Landcare Research
Manaaki Whenua

Using Landcare Research's collections to find answers to PSA on kiwifruit

Pathogens don't carry passports !

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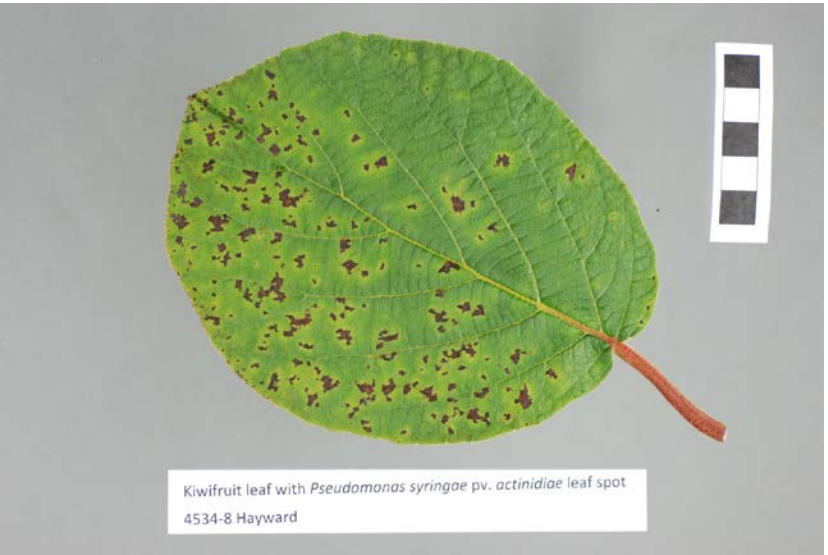
Biosecurity Bonanza 19 May 2014

Outline

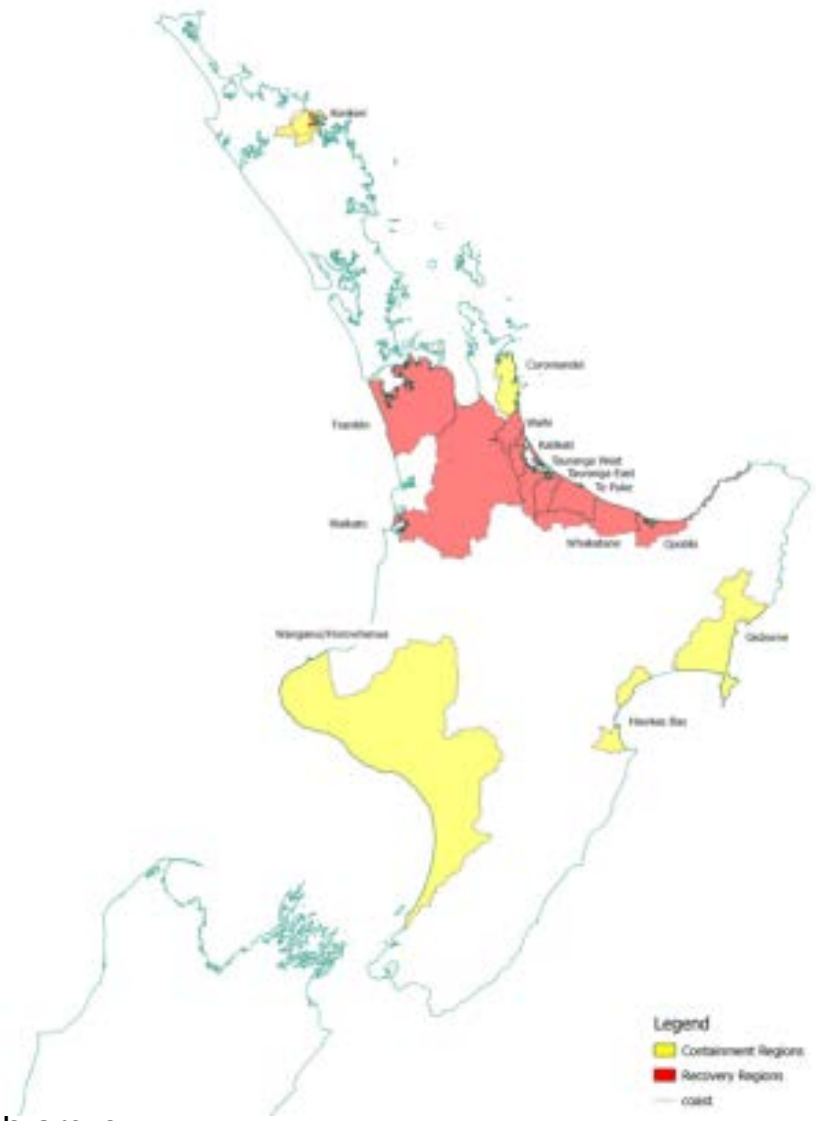
- Pathogens don’t carry passports
  - How do we know what they are?
- How taxonomy + collections + databases are important for biosecurity
- With reference to the recent Psa kiwifruit disease
  - But relevant to many plant pathogens and fungi
  - PTA, Myrtle rust, Citrus canker, *Xylella* etc.

What is Psa?

- A bacterial disease of kiwifruit
  - Leaf spots, canker, death
- ***P****seudomonas* ***s****yringae* pv. ***a****ctinidiae*
  - bacterium



Severe kiwifruit disease



- **Psa-V Statistics**
  - 8 May 2014
- **2485** orchards have Psa-V
- **81%** of New Zealand's kiwifruit hectares
- Not Nelson or Whangarei

Why Landcare Research?

- History
- DSIR split into CRIs in 1992
- The PDD of DSIR was split between Crop & Food, Hort Research, AgResearch, and Landcare Research
- Landcare retained:
  - National collections (CHR, PDD, NZAC, **ICMP**)
  - Taxonomists

DSIR Bacteriology 1988

Psa response

Genome sequence

- November 2010 from Te Puke
- MAF ID'd bacterium as Psa
- But which strain?
  - Asian
  - Italian
- Asked by MAF to do whole genome sequence
  - Sequenced in 3 days
  - EcoGene

Genome analysis

Gene	Japan 84, Italy 94	Italy 08/09	NZ 2010
avrPto1	-	-	
avrD1	+	+	
avrAE1	+	+	
hopA1	-	+	
hopB1	-	-	
hopC1	-	-	
hopD1	+	+	
hopF2	-	-	
hopG1	-	-	
hrpK1	+	+	
hopAF1	±	-	
hopAN1	+	+	
Coronatine	±	-	
Phaseolotoxin	+	-	

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Phaseolotoxin	+	-	-

ICMP: International Collection of Microorganisms from plants

- National coll. of living bacteria and fungi
  - All of NZ, stakeholders
  - Liquid N_2
- 19,371 cultures
  - 50%:50% Bact:Fungi
  - 57%:43% NZ:World
- Important collection of plant pathogenic bacteria
  - type of Psa + 700

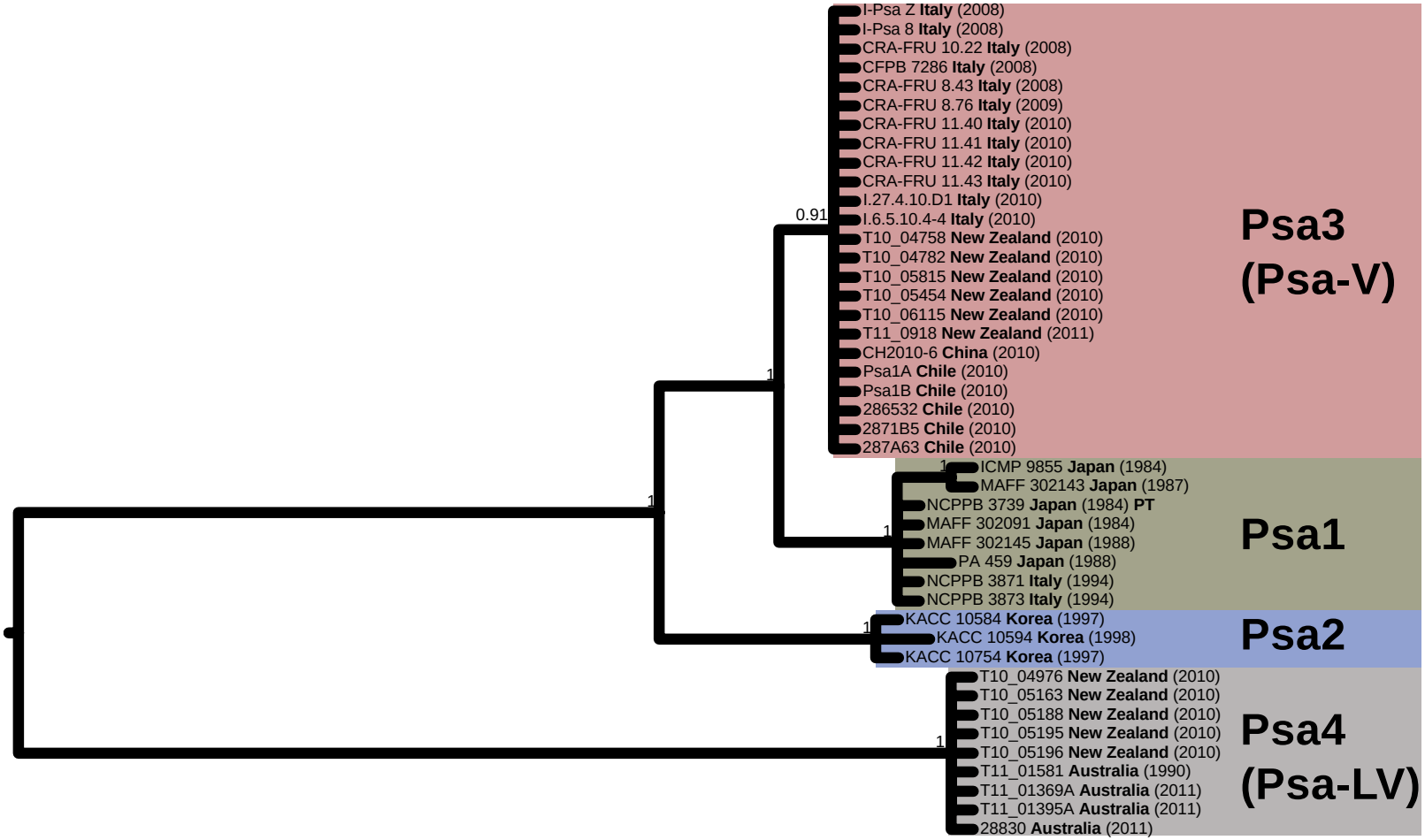
New or Old disease in NZ?

- Was Psa-V a recent introduction?
- Or present for a long time?
  - changing conditions caused severe disease?
- Screened 40 years of ex- kiwifruit bacteria in the ICMP looking for Psa
  - Found no matches from 143
- Value of collections to NZ
  - Keep collecting NZ material

Different Psa populations in NZ?

- The genome matched ‘Italian’
- Diagnostic test of the time did not differentiate populations
  - Testing from around the country indicated Psa was widespread
  - Impacted policy & biosecurity decisions
- But subsequent sequencing revealed a novel Psa population in NZ
  - Psa-V: strong pathogen, canker
  - Psa-LV: Leaf spots, plants survive, been here a while

Psa global populations



Chapman et al. 2012 – doi:10.1094/PHYTO-03-12-0064-R

Diagnostics

Psa diagnostic service

- CRIs have immediate capability
- Did 300+ Psa tests by isolation + seq.
  - Living bacteria gold standard
  - Into the ICMP
- Trained commercial labs
  - Tech transfer
- Now occasional tests
- Did sequencing for MAF
  - weekends

New diagnostic tests

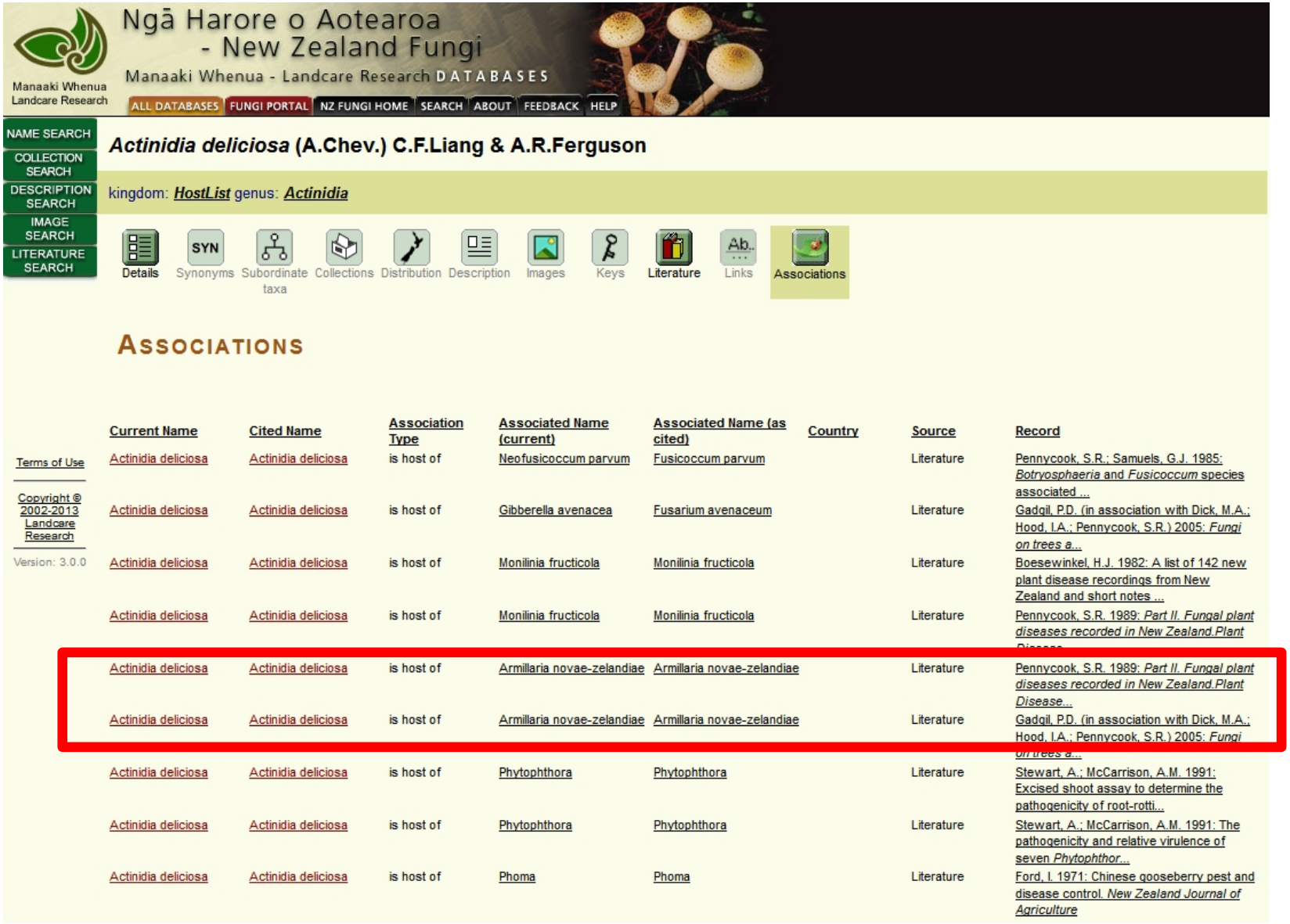
- Helped validate new diagnostic tests
  - Faster, more specific
  - Directly from plant tissue
- Provided positive controls and 150+ DNA
  - genetically similar pathovars
  - other ex-kiwifruit bacteria
  - Based on *P. syringae* taxonomy research
- Validation very important
  - False positives have economic consequences

NZfungi database

- Database of Fungi and bacteria
  - Pansectorial, national database
  - Taxonomy (What is the current name?)
  - Biostatus (Is this organism here? Exotic or native?)
  - Associations (What plant is it found on?)
  - Collection specimen data
- http://NZfungi2.LandcareResearch.co.nz/
- Feeds through to NZOR

NZfungi database

NZfungi database



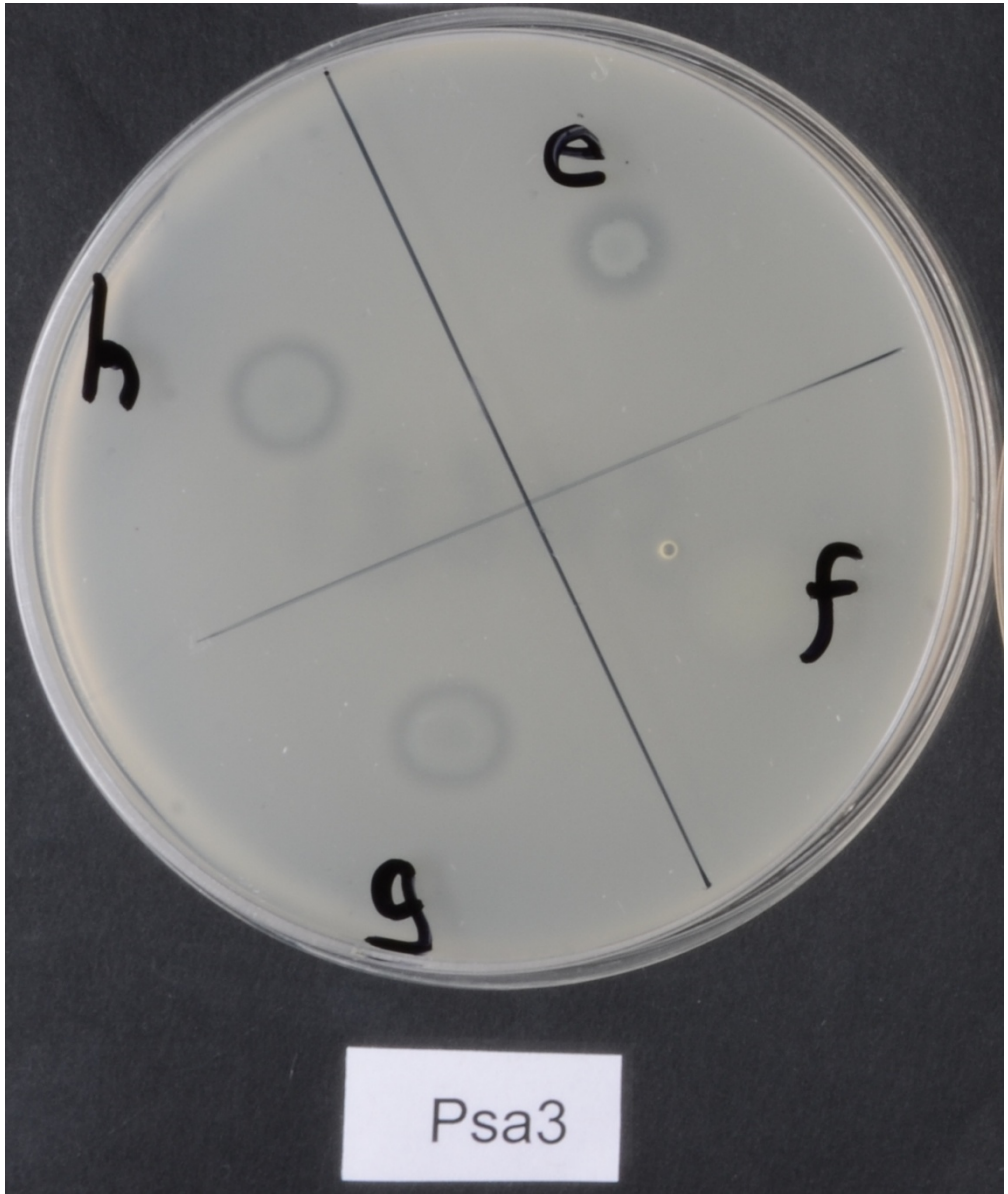
Current Name	Cited Name	Association Type	Associated Name (current)	Associated Name (as cited)	Country	Source	Record
Actinidia deliciosa	Actinidia deliciosa	is host of	Neofusicoccum parvum	Fusicoccum parvum		Literature	Pennycook, S.R.; Samuels, G.J. 1985: *Botryosphaeria* and *Fusicoccum* species associated ...
Actinidia deliciosa	Actinidia deliciosa	is host of	Gibberella avenacea	Fusarium avenaceum		Literature	Gadgil, P.D. (in association with Dick, M.A.; Hood, I.A.; Pennycook, S.R.) 2005: *Fungi on trees a...*
Actinidia deliciosa	Actinidia deliciosa	is host of	Monilinia fructicola	Monilinia fructicola		Literature	Boesewinkel, H.J. 1982: A list of 142 new plant disease recordings from New Zealand and short notes ...
Actinidia deliciosa	Actinidia deliciosa	is host of	Monilinia fructicola	Monilinia fructicola		Literature	Pennycook, S.R. 1989: *Part II. Fungal plant diseases recorded in New Zealand.Plant Disease...*
Actinidia deliciosa	Actinidia deliciosa	is host of	Armillaria novae-zelandiae	Armillaria novae-zelandiae		Literature	Pennycook, S.R. 1989: *Part II. Fungal plant diseases recorded in New Zealand.Plant Disease...*
Actinidia deliciosa	Actinidia deliciosa	is host of	Armillaria novae-zelandiae	Armillaria novae-zelandiae		Literature	Gadgil, P.D. (in association with Dick, M.A.; Hood, I.A.; Pennycook, S.R.) 2005: *Fungi on trees a...*
Actinidia deliciosa	Actinidia deliciosa	is host of	Phytophthora	Phytophthora		Literature	Stewart, A.; McCarrison, A.M. 1991: Excised shoot assay to determine the pathogenicity of root-rotti...
Actinidia deliciosa	Actinidia deliciosa	is host of	Phytophthora	Phytophthora		Literature	Stewart, A.; McCarrison, A.M. 1991: The pathogenicity and relative virulence of seven *Phytophthor...*
Actinidia deliciosa	Actinidia deliciosa	is host of	Phoma	Phoma		Literature	Ford, I. 1971: Chinese gooseberry pest and disease control. *New Zealand Journal of Agriculture*

Armillaria novae-zealandiae

Management of Psa?

- Psa can be controlled by antibiotics
  - improper use problem
  - Resistance problem
  - EU zero residue problem
  - Problems can be mitigated
- Need a novel biological solution:
  - KVH Investigating biologicals
  - Screened ICMP collection for anti-Psa bacteriocins
  - Found 10 promising candidates (from 200)

Management of Psa?



Conclusions

- Pathogens don't carry passports
  - Can’t check everything at the border
- Collections are important
  - Reference material
  - Historic collections
  - Biological resource
- Taxonomy changing rapidly
  - need to stay up to date with what is in NZ
  - LCR databases

Acknowledgements

- LCR technical staff
  - Maureen Fletcher, Paula Wilkie, Elsa Paderes
  - Duckchul Park
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