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LIGNIN DISTRIBUTION IN WOOD FROM A BORON DEFICIENT SITE

by

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INTRODUCTION

Mineral nutrition is known to affect the chemical composition of wood. Downes and Turvey (1986) have reported a reduction in lignin content from 30.3 to 19.9% in trees showing symptoms of copper deficiency. This reduced lignification was associated with collapsed tracheids and wound parenchyma. Boron deficiency has been associated with reduced lignification of stems in sunflower and tobacco plants (McIlrath and Skok 1964).

Donaldson (1986) has reported between tree variation in lignin concentration in the cell walls of *Pinus radiata* trees. More recently a genetic component of this variation has been identified (Donaldson unpublished).

As part of an investigation of the physical and chemical properties of *Pinus radiata* wood grown on boron deficient sites, a study of lignin distribution in the cell walls of this wood was carried out. This report describes the results of that study.

MATERIALS AND METHODS

Increment cores were collected from 12 trees growing in a fertiliser trial on a boron deficient site in compartment 106 of Kaweka forest. Three trees were sampled from each of four plots. Two of the plots had received a nitrogen/phosphorus treatment while the other two plots had received an additional minor nutrient treatment (including boron). Samples of wood were collected from single, randomly selected growth rings among the outer 10 rings of each core. Each sample was dissected into small

blocks, dehydrated in acetone and embedded in Spurr's resin. Measurements of lignin concentration were made using the technique described by Donaldson (1985). Measurements were made using glycerol and immersion oil as reference media and were carried out on the cell corner middle lamella (ccml) region of the cell wall. A small number of measurements were made on the S2 region for comparison. Sections of wood were also examined by toluidine blue to look for any abnormalities in lignin distribution in other regions of the cell wall. Quantitative data were analysed using a nested analysis of variance.

RESULTS AND DISCUSSION

Quantitative measurements of lignin concentration in the ccml region of the cell wall showed considerable variation as shown in Table 1. Table 2 shows the variance components analysis for these data indicating that virtually all of the variation is among trees with no significant additional variance due to plot or treatment. This indicates that for the trees examined, the presence or absence of micronutrients in the fertiliser treatment did not significantly influence ccml lignin concentration.

Table 1. Variation in ccml lignin concentration.

Tree no.	Nitrogen/Phosphorus		Nitrogen/Phosphorus Micronutrients	
1	78.7% ± 1.5	78.1%	78.7%	75.1%
2	80.6%	63.7%	80.6%	78.4%
3	76.8%	81.8%	76.8%	58.0%
Mean	78.7%	74.5%	78.7%	70.5%

Table 2. Analysis of variance.

Factor	df	SS	MS	F	%S²
Treatments	1	168.27	168.27	0.31 ns	0%
Plots	2	1372.19	686.10	1.27 ns	0%
Trees	8	4329.50	541.19	232.82***	95.9%
Residual	108	251.05	2.32		4.1%

Measurements of S2 lignin concentration on a reduced sample (Table 3) did not indicate any significant change in lignin concentration from the normal level of 20% v/v in either of the two treatments.

Table 3. S2 Lignin concentration.

Tree	Nitrogen/Phosphorus	Tree	Nitrogen/Phosphorus Micronutrients
B^- 29	21.9% ± 1.0	B^+ 36	19.3%
B^- 31	20.2%	B^+ 38	20.2%
B^- 33	19.1%	B^+ 40	21.3%
Mean	20.4%		20.3%

Brief examination of stained specimens indicated some deviations from normal lignin distribution in both groups of trees although this was more apparent in the boron deficient group. A more detailed study is required to determine the frequency and severity of this observed effect.

It is interesting to note the two low lignin trees in Table 1. These trees occur at the expected frequency of 1 in 5 for the wild population (Donaldson 1986, 1991). Since these trees were non-destructively sampled it would be interesting to attempt to capture this variation by cloning these two trees, especially the tree showing values of 58% lignin which is among the lowest

values recorded so far.

CONCLUSIONS

This study did not give any indication that the fertiliser treatments studied had any effect on lignification. This study does not support the hypothesis that boron deficiency causes reduced lignification in *Pinus radiata*, however some further work is warranted to confirm potentially significant observations on stained material.

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