POTENTIAL FOR BIOCONTROL OF PATHOGENS

Presenter: Dr. Helen Whelan

FOREST GROWERS RESEARCH

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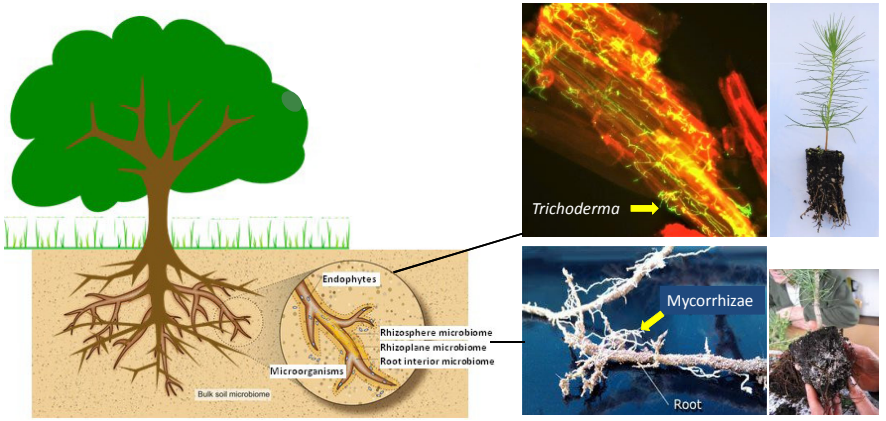
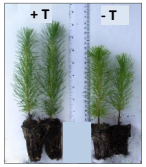
Bio-Protection
Bioprotection science for New Zealand

The root microbiome - beneficial fungi





Trichoderma root endophytes

- Naturally occurring fungus found in roots and soil;

  - has a symbiotic/mutualistic relationship with plants

- Benefits of *Trichoderma*:
  - plant growth promotion
  - activate plant defence systems
  - be aggressive against other fungi
  - increased plant tolerance to stress
  - improved nutrient uptake

⇒ ***Trichoderma* do a similar job to Mycorrhizae fungi (eg. *Rhizopogon*)**

- Easy to grow and propagate; easy to use in nursery

Management of Foliar Disease

Management of foliar diseases often involves inputs of agrichemicals:

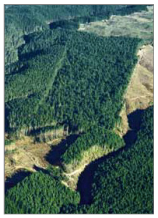
but recently
- emphasis on minimizing environmental impact
- finding more sustainable ways to operate
- pressure to reduce or eliminate use of agrichemicals

➡ naturally occurring organisms (eg. *Trichoderma*) offer a non-chemical alternative for disease control and growth promotion

Trichoderma Pine Research Programme:

To reduce foliar disease losses using <u>beneficial *Trichoderma* root endophytes</u> by suppressing disease and enhancing growth in nurseries and plantations

Reduced chemicals and improve growth in nurseries



Healthier forests and faster growth

Protection against pathogens not yet here

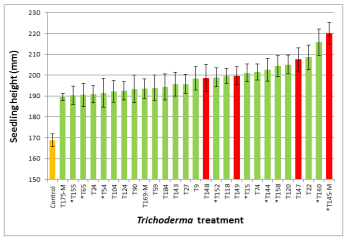
Trichoderma Pine Research Programme:

1. **Selection of *Trichoderma* endophyte strains from the roots of very healthy, strongly growing plants** (***P. radiata,*** **mint, rose, garlic, agapanthus, lily etc.)**

Trichoderma Pine Research Programme:

2. **Hundreds of *Trichoderma* strains were tested in containerised nursery trials**

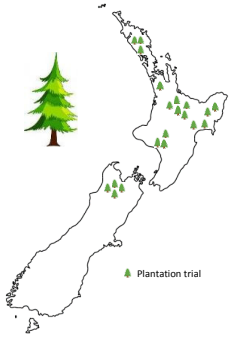
   Disease challenge assays developed (*Dothistroma, Diplodia, Terminal Crook)*



➡ **The most effective *Trichoderma* strains for increasing growth and health of pine seedlings were selected**

Trichoderma Pine Research Programme:

3. **20 x plantation trials from Nelson to Northland**



Results of National Trials:

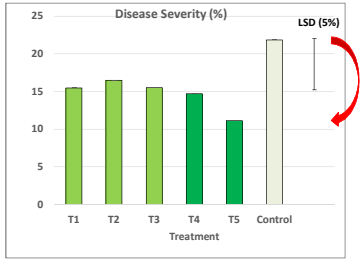
***Trichoderma* increased early tree growth in many of the trial sites, often in sites with growth limitations:**

- up to 20% increase in tree height in young trees
- average 6% reduction in mortality from disease at 12 months
- up to a 19% increase in DBH at year 3
- up to a 17% increase in tree height at year 5.5 year

any benefit to early growth seem to be maintained over time

Impact of *Trichoderma* on Disease?

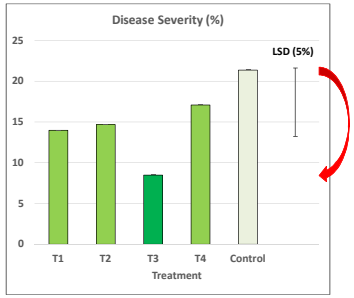
Dothistroma needle blight in Kaingaroa Forest trial:



49%

Impact of *Trichoderma* on Disease?

Dothistroma needle blight in Ohakune Forest Trial:



60%

⇒ ***Trichoderma* nursery seed-treatment reduced but did not eliminate the expression of disease in the field**

Trichoderma Pine Research Programme:

4. Eight large validation trials (2-3ha; winter 2018)

The best two *Trichoderma* treatments were selected from the national trials:

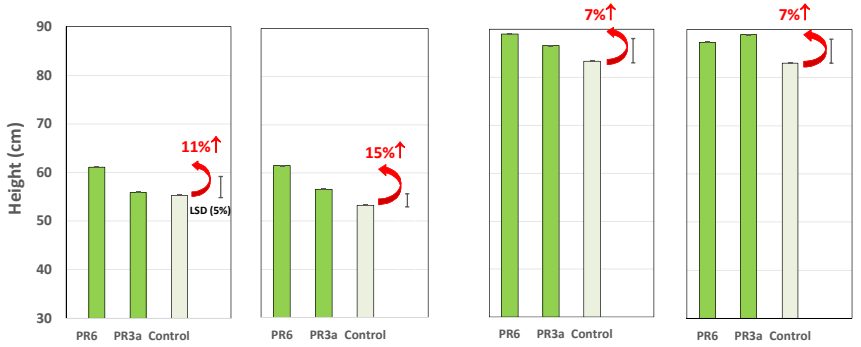
PR6 mixture, **PR3a mixture** (applied as a seed-coat in the nursery) and **untreated control**

Four Regions:
Gisborne
Northland
Nelson
Bay of Plenty/Waikato

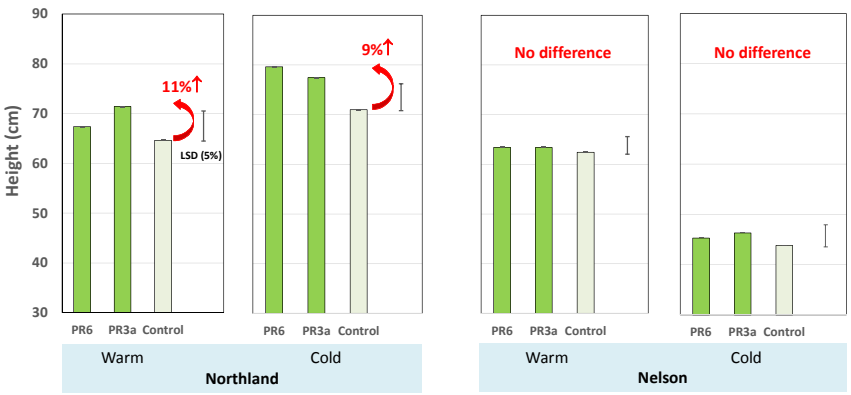
Two Sites per Region:
High altitude/cooler and Low altitude/warmer

Robust design:
81 trees per plot (9 x 9 trees)
7 to 10 Replicates per trial

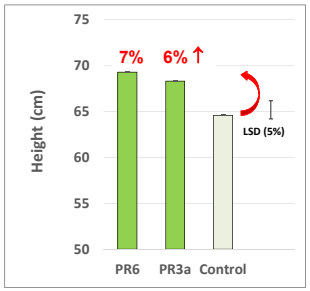
Height measurements (year one):



Height measurements (year one):



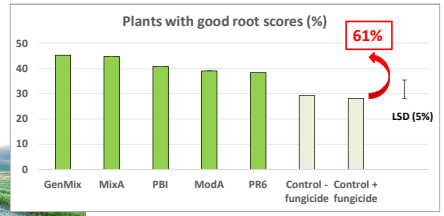
Data analysed from all locations:



✓ => *Trichoderma* applied as a seed-coat gave a significant boost to early growth in the plantation

Trichoderma improved root initiation and growth

Two *P. radiata* trials with difficult-to-root clones



The most beneficial *Trichoderma* treatments gave:

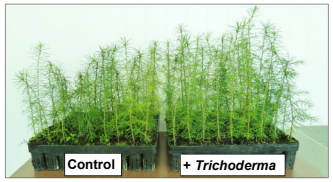
- 21% ↑ in survival (%)
- 38% ↑ in number plants with RCD ≥ 7mm
- **75% ↑ in marketable cuttings (RCD ≥ 7mm and good root scores)** ✓

compared to control treatments

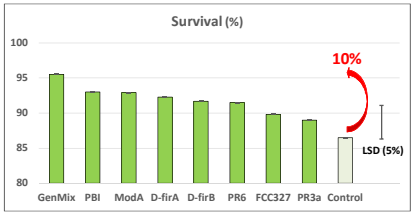
Trichoderma improved seedling growth in Douglas-fir

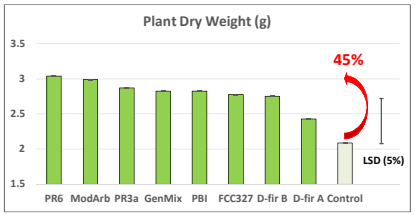
=> very high root colonisation levels at 12 months

✓ ***Trichoderma* + Douglas-fir = highly compatible**



✓ ***Trichoderma* is highly beneficial to Douglas-fir seedling growth**





Does *Trichoderma* persist in inoculated trees once planted in plantations?

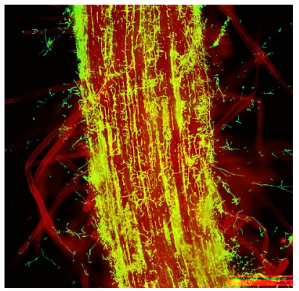
Seedlings:

✓ Good colonisation and persistence of *Trichoderma* in roots of nursery plants

Plantation trees:

A sensitive, species/strain specific molecular test available:

✓ 90% of tested trees (at 3.5 years of age) had the presence of an applied *Trichoderma* (LU633)



Trichoderma (green) inside roots

Can *Trichoderma* treatments mitigate disease problems in established trees?

The most practical/cost effective to apply *Trichoderma* in the nursery as a seed-coat or soil drench

- but can you apply *Trichoderma* to established plantation trees?
- or as a top-up?

Two **"proof of concept"** trials established in Bay of Plenty

✓ You can introduce *Trichoderma* into roots of established trees and generate growth improvements

⇒ but we need a more practical way of doing this

⇒ 2 trials with *Trichoderma* applied to foliage and the ground were established in Bay of Plenty this spring

Other on-going or future work:

1. Can *Trichoderma* improve growth and control canker in Cypress?
2. Can *Trichoderma* control Swiss needle cast in Douglas-fir?
3. Should *Trichoderma* strains be targeted to different regions/environments?
4. Impact of nursery chemicals on colonisation and persistence of *Trichoderma* strains?
5. Can *Trichoderma* be used to boost poor soils in nurseries?

Conclusions:

- *Trichoderma* root endophytes significantly improved plant growth and health in nursery and plantation trees
- Early indications that *Trichoderma* inoculated plantation trees may have less foliar disease than untreated trees
- Nursery seed-coating or drenches are an efficient and effective way to introduce *Trichoderma* into the forestry system

✓ **Confidence to begin the commercialisation discussion process of these beneficial *Trichoderma* mixtures as biocontrol agents in NZ forestry**

A big thank you to:
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- Nelson Forests Ltd
- Tasman Pines Ltd
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- Proseed NZ Ltd

and many private growers

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