



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

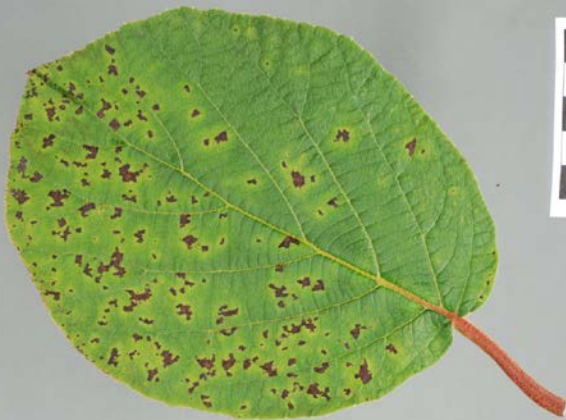


Outline

- 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?

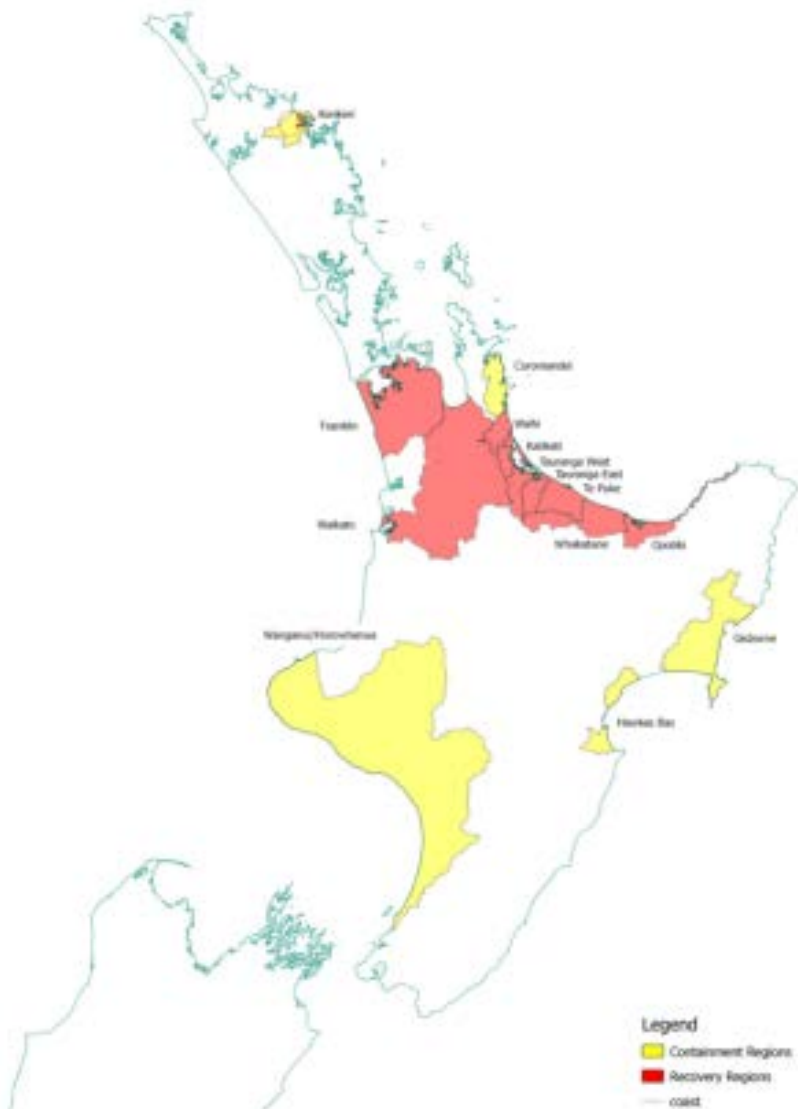
- A bacterial disease of kiwifruit
 - Leaf spots, canker, death
- *Pseudomonas syringae* pv. *actinidiae*
 - bacterium



Kiwifruit leaf with *Pseudomonas syringae* pv. *actinidiae* leaf spot
4534-8 Hayward



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	+	+	
avrAF1	+	+	
hopA1	-	+	
hopB1	-	-	
hopC1	-	-	
hopD1	+	+	
hopF2	-	-	
hopG1	-	-	
hrpK1	+	+	
hopAF1	±	-	
hopAN1	+	+	
Coronatine	±	-	
Phaseolotoxin	+	-	

Genome analysis

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hopG1	-	-	-
hrpK1	+	+	+
hopAF1	±	-	-
hopAN1	+	+	+
Coronatine	±	-	-
Phaseolotoxin	+	-	-

ICMP: International Collection of Microorganisms from plants

- National coll. of living bacteria and fungi
 - All of NZ, stakeholders
 - Liquid N₂
- 19,371 cultures
 - 50%:50% Bact:Fungi
 - 57%:43% NZ:World
- Important collection of plant pathogenic bacteria
 - type of Psa + 700



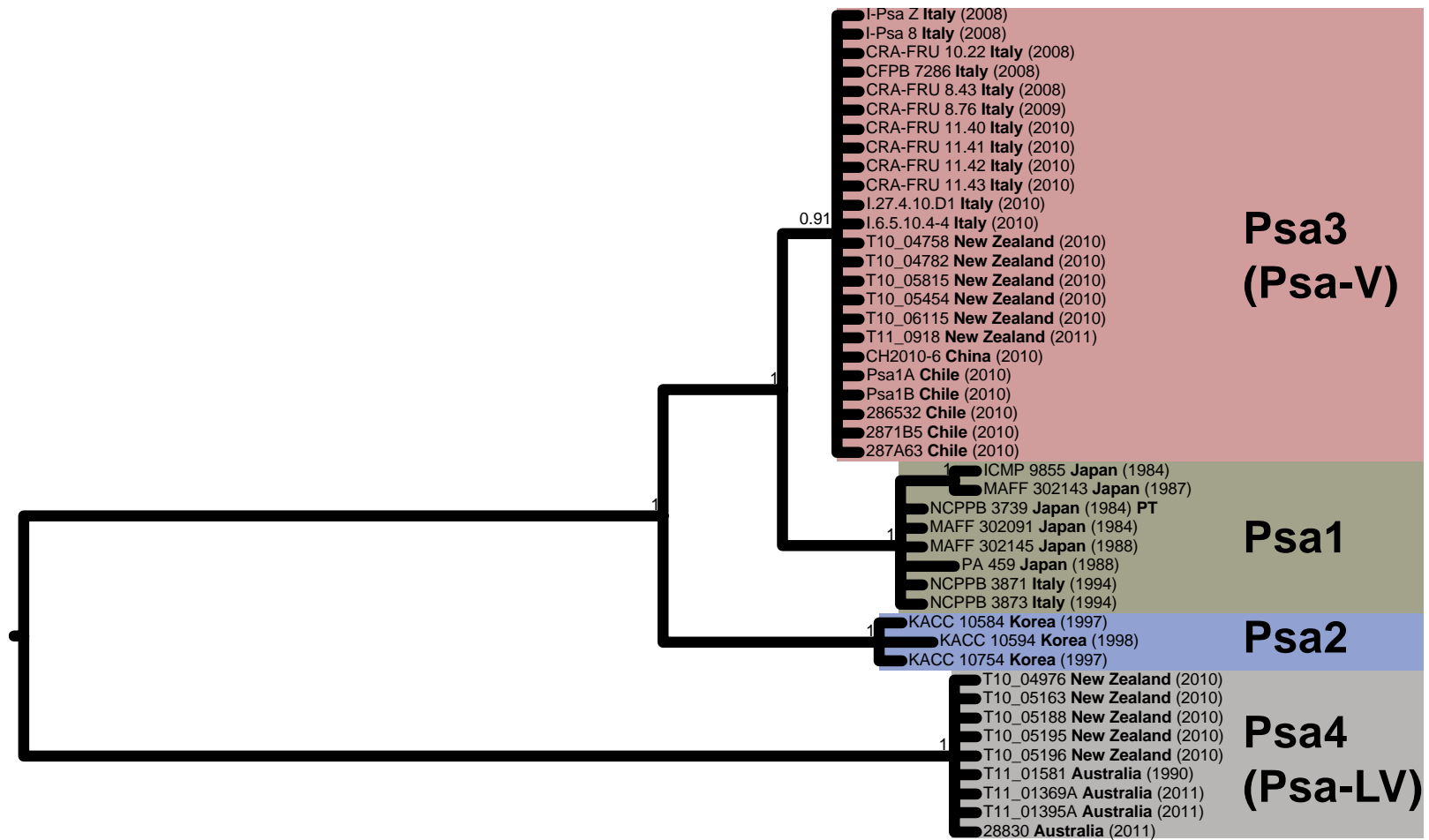
New or Old disease in NZ?

- 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



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













Ngā Harore o Aotearoa - New Zealand Fungi
 Manaaki Whenua - Landcare Research **DATABASES**


[ALL DATABASES](#) [FUNGI PORTAL](#) [NZ FUNGI HOME](#) [SEARCH](#) [ABOUT](#) [FEEDBACK](#) [HELP](#)

- NAME SEARCH
- COLLECTION SEARCH
- DESCRIPTION SEARCH
- IMAGE SEARCH
- LITERATURE SEARCH

Pseudomonas syringae pv. *actinidiae* Takikawa et al. (1989)

kingdom: *Bacteria* phylum: *Proteobacteria* class: *Gammaproteobacteria*
 order: *Pseudomonadales* family: *Pseudomonadaceae* genus: *Pseudomonas* species: *syringae*

 **Details**
 Synonyms
  Subordinate taxa
  Collections
  Distribution
  Description
  Images
  Keys
  Literature
  Links
  Associations

DETAILS

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Name Status: Preferred Name
Place of Publication: Takikawa, Y.; Serizawa, S.; Ichikawa, T.; Tsuyumu, S.; Goto M. 1989: *Pseudomonas syringae* pv. *actinidiae* pv. nov.: the causal bacterium of canker of kiwifruit in Japan. *Annals of the Phytopathological Society Japan* 55: 437-444.
Rank: pv.
Biostatus: New Zealand (Political Region): Present, Exotic ([Chapman, J.R.](#); [Taylor, R.K.](#); [Weir, B.S.](#); [Romberg, M.K.](#); [Vanneste, J...](#))
First reported in Bay of Plenty, November 2010. Virulent intrapathovar group Psa1 (Psa-V) and low virulence intrapathovar group Psa4 (Psa-LV) present. Intrapathovar groups Psa1 and Psa2 not present.
Treatment Article: Bull, C.T.; De Boer, S.H.; Denny, T.P.; Firrao, G.; Fischer-Le Saux M.; Saddler G.S.; Scottichini, M.; Stead, D.E. and Takikawa, Y. 2010: Comprehensive list of names of plant pathogenic bacteria, 1980-2007. *Journal of Plant Pathology* 92(3): 551-592.
Vernacular: PSA (English)
Notes: (taxonomic status) There are four described intrapathovar groups: Psa1, Psa2, Psa3, Psa4. The most serious pathogen is Psa3 = Psa-V
 This name is governed by the ICNB.

[Synch to Tree >>](#)

s = synonym
 m = misapplied
 (eg. *triandra*^s)

- A** Root
 - abiotic
 - biotic
 - K** Archaea
 - K** Bacteria
 - P** Acidobacteria
 - P** Actinobacteria
 - P** Armatimonadetes
 - P** Bacteroidetes
 - P** Chloroflexi
 - P** Cyanobacteria
 - P** Deinococcus-Thermus
 - P** Firmicutes
 - P** Fusobacteria
 - P** Proteobacteria
 - C** Alphaproteobacteria
 - C** Betaproteobacteria
 - C** Epsilonproteobacteria
 - C** Gammaproteobacteria
 - O** Aeromonadales
 - O** Alteromonadales
 - O** Cardiobacteriales
 - O** Chromatiales
 - O** Enterobacteriales
 - O** Legionellales
 - O** Oceanospirillales
 - O** Pasteurellales
 - O** Pseudomonadales
 - F** Branhamaceae
 - F** Moraxellaceae
 - F** Pseudomonadaceae
 - G** Azomonas
 - G** Azomonotrichi
 - G** Azorhizophilus

NZfungi database



Ngā Harore o Aotearoa
- New Zealand Fungi

Manaaki Whenua - Landcare Research DATABASES

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IMAGE
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LITERATURE
SEARCH

***Actinidia deliciosa* (A.Chev.) C.F.Liang & A.R.Ferguson**

kingdom: [HostList](#) genus: [Actinidia](#)



Details



Synonyms



Subordinate
taxa



Collections



Distribution



Description



Images



Keys



Literature



Links



Associations

ASSOCIATIONS

	<u>Current Name</u>	<u>Cited Name</u>	<u>Association Type</u>	<u>Associated Name (current)</u>	<u>Associated Name (as cited)</u>	<u>Country</u>	<u>Source</u>	<u>Record</u>
Terms of Use	Actinidia deliciosa	Actinidia deliciosa	is host of	Neofusicoccum parvum	Fusicoccum parvum		Literature	Pennycook, S.R.; Samuels, G.J. 1985: <i>Botryosphaeria</i> and <i>Fusicoccum</i> species associated ...
Copyright @ 2002-2013 Landcare Research	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: <i>Fungi on trees a...</i>
Version: 3.0.0	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: <i>Part II. Fungal plant diseases recorded in New Zealand Plant Diseases</i>...
	Actinidia deliciosa	Actinidia deliciosa	is host of	Armillaria novae-zelandiae	Armillaria novae-zelandiae		Literature	Pennycook, S.R. 1989: <i>Part II. Fungal plant diseases recorded in New Zealand Plant Disease...</i>
	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: <i>Fungi on trees a...</i>
	Actinidia deliciosa	Actinidia deliciosa	is host of	Phytophthora	Phytophthora		Literature	Stewart, A.; McCarrison, A.M. 1991: <i>Excised shoot assay to determine the pathogenicity of root-rotti...</i>
	Actinidia deliciosa	Actinidia deliciosa	is host of	Phytophthora	Phytophthora		Literature	Stewart, A.; McCarrison, A.M. 1991: <i>The pathogenicity and relative virulence of seven <i>Phytophthor...</i></i>
	Actinidia deliciosa	Actinidia deliciosa	is host of	Phoma	Phoma		Literature	Ford, I. 1971: Chinese gooseberry pest and disease control. <i>New Zealand Journal of Agriculture</i>

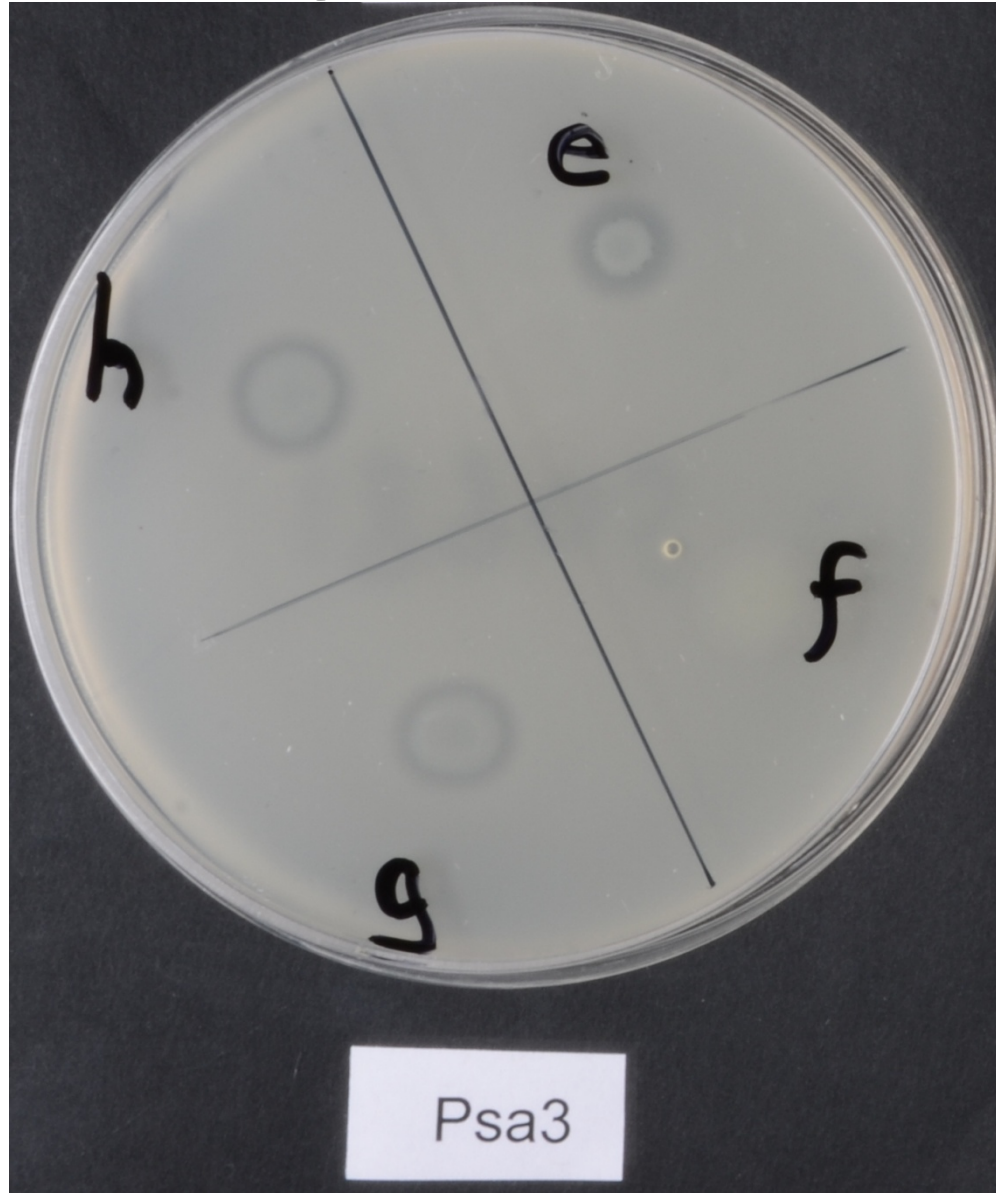
Armillaria novae-zealandiae



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
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