CONTROLLED-RELEASE FERTILIZER TRIALS ON FOUR CONTAINERIZED WOODY PLANTS

prepared by
Donald R. Ross
for the

Alaska Department of Natural Resources
Division of Agriculture
Plant Materials Center
SRB Box 7440
Palmer, Alaska 99645

February 1987

SLOW-RELEASE FERTILIZER TRIALS ON FOUR CONTAINERIZED WOODY PLANTS

INTRODUCTION

Each growing season, the Alaska Plant Materials Center's (PMC) Horticultural Development and Conservation Plant Projects require the propagation of thousands of containerized woody trees and shrubs. While some plants are distributed the same year, the majority are overwintered one or more years before field planting.

The usual nursery practice after the cuttings are rooted and transplanted is to initiate a liquid-feed fertilizer program which continues until the middle of August. At this time the fertilizer is discontinued to hasten the hardening-off process in preparation for winter. Fertilization begins again the following spring as dormancy ends and new growth begins.

In recent years, controlled-release fertilizers have become available that are designed to release nutrients over a period of months. Once the fertilizer is incorporated into the soil, no additional fertilization is needed, thereby saving time and labor. However, because of Alaska's cold soil temperatures, their effectiveness in releasing nutrients into the soil has been questioned. Another concern is the inability of the greenhouse operator to withhold nutrients to hasten the hardening-off process in preparation for winter. To help answer these questions, the PMC, in cooperation with the Sierra Chemical Company, initiated controlled-release fertilizer trials in July, 1984.

Four treatments of controlled-release fertilizers were applied to four species of woody plants commonly used in PMC projects. A fifth treatment received no additional fertilizer and served as a control. Growth and mortality data were then collected and compared over two growing seasons.

MATERIALS AND METHODS

Plant Materials The plants used in the trials were: 'Roland' Pacific Willow (*Salix lasiandra*), 'Oliver' Barren Ground Willow (*Salix brachycarpa* ssp. *niphoclada*), Petrowsky Poplar (*Populus* x *petrowskyana*), and Red-Osier Dogwood (*Cornus stolonifera*). Cuttings from stock plants of these species were collected in April, 1984 and rooted in bottom heated sand-beds under intermittent mist. They were transplanted on July 5 into 2" x 10" cylindrical pots (McConkey Deepots) and placed on a bench in the greenhouse. These rooted cuttings were then watered by hand whenever necessary. At the end of the first growing season the plants were overwintered in an unheated greenhouse. In July, 1985 the plants were transplanted again into 1-gallon plastic containers and moved outside, where they remained until the end of the trials.

Fertilizer The four fertilizers used are all controlled-release fertilizers manufactured by the Sierra Chemical Company. Three of the four are sold under the brand name *Osmocote* and are encapsulated in small beads or "prills" composed of a permeable resin. Moisture penetrates the resin shell and dissolves some of the water soluble nutrients within. The resulting osmotic pressure causes these dissolved nutrients to diffuse through the coating to the surrounding soil medium becoming available to the roots. The formulations used were 13-13-13, 18-6-12, and 0-40-0. All are designed to release nutrients over an 8 to 9 month period when the soil temperature averages 70°F. Below this temperature, the release of nutrients slows and eventually stops at 32°F. The fourth fertilizer was a controlled-release micronutrient mixture in granular form called *Micromax*. Table 1 lists the fertilizer combinations and concentrations used in each treatment.

The soil media used in transplanting the plants after rooting was a commercially available soilless potting mix to which was added sand and top soil. The resulting mix had a composition of 18.2% each of peat, pumice, perlite, vermiculite, and sand, with 9% top soil. Additionally, 3 pounds per cubic yard of potassium nitrate (KNO_3) and 6 pounds per cubic yard of phosphoric acid (P_2O_5) had been added to the soilless mix. Both of these nutrients were readily soluble and immediately available for plant uptake. During the first growing season, these additional nutrients were available to all treatments, including the control.

A new potting mix was made for transplanting the plants into 1-gallon pots during the second growing season. It was composed of 53% peat, 20% sand, 20% vermiculte, and 7% top soil. Fresh controlled-release fertilizer was incorporated into the soil mix according to Table 1. No other nutrients were added. Table 3 lists the nutrient concentrations in the media for each treatment.

Treatments Four treatments plus a control were used. Treatment A consisted of a combination of *Osmocote* 13-13-13, 0-40-0, and *Micromax*, each at the rate of one and one-half pounds per cubic yard. Treatments B, C, and D used *Osmocote* 18-6-12 at increasing rates of 6, 8, and 10 lbs. per cubic yard respectively. Treatment E was the control group with no additional fertilizer (Table 1). Most treatments consisted of four replications of ten plants each for each of the four species. However, due to a shortage of plant material, treatments D and E were eliminated for Petrowsky Poplar and two replications each of treatments D and E were eliminated for Red-Osier Dogwood (Table 2).

Measurements Initial measurements of the height of each plant were made in July, 1984. These were based on the distance from the soil line to the highest growing point measured vertically to the nearest one-half inch. The plants were measured again in February, 1985 during dormancy. The last height measurements were made in January, 1986 after the second growing season.

Table 1

TREATMENT	
A	1½ lbs./cu. yd. @ 13-13-13, 0-40-0, MICROMAX
B	6 lbs./cu. yd. @ 18-6-12
C	8 lbs./cu. yd. @ 18-6-12
D	10 lbs./cu. yd. @ 18-6-12
E	CONTROL

Table 2. Number of Replications Per Treatment, Ten Plants Per Rep

SPECIES	TREATMENT				
	A	B	C	D	E
Salix Lasiandra	4	4	4	4	4
Salix Brachycarpa ssp. Niphoclada	4	4	4	4	4
Populus x Petrowskyana	4	4	4	0	0
Cornus Stolonifera	4	4	4	2	2

TABLE 3
lbs. actual nutrient/cu. yd. media

Treatment	Nitrogen	Phosphorus	Potassium
A	.195	.795	.195
B	1.080	.360	.720
C	1.440	.480	.960
D	1.800	.600	1.200

Height measurements were expressed as percent increase over the initial height. The percent increase was averaged in each replication resulting in an average percent gain for each treatment.

Additionally, measurements of stem girth to the nearest 1/100 inch were made in May, 1985 and compared to measurements taken in January 1986. These measurements were made on the main stem 3-5 cm. from the soil surface using dial calipers. The exact location on each stem was noted during the first set of measurements to ensure that subsequent measurements would be taken at the same location. Gain in stem girth is expressed in thousandths of inches gained (Tables 4 through 7).

RESULTS AND DISCUSSION

For all species, the 18-6-12 treatments (Treatments B, C, and D) registered the most growth, with Treatments A and E showing the least growth (Figs. 1 - 4). Average gains in girth, although small, correlated with the gains in height. Within Treatments B, C, and D, there was little difference in growth. Consequently, Treatment B, at 6 lb./cu. yd., should be the most economically effective treatment.

Treatment A, while showing slightly better growth than the control, showed substantially less growth than B, C, and D. In Treatment A, the amount of phosphorus was 1.3 - 2 times greater than Treatments B, C, and D (Table 3). However, Treatment A contained 5.5 to 9 times less nitrogen and 3.5 to 6 times less potassium than Treatments B, C, and D. It appears both nitrogen and potassium were the limiting nutrients in Treatment A.

Tables 4 through 8 indicate that mortality was greater in the high fertility treatments. Also, *Salix lasiandra* and *Cornus stolonifera* had relatively high mortality rates compared to *Salix brachycarpa* and *Populus* x *petrowskyana*. Most of the mortality occurred during the first winter, and suggest a lack of hardiness in the young plants.

For all species, Treatment E (Control) had only an average of 6% mortality which increased to 12% for Treatment A and kept increasing through Treatments B, C, and D. Increasing fertility, especially nitrogen, appears to have made the more actively growing plants more prone to winter injury.

While *Osmocote* is designed to release fewer nutrients at colder soil temperatures and cease nutrient release below 32°F., it is possible that diurnal temperature fluctuations above and below freezing recorded during September and October of 1984 could have allowed the continued release of nutrients, thereby delaying the hardening-off process. After November 6, 1984, daytime temperatures fell below freezing and remained there until December when another warm period occurred. By this time, the soil in the containers had frozen.

CONCLUSIONS & RECOMMENDATIONS

Treatment B, *Osmocote* 18-6-12 at 6 lbs./cu. yd., was the most economically effective treatment.

Using higher rates of controlled-release fertilizers on the unprotected containerized plants in these trials resulted in an increase in winter-induced mortality. Inducing the onset of dormancy by withholding nutrients is more difficult with controlled-release fertilizers. Extra winter protection may be necessary.

Controlled-release fertilizers are more convenient to use than liquid-feed fertilizers; however, the greenhouse operator has less control over the fertilization program.

In comparing growth rates, further trials directly comparing a liquid-feed fertilizer program with controlled-release fertilizers should be conducted.

These trials included only containerized plants. The effect of controlled-release fertilizers on field-transplanted plants should be explored in future trials.

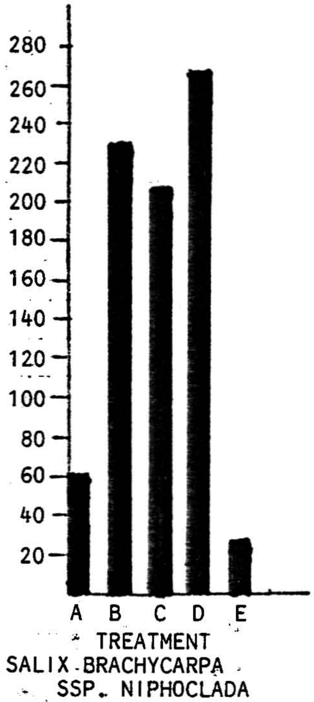

Fig. 1

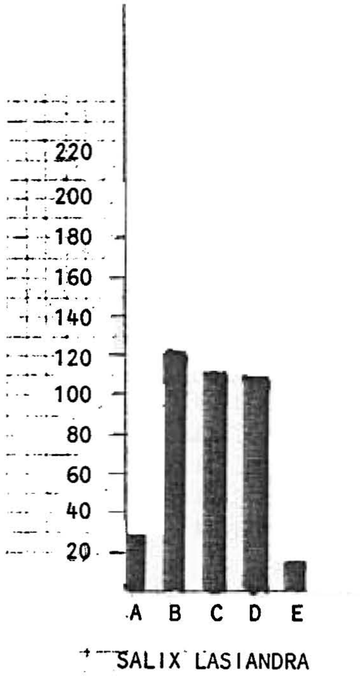

Fig. 2

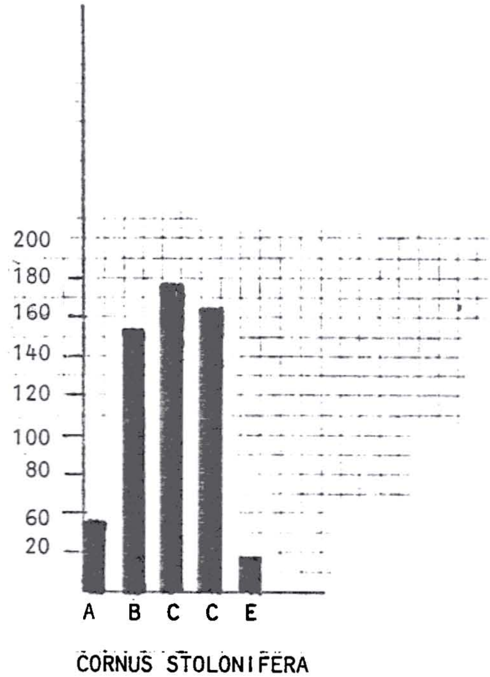

Fig. 3

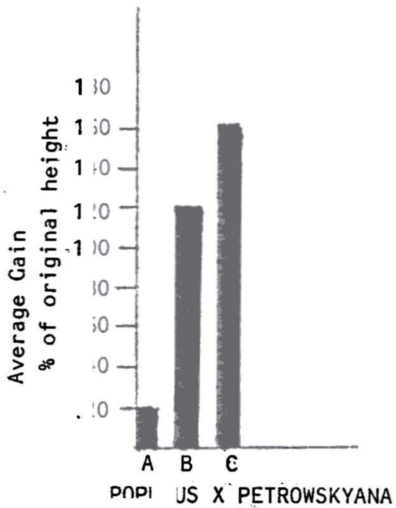

Fig. 4

TABLE 4
SALIX BRACHYCARPA SSP. NIPHOCLADA

Treatment	Avg. % Gain (Height)	Avg. Gain (Girth)	Range: % Gain (Height)	% Mortality
A	61	.020"	5-217	25
B	230	.083	85-379	3
C	208	.073	43-394	5
D	268	.093	57-500	13
E	24	.010	0-57	3

TABLE 5
SALIX LASIANDRA

Treatment	Avg. % Gain (Height)	Avg. Gain (Girth)	Range: % Gain (Height)	% Mortality
A	29	.016"	0-125	10
B	122	.073	35-271	38
C	110	.068	18-377	53
D	109	.072	0-337	18
E	13	.010	0-60	13

TABLE 6
CORNUS STOLONIFERA

Treatment	Avg. % Gain (Height)	Avg. Gain (Girth)	Range: % Gain (Height)	% Mortality
A	35	.020"	0-145	3
B	133	.056	4-288	10
C	156	.088	26-464	33
D	144	.088	73-418	75
E	18	.004	10-73	0

Note: Treatment E is two replications only.

TABLE 7
POPULUS X PETROWSKYANA

Treatment	Avg. % Gain (Height)	Avg. Gain (Girth)	Range: % Gain (Height)	% Mortality
A	20	.035"	0-69	10
B	120	.100	0-243	13
C	162	.079	47-359	38

Note: No treatments D and E

TABLE 8
MORTALITY-SPECIES COMBINED

Treatment				
A	B	C	D	E
12%	16%	32%	35%	6%