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CORRELATION BETWEEN GROWTH AND DENSITY IN YOUNG WHITE SPRUCE (PROGRESS REPORT)

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 OBJECTIVES

1. To determine the correlation between wood relative density and volume growth rate in interior spruce.

2. To provide the B.C. Tree Improvement Program with this information that will help in making decisions for incorporating relative density in the roguing of first generation seed orchards.

2.0 BACKGROUND

Relative density of juvenile wood in interior spruce has been recommended as a trait to be considered in the roguing of first-generation orchards, but how to incorporate it is still a question. To help in resolving this question, it would be useful to have information on correlation between this trait and volume growth rate which is considered a primary consideration in tree improvement programs. Current information on relative density-growth rate relationship in white spruce is based on a negative but low correlation. A closer look at this correlation is warranted because of concern that selection for fast growth could mean a trade off in the quality of the wood. Opportunity exists for estimating this correlation in interior white spruce through the sampling of progeny in tests of at least 15 years of age.

3.0 PROPOSED APPROACH

Samples will be taken from a white spruce progeny test in interior British Columbia. Forty families will be selected on the basis of their volume growth rate. Thirty trees per family will be selected from two sites (15 trees/family/site) for a total of 1200 trees.

Bark-to-bark increment cores will be taken at one height from each selected tree using the same cardinal direction. The cores will be analyzed by the maximum-moisture-content method. Ten families will be analyzed further by the X-ray method to examine individual growth trends.

Growth traits (height and diameter at breast height) of the trees measured at 15 years of age will be used in the analyses. Phenotypic and genotypic correlations between wood density and growth rates will be determined. Analysis of variance will be carried out to examine family and within family differences in wood density.

4.0 PROGRESS IN 1989-90

The core samples in this study generally consisted of 12 growth rings from the pith. The transition from juvenile to mature wood in white spruce based on wood density has been reported earlier to occur anywhere between 10 and 15 growth rings from the pith. Using wood density as a criterion, the cores in the present study would be considered juvenile wood.

Mean wood density, height, and diameter for each family are presented in Table 1. The values are arranged in increasing order of magnitude of wood density to rank family performances. The most promising family in terms of wood density was 13% higher than the bottom-ranked family. The family means ranged from 384 kg/m^3 to 443 kg/m^3; the overall mean was 407 kg/m^3 with a coefficient of variation of 7.6%. The spread in the wood density values of individual trees within family ranged from 18% to 33%, reflecting a higher range within family than between families.

The wood density values obtained in the present study may appear high compared to the average value of 328 kg/m^3 reported earlier for interior white spruce parent trees. It should be pointed out that this earlier value was determined on mature wood from the outer half of breast-height cores. Mature wood has been shown to have lower wood density than juvenile wood in white spruce.

Family means for the combined sites ranged from 2.60 m to 3.77 m for height and from 33.2 mm to 52.9 mm for diameter. The percentage difference between the minimum and maximum values for height and diameter is much higher than that for wood density, reflecting the larger variation in growth traits than in wood quality.

The phenotypic correlations between family mean wood density and the family mean growth traits (height and diameter) were examined by regression analysis. Plots of the data are shown in Figures 1 and 2.

Analyses showed non-significant relationships between wood density and growth traits. It was also shown that correlation between height and diameter was highly significant ($p < 0.0001$)(Figure 3).

Table 1

Mean Density, Height, and Diameter at Breast Height of forty families of interior white spruce from the combined sites of Red Rock and Quesnel. Values are arranged in increasing order of magnitude of wood density.

Family #	No. of Trees	Wood Density (kg/m^3)	Height (m)	Diameter at Breast Height (mm)
22	29	384	3.49	50.0
87	26	389	3.77	52.1
86	28	390	3.14	44.2
168	24	391	2.82	38.3
82	27	391	2.96	44.7
1	28	391	3.24	45.5
17	27	394	3.54	48.4
16	26	394	3.50	47.0
106	25	394	2.85	40.1
158	24	395	3.21	43.8
85	27	397	3.31	43.6
36	25	399	2.89	38.4
160	23	400	3.37	50.5
115	25	402	3.16	45.7
161	28	402	3.61	49.0
40	22	403	3.47	48.9
26	28	404	3.38	46.1
142	24	404	3.08	43.7
9	26	404	3.40	48.6
27	27	405	3.38	43.9
143	28	405	3.42	45.1
153	25	406	2.80	41.8
39	28	407	3.24	45.5
170	27	407	2.97	40.2
84	25	408	3.41	47.5
163	26	408	2.97	40.3
156	25	410	2.76	40.9
149	24	412	2.71	35.5
21	28	414	3.37	47.1
122	28	414	3.10	45.5
80	26	415	3.27	47.3
103	18	415	3.15	46.0
3	23	416	3.38	52.9
13	28	417	3.17	42.6
25	26	419	3.17	44.0
41	27	419	2.75	37.2
15	24	424	3.29	45.2
6	28	429	3.53	48.2
90	27	441	2.60	33.2
104	26	443	2.89	38.0