyses by treatment and location.

Brush growth/coverage immediately around the seedlings is being monitored in this trial. After 2 growing seasons, there were no significant increases in brush coverage around the fertilized seedlings as compared to the control.
By Treatment: A Chi-square test indicates that there were significant differences (p<0.05) in survival of the 12 treatments after 2 growing seasons. All Engelmann spruce and lodgepole pine treatments had survival rates 10-20% higher than similar treatments using Douglas fir. Tillis location 1 is a water receiving site, subhygic in moisture status and is not a preferred location for Douglas-fir growth and survival. For all 3 species, the Control (#1) and both Gromax (#2, #3) treatments had survival rates 10-20% higher than the Ani-Pel (#4) treatments. There were no differences between the Control (#1) and the Gromax (#2, #3) treatments or between the Gromax treatments using 1 teabag (#2) and Gromax using 2 teabags (#3).

Note: The high mortality of seedlings treated with the Ani-Pel (#4) was due to the manufacturer accidently producing a batch of Ani-Pel at a concentration toxic to seedlings. The manufacturer claims this problem has been rectified in new batches of Ani-Pel.

By Location: A Chi-square test indicates that there were differences in survival between the locations after 2 growing seasons. At Tillis Location 1, survival for the Ani-Pel (#4) treatments were higher by 49% for Douglas fir and 17% for Lodgepole pine than at Tillis Location 2. For Douglas fir, the 2 teabag Gromax (#3) treatment at Tillis Location 1 also had 17% higher survival rate than at Tillis Location 2.

Graph 1 shows survival for the 12 treatments.
Graph 1. Survival
Summary of treatments for entire trial two years after outplanting

Survival (%)

100
90
80
70
60
50
40
30
20
10
0

1 2 3 4
Douglas fir

1 2 3 4
Engelmann spruce

1 2 3 4
Lodgepole pine

Treatments
1 Control
2 Gromax 12-5-8 1-Teabag
3 Gromax 12-5-8 2-Teabags
4 Anipel Plus 18-6-12 1-Tablet
**Height**

**By Treatment:** An analysis of variance indicates that there were significant differences ($p<0.05$) in height and height increment between the 12 treatments after 2 growing seasons. The Engelmann spruce fertilized with 1 and 2 teabags of Gromax (#2, #3), had significantly larger 2 year total height and height increment than the Control (#1) and Ani-Pel (#4) treated Engelmann spruce.

At each location, lodgepole pine seedlings fertilized with 1 and 2 teabags of Gromax had significantly greater height increments than the control.

All 4 Douglas fir treatments had significantly lower 2 year height increments than the Engelmann spruce and lodgepole pine treatments. Other differences were not statistically significant; however, for lodgepole pine and Douglas fir, the Gromax treatments (#2, #3) had larger total height and height increment than the Control (#1) and Ani-Pel (#4) treatments.

**By Location:** Analysis of variance indicates there was a significant difference between locations in the 2 year height increment. The height increments at Tillis Location 1 were lower for 11 of the treatments than at Tillis Location 2. Only the Douglas fir Ani-Pel treatment was higher at Tillis Location 1. The Tillis Location 2 was on a west-facing slope, with mesic site conditions, while Tillis location 1 was on a east-facing slope with subhygric moisture conditions. The greater height increment at Tillis Location 2 is probably due to the loamy soil, increased soil warming and exposure to sun.

Graph 2 shows the height and height increments.
Graph 2. Height
Summary of treatments for entire trial at outplanting to second growing season

![Graph showing height growth comparison for different treatments and species](image)

- **Douglas fir**
  - 1 Control
  - 2 Gromax 12-5-8 1-Teabag
  - 3 Gromax 12-5-8 2-Teabags
  - 4 Anipei Plus 18-6-12 1-Tablet

- **Engelmann spruce**

- **Lodgepole pine**

**Legend:**
- Planting
- 1st Season
- 2nd Season

**Height (cm):**
- 0
- 10
- 20
- 30
- 40
- 50
<table>
<thead>
<tr>
<th>Root Collar Diameter (RCD)</th>
</tr>
</thead>
</table>

**By Treatment:** An analysis of variance indicates that there were significant differences \((p < 0.05)\) in RCD and RCD increment between the 12 treatments after 2 growing seasons. The total RCD for Engelmann spruce fertilized with 1 and 2 teabags of Gromax \(#2, #3\), was significantly larger than the Control \(#1\) and Ani-pel \(#4\) treated Engelmann spruce. The Engelmann spruce fertilized with 1 and 2 teabags of Gromax \(#2, #3\), also had significantly larger 2 year RCD increments than the Control \(#1\) and Ani-pel \(#4\) treated Engelmann spruce.

Other differences were not statistically significant when examining both locations combined; however, all Engelmann spruce (except the Control treatment) and lodgepole pine treatments had greater RCD increments than the Douglas fir treatments. Also for lodgepole pine and Douglas fir, the Gromax treatments \(#2, #3\) had greater RCD and RCD increments than the Control \(#1\) and Ani-Pel \(#4\) treatments.

**By Location:** Analysis of variance indicates there was a significant difference between locations in the overall total RCD and 2 year RCD increment. The RCD increments at Tillis Location 1 were lower for all 12 of the treatments than at Tillis Location 2. Tillis Location 1 has an easterly aspect and is a subhygric site with a loam to clay-loam soil texture. These site factors resulted in the lesser growth on this site as compared to site 2 which was a west-facing mesic site with loamy soil texture.

At each location lodgepole pine fertilized with 1 and 2 teabags of Gromax had significantly larger RCD's and RCD increments than the control.

Graph 3 shows the RCD and RCD increments.
Graph 3. Root Collar Diameter
Summary of treatments for entire trial at outplanting to second growing season

Root Collar Diameter (mm)

Planting 1st Season 2nd Season

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas fir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engelmann spruce</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lodgepole pine</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Treatments
1 Control
2 Gromax 12-5-8 1-Teabag
3 Gromax 12-5-8 2-Teabags
4 Anipel Plus 18-6-12 1-Tablet
Seedling stem volume was calculated by the following formula: $(22/21)^2 (RCD/20)^2 \times \text{Height})$. The calculated volume in cubic centimetres is a combined measure of height and root collar diameter and gives an indication of total seedling biomass.

By Treatment: An analysis of variance indicates that there were significant differences ($p<0.05$) in volume between the 12 treatments after 2 growing seasons. With both locations combined, Engelmann spruce fertilized with 1 and 2 teabags of Gromax (#2, #3), had significantly larger calculated volumes than the Control (#1) and Ani-pel (#4) treatment. There were no significant volume differences between 1 and 2 teabags being applied to the Engelmann spruce. With the statistics for both locations combined, a general pattern was evident with all Gromax treatments (#2, #3) having larger volumes than the Control (#1) and Ani-Pel (#4) treatments.

Douglas fir seedlings fertilized with 1 teabag of Gromax had 69% greater calculated volumes than the control, while seedlings fertilized with 2 teabags of Gromax had an 80% greater volume than the control. Engelmann spruce fertilized with 1 teabag of Gromax had 158% greater volume than the control. Engelmann spruce fertilized with 2 teabags of Gromax had a 168% greater calculated volume over the control. Lodgepole pine seedlings fertilized with 1 teabag of Gromax had 76% greater calculated volumes than the control, while seedlings fertilized with 2 teabags of Gromax had an 73% greater volume than the control.

By Location: Analysis of variance indicates there was a significant difference between locations in the calculated volume after 2 growing seasons. For all 12 treatments, the volumes at Tillis Location 1 were much lower than at Tillis Location 2. At location 1, the lodgepole pine fertilized with 2 teabags of Gromax (#2, #3), had significantly larger calculated volumes than the Control (#1) and Ani-pel (#4) treatment. At location 2, lodgepole pine fertilized with 1 and 2 teabags of Gromax had significantly larger calculated volumes than the control. For both sites there were no significant volume differences in the lodgepole pine when 1 or 2 teabags were applied.

Graph 4 shows the calculated volumes.
Graph 4. Volume
Summary of treatments for entire trial at outplanting to second growing season

Volume (cc)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas fir</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Engelmann spruce</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Lodgepole pine</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Treatments

1. Control
2. Gromax 12-5-8 1-Teabag
3. Gromax 12-5-8 2-Teabags
4. Anipel Plus 18-6-12 1-Tablet

*Volume calculated using (22/21"^3)^*2'HEIGHT) formula*
Seedling stem to RCD ratio was calculated by the formula Height/RCD. The calculated stem to RCD ratio (referred to as the SR ratio) is a combined measure of height and root collar diameter and gives an indication of seedling sturdiness. Seedlings with a smaller ratio may be more sturdy and better able to withstand vegetation or snow press.

**By Treatment:** An analysis of variance indicates that there were significant differences ($p<0.05$) in the SR ratio between the 12 treatments after 2 growing seasons. The SR ratios for the Engelmann spruce and lodgepole pine treatments were significantly smaller than the Douglas fir Gromax treatments (#2, #3) which were significantly smaller than the Douglas fir Control (#1) and Ani-Pel (#4) treatments. The Douglas fir were tall spindly seedlings at time of planting; they had seedling stem to root collar diameter ratios of 102 to 108.

After 2 years, the Douglas fir seedlings fertilized with 1 and 2 teabags had significantly smaller stem to root collar diameter ratios than the control and the anipel treatment. The Gromax fertilizer treatments significantly decreased seedling spindliness, possibly producing a more balanced seedling. Other differences were not statistically significant; however, for Engelmann spruce and lodgepole pine the Gromax treatments (#2, #3) had smaller SR ratios than the Control (#1) and Ani-Pel (#4) treatments. The Gromax treatment produced seedlings with larger RCDs. The lower SR ratio in the seedlings treated with Gromax may indicate sturdier seedlings, better able to withstand vegetation or snow press.

**By Location:** Analysis of variance indicates there was a significant difference between locations in the calculated SR ratio. At Tillis Location 1, all 4 Douglas fir treatments had higher SR ratios than at Tillis Location 2. Differences in SR ratios for the Engelmann spruce and lodgepole pine treatments varied between locations.

Graph 5 shows the calculated SR ratio.
Graph 5. Stem to RCD Ratio
Summary of treatments for entire trial at outplanting to second growing season

Stem to RCD Ratio

120
110
100
90
80
70
60
50
40
30
20
10
0

1 2 3 4
Douglas fir
1 2 3 4
Engelmann spruce
1 2 3 4
Lodgepole pine

Treatments

1 Control
2 Gromax 12-5-8 1-Teabag
3 Gromax 12-5-8 2-Teabag
4 Anipe Plus 18-6-12 1-Tablet
CONCLUSION

This trial was conducted to compare the benefits of fertilization at time of planting and the prevention of animal damage in three seedling species.

The three stocktypes planted were:

1) Fdi 1+0 PSB 313A
2) Se 1+0 PSB 313A
3) Pli 1+0 PSB 211A.

Four treatments were applied at the time of planting:

<table>
<thead>
<tr>
<th>Treatment No.</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control. No other amendments.</td>
</tr>
<tr>
<td>2</td>
<td>1 package (&quot;teabag&quot;) of Gromax Transplant 2 (12-5-8) fertilizer placed in planting hole. Each package contained 12 grams of 12-5-8 fertilizer and 3 grams of super absorbant gel.</td>
</tr>
<tr>
<td>3</td>
<td>2 packages (&quot;teabags&quot;) of Gromax Transplant 2 (12-5-8) fertilizer placed in planting hole.</td>
</tr>
<tr>
<td>4</td>
<td>1 tablet of Ani-Pel Plus (18-6-12) placed in planting hole and seedling sprayed with Ani-Spray.</td>
</tr>
</tbody>
</table>

All four treatments were applied to each of the three species for a total of twelve different treatments.

Two locations were established in the Salmon Arm District, Kamloops Region at Tillis Landing approximately 35 km from Salmon Arm to the northeast in openings 82 L 085 - 4 and 5 in the ICH m1 subzone.

Comparisons were made between treatments and locations of survival, height and height increment, root collar diameter (RCD) and RCD increment, volume, and stem to RCD ratio (SR ratio).

The significant results and general trends after 2 growing seasons by treatment for each variable analysed were:

- Survival
  - Se and Pl > Fd
  - 1-Gromax, 2-Gromax & Control > Ani-Pel
  - generally, Control = 1-Gromax and 2-Gromax
  - generally, 1-Gromax = 2-Gromax
o Height  
- Se 1-Gromax & 2-Gromax > Se Control & Ani-pel

o Height Increment
- Se 1-Gromax & 2-Gromax > Se Control & Ani-pel
- Se and Pl > Fd
- generally, Pl and Fd 1-Gromax & 2-Gromax > Pl and Fd Control & Ani-Pel

o Root Collar Diameter (RCD)
- at each location, Se 1-Gromax & 2-Gromax > Se Control & Ani-pel
- generally for both locations combined, all species 1-Gromax & 2-Gromax > Control & Ani-Pel

o Root Collar Diameter (RCD) Increment
- Se 1-Gromax & 2-Gromax > Se Control & Ani-pel
- generally, Se and Pl > Fd
- generally, Pl and Fd 1-Gromax & 2-Gromax > Pl and Fd Control & Ani-Pel

o Volume
- at each location, Se 1-Gromax & 2-Gromax > Se Control & Ani-pel
- generally for both locations combined, all species 1-Gromax & 2-Gromax > Control & Ani-Pel

o SR Ratio
- Se and Pl < Fd 1-Gromax & 2-Gromax < Fd Control & Ani-pel
- generally, Se and Pl 1-Gromax & 2-Gromax < Control & Ani-Pel

By Treatment: For height, height increment, RCD, RCD increment, volume, and SR ratio, Engelmann spruce fertilized with 1 and 2 teabags of Gromax performed significantly better than the Control and Ani-pel treated Engelmann spruce. In general, lodgepole pine and Douglas fir seedlings in both Gromax treatments also performed better than in the Control or Ani-Pel treatments. Engelmann spruce and lodgepole pine treatment seedlings generally performed better than Douglas fir treatment seedlings. For survival, both Gromax treatments and the Control treatments performed better than the Ani-pel treatments.
After 2 growing seasons, there was no evidence of significant animal browse on any of the treatments.

**Note:** The batch of Ani-Pel received from the manufacturer was at a concentration toxic to the seedlings. This resulted in the lower survival for seedlings treated with Ani-Pel spray. The manufacturer claims to have corrected their formulation problem.

**By Location:** Overall, significant differences were observed between the 2 locations. Seedlings at Tillis Location 1 had higher survival and SR ratio and lower height increment and volume than at Tillis Location 2. Tillis Location 2 had a westerly aspect, loamy soil texture, and mesic moisture conditions, whereas Tillis Location 1 had an easterly aspect, loamy to clay loam soil texture, and subhygic moisture conditions.

**RECOMMENDATIONS:**

1. On these sites, one package of Gromax Transplant 2 (12-5-8) containing 12 grams of fertilizer and 3 grams of super absorbant gel properly placed in the planting hole can result in considerable increases in seedling size for different tree species. Where brush encroachment and vegetation press are a concern, fertilizing at time of planting will develop larger seedlings which may be better able to withstand brush competition.

2. Operational trials to determine the efficacy and cost-effectiveness of planters adding teabags to the seedling at time of planting should be undertaken. Careful monitoring of planters must be carried out in order to ensure proper placement and handling of trees and teabags.

3. Further trials should be carried out examining the survival and growth rate of conifers using teabags with different amounts of fertilizer. On this site two teabags of fertilizer did not appreciably increase seedling volume over one teabag. More trials need to be undertaken to determine optimum amounts of fertilizer to be included in the teabags.

4. Seedling root development of the control and fertilized trees should be undertaken in the fall of 1993. Further trials should be carried out examining the survival and growth rate of conifers using teabags with different N-P-K formulations. Fertilizer formulations using higher levels of phosphorous (to increase root development) and higher levels of potassium (for shoot and bud development) should be examined.
APPENDIX

Appendix 1 Location Map