# Tomato-potato psyllid - a workshop series for the Tasmanian vegetable industry

Frank Mulcahy
Simplot Australia Pty Ltd - Tasmania

Project Number: MT09095

**MT09095**

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Tomatoes - Fresh

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Reference No. MT09095

# Tomato-potato psyllid – a workshop series for the Tasmanian vegetable industry

Final Report (August 2010)

*Donna Lucas*

*RDS Partners Pty Ltd*
*(Rural Development Services)*

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## Project number: MT09095

## Project Leader

Frank Mulcahy
Simplot Australia Pty Ltd
Mason Street
Ulverstone
TASMANIA 7315

Phone: (03) 6429 6108
Email: Frank.Mulcahy@simplot.com.au

## Purpose

The purpose of this final report is to summarise the project MT09095: *Tomato-potato psyllid – a workshop series for the Tasmanian vegetable industry*, which ran workshops during July 2010.

This project was funded by Horticulture Australia Limited (HAL) using a voluntary contribution from Simplot Australia Pty Ltd and matched funds from the Federal Government.

## Date of report

August 2010

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# Media summary

Three workshops were held in Tasmania on the Tomato-potato psyllid / Liberibacter / phytoplasma complex. One workshop was held in each of the North West, North East and Southern regions of Tasmania.

The psyllid has become established in New Zealand in recent years, causing serious concern for the potato and vegetable industries. The psyllid causes considerable crop damage through feeding. The psyllid also vectors liberibacter, which causes Zebra chip. Zebra Chip cost New Zealand potato producers $43 million in the 2008/09 season. New Zealand is also troubled by phytoplasma, and it is unknown at this stage what the interaction is between the psyllid and phytoplasma.

The objectives of the workshop series was to:

1. Increase awareness of the risks associated with the tomato-potato psyllid to the Australian vegetable industries (in particular the Tasmanian potato industry)
2. Increase preparedness of industry (particularly potato and tomato) for possible incursion and establishment of the psyllid in Australia
3. Expose Tasmanian growers, researchers, agronomists and contractors to New Zealand expertise and research to date
4. Strengthen networks between New Zealand and Tasmanian vegetable industries
5. Develop communication links between industry stakeholders (e.g. processors, growers, researchers, and AQIS) and across industry e.g. tomato and potato
6. Identify key issues for Tasmania

The workshop program included:

Bryan Hart - Horticentre Limited, Pukekohe, New Zealand
Monty Spencer - AS Wilcox & Sons Ltd , Pukekohe, New Zealand
Rob Cox - Agronomist, Balle Bros Fresh Produce, Pukekohe, New Zealand
Eamon Balle - Balle Bros Fresh Produce, Pukekohe, New Zealand.
Fiona Macbeth - Emergency Response and Coordination Office of the Chief Plant Protection Officer, DAFF
Darryl Barbour - Americas, New Zealand, Europe and Africa, Plant Biosecurity – Horticulture, DAFF
Frank Mulcahy, Senior Agronomist, Simplot Australia

The events were promoted through Tasmanian rural newspapers, SpudNews (Simplot potato grower newsletter), emails, media release and radio interviews. The most effective promotion was email distribution of a flier and the Simplot "Spud News" grower newsletter. Email was more effective in reaching service providers and "Spud News" was the most effect way to reach potato growers.

Information from the event was also presented at 'potato futures 2010' – three workshops (one in Ulverstone, Scottsdale and Longford) – in August 2010.

Potato growers who attended the workshops found the New Zealand presentations in particular were very informative, and they enjoyed hearing a grower's perspective.

The workshops have increased industry knowledge of the psyllid; and have increased awareness about the threat and associated risk of tomato-potato psyllid.

# Evaluation of effectiveness - survey results

The effectiveness of the workshops was assessed through survey of participants after the event (online plus some phone interviews) (see appendix 1 for copy of survey), and subjective evaluation based on workshop observations, and comments from participants at the workshop.

There were 31 survey respondents, including two from Victoria and one from Queensland. Almost half of respondents were potato producers.

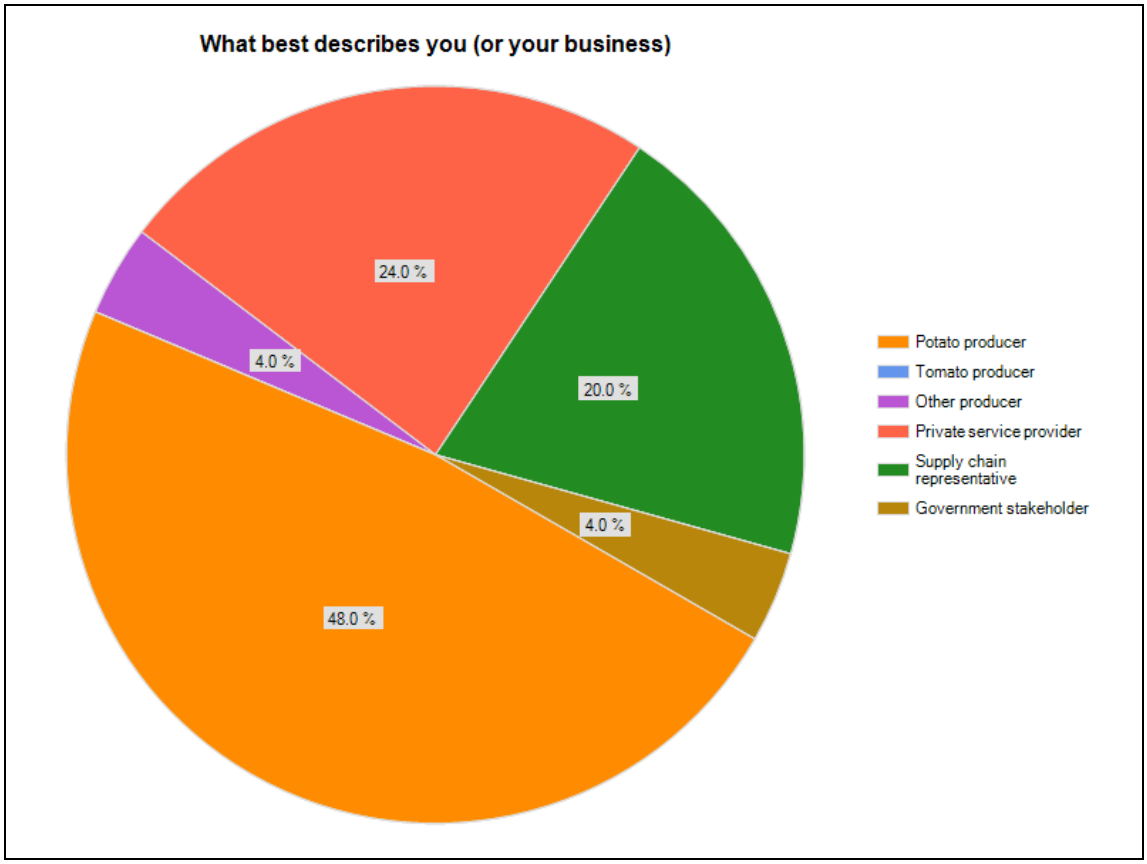



**Figure 1: Analysis of survey respondents**

Respondents were asked how they found out about the workshops. Overall, the most effective promotion was through emails, "Spud News" grower newsletter, followed by Simplot Field Officer contact. Of the potato producers who completed the survey 75% (9 out of 12) found out about the workshop through the SpudNews and only 2 out of 12 found out through email. Email was more effective in reaching service providers and supply chain representatives and the SpudNews newsletter was more effective in reaching potato growers.

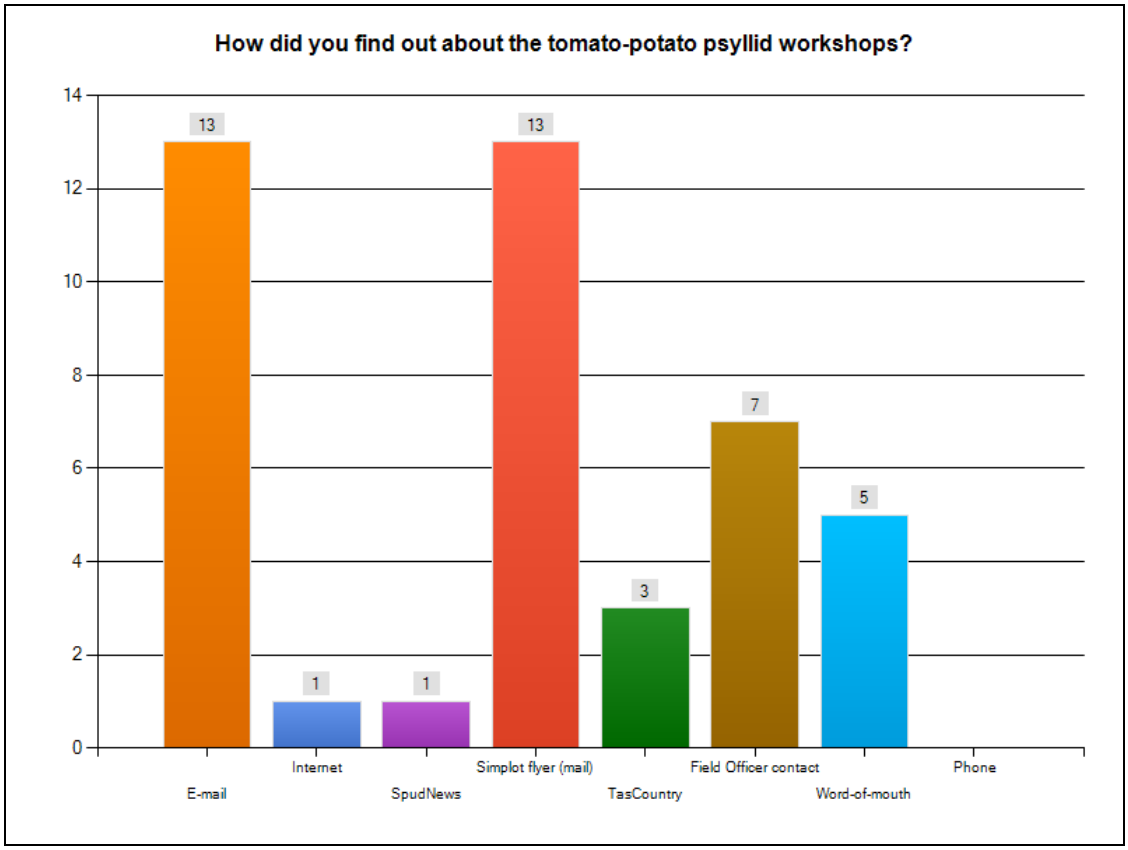



**Figure 2: How participants found out about the workshop**

*Objective one: Increase awareness of the risks associated with the tomato-potato psyllid to the Australian vegetable industries (in particular the Tasmanian potato industry).*

Participants were asked to rate to what extent they agreed with the statement "attending the workshop increased MY AWARENESS of the threat and associated risk of tomato-potato psyllid"

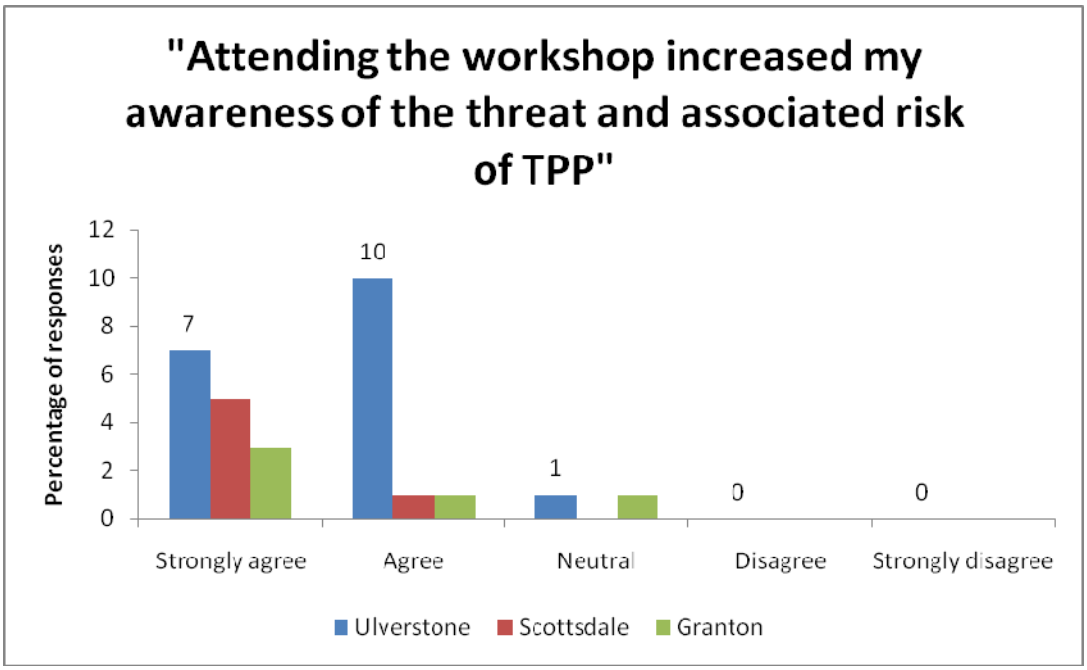



**Figure 3: Extent to which participants agreed that, attending the workshop increased their awareness of the threat and associated risk of TPP**

All, except two, respondents either agreed or strongly agreed that attending the workshops increased their awareness. At the Scottsdale workshop there was a greater proportion who 'strongly agreed'.

*Objective two: Increase preparedness of industry (particularly potato and tomato) for possible incursion and establishment of the psyllid in Australia*

Survey respondents were asked to what extent they agreed with the statement "the workshop has increased INDUSTRY PREPAREDNESS for a possible incursion of psyllid in Australia".

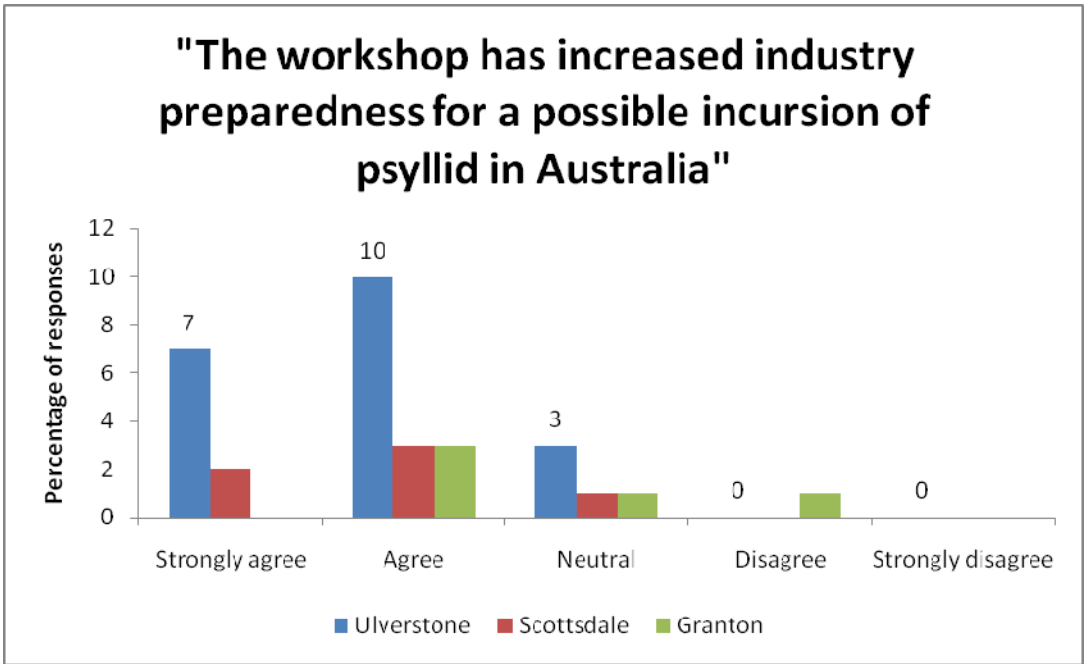



**Figure 4: Extent to which participants agreed that, attending the workshop increased industry preparedness for a possible incursion of TPP in Australia**

A majority of respondents either agreed or strongly agreed that the workshop increased industry preparedness. Some growers did express their concerns about industry preparedness and proactive/ reactive ability to a crisis.

*Objective three: Expose Tasmanian growers, researchers, agronomists and contractors to New Zealand expertise and research to date*

The workshop was attended by Tasmanian growers, researchers, agronomists and service providers. Participants were exposed to four New Zealand presenters including two growers. Based on comments at the workshop, and survey feedback – participants valued hearing about the New Zealand experience and in particular a grower's perspective. Presentations from NZ were the most popular sessions.

*Objective four: Strengthen networks between New Zealand and Tasmanian vegetable industries*

New Zealand guests toured processing facilities at Ulverstone Tasmania, visited growers and presented sessions at workshops. Through these activities the NZ guests have developed networks with growers, the processing industry and other supply chain members. Survey feedback indicated that growers would like to be kept informed about the situation in NZ and their research results.

*Objective five: Develop communication links between industry stakeholders (e.g. processors, growers, researchers, and AQIS) and across industry e.g. tomato and potato*

Based on discussions at the workshops, networks and communication links were developed between industry stakeholders. For example government entomologists and researcher now have information and contacts within industry both in Tasmania and also New Zealand.

*Objective six: Identify key issues for Tasmania*

Issues identified through the workshop include:

- Potato growers now have increased awareness of the TPP, however there was a lack of awareness amongst other vegetable growers (e.g. tomato growers)
- Reaction time to an incursion. TPP may already be in Australia and given the diversity of climate, poor performing crops may have been dismissed as "influenced by other agronomic factors". In effect, this will result in financial pain before industry commences the fight for control (as in New Zealand).
- Tasmania has a potato industry almost solely reliant upon processing. The brunt of commercial loss through TPP and liberibacter occurs in the french fry processing industry (both growers and processors). This is due to liberibacter being difficult to detect during processing and becoming fully apparent in the final frying of product at retail level. The industry is now fully aware of the impact of a TPP/liberibacter incursion in Australia.

## Respondents were asked which session they liked the most, and why they liked those sessions:

**Table 1: Survey comments regarding the sessions that they liked the most**

| |
|---|
| *"Relevant --Informative –structured"* |
| *"NZ situation will give us the best info on how to handle the disease in Australia"* |
| *"Informative without rambling on. To the point."* |
| *"The NZ experience was good.<br>Learning how to farm with it.<br>One of the NZ talks was a bit hard to understand.<br>DAFF presentations OK - but planning for incursion didn't give me confidence."* |
| *"NZ good because they explained the way the crops were affected and symptoms.<br>DAFF people weren't informed"* |
| *They were all honest experiences.* |
| *"Liked Eamon but he may have been a bit cautious.<br>Talk about NZ distribution good (Monty).<br>[One presenter] didn't listen."* |
| *"Not all of above presented talks at Granton session - all speakers were good except I found [one presentation] off-target and not entirely relevant"* |
| *"Good mix of data and interpretation, high value information."* |
| *"All good."* |
| *"Interesting to hear about the findings from research in NZ, and grower experiences.<br>NB Rob and Eamon were not at Granton workshop."* |
| *"Very informative and relevant to the issue at hand. In space of 2hrs gave all relevant info on where NZ is at with disease."* |
| *"Clear and concise information."* |
| *"Creating grower awareness on issue."* |
| *"I attended all 3 workshops. All 3 meetings were very informative and the presentations were all very good."* |
| *"Lots of information provided."* |
| *"Good communicators, real info."* |
| *"Interesting insights into the extent of the problem as experienced in NZ."* |
| *"It was excellent to hear from growers who have been affected, their management strategies and options for control.<br>Also interested in how the AQIS handled to import of veggies and other risks to our industry."* |
| *"All very informative and well presented."* |

**Venues:**
Survey respondents were asked to rate the venue as excellent, good, adequate, needs improvement or poor. The average rating was 3.5 out of 5.

Three from the Ulverstone workshop indicated that the venue needed improvement. There were a couple of comments about poor acoustics at the Ulverstone venue.

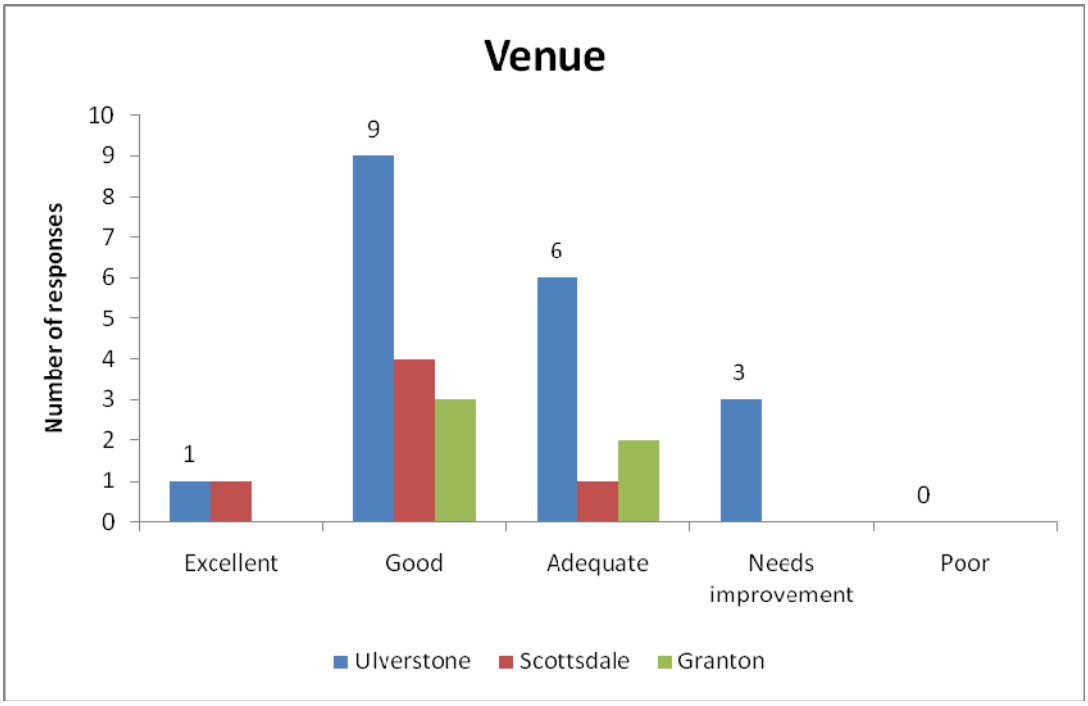



**Figure 5: Survey respondent rating of the venues.**

**Quality of the talks:**
Survey respondents were asked to rate the quality of the talks as excellent, good, adequate, needs improvement or poor. Where excellent is 5 and poor is 1, the average rating was 4.2 out of 5.

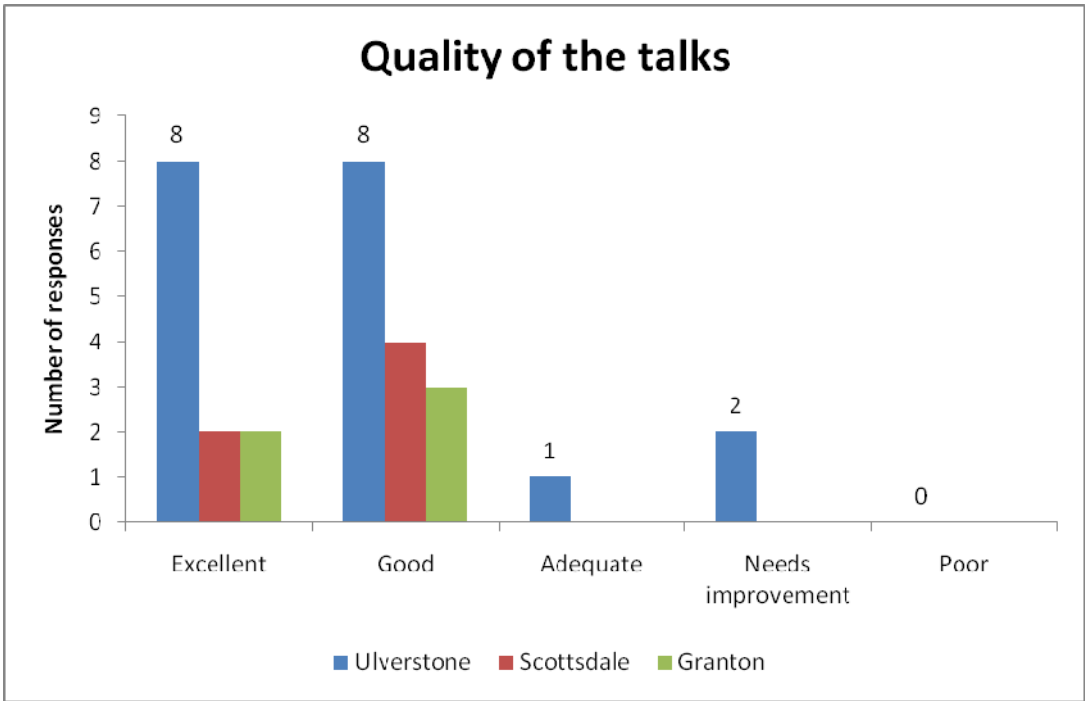



**Figure 6: Survey respondent rating of quality of the talks.**

**The workshop overall:**
Survey respondents were asked to rate the workshop overall as excellent good, adequate, needs improvement or poor. Where excellent is 5 and poor is 1, the average rating was 4.3 out of 5.

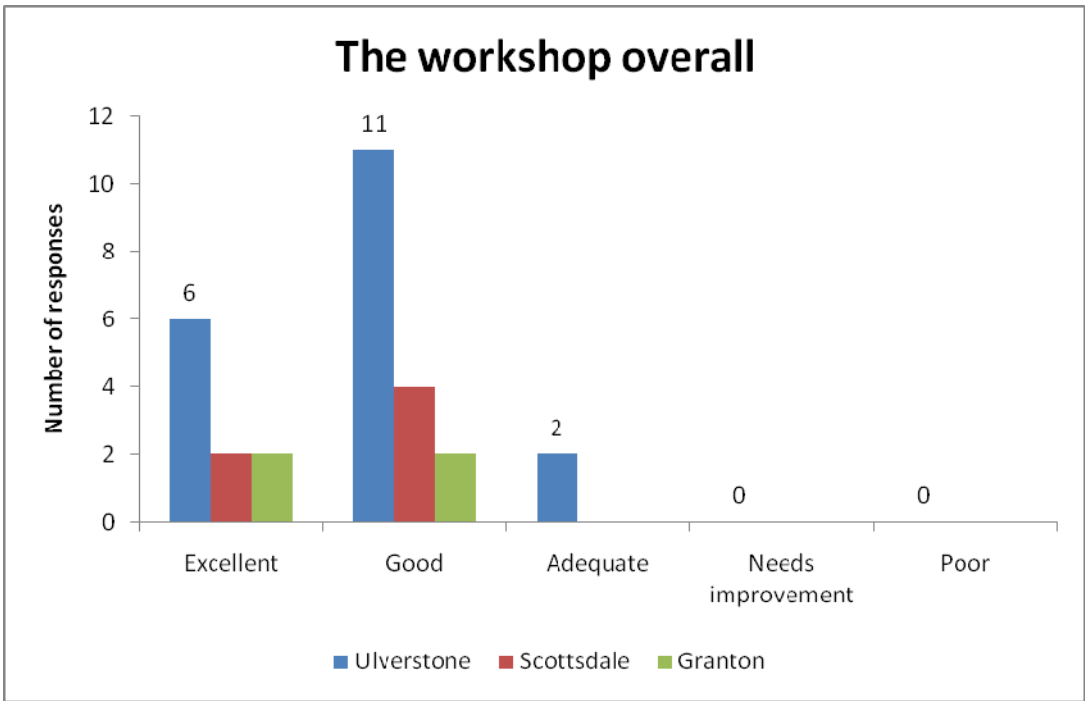



**Figure 7: Survey respondent rating of the workshop overall**

**Survey respondents were asked to what extent they agreed with the statement "there was enough time and opportunity for questions"**

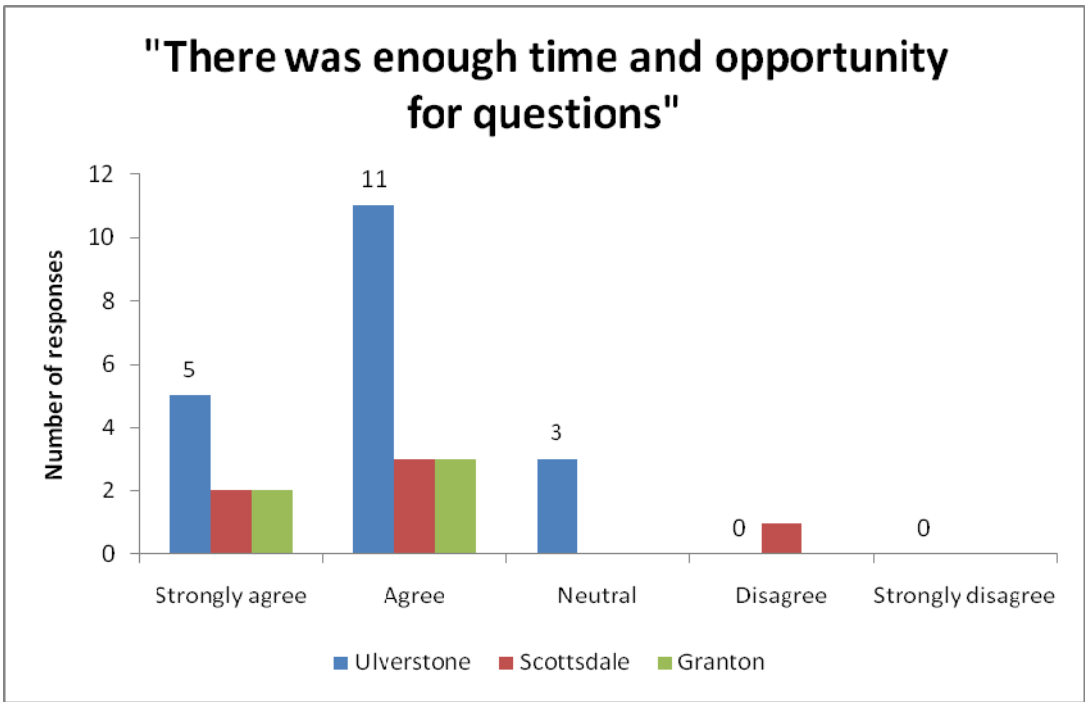



**Figure 8: Extent to which respondents agreed that there was enough time and opportunity for questions.**

**Survey respondents were asked to what extent they agreed with the statement "there was enough time and opportunity for discussion"**

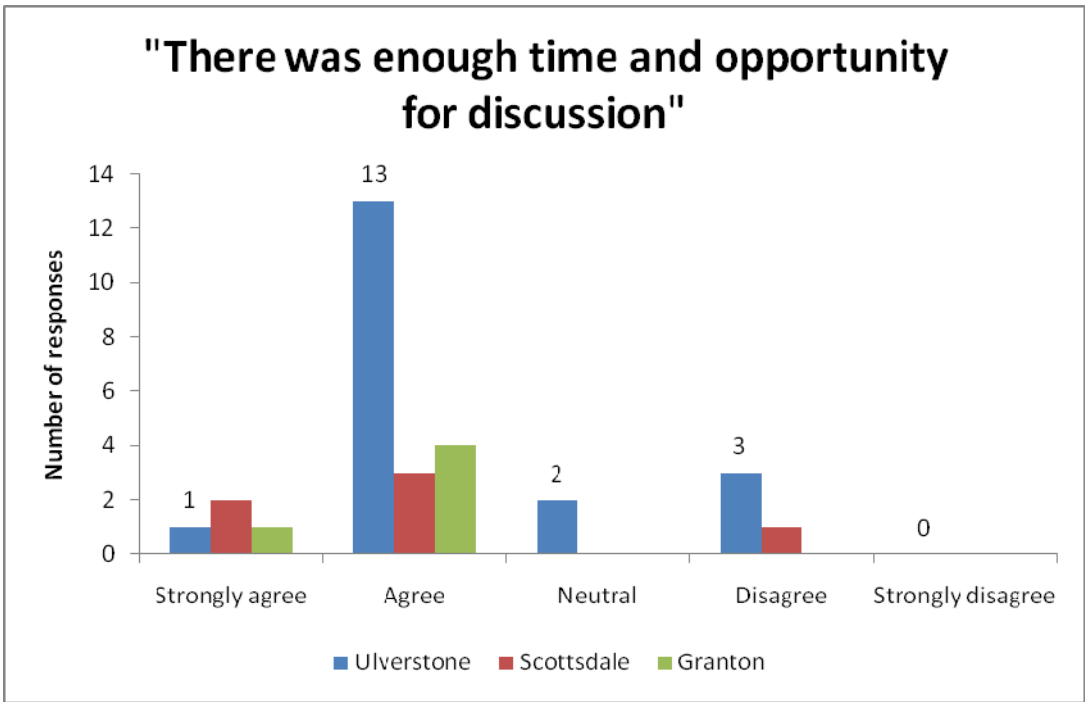



**Figure 9: Extent to which respondents agreed that there was enough time and opportunity for discussion.**

## If you would like further information about the tomato-potato psyllid, please tell us what this information would be like.

**Table 2: Survey comments about further information that they would like.**

| |
|---|
| "*The opportunity to help prepare for a sudden invasion into Tasmania"* |
| *"Just ongoing control strategies"* |
| *"More information on overseas experience.<br>Want to know where we are going to be in 5 years if we get psyllid here.<br>Overseas, what are the pesticide effects on other insects."* |
| *"Get Eamon Balle to write something for SpudNews.<br>Provide follow up."* |
| *"Would like all the information I can get."* |
| *"Add a glossy picture to the potato disease book of symptoms.<br>Send out a glossy picture."* |
| *"It might be good to get a ute guide to help identify the psyllid and zebra chip systems."* |
| *"It is a very new subject. Any information would be good."* |
| *"A monthly/quarterly newsletter giving a summary of progress on research on psyllid in NZ and US, new findings, Australian government initiatives, people involved in Australian taskforce and contacts."* |
| *"Updates on research into the disease.<br>Updates on Australian based activities to monitor for and manage potential threat of disease."* |
| *"Opportunity to export clean disease free seed to NZ"* |
| *"Updates from work in NZ - grower learnings and industry research.<br>Information on phytoplasma, including what we might already have in Tasmania.<br>Information on native Tasmanian psyllids - can they spread ZC or phytoplasma."* |
| *"As the seed certification officers for Tasmania we need to be keeping up with all the relevant information relating to any threats to the potato industry."* |
| *"Electronic colour tech note on the identification of the TPP."* |
| *"Further updates on management options.<br>Further updates on role of phytoplasma on disease."* |

## Are there any other comments you wish to make, including issues for industry?

**Table 3: Other comments from survey**

| |
|---|
| *"NO"* |
| *"Interested in new varieties"* |
| *"A job well done to all who organised it. I thank you for the opportunity to attend."* |
| *"Amazed that there was a story on the Country Hour today about considering importing NZ potatoes"* |

*“poor attendance by growers of concern”*

*“growers need to be kept up to date on any future information”*

*“Potato imports into Aus and Apples should be stopped due to risks associated with this pest.”*

*“It was interesting to note that tomato growers who attended the Granton workshop were unaware of the potential risks to the tomato industry, until they were invited to attend the workshop. It would appear that tomato industry leaders are aware of the TPP and associated risks, but the message has not filtered down to growers.”*

*“A quarterly update on the TPP taskforce and what is happening in NZ would be great.”*

*“Sound was not excellent at venue, and a couple of speakers, cant remember which were hard to hear, and hence missed what they were trying to say, and I was only a few rows from front”*

*“The acoustics at the Ulverstone venue were poor. Very difficult to hear the quietly spoken presenters. Suggest a microphone system would have improved the workshop.*
*The workshop was well organised.”*

# Conference program

**Tomato Potato Psyllid – Small Insect, Big Threat**

| **Programme** | | | **Total time** |
|---|---|---|---|
| Peter Hardman | Introduction | 2.00 – 2.05pm | 5 |
| Frank Mulcahy | A brief overview | 2.05 – 2.15 | 20 |
| Eamon Balle | A NZ growers perspective | 2.15 – 2.35 | 40 |
| Bryan Hart | An agronomists' perspective | 2.35 – 2.55 | 60 |
| Monty Spencer | Monitoring the pest | 2.55 – 3.15 | 80 |
| Discussion | | 10 minutes | 90 |
| **Break** | | 20 minutes | |
| Darryl Barbour | Pest risk analysis | 3.45 – 4.05 | 20 |
| Fiona Macbeth | Emergency response | 4.05 - 4.25 | 40 |
| Rob Cox | Cage trials | 4.25 – 4.45 | 60 |
| Monty Spencer | NZ research results | 4.45 – 5.00 | 75 |
| Closing and discussion | | 5.00 - | |

# Workshop attendance

Attendance at each workshop:

| Region | Venue | Number of farmers | Number from interstate | Total number of attendees (not including presenters) |
|---|---|---|---|---|
| North West | Ulverstone | 40 | 5 | 80 |
| North East | Scottsdale | 32 | 0 | 38 |
| South | Granton | 8 | 0 | 20 |

# Key outcomes of the workshops

Key outcomes of the workshops include:

- Increased knowledge of the psyllid, its life cycle and symptoms
- Increased awareness and knowledge of the threat of tomato-potato psyllid and associated risks – especially the Tasmanian potato industry
- Increased industry preparedness for a possible incursion of the tomato-potato psyllid in Australia – especially the Tasmanian potato industry
- Development of networks between New Zealand and Tasmanian vegetable industries (growers, service providers and other supply chain members)
- Increased knowledge of how New Zealand and other growers are managing the psyllid

# Recommendations

*Recommendation one* – continue to keep Tasmanian potato growers informed - including through the Simplot "Spud News" grower newsletter.

*Recommendation two* – prepare regular summaries of research from New Zealand, to include in "Spud News" or other information channels.

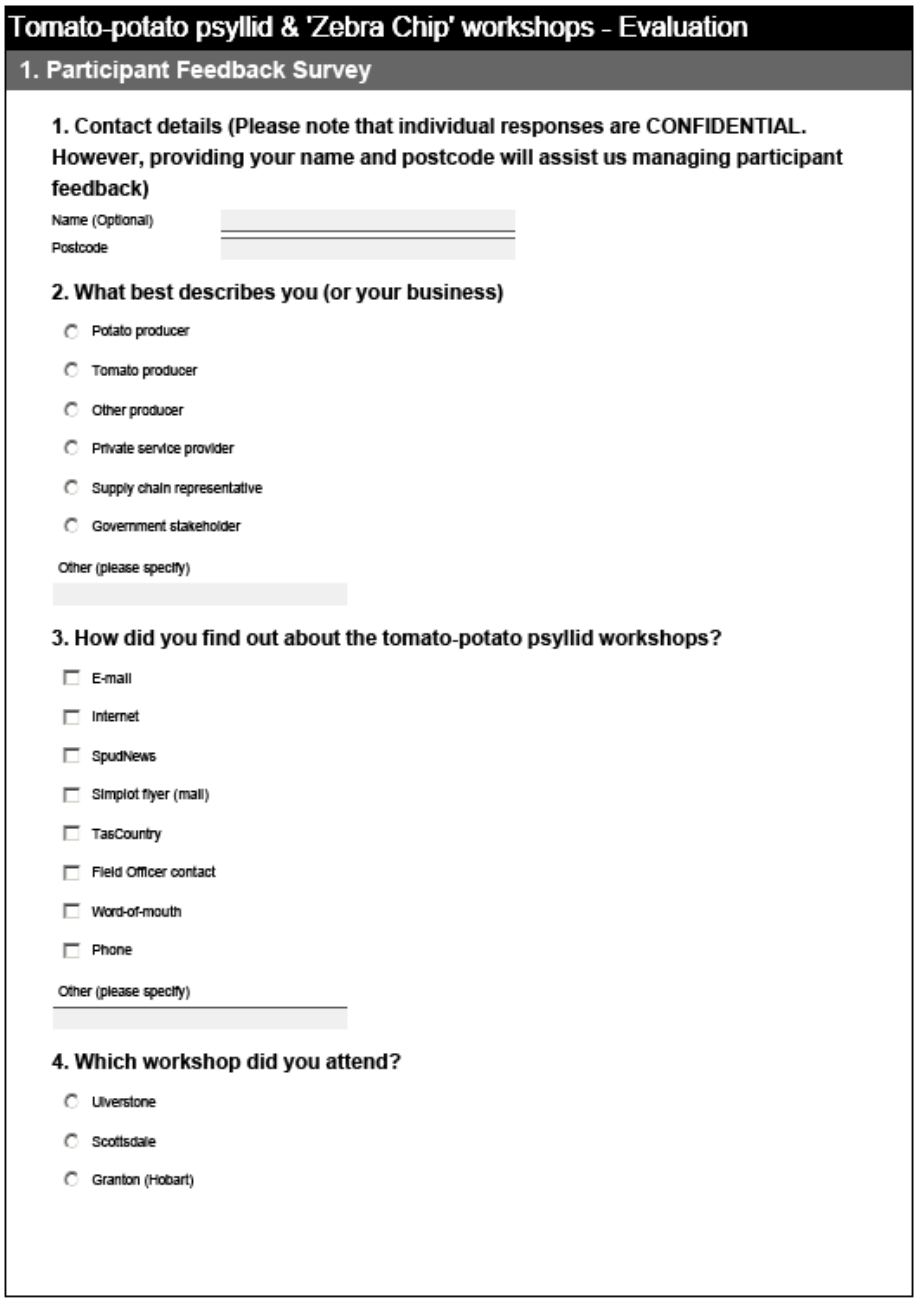
*Recommendation three* – the HAL Vegetable Industry Development program ensures that relevant information reaches potato, tomato and other vegetable growers regarding the threat and associated risk of tomato-potato psyllid.

# Acknowledgments

The project team would like to acknowledge the following organisations and individuals for contribution to the project:

- Horticulture Australia Ltd
- Department of Agriculture Forestry and Fisheries
- Balle Bros Fresh produce
- A.S. Wilcox & Sons
- Horticentre Limited
- RDS Partners Pty Ltd
- ABC Rural Radio

# Appendix 1: Evaluation survey



Tomato-potato psyllid & 'Zebra Chip' workshops - Evaluation

1. Participant Feedback Survey

**1. Contact details (Please note that individual responses are CONFIDENTIAL. However, providing your name and postcode will assist us managing participant feedback)**

Name (Optional)

Postcode

**2. What best describes you (or your business)**

- ○ Potato producer
- ○ Tomato producer
- ○ Other producer
- ○ Private service provider
- ○ Supply chain representative
- ○ Government stakeholder

Other (please specify)

**3. How did you find out about the tomato-potato psyllid workshops?**

- ☐ E-mail
- ☐ Internet
- ☐ SpudNews
- ☐ Simplot flyer (mail)
- ☐ TasCountry
- ☐ Field Officer contact
- ☐ Word-of-mouth
- ☐ Phone

Other (please specify)

**4. Which workshop did you attend?**

- ○ Ulverstone
- ○ Scottsdale
- ○ Granton (Hobart)

Page 1

## Tomato-potato psyllid & 'Zebra Chip' workshops - Evaluation

**5. Which sessions did you like the most?**

- ☐ Eamon Balle (Balle Bros Group)
- ☐ Rob Cox (Balle Bros Group)
- ☐ Monty Spenser (The Wilcox Group)
- ☐ Bryan Hart (Horticentre Limited)
- ☐ Darryl Barbour (DAFF)
- ☐ Fiona Macbeth (DAFF)
- ☐ Frank Mulcahy (Simplot)

Why did you like those sessions?

**6. Overall, how would you rate the following?**

| | Excellent | Good | Adequate | Needs improvement | Poor |
|---|---|---|---|---|---|
| Venue | ○ | ○ | ○ | ○ | ○ |
| Quality of the talks | ○ | ○ | ○ | ○ | ○ |
| Workshop | ○ | ○ | ○ | ○ | ○ |

**7. To what extent do you agree with the following statements about the tomato-potato psyllid workshop?**

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| There was enough time and opportunity for questions | ○ | ○ | ○ | ○ | ○ |
| There was enough time and opportunity for discussion | ○ | ○ | ○ | ○ | ○ |
| Attending the workshop increased MY AWARENESS of the threat and associated risk of tomato-potato psyllid | ○ | ○ | ○ | ○ | ○ |
| The workshop has increased INDUSTRY PREPAREDNESS for a possible incursion of psyllid in Australia | ○ | ○ | ○ | ○ | ○ |

**8. If you would like further information about the tomato-potato psyllid, please tell us what this information would be like.**

**9. Are there any other comments you wish to make, including issues for industry?**

Page 2

## Tomato-potato psyllid & 'Zebra Chip' workshops - Evaluation

**10. Thank you for taking the time to complete the feedback survey. Would you like a copy of the completed report?**

| | |
|---|---|
| YES / NO | |
| If YES, Your Name | |
| Postal Address | |
| Or e-mail address | |

Page 3

# Control of Potato Psyllid with an IPM strategy

Paul Horne and Jessica Page
IPM Technologies P/L

## Biological Control?

- What generalist predators that occur in Australian potato crops would eat potato psyllid?
- 3 species nominated (that also occur in NZ)
  - Brown lacewings
  - Damsel bugs
  - Common spotted ladybird

Know-how for Horticulture™

# Biological Control?

- So far – all 3 species will eat psyllids
- Further lab-testing underway
- Field trials this coming season in NZ
- Essential to have an IPM approach for ***all pests***, not just potato psyllid
- Any pesticide that disrupts biocontrol will upset control of psyllids

IPM TECHNOLOGIES

HAL
Know-how for Horticulture™

# Project Stakeholders

Australian Potato Research Proramme Phase 2

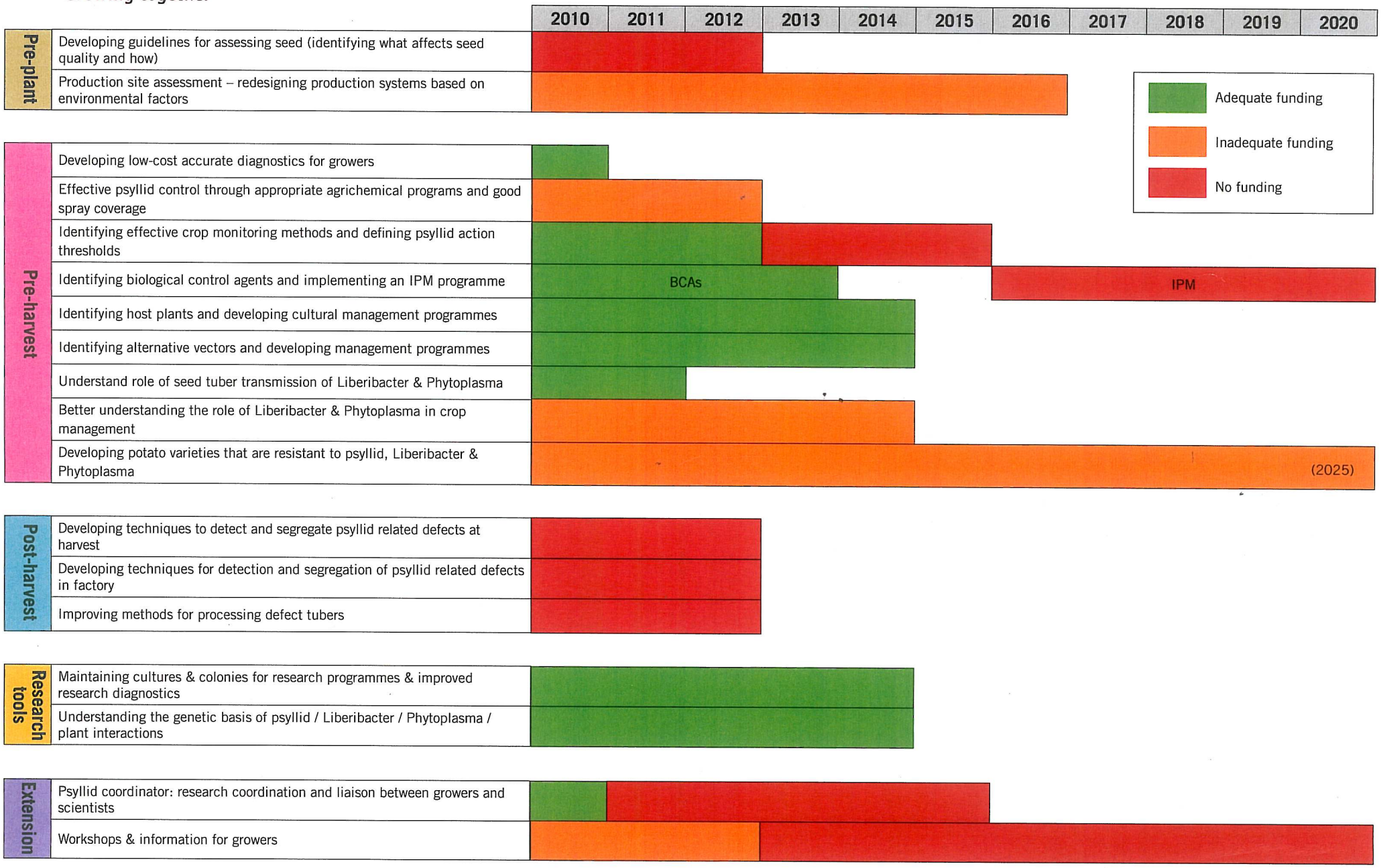
IPM TECHNOLOGIES

HAL
Know-how for Horticulture™

Potatoes™ NEW ZEALAND

*Growing together*

# Psyllid research roadmap - overview



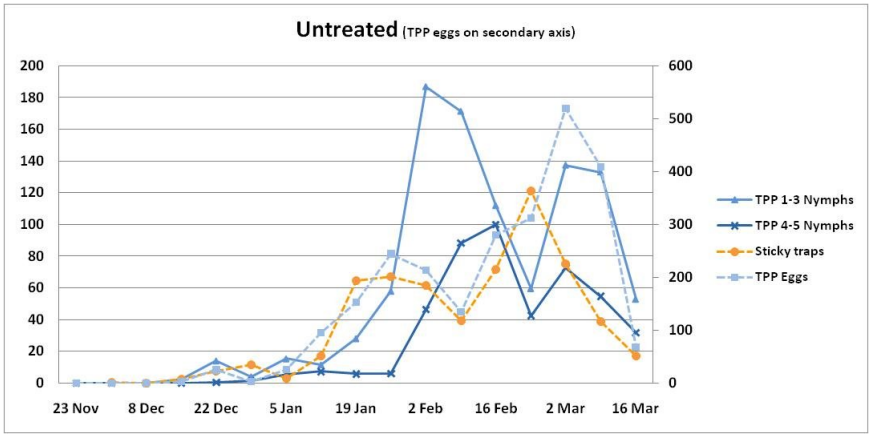
The New Zealand Institute for Plant & Food Research Limited

Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI

# SFT TPP potato insecticide trials, Pukekohe: Results (2009/10) & Trial proposals (2010/11)

**Graham Walker, Frances MacDonald, Ngaire Larsen, Peter Wright**

## Untreated plots: plant infestations vs trap catches

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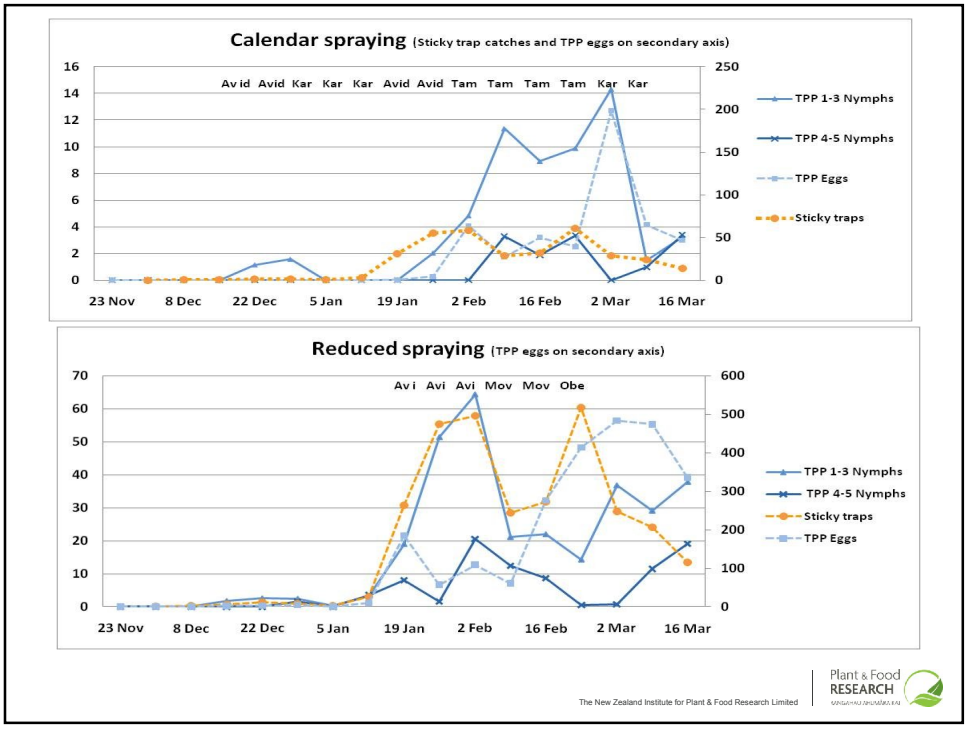
Calendar spraying (Sticky trap catches and TPP eggs on secondary axis)
Avid Avid Kar Kar Kar Avid Avid Tam Tam Tam Tam Kar Kar
TPP 1-3 Nymphs
TPP 4-5 Nymphs
TPP Eggs
Sticky traps
23 Nov 8 Dec 22 Dec 5 Jan 19 Jan 2 Feb 16 Feb 2 Mar 16 Mar
Reduced spraying (TPP eggs on secondary axis)
Avi Avi Avi Mov Mov Obe
TPP 1-3 Nymphs
TPP 4-5 Nymphs
Sticky traps
TPP Eggs
23 Nov 8 Dec 22 Dec 5 Jan 19 Jan 2 Feb 16 Feb 2 Mar 16 Mar
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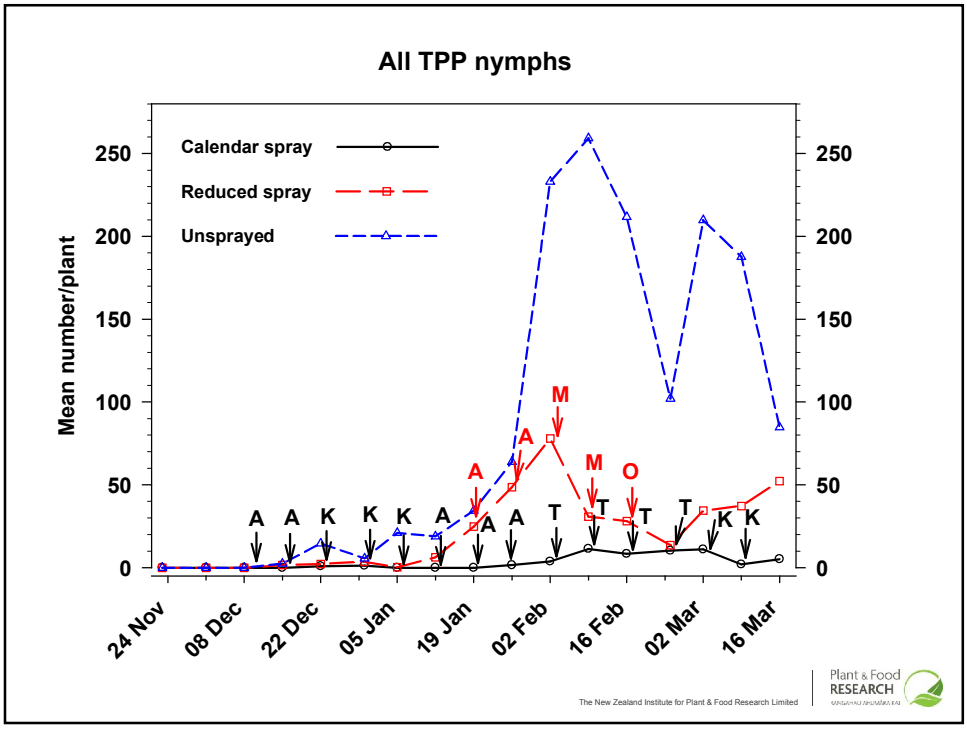
All TPP nymphs
Calendar spray
Reduced spray
Unsprayed
Mean number/plant
A A K K K A A A A T T T T O M M K K
24 Nov 08 Dec 22 Dec 05 Jan 19 Jan 02 Feb 16 Feb 02 Mar 16 Mar
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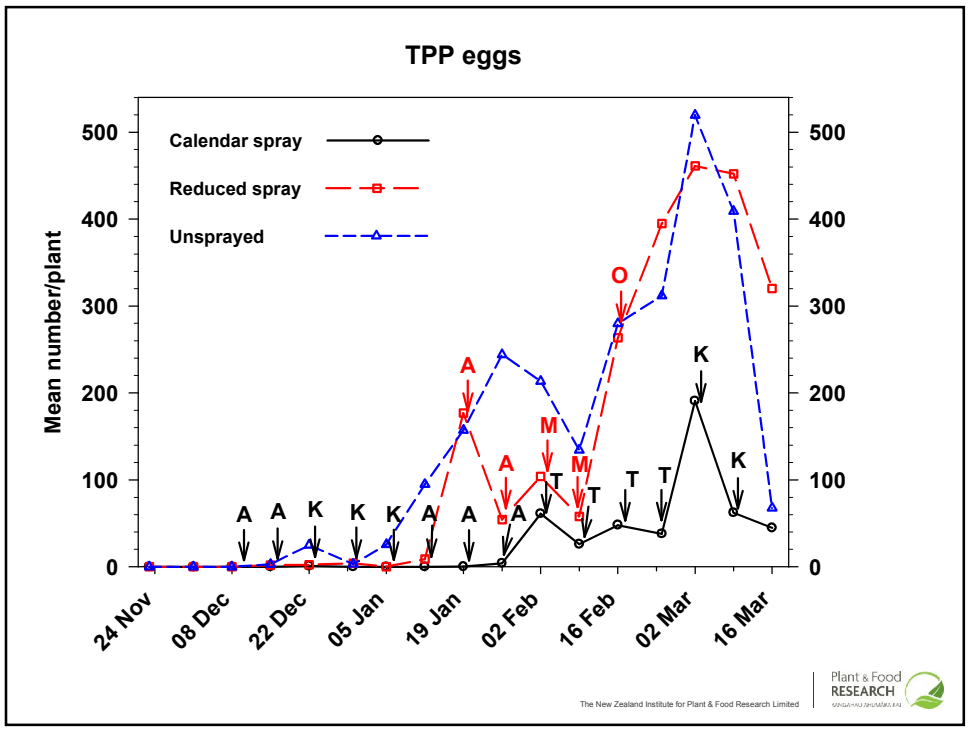


TPP damage symptoms in different treatments, Pukekohe trial, 10 February 2010

## Tuber dry matter and specific gravity; Cooking tests – zebra chip crisps

| | Mean average DM % | Mean Specific gravity | Mean % severe ZC (>3) cook score | Mean % ZC incidence | Mean Cook Score |
|---|---|---|---|---|---|
| Untreated Control | 17.35 | 1.066 | 4 | 64 | 0.25 |
| Reduced sprays | 19.16 | 1.075 | 3 | 27 | 0.12 |
| Calendar sprays | 20.81 | 1.083 | 1 | 10 | 0.04 |

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## Crop yields and grades

| | Mean 1st grade (kg) | Mean reject grade (kg) | Mean total yield (kg) |
|---|---|---|---|
| Untreated Control | 19.88 | 5.74 | 25.62 |
| Reduced sprays | 25.29 | 5.32 | 30.62 |
| Calendar sprays | 35.63 | 2.66 | 38.29 |

Data from 5 m length of plot x two (middle) rows of potatoes

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## Summary: Pukekohe insecticide trial

- No TPP infestations until 15 December
- Large increase of adults and plant infestations in mid January
- TPP damage symptoms 2-3 weeks later
- Remote (untreated) plots were 'different' to spray plots
- We have a cost-effective sampling system: using middle leaves

**Insecticide treatments:**

- Actara activity time corresponded with no infestations of TPP
  - No TPP in the local area
- Then, at high pest pressure: foliar sprays failed to stop infestations
- Calendar spraying delayed damage symptoms by 2-3 weeks
- Severe ZC (cooking) symptoms were low
- High incidence of low levels of ZC in untreated potatoes
- DNA analysis of Liberibacter in tubers planned for July



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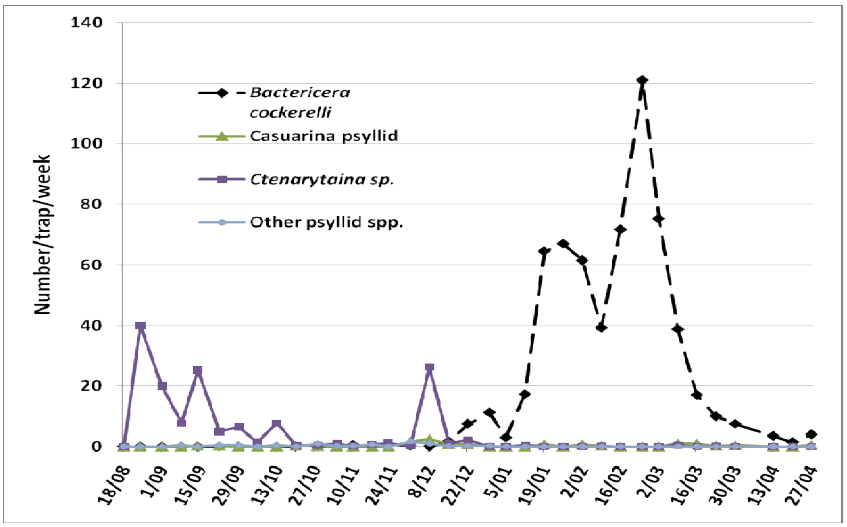
Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI

# FRUIT programme: Assess pests & natural enemies in brassicas and potatoes

**Graham Walker, Frances MacDonald, Ngaire Larsen, Andrew Wallace**

## Walker et al.: monitoring unsprayed potatoes for 12 months

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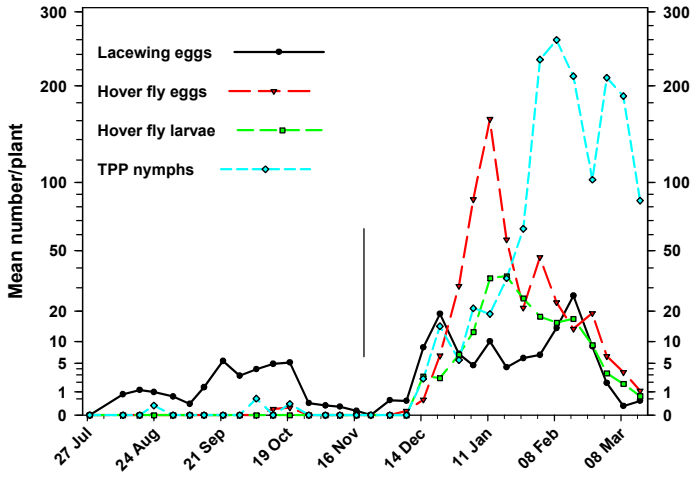
## Walker et al.: monitoring unsprayed potatoes for 12 months

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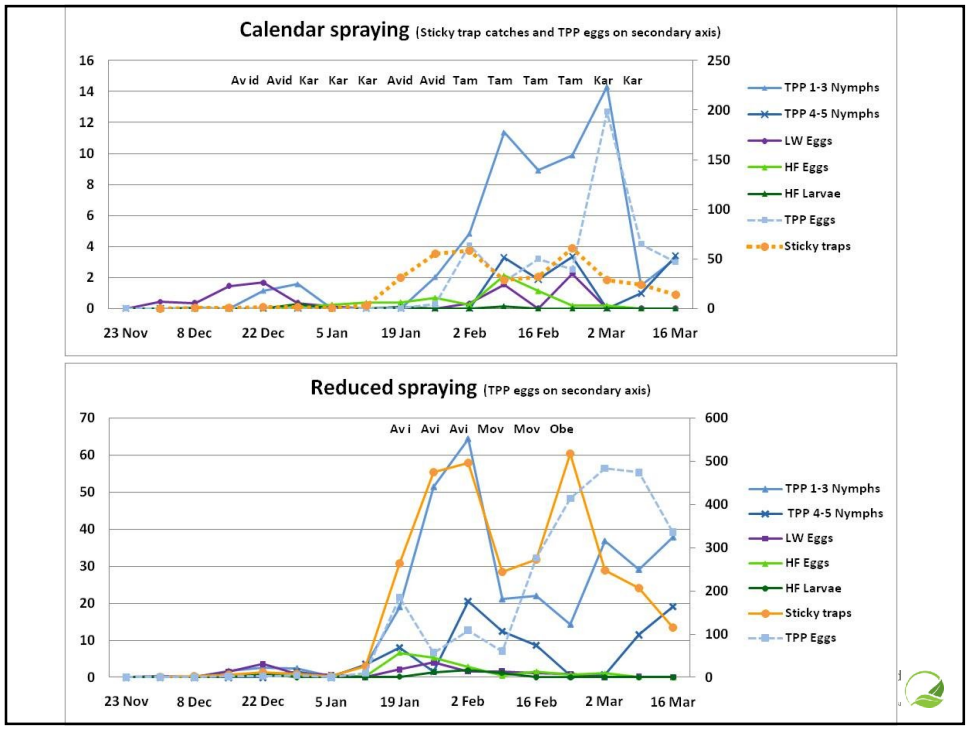
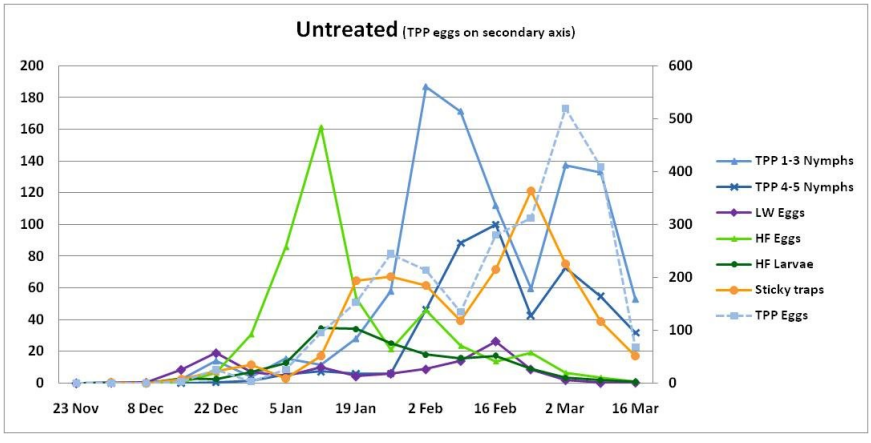
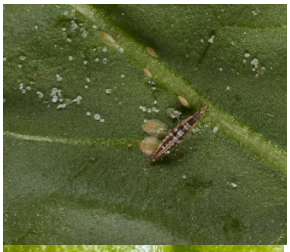



## Untreated (remotely located) plots (Walker et al.: in prep.)



## Summary of results:

(Predation of TPP in potatoes)



•Insect predators are very abundant in potatoes

•Assessing potential to predate on TPP:

- brown lacewing
- small hover fly
- 11-spotted ladybird
- sheet-web spiders

In Lab studies:

•All predators eat TPP nymphs

- All eat TPP eggs, nymphs & adults



Thank you

# CAGE TRIALS

**Pukekohe**
**23/02/2010 – 11/05/2010**

## 3 known issues in past 2 years...

- Liberibacter *solanacerum* (liberibacter)
- Psyllid yellows
- Phytoplasma australiense

# Liberibacter

- Causal pathogen of Zebra Chip
- Foliar symptoms include upward curling and yellowing of leaves
- Can lead to plant death

# Psyllid yellows

- A reaction by the plant to the act of psyllid nymph feeding
- Foliar symptoms similar to that of ZC
- Detrimental effect to yield and dry matter

# Phytoplasma australiense

- Responsible for Sudden Cabbage Tree Decline and Strawberry Lethal Yellows
- Known to be transmitted by plant hoppers
- Caused huge amount of confusion within NZ potato industry

# Objectives

- We decided to undertake a simple trial of our own to help answer some basic questions
- Confirm that the visual symptoms observed within potato fields are a direct result of psyllids
- Identify whether the foliar symptoms observed are a result of liberibacter or psyllid yellows
- To establish the effect of the timing of psyllid introduction on both foliar symptoms and tuber development

# Method

# Method

- At 16 days post planting (16 DPP) 10 adult psyllids were released into 3 cages
- At 30 DPP 10 adults psyllids were released into a further 3 cages
- The remaining 6 cages stayed free of insects

# Observations

- Foliar symptoms first noticed in Cage 11, plant 1 at 29 DPP. Symptoms visible in cages 1, 6 & 11 over a wide range of plants at 36 DPP.
- Foliar symptoms first noticed in cages 3, 5 & 12 at 75 DPP.

# Observations

# Observations

*Large numbers of eggs on leaf margins and presence of adults on upper leaves*

# Observations – Foliar symptoms

*Upward curling and yellowing of leaves*

*Aerial tubers*

# Observations

- Most plants had high numbers of psyllid eggs and adults. Populations of nymphs varied from plant to plant
- **ALL** plants where psyllid nymphs were present exhibited foliar symptoms
- There was no correlation between adult numbers and foliar symptoms

# Results – Tuber symptoms

*No tubers set*

*Secondary sprouting of tubers*

## Results – Control

*No foliar symptoms*

*No tuber symptoms*

## Results

| | 16 DPP | 30DPP |
|---|---|---|
| Asymptomatic: | 7 | 24 |
| Slight foliar symptoms: | 2 | 3 |
| Moderate symptoms: | 10 | 3 |
| Severe foliar symptoms: | 10 | 0 |
| Tuber sprouting: | 18 | 1 |
| No tuber symptoms: | 11 | 29 |

# Results

- 41 plants tested by PCR analysis
- 39 plants were negative for both *C.liberibacter solanacearum* and phytoplasma
- 2 plants tested positive for C.Liberibacter solanacearum – in both cases psyllids were introduced at 16 DPP
- 1 plant tested positive for phytoplasma – originated from a control cage with no psyllids present

# Liberibacter Positive

*-Yellowing and curling of foliage*
*-Aerial tubers*
*-Secondary tuber sprouting*

# Liberibacter Positive

*-'Zig Zag' shaped stem*
*-Yellowing and curling of foliage*
*-Tubers sprouting*
*-Aerial tubers*

# Phytoplasma Positive

*No obvious foliar or tuber symptoms*

# Conclusions/Thoughts

- The earlier the introduction of psyllids the greater the severity of foliar and tuber symptoms
- High populations of adults does not necessarily lead to foliar symptoms
- The higher the nymphal population the greater the severity of foliar & tuber symptoms
- This possibly indicates most of what we are seeing is Psyllid Yellows?
- Due to the inconsistencies of the current diagnostic testing limited conclusions can be drawn from these results

Australian Government
Department of Agriculture, Fisheries and Forestry

# Currant Lettuce Aphid Tasmania 2004

## *Nasonovia ribisnigri*

Fiona Macbeth
Manager Emergency Response Coordination
OCPPO



## Currant Lettuce Aphid

Found in New Zealand in March 2002
Within a few months spread across NZ

Found in Tasmania in March 2004
Classified as an Emergency Plant Pest

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## Initial investigation

Delimiting surveys in Tasmania found the aphid on 11 properties: eight across northern growing areas, and three near Hobart.

Detection surveys began simultaneously in other States -no aphids were found.



## Pathways

There are two credible pathways for entry of the aphid to Tasmania:

- Wind borne from New Zealand during an unusual weather anomaly in late January.

- On nursery stock of other host plants including the primary hosts currants/gooseberries.

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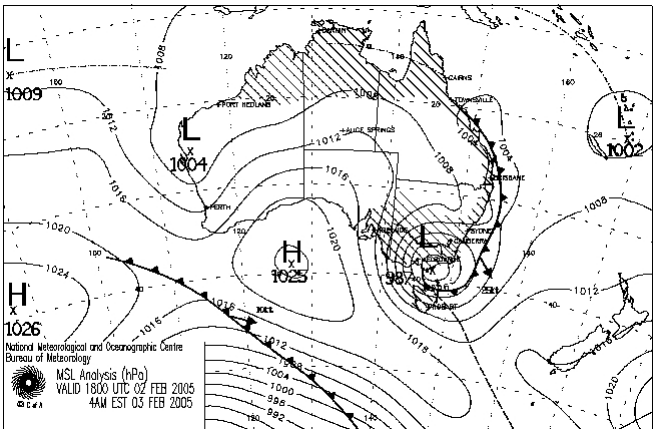


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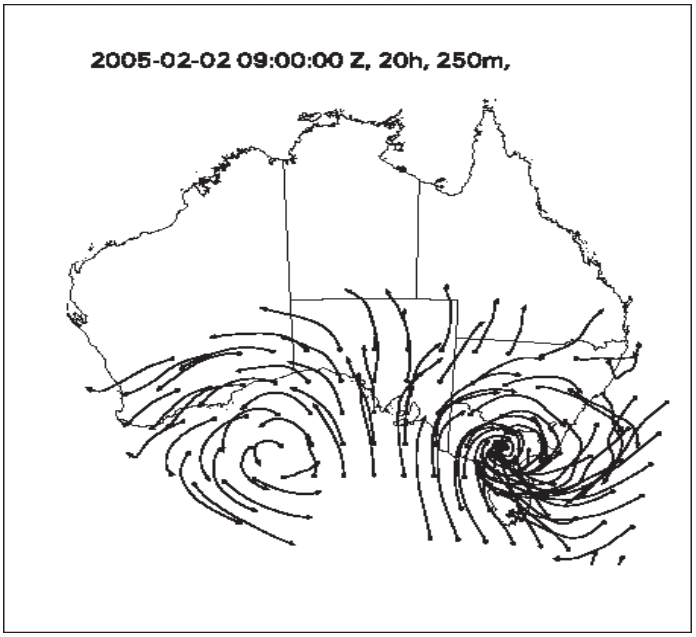


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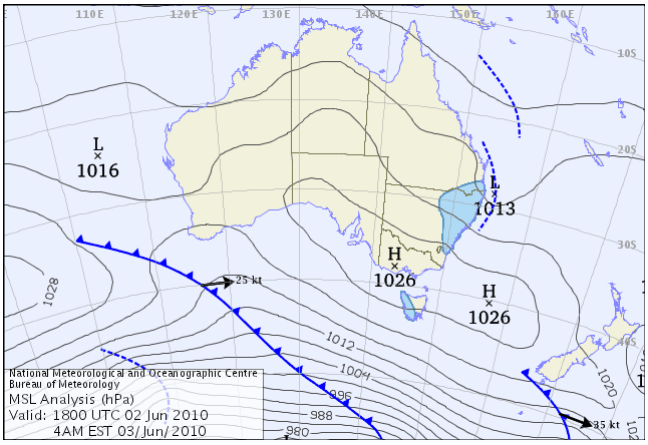




## Domestic Market Access restrictions

All lettuces are exported from Tasmania to the mainland are either whole head lettuce (preferred by the aphid) and specialty leaves washed and pre-packaged for supermarkets.

Other states agreed that all lettuce exports from Tasmania be halted and would resume a washed loose leaf lettuce if a management system proposed by the exporting company could be demonstrated to exclude all aphids. The validation process started by May 2004.

## International market access

Australia exports lettuce to a number of countries in South-East Asia and the Pacific.

Almost all of these markets were sensitive to the presence of the aphid.

It will be important to maintain area freedom for all, or parts of, the mainland states for as long as possible.



## Spread of CLA

Currant-lettuce aphid was expected to continue to spread as it is readily moved on air currents and movement of hosts. Agreement by State quarantine regulators was secured by AUSVEG, to minimise restrictions on movement of lettuce after detection of the aphid on the mainland.

This was not implemented following opposition to the decision by sectors of industry in affected States and lobbying of State Ministers.

## Spread

In May 2005 the aphid was found in Victoria

By October 2006 it had been found in all other states the last being Queensland.



Australian Government
Department of Agriculture, Fisheries and Forestry

# *Liriomyza sativae* (vegetable leafminer)

Fiona Macbeth
Manager Emergency Response Coordination
OCPPO

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# *Liriomyza sativae* Blanchard 1938

*Agromyza subpusilla* Frost 1943
*Liriomyza verbenicola* Hering 1951
*Liriomyza pullata* Frick 1952
*Liriomyza canomarginis* Frick 1952
*Liriomyza minutiseta* Frick 1952
*Liriomyza propepusilla* Frost 1954
*Liriomyza munda* Frick 1957
*Liriomyza guytona* Freeman 1958
*Lemurimyza lycopersicae* Pla & de la Cruz 1981

**Common names:**
vegetable leafminer, American leafminer, chrysanthemum leafminer, serpentine vegetable leafminer, melon leafminer



## Distribution

**Asia:** China, India, Indonesia, Iran, Israel, Japan, Jordan, Malaysia, Oman, Philippines, Saudi Arabia, Sri Lanka, Thailand, Timor Leste, Turkey, Uzbekistan, Vietnam, Yemen

**Europe:** Estonia, Finland, United Kingdom

**Africa:** Cameroon, Egypt, Nigeria, South Africa, Sudan, Zimbabwe
**North America:** Canada, Mexico, USA

**Central America:** Bahamas, Barbados, Costa Rica, Cuba, Dominica, Dominican Republic, Guadeloupe, Guatemala, Honduras, Jamaica, Martinique, Montserrat, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Trinidad and Tobago

**South America:** Argentina, Brazil, Chile, Colombia, French Guiana, Peru, Venezuela

**Oceania:** American Samoa, Cook Islands, Federated States of Micronesia, French Polynesia, Guam, New Caledonia, Northern Mariana Islands, Samoa, Vanuatu

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## *Liriomyza sativae*

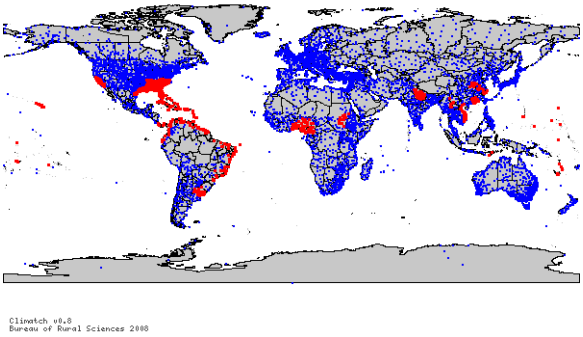
Discovered on Warraber in mid 2008, currently on three islands in the Torres Strait

## Host Range

*Liriomyza sativae* is a polyphagous pest of many vegetable and flower crops (Spencer 1973, 1990). It has been recorded from nine plant families, although its preferred hosts tend to be in the Cucurbitaceae, Fabaceae and Solanaceae.

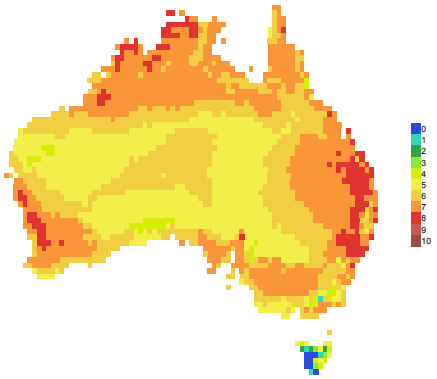
# Climate analysis

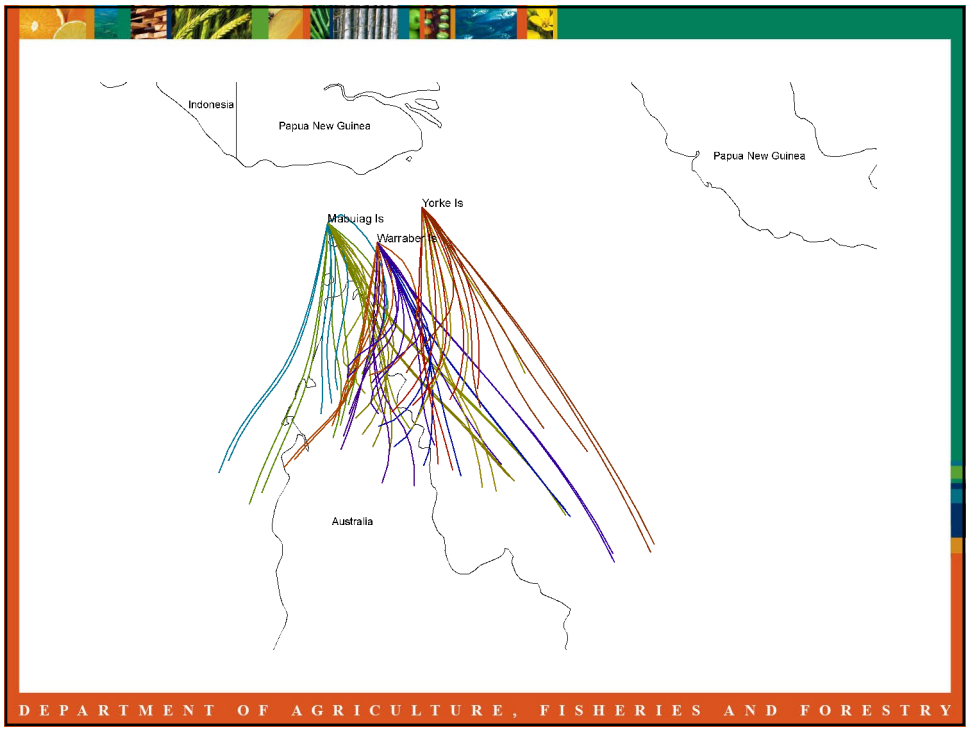
**Climatch analysis for *Liriomyza sativae* using BRS developed application**
**Input met stations coarsely derived from EPPO distribution map and filtered for extremes of altitude (> 2000m), temperature (<-2 C minimum monthly temp) and rainfall (<250mm annual rainfall)**






# Areas of similarity to input met stations (Highest match dark red).



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## Control

Insecticide control results in a higher rate of damage and a lower percentage of parasitism (Thang 1999)

Best control options are enhancement of indigenous natural enemies

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## Torres Strait Program

Potential for removal of preferred host (Castor oil plant)

Potential for survey of parasitoids

No over-winter reservoir will favour control of the population

Potential to contain in the national interest

# Emergency Management Procedures under the Emergency Plant Pest Response Deed

Fiona Macbeth
Manager
Emergency Response Coordination
Office of the Chief Plant Protection Officer
DAFF

## Emergency Plant Pest Response Deed (Cost-Sharing Deed)

- In October 2005 the Emergency Plant Pest Response Deed was activated.
- The Deed has been signed by all State and Territory Governments and several peak industry organisations.
- The Deed allows for owner reimbursement costs and ensures that growers affected by an incursion will neither lose or benefit as a consequence of an emergency response.
- The Deed facilitates shared responsibility, industry is part of the decision making process and contributes to the cost of an eradication program.

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## Emergency Management under the Emergency Plant Pest Response Deed (Cost-sharing Deed)

**Legal obligations under the Deed apply to all government employees, not just those working in biosecurity programs.**

**Signatories to the Deed have a legal requirement to notify their CPHM of a reasonably held suspicion within 24 hours – this is usually before the ID is confirmed.**

**The Australian Chief Plant Protection Officer will hold a meeting of the Consultative Committee on Emergency Plant Pests (CCEPP) usually when the ID is confirmed.**

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## Committees under the Emergency Management under the Emergency Plant Pest Response Deed (Cost-Sharing Deed)

**Consultative Committee on Emergency Plant Pests (CCEPP)**

-consists of all state and territory Chief Plant Health Managers and the affected industry and chaired by the Australian CPPO

-presents proposed response plan and provides technical advice to the NMG on

**National Management Group (NMG)**

-consists of all state and territory Heads of Department of Primary Industries and the affected industry and chaired by the Secretary of DAFF.

- Accepts or rejects proposed advice and approves funding in principle.

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## Committees cont.

**Scientific Advisory Panel (SAP)**

-consists of technical specialists relevant to the incursion, may include overseas experts if required.

-is a subcommittee of CCEPP and convenes at the request of CCEPP

CCEPP sets specific questions for the SAP who make recommendations back to the CCEPP

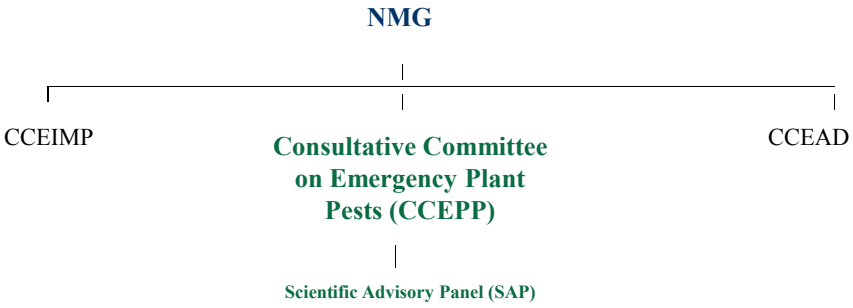
**Surveillance Reference Group (SRG)**

-a subcommittee of Plant Health Committee

-consists of technical and policy specialists relevant to plant health surveillance

-provides assistance to CCEPP in the same way the SAP does

## Institutional Arrangements under the Deed



## Emergency Response is a step-wise process

**After notification to OCPPO:**

**The CCEPP will determine:**

**Is the Pest and Emergency Plant Pest as defined by the deed?**

**If yes – Is it technically feasible to eradicate the new EPP?**

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## Factors to Consider - Technical Feasibility and CBA

**Distribution**
-distribution and abundance of pest and host and/or vector
**Epidemiology**
Lifecycle
Spread
**Survival**
-capacity of pest to survive undetected
-susceptibility to treatment or destruction
**The law**
**National arrangements / agreements / standards/ plans**
accessibility of pest eg urban/rural/heritage listed
**The human impact on epidemiology**
-movement controls
**Market access (domestic and international)**
**CBA**
**Delivery**

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## Contingency Plan

- Provides the science, biology, background, global distribution of the pest.
- Allows for planning and consideration of operational requirements such as screening, delimiting surveillance and quarantine zones.
- Advises on destruction and suppression techniques .
- Provides a source of material to write initial briefing to stakeholders.
- Provides guidance only.

## Response plan

- Defines a set of agreed actions that will lead to eradication.
- Defines the cost of the actions.
- Identifies risks and triggers for review of the program.

## Emergency Management

- Emergency Plant Pest Response Deed
- PlantPlan
- Response Plan – set of agreed, cost-shared actions
- Consultative Committee on Emergency Plant Pests
- National Management Group
- International cooperation and collaboration

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Australian Government
Department of Agriculture, Fisheries and Forestry

# A pest risk analysis for "*Candidatus* Liberibacter psyllaurous" and its vector, the tomato-potato psyllid

***Plant Biosecurity – Biosecurity Services Group***



**June 2008:**

**-NZ informs of the detection of an undescribed bacterium affecting tomatoes and capsicums.**

**-NZ stops issuing phytosanitary certificates.**

**-Australia imposes emergency measures, prohibiting the importation of solanaceous fruit and nursery stock from NZ and commences a risk analysis.**

**November 2008:**

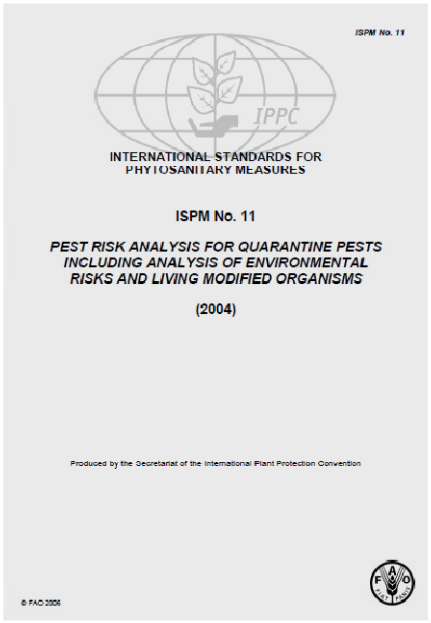
**-NZ publishes voluntary 'Code of Practice' for the management of tomato/potato psyllids in glasshouses.**

**December 2008:**

**-Australia amends conditions to permit glasshouse tomatoes and capsicums from NZ, subject to control measures and mandatory methyl bromide fumigation. Other solanaceous fruit remain prohibited.**

## Stages of a pest risk analysis:

1. Initiation
2. Pest categorisation
3. Assessment of the probability of entry, establishment and spread
4. Assessment of potential consequences
5. Estimation of the unrestricted risk
6. Pest risk management


ISPM No. 11

IPPC

INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES

ISPM No. 11

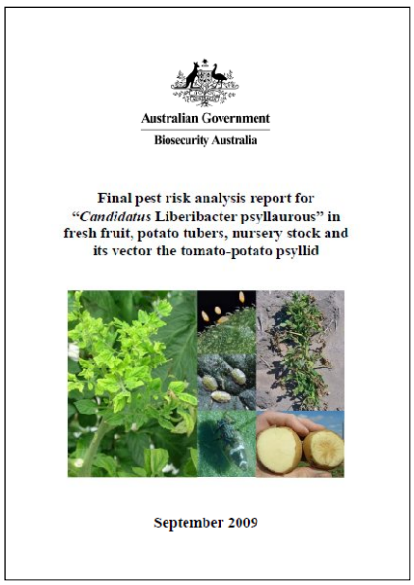
*PEST RISK ANALYSIS FOR QUARANTINE PESTS INCLUDING ANALYSIS OF ENVIRONMENTAL RISKS AND LIVING MODIFIED ORGANISMS*

(2004)

Produced by the Secretariat of the International Plant Protection Convention

© FAO 2006




Australian Government
Biosecurity Australia

Final pest risk analysis report for "*Candidatus* Liberibacter psyllaurous" in fresh fruit, potato tubers, nursery stock and its vector the tomato-potato psyllid



September 2009

**May 2009:**
**-Australia publishes draft PRA for "*Ca*. L. psyllaurous" and invites comments.**

**September 2009:**
**-Australia publishes final PRA for "*Ca*. L. psyllaurous"**

**October 2009:**
**-Mandatory methyl bromide fumigation is lifted for NZ loose tomatoes. Other solanaceous fruit from NZ are allowed for importation if fumigated with methyl bromide.**

http://www.daff.gov.au/__data/assets/pdf_file/0008/1258271/Final_PRA_for_Candidatus_Liberibacter_psyllaurous_and_its_vectors.pdf

**Pest:** "*Candidatus* Liberibacter psyllaurous"
(syn. "*Candidatus* Liberibacter solanacearum")

**Disease:** Psyllid yellows, zebra chip

**Vector:** *Bactericera cockerelli*
(tomato/potato psyllid)

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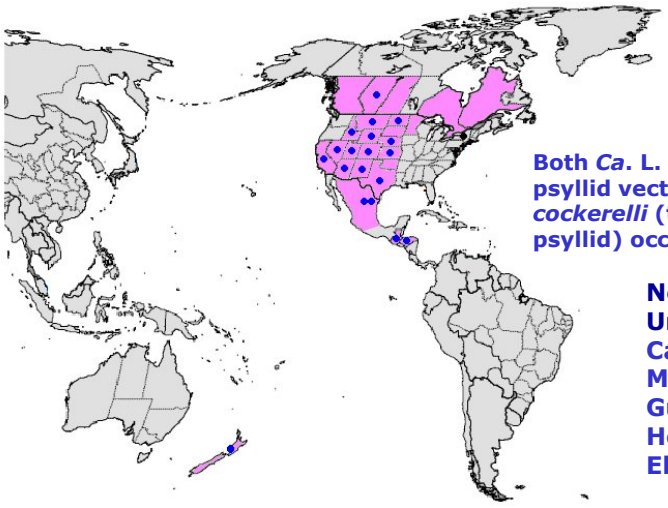
## Worldwide distribution of psyllid yellows/zebra chip



Both *Ca*. L. psyllaurous and its psyllid vector, *Bactericera cockerelli* (the tomato/potato psyllid) occur in:

**New Zealand**
**United States**
**Canada**
**Mexico**
**Guatemala**
**Honduras**
**El Salvador**

• psyllid yellows/zebra chip

*Bactericera cockerelli*

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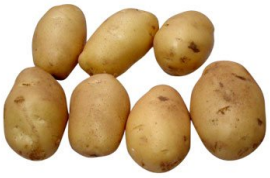
## Pathways for the introduction of "*Ca*. Liberibacter psyllaurous"

**Pathway 1**
**Fruit (including seed)**

**Pathway 2**
**Potato tubers**



**Pathway 3**
**Nursery stock**

**Pathway 4**
**Tomato/potato psyllid**

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## Pathway 1: Fruit (including seed)

**In the absence of a vector:**

- **The bacterium cannot be transmitted from a fruit to a new host.**

- **The bacterium is not transmitted by seed.**

- **The risk associated with fruit alone is NEGLIGIBLE, i.e. it satisfies Australia's ALOP.**

**NB: Tomato/potato psyllids can transmit the bacterium from fruit (e.g. tomato). If Australia acquires the vector, the risk associated with fruit needs to be re-assessed.**

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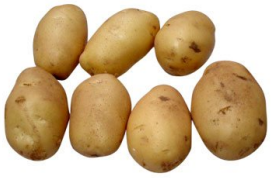
## Pathway 2: Potato tubers

- The psyllid vector does not occur on tubers.

- An infected tuber could grow into an infected plant.

- Infected plants have reduced vitality but are viable.

- The risk associated with potato tubers is **LOW**, i.e. it exceeds Australia's ALOP.



**Risk mitigation:**

- Importation from pest-free areas.
- Processing in quarantine approved premises.

**NB: Currently, importation of fresh potatoes into Australia is prohibited. NZ has requested access to Australia for fresh potatoes for processing.**



## Pathway 3: Nursery stock

**In the absence of a vector:**

- Infected nursery stock could grow into an infected plant.

- Infected plants have reduced vitality.

- The risk associated with nursery stock is **MODERATE**, i.e. it exceeds Australia's ALOP.

**Risk mitigation:**

- Importation from pest-free areas.
- Post-entry quarantine and testing. PCR-based tests are available.

## Pathway 4: Tomato/potato psyllid

**Tomato/potato psyllids may arrive on**

- fresh fruit
- nursery stock.

**They are likely to**

- carry "*Ca*. L. psyllaurous"
- transmit the bacterium to hosts in Australia
- establish a population.

**The risk associated with psyllids is HIGH, i.e. it exceeds Australia's ALOP.**

**Risk mitigation:**

- Importation from pest-free areas.
- Systems approach for fruit using pre- and post-harvest measures.
- Treatment of fruit and nursery stock



## Importation of fresh fruit under a systems approach

**At present, Australia recognises the "New Zealand Psyllid Code".**

**The code combines greenhouse measures with washing and brushing in the packing house, which removes any psyllids.**

**These measures are accepted for loose tomatoes.**

New Zealand Code of Practice
for the Management of
the Tomato/Potato Psyllid
in Greenhouse Tomato and Capsicum Crops

Published by: Horticulture NZ's Fresh Tomato and Fresh Vegetable Product Groups

Prepared by:
Bioforce Limited
P.O. Box 73
Drury 2247
New Zealand

Market Access Solutionz Ltd
PO Box 10629
Wellington

Horticulture NZ
PO Box 10232
Wellington

1st Edition
4 November 2008

## Importation of fresh fruit under a systems approach

**Australia does not accept the measures under the NZ psyllid code for:**

Capsicums

Truss tomatoes

**Washing and brushing may not completely remove psyllids from around the calyces and stems of these fruit.**

DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY

## Importation of fresh fruit under a systems approach

**Presently, there is no accepted psyllid code for field-grown fruit such as:**

Tamarillos

Cape gooseberries

Tomatillos

**Imported truss tomatoes, capsicums, tamarillos, tomatillos, cape gooseberries and other solanaceous fruit must be treated to kill the psyllid, e.g. by methyl bromide fumigation.**

DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY

## Importation of nursery stock

Currently, all imports of nursery stock of members of the Solanaceae (excluding tissue cultures) must be fumigated with methyl bromide before post-entry quarantine.

This removes the psyllid risk attached to nursery stock.

The risk associated with the bacterium is addressed during post-entry quarantine.

DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY

## Future directions

Watch for:

-the spread of *Bactericera cockerelli* and "*Candidatus* Liberibacter psyllaurous" overseas

-identification of new vectors for the bacterium

-acceptable treatments for *Bactericera cockerelli*

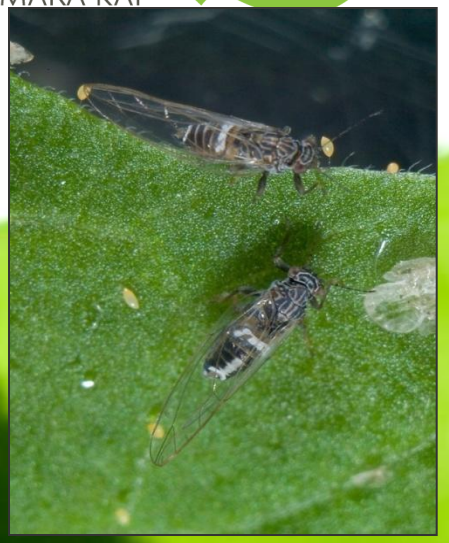
-interactions with other pathogens, such as "*Candidatus* Phytoplasma australiense".

DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY

Horticulture™ New Zealand

The New Zealand Institute for Plant & Food Research Limited

Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI



# Tomato Potato Monitoring Update

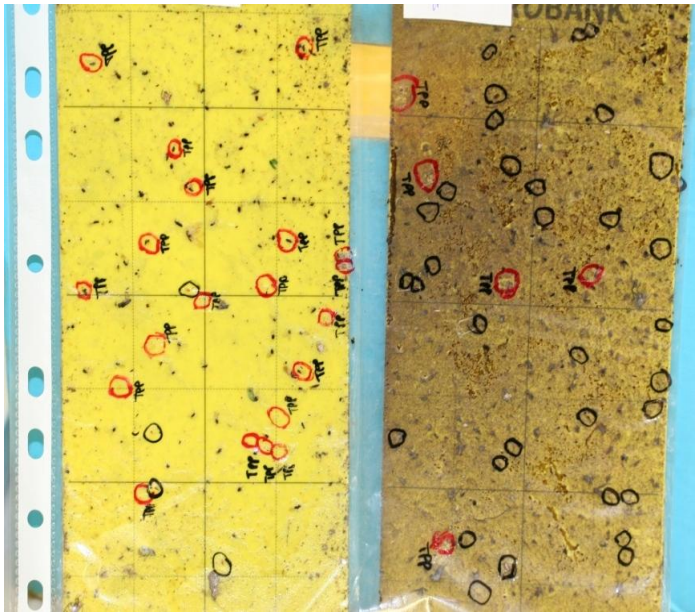
## Sustainable TPP Management SFF

**Dr Nadine Berry**
**Plant & Food Research**

# Method Summary

- Weekly monitoring using yellow sticky traps
  - Mid October 2009-April 2010
  - TPP and ‘other’ exotic & native psyllid species

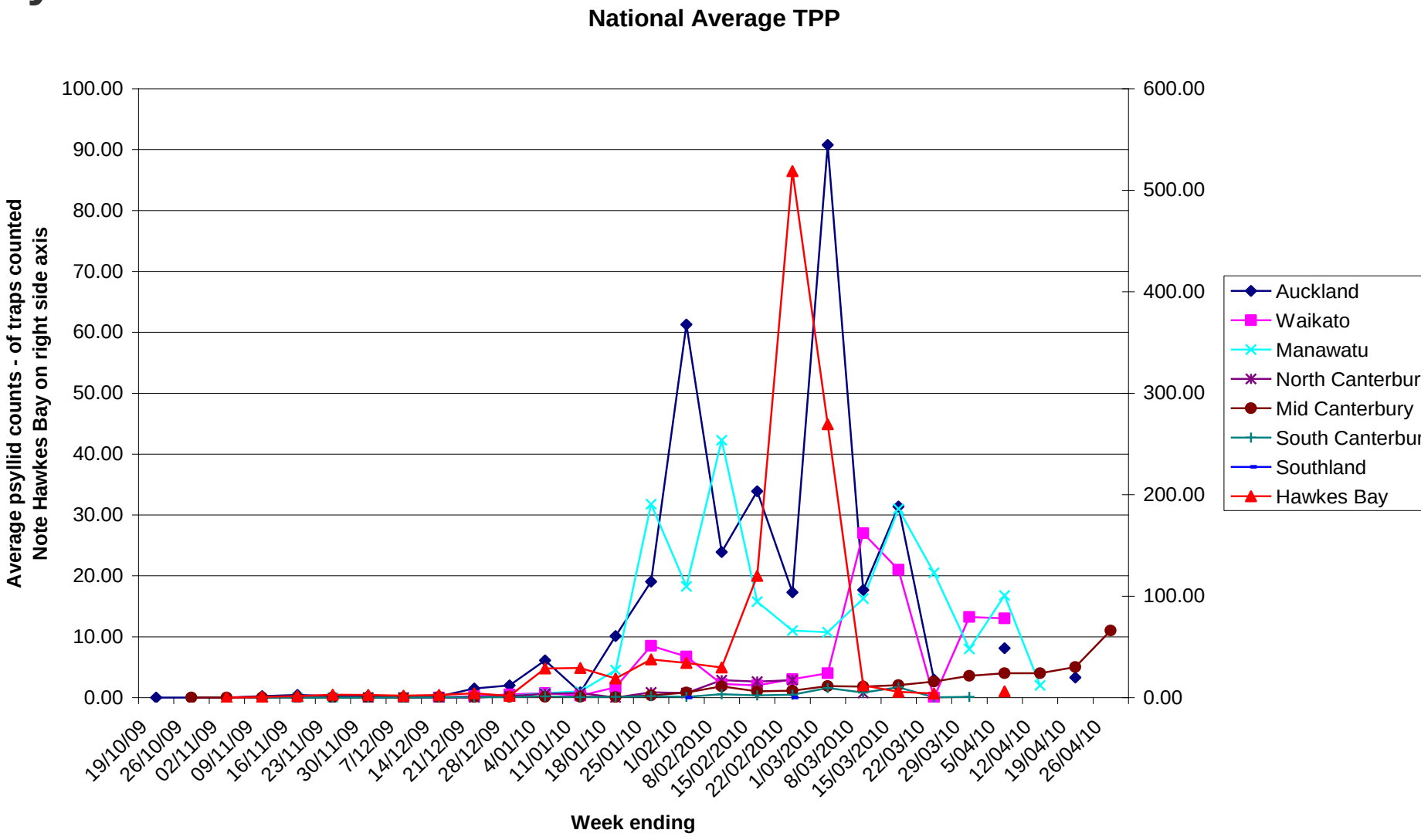
- Commercial potato, field tomato and tamarillo sites



# Monitoring Locations 2009-2010

| Region | Crop | Site No. | Funding/Participation |
|---|---|---|---|
| North Auckland | Tamarillos | 6 | A: SFF<br>B-F: Craig Watson |
| Auckland | Potatoes | 2 | SFF |
| Manawatu | Potatoes | 1 | SFF (Fruitfed Services) |
| Waikato | Potatoes | 1 | SFF (Wilcox Bros) |
| Hawkes Bay | Field Tomatoes | 2 | SFF (Heinz Watties) |
| Hawkes Bay | Potatoes | 1 | SFF (Fruitfed Srvices) |
| North Canterbury | Potatoes | 2 | A: SFF (EuroGrow Potatoes Ltd.)<br>B: SFF (McCains) |
| Mid Canterbury | Potatoes | 21 | A,B,C: Plant & Food Research<br>D-S,U,W: McCains<br>T,V: EuroGrow Potatoes Ltd. |
| South Canterbury | Potatoes | 13 | A-J,M: McCains<br>K,L: EuroGrow Potaotes Ltd. |

# National Average – note second y axis on right Hawkes Bay only

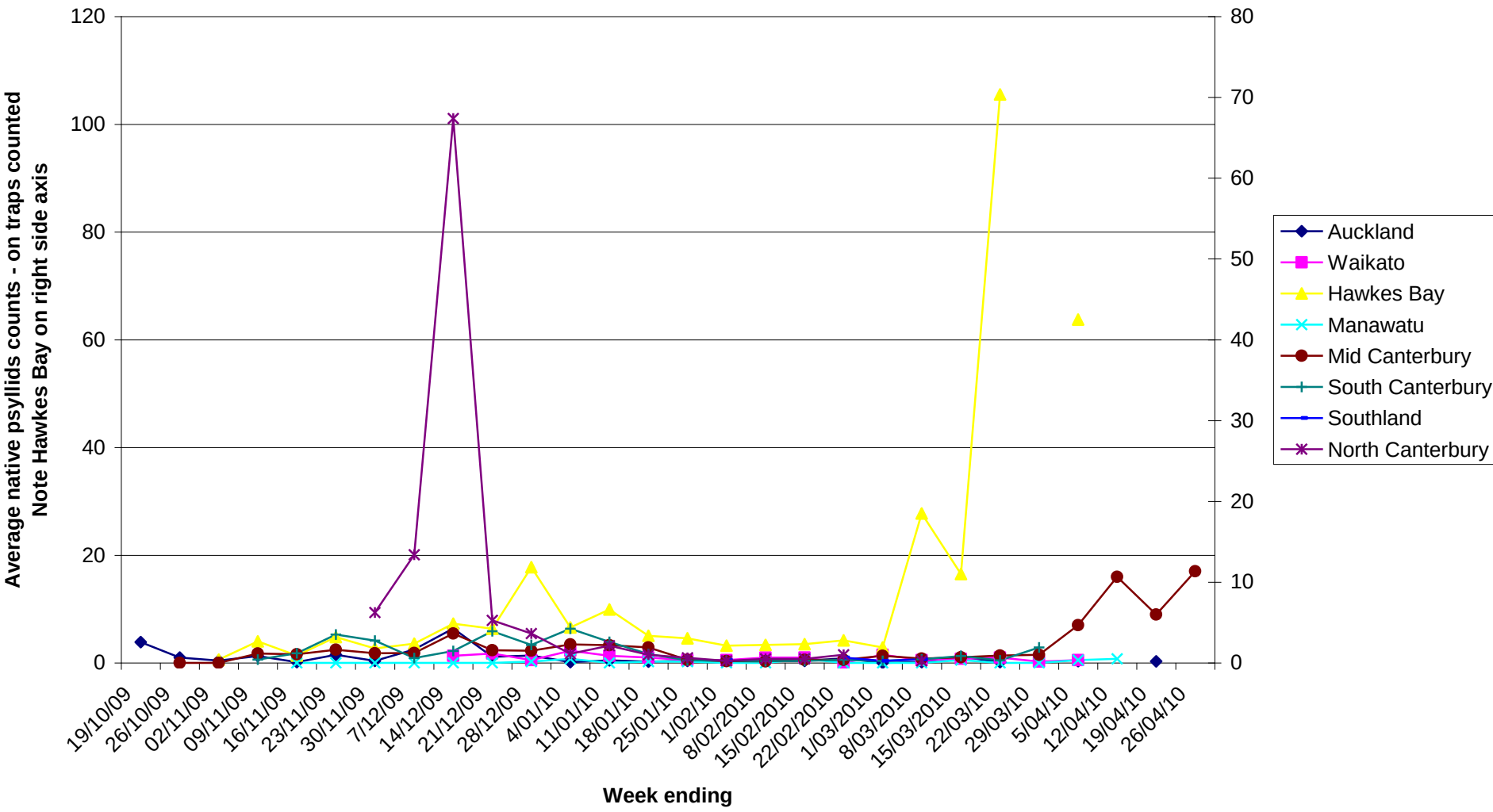


# National Monitoring Summary

## TPP

- TPP numbers rise significantly in early January and decline by early April in most regions.
- Higher TPP numbers in North Island (esp. Hawkes Bay and Auckland regions)
- Mid Canterbury TPP numbers appeared earlier and rose significantly in comparison to 2008-2009 season.
- TPP numbers low in South Canterbury region.
- TPP found in Southland region (1 specimen in non solanaceous crop)
- TPP numbers are highly variable between sites and regions.

## National Average Native Psyllid Numbers



# National Monitoring Summary

## ‘Other’ Exotic & Native Psyllids

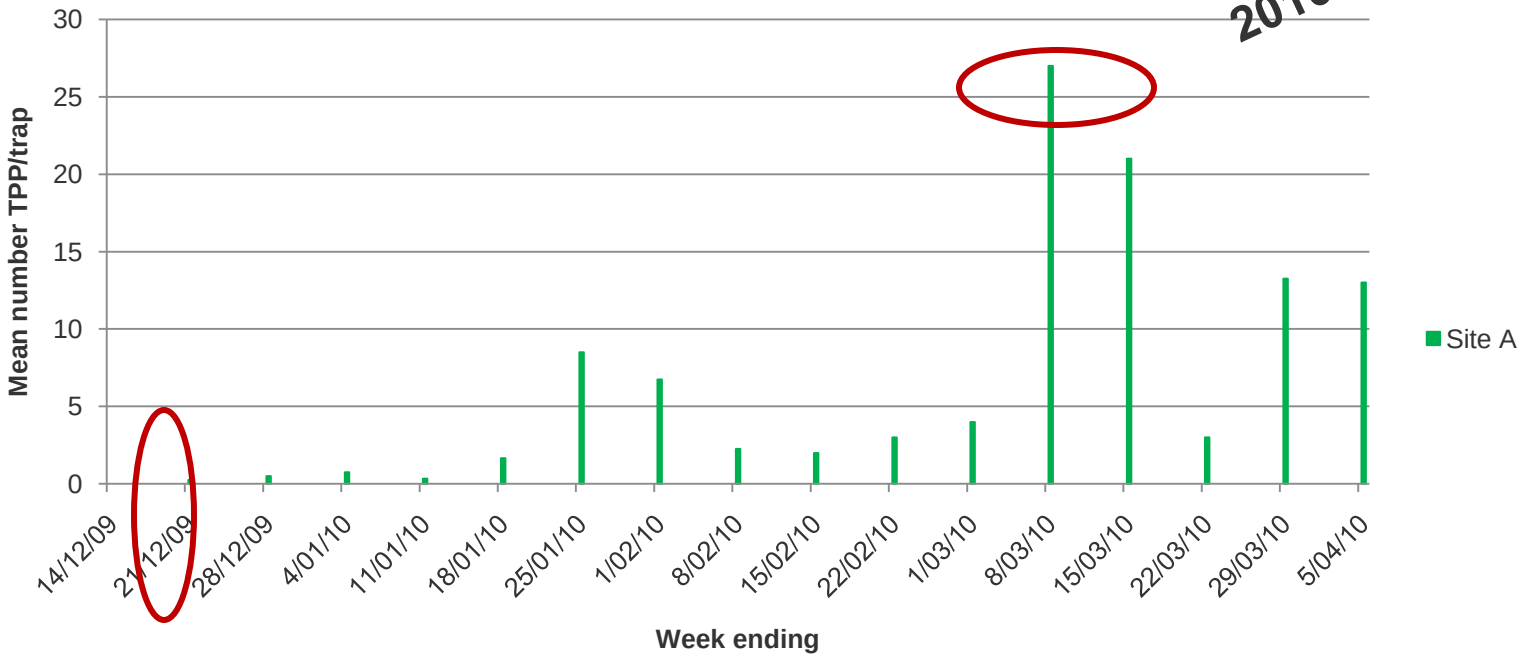
- “Other” psyllid numbers are highly variable between sites and regions.

- Higher “other” psyllid numbers in Hawkes Bay, Auckland and Manawatu regions.

- “Other” psyllid numbers rise in mid December, fall again by mid January and rise again toward the end of March.

# Regional Monitoring Summaries:

## Waikato 2009-2010

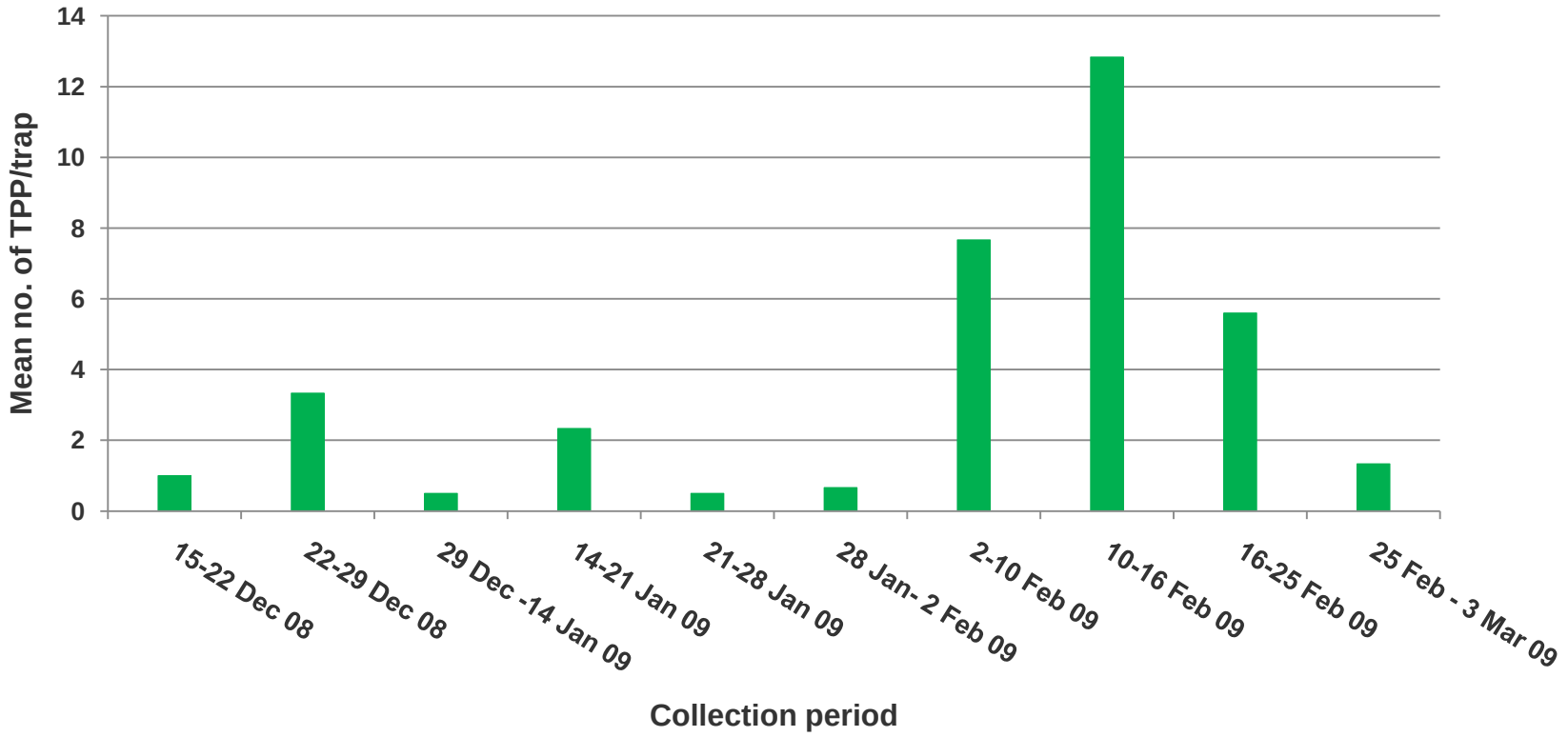



Early March 2010

End Dec 2009

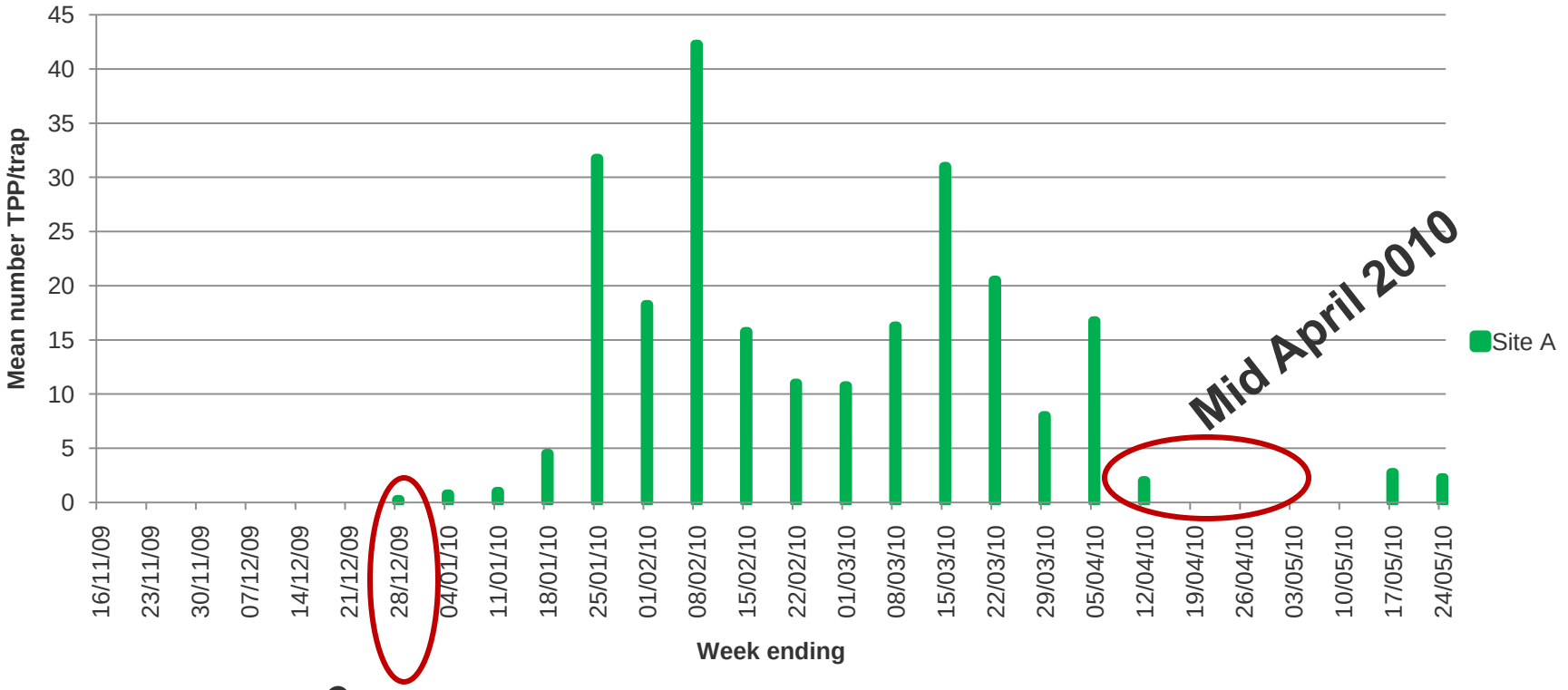
- 1 site only
- TPP numbers relatively low

# Waikato 2008-2009



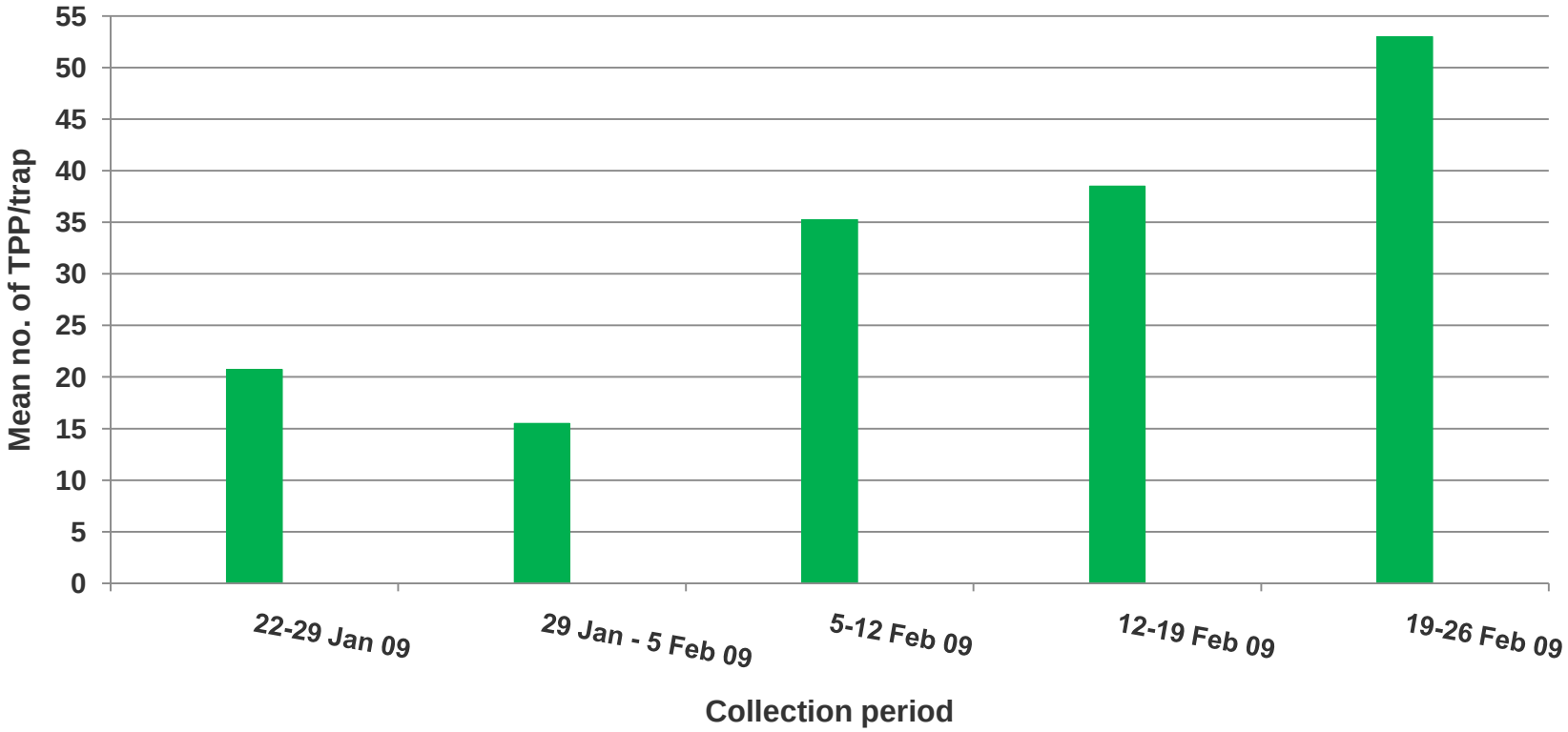
# Regional Monitoring Summaries:

## Manawatu 2009-2010




➢1 site only

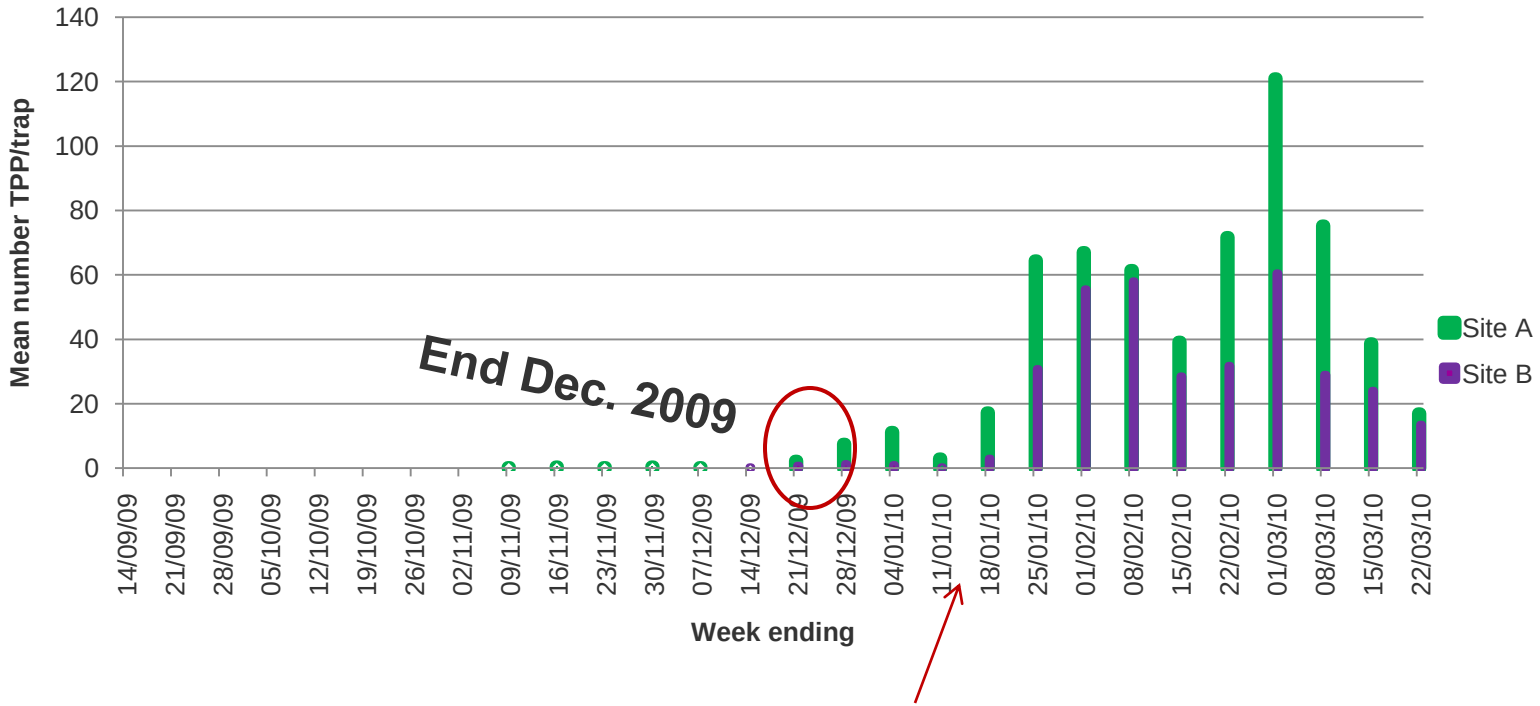
# Manawatu 2008-2009



# Regional Monitoring Summaries:

## Auckland 2009-2010

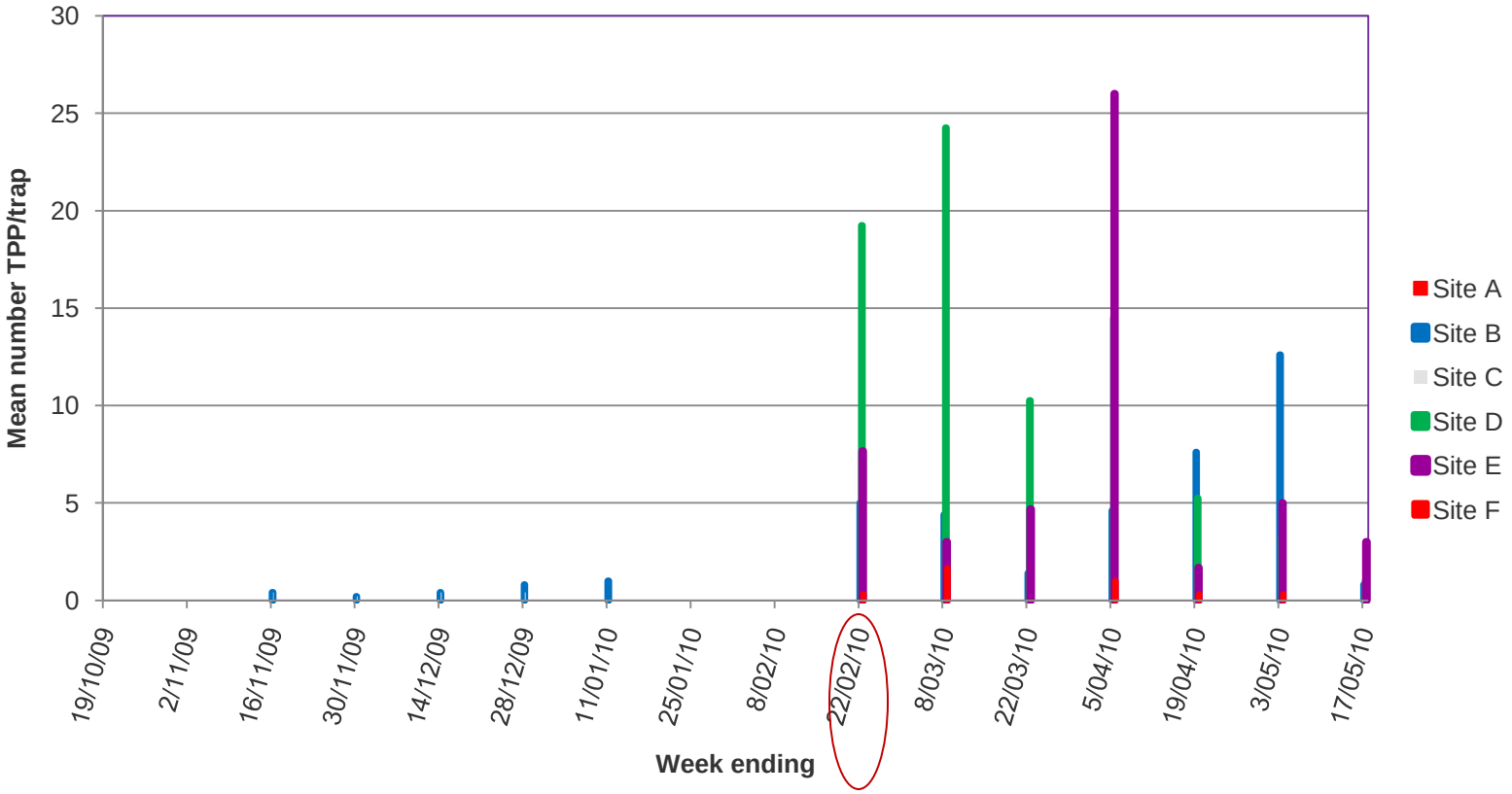
Pukekohe A, B = Potatoes



# Regional Monitoring Summaries:

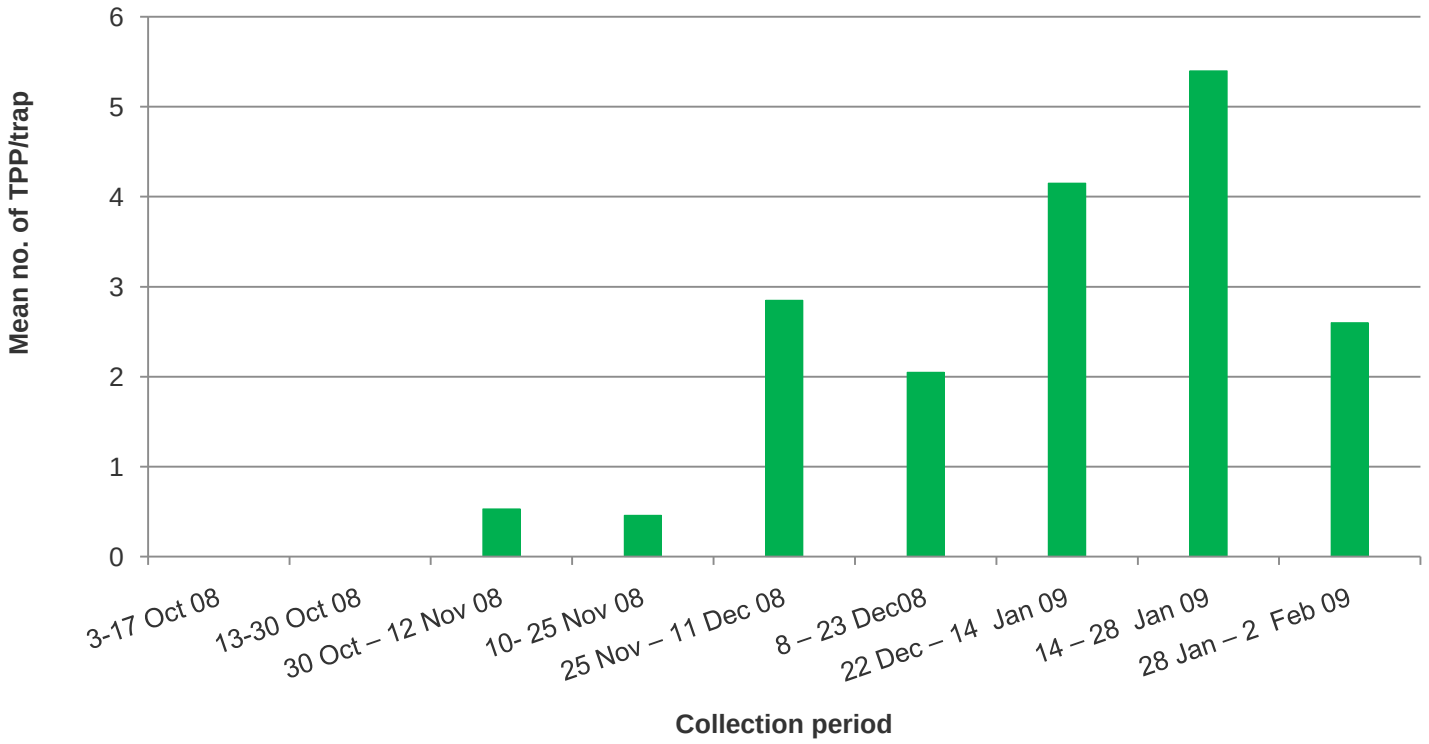
## Auckland 2009-2010

North Auckland A-F = 6 sites in Tamarillo Orchard



# Auckland 2008-2009

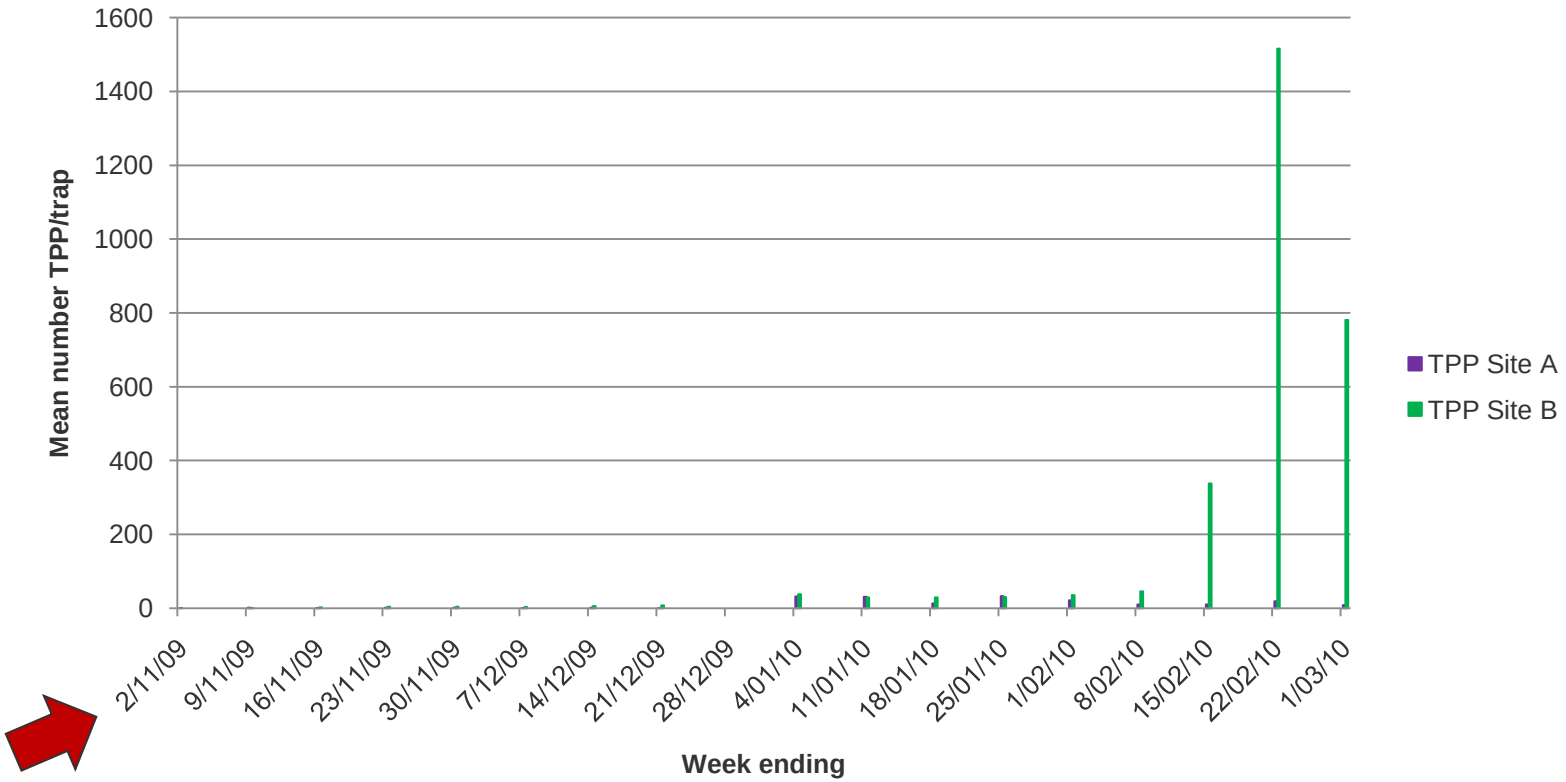
*Variable trap and site number*



# Regional Monitoring Summaries:

## Hawkes Bay 2009-2010

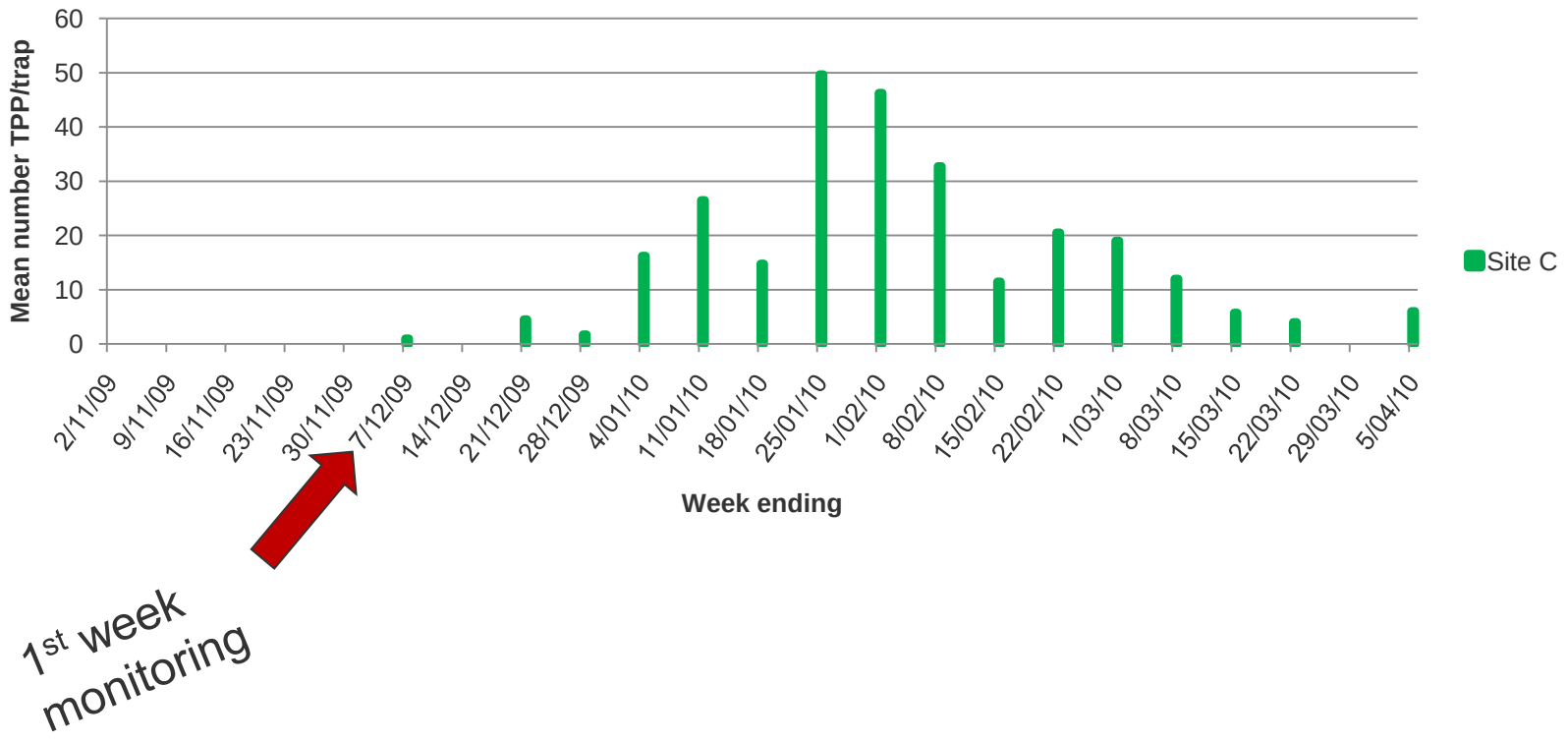
*Field Tomatoes*



# Regional Monitoring Summaries:

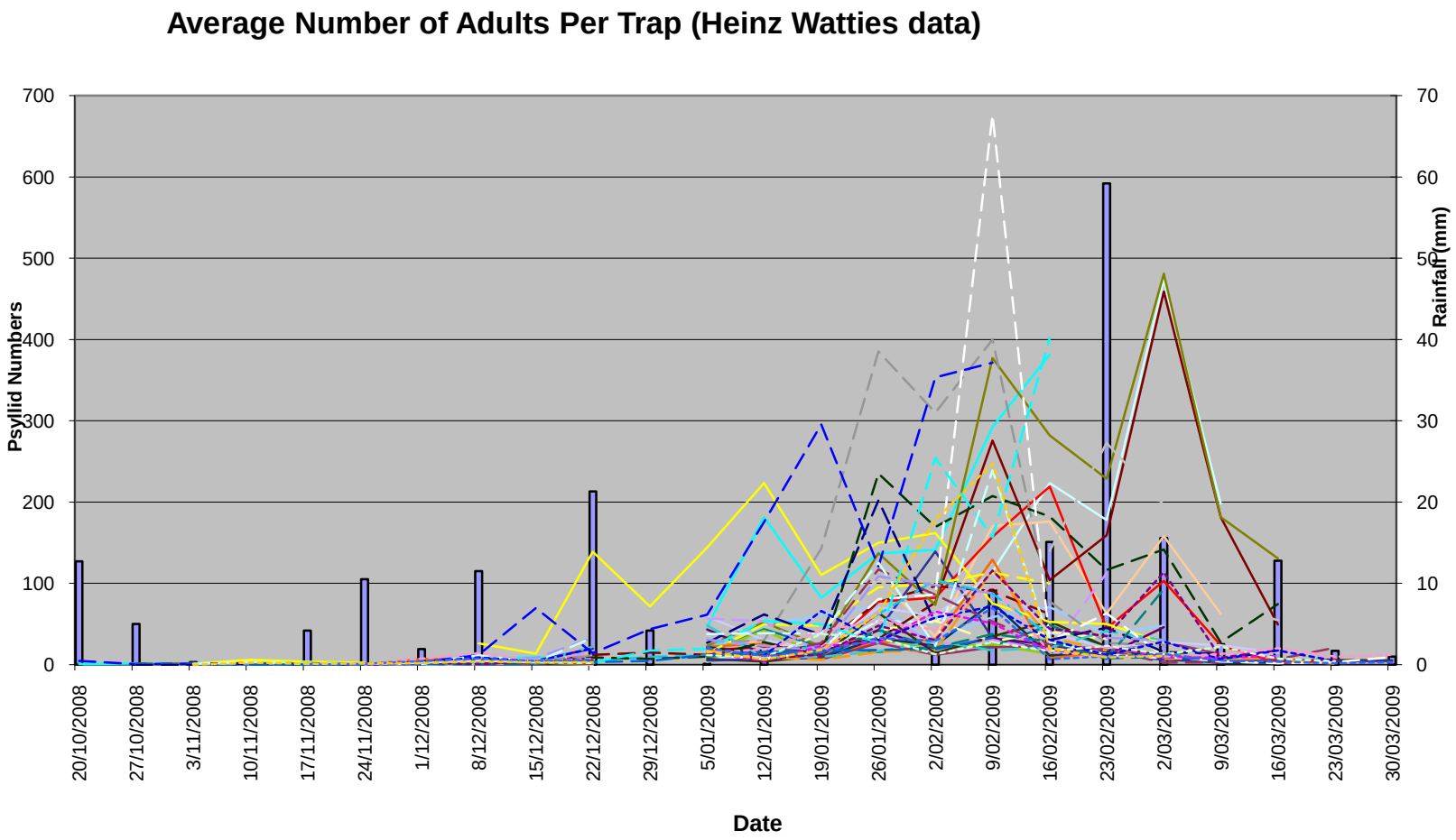
## Hawkes Bay 2009-2010

*Potatoes*



# Hawkes Bay 2008-2009

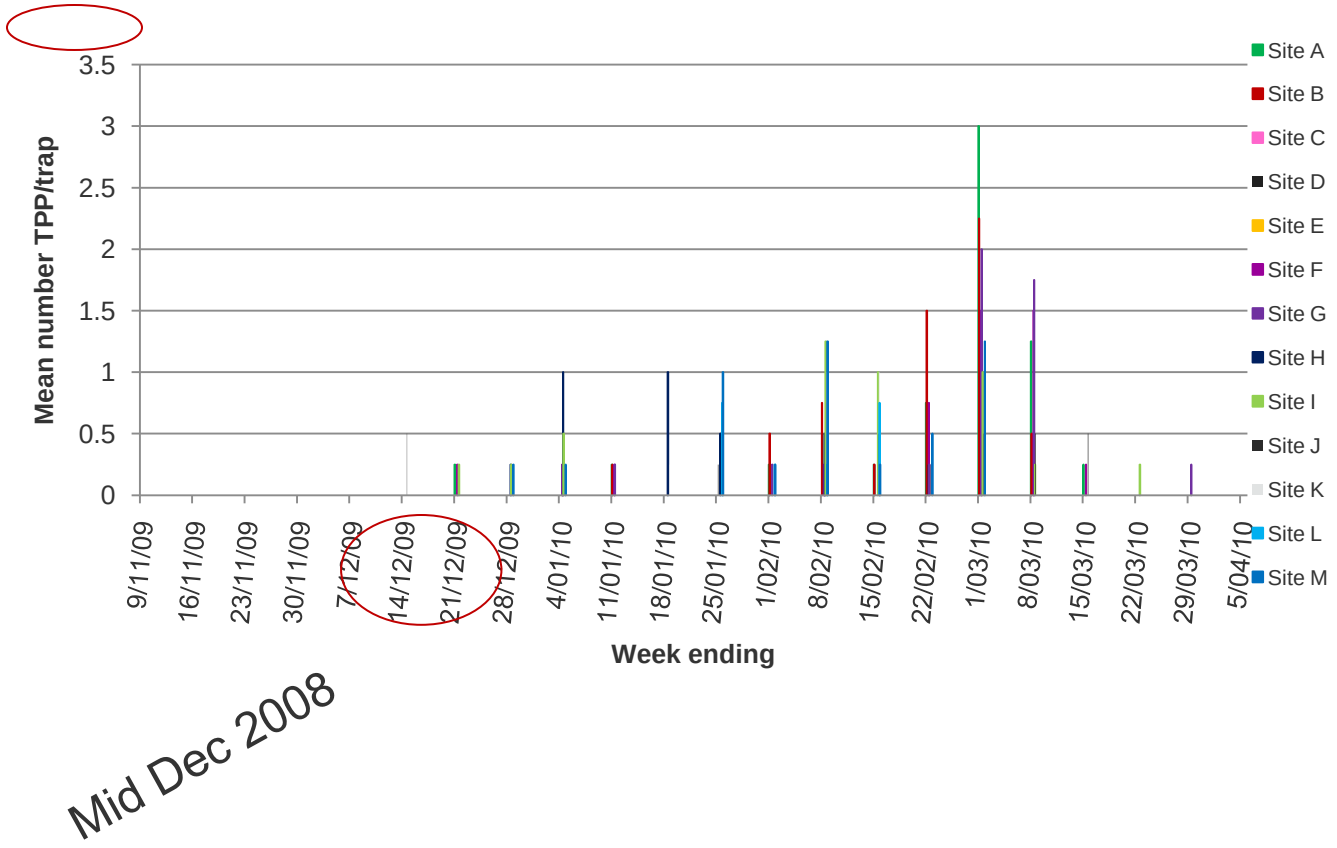
*Field Tomatoes*



# Regional Monitoring Summaries:

## South Canterbury 2009-2010

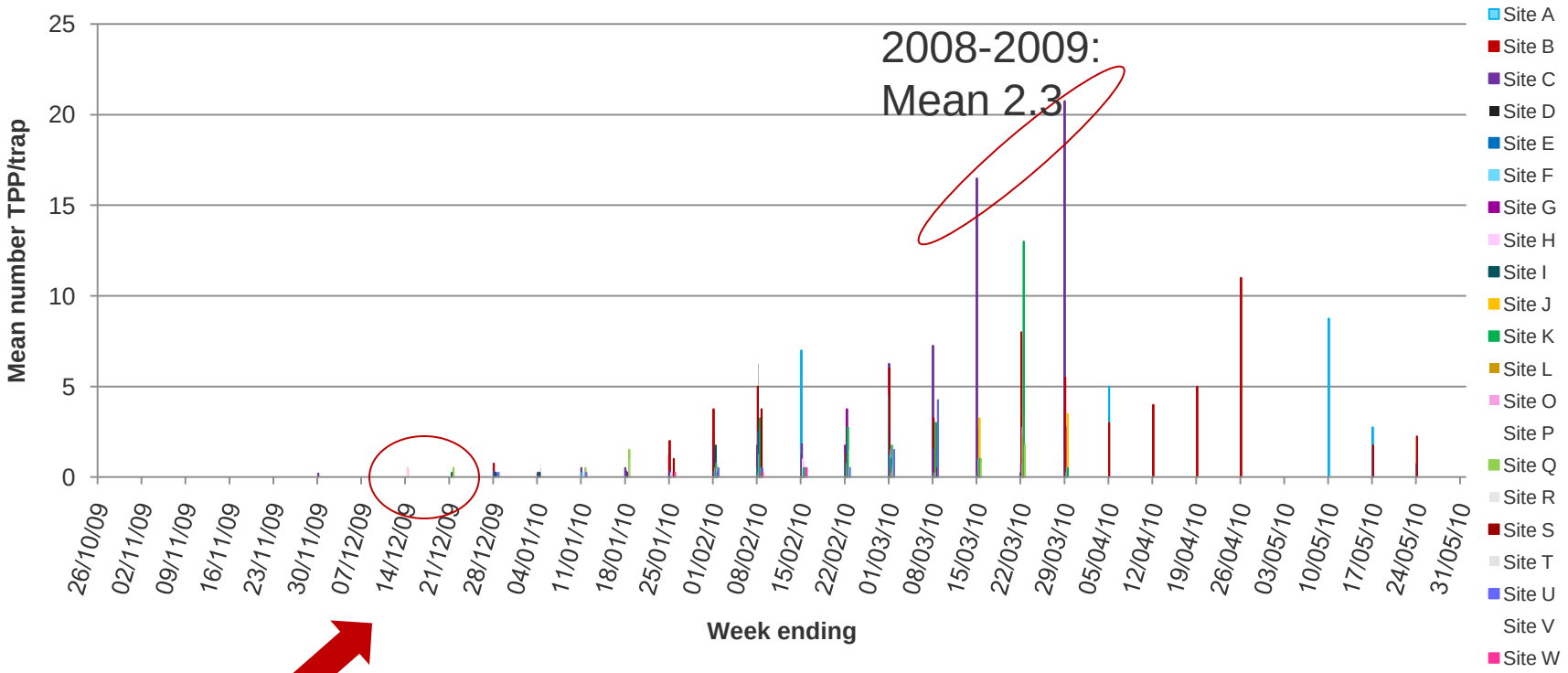
*Sites A-M (Potatoes)*



# Regional Monitoring Summaries:

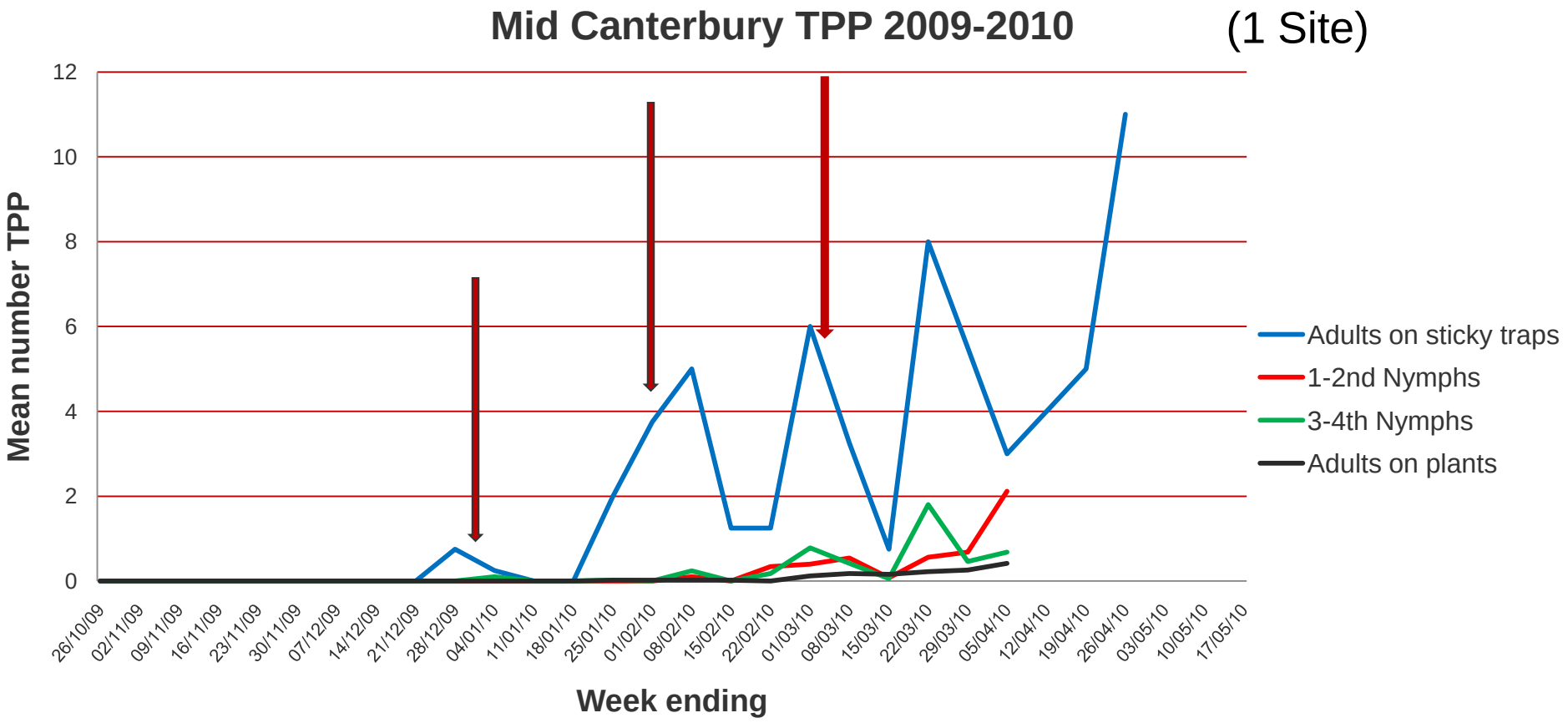
## Mid Canterbury 2009-2010

*Sites A-W (Potatoes)*

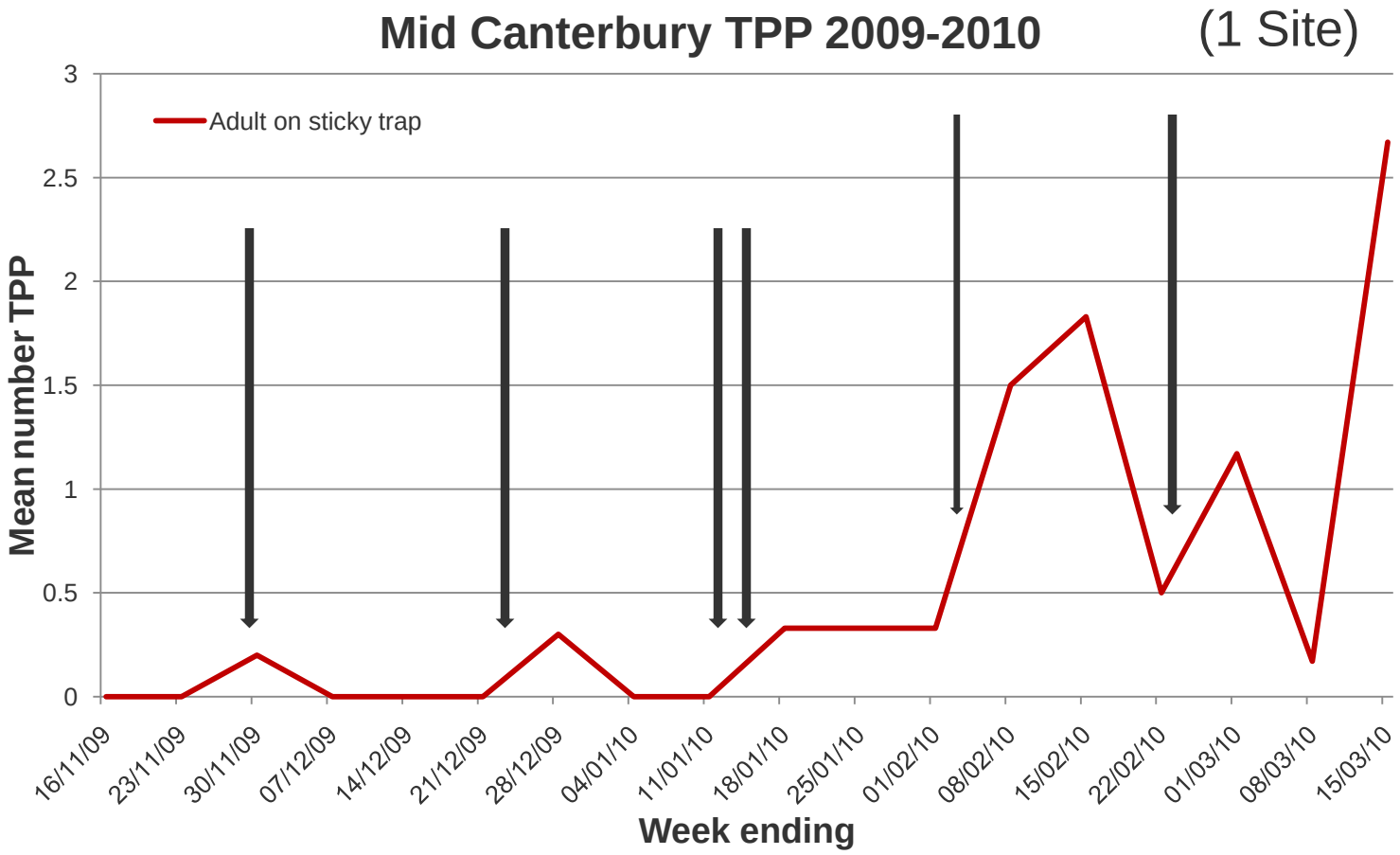



**Two months earlier than 2008-2009**

# TPP Trap and Plant Monitoring



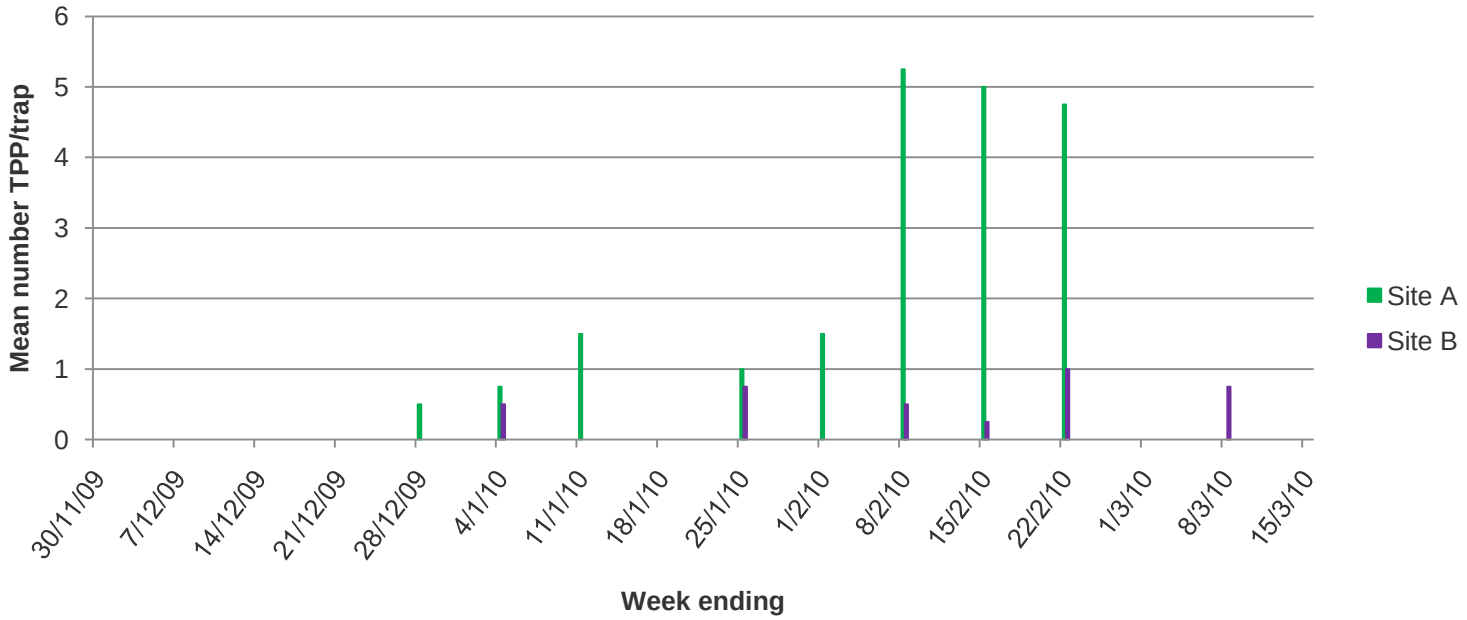
# TPP Trap and Plant Monitoring



# Regional Monitoring Summaries:

## North Canterbury 2009-2010

*Sites A,B (Potatoes)*



# Monitoring Update

- TPP found in Southland region (Early Feb)
- TPP numbers on sticky traps rose significantly January in the Hawkes Bay
- Mid-Late January:
  - TPP numbers increasing in other NZ growing regions
  - TPP/Liberibacter damage symptoms seen in crop
- Early Feb-:
  - Some positive Liberibacter tests/crop rejection

# Monitoring Objective Year 2: ?

- Continue as in Year 1? –
  - Consider: Highly variability between sites (as seen by Hawkes Bay and Canterbury (Large number of sites - McCains)

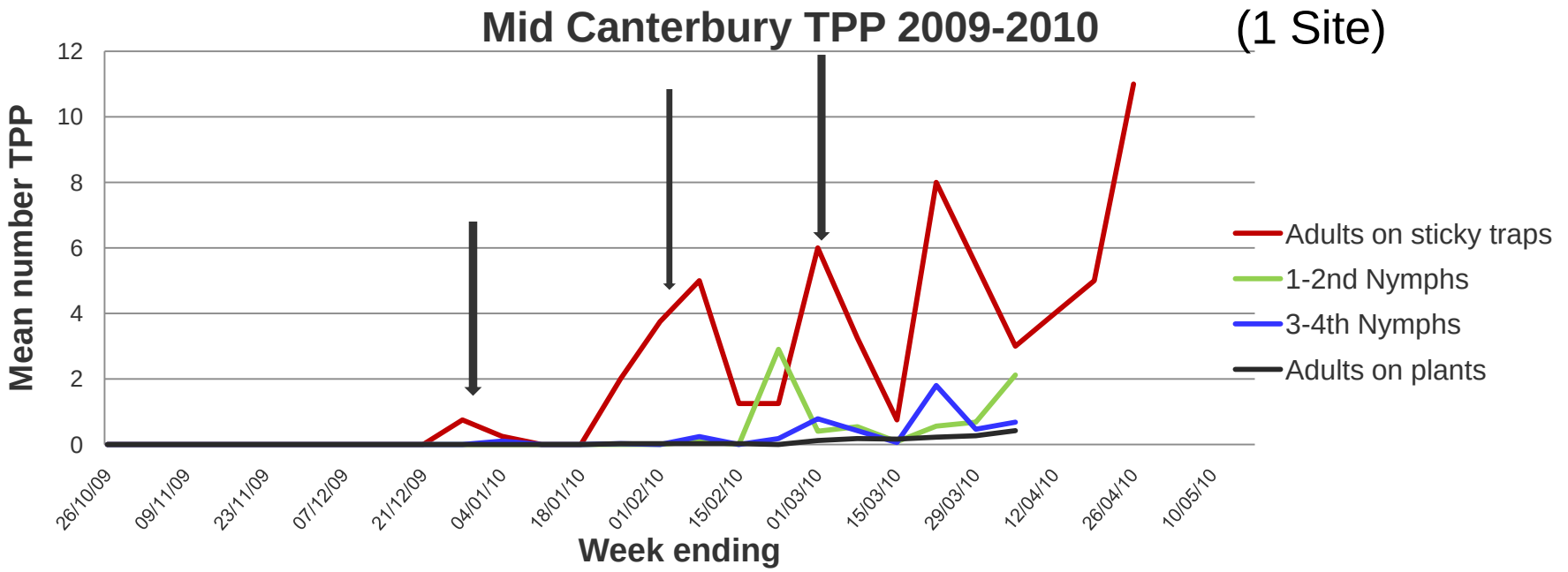
Current overwintering sites –

- Hawkes Bay – Heinz Watties
- Waikato – Plant & Food/Wilcox
- Pukekohe – HortiCentre
- Mid Canterbury –Plant & Food

- Correlation between sticky trap numbers and nymphal infestations? –
  - Only results from Pukekohe trial + 2 Canterbury sites monitored through Plant & Food Internal programme.

# TPP Trap and Plant Monitoring

TPP nymphal infestations in Mid Canterbury (Early Feb)

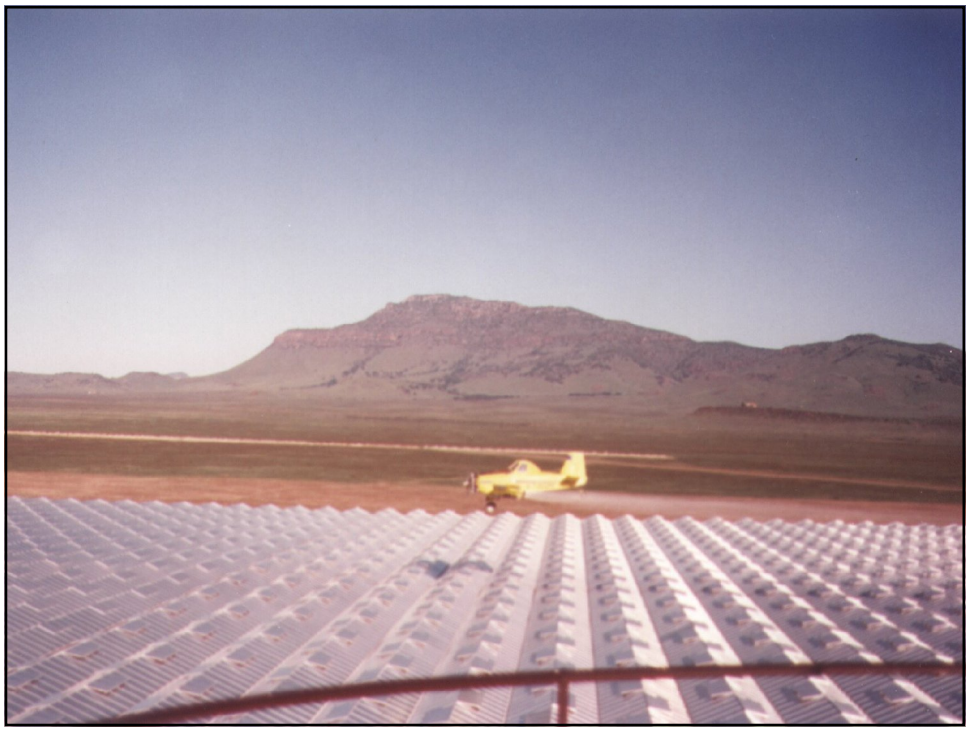


# Monitoring Objective Year 2: ? Cont.

- Currently carrying out retrospective analysis of 2009-2010 TPP on sticky traps to look at Liberibacter presence over the season.
- ➢ Helpful information in real time?
- ➢ Correlation between TPP adults/ +ve plant symptoms?

# Tomato Potato Psyllid

19-24th July 2010
Tasmanian Potato Growers & Industry Partners
Simplot Australia



## Key Points

- Overview of TPP development stages & lifecycle
- Overview of Liberibacter and transmission
- Monitoring
- Application Technology and Coverage
- Chemical trial data
- Review Chemical Groups – IRAC
- Potential Program – Using Groups
- Management of headlands & edge effect
- 2010 Plant & Food trial – nutrition & biostimulant effect

## Eggs & Nymphs

## Five (5) Nymph Instars

| Developmental Stage | Developmental time (d ± SE ) | |
|---|---|---|
| | Eggplant | Bell Pepper |
| **Egg** | **5.0 ± 0.1b** | **5.9 ± 0.1a** |
| **Nymph** | **19.1 ± 0.4b** | **20.2 ± 0.7a** |
| First instar | 5.0 ± 0.2b | 5.7 ± 0.3a |
| Second instar | 3.2 ± 0.1a | 3.1 ± 0.2a |
| Third instar | 3.1 ± 0.1a | 3.0 ± 0.2a |
| Fourth instar | 3.2 ± 0.1a | 3.1 ± 0.2a |
| Fifth instar | 4.7 ± 0.1b | 5.3 ± 0.2a |
| **Egg to Adult** @ 26.7ºC, 70%RH, 14:10 D/N | **24.1 ± 0.4b** | **26.2 ± 0.7a** |
| Preoviposition period (d) | 8.8 ± 0.7a | 8.0 ± 0.5a |
| Oviposition period (d) | 53.4 ± 4.8a | 47.0 ± 7.5a |
| Fecundity | 338 ± 61.4a | 403.6 ± 87.1a |

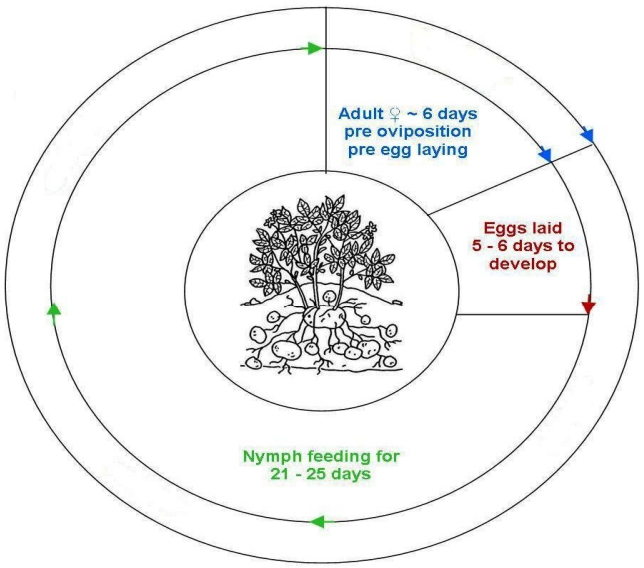
PLANT–INSECT INTERACTIONS

Life History and Life Tables of *Bactericera cockerelli* (Homoptera: *Psyllidae*) on Eggplant and Bell Pepper

XIANG-BING YANG[1,2] AND TONG-XIAN LIU[2,3]

Environ. Entomol. 38(6): 1661–1667 (2009)

## Tomato Potato Psyllid (TPP) Lifecycle

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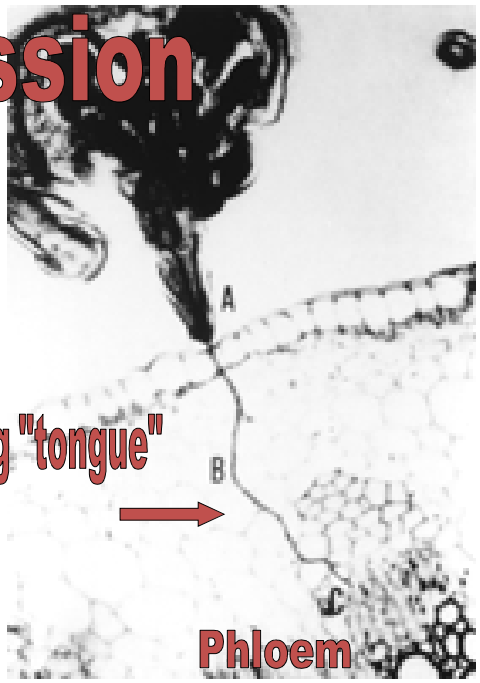
# Transmission

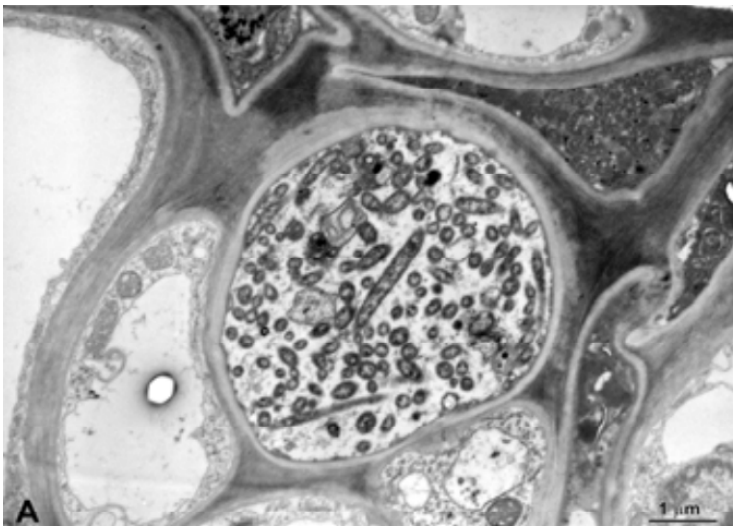
TPP Adult feeding




probing "tongue"

Phloem

## Liberibacter & Phloem cells




Source: Gary Secor, USDA

TPP on sticky traps

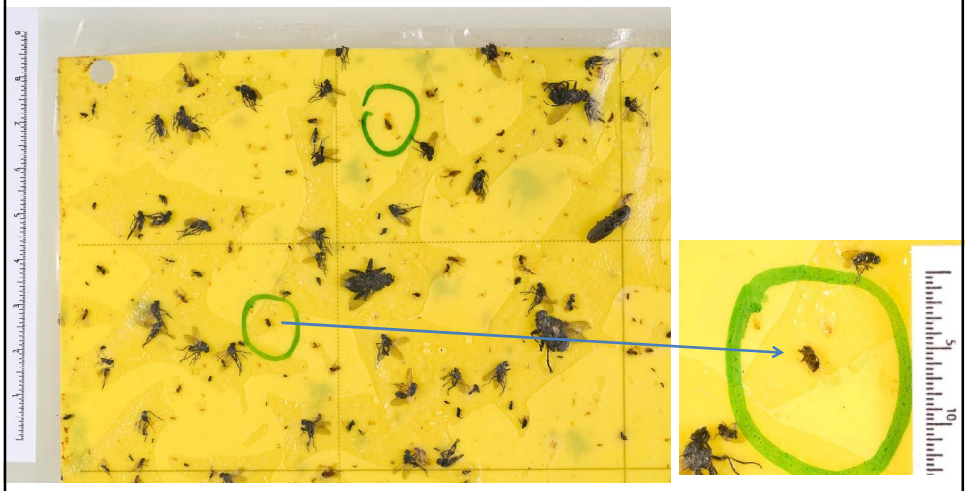
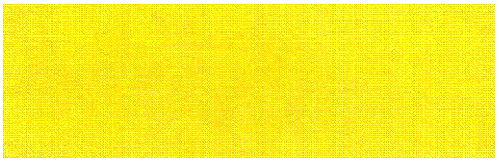


Photo by Dominic Hartnett, Plant & Food, 2009

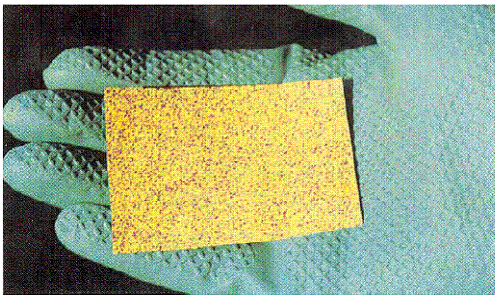
# Application technology

- Very difficult organism to target in mature crops
- Coverage is critical
- Highly effective knockdowns compromised
- Resistance risk very large
- Tank mix combinations – watch hydrolysis

# Coverage



*Water-sensitive paper before exposure to the spray.*



Water-sensitive paper after exposure.

# Physical Mode of Action Products

- Why consider these?
  - **Some high effective knockdown products like abamectin benefit significantly from them**.
  - Up to 500 eggs (on average) over 20-30 days.
  - Five nymphal instars 20 – 30 days (temp dependent) before winged adults.
  - Reduce photodegradation, Increase coverage &/or improved efficacy
- What are options?
  - Horticultural oils; (e.g mineral 'vs' plant based)
  - Plant extracts; (e.g alginates, sucrose, etc)

# Physical Mode of Action Products

- How do they work?
  - Assumes full coverage.
  - Horticultural oils – spread (across the leaf) & penetrate (insect exoskeletons)
  - Suffocation effect and repellency (by deterring Psyllid ovipositioning) due to the oily residue, + reduce drift, & some U.V protection
  - Plant extracts – (glue insects to the plant & can suffocate)

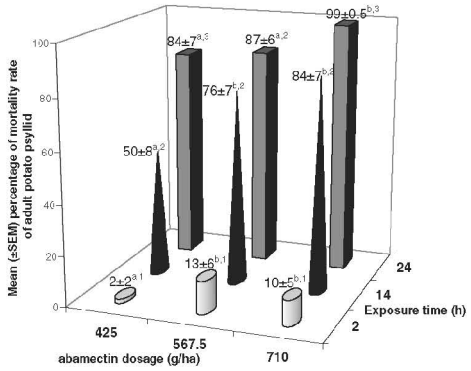



Fig. 1. Mean ± SEM percentage of mortality rates of adult *B. cockerelli*, when exposed to three different dosages (425, 567.5, and 710 g/ha) of abamectin on potato leaves. Mean mortality rates followed by the same letter inside a time interval or followed by the same number inside a dosage are not significantly different ($P < 0.05$).

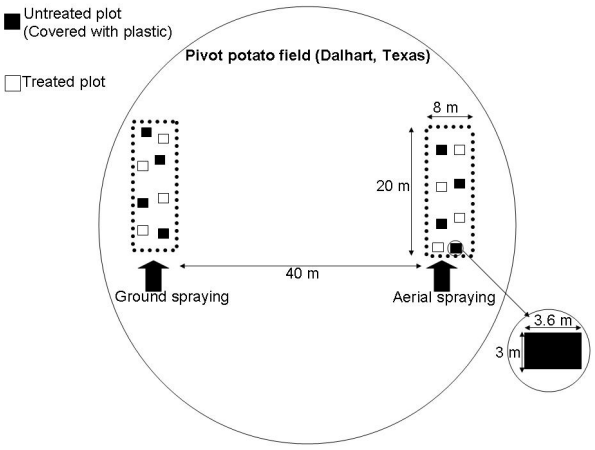
ECOLOGY AND BEHAVIOR

**Knockdown Mortality, Repellency, and Residual Effects of Insecticides for Control of Adult *Bactericera cockerelli* (Hemiptera: Psyllidae)**

A. H. CHARALARI,[1,2] C. NANSEN,[1] D. S. LAWSON,[3] J. CILLEY,[4] J. E. MUNYANEZA,[5] AND K. VAUCHN[1]

J. Econ. Entomol. 102(3): 1033–1038 (2009)

**Fig. 2**




ECOLOGY AND BEHAVIOR

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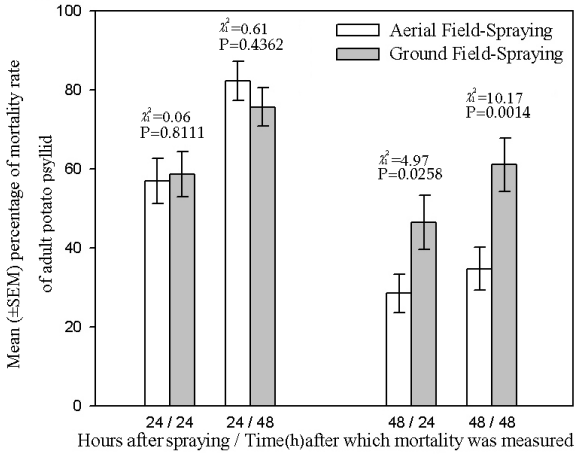
**Fig. 4.**

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Knockdown Mortality, Repellency, and Residual Effects of Insecticides for Control of Adult *Bactericera cockerelli* (Hemiptera: Psyllidae)

A. H. GHARALARI,[1,2] C. NANSEN,[1] D. S. LAWSON,[3] J. GILLEY,[4] J. E. MUNYANEZA,[5] AND K. VAUGHN[1]

J. Econ. Entomol. 102(3): 1032–1038 (2009)

New Technology
Quantum mist 380

Wingsprayer

# Chemical Trial Data

TABLE 2: Mortality (%) of TPP nymphs at the final assessment times; 48 and 168 h after spraying (95% confidence limits).
Untreated and control data averaged over all spray days

Source: Berry, N.A, M.K. Walker and R.C. Butler, 2009. Laboratory studies to determine the efficacy of selected insecticides on TPP. NZ Plant Protection Conference 2009.

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| Chemical | 48 h | 168 h |
|---|---|---|
| Untreated* | 4.0 (1.5-10.2) | 11.2 (7.4-16.5) |
| Control* | 5.0 (2.6-9.4) | 13.0 (9.7-17.4) |
| dichlorvos | 100.0 (92.9-100.0) | |
| lambda-cyhalothrin | 100.0 (92.6-100.0) | |
| methomyl | 97.9 (86.6-99.7) | |
| taufluvalinate | 98.0 (87.1-99.7) | |
| methamidophos | 98.0 (87.1-99.7) | |
| azadirachtin | | 100.0 (92.9-100.0) |
| buprofezin | | 44.9 (31.7-58.9) |
| spiromesifen | | 81.6 (68.3-90.2) |
| pymetrozine | | 36.0 (24.0-50.1) |
| abamectin | | 100.0 (92.9-100.0) |
| imidacloprid | | 53.1 (39.2-66.5) |
| thiacloprid | | 100.0 (92.7-100.0) |
| spirotetramat | | 96.0 (85.4-99.0) |

TABLE 1: Insecticide treatments used in the bioassays.

| Active ingredient | Registered use | Chemical group | Formulation | Field rate (ai) |
|---|---|---|---|---|
| dichlorvos | Greenhouse crops, vegetables | Organophosphate | 1000g/L EC | 350 g/ha |
| lambda-cyhalothrin | Tomato, potato | Pyrethroid | 250 g/L CS | 10 g/ha |
| methomyl | Tomato, capsicum | Carbamate | 200 g/L SC | 400 g/ha |
| taufluvalinate | Tomato | Pyrethroid | 240 g/L SC | 72 g/ha |
| methamidophos | Tomato, potato | Organophosphate | 600 g/L SC | 480 g/ha |
| azadirachtin | Greenhouse crops, potato | Tetranortriterpenoid | 10 g/L EC | 30 g/ha |
| buprofezin | Tomato, capsicum | Thiadiazine | 440 g/L SC | 132 g/ha |
| spiromesifen | Tomato, capsicum | Tetronic acid derivatives | 240 g/L SC | 144 g/ha |
| pymetrozine | Tomato | Pyridine azomethine | 500g/kg WDG | 200 g/ha |
| abamectin | Tomato | Avermetin | 18 g/L EC | 8.1 g/ha |
| spirotetramat | Kiwifruit | Ketoenols | 240 g/L SC | 96 g/ha |
| imidacloprid | Onions, vegetable brassicas, lettuce | Neonicotinoid | 350 g/L SC | 7 g/2.5 litres water/1000 plants |
| thiacloprid | Apples, avocados, kiwifruit, stonefruit | Neonicotinoid | 480 g/L SC | 288 g/ha |

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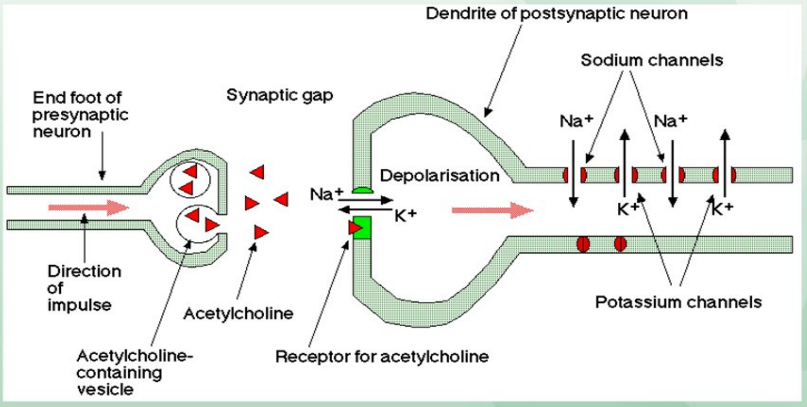
Table 1. Mortality rates of adult potato psyllid, *B. cockerelli,* when potato leaves were treated with 12 insecticides in the field. Values are presented as Mean±SEM. Data were collected 24 h after treatment.

| Insecticide | Rate/ ha | Conc. | Comparative product in NZ | Mean +/- SEM mortality on leaf sides | | |
|---|---|---|---|---|---|---|
| | | | | Both | Bottom | Top |
| **Thiamethoxam (Actara)** | **213g** | **25WG** | **Actara 25WG (533g/ha in-furrow)** | **100 ± 0** | **85 ± 7** | **34 ± 15** |
| **Abamectin (Agri Mek)** | **710g** | **15g/l EC** | **Avid (600ml)** | **100 ± 0** | **99 ± 1** | **95 ± 5** |
| Cyfluthrin (Baythroid) | 199g | | | 60 ± 11 | 62 ± 7 | 47 ± 10 |
| **Bifenthrin (Capture)** | **113g** | **25EC** | **Venom (282g)** | **85 ± 6** | **61 ± 10** | **53 ± 10** |
| Cyfluthrin + imidacloprid (Leverage) | 266g | | | 71 ± 8 | 6 ± 6 | 0 ± 0 |
| **Lambda – cyhalothrin (Warrior)** | **136g** | **22%** | **Karate Zeon (120ml)** | **31 ± 11** | **7 ± 4** | **41 ± 10** |
| Control (Water) | | | | 4 ± 1 | 16 ± 5 | 8 ± 4 |

Source: Gharalari et al, 2009

# Resistance Management

## Mode of Action




Pyrethroids work on Sodium Channel, OPs on Choline Esterase and neonicotinoids on the Choline receptor

Source: MAKHTESHIM AGAN

**IRAC Mode of Action Classification (for T.P.P)**

| Main Group | Chemical Sub-group | Active Ingredients | Trade names | Action & Stage |
|---|---|---|---|---|
| **1** Acetylcholine esterase inhibitors | **1A** Carbamates | Methomyl, Carbaryl | Lannate, Carbaryl/ Sevin Flo | Contact (short residual) Knockdown – Adults & Nymphs |
| | **1B** Organophosphates | Dichlorvos/ DDVP, Methamidophos, Dimethoate, Chlorpyrifos | Nuvos, Tamaron, Perfekthion, Lorsban /Pyrinex | Contact /Fumigant or Contact /Systemic (some residual) Knockdown – Adults & Nymphs |
| **3** | Pyrethroids | Bifenthrin, Lambda-Cyhalothrin, Deltamethrin, tau-Fluvalinate | Venom, Karate, Decis, Mavrik | Contact (some residual) Knockdown – Adults & Nymphs |
| **4** Nicotinic Acetylcholine receptor agonists / antagonists | **4A** Neonicotinoids | Imidacloprid, Thiacloprid, Thiamethoxam, Clothiniadin | Confidor, Calypso, Actara, Poncho | Systemic (residual) Nymphs & Adults |

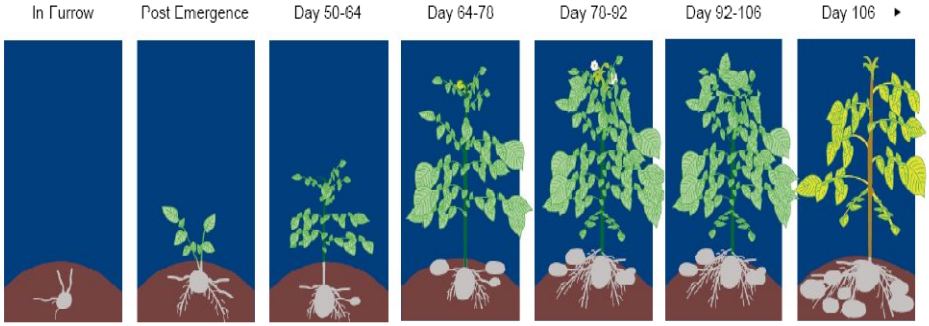
**IRAC Mode of Action Classification (for T.P.P)**

| Main Group | Chemical Sub-group | Active Ingredients | Trade names | Action & Stage |
|---|---|---|---|---|
| **6** Chlorine channel activators | Avermectins | Abamectin | Avid | Contact (& translaminar ) Knockdown & residual Nymphs & Adults |
| **23** Inhibitors of acetyl CoA carboxylase Inhibitors of lipid synthesis | Tetronic acid Tetramic acid derivatives (Cyclic ketoenols) | Spiromesifen | Oberon | Translaminar (residual) Nymphs, Eggs & Fecundity of Females (Transovarial) |
| | | Spirotetramat | Movento | Systemic (residual) Nymphs & Fecundity of Females |
| **UN** Compounds of uncertain or unknown modes of action | Azadirachtin | Azadirachtin | Neem WP / NeemAzal | Systemic (residual) Nymphs |
| **Others** | Plant Based Oils<br>Polysaccarides<br>Mineral Oil | Botanical oils<br>Alginates<br>Mineral Oil | EcoOil<br>Agri-50NF<br>Excell Oil | Contact (some short residual / deterrent) Physical Mode of Action Nymphs & Adults |

# Potential Potato Program 2009-10

**Potential Potato Program**

Horti centre
for growers by growers




***These products have indicated efficacy but this is not guaranteed. This information has been gathered from local and overseas sources.***

*(**NB:** * and ** are subject to regulatory approval.)*

DRAFT

## Maximising potato plant growth under potential potato psyllid-induced disease infection conditions

Wright PJ, Walker GP, Scheffer JJ & Hedderley D

May 2010

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Objective:

The aim of this trial was to compare potatoes treated with plant nutritional and plant stimulator products in different combinations, applied at specific plant stages to supply continual plant growth stimulation and supplemental foliar plant nutrition, with potatoes that did not receive these products.

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**Table 2:** Wuxal treatments.

| | |
|---|---|
| 1. | Plant Nutritional: Wuxal Top P, K40, Magnesium, Calcium, Super |
| 2. | Plant Stimulators: Wuxal AminoPlant, Wuxal Amino, Wuxal Ascofol |
| 3. | Plant Stimulators + Plant Nutritional: all of the above |
| 4. | Control: none of the above |

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**Table 3**: Agrichemicals used.

| Product | Active ingredient | Category |
|---|---|---|
| Actara® | 250 g/kg thiamethoxam | Insecticide |
| Amistar®SC | 250 g/L azoxystrobin | Fungicide |
| Avid® | 18 g/L abamectin | Insecticide |
| Decis® Forte | 27.5 g/L deltamethrin | Insecticide |
| Eco-oil® | 851.5 g/L canola oil | Miticide/insecticide |
| Karate® | 250 g/L lamba-cyhalothrin | Insecticide |
| Movento® | 240 g/L spirotetramat | Insecticide |
| Oberon® | 240 g/L spiromesifen | Insecticide |
| Partner® | Vegetable oil polymer | Adjuvant |
| Pyrinex | 480 g/L chlorpyrifos | Insecticide |
| Tamaron® | 600 g/L methamidophos | Insecticide |

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Figure 6: Horticentre trial at Pukekohe on 24 December 2009.

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**Table 4:** Treatment application dates.

| Week | Date | Control | Wuxal nutrition | Wuxal biostimulant | Wuxal nutrition + biostimulant |
|---|---|---|---|---|---|
| Planting | | Amistar WG + Actara | Amistar WG + Actara | Amistar WG + Actara + Amino Plant | Amistar WG + Actara + Amino Plant |
| 1 Emergence | 25 Nov | | | Amino | Amino |
| 2 | 2 Dec | Karate | Karate + Top P | Karate | Karate + Top P |
| 3 | 9 Dec | Movento + Partner + Decis | Movento + Partner + Decis | Movento + Partner + Decis + Ascofol | Movento + Partner + Decis + Ascofol |
| 4 | 16 Dec | Movento + Partner + Decis | Movento + Partner + Decis + Top P | Movento + Partner + Decis | Movento + Partner + Decis + Top P |
| 5 | 23 Dec | Avid + Eco Oil | Avid + Eco Oil + Magnesium | Avid + Eco Oil + Amino | Avid + Eco Oil + Magnesium + Amino |
| 6 | 30 Dec | Avid + Eco Oil | Avid + Eco Oil + K40 | Avid + Eco Oil | Avid + Eco + K40 |
| 7 | 6 Jan | Pyrinex | Pyrinex + Top P | Pyrinex + Ascofol | Pyrinex + Top P + Ascofol |
| 8 | 13 Jan | Pyrinex | Pyrinex + K40 | Pyrinex | Pyrinex + K40 |
| 9 | 20 Jan | Oberon + Decis | Oberon + Decis + Calcium | Oberon + Decis + Amino | Oberon + Decis + Calcium + Amino |
| 10 | 27 Jan | Oberon + Decis | Oberon + Decis + K40 | Oberon + Decis | Oberon + Decis + K40 |
| 11 | 3 Feb | Avid + Eco Oil | Avid + Eco Oil + Calcium | Avid + Eco Oil | Avid + Eco + Calcium |
| 12 | 10 Feb | Avid + Eco Oil | Avid + Eco Oil | Avid + Eco Oil + Ascofol | Avid + Eco Oil + Ascofol |
| 13 | 17 Feb | Tamaron | Tamaron + Super | Tamaron | Tamaron + Super |
| 14 | 24 Feb | Tamaron + Eco Oil | Tamaron + Eco Oil | Tamaron + Eco Oil | Tamaron + Eco Oil |
| 15 | 3 Mar | Tamaron + Eco Oil | Tamaron + Eco Oil | Tamaron + Eco Oil | Tamaron + Eco Oil |
| 16 | 10 Mar | Tamaron + Eco Oil | Tamaron + Eco Oil | Tamaron + Eco Oil | Tamaron + Eco Oil |

Figure 7: Horticentre trial at Pukekohe on 10 February 2010.

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Table 4: Effect of treatment on tuber yield and grade. Weights of tubers plots (5 m long x 2 rows).

| Treatment | Mean 1st grade tubers (kg) | Mean reject tubers (kg) | Mean total yield (kg) |
|---|---|---|---|
| Control | 40.72 | 3.62 | 44.34 |
| Wuxal Nutrition | 40.93 | 2.12 | 43.05 |
| Wuxal Biostimulant | 44.61 | 2.80 | 47.41 |
| Wuxal Nutrition + Biostimulant | 42.88 | 2.11 | 44.99 |

**No Statistical Difference in Yield or ZC

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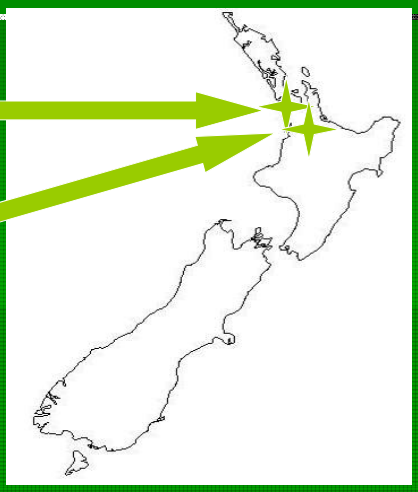
# Impact of the potato psyllid on a NZ potato grower

**Tasmanian Potato Growers & Industry Partners**
**July 2010**

# Production locations

PUKEKOHE

WAIKATO



## Our operation

- Main varieties grown for Simplot Mr Chips are Ranger, Moonlight and Agria
- Early crop grown on volcanic loams and ash soils south of Auckland (Pukekohe area)
- Main crop grown in Waikato region (sandy and clay loams)
- Some crops irrigated, some not

## Our experience……..

- **October 2008** - began to observe unusual leaf curling symptoms in Ranger Russet potato crop (at about 3-4 weeks post emergence
- Symptoms had some resemblance to Potato Leaf Roll Virus, but with purpling
- Over the coming months, many more main crop potatoes developed these symptoms
- Severity of symptoms varied between varieties

# Symptoms

- - Upward curling of leaves
- - Yellowing of leaves
- - Purple tinge of leaf margins
- - Aerial tubers
- - Death of stems (occasionally)
- - Symptoms usually started on field margin but eventually progressed into the entire crop

# Symptoms

# Symptoms

# Symptoms

# Symptoms

# As the 2008 main crop progressed…….

- Normal growth patterns in many crops seemed interrupted
- Plant development appeared restricted
- Tuber development appeared restricted

# What we were able to determine at that stage……

- The nature of these symptoms had not been observed previously in potatoes and were of great concern
- At this stage (2008), the NZ Tomato and Capsicum industry was being severely challenged by the Tomato Potato Psyllid (TPP). Exports of both tomatoes and capsicums were prohibited.
- The potato industry had been warned of the potential impact of the TPP on the industry

# Looking harder, we began seeing lots of these…..

## And observed some of these (to a lesser extent)……

## The TPP (Eggs & Nymphs)

## TPP eggs

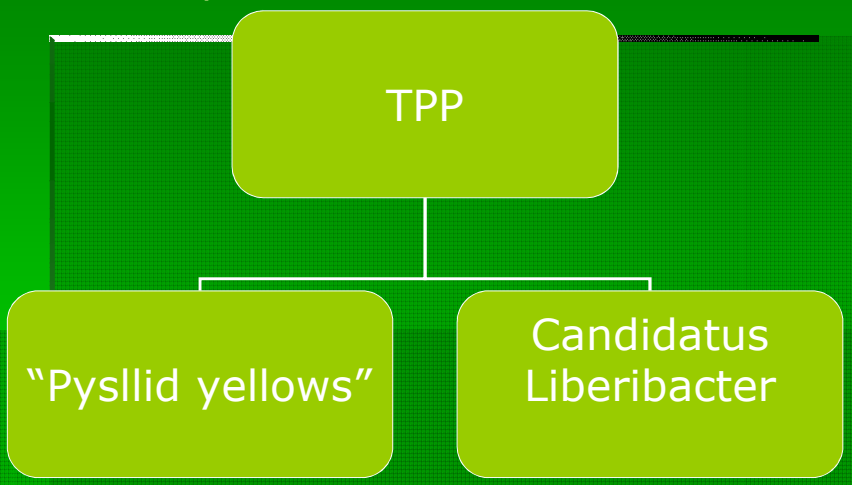
## TPP Nymph

# The TPP (ADULT)

# Trying to work out what was going on…

- We commissioned MAF (Ministry of Agriculture and Fisheries) to test potato plants showing symptoms (using methods recognised at the time)
- Testing **confirmed** presence of Candidatus Liberibacter in **some** plants
- **Some** potatoes tested **negative** for any pathogens
- An organism called Phytoplasma Australiense was detected in **some** potatoes (first time found in potatoes)

## Based on the USA experience with the TPP, we knew…




## "Psyllid yellows"

- The response of the plant to active nymph feeding
- The higher the population, the more likelihood of damage and yield loss
- Proven overseas in trials to cause significant yield loss. These trials with varieties in short growing season (90-100 days)
- In NZ, many varieties 150-160 days, so psyllid yellow issue may be more significant

# Liberibacter

- Called a BLO (Bacteria Like Organism)
- Vectored (transmitted) by the TPP
- A big issue in Southern USA/Mexico
- Causes symptoms similar to psyllid yellows
- Often plants will completely die out
- When crop infected early, causes Zebra Chip (ZC) – see next slide

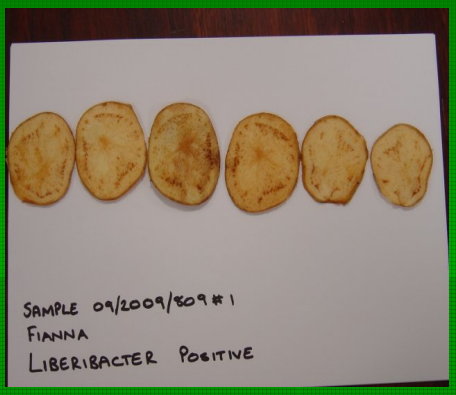
# Zebra Chip

RAW TUBERS

FRIED TUBER

# At the processor…

- In March 2009, Simplot Mr Chips began noticing lower than normal dry matters as well as a darkened vascular ring and burning of tubers
- A low percentage of tubers displayed dark streaking consistent with Zebra Chip




# Cook tests

## Cook tests

## Cook tests

# Cook tests

Liberibacter Free

Liberibacter positive (same crop)

# Impact on size, yield, quality in 2008/09 season

- As a result of the restricted plant growth, tuber size was considerably smaller in many crops
- Overall yields were significantly down for our main crop harvest
- Another issue we encountered was potatoes with increased sugars. We do not know whether this issue is related to psyllid damage. However this could correlate to immature potatoes from stunted growth patterns and early die off

## Overall impact 08/09 season

- Much product grown for Simplot Mr Chips was deemed unacceptable for the factory, and rejected (same for most SMC potato growers in North Island of NZ)

## This season just gone (09/10).....

- Psyllids turned up around the same time as the previous year – mid September 2009.
- Heavy preventative insecticide programmes were implemented. Commencing with in-furrow Actara, then an intense foliar programme.
- We experienced a colder and wetter Oct/Nov/Dec, populations seemed to be a lot lower than the previous season anyway

## This season just gone (09/10).....

- Generally control was acceptable. However we did not achieve 100% control.
- Still evidence of damage with leaf curling & purpling
- Still odd tuber showing Liberibacter infection (ZC)

## This season just gone (09/10).....

- Simplot Mr Chip factory better able to deal with issues
- Most crop has been processed successfully
- Still a concern about lower SG's on some varieties

# Insecticide costs

- Pre 2010 – 6 x insecticide applications @ $18/ha = $108/ha
- 2010 – 21 x insecticide applications @ $58/ha = $1218/ha

**An additional cost of $1110/ha**

- In upcoming season, we anticipate rationalising our programme from the 2009/10 season

# Seed

- Each year we inspect all seed crops grown for us
- Seed grown in different locations in NZ
- In 08/09 season, we observed some seed crops with severe TPP infestation

## seed

- Where the seed from these severely infested crops was planted, we observed:
  - Higher stem numbers
  - Thinner, less vigorous stems
  - Higher tuber numbers (up to 25% higher)
  - Resulting crop with smaller tubers, lower SG's and lower yield

## seed

- Too early to draw conclusions on this, but:
  - It is possible psyllid interaction with plants may also be causing physiological interference with tubers (or seed)

## Seed treatment

- Another observation, but too early to draw conclusions on…….
- We treated all our crop with in-furrow Actara (thiamethoxam)
- It is well documented that Actara can induce higher stem numbers
- Maybe this is compounding the issue of higher stem numbers????

## Concluding thoughts……

- TPP has posed a significant challenge for our business over the past two seasons
- We believe that a proactive approach with a preventative insecticide programme has helped us to manage this issue

# Concluding thoughts……

- A complex puzzle of issues, with many contributing factors:
  - Impact of psyllid yellows on yield and tuber qualtiy
  - Impact of Liberibacter (ZC)
  - Phytoplasma…an issue or not????
  - Seed health….has seed physiology been interfered with?
  - Seed treatment…..could we inadvertantly be manipulating stem numbers and compounding issues??

# Our advice……

- Take the issue seriously
- The TPP has not found its way to Australia yet…..but be aware, it somehow got from US to NZ
- If it does establish in Australia, be prepared to react quickly and have a proactive attitude
- With the heavy R&D programme in NZ and elsewhere in world, we will learn much more and understand the issues better in the next few years

# Thank you