



Psyllid News

February 2010

Welcome to Psyllid News

Psyllid News is intended to be a fast and economical way for Potatoes New Zealand to communicate with the potato industry on the latest developments in research and management of the tomato potato psyllid (*Bactericera cockerelli*), Liberibacter (*Candidatus Liberibacter solanacearum*) and Phytoplasma (*Candidatus Phytoplasma australiense*). The newsletter will be produced each quarter in email format, although a very limited number will be distributed by post – unfortunately those will take a few extra days to reach you.

If you have received this by post but would prefer to receive it by email, please send your email address to kate.shannon@hortnz.co.nz

Field meetings: Joe Munyaneza visit 22nd February – 4th March

Potatoes NZ is pleased to welcome US psyllid scientist Joe Munyaneza to New Zealand this month. Joe's travel is being funded by Potatoes New Zealand in order to encourage research cooperation and improve knowledge of psyllid management. The visit will include a series of grower field meetings -

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the format of the meetings is either an evening discussion meeting or to meet at a grower's property, have a look at a crop, and have a question / answer and discussion session. There will be many of our own industry advisors and scientists at the meetings, so it will provide a good opportunity for everyone to share knowledge and ask questions. All growers, distributors, processors, scientists and advisors are welcome so we hope you will join us.

Joe Munyaneza's visit schedule

| Date | Time | Place | Address |
|------------------------------------|--------|------------|---|
| Tuesday 23 rd February | 5.30pm | Pukekohe | Horticulture Store, Manukau Road (5.30pm start with drinks and BBQ meal, discussion / presentations to start around 6.30pm) |
| Thursday 25 th February | 9am | Hastings | Trevor Good, 120 Morley Road (if wet held at Fruited Supplies, Hastings) |
| Friday 26 th February | 2pm | Fielding | Ian Corbett, Kimbolten Road, Cheltenham |
| Tuesday 2 nd March | 9am | Darfield | Darfield Rugby Club (then travel to view a crop) |
| | 2pm | Rakaia | Andy Innes, 1149 Somerton Rd, Rakaia |
| Wednesday 3 rd March | 10am | Winchester | Nick Tayler, Rise Road, Winchester |

Situation update

The number of tomato potato psyllids (TPP) being caught in traps increased significantly during early January in most parts of New Zealand. Auckland, Hawkes Bay, and the Manawatu have reported the highest trap counts, while trap counts in the Waikato remain quite low. TPP numbers have increased rapidly in the Manawatu in recent weeks. Trap counts in North, Mid, and South Canterbury have been very low compared with the rest of the country (see Figure 1) but numbers in Mid-Canterbury increased in the week to 15th February. TPP has been detected from sticky traps set for non-psyllid purposes in

Southland, but not in target crops. Regularly updated trapping results are available on the Potatoes NZ website at www.potatoesnz.co.nz/psyllid.html

By mid-January growers in Pukekohe, Waikato and Hawkes Bay were beginning to see symptoms of psyllid damage in their crops. This is concerning, as most growers have been reasonably satisfied that their control programmes have kept psyllid numbers at low levels. Some crops have also been rejected for processing in the North Island, due to sugars and Zebra chip symptoms. Many of these have tested positive for Liberibacter.

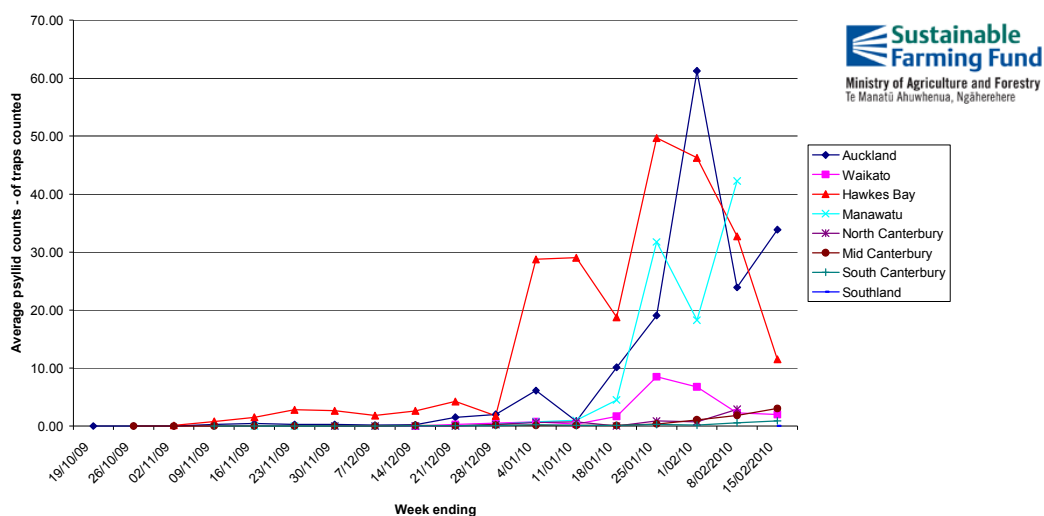


Figure 1: Tomato potato psyllid trap counts from eight regions of New Zealand

Psyllid coordinator



Potatoes New Zealand has contracted Dr Stephen Ogden of Market Access Solutionz to coordinate the industry's response to the psyllid. Stephen has been advising Potatoes NZ on biosecurity and market access issues for several years as well as

contributing to Potatoes NZ's psyllid strategy.

This new advisory and co-ordination role will occupy 75% of his time during the next 12 months, and he will be responsible for:

- communications between growers and researchers,

- monitoring the impacts of psyllid nationally,
- keeping growers and the science community informed of the psyllid's impacts,
- advising on the development of the science programme,
- helping develop recommendations for psyllid management, and
- monitoring grower implementation of recommendations for psyllid control.

Stephen has already been visiting growers in several districts and will be attending field days and meetings around the country over the course of the season so please take advantage of this to ask any questions you might have.

Potatoes NZ email newsletter

From early March Potatoes NZ will be producing a regular email newsletter on general information about the activities of Potatoes NZ and items of interest to growers. It will only be distributed by email, so if you have received this edition of Psyllid News in the post it means we don't have your email address and you won't receive the Potatoes NZ email newsletter. If you would like to be added to the email list please send your email address to Kate (kate.shannon@hortnz.co.nz).

Psyllid Levy – due 31 March 2010

Potatoes NZ has requested that everyone in the potato value chain – growers, merchants, retailers, processors, and exporters – contribute \$1 per tonne of potatoes harvested or handled during 2010 to a voluntary fund for fighting the potato psyllid. It has been estimated that \$5 million of research might be needed over the coming five years and Potatoes NZ cannot fund this without voluntary support from the industry. Your voluntary contributions will help us leverage the additional research funds that we are trying to obtain from Government agencies.

There is widespread support for this initiative so it is hoped that this will translate into a significant income stream that can be fed into important research. Potatoes NZ asks everyone to play their part and notes that all contributions are donations to the newly established Potatoes NZ Charitable Trust, which means that these are tax deductible. The first cheque has already been received. All contributors will be acknowledged on the Potatoes NZ website.

Use of approved agrichemicals

Growers are reminded that they may only apply approved agricultural compounds to their crops. Approved compounds fall into several categories:

- Registered for use on potatoes – must be applied in accordance with label directions and withholding periods (pre-harvest intervals) observed.
- Registered for use in New Zealand, but with no label claim for use on potatoes – may

be applied only if the default maximum residue limit (MRL) of 0.1ppm is not exceeded. The grower applying such compounds must know (e.g. through residue testing) that the MRL will not be exceeded. ACVM restrictions mean that some products may not be used off-label, so check with your supplier if you intend to use any product off-label.

- Exempt from registration – some compounds may not be required to be registered. However we have been advised that naturally occurring compounds being used as treatments for plant diseases on food or animal feed crops require registration under the ACVM Act. If in doubt ask your supplier for more information, or contact Potatoes NZ.

Psyllid identification training

Potatoes New Zealand, in conjunction with Plant & Food Research, held psyllid identification training courses in Auckland, Havelock North, and Lincoln in January 2010. As more growers are monitoring adult psyllid numbers in their crops it was recognized that accurate identification is needed – there are several species of native psyllids, and microscopes are needed to identify TPP accurately.

Each course was open to up to 10 participants from growers' businesses as well as companies providing crop monitoring and support services.



Psyllid identification training in Auckland

Research update

A lot of growers are asking about the psyllid research that is being done in New Zealand. Psyllid News, the Grower, and the Potatoes NZ website will be used to provide information on research findings both here and in the USA. This issue focuses on summarising the work being done in New Zealand, and also provides a summary of some of the papers presented at the Zebra Chip workshop held in Texas at the end of last year.

Over \$1.2 million is being spent in the current financial year on psyllid research in New Zealand. The funding comes from Potatoes NZ, Plant & Food Research, MAF Sustainable Farming Fund (SFF), FRST, HAL, with cash or in kind contributions from industry. Potatoes NZ is confident that we have established a well planned and methodical approach to finding the answers needed to manage this problem in New Zealand. That's not to say that there isn't room for more work to be done – that's why your representatives have been meeting with Government Ministers and Officials seeking another \$5 million in research funding over the next five years. We have also been talking to Plant & Food Research about capability building so that we can sustain the research initiative over the medium term. To help with all of this, Potatoes NZ has contracted a Psyllid Coordinator (see story on page 2) to help coordinate the research effort and provide a link between industry and scientists.

The two main research streams that you will probably hear about are the Sustainable Psyllid Management project under the MAF Sustainable Farming Fund (SFF), and the Plant & Food Research internal programme. There are also several projects being carried out by Plant and Food Research via other funding sources (including Potatoes NZ), as well as two post-graduate students working on the psyllid at Lincoln and Massey universities. In addition, agrichemical companies and supply companies are running spray trials, and many growers are gathering information on crop monitoring and the impacts of the psyllid on yield and quality of harvested tubers. All of this information will be useful to the research effort. There's a lot going on.

The SFF project is a three year joint project by the potato, tomato, capsicum, and tamarillo industries being funded with a \$533,000 Sustainable Farming Fund grant, with \$133,000 contributed by Potatoes NZ, and \$213,000 contributed by other Product Groups and McCains Foods Ltd, Mr Chips Ltd, and Bluebird Foods Ltd. Work under the SFF project that is applicable to potatoes includes:

- Three seasons of insecticide field trials - spraying thresholds, best practices and technology for spray applications, and a pesticide rotation strategy, as well as the development of effective monitoring methods.
- Assessment of "soft chemicals" and biological control agents for effectiveness in psyllid control.
- National psyllid monitoring and reporting (the weekly reports as discussed on page 2 and posted on the Potatoes NZ website at www.potatoesnz.co.nz/psyllid.html).
- Development of an accurate and cost-effective testing system for detection of *Liberibacter* in a range of crops.
- Determining the impact of the biological control agent *Tamarixia triozae* on native psyllid populations, a key step towards applying for the release of *Tamarixia* into New Zealand.
- Grower education is also a key priority, with resources containing up-to-date research results and other information about the psyllid and *Liberibacter* being sent to growers at regular intervals.

The Plant & Food Research internal programme involves the reinvestment of \$500,000 of its own internal funding into psyllid research to answer a number of fundamental research questions to underpin the SFF project and other research. This includes:

- Development of a system to culture *Liberibacter* in the laboratory (currently this cannot be grown in the laboratory) – this will increase the accuracy and speed of experimental work.
- Improved diagnostics for *Phytoplasma* (the SFF project only includes diagnostic work for *Liberibacter*).

- Determine the role of Phytoplasma in potato production.
- Identify alternative host plants for the psyllid, as well as alternative hosts for Liberibacter and the Phytoplasma, while also trying to determine whether any other insects may spread these diseases.
- More detailed work on the role of pest monitoring in psyllid management (which contributes to the work in the SFF programme)

Several other projects are underway which either directly or indirectly contribute knowledge to psyllid management:

- Determine the causal relationship between Phytoplasma and plant symptoms – at present it is not proven that Phytoplasma alone causes plant or tuber symptoms, other agents may be the cause.
- Assessment of a New Zealand species of Tamarixia as a potential biocontrol agent for psyllids.
- Assessing other natural enemies of pests in potato crops.
- Assessing New Zealand beneficial insects which also occur in Australia as potential biological control agents should the psyllid become established in Australia (in conjunction with Horticulture Australia Limited)
- Identification of chemicals to attract psyllids – these could be used to improve sticky traps, or be developed into management strategies such as a lure for mass trapping for psyllid population control.
- Luc Trans, a PhD student at Lincoln University, is studying the development rate and life history of the psyllid in order to predict when particular life stages will be present in crops. This information will be used to optimise monitoring and identify the best time to apply pesticides.
- Aleise Puketapu, a MSc student at Massey University, is studying psyllid host preference and population dynamics.

Zebra Chip conference - Texas 2009

In late 2009 US scientists gathered in Texas for a combined Zebra Chip / Huanglongbing research seminar. Huanglongbing, or citrus greening, is caused by closely related species of Liberibacter and potato and citrus scientists hoped to learn from each other's experiences. A strong contingent of New Zealanders was present at the meeting. Key findings of some of the more relevant papers are summarised below – full presentations are available at www.fritolayag.com.

This summary reports on research as presented at the Zebra chip meeting – the mention here of results or agricultural compounds does not constitute an endorsement by Potatoes New Zealand. Findings observed in the USA may not be representative of the situation in New Zealand. In particular, growers are reminded that only agrichemicals approved for use in New Zealand may be used on potato crops.

Alvarado & Scholthof: Monitoring zebra complex-associated physiological properties and Liberibacter population dynamics in individual psyllids and potatoes

- When psyllids which aren't infected with Liberibacter feed on potato plants, the plants show symptoms and physiological effects which resemble Liberibacter infection but the tubers don't show any sign of Zebra chip.
- Lugol staining (see the paper by Odokonyero below) of infected plants showed that starch was present in the stems and that tubers showed typical Zebra chip symptoms when cooked - healthy plants did not show these symptoms.
- Infested plants also showed accumulation of protein (Cyclophilin) in the stems.
- Both of these findings can be related to the action of Liberibacter in blocking the phloem of the plant.
- Psyllid populations can show a lot of variation in rates of Liberibacter infection over time - this research didn't find a correlation between the percentage of infected psyllids and level of crop infection (which is in contrast to other work suggesting there is).

Bextine: Beating Zebra chip: a molecular approach to understanding potato psyllid biology

- Biotype testing – 85% of psyllids are biotype I, while 12.3% of the psyllids from Texas, 13.2% from Guatemala, 17.1% from Mexico and 100% from Washington are Biotype II.
- Working to determine if *Liberibacter* and biotype are linked.

Buchman et al: Impact of *Liberibacter* infection timing on Zebra chip incidence, potato yield, and tuber processing quality

- Questions to be answered – Should I keep spraying right to harvest (i.e. does late infection cause Zebra Chip)? How long after psyllids are in the field do tuber symptoms develop?
- Psyllids infected with *Liberibacter* were allowed to feed on potato plants at different times after bloom to see whether *Liberibacter* infection is only a concern when the plants are young. The results were inconclusive, with one site suggesting that infection of older plants does not cause Zebra chip, while the second site showed that plants of all ages were susceptible to infection and went on to show Zebra chip symptoms (but at a lesser extent in older crops).
- It takes less than three weeks for Zebra chip symptoms to appear following infection (note only data points were 0, 3, 5, 7, 9, 11 weeks).
- Older plants may be less susceptible to Zebra chip.
- Very poor tuber set was reported if plants infected before bloom.

Butler & Trumble: Sampling and IPM of psyllids on potatoes

- Aim to develop a reliable presence / absence survey plan – so growers can look at a certain number of leaves and get a reliable presence / absence result.
- Strong edge effect reported – pre-bloom about 70% of psyllid nymphs were on field margins, post-bloom 35% were on the margins. There was a steady drop in psyllid numbers towards the centre of the field with ~8% of psyllid nymphs 80m into the field.
- Pre-bloom 90% of nymphs were at the middle of the plant and remainder at top of

plant (none at bottom). At bloom, similar numbers at all three plant locations, returning to mostly middle by post bloom.

- 100% of psyllids found on leaves, with ~90% of nymphs on the bottom of leaves.
- Lab work showed that imidacloprid reduced psyllid feeding for six weeks – note this was applied by drip. Avermectin and oil also had an effect, particularly when combined.

Crosslin: Zebra chip research and research support

- Over 2000 psyllids tested individually for presence of *Liberibacter* and found 2.3% were infected.
- Data suggests a correlation between the percentage of psyllids infected and the percentage of plants infected.
- PCR primers tested to determine which was the most accurate – some gave false positive results, and others were not sensitive enough to detect low concentrations of *Liberibacter*.
- Appears that the ribosomal protein pair CL514F/R 55-3-40 is the most consistently accurate primer.

French: Extension plant pathology & management of Zebra chip of potato

- Tested a range of products which treat Zebra chip symptom expression.
- The only treatment to result in increased tuber size was the application of a synthetic salicylic acid.

Geo et al: Relationship between potato psyllid infestation and Zebra chip incidence in potato plants

- Early psyllid infestation of young plants was associated with more severe symptoms in foliage and Zebra chipping in tubers.
- Five psyllid per cage - the minimum number tested - was enough to cause symptoms.
- Psyllid nymph and egg populations peaked six weeks after being put on plants.
- Psyllid infestation reduced photosynthesis, resulting in less starch and more sugars in tubers.
- Symptom severity differed between potato varieties – some varieties appeared to attract more psyllids, some didn't show foliar symptoms, some showed greater reduction in photosynthesis, some had more sugars

accumulating in tubers (leads to Zebra chip symptoms), and some showed a greater impact on yields.

Goolsby et al: Regional monitoring of potato psyllid populations and associated *Liberibacter* pathogens

- Monitoring methods – use sticky traps and egg & nymph counts.
- Sticky traps – used five cards per field, first card 9 m into the field and then every 60 m to the centre (circular fields).
- Adults removed and tested for *Liberibacter*.
- Egg and nymph counts done at 10 locations around the perimeter of the field, each count was of 100 mature leaves. Started at the bottom of the plant and found the first fully mature leaf that is not dirty, then sample 4-10 leaves per plant upwards from there.
- The percentage of adults infected with *Liberibacter* was variable – infection levels were generally below 5% on average over season, but there were some spikes of 20% infection at times. In five sites tested there was a mid-season spike as well as early and late season spikes at some sites.
- This research indicated that if more than 20 nymphs were found per 100 leaves there will be a Zebra chip problem in the harvested tubers.
- The rate of psyllids infected with *Liberibacter* was a good predictor of Zebra chip in tubers (though see the report by Alvarado & Scholthof).
- IPM programme was effective for psyllid control – refer to the full presentation for programmes used.
- Suggested that growers target the “expensive” insecticides around the perimeter of the field. Pymetrozine was found to provide good early season adult control, and abamectin also gave very good adult and egg control in this study.

Henne et al: Epidemiological studies of potato psyllid and Zebra chip

- 6% of psyllids caught were positive for *Liberibacter*.
- No correlation was seen between psyllid abundance and Zebra chip incidence.
- Early infected plants showed more Zebra chip symptoms and had lower tuber weight.
- *Liberibacter* infected tubers lost more

moisture and shrivel up.

- *Liberibacter* incidence peaked two weeks after the initial psyllid detection and then declined.
- There was a temperature effect on *Liberibacter* titre in psyllids – lower at low (5°C) and high (33°C) temperatures, and higher around 19°C.
- More psyllids recorded at edges of potato fields than in centre. In three fields tested numbers were significantly higher at edge than centre.

Kolber et al: Investigation into the presence of stolbur and other Zebra chip causal agents in processing potato varieties in Romania and South Russia

- Reports on potato stolbur in South eastern Europe - stolbur is a phytoplasma that has been present in Europe for many years and is vectored by planthoppers. This paper reports on host plants and vector species.
- With the establishment of crisping plants in the region Zebra chip-like symptoms are causing problems for processors.
- Interestingly, one psyllid (*Trioza chenopodii*) tested positive for *Ca. Liberibacter solanacearum*. Further work is required to confirm this finding.

Lawson: Zebra chip conference

- Report on Syngenta's field research looking at extending the protective effect of seed or in-furrow treatments and the “edge effect”.
- Results of trials are reported in the paper.
- Edge effects also investigated, with a significantly lower weight and lower number of “good” crisps at the edges of a field than closer to the centre of the crop.

Miller et al: Identification / development of Zebra chip tolerant resistant cultivars

- In 2008/09 over 32,000 tubers from 441 different selections or named varieties were assessed for Zebra chip. Twenty of these have been tentatively identified as “Zebra chip tolerant” and will be subject to further evaluation.
- Researchers are also looking at crossing potato plants with related wild species which are resistant to pest insects.

Munyaneza: Potato psyllid transmission of Liberibacter and its impact on Zebra chip development

- Psyllids can acquire Liberibacter after feeding on infected potato plants for as little as one hour, and they can inoculate other potato plants with Liberibacter within two hours.
- Only a single infected psyllid is needed to infect a plant – this single psyllid, passing on the infection, can reduce a plant's yield by 70%.
- The more infected psyllids on each plant the more the yield is reduced, though the initial infection from a single psyllid has the greatest impact.
- Even psyllids which aren't carrying Liberibacter impact on potato production, causing psyllid yellows and reducing yield. Psyllid yellows do not lead to Zebra chipping, however.
- Psyllid yellows, combined with Liberibacter, cause more pronounced losses than either does alone.

Munyaneza: Impact of environmental factors on Zebra chip development

- Examined the impact of temperature on Zebra chip and Liberibacter development, impact of planting time on Zebra chip development, and susceptibility of different potato varieties to Zebra chip and Liberibacter.
- Low temperatures (below 13°C) appear to slow Zebra chip development in potatoes, while high temperatures (above 35°C) also slow development – the optimum temperature for Zebra chip development was 22-32°C.
- Temperatures above 32 °C appear to prevent the psyllid from laying eggs and can be lethal to the insect.
- Early planted potatoes in Southern Texas may be more affected than late plantings.
- Researchers also tested nine currently available potato cultivars to see if any were resistant to Zebra chip but all were severely affected.

Nansen et al: Performance studies of potato varieties and insecticides

- Different potato cultivars appear to have different levels of "attractiveness" to potato psyllids. Flowering appears to increase this

attractiveness.

- Measured feeding by McBride staining of feeding sheathes in leaves, enabling the number of probing events to be measured. There was no obvious link between psyllid feeding rates and egg laying.
- Insecticides can reduce the attractiveness of leaves but only when there is sufficient coverage of the leaves – although there are significant concerns that patchy coverage negates this effect.
- Abamectin appears to kill adults and shut down probing.
- Spray coverage – better coverage was reported with a ground rig than aerial application even when corrected for actual water volumes used.

Odokonyero et al: Etiology of zebra complex disorder in potatoes

- This paper reported on the correlation between Zebra chip symptoms on plants and presence of Liberibacter in various plant tissues.
- When various parts of symptomatic plants were tested for Liberibacter using PCR, half or less tested positive: 50% of roots, 37.5% of tubers, 37.5% of lower stems, 25% of upper stems and 3% of leaves.
- Several reasons were suggested, including low sensitivity of the PCR test.
- The stems of the same plants were also tested by Lugol staining, which dyes starch purple. All symptomatic plants stained positive indicating the presence of starch, whereas none of the asymptomatic plants stained positive.
- Editor's note: As this test only takes 20 minutes, perhaps it has some value as a quick diagnostic tool?

Rush: Specialty crop research initiative – management of Zebra chip to enhance profitability and sustainability of US potato production

- Outlined a US\$6.7 million, 5 year research programme to deliver the following outcomes:
 - Best management practices
 - A Zebra chip assessment / disease forecasting model
 - Tolerant varieties
 - Economic models with cost-benefit analyses

- Extension publications, demonstration trials, training and educational programmes

Trumble: History, range, and scope of the potato psyllid problem

- Liberibacter reduces nitrogen, causes conversion of starches to sugars, reduces the size of chloroplasts and causes chloroplast distortion, 60-65% vertical transmission, mixed populations with / without liberibacter.
- Tested aspects of "fitness" of native vs invasive strains of psyllid and concluded that "invasive" strain no more fit than the native strains.
- Noted that in California the level of resistance much higher than in Texas.
- Reported that monitoring through trapping is of limited value as there is no way to relate trap numbers to infestation in the field – the only way to do this is through egg and nymph counts.
- Strong edge effects and patterns of infestation – these can be treated to contain spread.
- Trichome based resistance the only basis for resistance found so far.

Wen et al: Zebra chip research 2009

- This research was aimed at determining the impact of Zebra chip on the development of potato plants from seed-borne infection of Liberibacter. However it should be noted that the identification of "Zebra chip-free" and "Zebra chip-infected" seed lines was done by cutting and visual examination for symptoms.
- In subsequent testing it was found that both seed lines had identical (70% and 71%) levels of Liberibacter infection.

- Editor's note: The results may reflect the effects of low and high levels of Liberibacter in the seed, rather than absence / presence.
- Potato seed from the Zebra chip-free line had significantly lower emergence than the Zebra chip-infected seed line. 95.9% of Zebra chip-free seed germinated in 7 days compared to 6.1% Zebra chip-infected seed.
- After 56 days 99% of Zebra chip-infected and 41.8% of Zebra chip-free seed had emerged.
- In the Zebra chip-infected seed growth was also affected, with only 47% of plants viable at harvest, 44% producing tubers, and 15% producing tubers with Zebra chip symptoms.
- Tuber size was also smaller from Zebra chip-infected seed.
- Zebra chip-infected seed produced plants with Liberibacter in the foliage (i.e. could be acquired by a psyllid) and in daughter tubers, whereas this was not the case in the Zebra chip-free lines.

Yang et al: Interactions between host plant and potato psyllid

- The amino acid (protein) profile of potato leaves changes after psyllid feeding (tubers still being tested). The phenolic acid compounds in leaves and tubers also change.
- Laboratory assessments - Abemectin was reported to be very effective on small and medium nymphs. Pyriproxyfen was reported to be very effective on eggs. Mineral oil was reported to be very effective on small nymphs. Mineral oil and a patented mineral oil / essential oil blend both had strong repellent effects on adults.

Front page header image courtesy of Joseph E. Munyaneza, USDA

Potatoes New Zealand

www.potatoesnz.co.nz

Ron Gall (Business Manager)
Horticulture New Zealand
PO Box 10 232
Wellington

Phone 04 472 3795
Fax 04 471 2861
Mobile 027 446 6838
Email ron.gall@hortnz.co.nz

Stephen Ogden (Psyllid Coordinator)

Phone 04 473 6040
Fax 04 473 6041
Mobile 021 773 502
Email stephen@solutionz.co.nz