Research Forest

Five Year Growth and Performance of Copper Treated Lodgepole Pine

Research Project 94-08

Quick Sheet #8

March, 99

Introduction

Poor stability and toppling of container grown out-planted pine was being observed on the Research Forest in the early 1990's. This trial was established to evaluate the effects of copper root pruning on the growth and performance of out-planted nursery container grown lodgepole pine (*Pinus contorta latifolia* (Dougl).

Cupric carbonate treated container walls inhibit root elongation at the root-container interface in container grown pine (Burdett 1978). Pruned root tips resume growth once seedlings are out-planted. In the mid 1980's, this method of chemical pruning became accepted practice as a means to alleviate problems of root spiraling, down growth and poor lateral root development in nursery grown seedling stock. The expectation is that root pruning will promote more natural and improved lateral root development and therefore better mechanical stability and windfirmness of plantation trees (Kooistra 1991). Many studies on chemical root pruning of this type of planting stock have taken place in the nursery but we found little information about the long term effects of copper root pruning on out-planted seedlings. Wenny et.al. (1988) found that field planted Ponderosa pine (*Pinus ponderosa* Dougl. ex Laws. var. *ponderosa*) and western white pine (*Pinus monticola* Dougl. ex D. Don) seedling height and diameter were unrelated to treatment after one growing season. In a five-year trial, Winter (1990) found no significant treatment difference in lodgepole pine survival, height, height increment, or root collar diameter. Both of these studies, however, observed increases in root growth in the upper portion of plug.

This project was initiated in 1994 to test the assumption of short and/or long-term treatment benefits of copper root pruning.

Methods

This project was established in the SBSdw1 biogeoclimatic subzone on the Gavin Lake block of the Alex Fraser Research Forest. Two replicates blocks were planted in fine textured Brunisolic and Luvisolic soils on mesic sites within openings 93A042-356 and 357. Both openings were logged in 1988. Due to non-sufficient re-stocking, both blocks were fill planted with 415B 1+0 container Pli stock in the spring of 1994. The site was spot prepared to a depth of 15 cm, using a small excavator with screefing head to remove a grass mat prior to planting. One hundred pairs of sample trees were established along randomly located transects in each block. One control (untreated) and one copper treated seedling was planted per prepared spot. Aboveground growth and performance (height, diameter, and condition) was assessed annually. In 1995, 1996 and 1997, subsets of undamaged sample trees were randomly selected for destructive sampling to assess belowground root growth and form. Sample trees were carefully excavated and the following measurements and estimates were made:

- total length of root mass
- width, % fine roots, and % coarse roots of the top and bottom 10 cm of the root mass.

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By the fourth growing season (1997), root growth made complete excavations and belowground assessments very difficult and this component of sampling was abandoned due to the low reliability of the data.

Results

Condition

Seedling survival and condition was good during the first five years of the trial. More than 70% of the trees remained in good condition for the first four years after out-planting. Seedling condition was not significantly affected by the treatment or block (figure 1), although there was slightly higher mortality in opening 356.

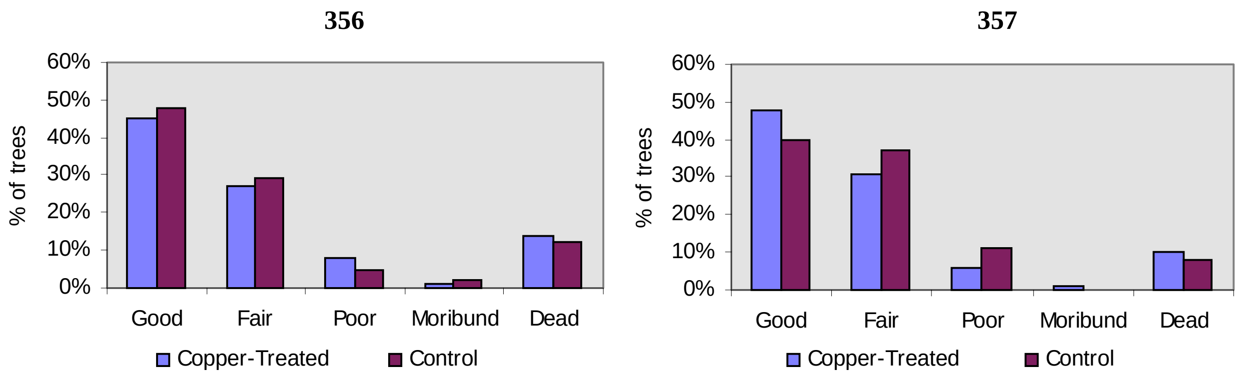

Figure 1) Fifth year tree condition by treatment and replicate site

Seedling condition assessments included an evaluation of damages and overall vigor. The main damaging agents in the first five growing seasons were cattle trampling, wildlife browse, snow press and frost.

In the first year, damage from cattle trampling and wildlife browse was greater on opening 356 (13%) than 357 (4%). During years 4 and 5, there was more cattle trampling and vole/hare herbivory on both blocks than in previous years. In year 4, small mammal browsing affected 9% of the trees on opening 357 and 5% of the trees on opening 356. Small mammal populations and related damage was high in years 4 and 5. The higher incidence of small mammal browse in opening 357 could be attributed to a diversionary feeding trial that was established on that site. Diversionary feeding was intended to reduce small mammal damage by drawing them away from the trees to a more preferred food source (sunflower seeds). This treatment probably attracted higher numbers of hare and voles to opening 357 and possibly resulted in increasing tree damage rather than reducing it. In year 5, stem scarring by cattle and vole was higher (8%) on opening 356 than opening 357 (3%).

Dead, missing or animal damaged trees were removed from the sample for growth analyses.

Aboveground growth:

We observed the following (at $p<0.05$):

- Tree height and stem diameter were unrelated to copper treatment, with the exception that the mean height and diameter of the control trees was significantly greater than that of the copper treated trees on opening 356 in year one.
- Opening 356 supported significantly higher height and diameter growth increment than 357.

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- There was a significant difference in mean height growth between sites in all years except year 1.
- There was a significant difference in mean diameter growth between sites in all years.

The between-site differences in height growth and lack of significant treatment effect are shown in Figure 2.

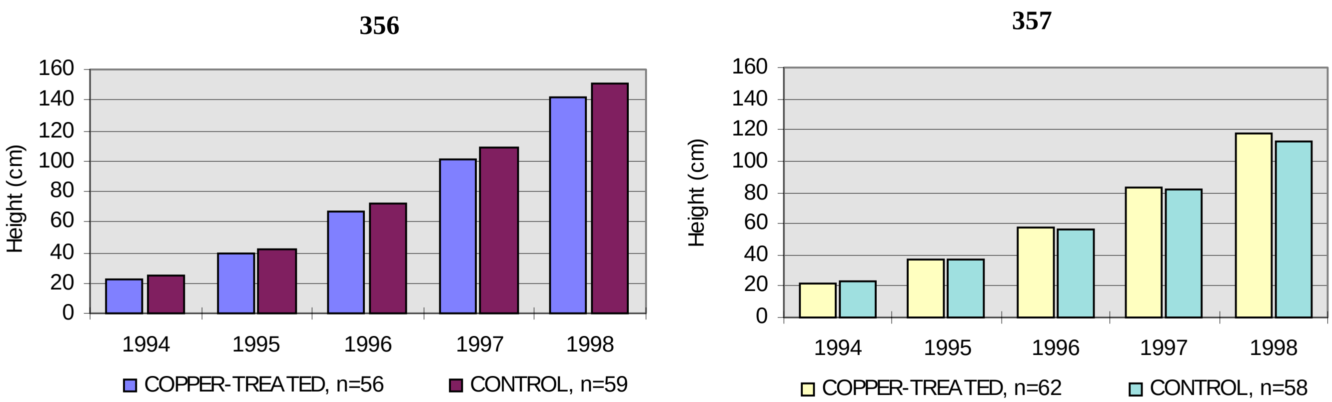

Figure 2) **Mean tree height by treatment and year on openings 356 and 357**

Diameter growth trends were similar to those for height. In year one, the control seedlings had a significantly greater mean diameter than the copper-treated seedlings in opening 356. The lack of treatment effect and the greater diameter growth on opening 356 can be seen in Figure 3.

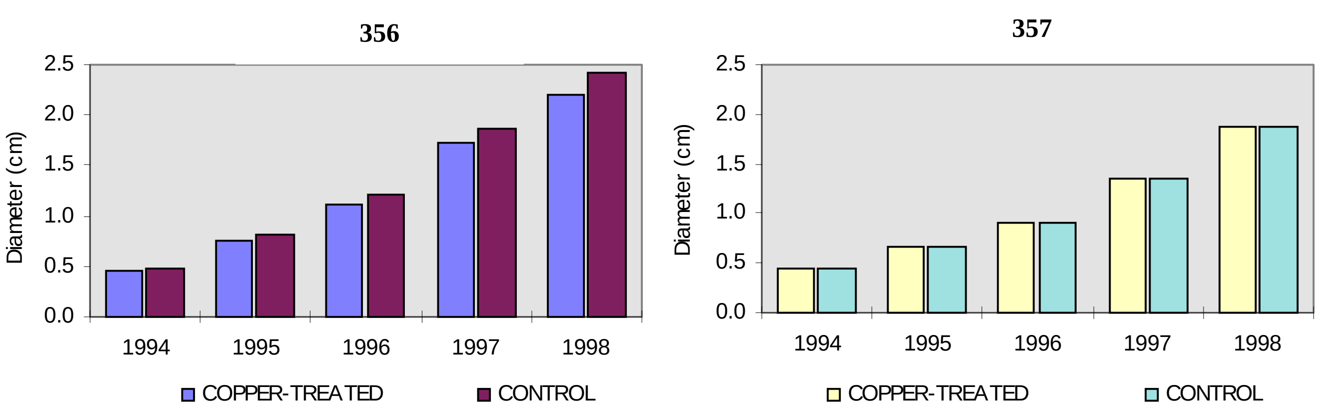

Figure 3) **Mean tree diameter by treatment and year on openings 356 and 357**

Belowground growth:

Sixteen seedlings were destructively sampled for belowground growth in 1995 and 1996. The results of the sample tree root excavations and assessments were highly variable and based on relatively subjective estimates on a very low sample size. We could not conclusively demonstrate improvement of the lateral root growth of the copper treatment although there appeared to be some trends.

We noticed a somewhat wider root mass in the top 10 cm of the copper treated trees, which was generally comprised of more fine roots than the untreated trees (Table 1). In 1995, the copper treated seedling plugs appeared to have better lateral root development. In both years, there was no clear trend in the width or percent of fine roots in the bottom 10 cm of root mass.

An increased sample size and more rigorous methodology is needed to draw any firm conclusions about belowground root development.

Table 1) Means of belowground root form assessed in years 2 and 3

Block		**Total Length**	**Top 10 cm**		**Bottom 10 cm**	
356		**Cm**	width	% fine roots	width	% fine roots
Control	1995	12	6	13%	9	10%
	1996	23	6	25%	5	25%
Treated	1995	4	8	18%	4	13%
	1996	31	8	33%	7	28%
357						
Control	1995	13	4	10%	6	11%
	1996	26	7	35%	5	18%
Treated	1995	11	6	10%	7	13%
	1996	26	8	25%	10	13%

n=4 for each treatment sampled.

Discussion

These results do not demonstrate any growth advantage from the copper-treatment of lodgepole pine seedlings. This is supports the work of Wenny et.al (1988) and Winter (1990). We found no indication that copper-treated container grown stock would produce a more robust pine plantation than untreated stock, in the SBSdw1. Although greater fine root growth in the top 10 cm of treated root plugs was observed, a more comprehensive study of root mass would be needed to draw firm conclusions. This observation, however, does support findings in other studies.

Conclusion

This trial will be assessed for aboveground growth, root form and mechanical tree stability at year 10. In the first five years of this trial, we were not able to determine any significant growth differences between copper treated and untreated trees.

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