AN EVALUATION OF A CHEMICAL ROOT PRUNING TECHNIQUE FOR IMPROVING THE ROOT SYSTEM MORPHOLOGY OF CONTAINERIZED SEEDLINGS

A Thesis

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ABSTRACT

Three western conifer species, *Psuedotsuga menzesii* var. *glauca* (Beissn.) Franco, *Pinus ponderosa* Laws. var. *ponderosa*, and *Pinus monticola* Dougl. were chemically root pruned with cupric carbonate ($CuCO_3$) during greenhouse production. The interior walls of four cubic inch styroblock and Ray Leach pine cell containers were coated with four concentrations of $CuCO_3$ in a latex paint carrier: 0 g $CuCO_3$/liter of paint, 30 g/liter, 100 g/liter, and 300 g/liter. Seedlings were potted after one growing season, initiating a standard root growth potential test (Duryea 1984). The number and length of new roots, greater than one cm in length, were measured and a surface area index was calculated. Seedling root systems increased in total surface area, especially in the upper segments of the root plug, as a result of chemical root pruning. Seedling height and caliper were unaffected by the cupric carbonate treatments during the production phase, and a latex paint carrier did not decrease seedling growth or alter the root system surface area of potted seedlings. Cupric carbonate concentrations needed to produce a maximum surface area index were determined with a multiple regression procedure.

INTRODUCTION

Controlling root system growth habit is necessary to improve seedling quality, growth, and survival (Fayle 1978). A well developed root system is important for the movement of water, nutrients, hormones, and assimilates within the tree. Stability of planted seedlings depends on the number and distribution of horizontal roots around the stem base, development of vertical roots, thickening of the root bases, and resistance of the roots to tension, twisting, and bending. A naturally regenerated tree (a tree renewed by natural means) normally develops well distributed lateral roots, leading to maximum growth and mechanical stability.

The design and volume of a seedling container, as well as nursery cultural practices, ultimately determine the characteristics and development of planted container stock root systems (Van Eerden and Arnott 1974). Root diseases, such as *Armillaria*, may develop in root bound planting stock as a result of strangulation and a mass of dead roots (Stoszek pers. comm.). When removed from the container and planted, the root system of a container seedling remains pressed together in a container-shaped root plug (Stein 1978). The persistence and long term effect of containers on seedling growth and survival are not clear. More research is needed to reliably produce containerized seedlings that, when planted, will be mechanically stable, disease free, and will grow as well as or better than naturally regenerated seedlings (Burdett 1978, McDonald 1981).

A chemical root pruning technique, developed for the production of lodgepole pine and ponderosa pine container stock, reduces the effects of the container imprint on early root system form (Burdett 1978, McDonald 1981). The technique involves coating the interior walls of containers with cupric carbonate ($CuCO_3$) in a latex paint carrier. Root growth is inhibited when roots contact the wall coating. Lateral roots stop growing rather than growing down or around the container wall.

The way in which $CuCO_3$ acts to chemically root prune a container seedling is not clearly understood. Heavy metals are known inhibitors of enzymes and copper binds readily with the sulfhydryl groups of proteins. Copper may bind to cell membranes preventing mitosis (Guach 1972). According to an investigation for excess copper effects on *Chorella*, the focal point of copper action may be to alter cell membrane integrity (Gross 1970). This study further suggests that excess copper will inhibit respiration and cause a decline in packed cell volume.

The root apical meristem appears to inhibit lateral root initiation for some distance basipetally. Root decapitation has been shown to enhance root branching in a number of cases (Street 1969). The inhibitory effects of the root apex may be suppressed as a result of chemical root pruning and result in enhanced lateral root initiation.

McDonald, Tinus, and Reid (1981) tested the chemical root pruning response of ponderosa pine to trifluralin herbicide, indole-3-butyric acid (IBA), and cupric carbonate. Trifluralin had a harmful effect on the seedlings and was dropped from the test. Half of the remaining test seedlings, after being chemically root pruned in Spencer-Lemaire thirty cubic inch bookplanters, were planted in moist vermiculite and grown in a greenhouse bench for approximately five weeks. The total length of each new side and bottom root was measured and the length of side roots expressed as a percentage of total root length. Cupric carbonate at a concentration of 100 g/l resulted in a side root length percentage of 27.1 % compared to 7.8 % for the control. IBA at 50 g/l resulted in a side root length percentage of 34.3 % compared to 9.4 % for the control. The overall performance of IBA was judged to be slightly less than that of cupric carbonate.

Cupric carbonate is practically insoluable in water (Merk Index 1976), allowing the container coating to remain effective for one or more growing seasons. In contrast, cupric sulfate is soluable in water, a characteristic which may not be desirable for a chemical root pruning compound. Cupric sulfide may oxidize to form cupric sulfate upon exposure to moist air, however Dong and Burdett (1986) were successful in using cupric sulfide to chemically root prune Chinese pine.

Burdett (1981) tested the field performance of chemically root pruned lodgepole pine. In second and fourth season field trials, planted untreated lodgepole pine seedlings produced very few roots emerging from the plug except at the bottom.

The roots of planted chemically pruned seedlings emerged at the top of the root plug near the soil surface, and a root system much like that of a naturally regenerated seedling developed. First and second season growth was similar for both treated and untreated seedlings, while the third and fourth season height growth was 15% greater for treated than untreated seedlings.

The objectives of this study were to validate previous work done with chemical root pruning using northern Idaho sources of Douglas-fir (*Psuedotsuga menzesii* var. *glauca* (Beissn.) Franco), ponderosa pine (*Pinus ponderosa* Laws. var. *ponderosa* Engelm.), and western white pine (*Pinus monticola* Dougl.) seed, and determine the optimal cupric carbonate concentrations necessary to chemically prune the roots of these three western conifers.

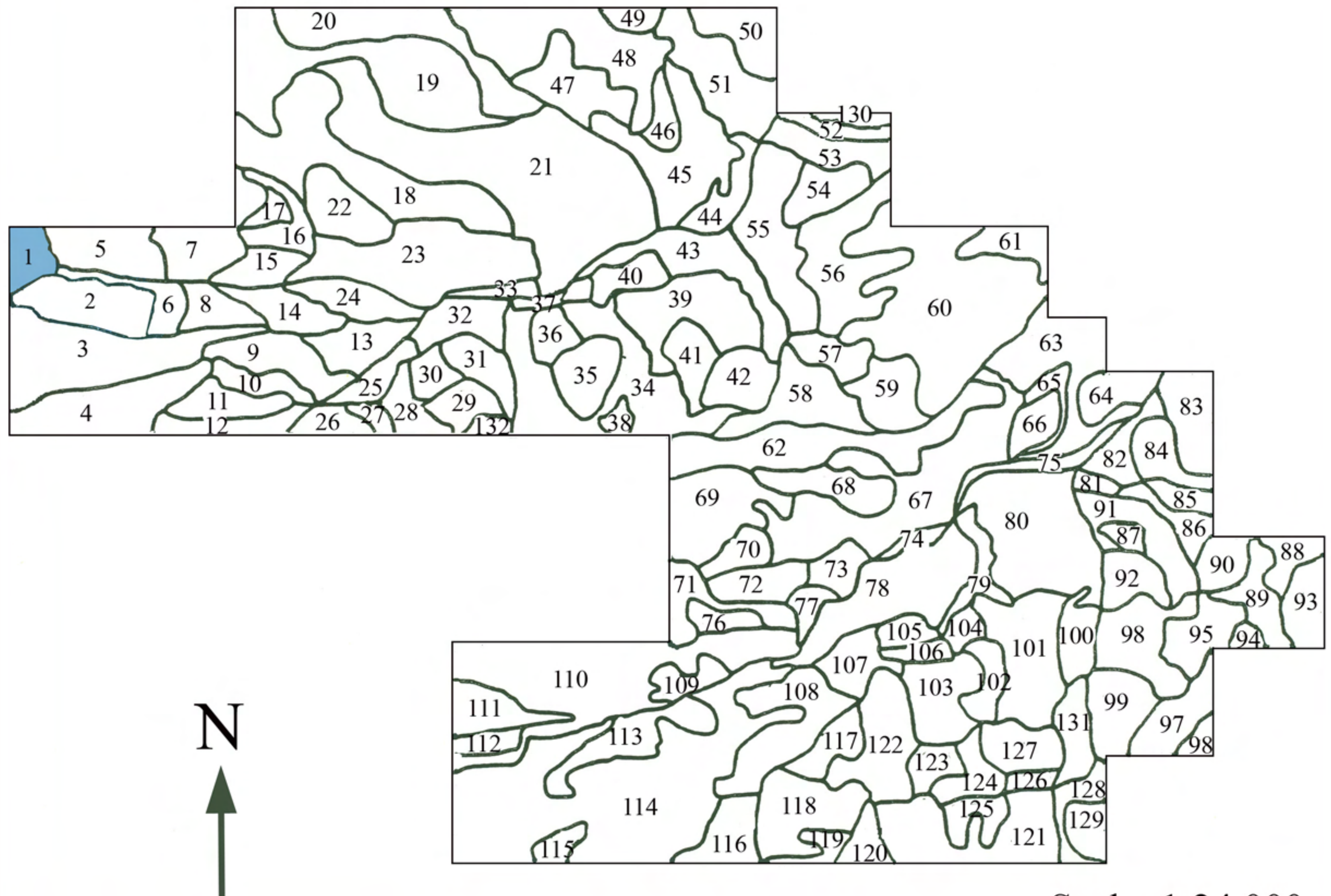
MATERIALS AND METHODS

Douglas-fir, ponderosa pine, and western white pine seedlings were chemically root pruned while growing in the University of Idaho College of Forestry, Research Nursery greenhouse. The seedlings were removed from the containers after one growing season, and were potted to evaluate the chemical root pruning response.

Greenhouse Phase

Ray Leach pine cell and four cubic inch styroblock container cells were randomly assigned one of five treatments: an unpainted control; an interior wall coating of a latex paint; a coating of 30 g cupric carbonate/liter of latex

Stand Map of the West Hatter Creek Unit, College of Forestry, Experimental Forest 1986



By finding the stand number on the table for the map, you are able to then find the stand number on the map an see where the research took place on the experimental forest. This map and table came from *A Combined Report For Fiscal Years 1980 Through 1986*

By
Forest Manager,
Harold Osborne
The maps were edited by
Rachel Voss

Table 6-1. Continued

STAND #	MAP #	STAND DESCRIPTION	ACRES	HARVEST ACTIVITY CODE	FY HARVEST	SLASH/ SITE PREP CODE	FY PREP	REFOREST CODE	FY REFOREST	LOGGING METHOD
30707	42	CULVERT PILE CLEARCUT	9	CC	86	BB	87	P	87	G
31201	1	ROCKY POINT CLEARCUT	25	CC	86	BB	86	P	86	C
31202	2	ROCKY POINT SELECTION UPPER	40	SE	86	DP&B	86	NR	88	G
31203	3	ROCKY POINT SELECTION LOWER	26	SE	86	DP&B	86	NR	88	G
40201	6	KOHLER THINNING	3	T	86	L&S	86			C
40501	5	FIREWOOD THINNING	12.4	T	86	L&S	86			

TABLE 6. AN EXPLANATION OF CODES USED IN TABLES 6-1 AND 6-2.

HARVEST ACTIVITY CODES

CC - CLEARCUT
SHWD - SHELTERWOOD
ST - SEEDTREE
SE - SELECTION
T - THINNING
LT - LOW THINNING
N - NO HARVESTING
IMP - IMPROVEMENT CUT
P - CUT PRIOR TO FY80

REFORESTATION CODES

P - PLANTED
NR - NATURAL REGENERATION
IP - INTERPLANT

SITE PREPARTAION CODES

BB - BROADCAST BORD
DP&B - DOZER PILE AND BURN
L&S - LOP AND SCATTER
JPB - JACKPOT BURN
HPB - HAND PILE AND BURN

LOGGING METHOD CODES

C - CABLE LOGGING
G - GROUND SKIDDING
H - HORSE LOGGING

Location of Complete Research:

Author & Title: Woolen, Richard L. An Evaluation of a Chemical Root Pruning Technique for Improving the Root System Morphology of Containerized Seedlings(1986)

University of Idaho Library:

Call Number- SD 404.3.W66 1986

College of Natural Resources:

Department- Forest Resources

Other Sources: