Understanding cambium wood forming machine towards gains in commercial forestry

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Seasonal Variation in the Ultrastructure of the Cambium in New Zealand Grown Pinus radiata D. Don

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ABSTRACT
Examination of Pinus radiata cambium from trees growing in the central North Island of N Zealand has revealed that many of the structural changes occurring in other tree species at the onset of cambial activity are not found in this species. The winter cambium bears a closer resemblance to the summer cambium than it does to the summer cambium of any other angiosperm or gymnosperm in the literature. In particular there is little change in vacuolar structure, endoplasmic reticulum, and dictyosome activity during the year. The only changes which take place involve a slight increase in vacuole volume, storage of starch in vacuoles, and a decrease in numbers of spherosomes in the summer. These observations confirm that, while the degree of cambial activity is reduced in complete dormancy is absent.

Understanding Tree Physiology to Produce Better Wood

There has been a distinct lack of effort in tree physiology research since funding to this area was cut in the early 1980s. Our understanding of how trees grow, how management practices and environmental conditions affect wood properties at the fundamental level and basically our lack of knowledge as to what can be done to grow straighter, stronger, “resin-free” and more stable wood, is holding the industry back. The advantages of reducing the variability in plantation grown radiata pine are enormous and tree physiology research is a key element. The Wood Quality Initiative was established in 2003 and has been moving in some way to tackling these issues but has since moved firmly into the processing space. Unfortunately there is a general lack of science capability in this area and many questions remain unanswered.

Presentation outline

1. Wood formation/xylogenesisis

2. Microcores a non-destructive method for studying wood formation

3. Radiata cambial dynamics in North island conditions
NOW | FUTURE
---|---
Doubling Productivity (volume/properties) | GCFF goals
Mechanisms Genetics, practices, conditions | Measurements
Global (Forest) Field trials | Macro (Tree) DiscBot
Micro (cambium) Microcores
Process based Models | Cabala
SFSim | e-cambium
Predict
Simple illustration of wood formation
Mid-rotation interventions e.g. fertilizer, thinning, phytohormones

Forest Accelerator Trials to evaluate cambial response to growth promoting treatments

**Microcoring technique has potential to study WQ when the wood is formed rather than after tree is harvested**

Climate effects
Central north island
Canterbury

Cambium responses to forest diseases e.g. RNC
Microcore samples for wood formation

Microcore sampling using Trephor tool (Rossi 2009)

Microcore images have a wealth of information.
Information derived from microcore images

Key xylem differentiation zones contributing to wood density

- Width of cambium and enlarging zone (CE)
  - Rate and duration of enlargement
- Width of lignification and thickening zone (LT)
  - Rate and duration of thickening

Morphological measurements

- Radial diameter
- Wall thickness
- Lignification by blue fluorescence
Wood formation of radiata

Fast Growing

Slow growing

Radial growth avg for 7 days

Radial growth avg for 54 days
Nitrogen fertilization effect on cambial dynamics

- Compartment 168/2
- Mid-rotation/planted 2003
- Thinned to 374 SPH

- Treatments applied late Sep and Oct
- Urea granules: 450 Kg/Ha
- Foliar spray of urea solution: 15.65 Kg/Ha

- Microcores sampled every two weeks for a full year and density core at the end of experiment
- Height, diameter and leaf area index
- Climate station near by
Relative contributions of different components of tracheid development and density

Summary

- Microcore methodology suitable for faster growing trees with wider rings and delicate and large cambial zones has been established.

- Microcore technique has potential to show effects of environmental factors and experimental treatments on wood and fibre properties.

Future work
- Validation of ecambium for central north island conditions using cpt 168 control tree data
- Application of growth hormone during LW formation
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