



Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI



Identifying resistance to the pandemic biotype of *Austropuccinia psidii* in New Zealand Myrtaceae

Grant Smith, Plant & Food Research, Lincoln

Beccy Ganley, David Chagné, Jayanthi Nadarajan, Ranjith Pathirana, Julie Ryan, Elise Arnst, Roanne Sutherland, Julia Soewarto, Gary Houlston, Alby Marsh, Emily Koot, Angus Carnegie, Tracey Menzies, David Lee, Louise Shuey, Geoff Pegg

Myrtle Rust Symposium, Jet Park Hotel, Auckland Airport, 9th September 2019

The New Zealand Institute for Plant & Food Research Limited

Winner
2017



**The
Prime
Minister's
Science
Prizes**

Big Trans-Tasman Team Effort

Grant Smith, Beccy Ganley, David Chagné, Jayanthi Nadarajan, Ranjith Pathirana, Julie Ryan, Elise Arnst, Roanne Sutherland, Julia Soewarto, Gary Houlston, Alby Marsh, Emily Koot, Angus Carnegie, Tracey Menzies, David Lee, Louise Shuey, Geoff Pegg

Landowners and Iwi representatives for their agreement to collect and test seed

Seed collectors

MPI RFP program 18608, *Myrtle Rust Research Programme 2017/18*

MBIE Catalyst program C11X1607, *Myrtle Rust: a significant threat to Australasia and the Pacific*

MBIE Endeavour program C09X1608, *Building resilience and provenance into an authentic Māori honey industry*



Biosecurity New Zealand
Ministry for Primary Industries
Manatū Ahu Matua



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HIKINA WHAKATUTUKI



Plant Health
AUSTRALIA



B3



Department of
Primary Industries



Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI



Definitions

Seed family



- Seed collected from an individual tree
- Common genetics from the mother tree
- Each seedling is genetically different
- Seedlings are not replicates or clones

Phenotype



- Observable characteristic
- Underlying genetics can be complex



Biosecurity New Zealand
Ministry for Primary Industries
Manaio Ahu Matua



MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI



Plant Health
AUSTRALIA



B3



Department of
Primary Industries



Plant & Food
RESEARCH
RANGAHAU AHUMARA KAI



How is resistance to *A. psidii* (pandemic) identified?

- Discussions leading to agreements to collect and test seed
- Seed collected from mother plants (seed family)
- Prepared and treated as per Australian import permit conditions
- Shipped to QDAF, Queensland
- Germinated, grown, sprayed with fungal spore suspension
- Fungal infection monitored and then assessed
- Analysis and interpretation of results
- Results discussed at huis and meetings



Louise Shuey inoculating plants at QDAF, Brisbane



Biosecurity New Zealand
Ministry for Primary Industries
Manatū Ahu Matua



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HĪKINA WHAKATUTUKI



Plant Health
AUSTRALIA



B3



Department of
Primary Industries

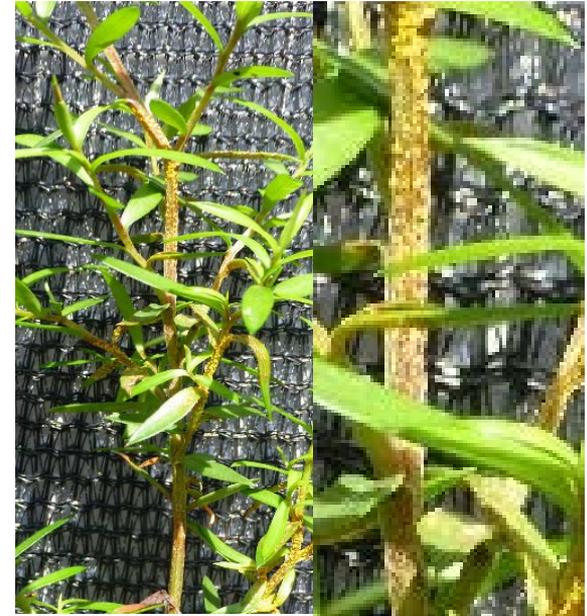


Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI



Yes, there is resistance to *A. psidii* in mānuka

- Leaf infection
 - Two types of leaf resistance: immune (L1) & hypersensitive (L2)
 - Consistent with previous studies/reports on other species
- Substantial stem infection was also noted
- Most seed families produced resistant plants
 - Resistance genes are widespread in mānuka
- Most seed families only produced a few resistant plants
 - Resistance genes are not present, or not expressed, in most plants
- Some seed families produced either leaf, or stem, resistant plants
 - Both leaf and stem resistance would be needed in the field
- Some seed families produced no resistant plants



Mānuka pant with heavily infected stem



Biosecurity New Zealand
Ministry for Primary Industries
Manaio Ahu Matua



MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI



Plant Health
AUSTRALIA



Department of
Primary Industries



Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI



Yes, there is resistance in kānuka and rawiri mānuka

- Kānuka (*Kunzea robusta*) and rawiri mānuka (*Kunzea linearis*)
 - Data set is limited as this time
- Infection of leaves, stems and branch tip dieback
 - Both forms of leaf resistance as seen previously in other species
 - Leaf, stem and dieback resistance needed for field resistance
- Most seed families produced resistant plants
- Most seed families only produced a few resistant plants
- Some seed families produced no resistant plants



Biosecurity New Zealand
Ministry for Primary Industries
Manaio Ahu Matua



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HIKINA WHAKATUTUKI



Plant Health
AUSTRALIA



B3



Department of
Primary Industries

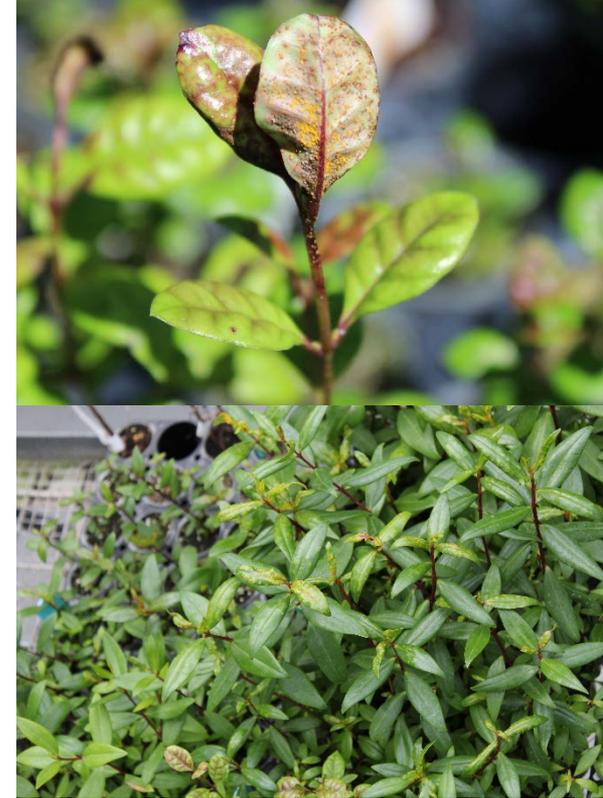


Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI



Pōhutukawa, ramarama and rohutu

- Pōhutukawa (*Metrosideros excelsa*)
 - Average 18 plants/ family tested
- Ramarama (*Lophomyrtus bullata*)
 - Three families, limited seed
- Rohutu (*Lophomyrtus obcordata*)
 - One family, very limited seed
- Only leaf infection noted
- One resistant pōhutukawa plant
- No resistant ramarama or rohutu



Flower/bud infection, teliospores (sexual spore), stem crooking



Provenance effects

- Populations of species in different locales
- Some seed families produced significantly more leaf, stem (and in *Kunzea* branch tip dieback) resistant plants
- Some provenances provided more/ less resistant families
- Limited seed tested too date, so still high level analysis
 - East of the North Island: a third of the mānuka plants: >50% of the L1 leaf resistant plants
- All provenances have seed families that produce resistant and susceptible plants



Biosecurity New Zealand
Ministry for Primary Industries
Manatū Ahu Matua



MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI



B3



Department of
Primary Industries



Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI



So what do these results mean?

Mānuka, kānuka, rawiri mānuka, pōhutukawa, ramarama, rohotu

1. All six species should be considered as susceptible
 - There are leaf, stem, tip dieback resistant individuals
2. More research is needed to understand resistance
 - Resistance genes are widespread in the families
 - No understanding of the linkage of resistance to other traits
3. Surveillance may be more difficult
 - Stem infection with out leaf infection on mānuka, kānuka, rawiri kānuka
4. Long term germplasm conservation strategy and process urgently needed



Where to next?

1. More seed to test (more species, different provenances)
2. Results are being used in Beyond Myrtle Rust research to understand the basis of resistance to *A. psidii* in mānuka
 - Phenotype data
 - Pathogen genome
 - Draft mānuka genome
3. Two different tissue (leaf, stem) resistances in mānuka
 - Research is now far more complex (~~2~~ x^2)
4. Germplasm conservation
 - For mānuka, kānuka, rawiri kānuka don't use resistant/ susceptible results to prioritise collections/ conservation because we don't currently understand the linkage between resistance and other traits or provenance effects
 - Need to conserve as much plant genetic diversity as possible whilst we still can



Biosecurity New Zealand
Ministry for Primary Industries
Manatū Ahu Matua



MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI



B3



Department of
Primary Industries



Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI





Plant & Food
RESEARCH
RANGAHAU AHUMĀRA KAI



Ngā mihi

grant.smith@plantandfood.co.nz

Winner
2017



**The
Prime
Minister's
Science
Prizes**