Landcare Research
Manaaki Whenua

PTA research: underpinning conservation of *Kauri*

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Acknowledgements

From left; Ross Beever, Joan Webber (UK, Forestry Commission, Margaret Dick (Scion) and Tod Ramsfield (ex-Scion; CA)

- Daniel Than – RT PCR
- Bevan Weir – Phylogeny
- KDJAR
- Professor Steve Williams

- Two years since the passing of Matua Dr Ross Beever - laid the foundation for the current and future research.

Talk Overview

- Kauri
- Kauri Dieback Response
- Distribution
- Identity
- Specificity
- Detection
- Pathways to impacts
- Control

Kauri = *Agathis australis*

- a national icon of NZ
- taonga species of cultural significance to Maori
- a major timber tree and source of resin (‘kauri gum’)
- originally 1 M ha, now less than 1% left of “old growth” forest (approx. 7,500 ha)
- Forest fragments

Distribution of *Agathis* spp.

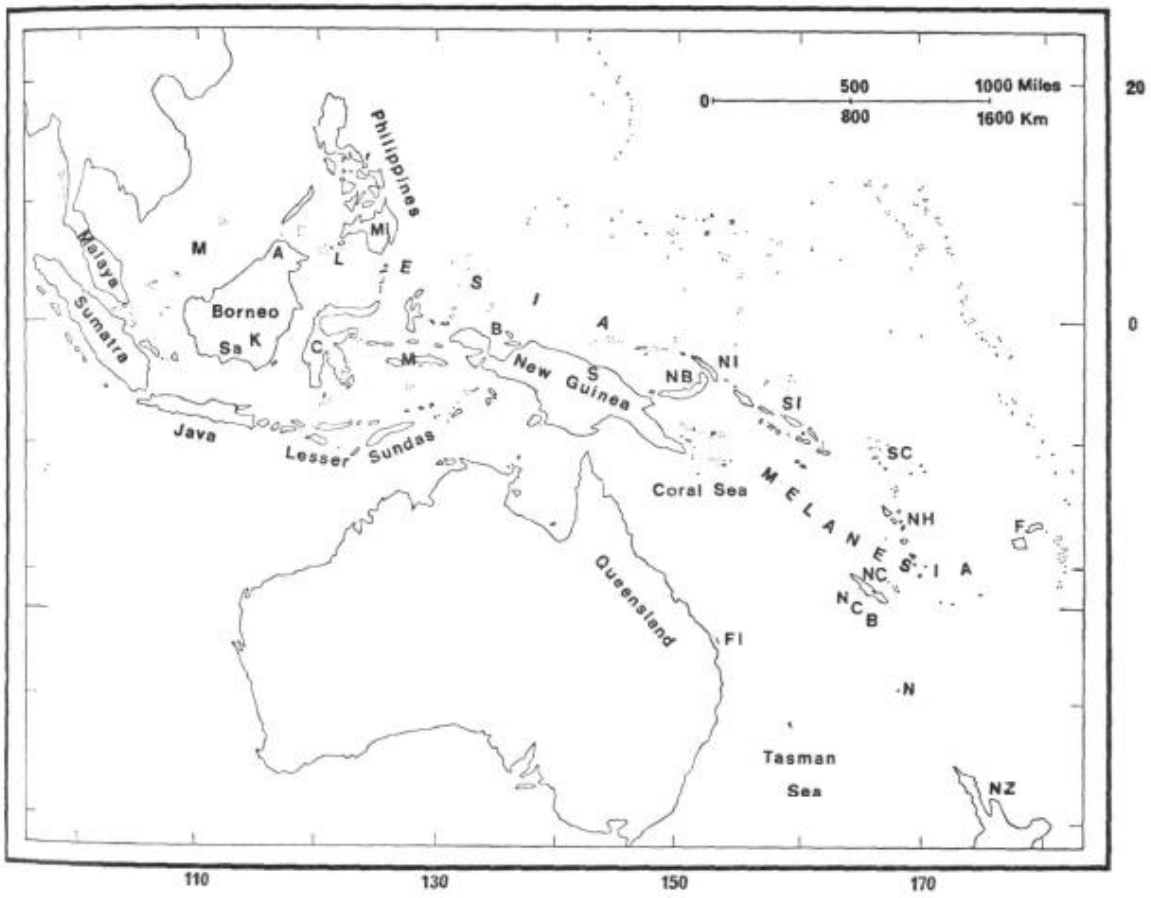
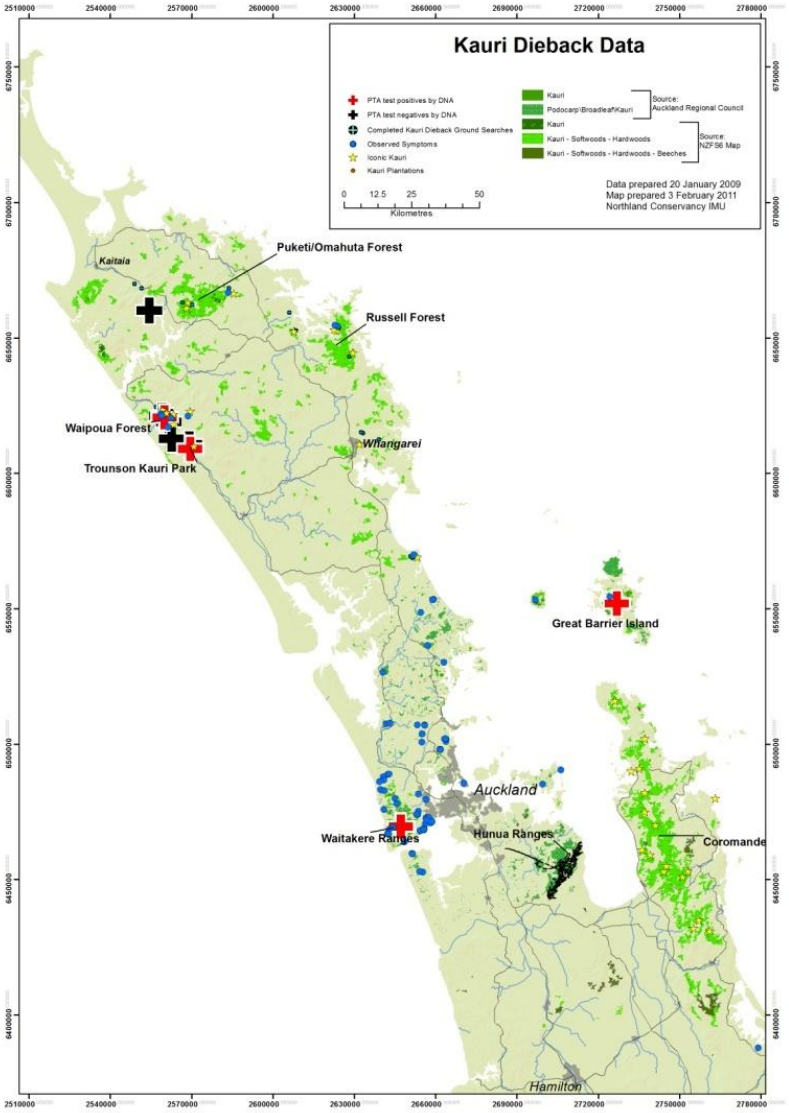


Fig. 1. Malesia, Melanesia and Australasia showing places mentioned in the text. B, Biak Island; C, Celebes; F, Fiji; K, Kalimantan; FI, Fraser Island; M, Moluccas; Mi, Mindanao; N, Norfolk Island; NB, New Britain; NC, New Caledonia; NCB, New Caledonia Basin; NH, New Hebrides; NI, New Ireland; NZ, New Zealand; S, Sepik; Sa, Sampit; SC, Santa Cruz island; SI, Solomon islands.

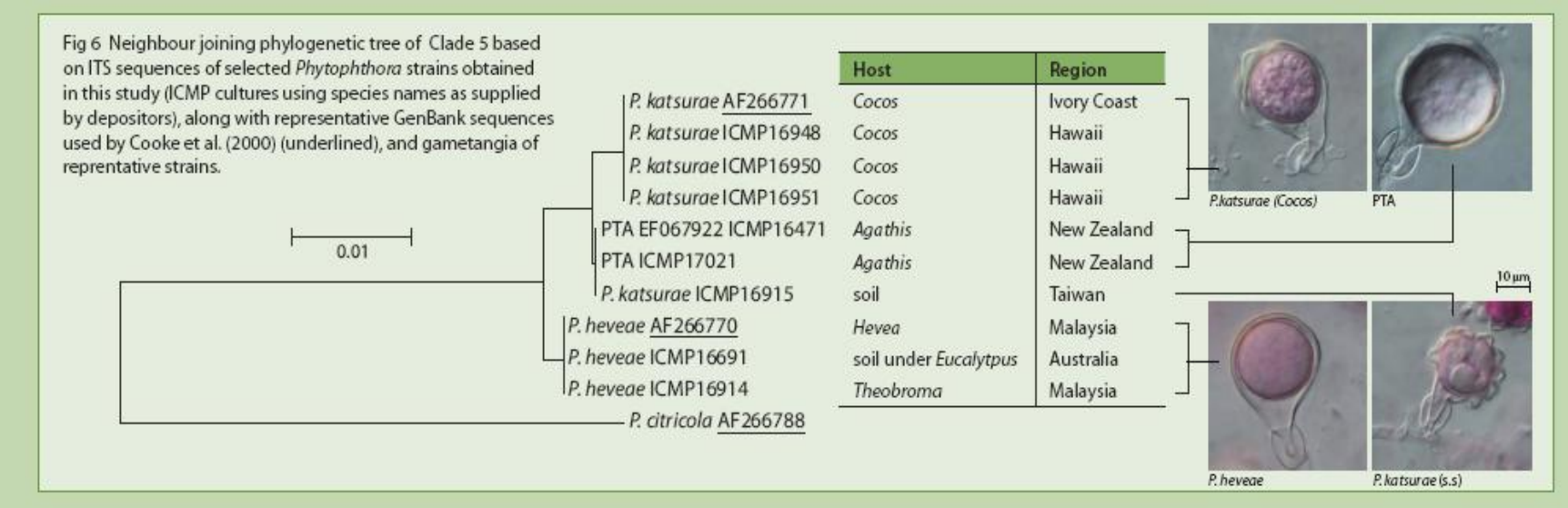
Background to incursion / response

- First observed on Great Barrier Island, 1974
- First observed on mainland, 2006
- Declared unwanted organism, October 2008
- Migrated to long-term management plan 2009
- Confirmed PTA in Waipoua Forest March, 2010
- Discovered PTA in Mangawhai (Robert Hastie Reserve October, 2010)
- Continuing delimitation studies

Distribution



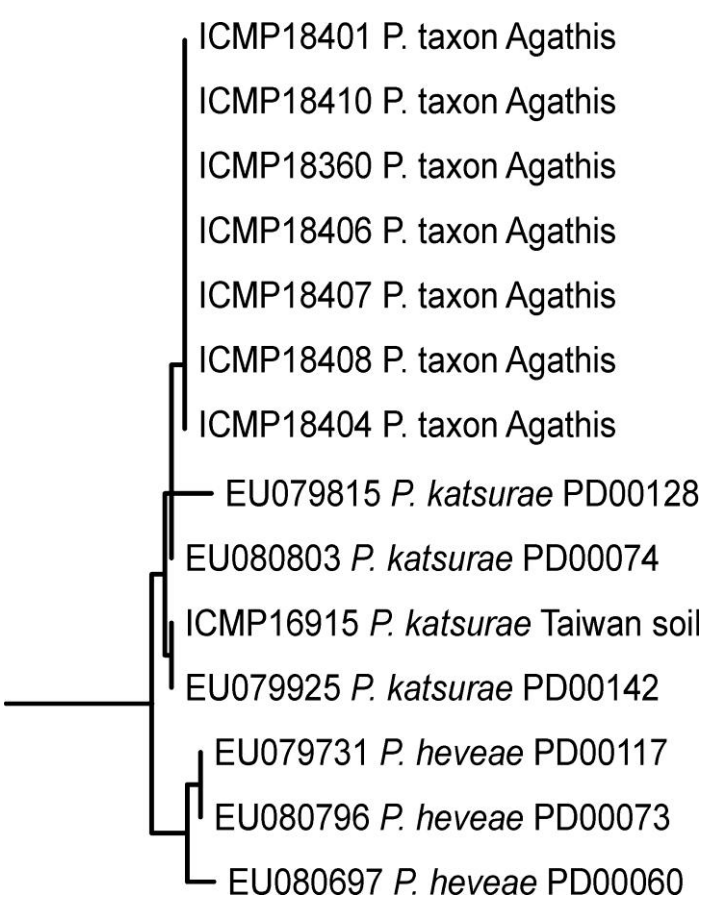
Mistaken identity?

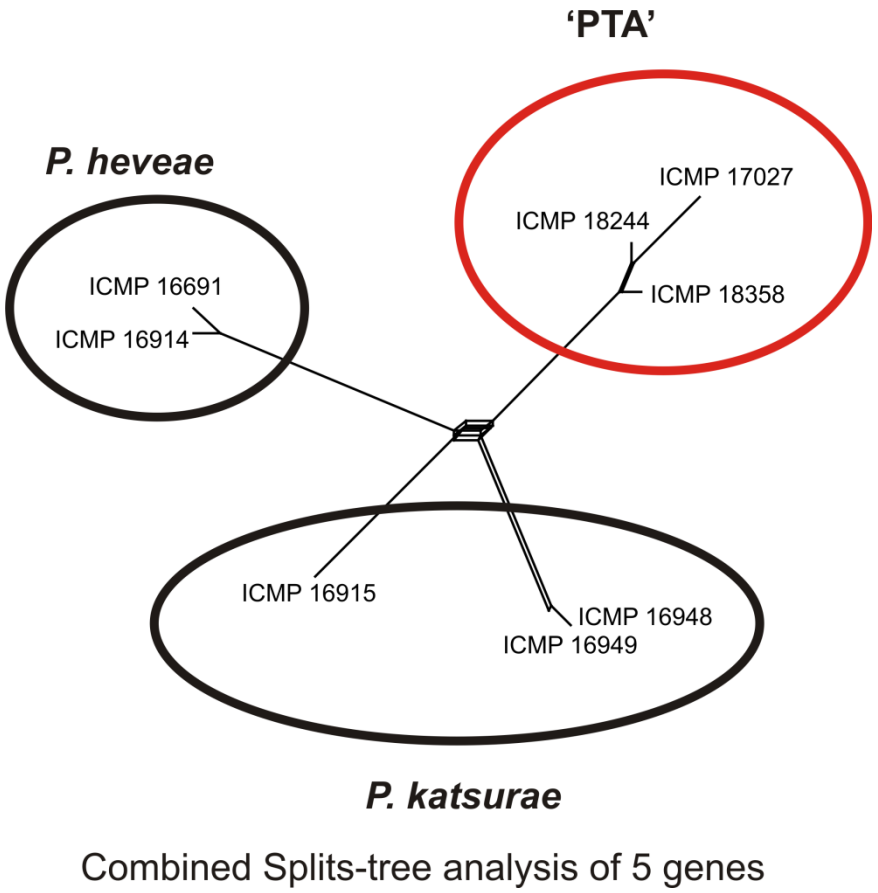


- *Phytophthora* Taxon Agathis: identified as *P. heveae* following kauri decline symptoms on Gt. Barrier Island (Gadgil 1974)
- PTA is as morphologically distinct from *P. heveae*
- ITS-analysis matched PTA with *P. katsurae* from soil in Taiwan
- However, PTA is morphologically distinct from *P. katsurae s.s.*

- ***Proximal hypothesis – PTA is an exotic introduction***
- ***PTA is a discrete taxon – new to science***

Multi-gene analysis





Combined Splits-tree analysis of 5 genes

From sequencing the B-tubulin locus and four other genome regions, we have discriminated PTA from P. katsurae and P. heveae

Pathogenic specificity

Pathogenicity of PTA v. *P. cinnamomi*

- PTA only recovered from lesions in kauri
- PTA only caused death in kauri
- *P. cinnamomi* has a wider, non-lethal, host-range
- *P. cinnamomi* recovered from PTA-infected kauri
- *P. multivora* also recovered with PTA/P.c.

Results from stem inoculations

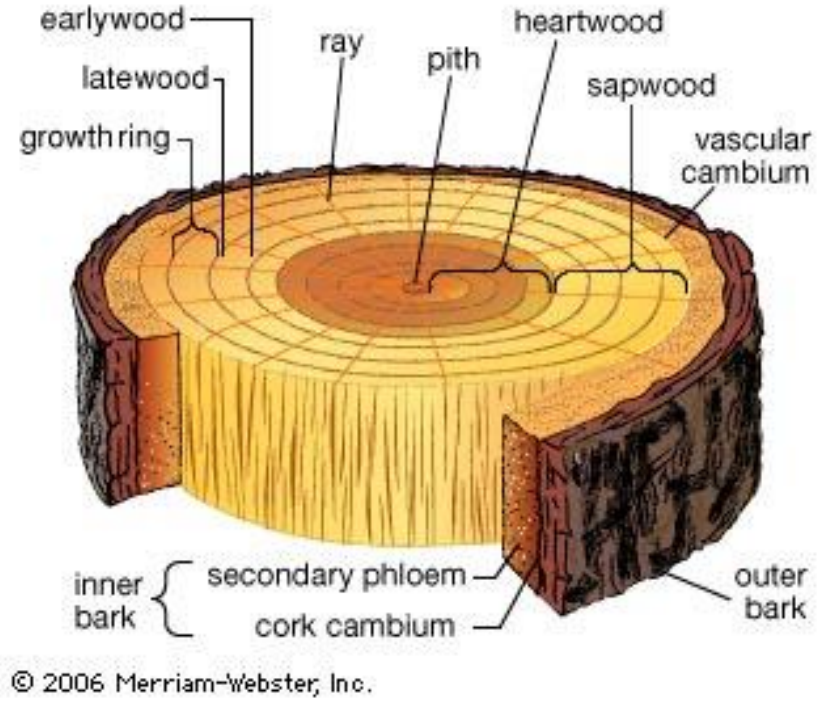
Table 1. Responses of various woody tree species found in association with kauri to PTA and *Phytophthora cinnamomi*

	Lesion length ratio*	
Species	**PTA**	***P. cinnamomi***
Agathis australis (Araucariaceae) - Kauri	DEAD	++
Beilschmiedia tawa (Lauraceae) - Tawa	0	+
Beilshmiedia tarairi (Lauraceae) - Taraire	0	+
Coprosma robusta (Rubiaceae) - Karamū	0	+++
Corynocarpus laevigata (Corynocarpaceae) - Karaka	0	++
Dacrycarpus dacrydioides (Podocarpaceae) - Kahikatea	0	0
Dacrydium cuppressinum (Podocarpaceae) - Rimu	0	0
Hebe stricta (Plantaginaceae) - Koromiko	0	0
Knightia excelsa (Proteaceae) - Rewarewa	0	+++
Kunzea ericoides (Myrtaceae) - Kānuka	0	0
Leptospermum scoparium (Myrtaceae) - Mānuka	0	0
Metrosideros excelsa (Myrtaceae) - Pōhutukawa	0	++
Myrsine australis (Myrsinaceae) - Māpou	0	++
Olearia albida (Asteraceae) - Tanguru	0	0
Pittosporum tenuifolium (Pittosporaceae) - Kōhūhū	0	0
Podocarpus hallii (Podocarpaceae) - Tōtarakotukutuku	0	0
Podocarpus totara (Podocarpaceae) - Tōtara	0	0
Pseudopanax arboreus (Araliaceae) - Whauwhaupaku	0	++
Weinmannia racemosa (Cunoniaceae) - Kāmahi	0	+

*lesion length relative to water control: 0 $\leq$2.0, + >2$\leq$4, ++ >4$\leq$8, +++ >8

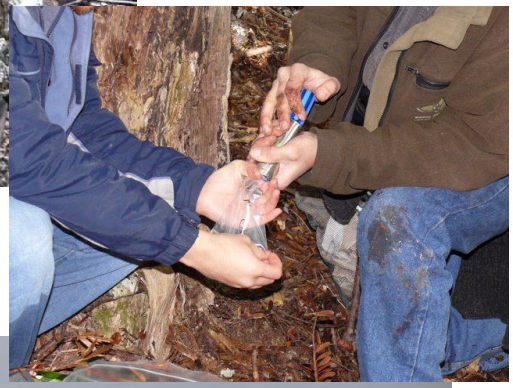
Tissue-based detection

- Knowledge of the gummosis typical of PTA infection
- LFD's give us *generic* indication of presence of *Phytophthora*

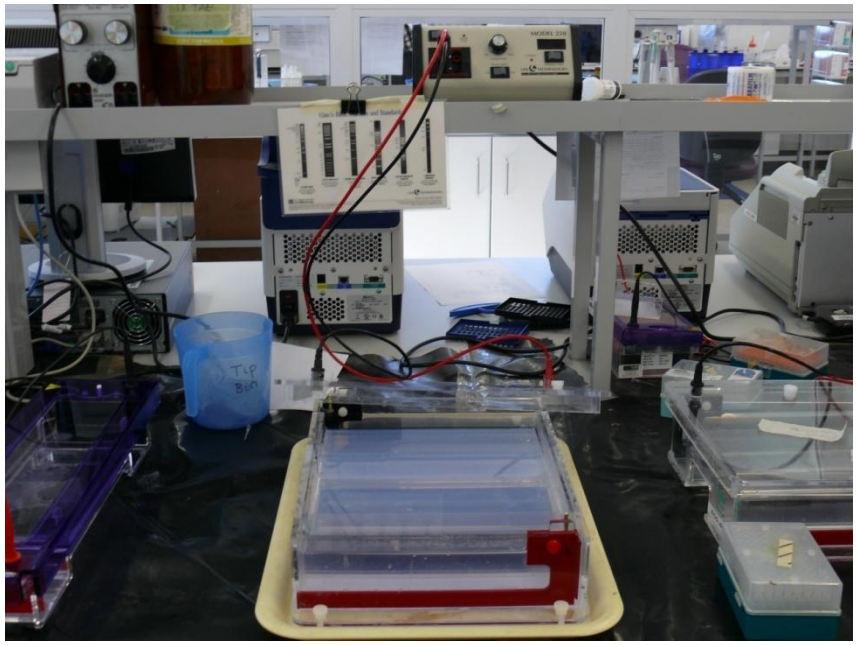


Soil-based detection

- Soil taken from around trees showing gummosis
- Not a “direct” assay, as the soilborne inoculum is not visible to the eye
- Requires pre-treatment – air-drying, re-wetting, and flooding
- Add “baits” to water to “fish-out” PTA
- Have recovered PTA from 0.5 g of soil.



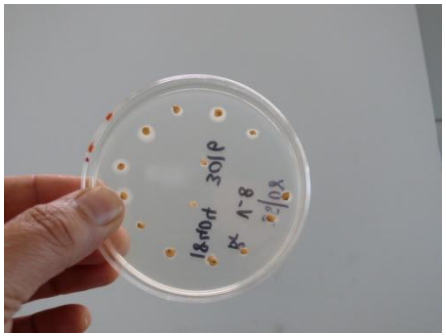
Real-Time PCR detection



- TaqMan Real-Time PCR assay for specific detection of PTA
- Detection limit of 2 fg ($X10^{-15}$) of PTA DNA
- Efficacious in the presence of soil
- Looking to apply to tissue e.g. cork cambium
- Where in the wood is PTA?

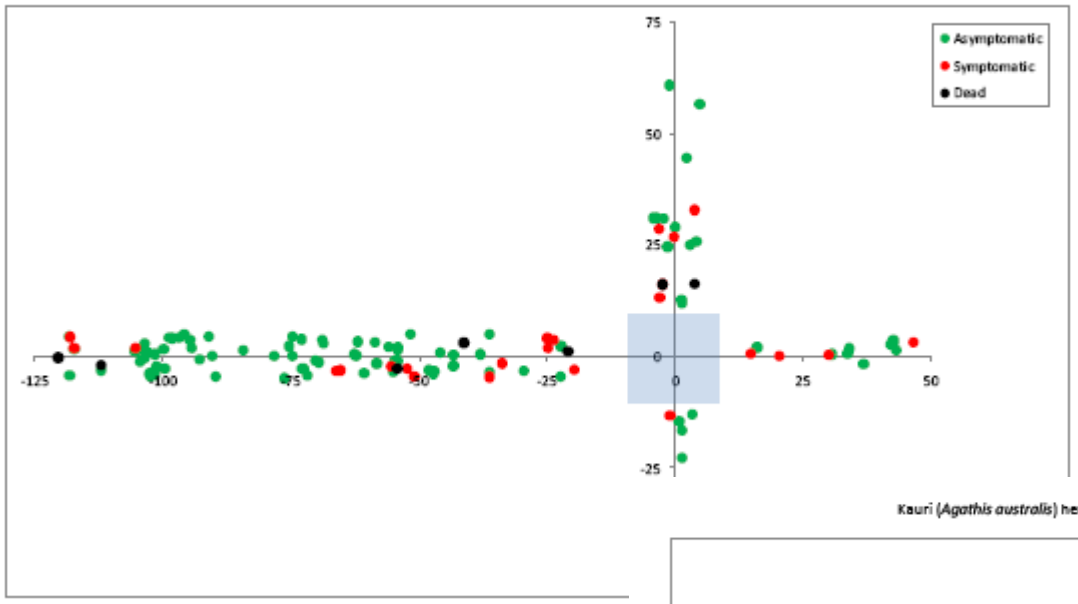
Pathways of infection

- Non-target host range studies to identify potential asymptomatic disease promoters
- Root inoculation studies using roots infected with PTA as pathogen inocula on juvenile kauri
- Confirmation that PTA infection can be initiated from artificially, infected root- and collar-material

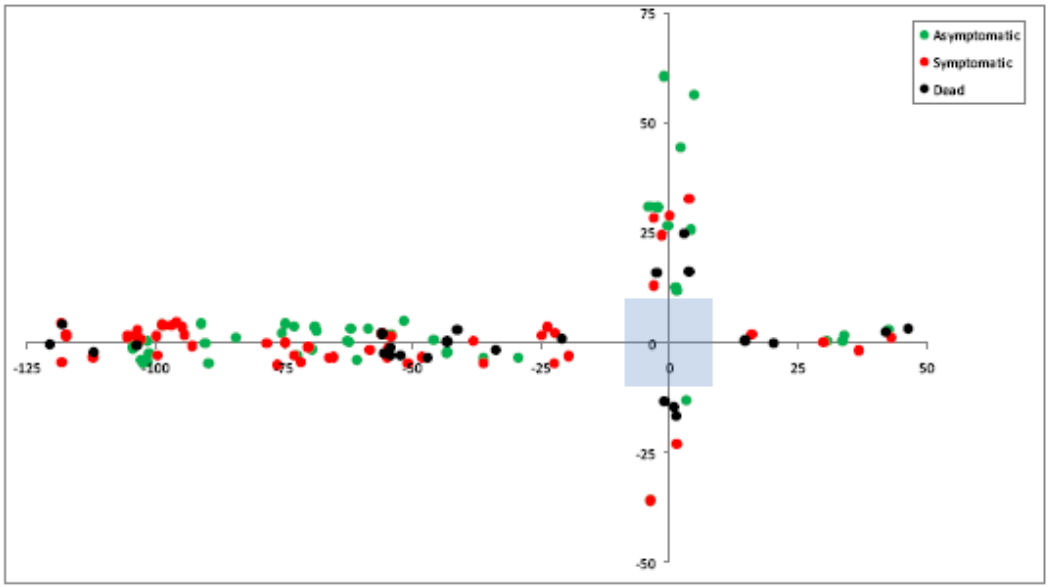


Twin Peaks Track: 2006-2012

Kauri (*Agathis australis*) health status at Twin Peaks track, Huia along transects in 2006.

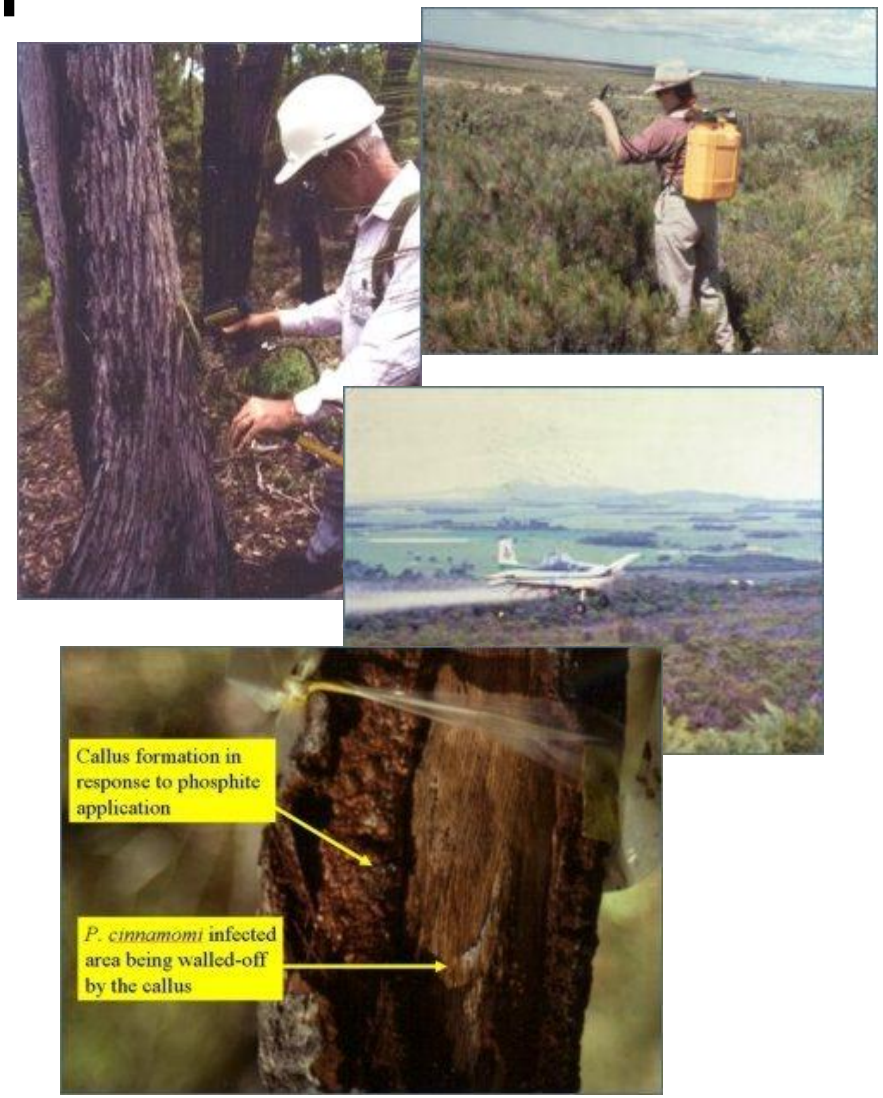


Kauri (*Agathis australis*) health status at Twin Peaks track, Huia along transects in 2012.



Research – control efficacy of phosphite

- The potential for foliar and bark applications of phosphite to control PTA have shown positive glasshouse results.
- Phosphite acts directly on the pathogen, and indirectly stimulating a strong and durable defence response.
- The host responds to injury by producing callus tissue – walling off the infection.
- In slow-growing, long-lived trees these responses can take years to become apparent.



Thank you

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