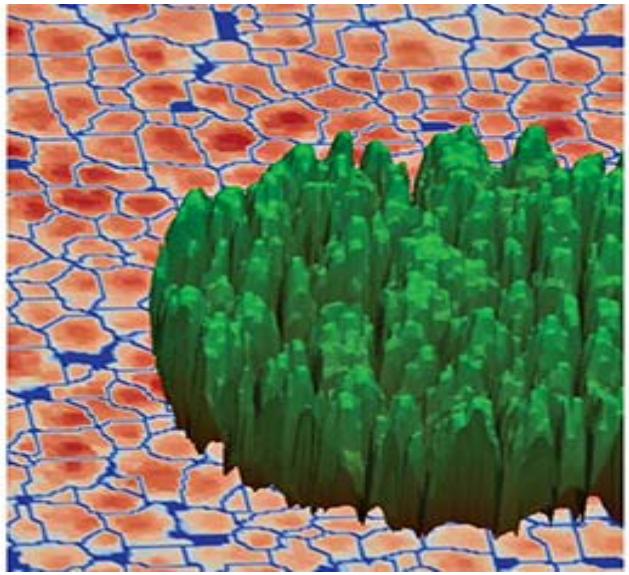
Growing confidence in forestry's future Research Programme

SCION
FORESTS | PRODUCTS | INNOVATION

Determining attainable productivity – the new accelerator trials

Authors: Loretta Garrett, Simeon Smaill, Peter Beets, Dean Meason, Peter Clinton



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FOREST GROWERS RESEARCH

Outline

- Introduction
- The purpose behind the accelerator trial series
- How trial sites where selected
- Background on the 6 accelerator trials
- And where to next for the trials

Introduction

What is limiting this forests potential?

Hint:

- Stantoft Forest
- Sandy soils

This forest is low in nitrogen, low **soil** nitrogen is limiting productivity

Introduction

What is limiting this forests potential?

Hint:

- Tairua
- Allophanic Soil

This forest is low in phosphorous, low available **soil** phosphorous is limiting productivity

Introduction

What is limiting this forests potential?

Hint:

- Needle retention

This forest is impacted by disease, **planting stock GF+ rating** is limiting productivity

Introduction

What is limiting this forests potential?

Hint:

- Ex-farm

This forest is a high fertile **farm site**, at age 15 years =

CAI 45 m^3/ha

Live BA 54 m^2/ha

LETTER

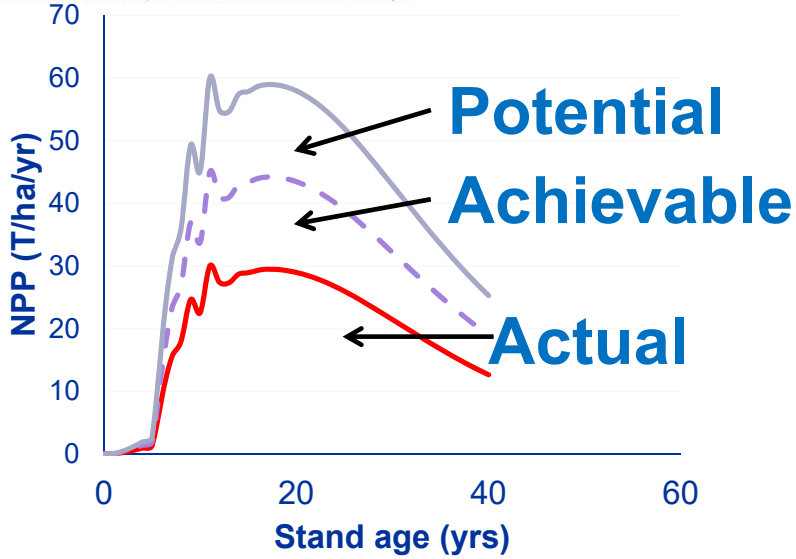
doi:10.1038/nature11420

Closing yield gaps through nutrient and water management

Nathaniel D. Mueller[1], James S. Gerber[1], Matt Johnston[1], Deepak K. Ray[1], Navin Ramankutty[2] & Jonathan A. Foley[1]

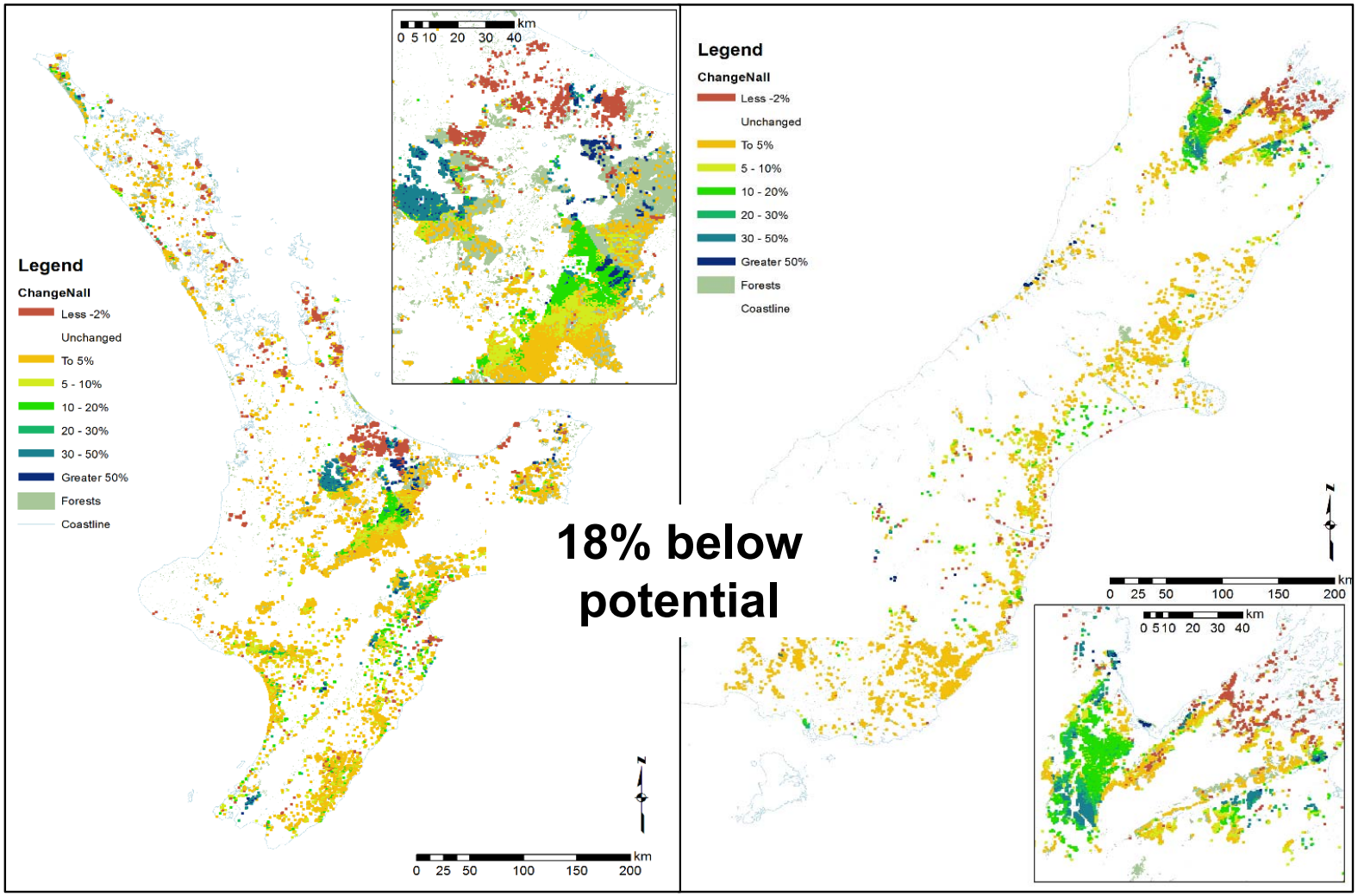
the spatial patterns of agricultural management practices and yield limitation, and the management changes that may be necessary to achieve increased yields. We find that global yield variability is heavily controlled by fertilizer use, irrigation and climate. Large production increases (45% to 70% for most crops) are possible from closing yield gaps to 100% of attainable yields, and the changes to management practices that are needed to close yield gaps vary considerably by region and current intensity. Furthermore, we find that there are large opportunities to reduce the environmental impact of agriculture by eliminating nutrient overuse, while still allowing an approximately 30% increase in production of major cereals (maize, wheat and rice). Meeting the food security and sustainability challenges of the coming decades is possible, but will require considerable changes in nutrient and water management.

Opportunities for agricultural intensification were analysed for



- Large increases are possible but also large opportunities to reduce environmental impact through better nutrient and water management

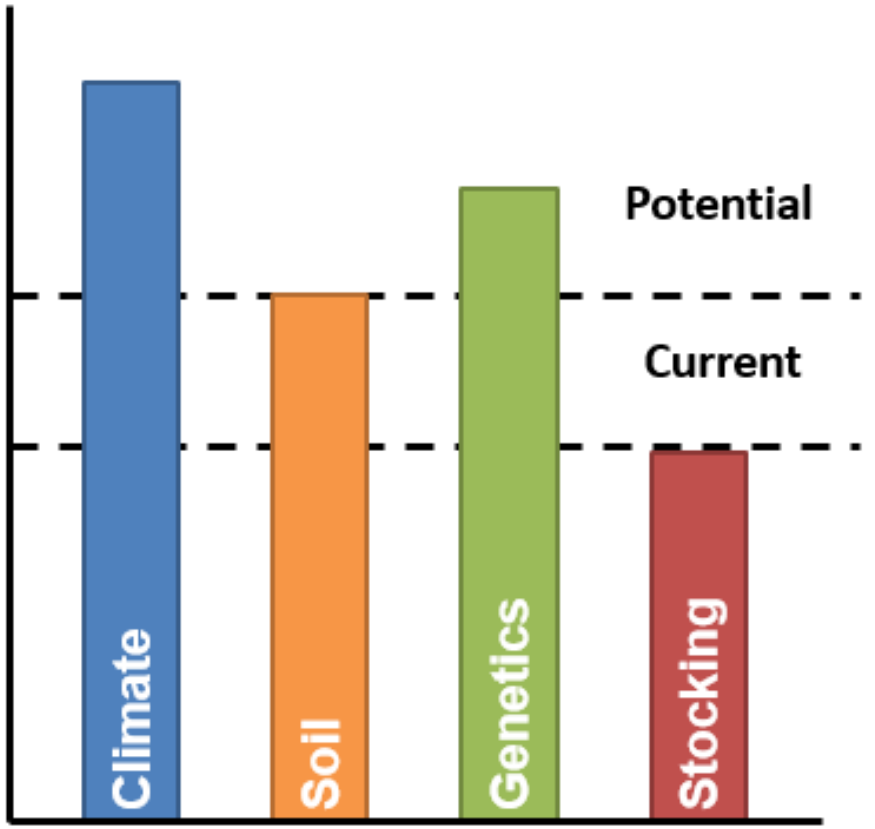
The national potential is there



Accelerator trial series

- *Aim:* To demonstrate the productivity gains achievable through site management practices, and to serve as a productivity benchmark

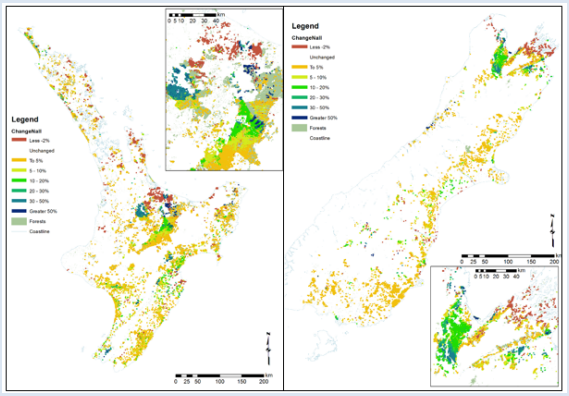
What is limiting your forest potential?



Powers (1999)

Accelerator trial series – how site selected

Productivity gap analysis



- Nitrogen limitation
- Soil water holding limitation
- Soil organic matter low

Site known to have a specific limitation

e.g.

- Phosphorus limitation
- Site crop occupancy limitation

Accelerator trial series – how sites selected

Current 300 Index

Surface 300 Index

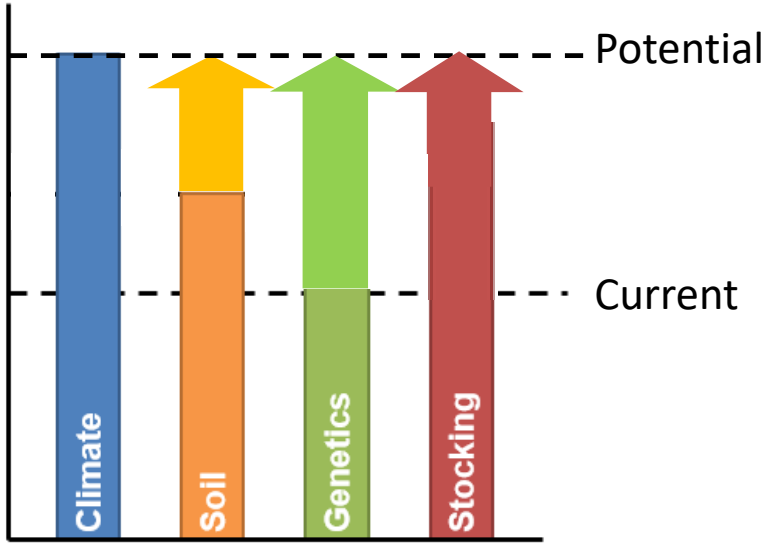
20.4

Details:

- Seedlot
- Tree health
- Stocking

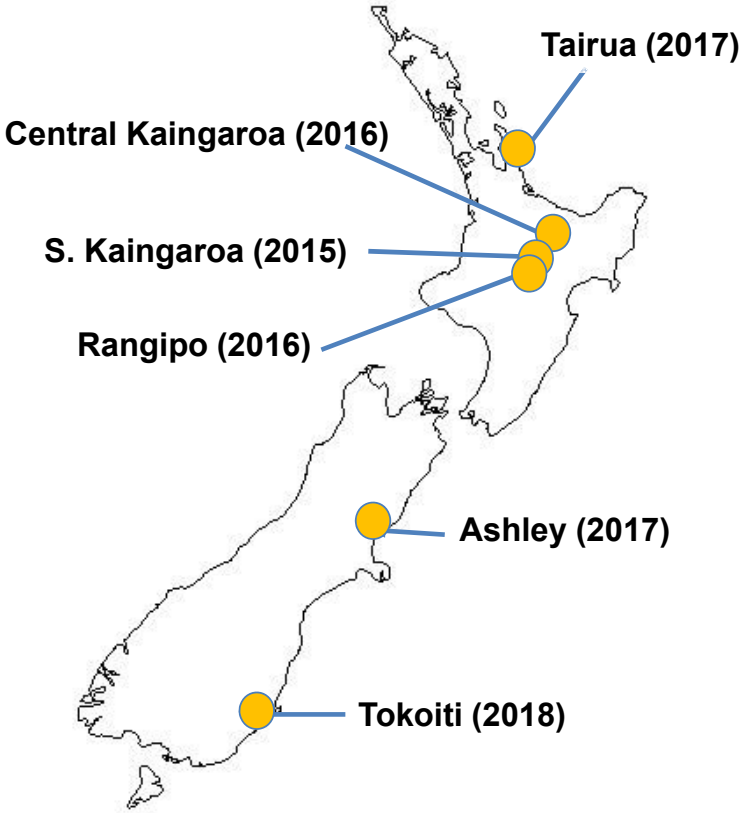
Questions:

- **What is causing the gap?**
- **Can the site do even better?**



Powers (1999)

Accelerator trial – locations



Dominant limitation	Sites
Genetics	All sites
Nitrogen	Southern Kaingaroa
Soil organic carbon	Central Kaingaroa
Phosphorus	Tairua
Climate (soil moisture)	Ashley
Future climate (soil moisture)	Tokoiti
Stocking potential?	Tokoiti, Rangipo

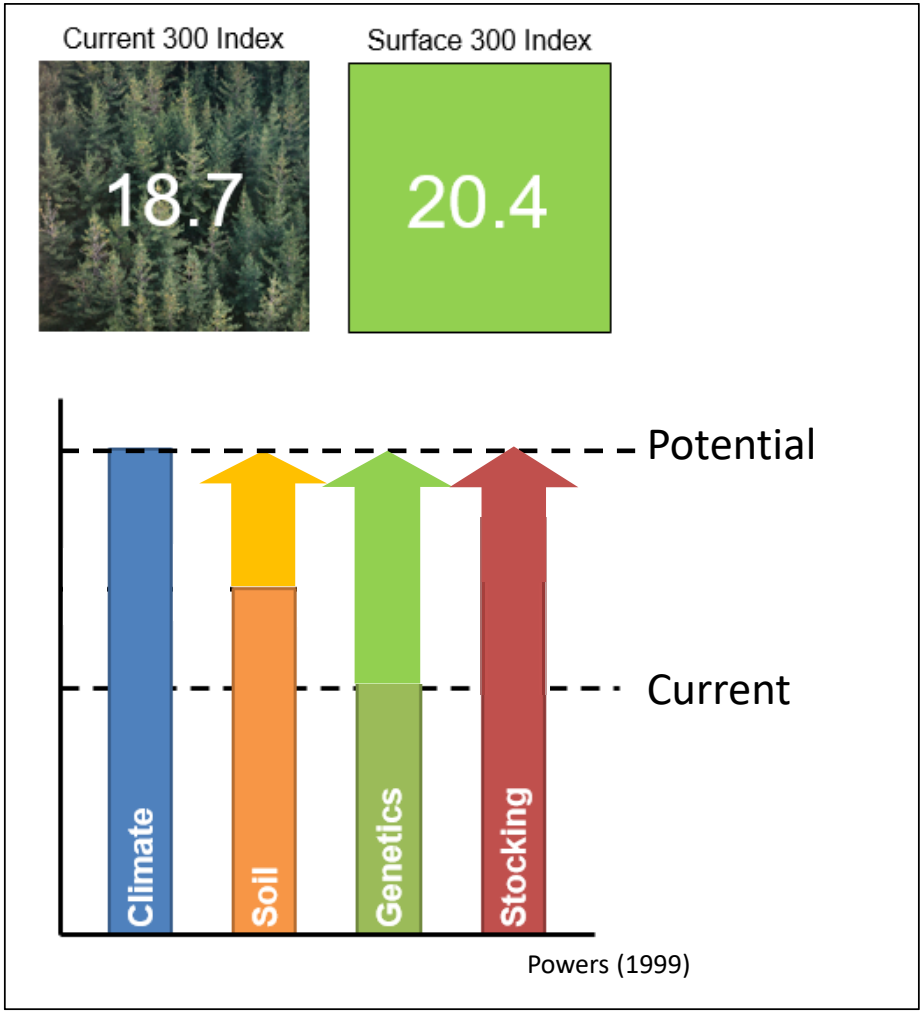
Accelerator trial series – basic design

- Replicated trial design for each site:
- Site specific treatments and a control
- 12 different planting stocks based on traits

Stock Code	High DBH	High MOE	High density	Low density	Dothistroma resistant	Drought tolerant
15	✓	✓	✓		✓	✓
19	✓	✓		✓		
24	✓	✓	✓			✓
25	✓	✓	✓			
30	✓	✓		✓		
31					✓	✓
37	✓	✓		✓		
38	✓	✓	✓		✓	
43	✓	✓		✓		
48	✓	✓	✓			
AxC hybrid						✓
GF19						

Some stock variation between sites due to supply – Stock trait retained

Method for setting targets

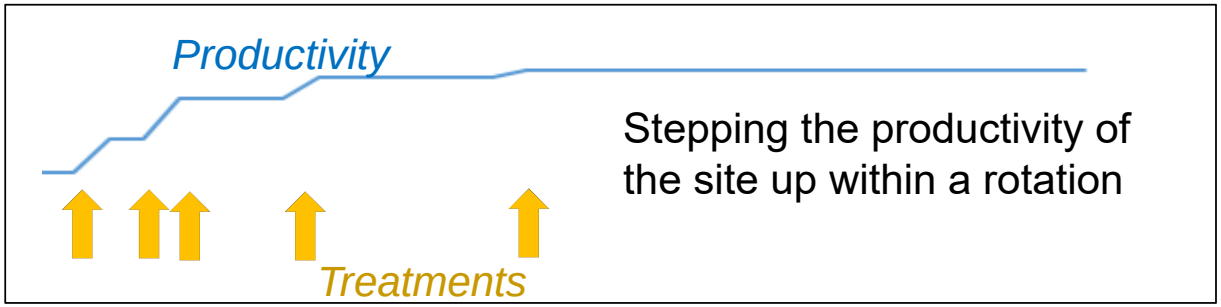


Target 300 Index

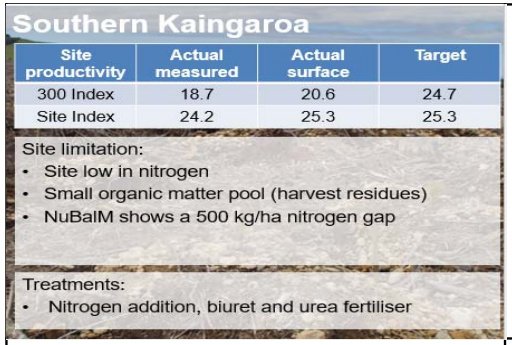
?

- Productivity gap analysis
- ‘Farm effect’ +20%
- Genetic effect – same site different 300 Index target

Over the rotation site limitations will be continuously addressed to keep pushing the site



Accelerator trial series



Southern Kaingaroa

Site productivity	Actual measured	Actual surface	Target
300 Index	18.7	20.6	24.7
Site Index	24.2	25.3	25.3

Site limitation:

- Site low in nitrogen
- Small organic matter pool (harvest residues)
- NuBalM shows a 500 kg/ha nitrogen gap

Treatments:

- Nitrogen addition, biuret and urea fertiliser

Accelerator trial series

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Rangipo

Site productivity	Actual Surface
300 Index	34.4
Site Index	32.5

Site limitation:
- Afforestation of pasture
- Chance to test site preparation and stocking limits

Initial treatments:
1. Rip-mounded and no rip-mounding
2. Stocking 833 stems/ha and 1282 stems/ha

Rangipo

Site productivity	Actual Surface
300 Index	34.4
Site Index	32.5

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Central Kaingaroa

Site productivity	Actual measured	Actual surface
300 Index	23.8	25.0
Site Index	30.0	31.2

Site limitation:
- Low nutrient stocks due to low organic matter

Treatments:
- Manage weeds to increase organic matter

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Ashley

Site productivity	Actual surface
300 Index	23.3
Site Index	25.7

Site limitation:
- Soil moisture availability

Treatments:
- Enhance stress tolerance via two pathways, chemical and biological

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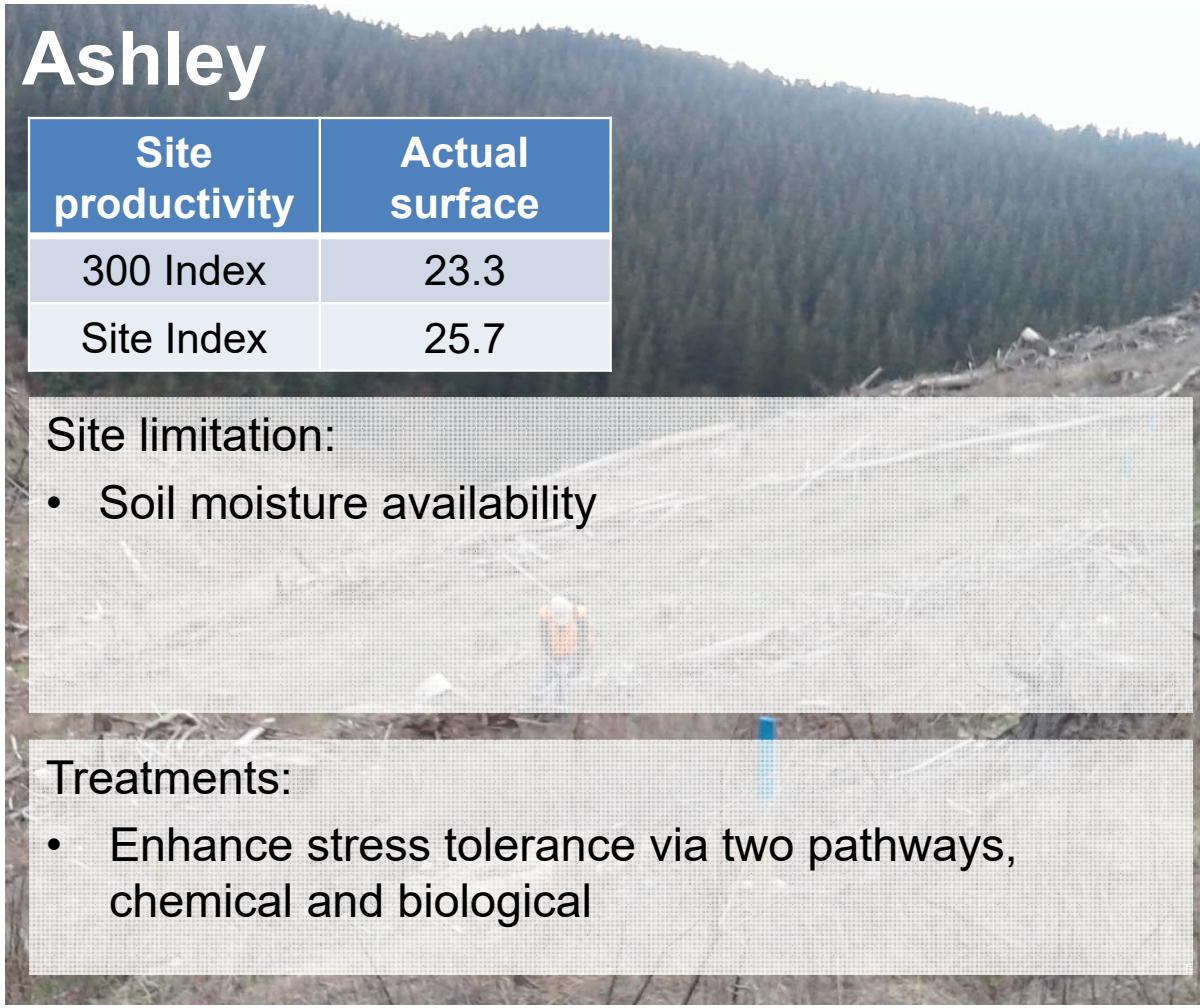

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Tairua

Site productivity	Actual surface
300 Index	29.3
Site Index	29.1

Site limitation:
- Site low in phosphorous

Treatments:
- Phosphorous addition to feed the trees not the soil and to influence phosphorous release in the soil

Central Kaingaroa

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300 Index	23.8	25.0
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Tokoiti

Site productivity	Actual measured	Actual surface
300 Index	25.9	26.6
Site Index	25.2	26.3

Site limitation:
- First rotation on improved pasture
- Site to become drier with climate change – Soil moisture will become limiting

Initial treatments:
- Increase soil organic matter – mulching harvest residues

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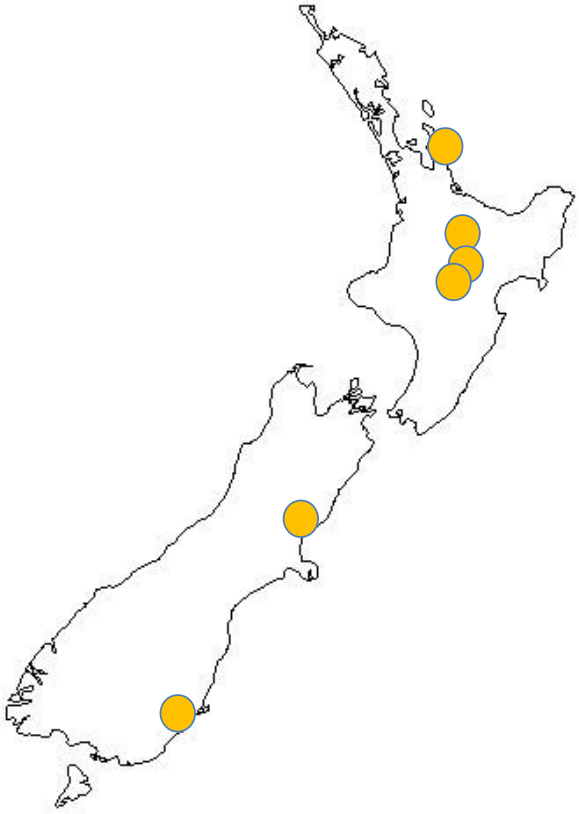
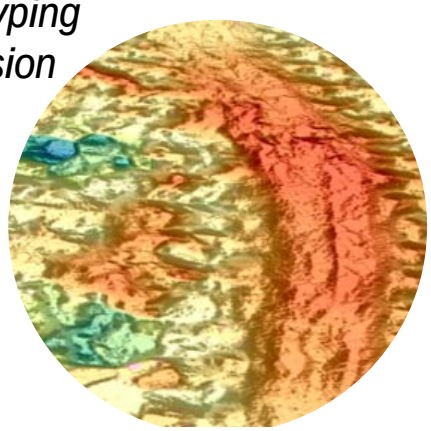
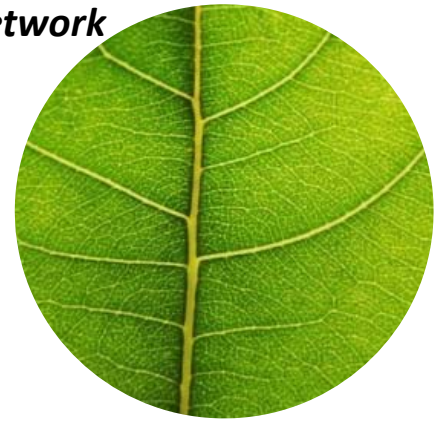


Accelerator trial linkages

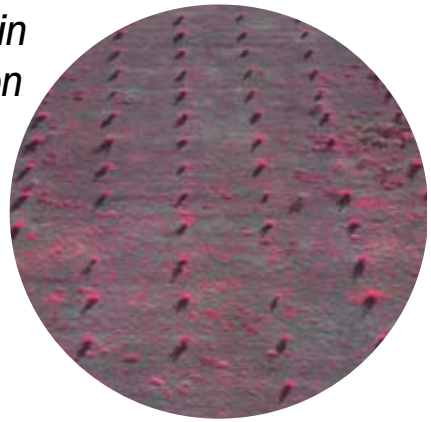
Phenotyping extension



Ecophysiology Sensor Network



UAV in action



Applying the DualEm

Interactions with soil biology

Nutrient leaching

Where to next

- Get involved:
  - Trial series infrastructure nearly completed
  - Treatment planning is underway – get involved
- On going data collection, analysis and treatments
- A high impact legacy that needs protection and care:
  - Underpin primary aim to demonstrate productivity gains that can be achieved when site limitations are addressed
  - Also allow for other future aims to be answered

Acknowledgements

- Funding – MBIE and the Forest Growers Levy Trust, with the support of the NZ Forest Owners Association and the NZ Farm Forestry Association
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