Plant & Food Research
Rangahau Ahumāra Kai

TPP and Liberibacter Refresher

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Presentation disclaimer

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Zebra Chip (TPP / Liberibacter) seminar - update for Pukekohe growers, 26 June 2025, Pukekohe (in person and online)

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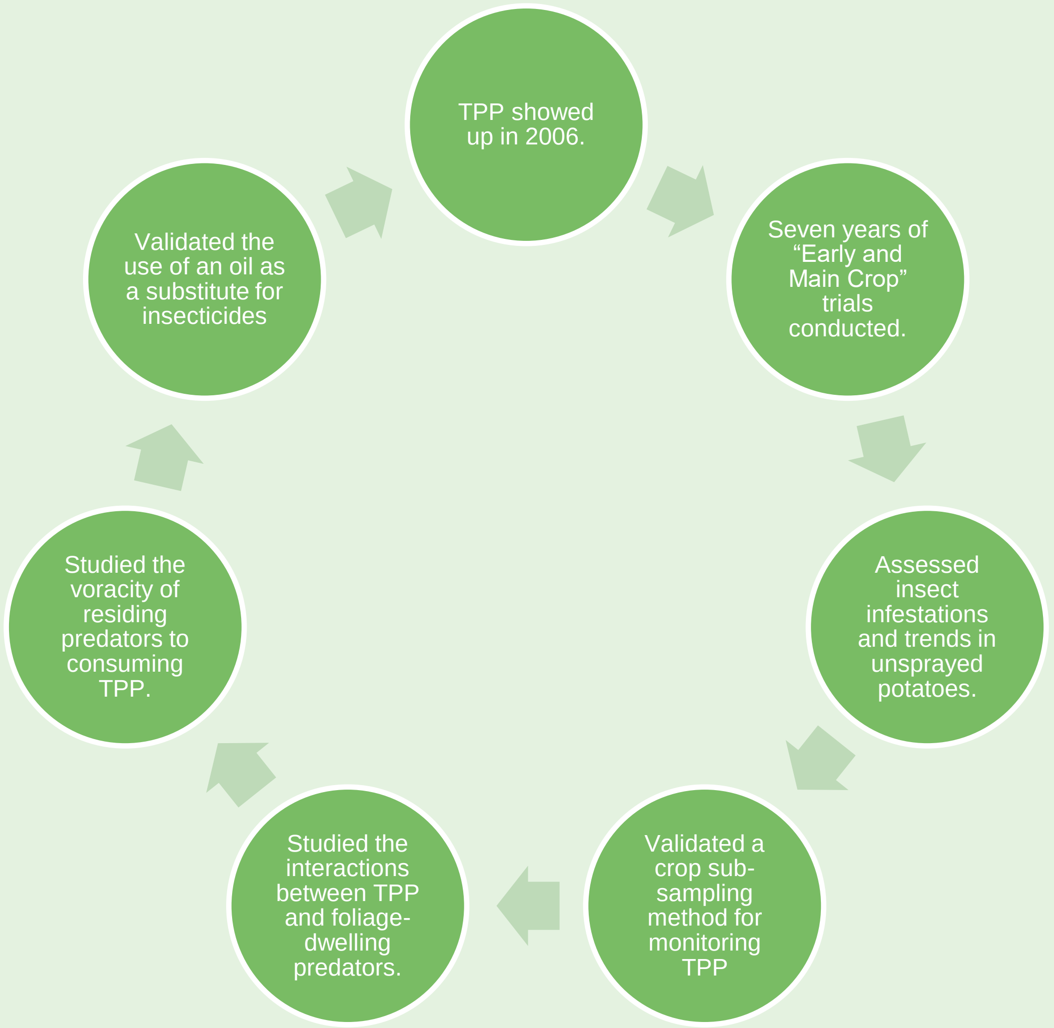
Some PFR Research on TPP in potatoes

Frances MacDonald

Working towards an Integrated Pest Management Programme (IPM) in potatoes in the North Island at Pukekohe Research Station



IPM tool: Beneficial insects

- Identified and counted all insects residing in potatoes in Pukekohe and Canterbury
- Identified key beneficial insects residing in unsprayed potato crops
- ‘No choice' testing of TPP at Lincoln to evaluate the best potential predators
- Tested five key species found in potatoes at Pukekohe: brown lacewing (*Micromus tasmaniae*), small hoverfly (*Melanostoma fasciatum*), Pacific damsel bug (*Nabis kinbergii*), 11-spotted ladybird beetle (*Coccinella undecimpunctata*) and large spotted ladybird beetle (*Harmonia conformis*) ate all life stages of TPP in 'choice' and 'no choice' testing lab studies (published 2016).

Naturally occurring beneficial insects found in potato crops

Lacewing egg

Lacewing larva

Lacewing adult

Hoverfly eggs

Hoverfly larva

Hoverfly adult

More naturally occurring beneficial insects in potatoes

11 spotted ladybird larva

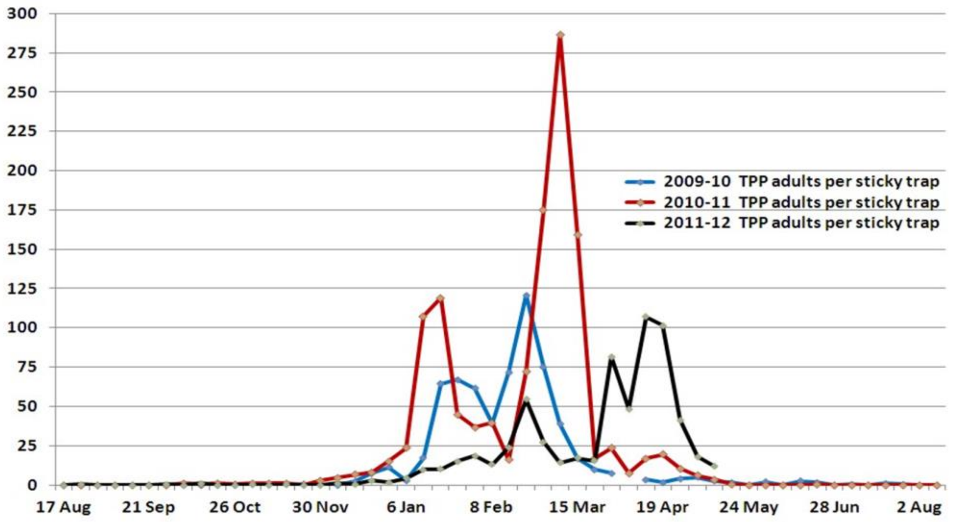
11 spotted ladybird adult

Nabid or damsel bug

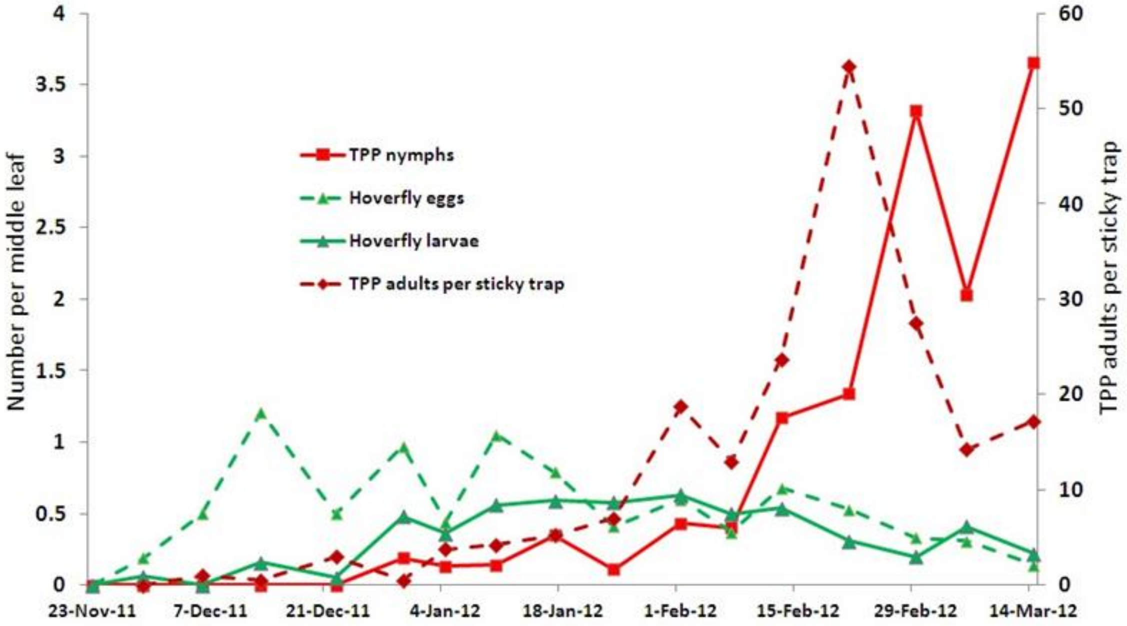
Sheetweb spider

IPM tool: Action thresholds

- Three years of weekly monitoring of unsprayed potatoes at Pukekohe. Average no. TPP caught per trap
- Demonstrated to some growers that spraying early potato crops for TPP wasn't generally necessary in this region

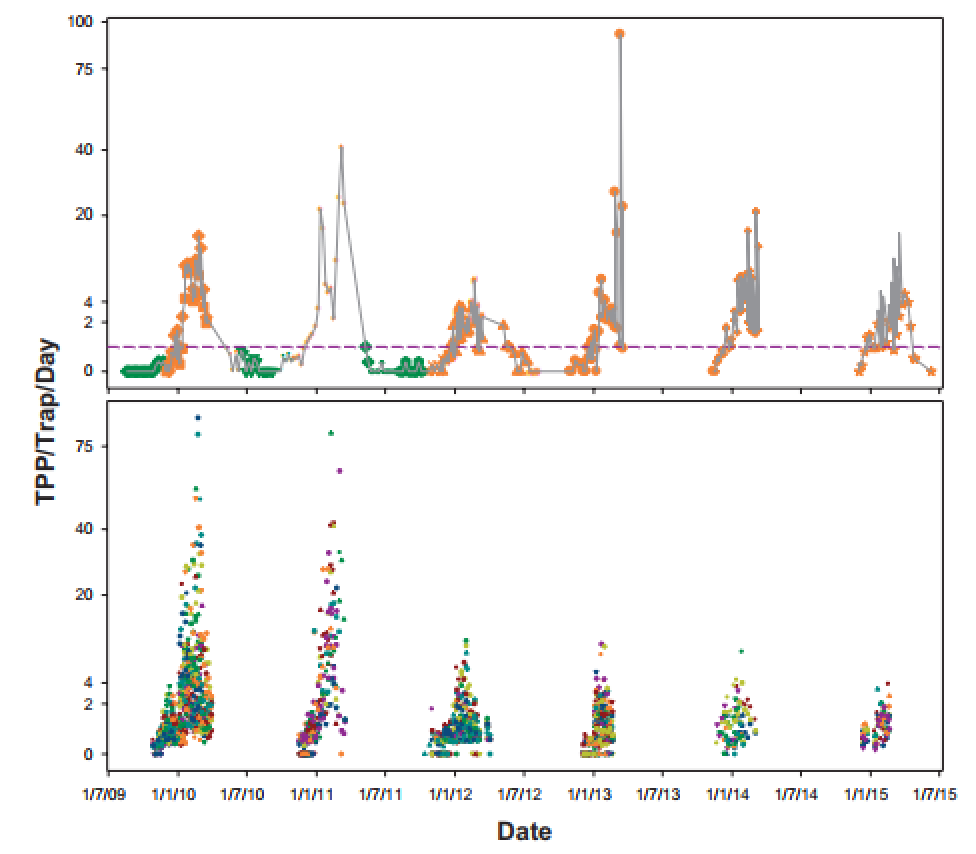


- We tested an action threshold of >3 TPP adults per yellow sticky trap per week that led to ZC damage ranging from 0.9 to 1.6%



IPM tool: Action thresholds

- 3 TPP/trap/week was very often too late in Canterbury
- So we looked at predicting the first TPP in a crop
- In 2013–2014 collated weekly trapping data from a large number of tomato and potato crops across several regions and seasons. These data were combined with temperature and other data
- Predicting the first TPP was not possible, however…
- At some point TPP on the traps increased exponentially, this was at:
  - North Island: 980 Degree Days from 1 July, which is quite close to the 3 TPP/trap/week action threshold
  - South Island: 712 Degree Days from 1 July; however, when boxthorn is present, 600 Degree Days was advised.



IPM tool: Selective insecticides

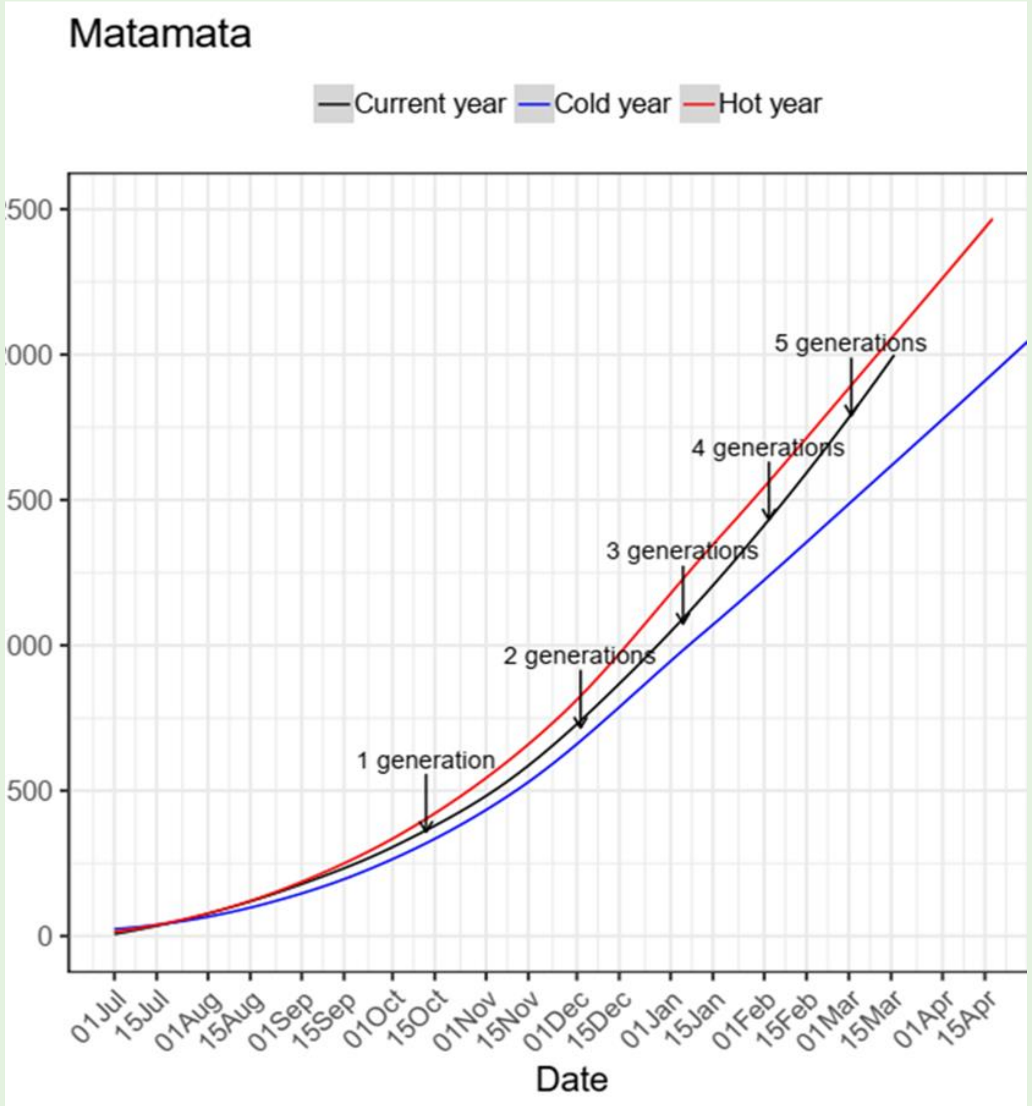
- Trialled different insecticides and oils, within different regimes.
- JMS Stylet-Oil® was selected from the oils to go forward with. It is a colourless, food grade mineral oil with high purity (99.1).
- 2012 conducted trials using Organic JMS Stylet-Oil® at Pukekohe to support registration for use by industry on potatoes
- Trialled different rotations of different “Mode of Action” groups to minimise build-up in resistance
- Determined the impact of different insecticides and oils on beneficial insects.

IPM tool: temperature models for TPP development

Degree days calculated for the main potato growing regions around NZ

On potato, it takes 358 DD to develop from egg to adult

Time between generations is shorter when temperatures are higher.



IPM tool: Beneficial plantings

- Farm-scale assessments of natural enemies for controlling TPP in potatoes with *Phacelia tanacetifolia* as a border planting
- With AS Wilcox & Sons (ASW), PFR investigated *Phacelia* plantings alongside commercially grown potatoes to attract natural enemies into the crop to control TPP
- Seven assessments were conducted
- Small hover fly numbers were significantly increased when compared with the site without.
- In Canterbury field trials investigated if grass strips planted alongside potatoes would support pest management by attracting beneficial insects.

Phacelia tanacetifolia continued

- The numbers of hover flies at *Phacelia* sites ranged from 7 per middle leaf 5 m away from the planting to >1 per middle leaf 100 m away, compared with >0.5 per middle leaf at the site with none
- *Phacelia* plantings are an important reservoir for hover flies and are likely to be a useful tool towards IPM in potatoes.

IPM tool: the role of agricultural oils

- 2011–2014 Laboratory trials with oils
- Tested agricultural oils on mortality and Liberibacter transmission
  - Showed repellency of TPP
  - Increased nymph mortality compared with water
  - Fewer adults emerged compared with water
  - Minimum of 23 days effectiveness
  - (Slight) reduction in Liberibacter transmission
- 2012–2013 Field tested the use of oils in Canterbury against insecticides
  - Excel Oil
  - JMS Stylet Oil
- No foliar burning damage noted, TPP control under low pressure, slight reduction in beneficial insects compared with untreated.

Figure 1: Set up for application of treatments to individual potato leaves.

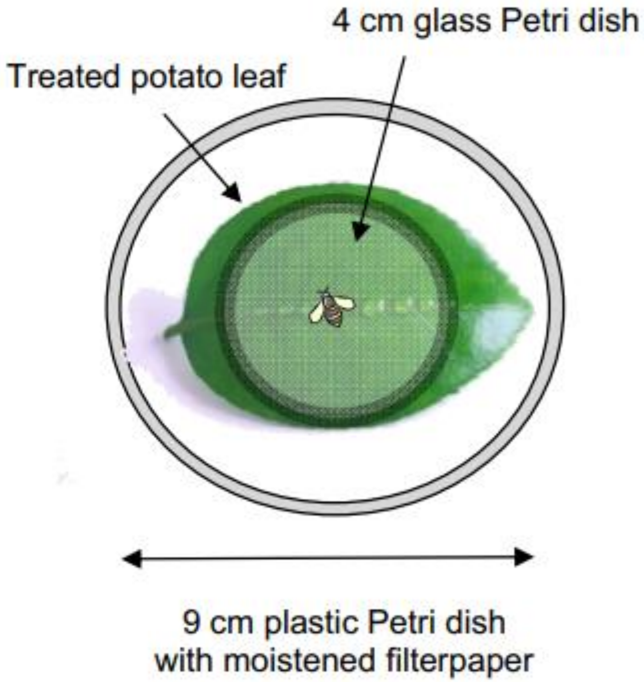


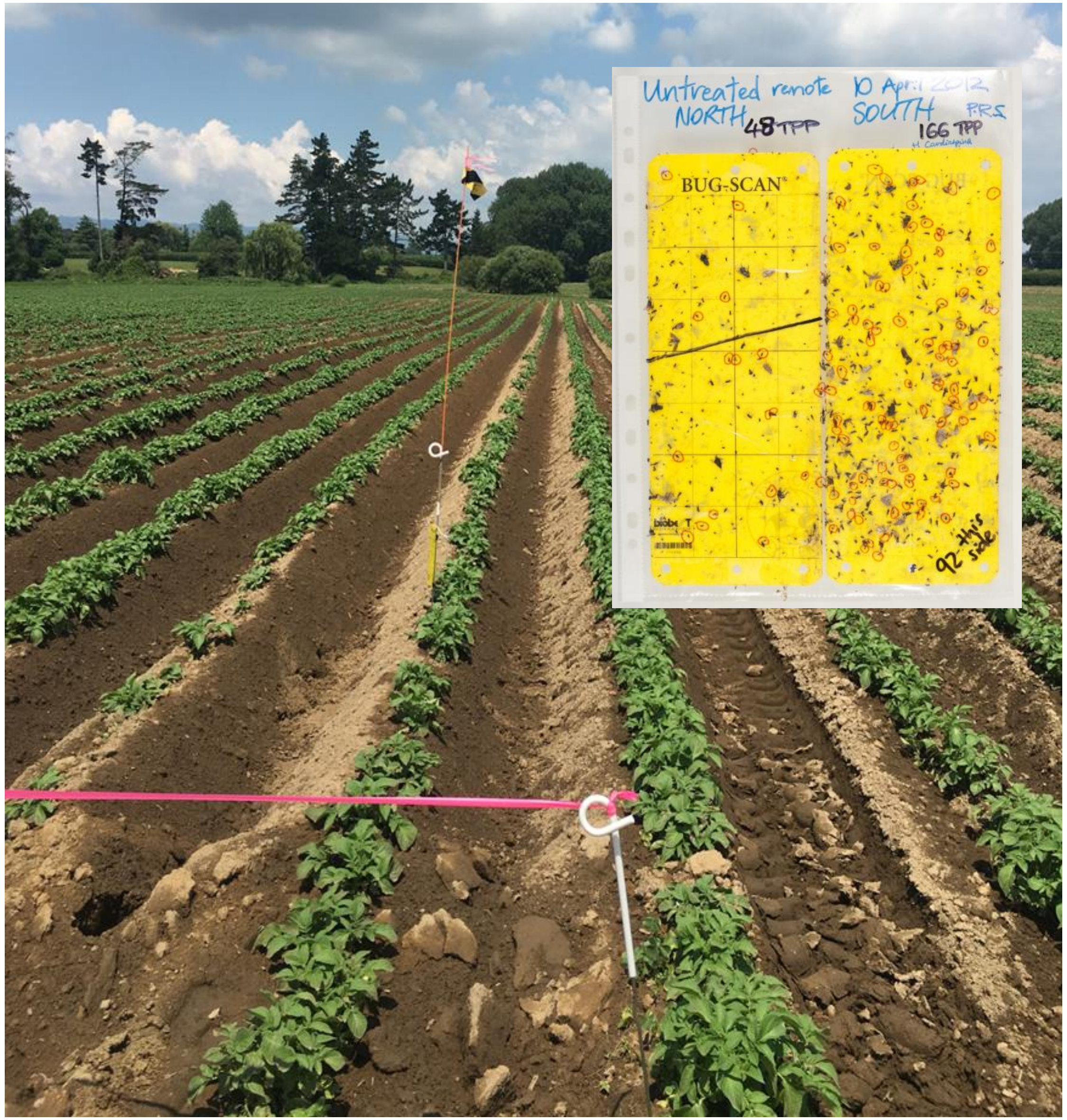
Figure 2: Arena set-up for TPP behaviour bioassay.

‘Maincrop’ Trials at Pukekohe and on-farm in Matamata

- Took successes from 7 years of research in Pukekohe potatoes onto commercial growing sites in Matamata.

- Collaborative trials: Aligned PFR science with ASW grower expertise, general practices, resources and aspirations.

Insect scouting methods
sticky trap thresholds for TPP (3 TPP/trap/week)
Degree day information
JMS Oil



On farm trials in Matamata; why try to reduce insecticides?

Part of an IPM strategy

The environment

Conservation of beneficial insects

Human health

Brand

Staff health and safety

$

Resistance management

Labour saving

Being good neighbours

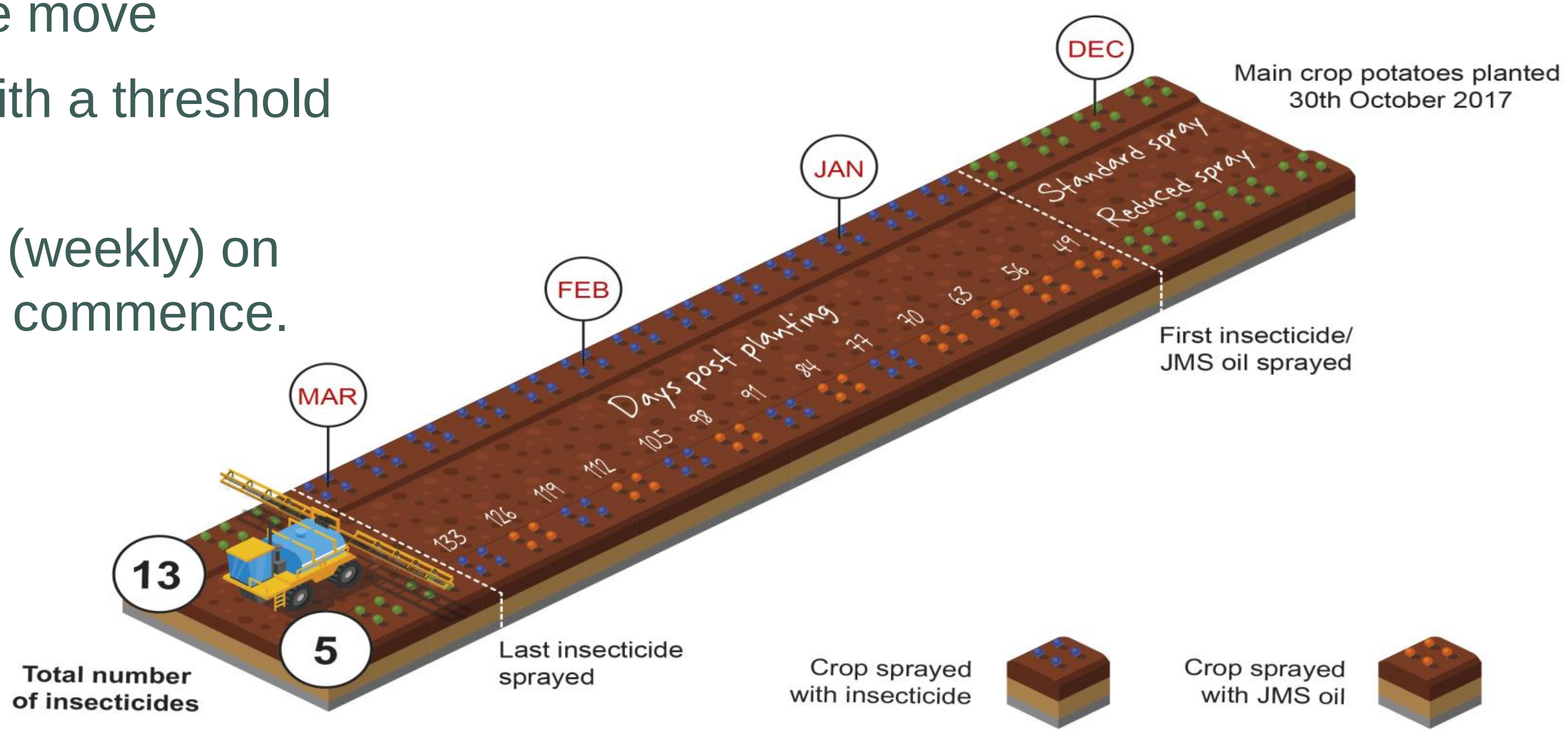
Environmental compliance

Where were the trials?

- All trials were conducted in the Matamata district on ASW sites over three consecutive main crop growing seasons
- There were four trial sites within commercial potato fields
- ASW estimated that the number of insecticide applications for maincrop potatoes in Matamata was typically between 14 and 16 per season.

How did we do it?

- Reduced spray areas at 4 sites in one region
- Weekly scouting prior to initial sprays
- Degree day information used to estimate generations of TPP adults on the move
- Weekly sticky trap information with a threshold number are deployed
- Alternation of insecticide with oil (weekly) on reduced areas once insecticides commence.



Outcomes

- Significant insecticide reductions achieved from delaying the first insecticidal spray and by weekly alternating of JMS with the standard/commercial insecticide regime at each site.
- Specific gravities, yields, and zebra chip assessments indicated no significant differences between treatments.
- 3 years of main crop potatoes from reduced-spray and standard-spray potato trials were combined and used for commercial purposes (2016/17, 2017/18, 2018/19).

IPM tool: Biocontrol agents

- Testing and surveying of biological control agents
  - Entomopathogens (fungi that kill insects)
  - Naturally occurring biological control agents in potato fields
- Imported the nymph parasitoid *Tamarixia triozae*
- Driven by industry
- Importation, host range testing and eventual clearance from quarantine and rearing – PFR funds
- Transferred rearing systems to commercial biocontrol company
- Release of Tamarixia – SFF funds – 2017–2018 season
  - Canterbury 2 sites
  - Hawke’s Bay 3 sites
- Tamarixia established in these areas
- Further industry releases at other sites including Auckland but not detected when surveyed

IPM tool: developing sustainable spray programmes

- 2013–2014 in Pukekohe and Lincoln
- 2014–2015 in Southbridge, Pukekohe, and Manawatu
- 2015–2016 in Southbridge, Matamata and Manawatu
- Aim was to reduce the number of synthetic insecticides in the TPP spray programme
- Treatments:
  - Standard insecticide programme and no treatment control
  - Extended spray intervals, 7 days in between sprays
  - Using Degree Days and 3 TPP/trap/week as action thresholds
  - Alternating insecticides with Excel Oil
  - Mesh (Southbridge only)
- Results showed
  - TPP management should be adjusted to the growing region
  - Oils can be part of TPP spray programmes
  - Extended spray intervals were not successful
  - Mesh size was too large, major aphid infestation.

IPM tool: future-proofing spray programmes

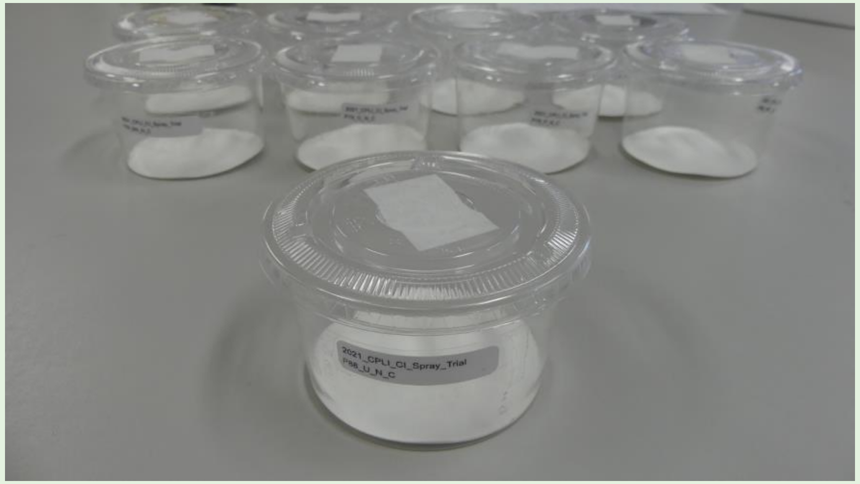
- Canterbury, 2018–2019 season
- Anticipating loss of organophosphates and synthetic pyrethroids
- Tested against
  - Standard Canterbury programme (from 100% emergence)
  - Standard programme alternating with Excel Oil (from 100% emergence)
  - Standard programme from Degree Day action threshold
  - Standard programme alternating with Excel Oil from Degree Day action threshold
- No significant difference between tuber marketable weights or numbers
- Zebra chip incidence lowest in Future Proof spray programme, but not significantly different to other spray programmes or control.

IPM tool: Understanding non-crop host plants

- 2012–2015
- All TPP life stages were present on non-crop host plants throughout the year
- Host plants for TPP included Lycium and Convolvulaceae species; host plant range of TPP is the plant Order Solanales
- Low background population of TPP flying around in the environment
- When African boxthorn was present adjacent to a crop, there was increased activity nearby and an edge effect may be observed in the host crop
- African boxthorn and poroporo are suitable hosts for TPP development.

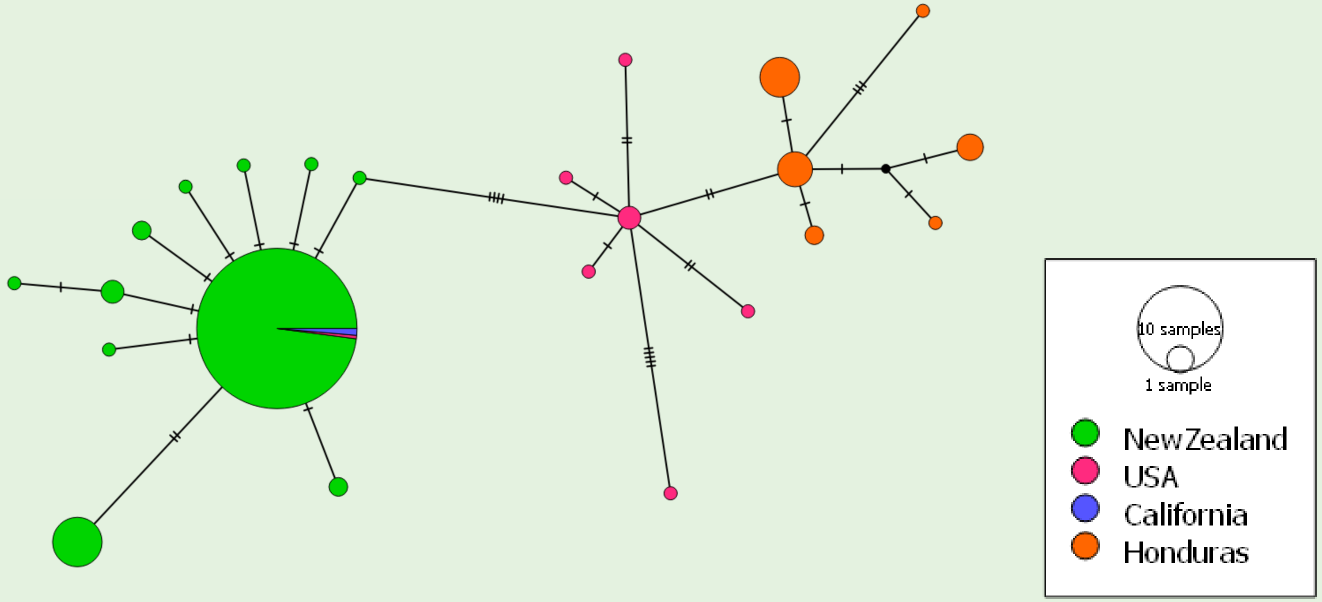
No decreased insecticide susceptibility in TPP in Canterbury

- 2021–2022 season
- Tested selected contact and systemic insecticides
- Tested field-collected TPP (Canterbury) against susceptible TPP lab colony
- Contact & systemic insecticides: No material difference in mortality of adults and nymphs between the field-collected colony and the susceptible colony
- Systemic insecticides: the transition from the to-be-assessed life stage to the next life stage for each insecticide reasonably reflected the label or manufacturer's claim of how the insect or individual life stages are affected by the insecticide.



Fundamental research

- How TPP interact with each other, the environment and the host plant through sensory cues (smell, vision, and acoustic), but none worked in the field
- Understand TPP population genetic variation in key potato growing regions
  - Mitochondrial DNA showed large variation in genetics
  - Endosymbionts (internal bacteria)
  - Insecticide resistance genes
- Understand host plant response to TPP and Liberibacter to assist breeding



Publications relating to North Island trials

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MacDonald FH, Connolly PG, Larsen NJ, Walker GP **2016**. The voracity of five insect predators on *Bactericera cockerelli* (Sülc) (Hemiptera: Triozidae) (tomato-potato psyllid; TPP) assessed in no-choice and choice laboratory assays. New Zealand Entomologist 39 (1): 15-22.

Walker GP, MacDonald FH, Wright PJ, Puketapu AJ, Gardner-Gee R, Connolly PG, Anderson JAD **2015**. Development of action thresholds for management of *Bactericera cockerelli* and zebra chip disease in potatoes at Pukekohe. American Journal of Potato Research 92: 266-275.

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Walker GP, MacDonald FH, Puketapu AJ, Wright PJ, Connolly PG, Anderson JAD **2013**. A field trial to assess action thresholds for management of *Bactericera cockerelli* in main crop processing potatoes at Pukekohe. New Zealand Plant Protection: 66: 349-355.

Acknowledgements

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Thank you

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