

Plant & Food
RESEARCH

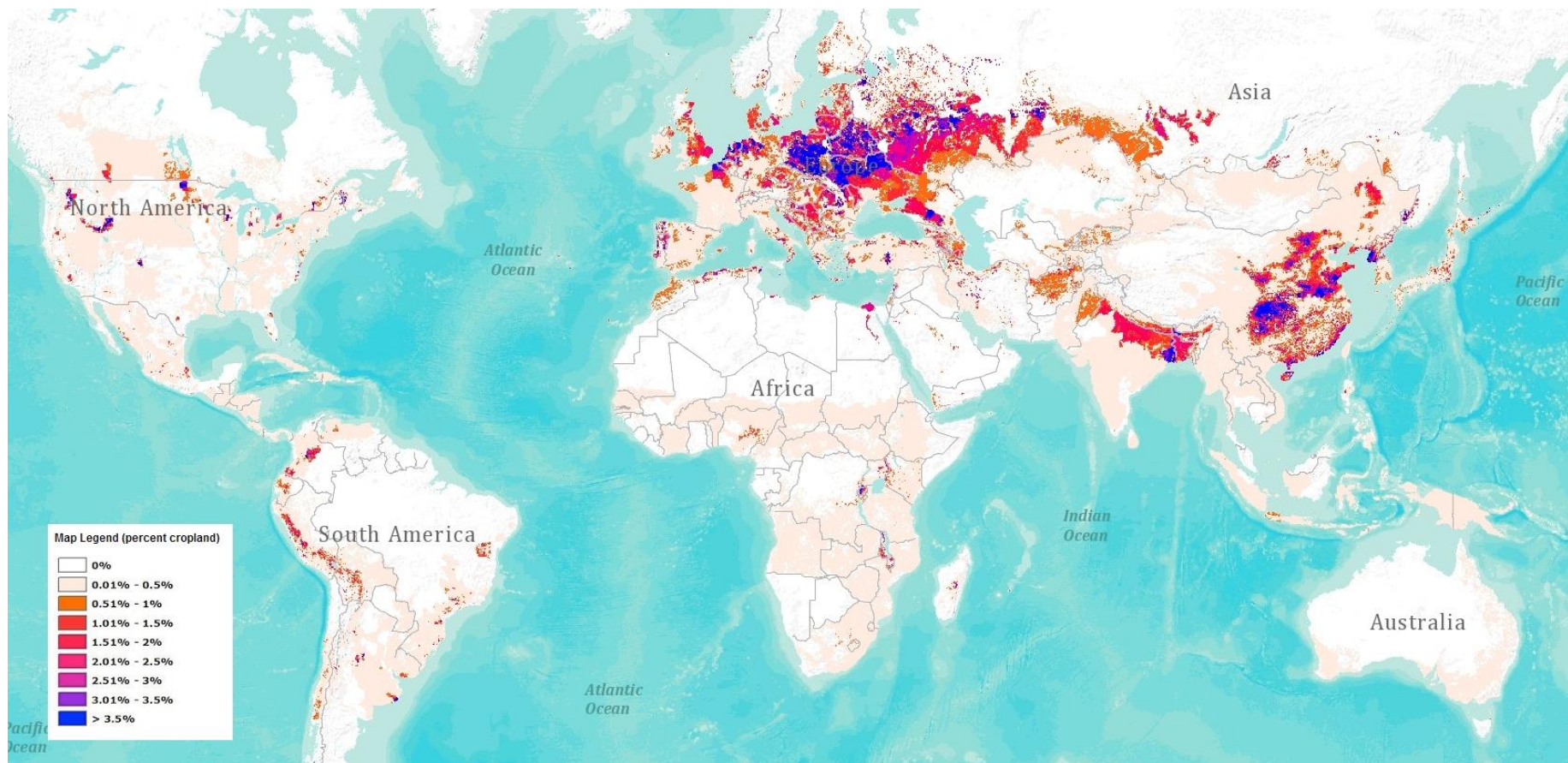
RANGAHAU AHUMĀRA KAI



The New Zealand Institute for Plant & Food Research Limited

New Zealand potato production constraints due to pests and diseases

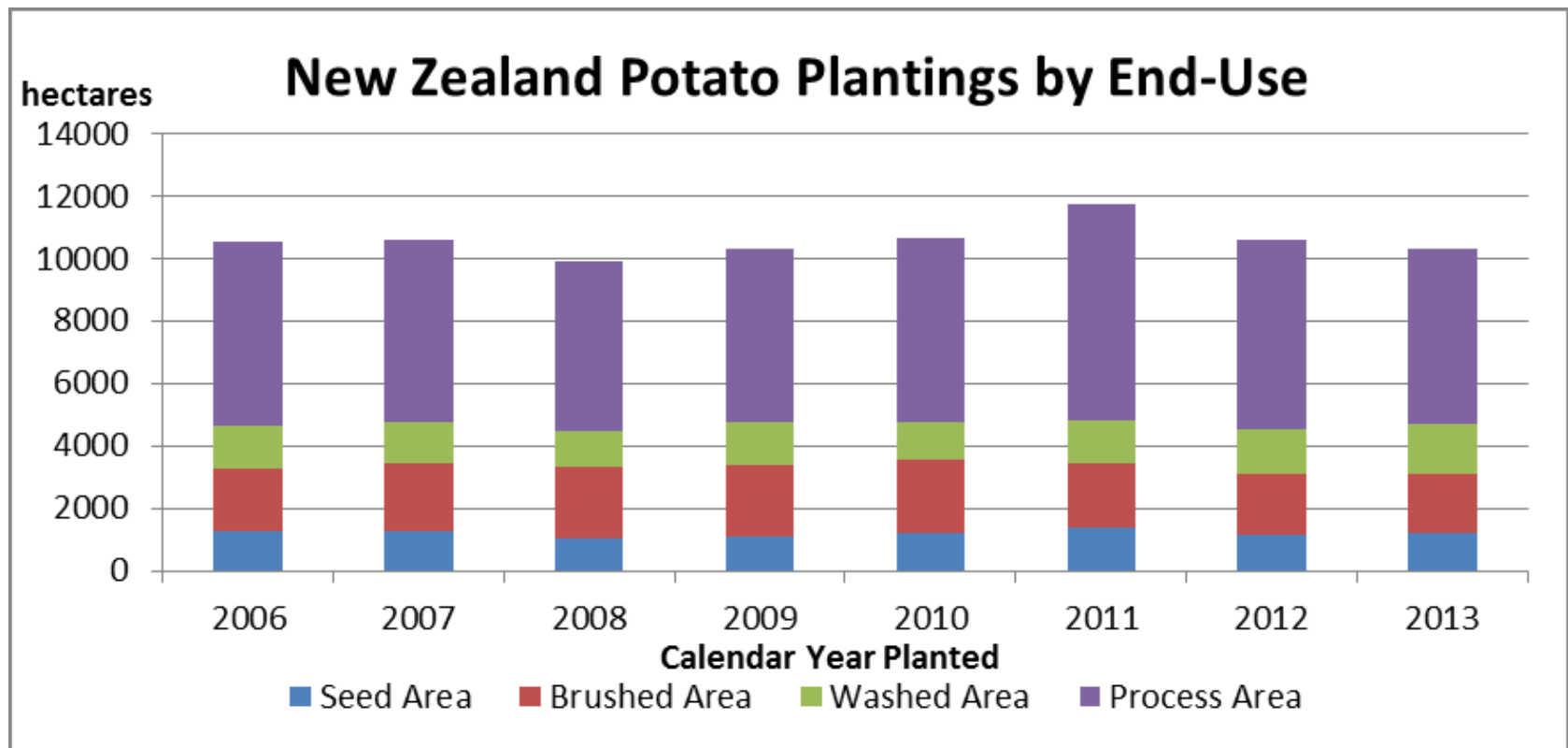
Andrew Pitman, 2016 EAPR Pathology & Pests Section,
Dundee, United Kingdom





Potato production in New Zealand

- New Zealand produces 525,000MT of potatoes per annum from approximately 10,329 hectares planted.

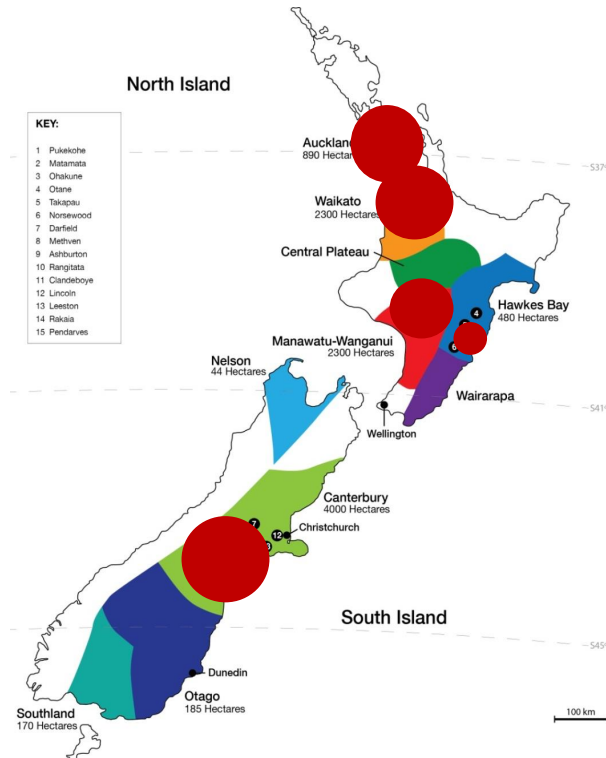


GAIN Report: New Zealand Potato Sector Report - 2014 (NZ1411)

Major potato growing regions in New Zealand



- Potatoes are grown throughout the country, with fresh potatoes harvested all year round in the North Island. Potatoes in Manawatu, Hawkes Bay & Canterbury are grown with irrigation.



Hectares of potatoes harvested in New Zealand

By region, excluding confidentialised data, as at June 2012

Source: Statistics New Zealand

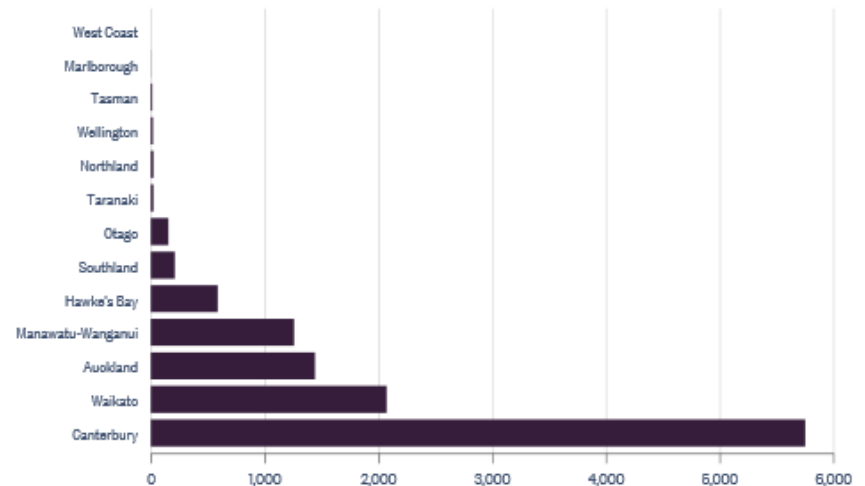


figure.nz

- **Commercial varieties:** Russett Burbank, Innovator, Rua, Nadine, Agria, Moonlight, Desiree, Ilam Hardy, Red Rascal, Ranger Russet and Shepody.

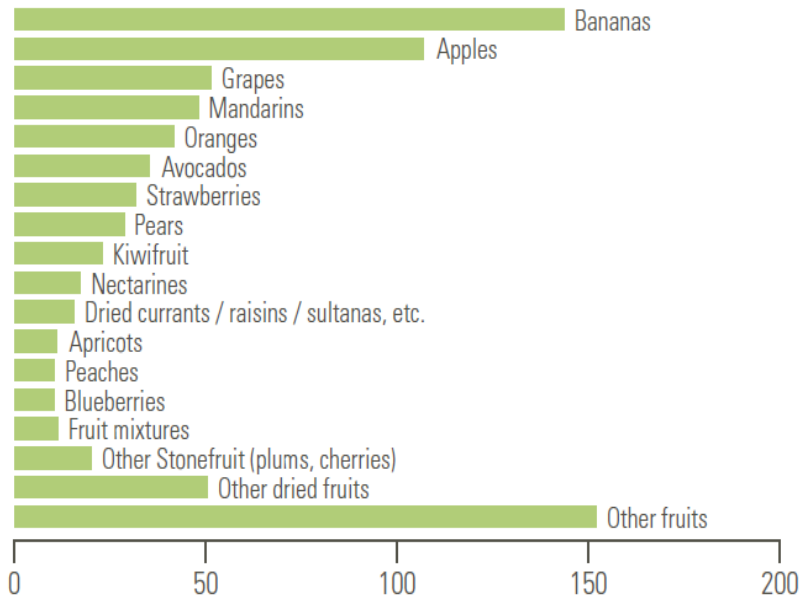
NZ Potato production: industry value & cultural importance



- The potato industry value is approximately NZ\$814 M.

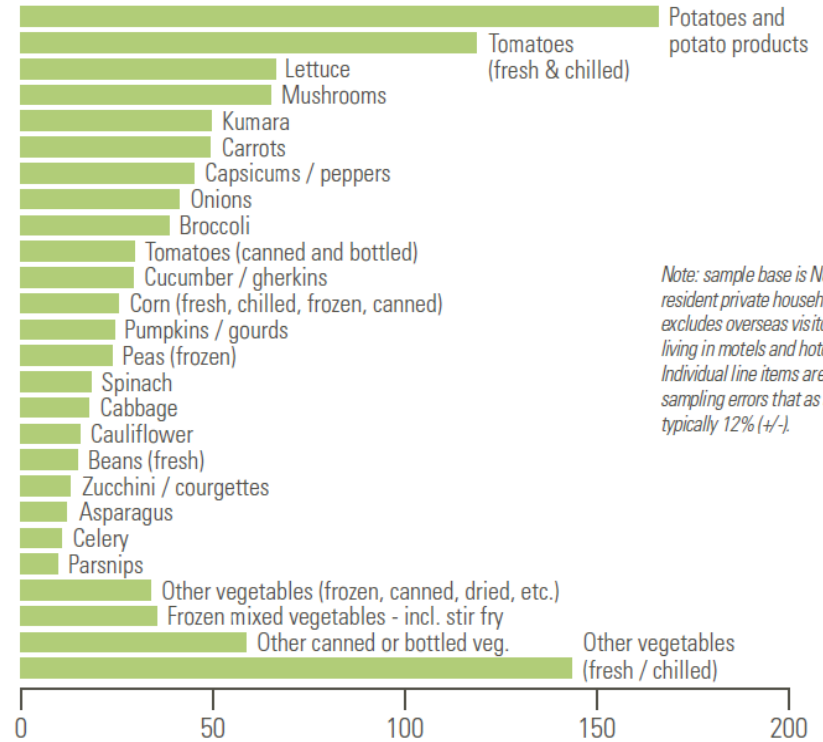
New Zealand consumer spending on fruit (\$ million)

Calculated aggregate annual expenditure by all private New Zealand households (local & imported produce, fresh / chilled / dried / canned / bottled / frozen)



New Zealand consumer spending on vegetables (\$ million)

(local & imported produce, fresh / chilled / dried / canned / bottled / frozen)

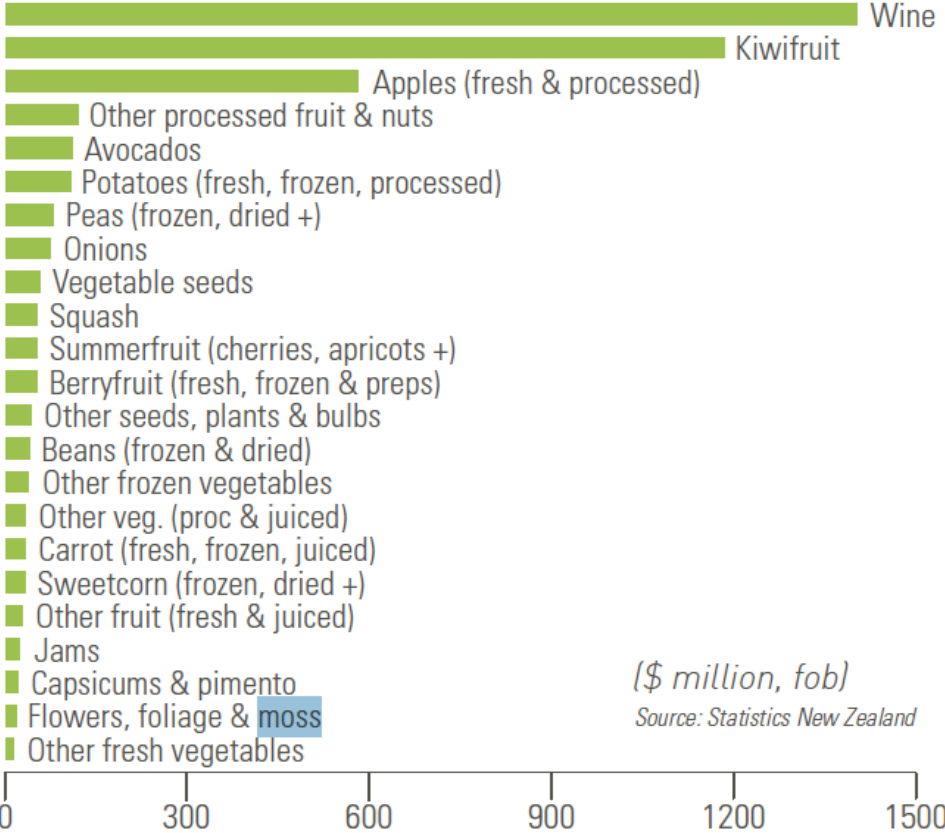


Note: sample base is New Zealand resident private households; i.e. excludes overseas visitors, people living in motels and hotels etc. Individual line items are subject to sampling errors that as a guide are typically 12% (+/-).

NZ Potato exports



Horticultural exports 2015 (\$ million, fob)



(\$ million, fob)
Source: Statistics New Zealand

Major players and export markets



- **170-plus potato grower members.**
- **Frozen processing is dominated by McCain Foods of Canada, with a plant in Timaru, with a potential output of 140,000 MT and Mr Chips (now owned by Balle Bros) with plants in Auckland and Christchurch, with potential output rated at 80,000MT.**
- **The crisping industry is small in New Zealand, with four processing companies operating here: Bluebird, owned by PepsiCo-Frito Lay; ETA, owned by PEP of Australia; New Zealand company, Fresher Foods; and grower owned Heartland.**
- **Australia and Fiji dominate our export destinations.**

Non-commercial potato cultivation

Purple potatoes (taewa - riwai) were a staple food crop of the Māori. Taewa refers to the collection of varieties of *Solanum tuberosum* cultivated by the Māori for at least 200 years.



New Zealand's 'yield gap'



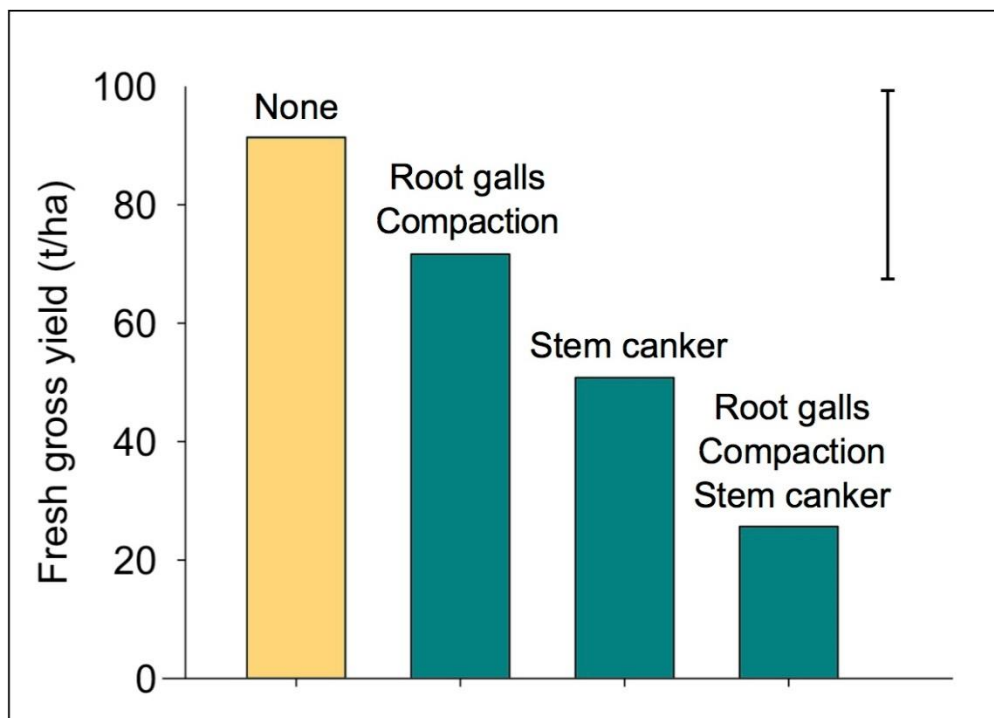
- **New Zealand potato growers produce on average 50 tonne/hectare (www.fao.org).**
- **New Zealand's theoretical yield potential is 80 to 100 tonne/hectare (Potato Calculator, CropLogic™).**

NZ potato production is affected by common pests and diseases



- Soilborne diseases appear to contribute substantially to New Zealand's 'yield gap'.

Graph showing factors limiting yield in selected plants in processed crops in Canterbury



(Sinton et al., 2013 PFR confidential report)

NZ potato production has recently also been affected by a unique pest and disease complex

Zebra chip (ZC) has been a major impediment to New Zealand potato production since 2008



- **ZC is primarily associated with reduced quality of processed potatoes, but also with poor tasting ware potatoes.**



Zebra chip has a range of symptoms



How is zebra chip caused?

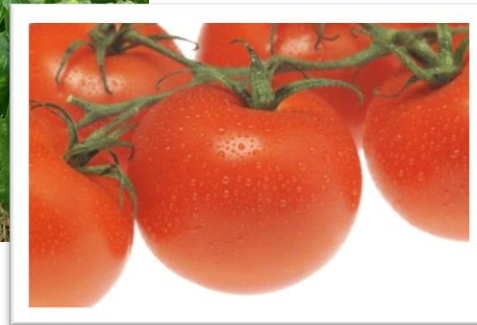
Ca. *Liberibacter solanacearum*
Haplotype A (CLso)



Bactericera cockerelli
(TPP)



How did TPP enter New Zealand?



- Unusual “Psyllid Yellows” in glasshouse tomato crops in Auckland
- Only reported region with zebra chip was North America

How quickly did TPP establish?

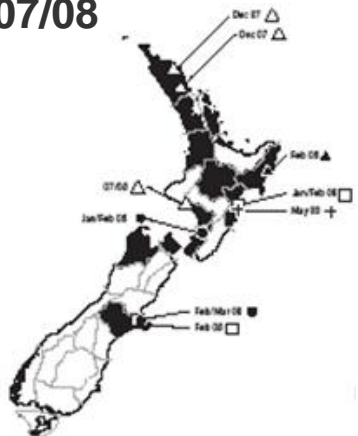
2005/06



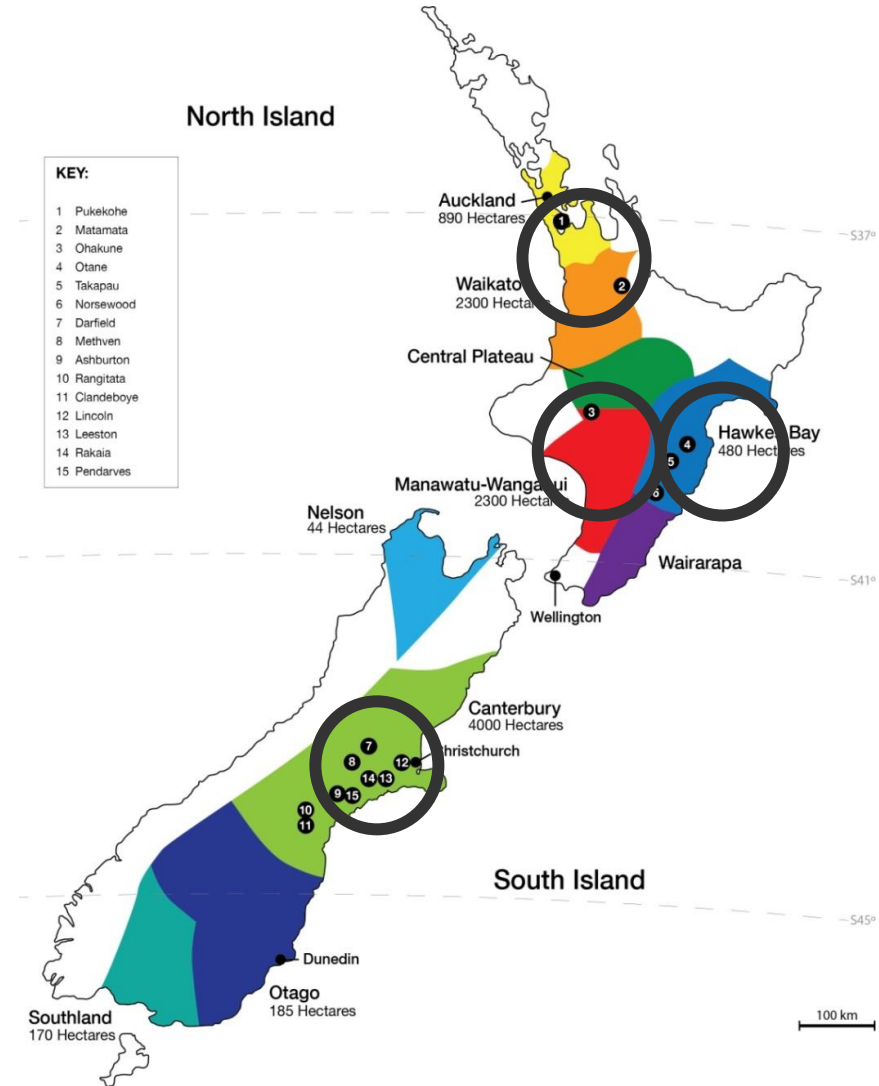
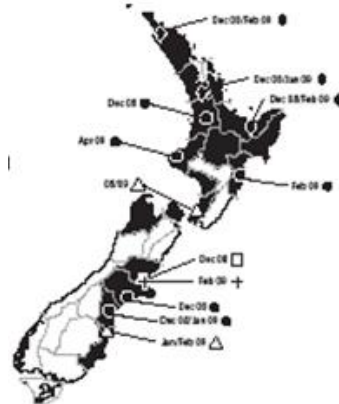
2006/07



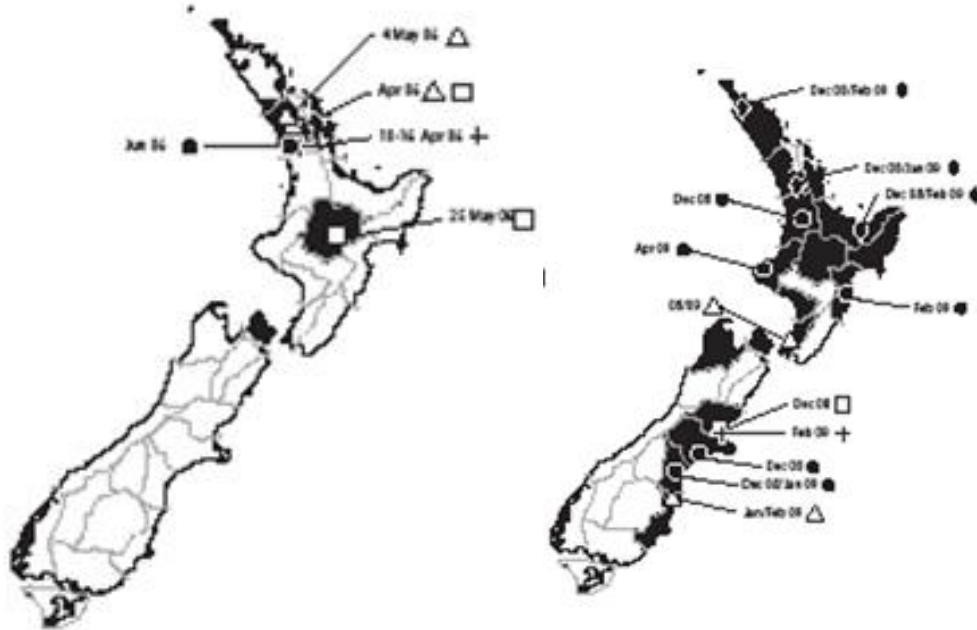
2007/08



2008/09



How did the landscape affect spread?

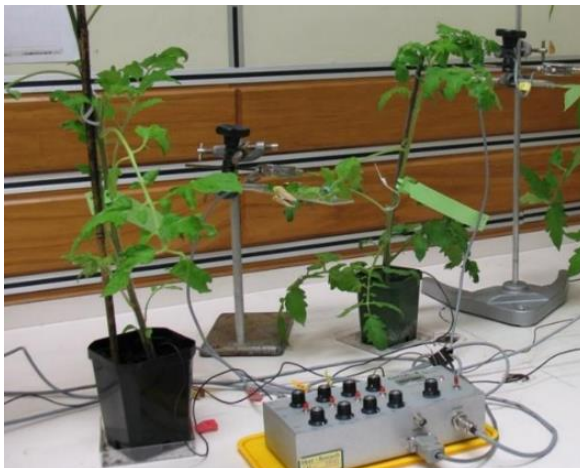


- Cultivated plants from Solanaceae family – potato, tomato, eggplant, tamarillo (*Solanum*), capsicum, chilli (*Capsicum*), goji berries (*Physalis*).



Were alternative hosts important?

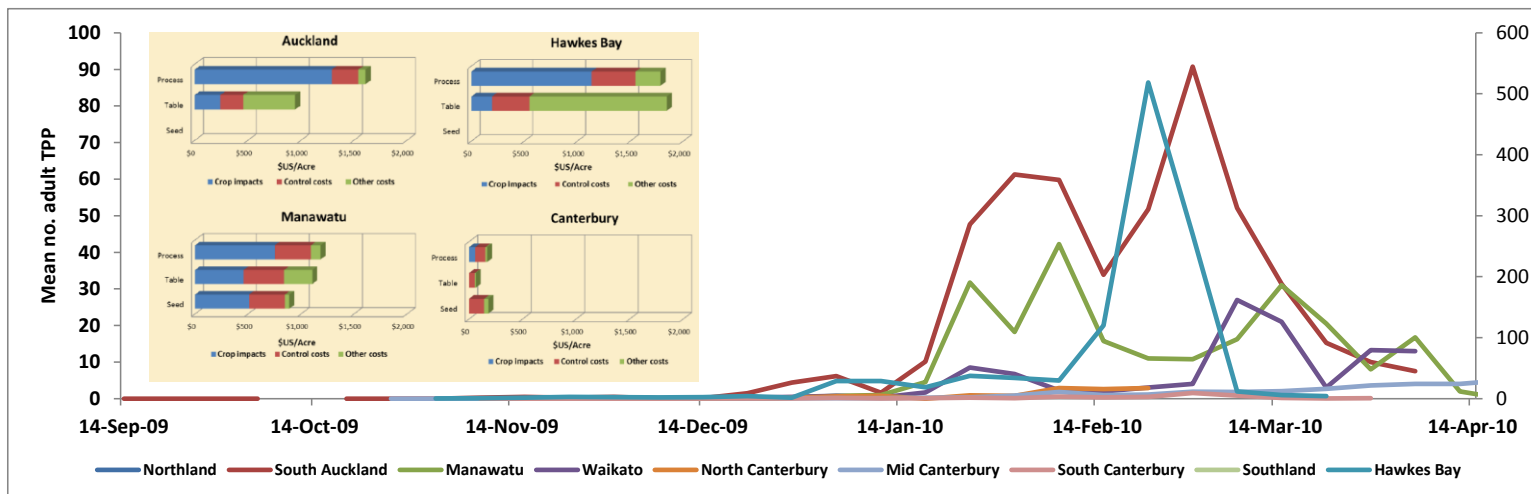
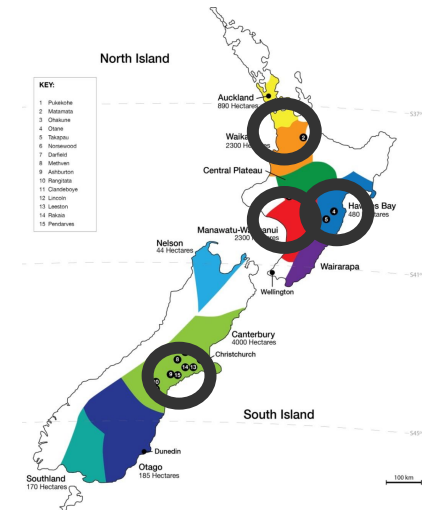
- Many weeds
 - ✓ Bitter Nightshade
 - ✓ African Boxthorn (*Lycium*)
 - ✓ Poroporo



Electrical Penetration Graph

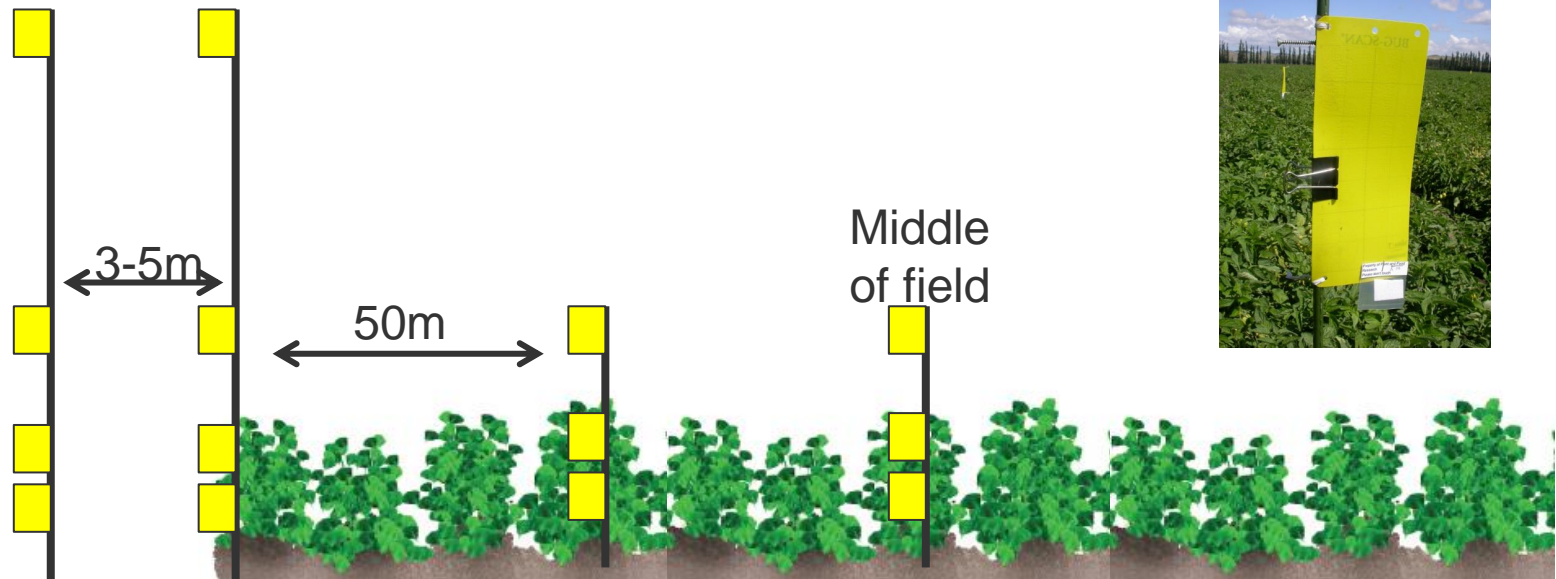
How did the potato industry respond?

- Before TPP incursion, a draft IPM system existed for potato
- After TPP incursion, IPM system development stopped
- Management mainly through frequent applications of insecticides
- Registration of new products



Management of zebra chip: monitoring, detection and diagnosis

1. TPP trapping



2. Scouting for TPP



Management of zebra chip: monitoring, detection and diagnosis

3. Testing Plants and TPP for CLso

- Detection by PCR a problem

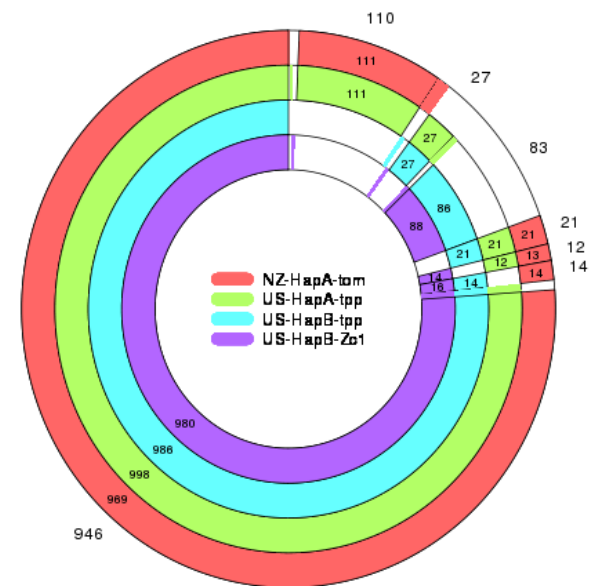
Sampling



Sensitivity



Specificity

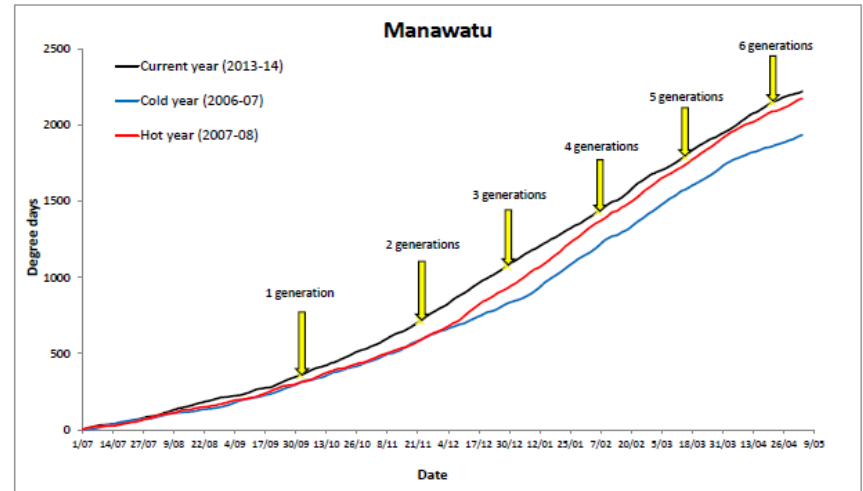


Management of zebra chip: sustainable insecticide use

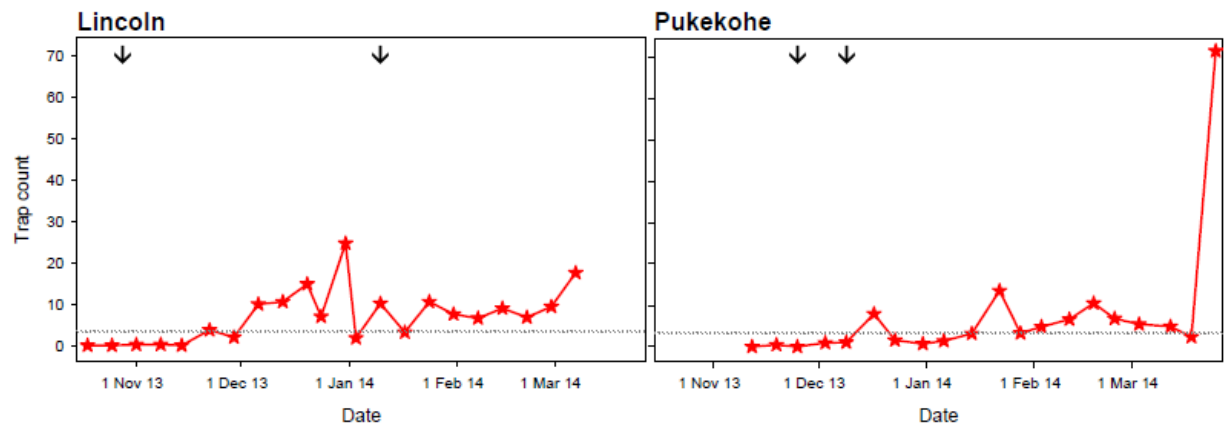


- Use reduced spray programmes where possible

- Degree Days
- Threshold
- Agricultural oils
- Increased spray interval



Movento	Movento	Movento
Movento	Movento	Movento
Avid	Avid	Avid
Avid	-	Excel oil
Avid	Avid	Avid
Sparta	-	Excel oil
Sparta	Avid	Avid
Sparta	-	Excel oil
Sparta	Sparta	Sparta
Proteus	-	Excel oil
Proteus	Sparta	Sparta
Proteus	-	Excel oil
Metafort	Sparta	Sparta
Metafort	-	Excel oil
Metafort	Sparta	Sparta



Management of zebra chip: breeding resistance



NZ Landscape

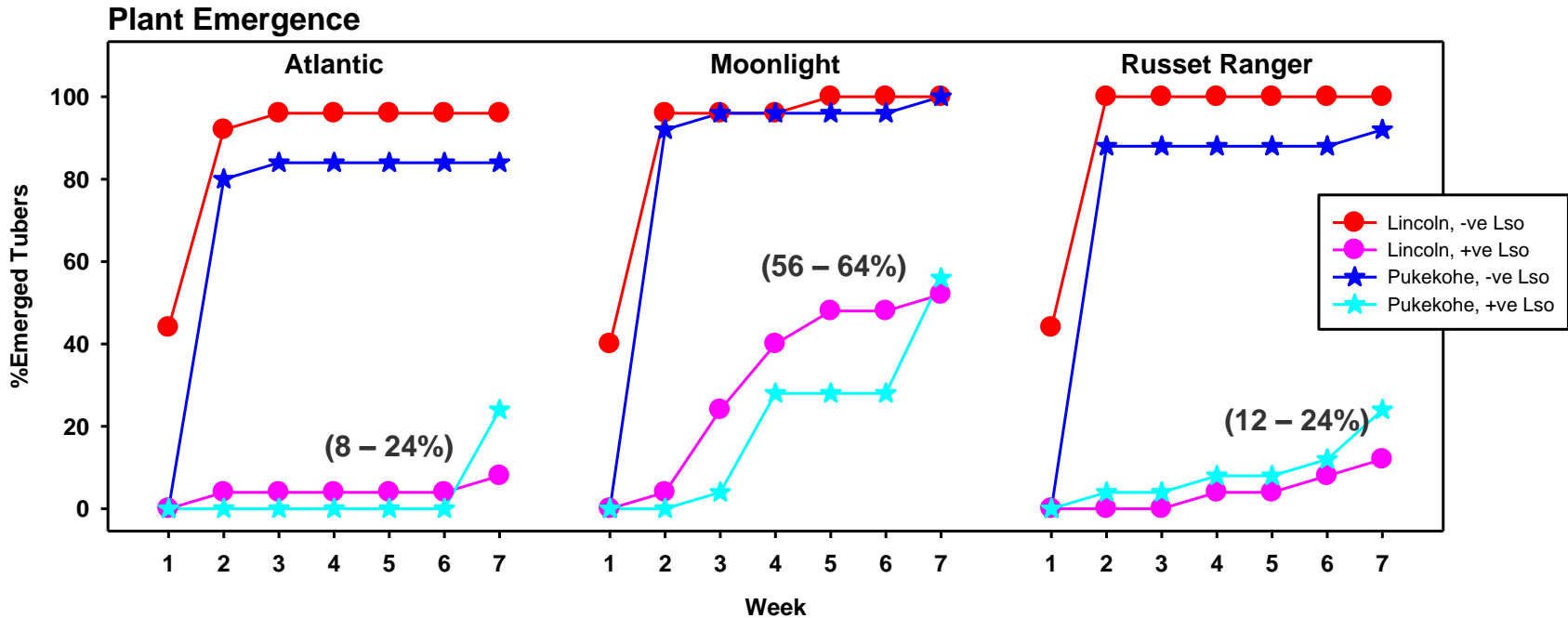
- Importation of potato plant material is prohibited.
- Germplasm can be introduced through tissue culture but is expensive.
- GM is presently not viable.

NZ Activity

- Importation of U.S hybrids derived from wild potato species (e.g. *S. chacoense*) exhibiting resistance to TPP and possible resistance to CLso.
- Screening material from existing breeding programme.

Management of zebra chip: regulating seed tuber production

Graphs of plant emergence associated with tuber-borne CLso in different potato cultivars



Fault type	Harvest class tolerance permitted (%)					
	G1	G2	G3	G4	G5	G6
Maximum Virus	0	0.05	0.05	0.05	0.1	0.2
Potato virus A, M, X, Y, & leafroll virus		(1 in 2000)	(1 in 2000)	(1 in 2000)	(1 in 1000)	(1 in 500)

Management of zebra chip: biocontrol

1. Natural enemies

Lacewings



Hoverflies

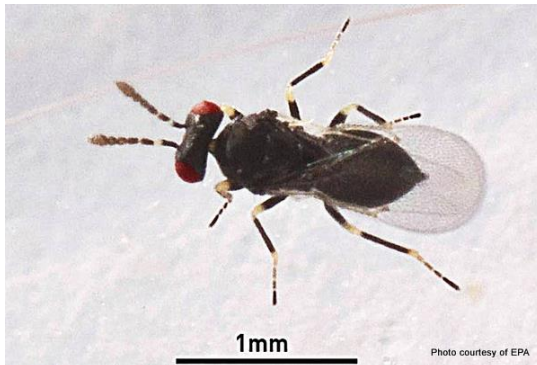


Ladybirds



2. Introduction of biological control agents

Tamarixia triozae – a small wasp and is a parasitoid of TPP.



Where are we at in 2016?



- Overall, yield from NZ's potato industry remains consistent.
- Seasonal ZC detection in processing factories.
- TPP/CLso is an increasing problem in seed tuber crops.
- Production, economic and social effects have been observed.
- Weekly spray schedules are routine in all regions where potato is being grown. Pressure for 5-day intervals.
- Lack of adoption of reduced insecticide programmes.
- Alternative management strategies are still limited.

What can European potato producers expect?



- A high risk of introduction of TPP and/or CLso through movement of solanaceous crops and ornamentals.
- Possibility of CLso acquisition by *Bactericera nigricornis*.
- An insect that will adapt to alternative solanaceous hosts in the European landscape.
- A high rate of establishment in warmer, drier regions, although the insect can clearly tolerate freezing winters.
- High costs associated with management of TPP in the most conducive landscapes due to extensive insecticide application.
- Loss of established IPM strategies.

Major learnings from the NZ TPP incursion



- **Biosecurity Readiness**
 - **R & D plan – short, medium and long**
 - **- cohesion**
 - **Adoption strategy**
 - **Industry readiness**
 - **GIAs**

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Recent observations in commercial seed crops

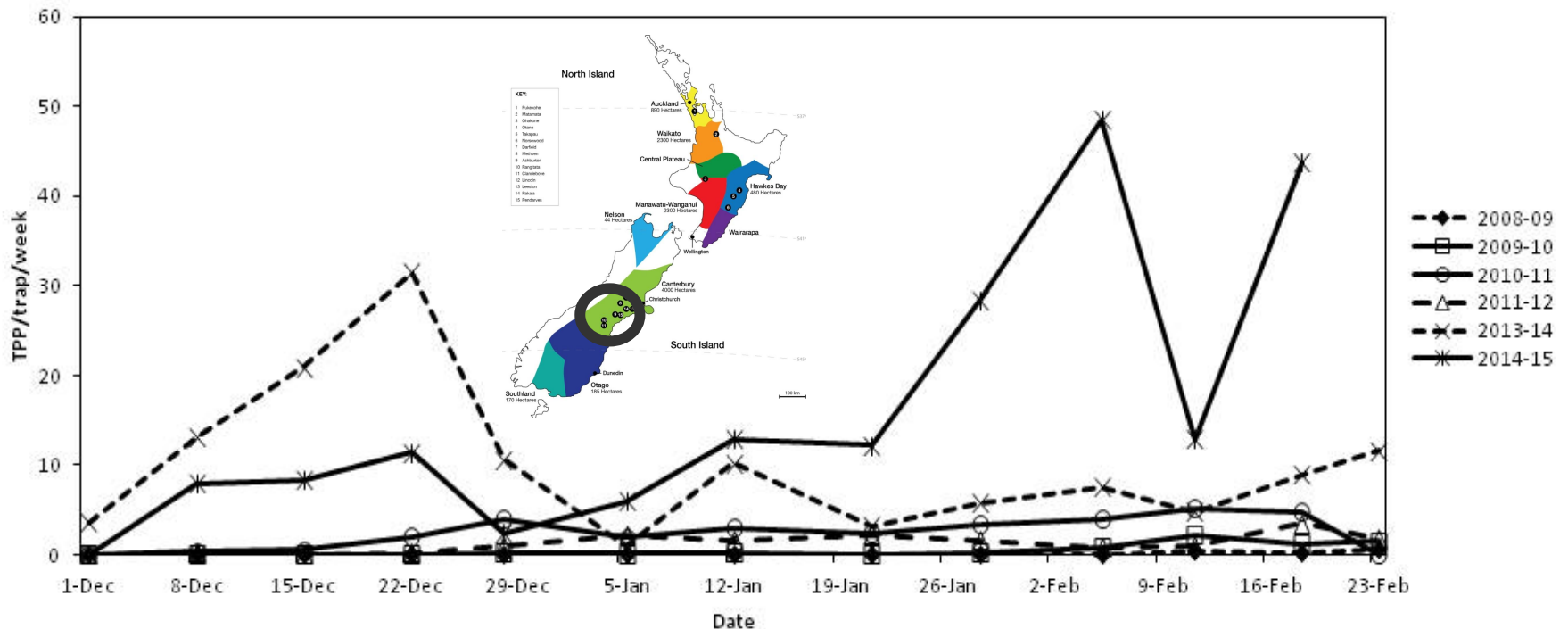


- A recent survey of TPP and plants from seed crops in Canterbury identified CLso in approximately 5% of insects and 5% of harvested tubers.
- In Canterbury, seed merchants have identified approximately 1% ZC in their crops despite extensive insecticide spray programmes.
- Insecticide application intervals of 10 days are unable to control ZC in crops.
- In light of the increasing levels of TPP and ZC in seed crops and their known impacts, the New Zealand Seed Certification Authority recently proposed a 0.1% tolerance for TPP/Liberibacter in their seed scheme.

A changing landscape of zebra chip

- Seasonal climate changes in some regions have altered the incidence of TPP and ZC in crops and processing factories

Graph of TPP trapped in Canterbury crops between 2008 and 2015



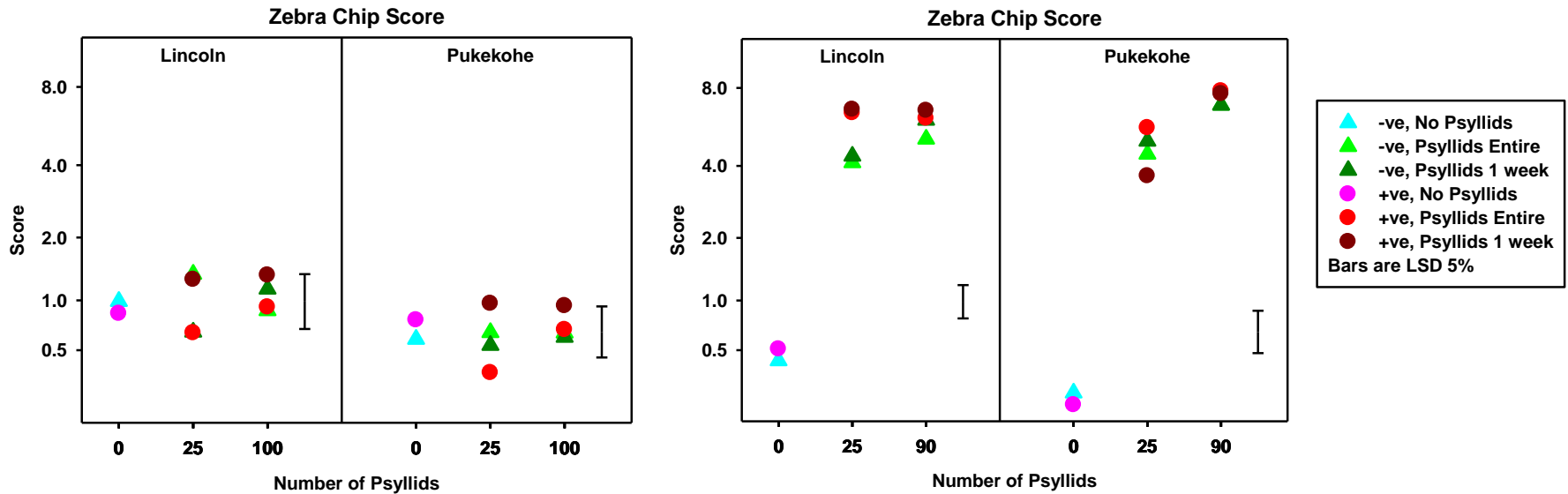
Zebra chip in fried tubers



Graphs of zebra chip associated with TPP and CLso in potato

CLso⁻ TPP

CLso⁺ TPP

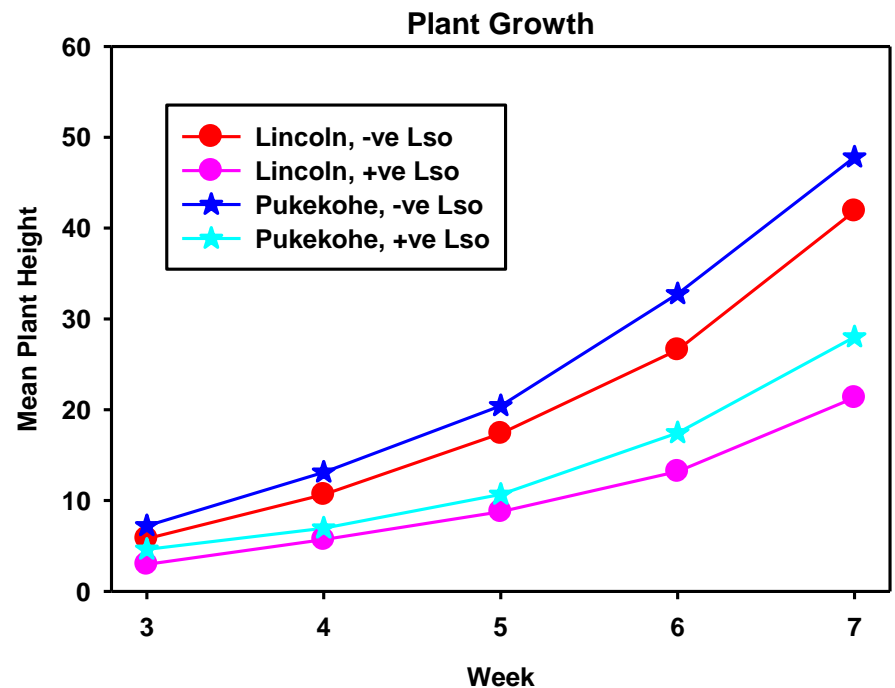
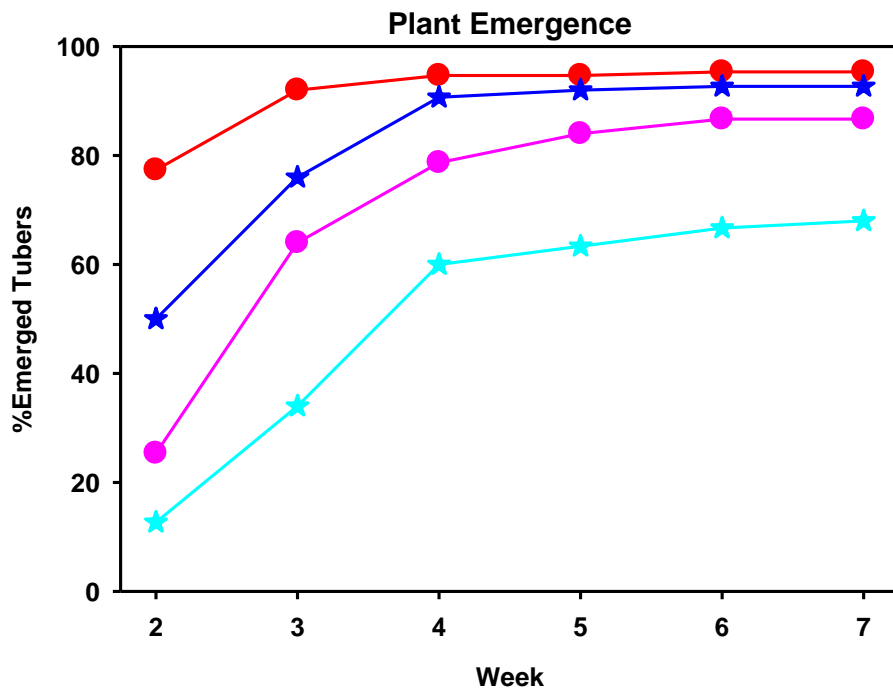


- **CLso⁺ TPP caused severe ZC**
- **CLso status of mother tubers did not affect ZC symptoms in daughter tubers**

Emergence and growth of potato plants

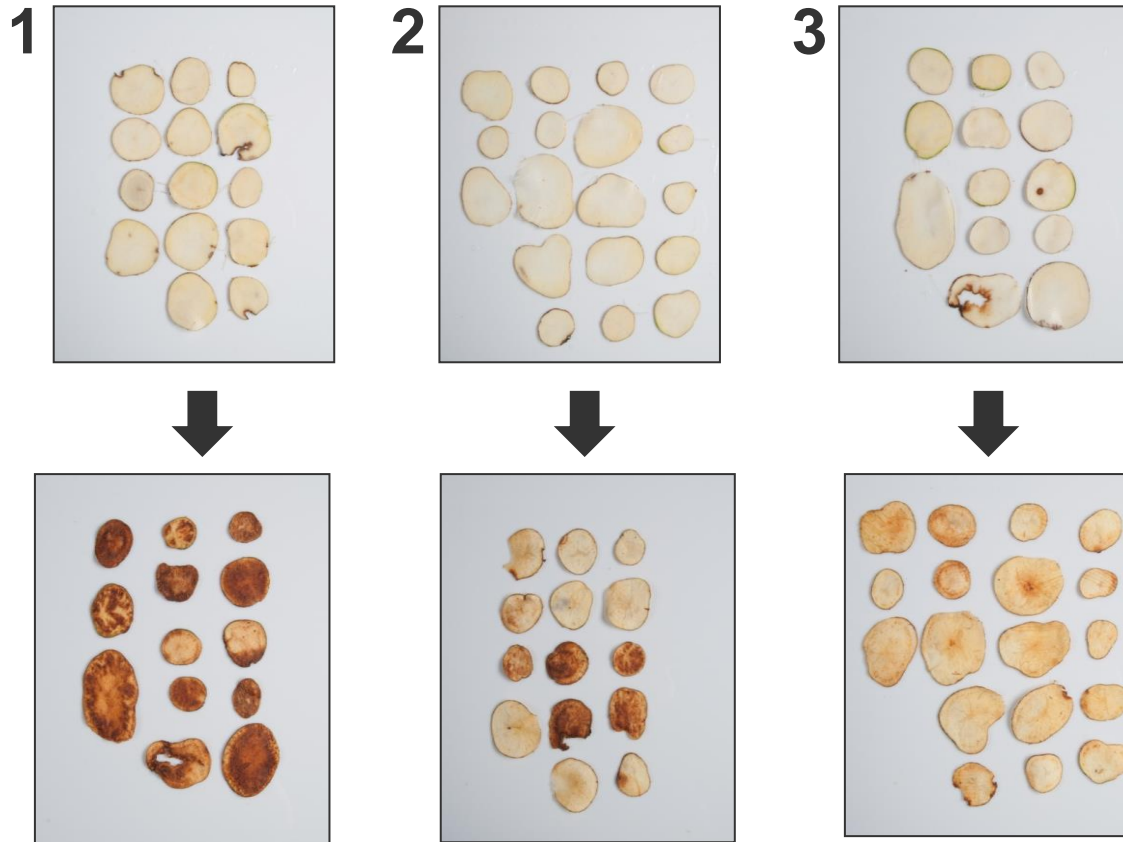


Graphs of plant emergence associated with CLso in potato tubers



- Plant emergence and growth from cLso⁺ seed tubers were less than from cLso⁻ tubers

ZC symptoms in New Zealand are different



Why?