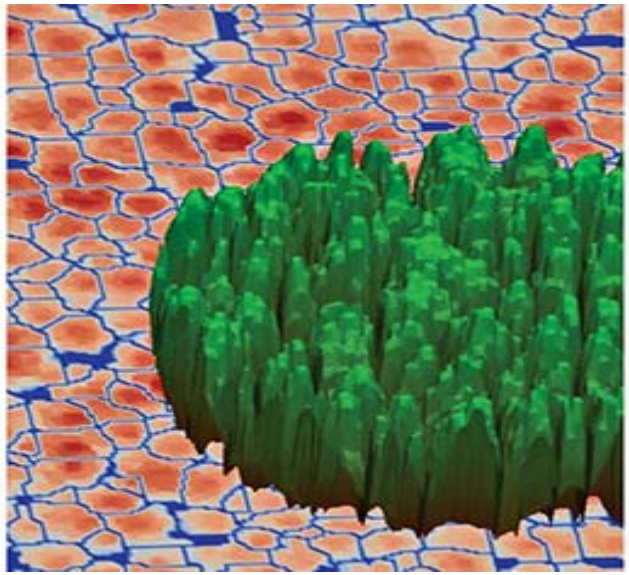
Growing confidence in forestry's future Research Programme

SCION
FORESTS | PRODUCTS | INNOVATION

Managing nursery soils – impacts on early tree performance in the forest

Simeon Smaill



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FOREST GROWERS RESEARCH

The contribution of nursery management

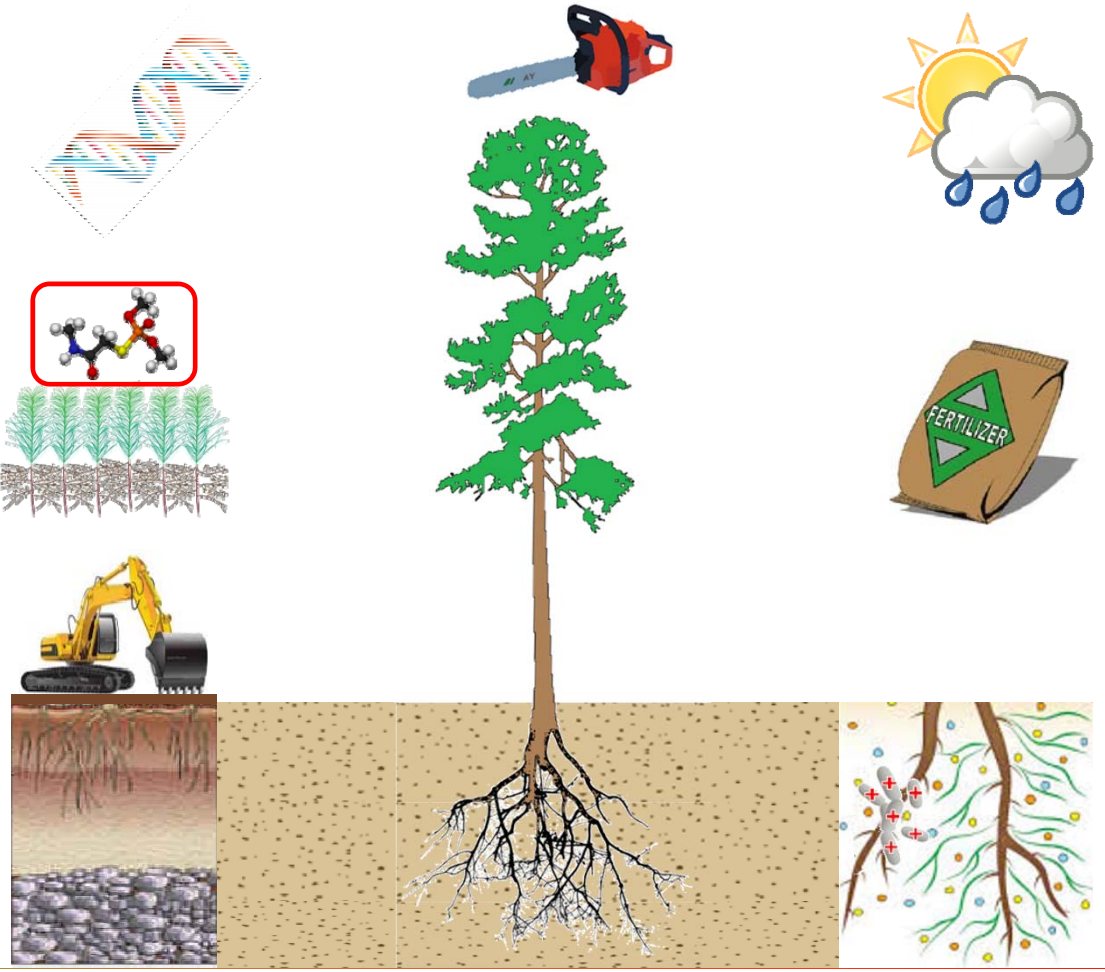
Many factors influence the performance of planted forests

In this presentation we will explore some of the impacts of nursery management on survival and growth in the field

The focus will be on examining the effects of altering the rates of chemical exposure on post-nursery performance

- Fertilisers
- Fungicides

We will also explore some results related to the attenuata x radiata pine hybrid



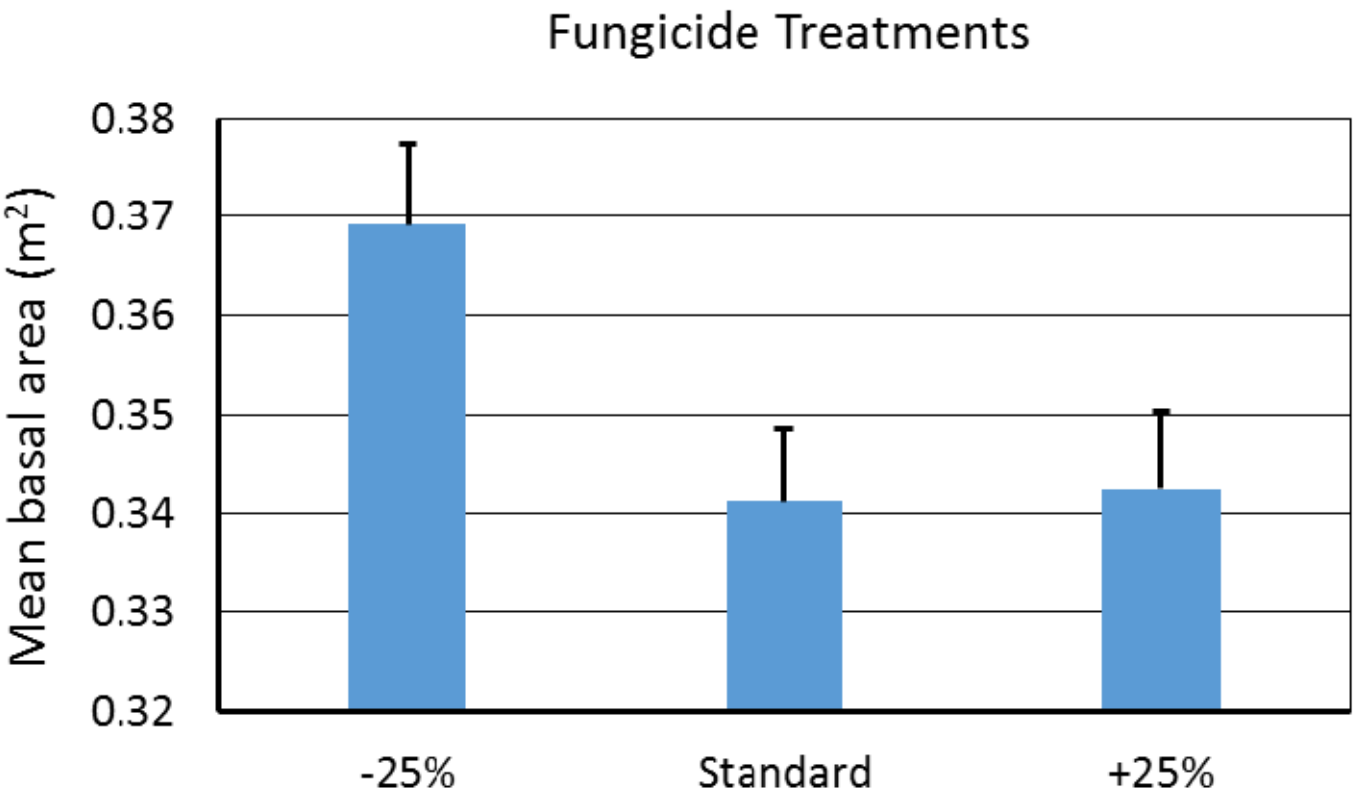
The value proposition

Te Ngae nursery fertiliser and fungicide trial, planted out in Kaingaroa

Six year after planting, saw considerable gains in forest productivity from using less fungicide

Driven by impact of chemical use reductions on beneficial ectomycorrhizal species

Is this a general trend?



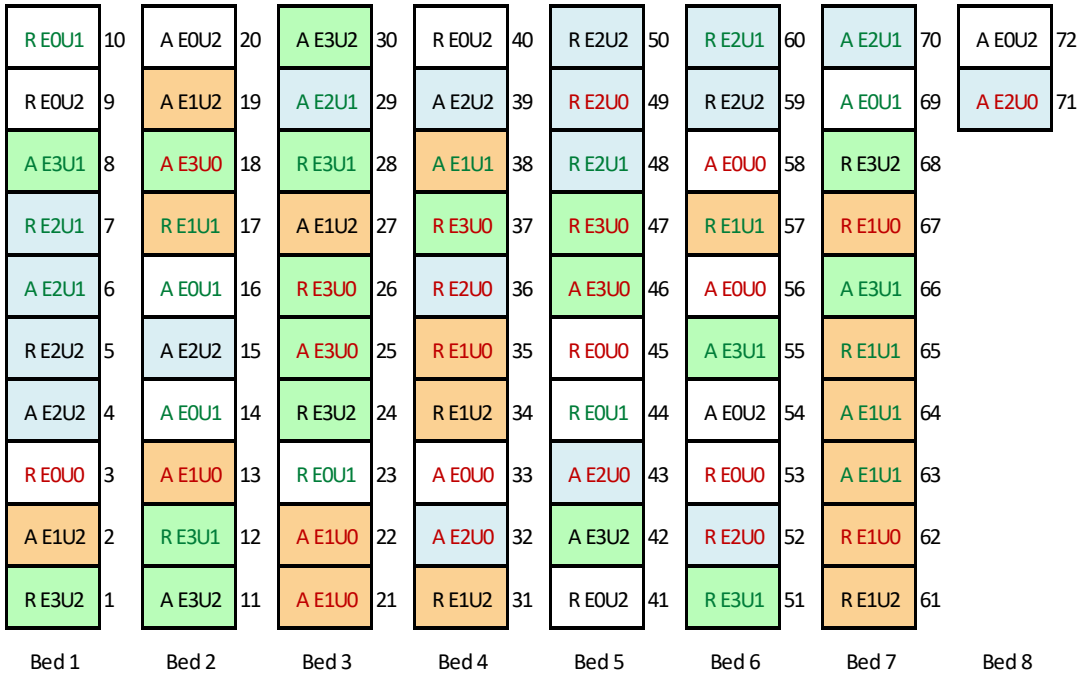
Extending the research

In 2014 a new trial was established at the Scion nursery testing fertiliser and fungicide rates, and also included an attenuata x radiata pine hybrid

Fertiliser rates were set at 0, 50, 100 and 150% of standard doses (E0, E1, E2 and E3)

Fungicide rates were 0, 50 and 100% of standard doses (U0, U1 and U2)

Established in a fully factorial design, totalling 72 plots - all 24 possible combinations of species and treatment replicated three times each



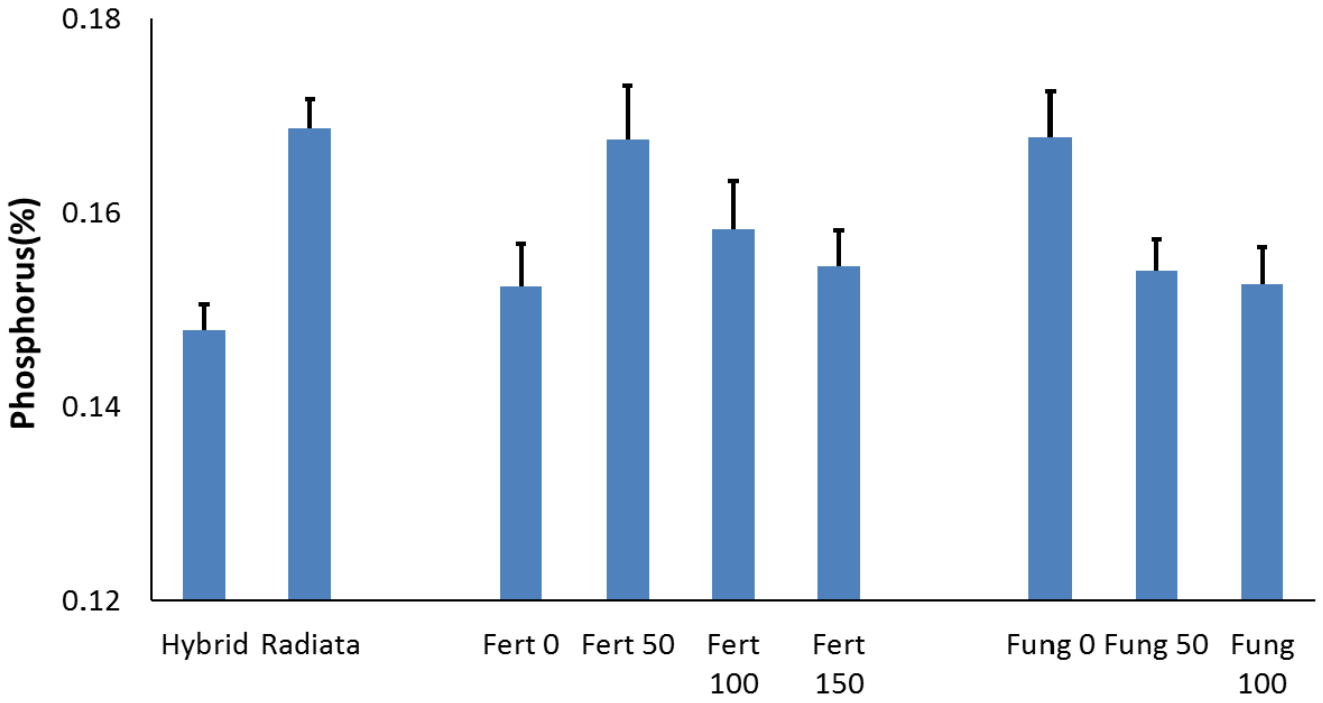
Leaving the nursery gate – physical and chemical state

Over nine months treatment in the nursery, no significant impact on health was detected from reducing the fungicide application rates, and no overall effect on root collar diameter (RCD)

Greater fertiliser use increased seedling N concentrations, but greater fungicide use decreased N

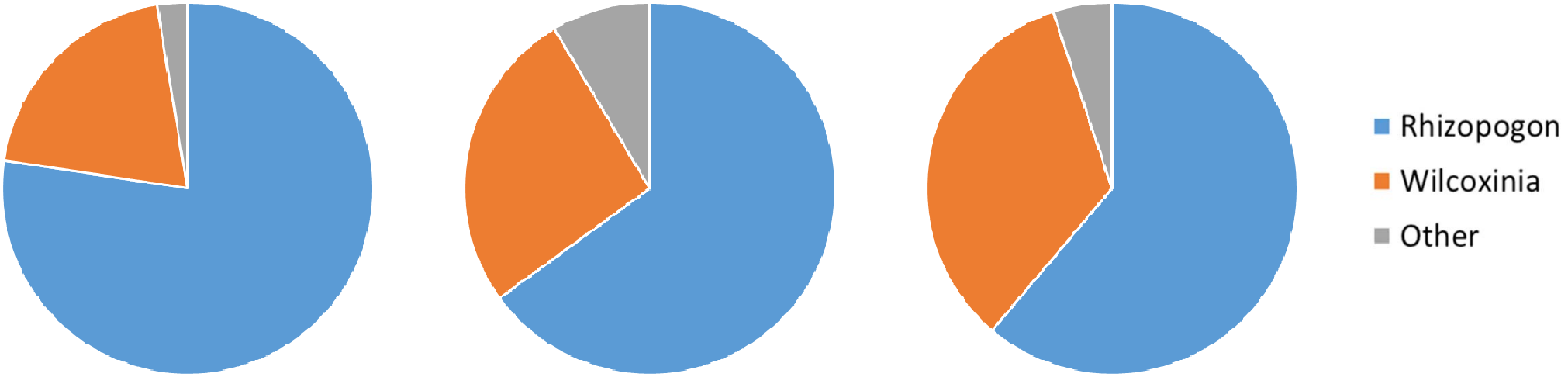
P concentrations also varied with fertiliser and fungicide

Mg concentrations decreased with more fungicide, as did B for radiata pine



Leaving the nursery gate – fungal associations

Morphological analysis determined that increasing fertiliser exposure decreased root tip counts of the dominant ectomycorrhizal species – previously linked to field performance in the Te Ngae trial



50% Fertiliser

100% Fertiliser

150% Fertiliser

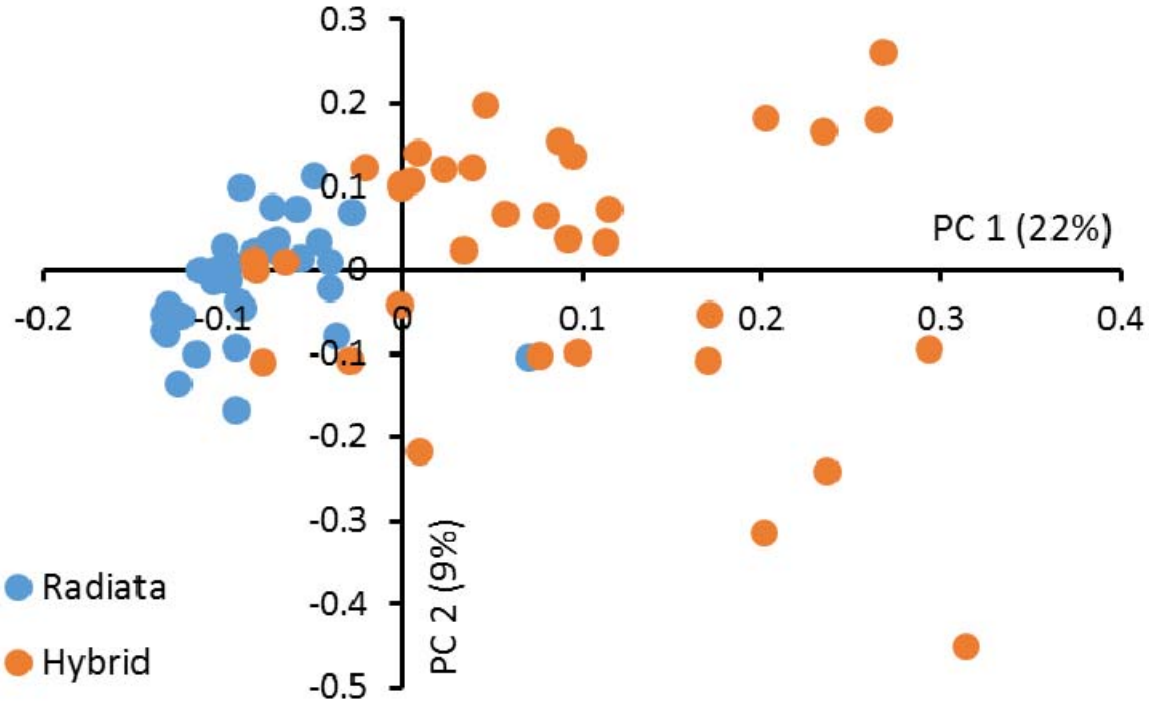
Leaving the nursery gate – fungal associations

Morphological analysis determined that increasing fertiliser exposure decreased root tip counts of the dominant ectomycorrhizal species – previously linked to field performance in the Te Ngae trial

In this study we were also able to employ molecular analysis and sequencing to go beyond what we could see on the root tips

Substantial differences in the fungal communities associated with radiata and the hybrid

- Different species
- Associations with the attenuata hybrid much more variable



Establishment in the forest

The seedlings from the trial were planted out at five locations around New Zealand

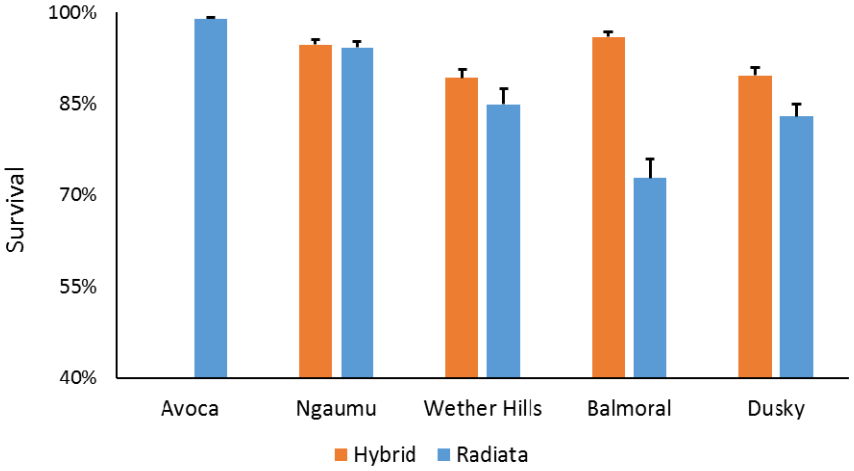
Provided a gradient of conditions for the seedlings

- Temperature
- Rainfall
- Soil fertility

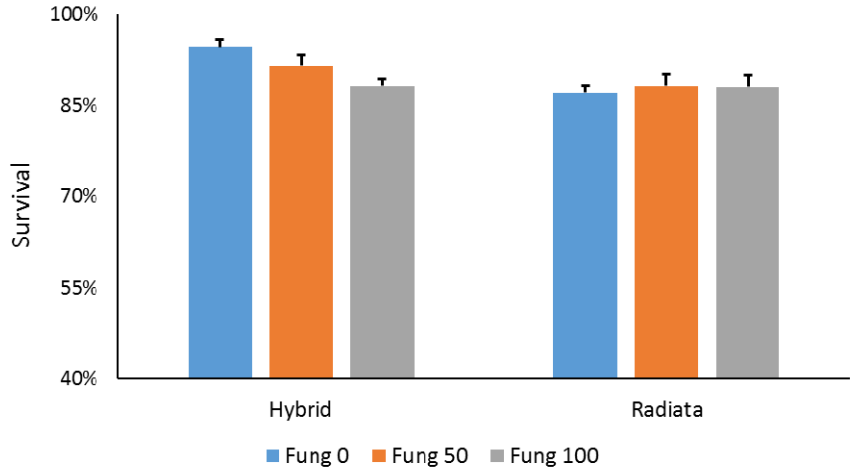
Also allowed us to compare the attenuata hybrid to radiata in designed trials – generate data comparing radiata and the hybrid in the field as well as the nursery

- Not planted at Avoca

After two years in the field – survival at all sites

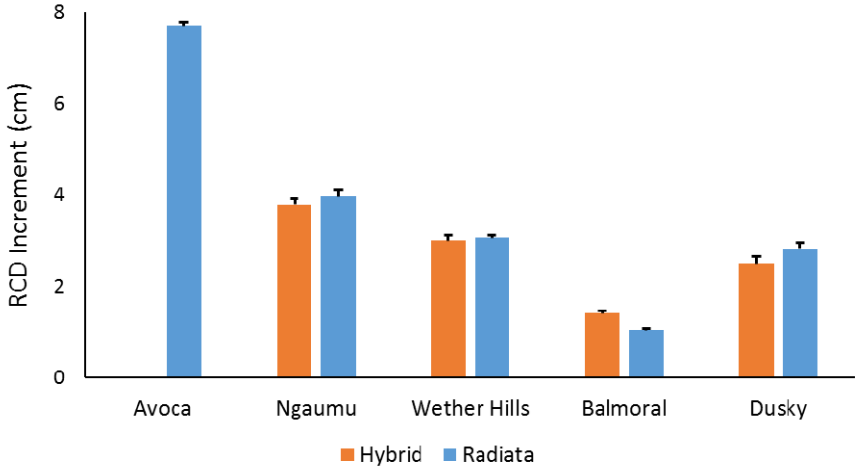


The attenuta hybrid had a better survival rate at most sites

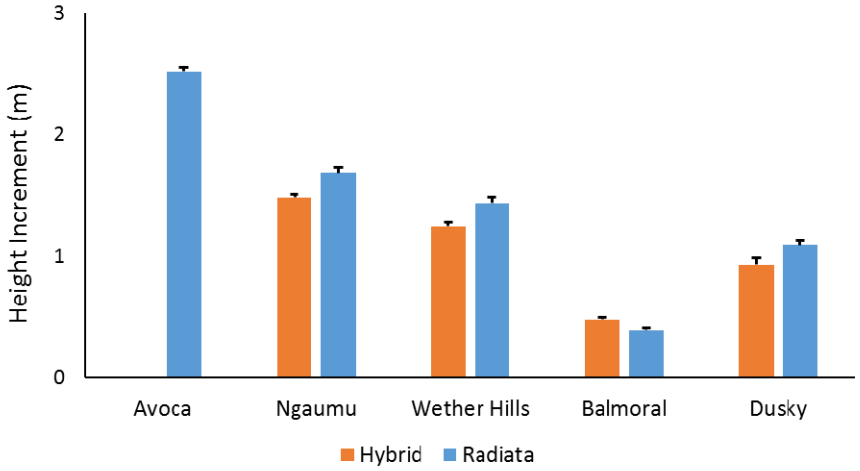


Decreased fungicide use in the nursery increased attenuata survival rates – no effect on the radiata in this case

After two years in the field – growth at all sites



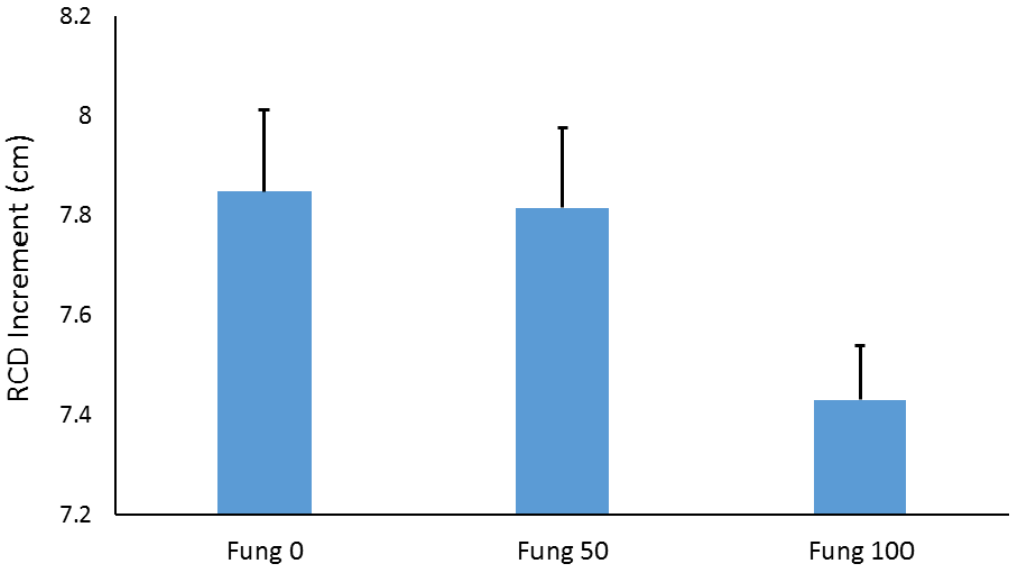
The attenuta hybrid increased RCD faster than radiata at Balmoral, otherwise no differences were observed

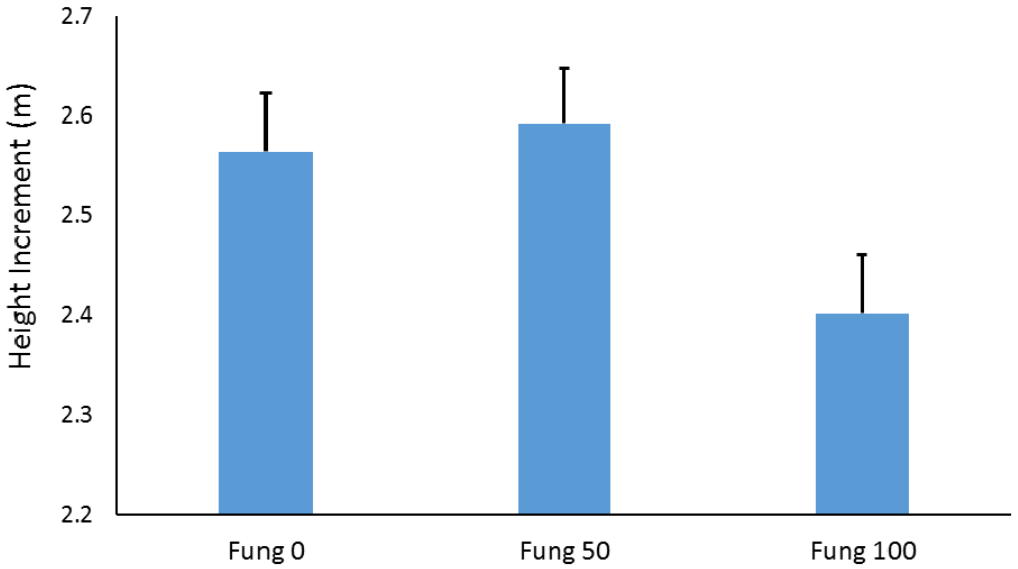


Radiata increased in height faster than the attenuata hybrid, except at Balmoral

Site specific effects – Avoca

Site specific effects – Avoca

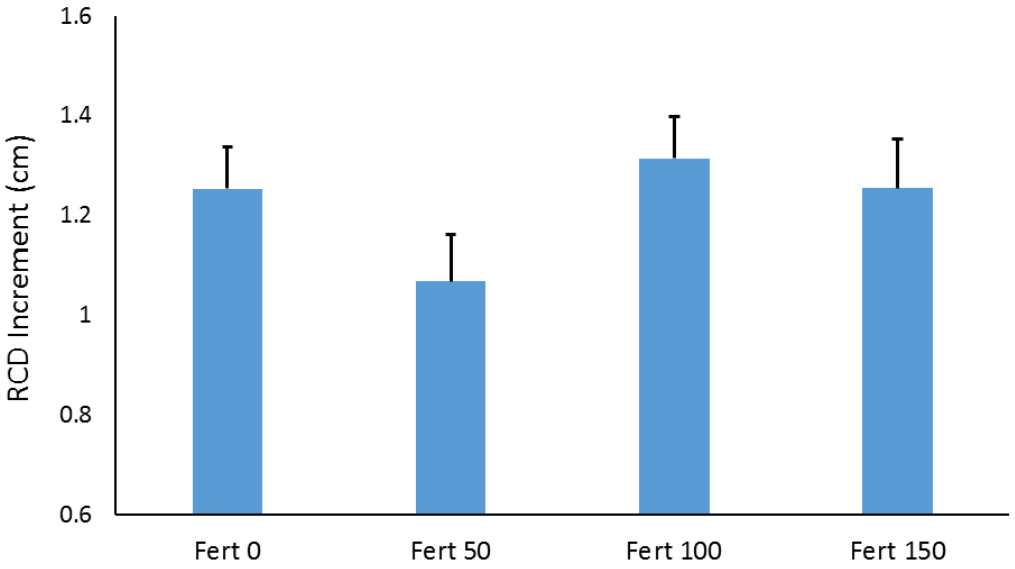


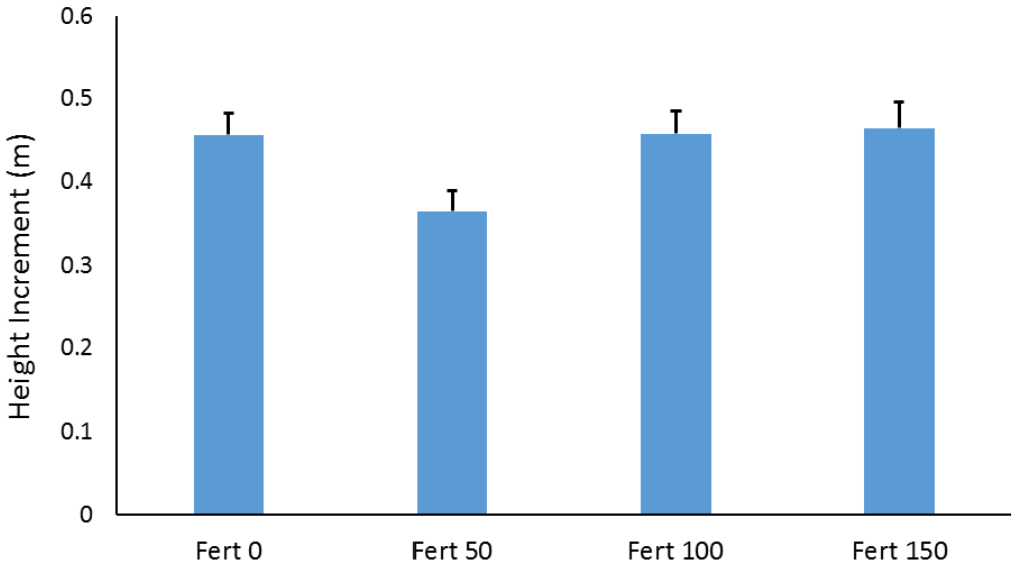


Reduced fungicide use in the the nursery was associated with greater growth rates

Site specific effects – Balmoral

Site specific effects – Balmoral

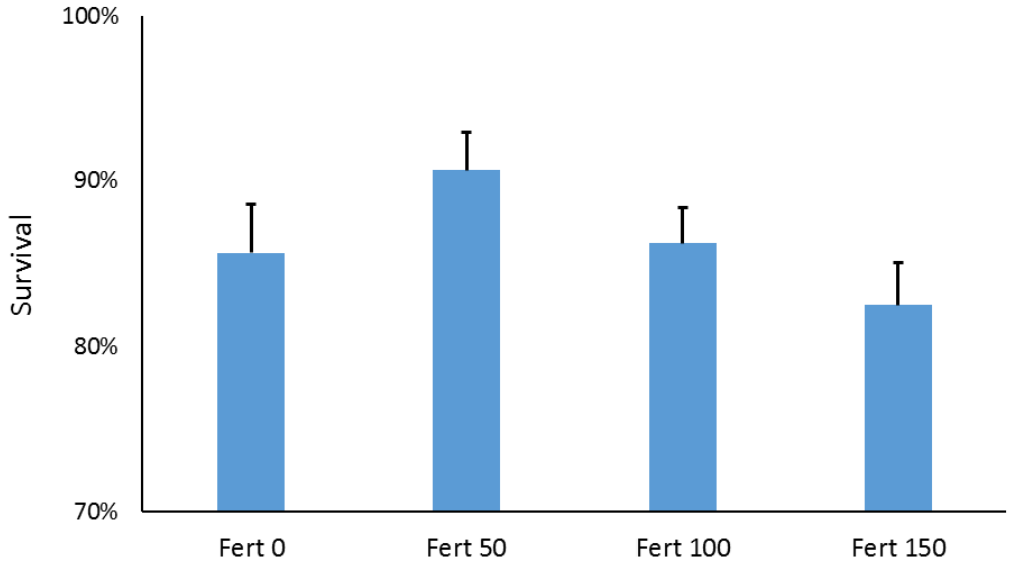




Fertiliser use in the nursery produced a reduction in growth for the low rate – but not at the zero rate – cannot readily explain this outcome

Site specific effects – Dusky

Site specific effects – Dusky



At Dusky, the maximum rate of survival was associated with the low rate of fertiliser use in the nursery – but this gain did not extend to the zero fertiliser rate

Well that was a lot of graphs – so what does it mean?

- These results shows that across the five sites reductions in fertiliser and fungicide use in the nursery have not decreased the productivity of the stock after being planted in the forest
- The site specific outcomes show that some levels of chemical reduction in the nursery could promote enhanced performance – but only under particular conditions
- Overall, as survival and productivity were not observed to decrease in the forest, the results continue to support the potential to reduce chemical use in tree nurseries
- These reductions would provide:
  - Economic benefits from reduced costs
  - Health and safety benefits from reduced chemical handling and exposure
  - Environmental benefits from reduced fertiliser use in nurseries

What was learnt about the attenuata hybrid?

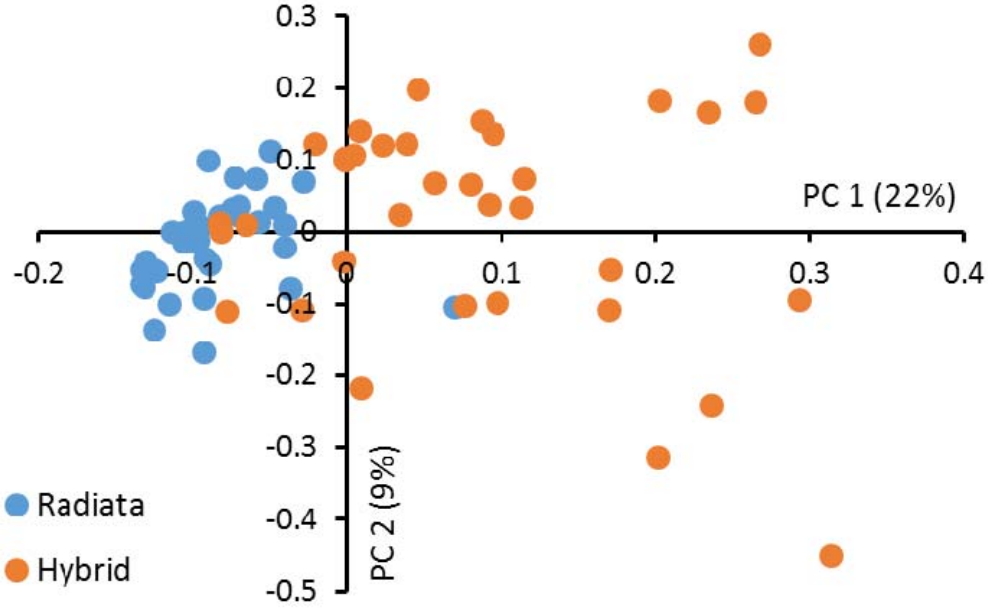
More robust in the field than radiata – but smaller, and with a lower nutrient loading leaving the nursery gate

In the forest, directs more effort to diameter growth than height compared to radiata

In terms of associations with soil fungi, very different to radiata pine

- How much does this shape the properties of the attenuata hybrid compared to radiata?

More evidence of the need to consider soil biology, and the interactions between trees and soil microbes, as a component of soil health



Current and future work

Considerable additional nursery research is underway

- Further measurements of these five sites to track growth and survival for several more years, with the aim of getting at least another four years of data to match the initial Kaingaroa trial

- A new national network of 46 nursery outplanting sites that is examining site specific responses in greater detail – testing to see if you can raise a seedling to suit a particular site

- Further examinations of interactions between nursery chemicals and beneficial microbes, and the implications for seedling health and performance – testing specific chemicals

Acknowledgements

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Thanks for your attention

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