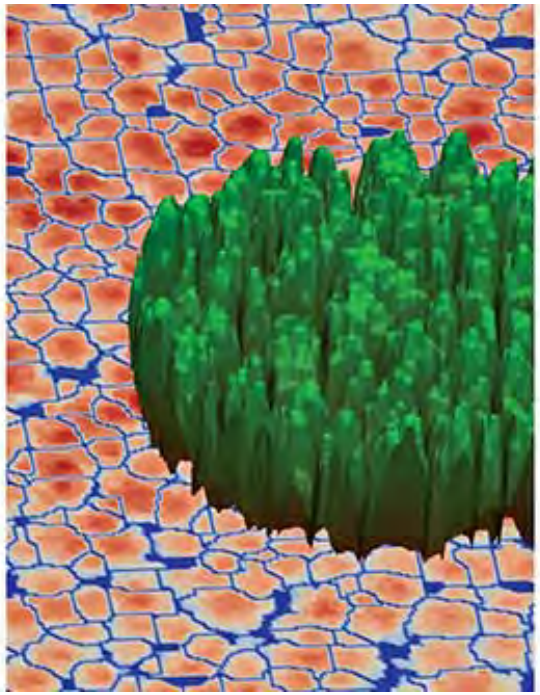
Growing confidence in forestry's future Research Programme

SCION
FORESTS ▪ PRODUCTS ▪ INNOVATION

# Understanding cambium wood forming machine towards gains in commercial forestry

Bernadette Nanayakkara, Alan Dickson, Damien Sellier and Dean Meason
Cyrille Rathgeber-INRA, Nancy



supported by forestgrowers commodity levy

FOREST OWNERS ASSOCIATION

*Ann. Bot.* 37, 1005–11, 1973

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

J. R. BARNETT

*Forest Research Institute, Private Bag, Rotorua, New Zealand*

Received: 22 September 1972

ABSTRACT

Examination of *Pinus radiata* cambium from trees growing in the central North Island of N 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 resemb summer cambium than it does to the winter cambium of any other angiosperm or gymnosper in the literature. In particular there is little change in vacuolar structure, endoplasmic reti and dictyosomal activity during the year. The only changes which take place involve a sligh vacuole volume, storage of starch in vacuoles, and a decrease in numbers of spherosome summer. These observations confirm that, while the degree of cambial activity is reduced i 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 went 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.

FOA (2012-Revised 2015) New Zealand Forestry Science and Innovation Plan.

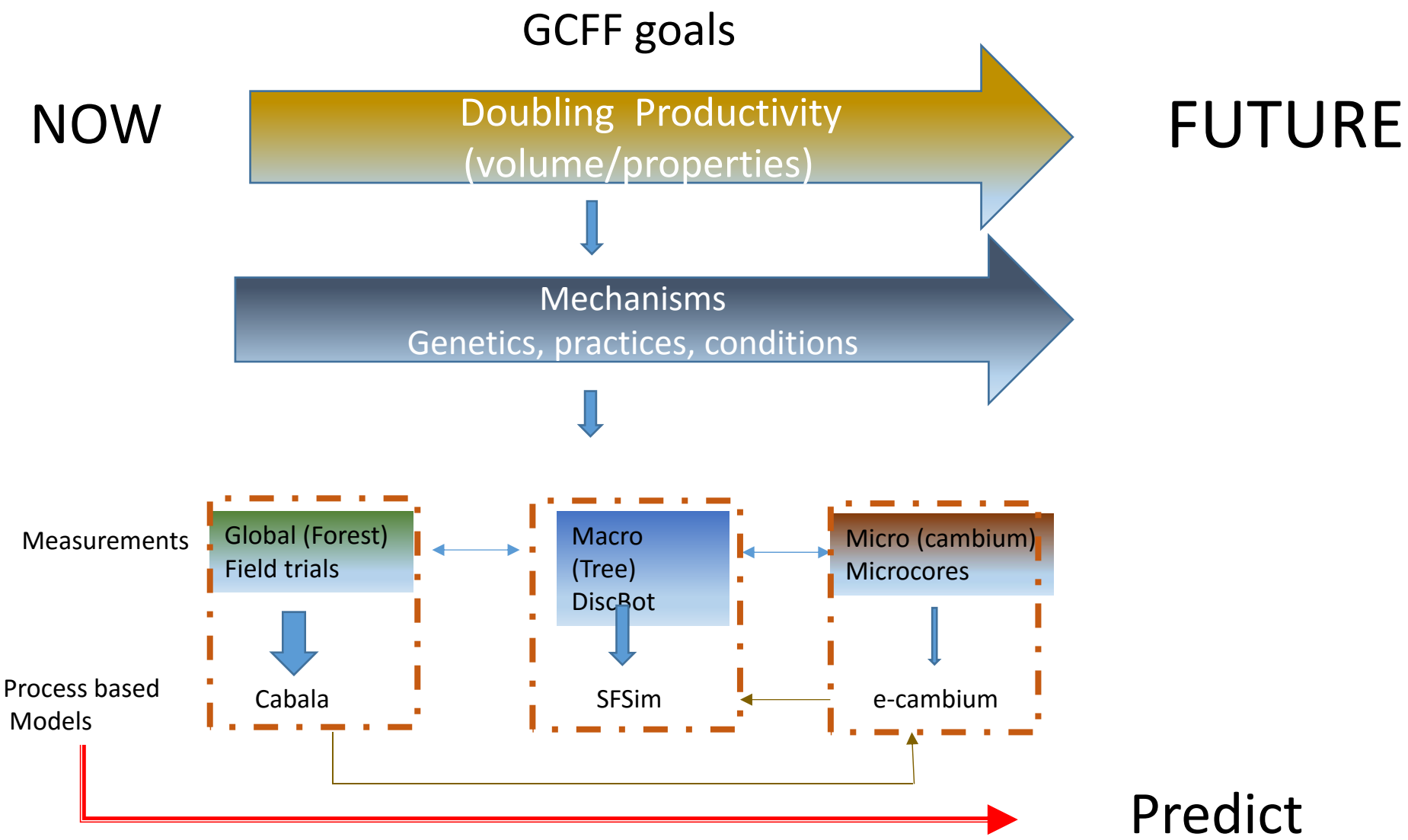
# Presentation outline

1. Wood formation/xylogenesis

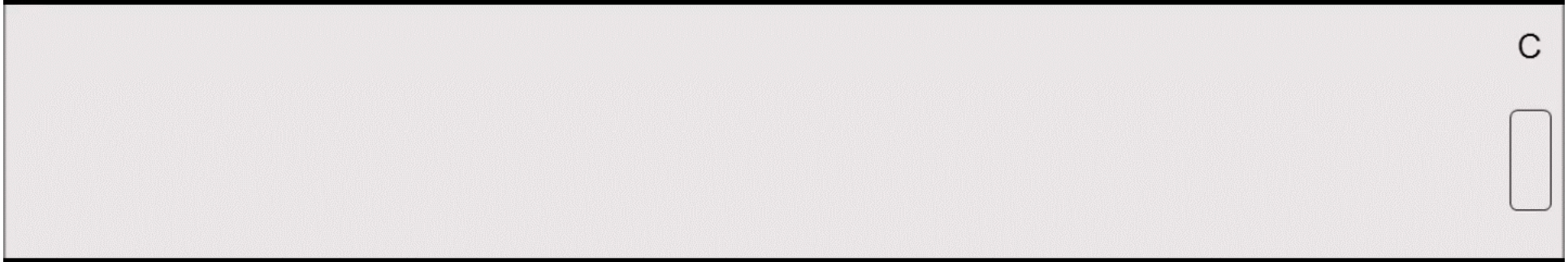
2. Microcores a non-destructive method for studying wood formation

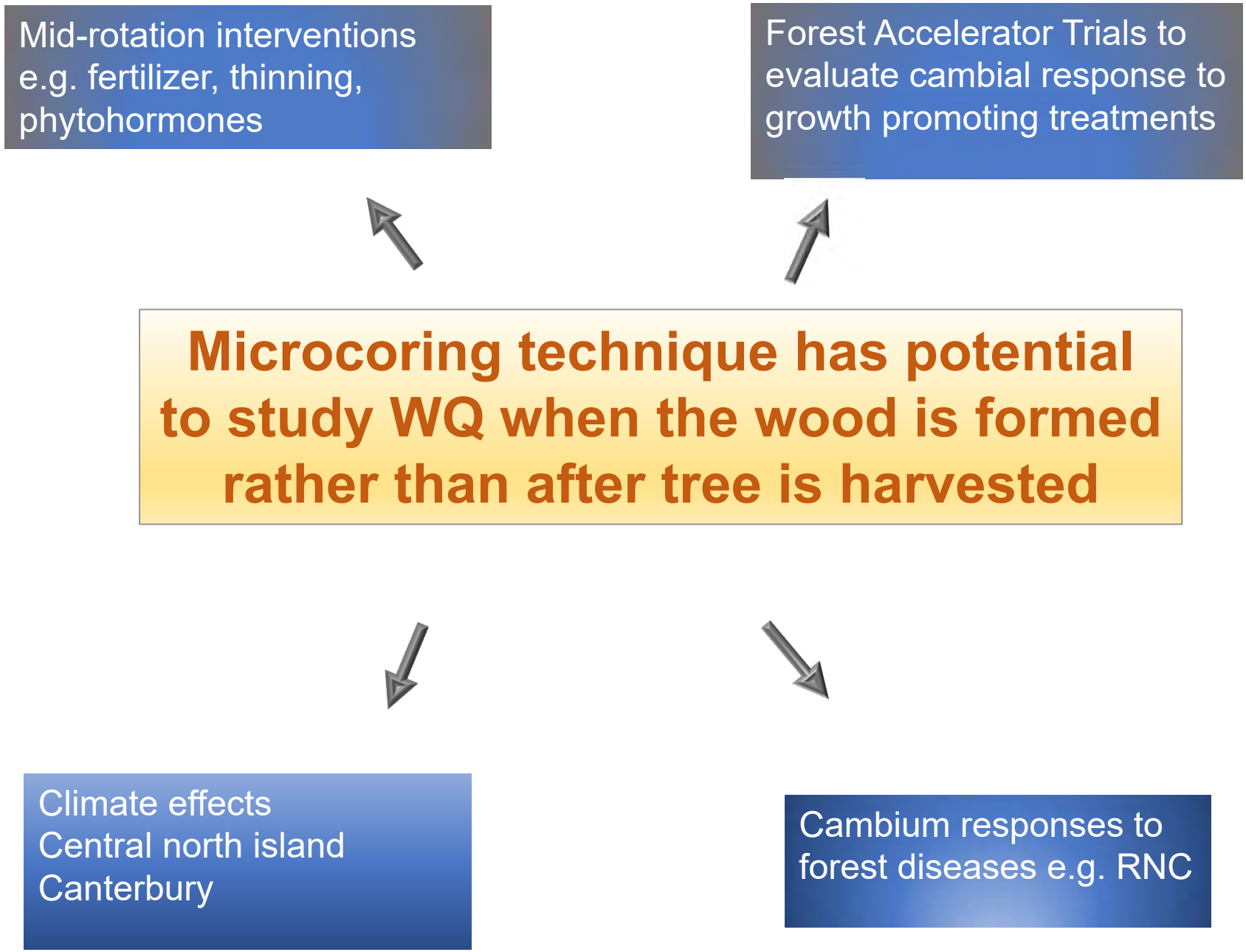
3. Radiata cambial dynamics in North island conditions

scion


GCFF goals
NOW
Doubling Productivity
(volume/properties)
FUTURE
Mechanisms
Genetics, practices, conditions
Measurements
Global (Forest)
Field trials
Macro
(Tree)
DiscBot
Micro (cambium)
Microcores
Process based
Models
Cabala
SFSim
e-cambium
Predict

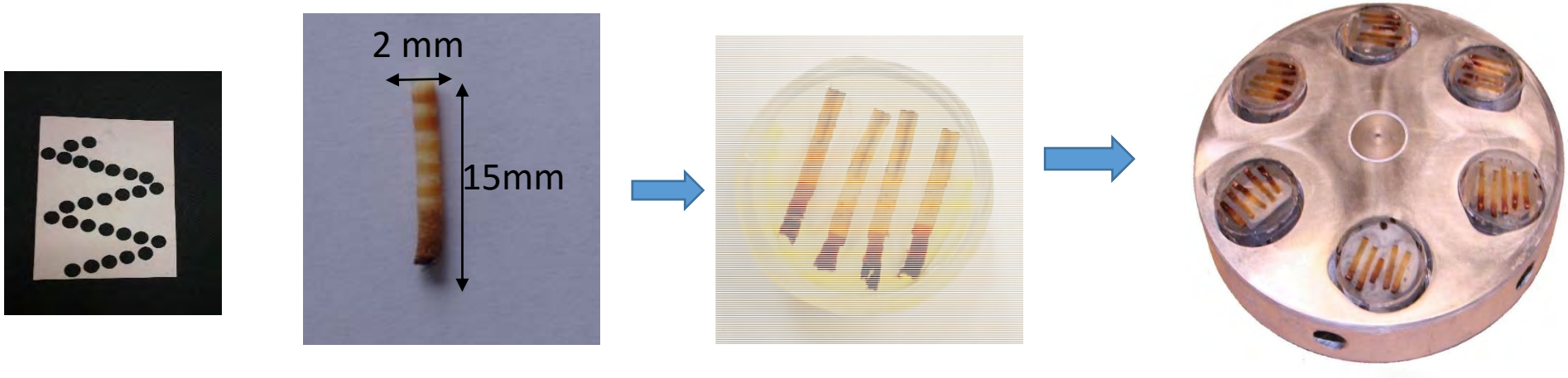
# Simple illustration of wood formation




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

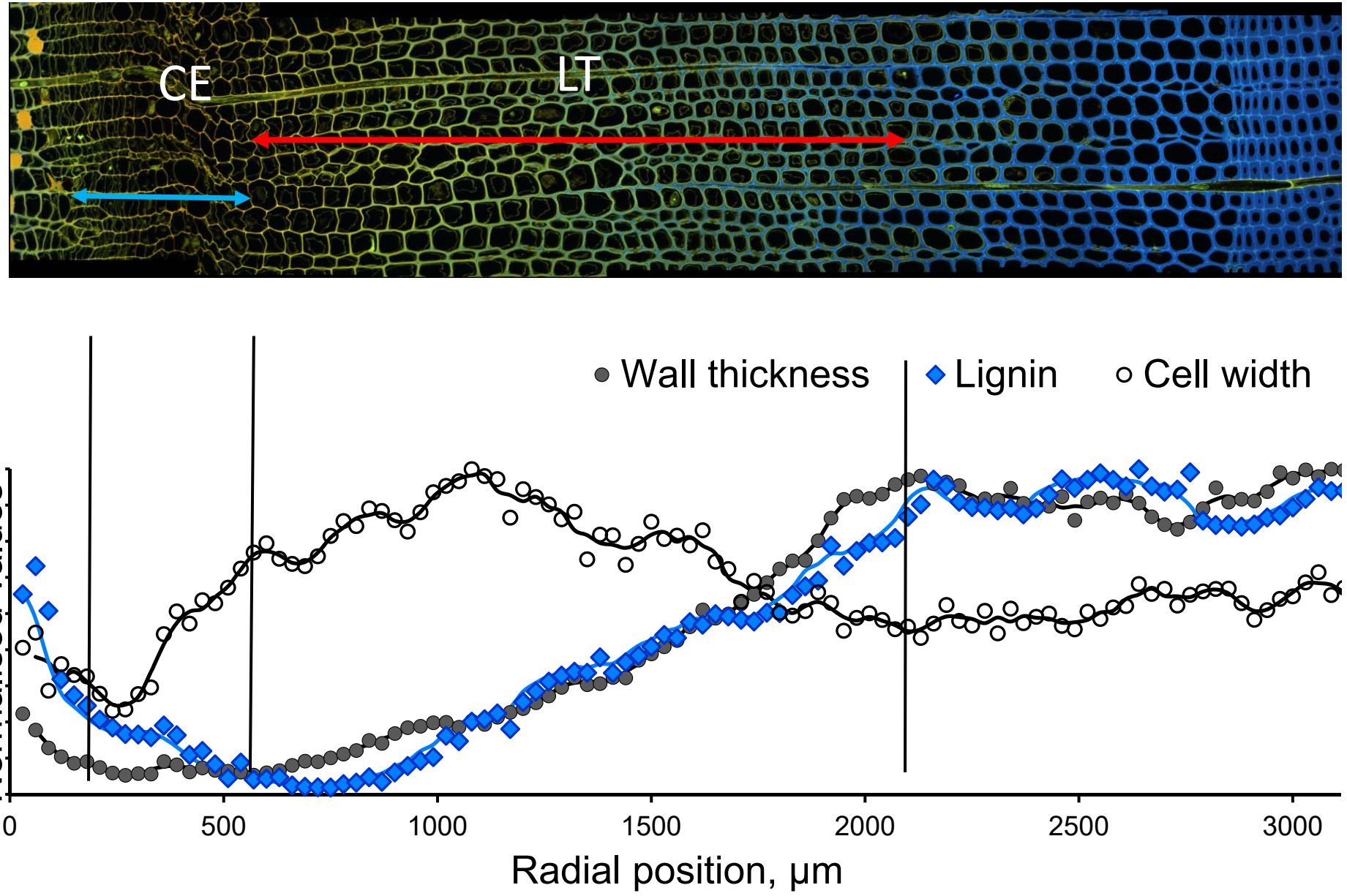
Microcore sampling using Trephor tool (Rossi 2009)




Dickson A.R., Nanayakkara B., Sellier D., Mason D., Brownlie R., Donaldson L. (2016) Fluorescence imaging of cambial zones to study wood formation in Pinus radiata D. Don. Trees, DOI 10.1007/s00468-016-1469-3

SCION

# 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 density

scion

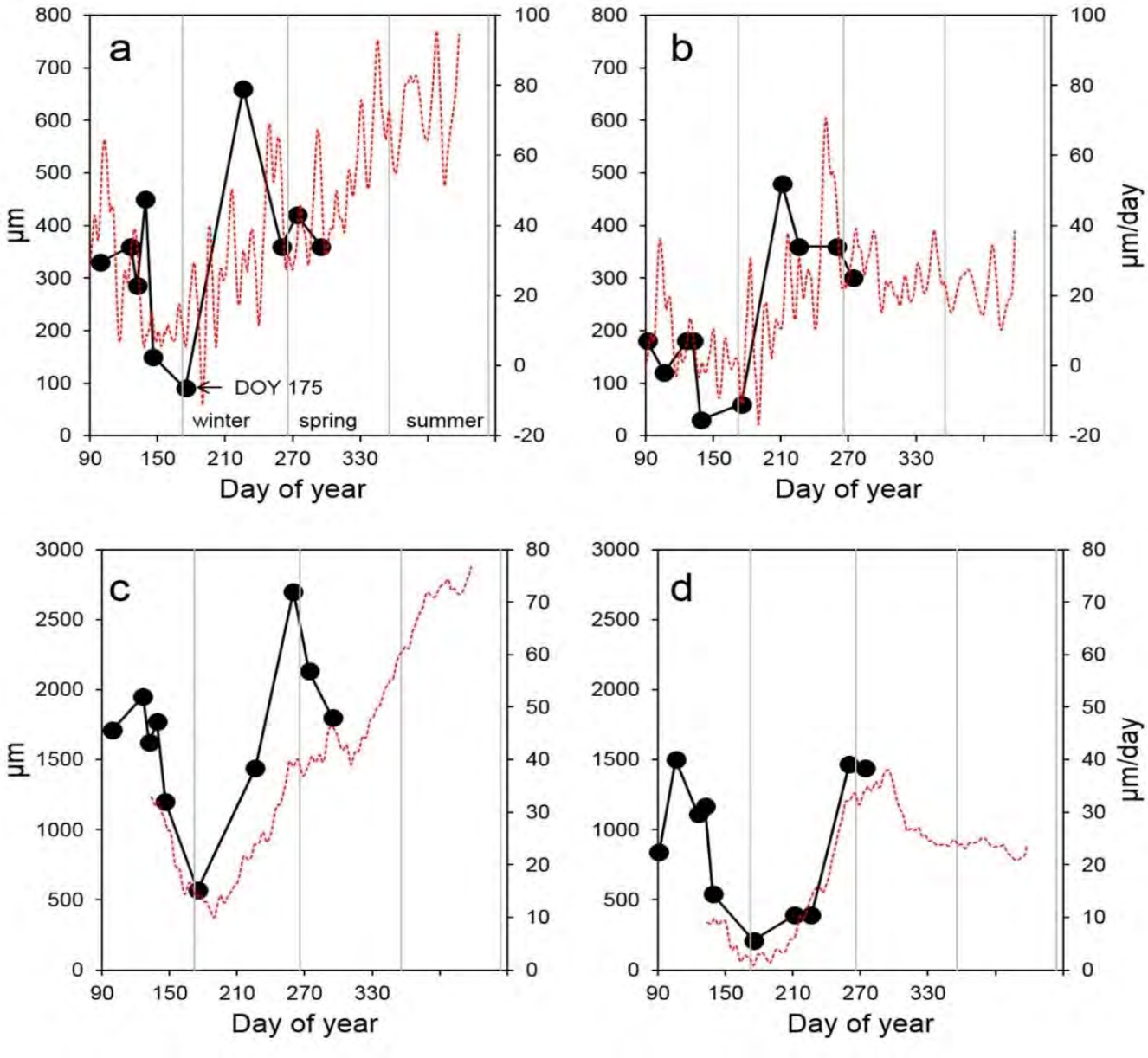
# Wood formation of radiata

**Fast Growing**

**Slow growing**

CE

LT




Radial growth aveg for 7days

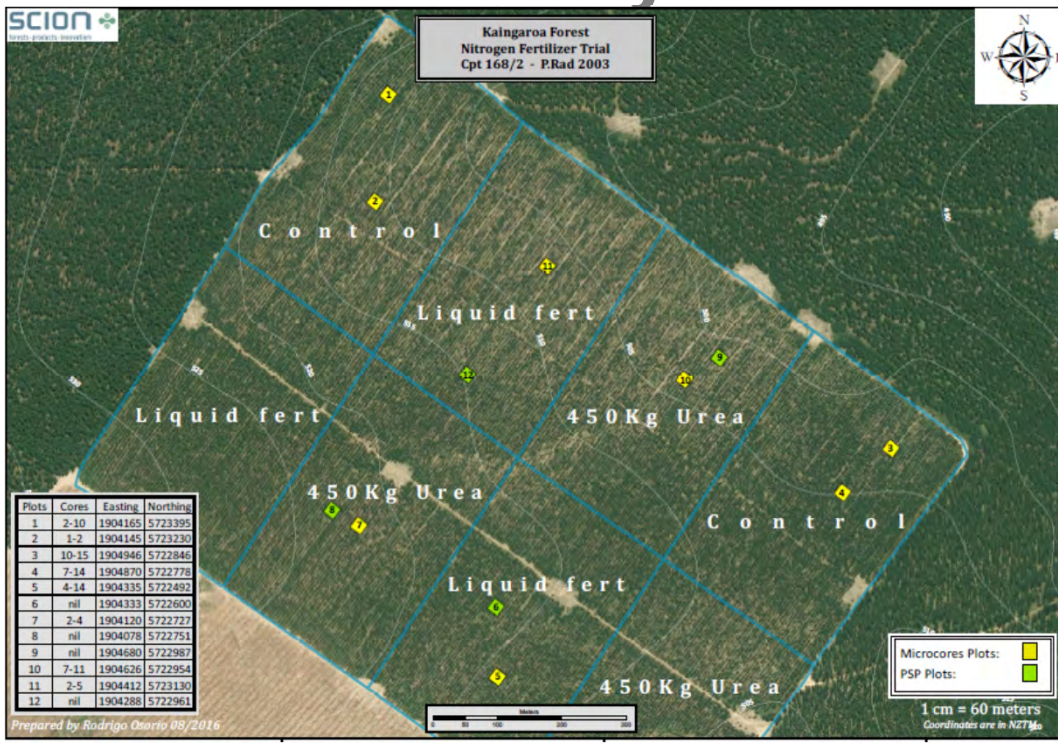
Radial growth aveg for 54 day

scion

# Nitrogen fertilization effect on cambial dynamics

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

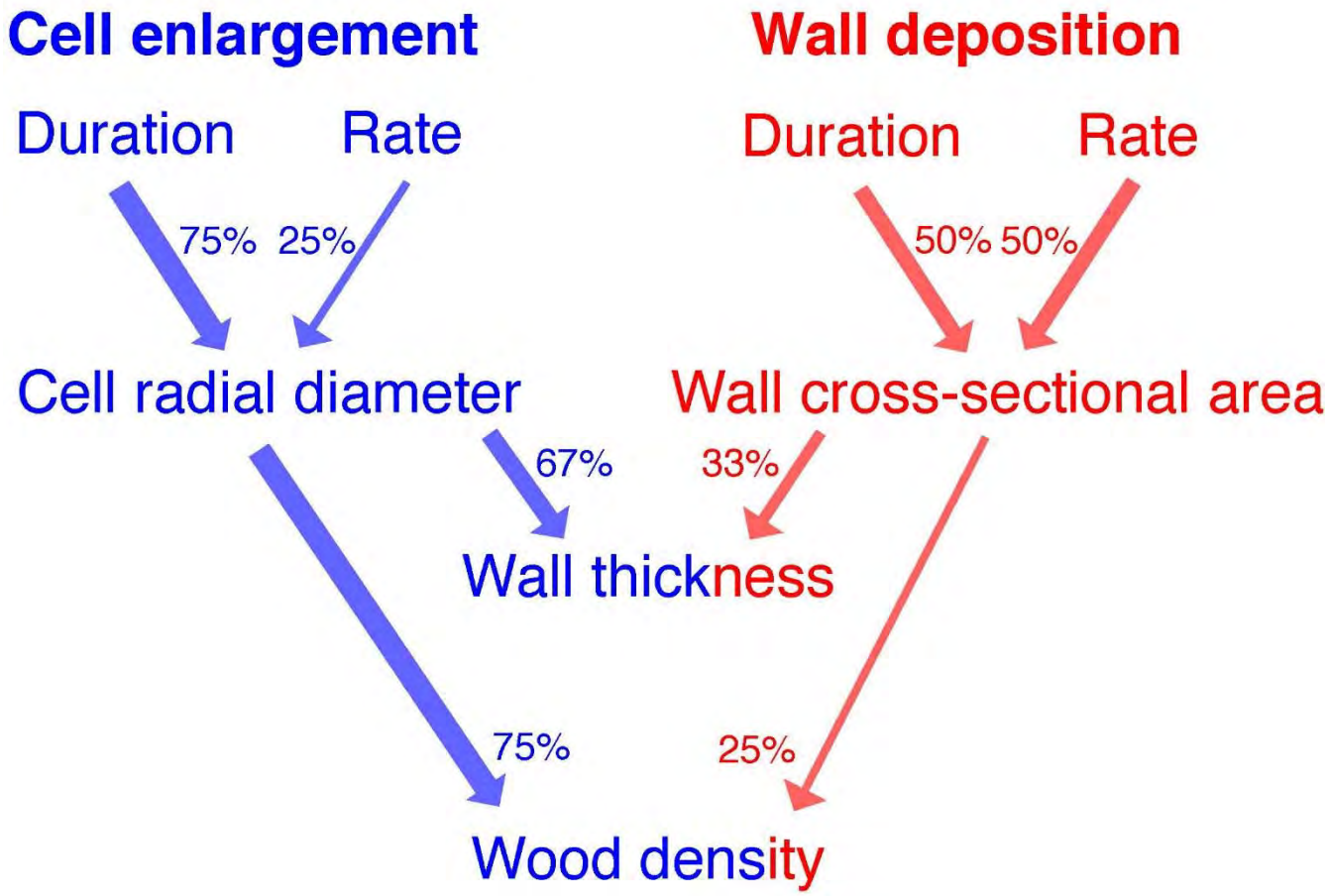
- Treatments applied late Sep and Oct
- Urea granules:450 Kg/Ha
- Foliar spray of urea solution:15.65 Kg/Ha




- 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

scion

# Relative contributions of different components of tracheid development and density




Cuny et al.. 2014. Kinetics of tracheid development explain conifer tree-ring structure. New Phytologist 203, 1231-1241

# 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

# Acknowledgements


- GCFF RA 2.2 for funding
- MBIE Catalyst funding to collaborate with INRA -Nancy xylogenesis team
- Steve Gatenby from KT for Cpt 168 nitrogen fertilizer study
- Rod Brownlie for dendrometer and climate station installation
- Alex Manig for microcore sampling
- Prisilla Lard and Pierre Bell for help with field work
- Nathan Friday for LAI and growth data from cpt 168


scion

Growing confidence in forestry's future Research Programme

SCION FORESTS PRODUCTS INNOVATION

Bernadette Nanayakkara
Scientist
bernadette.nanayakkara@scionresearch.com

http://research.nzfoa.org.nz
www.scionresearch.com
www.gcff.nz

29.03.2017

supported by forestgrowers commodity levy

FOREST OWNERS ASSOCIATION