

## Ontario Root System Management Practices

Glenn McLeod\*

### Introduction

I would like to cover the Ontario approach to, and objectives of, root system management in our coniferous nursery stock. My talk is divided into the following sections:

- terminology
- Ontario objectives
- controlling factors
- species response

### Terminology

**Root Pruning** - the preferred term is undercutting. This is the mechanical cutting of roots, in situ, in the seedbed or transplant bed.

**Horizontal** - is the drawing of a thin sharp blade under the seedbed/transplant bed, parallel to the soil surface. The blade severs roots extending below the set depth.

**Vertical** - is the severing of lateral roots by passing cutting blades or rolling coulters between the seedling rows. Lateral roots which grow from one row into another will be cut. Lateral roots which extend down the row will not be severed.

**Box** - is a combination of horizontal and vertical pruning with the added feature of cutting roots between trees in each seedling row. Lateral roots are cut in all four sides and horizontal undercutting severs the roots at the bottom of the box.

**Root Wrenching** - utilizing a horizontal angled blade to cause the physical disturbance of loosening and aerating the bed and the root system. Wrenching is carried out with a thicker, broader blade than root pruning. The loosening and aerating action breaks up the root:soil contract.

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Note: wrenching almost always follows a horizontal undercutting treatment. If pruning is not done prior to wrenching, then the wrenching will provide a very crude pruning action as the blade is drawn through the soil.

### Objectives

The objectives vary from nursery to nursery and species to species. In a survey (Racey, 1987) of the provincial nurseries, all Ontario nurseries reported carrying out undercutting and/or wrenching to one extent or another. Their main objectives were as follows:

1. Reduce top/root ratio to produce a better balanced seedling.
2. Increase the degree of fibrous root mass and overall root volume.
3. Produce seedlings with the attributes of transplants.
4. Condition stock for outplanting.
5. Condition stock for overwinter storage.

A single undercutting or wrenching treatment will not usually produce the desired results. Often multiple wrenchings will follow an undercutting treatment to increase the stock response. Whatever the objective(s) may be in your nursery, as far as modifying the physical features of the nursery stock, you must keep in mind that outplanting performance is the ultimate goal. Treatments that make nursery stock appealing to the eye may or may not produce a seedling capable of enhanced outplanting performance.

### Controlling Factors

I now want to touch on some of the controlling factors that affect a seedling and its ability to respond to the treatments.

### Density and Uniformity of Seedbeds

Seedbeds which are thicker than normal will have a reduced response due to the competition factor. Seedbeds with lower than normal density will show enhanced response as the amount of competition between seedlings will be substantially reduced.

I have included "Uniformity" here because a seedlot can be at the right density but with a very poor distribution. Seedlings inside the thick patches will not be able to respond the way individual scattered seedlings can.

### Depth of Treatment

**Undercutting** - the most effective depth of treatment is in the 5-10 cm range. At Orono we have found the 7.5 cm most effective on Scots and red pine. The literature cites a number of examples where pruning too deep has not provided the desired response.

**Vertical pruning** - the depth of the rolling coulters or knives must be equal to or exceed the depth of the horizontal undercutting. If this is not done, roots will be left untreated.

**Wrenching** - when conducted shortly after the undercutting, set the depth 2-3 cm (1 inch) below the depth of the undercut. If done later, the depth should be set deeper (5 cm/2 inches) to ensure the wrenching blade is not tearing roots.

### **Blade Angle**

**Undercutting** - the blade should be level to get a clean cut with very little soil disturbance.

**Wrenching** - the purpose of the wrenching is to provide a high degree of soil disturbance without exposure of root material. At Orono, we utilize a 20-25 degree angle at a fast walking pace (6-8 km/hr). We have found this to be very effective providing good cracking of the soil as it passes over the blade.

### Timing

The timing of the treatment will vary with the objective in mind. I recommend each nursery develops their own schedules for their stock taking into consideration climate, stock response, growing conditions and cultural practices.

**Undercutting** - basically there are three time periods available in relation to shoot elongation.

treatments initiated prior to elongation - April 1 - May 1  
 treatments initiated during elongation - May 15 - June 15  
 treatments initiated after elongation - July 1 - July 15

**Vertical pruning - when combining horizontal and vertical undercutting, I recommend that you leave 7-10 days between treatments. This allows the stock to settle back in with an irrigation and to adjust to the treatments in a progressive manner rather than severe shock. It is best to do the horizontal treatment first.**

**Wrenching -** again timing changes with your objectives. Treatments can be done close together immediately after undercutting to stop height growth or fixed intervals of 3-6 weeks can be used. For example, in the 2-0 and 3-0 year of red pine 3+0 crop.

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### Soil Moisture

**Prior to undercutting, the soil moisture should be at or near field capacity. This will result in a cleaner cut, less stock stress and less wear on the equipment.**

**Wrenching -** again I recommend being at or near field capacity. Then depending on the objective in mind, you let the stock dry down to the desired level prior to re-irrigating. Always start from a fixed base level for moisture to ensure uniformity of treatment from year to year.

### Diseases

**Concern has been expressed by nurserymen and pathologists regarding the possibility of root rot fungal infection of tree seedlings that have been undercut and wrenched. It is hypothesized that the stressed seedlings will be more susceptible to disease and that the cut surfaces of the roots will act as entry points for infection. Petaisto (1982) failed to demonstrate any relationship between incidence of fungal infection and pruning. However, McGowan and Juzwick (1987) showed a general trend towards higher incidence of root infection in undercut and wrenched seedlings, but could not conclude if the increase was significant enough to justify a change in management practice.**

**Much more work is required to determine if undercutting and wrenching benefits will contribute to disease problems.**

### Conclusions

Our planters do not dig large planting holes. Because of this we are trying to put more root mass in a compact planting package. Our nurseries are working with lower seedbed densities and aiming for more uniformity within the beds. Equipment such as precision seeders are being evaluated in our attempt to produce a seedling with transplant like qualities.

### References

- McGowan, D. and J. Juswick, 1987. **Effect of root pruning and wrenching treatments on infection of conifer seedling roots by Cylindrocladium floridanum.** Ont. Min. of Nat. Resources, Pest Control Section Report.
- Petaisto, R.L., 1982. Risk of fungal infection on coniferous seedlings after root pruning in forest nurseries. *Folia For.* 505:1-8.
- Racey, J.E. and G.R. Racey, 1987. **Undercutting and Root Wrenching: an Annotated Bibliography.** Ont. Min. of Nat. Resources, Ont. Tree Improvement and Forest Biomass Inst., For. Res. Report No. 121.

## Species Response

### Scots Pine Orono

- **treated in the** 2nd growing season

### Red Pine Orono

- **treated in the** 2nd & 3rd growing season

### White Pine Midhurst

- **treated in the** 2nd & 3rd growing season

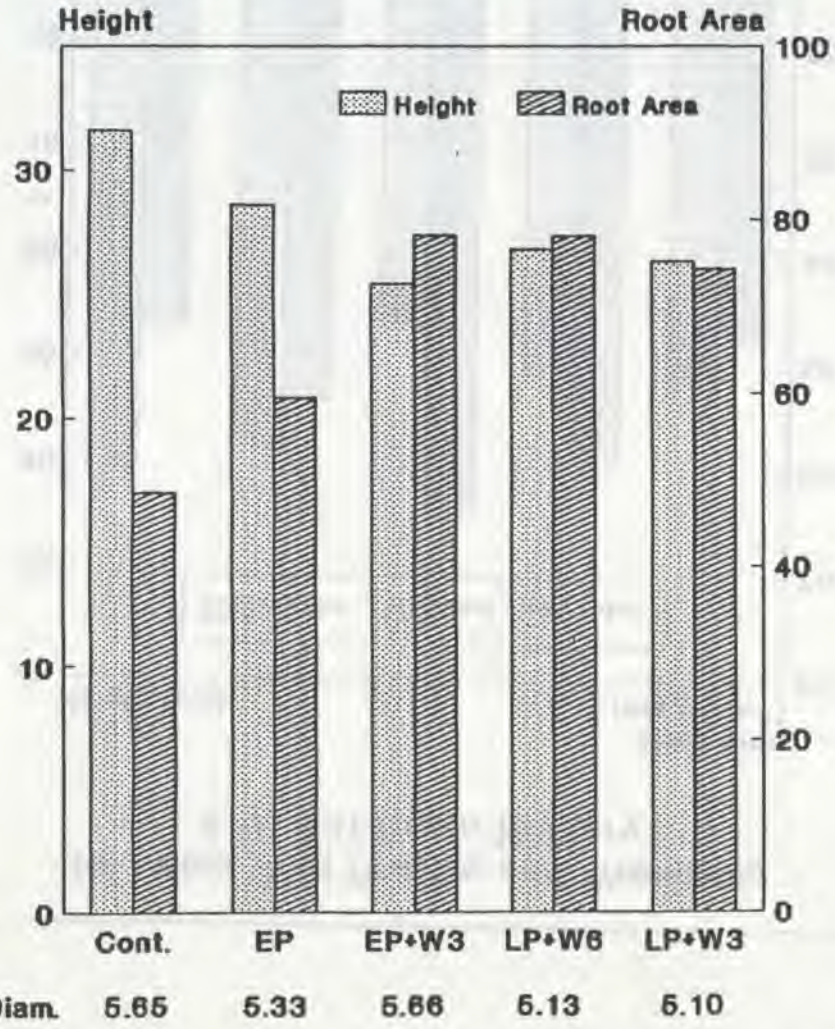
### White Spruce Midhurst

- **treated in the** 2nd & 3rd growing season

### Red Pine Midhurst

- **treated in the** 2nd & 3rd growing season

Scots pine root pruning and wrenching  
2-0 S25 Orono



Scots Pine Root Pruning & Wrenching  
2-0 S25 Orono

| 2-0<br>Treatmt.         | Height<br>cm | R.C.Diam.<br>mm | R.A.I<br>cm | Total<br>Dry Wt. | Top/Root<br>Ratio |
|-------------------------|--------------|-----------------|-------------|------------------|-------------------|
| Control                 | 31.57        | 5.65            | 48.6        | 10.11            | 5.29              |
| Early Prune             | 28.61        | 5.33            | 59.6        | 8.82             | 3.96              |
| E.Prune +1<br>Wrench    | 25.36        | 5.66            | 78.2        | 9.94             | 3.83              |
| L.Prune +6<br>wk Wrench | 26.80        | 5.13            | 78.1        | 8.74             | 3.12              |
| L.Prune +3<br>wk Wrench | 26.27        | 5.10            | 74.3        | 8.20             | 3.74              |

Early Prune - carried out May 6

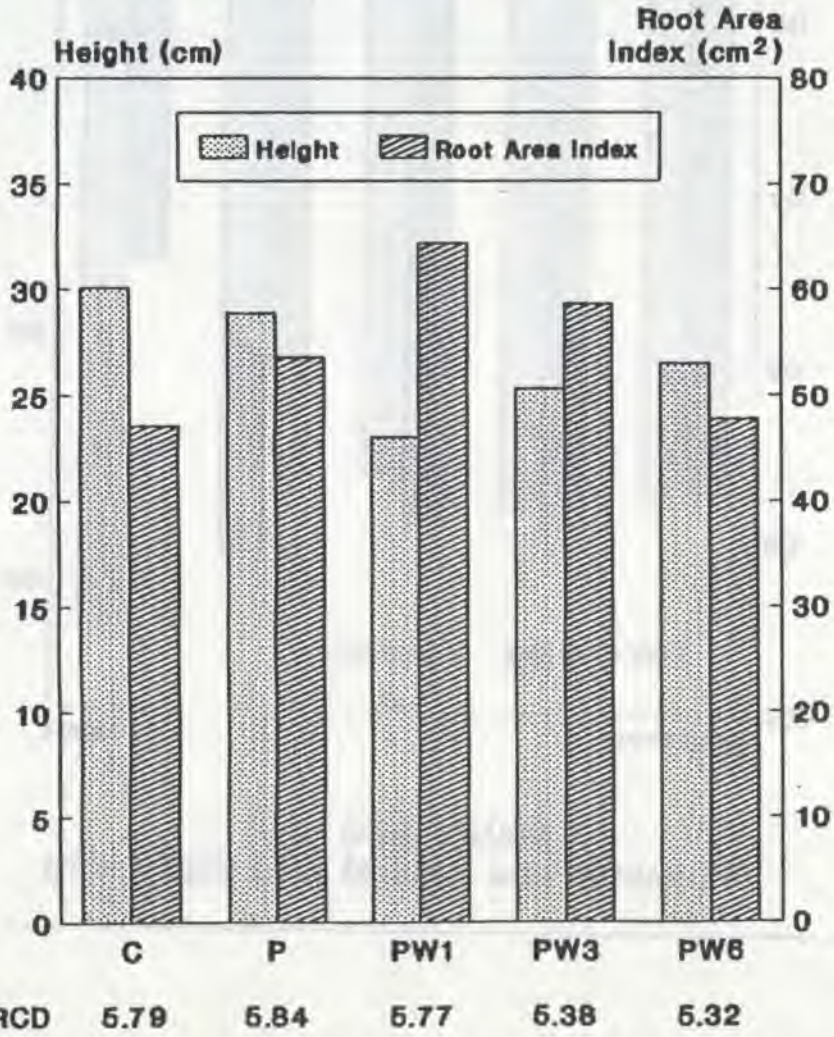
Late Prune - carried out July 8

1 Wrench - is one wrenching treatment three weeks after the early prune.

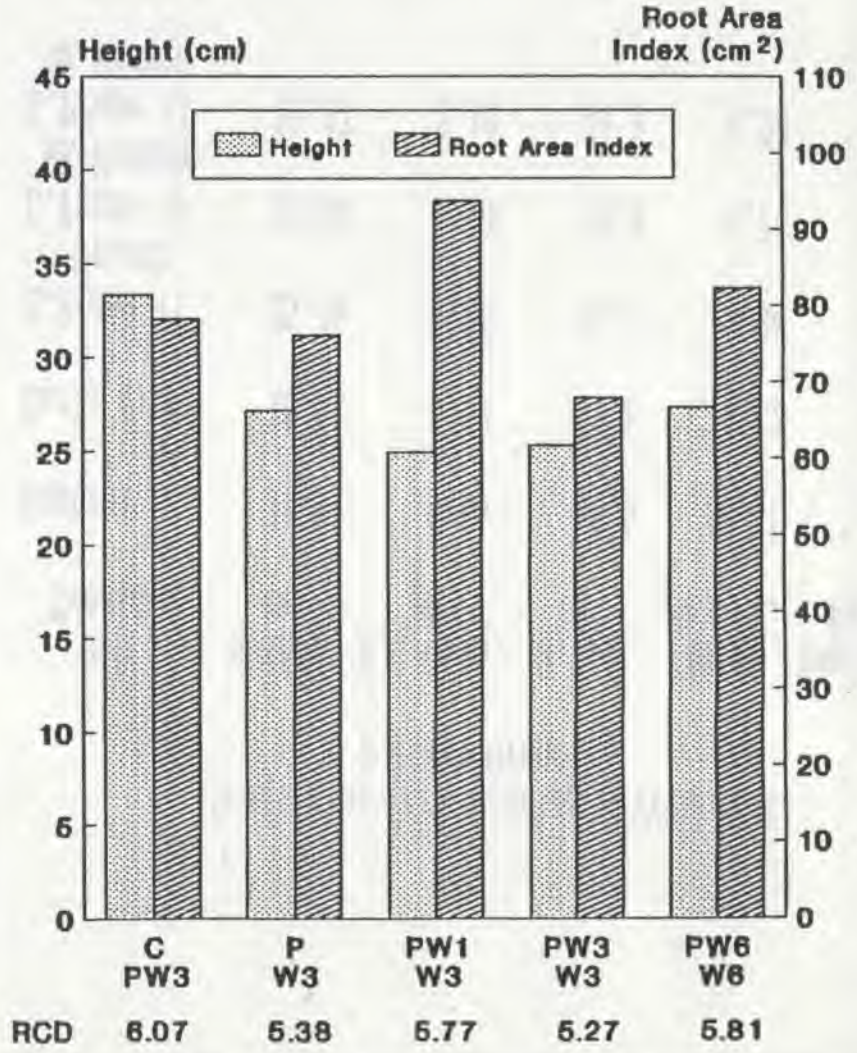
6 wk. & 3 wk.  
Wrench - wrenching at 6 & 3 week intervals for the rest of the growing season.



### Red Pine Root Pruning and Wrenching 2-0 S31 Orono Nursery



### Red Pine Root Pruning and Wrenching 2-0 & 3-0 S31 Orono Nursery



Red Pine Root Pruning & Wrenching  
2-0 & 3-0 S31 Orono

| 2-0<br>Treatmt.  | 3-0<br>Treatmt,  | Height<br>cm | R.C.Diam,<br>mm | R.A.I<br>cm | Total<br>Dry Wt, | Top/Root<br>Ratio |
|------------------|------------------|--------------|-----------------|-------------|------------------|-------------------|
| Control          |                  | 30,09        | 5,79            | 47,1        | 307.1            | 5.69              |
| Control          | Prun&Wren<br>3wk | 33.33        | 6.07            | 78.4        | 329.4            | 3.64              |
| Prune            |                  | 28,89        | 5.84            | 53.6        | 352.8            | 5.92              |
| Prune            | Wrench 3wk       | 27,16        | 5.38            | 76.2        | 284.1            | 3.76              |
| Prun&Wren<br>1wk |                  | 23.00        | 5.77            | 64.4        | 326.0            | 3.93              |
| Prun&Wren<br>1wk | Wrench 3wk       | 24.92        | 5,77            | 93,7        | 331,4            | 2.87              |
| Prun&Wren<br>6wk |                  | 26,48        | 5.32            | 47.7        | 314.3            | 6.15              |
| Prun&Wren<br>6wk | Wrench 6wk       | 27,29        | 5.81            | 82.2        | 358.5            | 3,99              |
| Prun&Wren<br>3wk |                  | 25.31        | 5.38            | 58.6        | 280.6            | 4.20              |
| Prun&Wren<br>3wk | Wrench 3wk       | 25,28        | 5,27            | 68.0        | 283,7            | 3,59              |

2-0 Treatments - prune carried out July 16

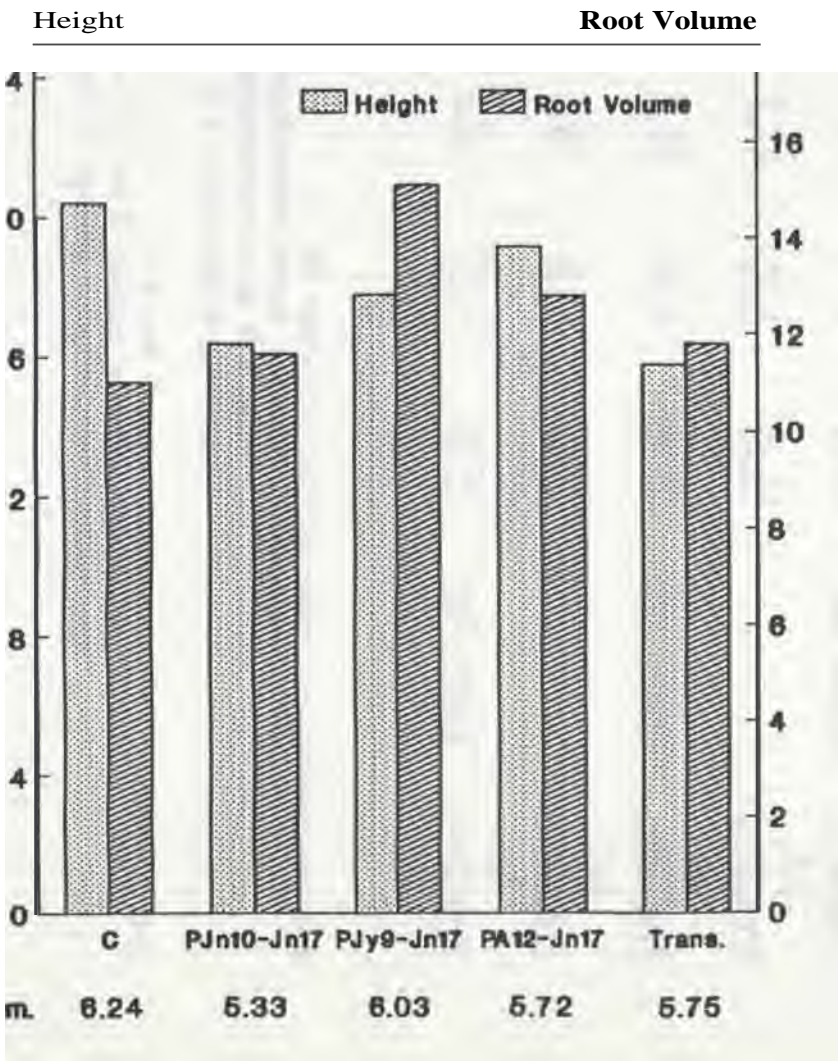
- wrenching: 1 wk is three wrenchings 1 week apart  
3 wk & 6 wk is wrenching the rest of the  
growing season on a 3 & 6 wk interval.

3-0 Treatments - prune carried out May 6

- wrenchings carried out at 3 wk & 6 wk intervals for  
the rest of the growing season as indicated.



## White pine root pruning 2-0 & 3-0 D-2 Midhurst



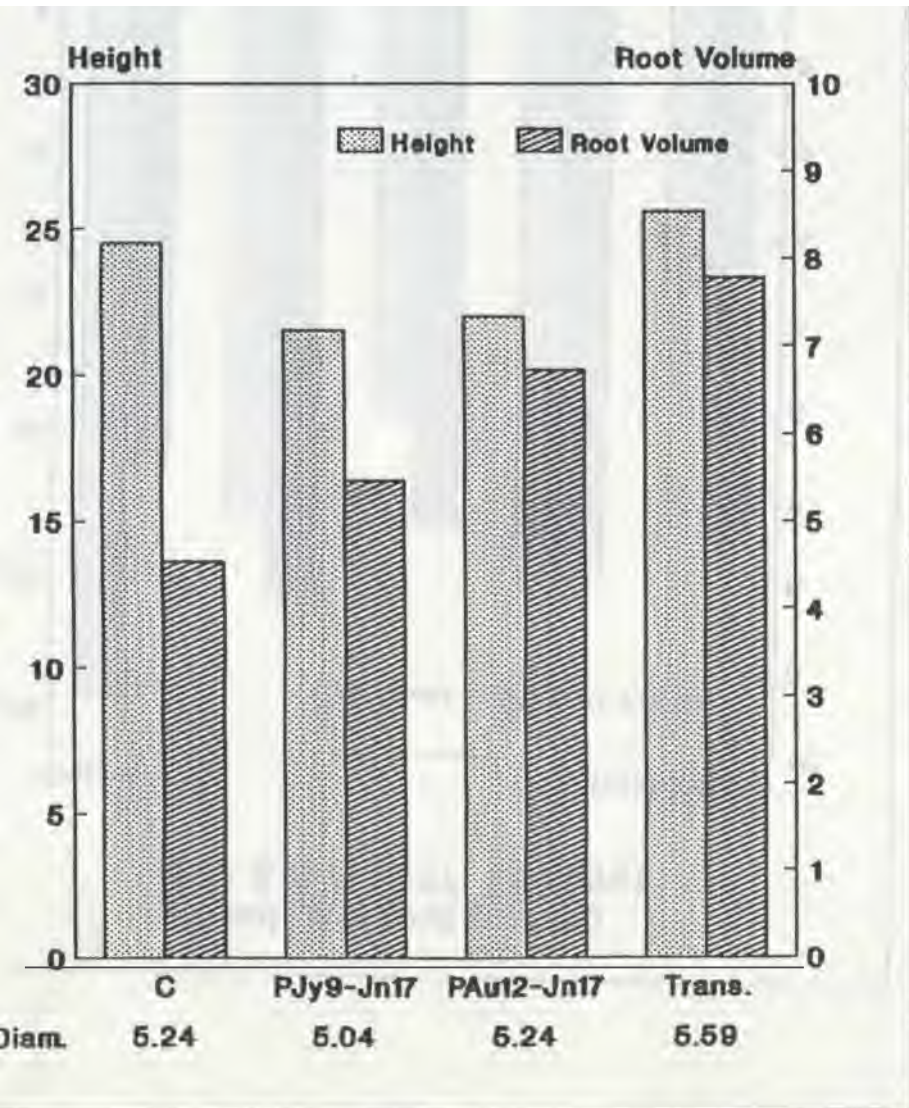
## White Pine Root Pruning & Wrenching 2-0 & 3-0 D2 Midhurst

| 2-0<br>Treatmt. | 3-0<br>Treatmt. | Height<br>cm | R.C.Diam<br>mm | Root Vol<br>ml | Total<br>Dry Wt. | Top/Root<br>Ratio |
|-----------------|-----------------|--------------|----------------|----------------|------------------|-------------------|
| Control         | Control         | 20.41        | 6.24           | 10.96          | 10.22            | 2.59              |
| Prun Jn10       | Prun Jn17       | 16.41        | 5.33           | 11.63          | 8.29             | 1.75              |
| Prun Jy9        | Prun Jn17       | 17.84        | 6.03           | 15.07          | 10.96            | 1.76              |
| Prun Au12       | Prun Jn17       | 19.24        | 5.72           | 12.75          | 9.77             | 1.98              |
| Transplanted    |                 | 15.80        | 5.75           | 11.82          | 10.20            | 2.18              |

2-0 Treatment - wrenched every 3 weeks after initial pruning.

3-0 Treatment - wrenched every 4 weeks after initial pruning.

**White spruce root pruning  
2-0 & 3-0 A-7 Midhurst**



**White Spruce Root Pruning & Wrenching  
2-0 & 3-0 A7 Midhurst**

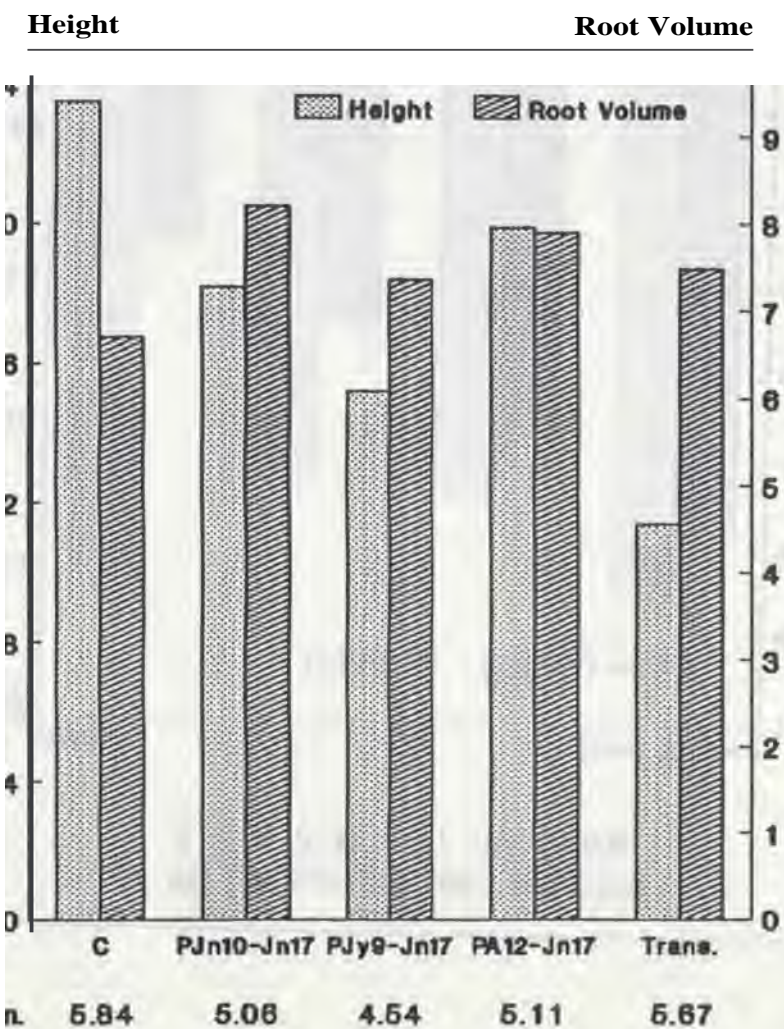
| 2-0<br>Treatmt. | 3-0<br>Treatmt. | Height<br>cm | R.C.Diam<br>mm | Root Vol<br>ml | Total<br>Dry Wt. | Top/Root<br>Ratio |
|-----------------|-----------------|--------------|----------------|----------------|------------------|-------------------|
| Control         | Control         | 24.47        | 5.24           | 4.54           | 6.15             | 3.30              |
| Prun Jy9        | Prun Jn17       | 21.46        | 5.04           | 5.46           | 6.26             | 2.84              |
| Prun Au12       | Prun Jn17       | 22.00        | 5.24           | 6.72           | 6.98             | 2.71              |
| Transplanted    |                 | 25.64        | 5.59           | 7.78           | 7.51             | 2.79              |

2-0 Treatment - wrenched every 3 weeks after initial pruning.

3-0 Treatment - wrenched every 4 weeks after initial pruning.



## Red pine root pruning 2-0 & 3-0 A47 Midhurst



## Red Pine Root Pruning & Wrenching 2-0 & 3-0 A47 Midhurst

| 2-0<br>Treatmt. | 3-0<br>Treatmt. | Height<br>cm | R.C.Diam<br>mm | Root Vol<br>ml | Total<br>Dry Wt. | Top/Root<br>Ratio |
|-----------------|-----------------|--------------|----------------|----------------|------------------|-------------------|
| Control         | Control         | 23.52        | 5.84           | 6.70           | 12.00            | 4.85              |
| Prun Jn10       | Prun Jn17       | 18.15        | 5.06           | 8.21           | 9.71             | 3.28              |
| Prun Jy9        | Prun Jn17       | 15.21        | 4.54           | 7.36           | 7.33             | 2.78              |
| Prun Au12       | Prun Jn17       | 19.90        | 5.11           | 7.90           | 9.34             | 9.34              |
| Transplanted    |                 | 11.36        | 5.67           | 7.49           | 10.72            | 4.15              |

2-0 Treatment - wrenched every 3 weeks after initial pruning.

3-0 Treatment - wrenched every 4 weeks after initial pruning.