The New Zealand Institute for Plant & Food Research Limited

Tomato potato psyllid and zebra chip disease – what's next?

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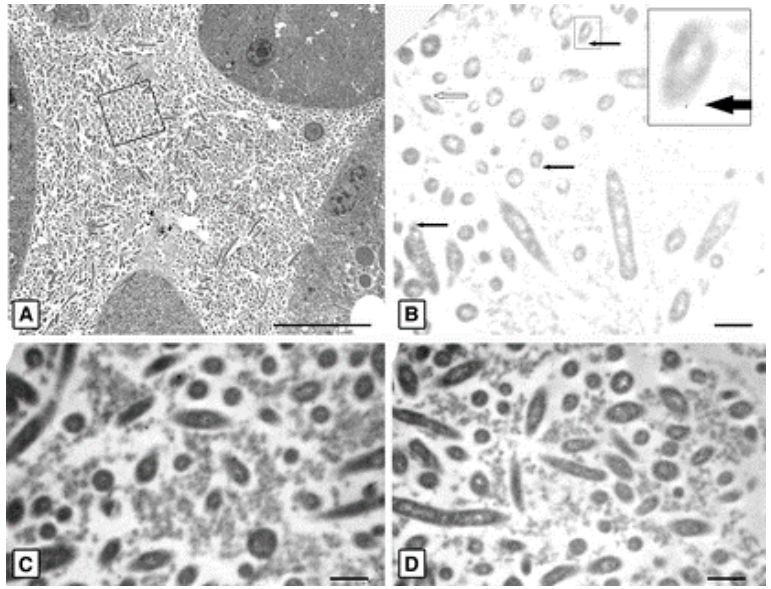
Potatoes NZ Conference, Pukekohe, 26 + 27 July 2017

Presentation lay-out

- Quick introduction to tomato potato psyllid (TPP) and *Candidatus* Liberibacter solanacearum (CLso)
- Myths around the psyllid and bacterium
- What do we know?
- How do we think we can stop ‘it’?
- A quick update on *Tamarixia triozae*

CLso in the insect



Cicero et al, 2016 Phytopathology

Myths

✗ You can see on the outside of the adult and nymph whether it is infected with CLso or not

- ✓ A very young adult is pale green, an older adult is blackish – the white stripe becomes more visible with age.
- ✓ Not all adults and nymphs are infected either!

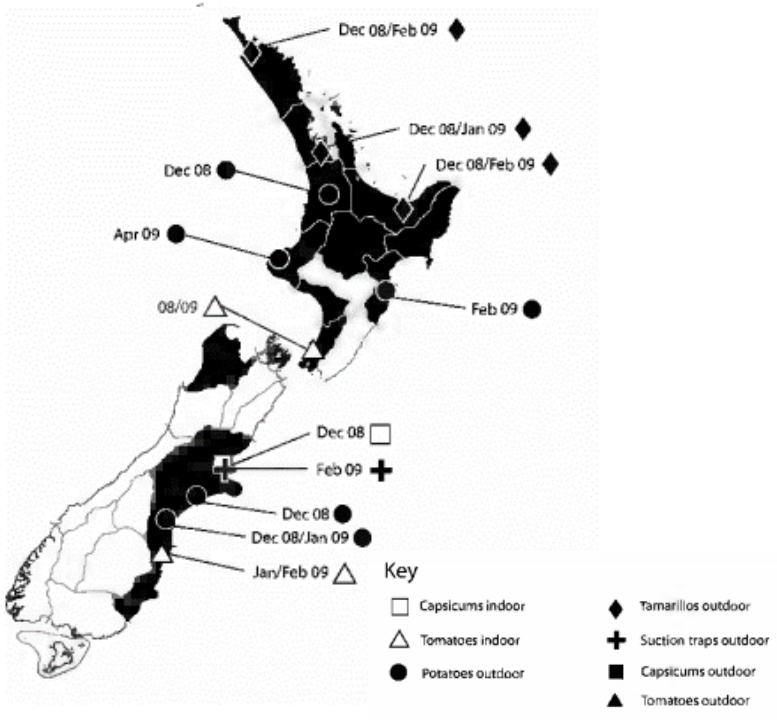
Two more then…

✖ One TPP can only infect one potato plant with CLso

✓ An adult or nymph can infect more than one plant as the transmission of the bacterium is circulative, propagative (part of the life cycle of bacterium is in the insect body and the bacterium replicates there as well)

CLso and TPP in New Zealand

- **2006:** TPP found in New Zealand
- **2008:** Zebra Chip found in New Zealand
- **2008:** CLso found in New Zealand
- **2008-2009:** Cost to potato industry NZ$47-56 M
  - Increased insecticide application
- **2009-2010:** Average $700/ha extra agrichemicals
- **2010-2011:** Cost to potato industry NZ$28 M
  - Includes NZ$6 M for pest control
- Management requirements varied between North and South Islands



Ogden 2012 SCRI Zebra Chip Reporting Session

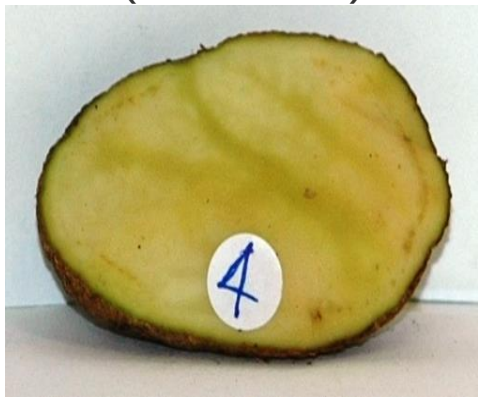
Teulon et al. 2009, NZPP

Zebra Chip symptom differences between NZ and USA

- Different zebra chip symptoms and severity in New Zealand compared to the USA
  - Less dominant striping in fried slices in NZ
  - Different biological results
  - Infected tubers sprouted (sensitivity of assays) in NZ
  - Different described epidemiology
  - Cultivar, environment, cultivation practices, vector behaviour
  - The more ‘aggressive’ variant is not present in NZ
  - Limited genetic diversity of CLso in NZ?

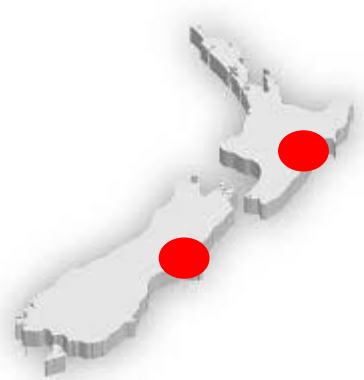
USA (Texas)

New Zealand (Pukekohe)



What other host plants are there around crops

- Host plants of TPP and CLso are not restricted to crop species, and include weed species, which provides challenges for management
  - All TPP life stages were present on non-crop host plants throughout the year
  - So they are not alternative or overwintering hosts, but hosts
  - Jerusalem cherry and thorn-apple tested positive for CLso in Hawke's Bay



CRC PLANT biosecurity

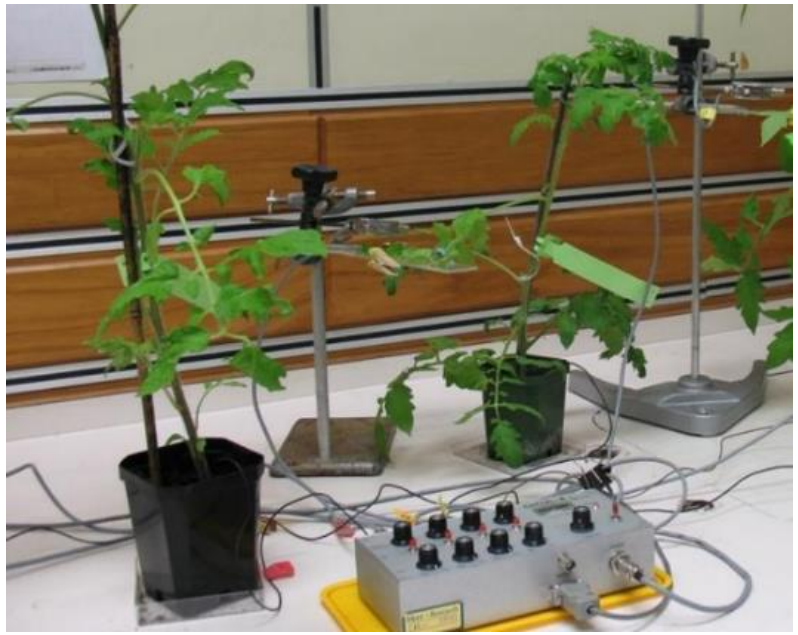
Activity of TPP throughout the year

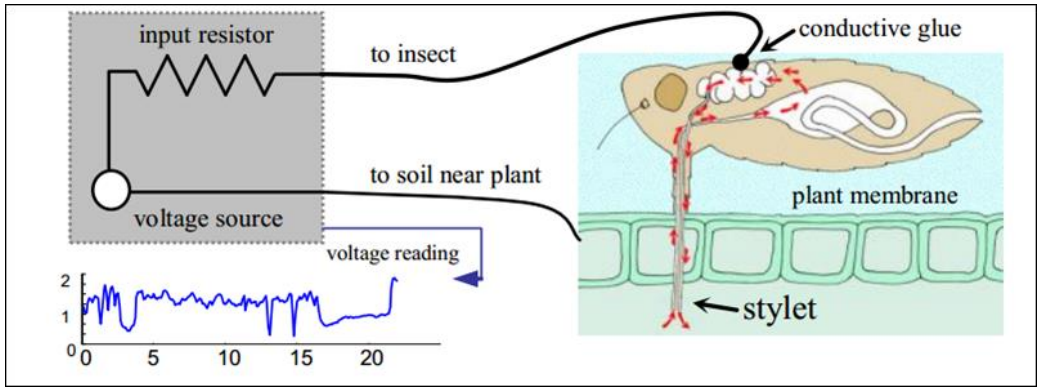
- There was a low background population of TPP flying around in the environment
- TPP multiplied in the crop but did not disperse far
- A desiccated crop increased adult flight in TPP

CRC PLANT biosecurity

Feeding of TPP on tomato and boxthorn

- Host plant species alone was not decisive in determining the number and duration of phloem salivation (‘spitting/drooling’) and ingestion (‘swallowing’) events in TPP



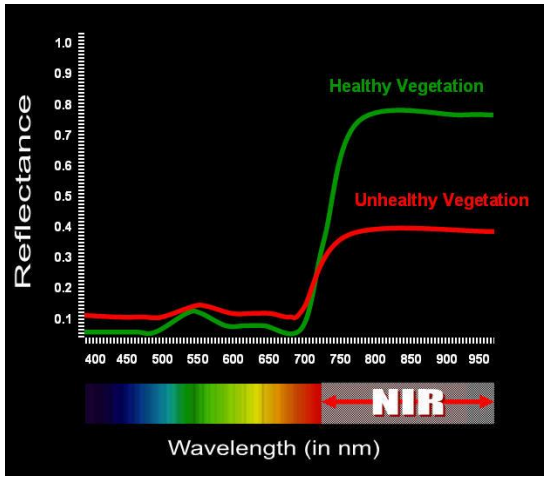


http://alumni.cs.ucr.edu/~yhao/NELTS.html

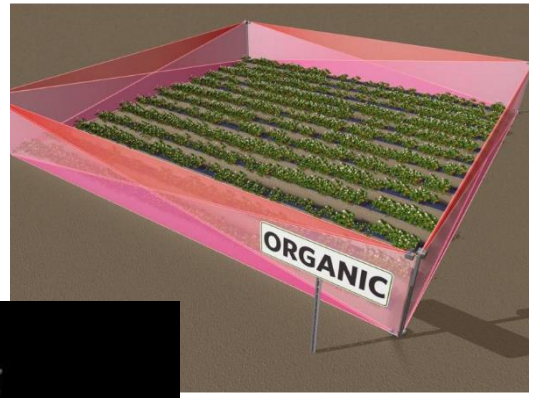
CRC PLANT biosecurity

How do we think we can stop ‘it’?

- Stopping at plant level
  - Use spectral cameras to identify infected plants for targeted roguing
    - Remove both a reservoir for infection and the potential of horizontal transfer through seed tubers
    - SFF project ‘Improving the quality of seed potatoes using precision agriculture’

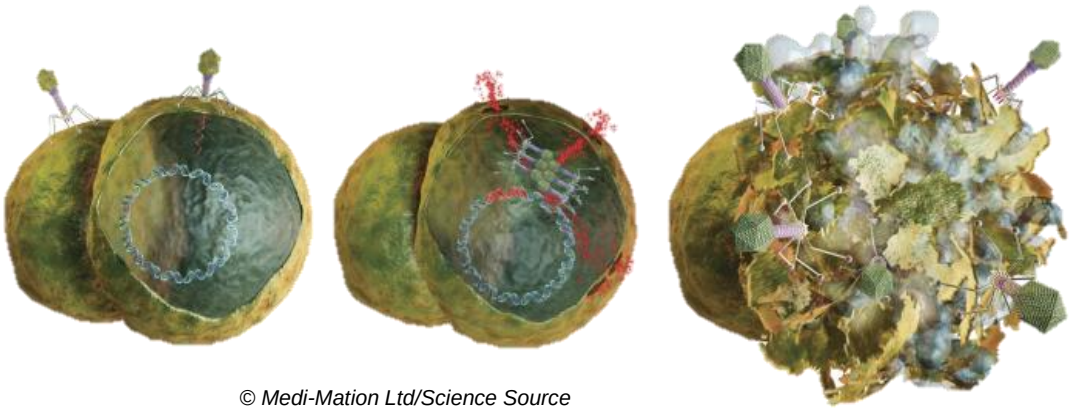


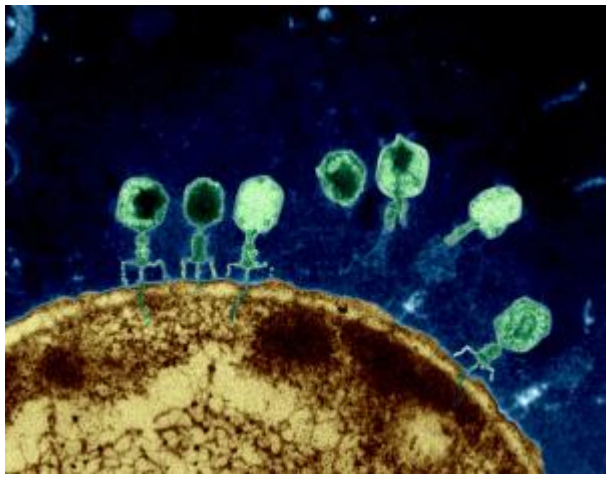
- Stopping the insect
  - Insecticide sprays, but not 100% result
  - Incorporate agricultural oils in spray programme
  - Phototonic fence (lasers) – test with Citrus psyllid
    - Identifies them according to their size and wing-beat frequency
  - Cultivars resistant to TPP feeding



How do we think we can stop ‘it’?

- Stopping CLso/zebra chip disease
  - Resistant or tolerant cultivars to CLso/zebra chip disease
  - dsRNA and RNAi, however seen as genetic modification
  - Using bacteriophage against CLso
  - Understanding and targeting the genetic / biochemical basis of pathology
    - Analysing bacterial genomes to identify possible control targets
    - Understand the function of potential targets (part of Jenna Gilkes’ PhD)
    - Stop the bacteria from ‘talking’ to each other





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Ca. L. solanacearum diversity

- Selected 3 genome regions that were variable in initial testing of USA and NZ samples
- All 29 New Zealand CLso samples contained all 3 loci
- Suggests limited genetic variability in CLso over time, location or host in New Zealand
  - » There were no Californian CLso samples in the initial American screen
  - » New Zealand assessment limited by availability of DNA extracts
- Origin of the CLso in New Zealand remains uncertain
  - » One or more inclusions from the same geographic location more likely than separate incursions from different regions
  - » Still remains unresolved whether genomic differences contribute to the differences in Zebra Chip pathology between New Zealand and the USA

B. cockerelli diversity

- Network analysis of mitochondrial genomes
- Each circle is a different sequence type
- Circles links based on DNA sequence changes
- Size of the circle represents number of samples
- Geographical split
- Overlap between New Zealand and California
- Lacking samples from USA, especially California