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Biological control of tree diseases

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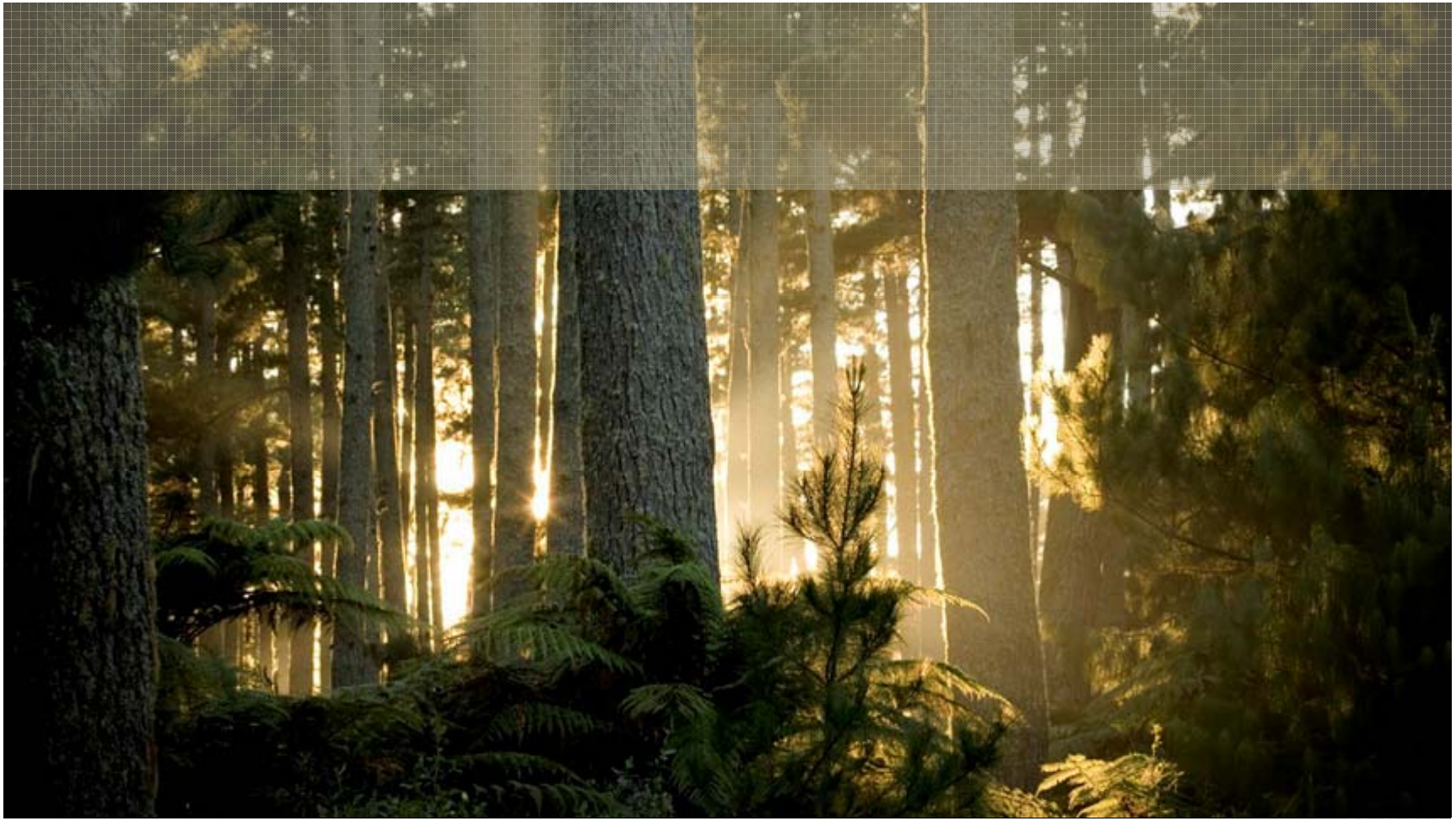

Objectives

1. Fungal endophytes

To identify and test fungal endophytes that can provide resistance against diseases of radiata pine in New Zealand.

2. Biological control of Dutch elm disease using viruses.

To develop a viral biological control agent against Ophiostoma novo-ulmi*, to reduce the impact of Dutch elm disease in New Zealand.*

To develop an alternative and effective method of control that could be used against pests and diseases that threaten New Zealand's forests nationwide.

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1. Fungal endophytes - background

- Fungi that live within their host without causing any disease symptoms.
- Some of these fungal endophytes are involved in providing resistance against pests and pathogens.
- Target needle endophytes of *P. radiata* as focused specifically on foliar diseases.
- Isolated and identified fungal endophytes from foliage of *P. radiata* trees affected by cyclaneusma needle-cast and healthy trees.
- Profiled and screened fungal endophytes to select those likely to be involved in resistance.
- Testing fungal endophytes for induced resistance.

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1. Results

- Selected 16 fungal endophytes that were likely to provide resistance in radiata pine.
- Screened these fungal endophytes against *Diplodia pinea* (Tony Reglinski, Plant and Food).
- Two fungal endophytes significantly reduce the symptoms of diplodia blight.
- Another four fungal endophytes have shown promise as effective biological control agents.

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1. Future directions

- Testing these endophytes against *Dothistroma septosporum*.
- Likely that these endophytes function by inducing resistance in their plant host.
- Expect they will be effective against multiple diseases.
- These six promising fungal endophytes were all isolated from healthy trees in stands with cyclanuesma needle cast – providing resistance against cyclaneusma needle cast as well.
- Field testing.
- GE manipulation of pathways activated in hosts.

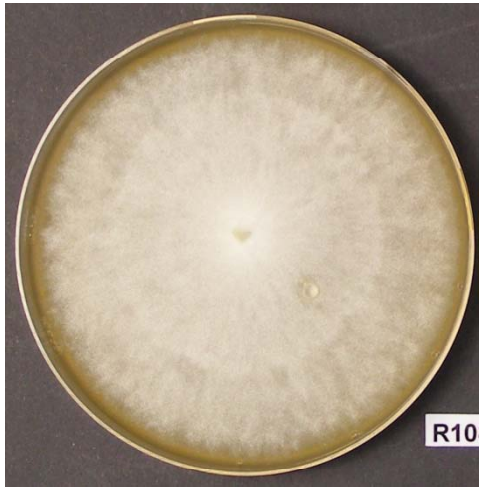
2. Dutch elm disease

One of the 20 worst pests introduced into NZ

- Dutch elm disease/*Ophiostoma novo-ulmi*, vectored by bark beetles
- Devastated Europe and North America
  - over 90% of elms died
- First discovered in 1989 in Auckland
- Eradication campaign begun immediately
- 2007: responsibility of local authorities
- High economic impact in absence of control ($350 million)

2. Saving the elms

- Control options are limited
- Viruses present in overseas populations
  - reduce pathogen virulence and ability to spread
- Suitable biological control agents
- NZ *O. novo-ulmi* population suitable for biological control as the population is small and currently virus free.
- Level of control could depend on genetic diversity (low diversity = more susceptible)



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2. Project overview

- ✓ Genetic diversity
  - vegetative compatibility groups
  - molecular analyses (RAPDs)
  - mating type

No genetic diversity detected, clonal population

- ✓ Imported viruses (quarantine)

- ➢ Testing the growth rate, viability and survival
- ➢ Investigating transmission, retention and competition

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2. Future directions

- ERMA application
  - only insect biological control agents have been approved for release in New Zealand
- Field release
- Bark beetles (*Scolytus multistriatus*) vector virus infected isolates

Control of Dutch elm disease!

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2. Outcomes beyond DED

- ✓ Change the way in which newly established pathogens of trees are treated
- ✓ Provide us with alternative and sustainable methods to deal with diseases that threaten our urban landscapes.
- ✓ Potential to be applied to the protection of commercial and indigenous tree species.
  - *Dothistroma septosporum* (low genetic diversity)
  - *Cyclaneusma*

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Summary

1. Fungal endophytes – biological control agents functional against diplodia blight, cyclaneusma needle cast and maybe other disease problems.
2. Control of DED – viral biological control agent effective against *O. novo-ulmi*
    - Alternative method to control other forest diseases

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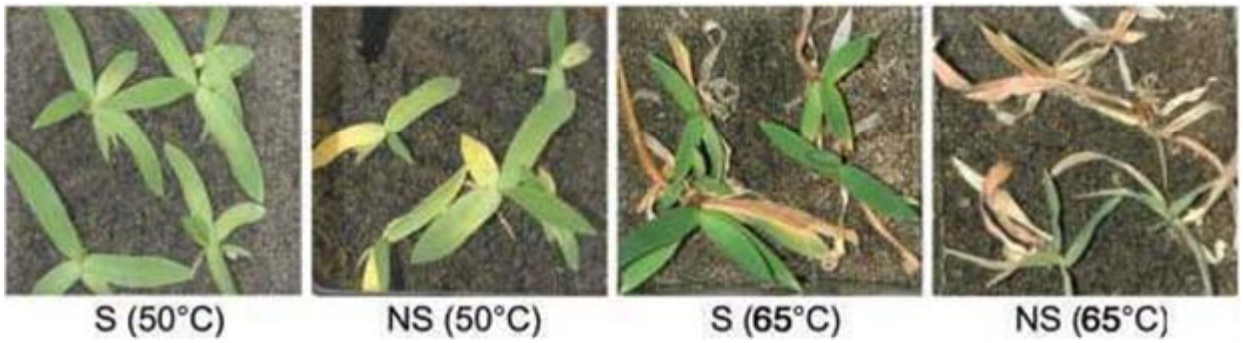
Virus-mediated thermotolerance



Host : panic grass (*Dichanthelium lanuginosum*)

\+

Fungal endophyte (*Curvularia protuberata)*

=

thermotolerance

Virus CThTV

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