Let's talk

Tomato Potato Psyllid (*Bactericera cockerelli)*

A known pest of the USA and Canada, and New Zealand as recently as 2006, the Tomato Potato Psyllid (TPP) has recently been found on the west coast of Australia.

TPP primarily feeds on potatoes, tomatoes and capsicums, but can be found on approximately 20 other plant families. Of these 20 families, TPP has a preference towards solanaceous crops (eggplants, tamarillos), solanaceous weeds (nightshade), sweet potatoes, and boxthorn.

LIFECYCLE

Egg – Psyllid eggs require a hands lens to view and are attached to the plant by a short vertical thread. They are usually laid on the lower surface of leaves or along the stalk. Eggs are white when first laid then develop into a yellow/orange after a few hours. Often, females will lay numerous eggs on a single leaf. The eggs measure around 0.3 mm long, 0.14 mm wide, and are mounted on a stalk of about 0.5 mm. Eggs take 3-7 days to hatch (Abdullah, 2008).

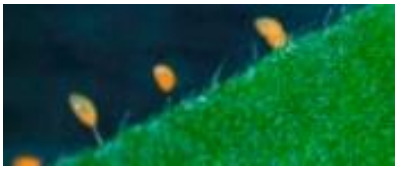

Figure 1. Tomato Potato Psyllid eggs (source: The New Zealand Institute for Plant & Food Research)

Nymph – Psyllid nymphs are oval, flat, and 2mm long, much like scale. There are five nymphal instars, with each instar differing morphologically. Nymphs have a pair of red eyes and 3 pairs of short legs (DAFWA, 2017). Nymphs change colour as they develop, with the youngest nymphs being orange, then becoming yellowish-green and then green as they mature. Around the third instar, the nymphs become fringed with wax filaments. Nymphs prefer sheltered/shaded locations, so they are found on the lower surfaces of leaves and usually remain inactive during their development. The time it takes for this nymphal progression is determined by temperature and host plant, and can range from 12 to 24 days (Yang XiangBing, 2009). Potato psyllid nymphs may be confused with the nymphs of whiteflies, although the whiteflies move when disturbed (Clayton-Greene).

Figure 2. Tomato Potato Psyllid eggs, left to right - older, younger (source: Western Australia Department of Agriculture and Food, 2017)

Adult – Adult psyllids have been said to resemble tiny cicadas under magnification (Clayton-Greene). They are about 3mm long, similar to adult aphids. The overall body colour ranges from pale green at emergence to dark green or brown within 2-3 days, and eventually becomes grey or black thereafter. The body has white or yellowish markings on the thorax and a wide white band on their abdomen. Wings are transparent and held vertically over the body. Adults are good fliers and readily jump when disturbed (Centre for Agriculture and Bioscience International, 2017).

Figure 3. Tomato Potato Psyllid adults. (source: Western Australia Department of Agriculture and Food, 2017)

MONITORING

Effective management of TPP requires constant monitoring. Early season management of this insect is crucial to decrease damage and TPP reproduction. Sweep nets or vacuum devices are commonly used to sample adult populations, but egg and nymphal sampling requires a hand lens and visual examination of foliage. Yellow sticky traps are currently being distributed by the Department of Agriculture and Food Western Australia, DAFWA, to monitor around WA, and yellow water-pan traps are used in USA (Horticulture New Zealand, 2008). Typically, TPP populations are at the highest around the edges of the crop, and as pressure increases they spread inwards (Butler CD, 2012).

NZ monitoring recommendations are as follows (New Zealand Fresh Vegetables, 2008) –

Aim to monitor at least 1 in 60 plants (60 being an approximate number of plants in a glasshouse bay). Monitoring should be done weekly, focussing on yellowing plants or plants with evidence of psyllid sugars. Inspect the top section of capsicum plants and middle section of tomato plants.

Score per plant as follows
1 – No psyllids present
2 – Adults only visible
3 – Adults and eggs (if psyllid sugars present)
4 – Adults, eggs, and nymphs on 1-5 leaves
5 – Adults, eggs, and nymphs on >5 leaves
6 – Psyllid infestation on adjacent plants
Also estimate the percentage that is infested with psyllids (0 – 100%)
At the conclusion of the monitoring session, calculate the following
- Average psyllid infestation score
- Average percentage of the plant infested.

THRESHOLDS

After each monitoring session, take the average psyllid infestation score and percentage of plant infested and use the table below to work out what action is required (New Zealand Fresh Vegetables, 2008).

In general you should take the action that applies to the highest of the value or percentage. For example, if the percentage value is <1% but the level of infestation is >1.8, then a full insecticide application should be made.

Percentage of sample infested with psyllids	Value indicating level of psyllid infestation	Action
0	0	No action
<1%	<1.5	Remove infected leaves
1-2%	1.5-1.8	Spot spray insecticides to infected area
>2%	>1.8	Full insecticide application to whole greenhouse

Figure 4: Action thresholds according to Vegetables New Zealand

CONTROL METHODS

Many options can be used to reduce populations (New Zealand Fresh Vegetables, 2008).

- Healthy crops will have a higher resistance to damage
- Utilize hygiene to prevent the psyllid from entering the crop by controlling weeds (focus specifically on solanaceous weeds such as nightshade) in a buffer zone around the property. Also ensure seedlings are free from psyllid when planting. Check that your seedling provider is implementing control measures.
- Certain spray options with a contact mode of action should be considered whenever possible. This will assist with minimizing pests from visiting plants and/or laying eggs. For example – "soaps, compounds that are sticky or have deterrent properties (spreader/sticker adjuvants), essential oils (e.g. cedar wood and neem). Care should be taken when trialling oils as many are phytotoxic". (Biosecurity Australia, 2009)
- Chemical options are available, however nothing is registered for the control of TPP in Australia currently. Good coverage with the insecticide or translaminar activity is significant because psyllids are frequently found on the underside of the leaves (Munyaneza JE, 2012). Chemical options are available under permit - **PER84063** in WA only.

Initial chemical trials found that numerous insecticides had a low mortality rate against the psyllid (mostly <40%) or took a couple of weeks to kill, this being a problem because of the potential for TPP to spread Zebra Chip disease before death. *Abamectin* and oil, and *bifenthrin* were the most effective against TPP with high mortality rate over 3 days (Page-Weir NEM, 2011).

Abamectin, *cyantraniliprole*, *spinetoram* and *sulfoxaflor* have a greater persistence of up to 14 days (Gardner-Gee R B. R., 2012).

There are a number of insect predators that attack TPP, including lacewing, hoverfly and ladybirds, but these are killed by full spectrum insecticides. *Abamectin*, *cyantraniliprole*, and *spirotetramat* do not do much harm to beneficial predators, while *spinetoram* will kill some species (Gardner-Gee R P. A., 2013).

Permit Chemical control options (PER84063)

Situation	Product	Active ingredient	Rate
Home gardens for control tomato potato psyllid, which feeds on tomato, potato, capsicum, chilli, eggplant, tamarillo, sweet potato, solanaceous weeds and solanaceous ornamentals	Success Neo	120g/L *Spinetoram*	Apply at maximum rate for insect pest control in fruiting and/or tuber vegetables (where listed on product label) or at the maximum rate in fruit bearing crops or ornamentals (where fruiting or tuber vegetables are not listed)
	Yates Success Ultra	5g/L *Spinetoram*	
	Abrade Abrasive Barrier	450g/L *Amorphous Silica*	
	ALL REGISTERED PRODUCTS containing	0.3g/L to 0.4g/L *Pyrethrins* & 1.2 to 20g/L *Piperonyl Butoxide*	
	Yates Nature's Way Vegie and Herb spray	285g/L *Potassium Salts of Fatty Acids*	
	Eco-oil Miticide/Insecticide Botanical oil	850g/L *Emulsifiable Botanical oil*	
	ALL REGISTERED PRODUCTS containing	815-847g/L *Paraffinic oil*	
	ALL REGISTERED PRODUCTS containing	801-861g/L *Petroleum oil*	

As TPP has been in NZ since 2006, there are many products registered there for their control. The following are off label in Australia currently, but are registered for insect control on the crops such as potatoes, tomatoes and capsicums. Always check registration for the crop before recommending/spraying. **Research is underway on the following options.**

Group	Active	Brand name Aus	NZ equivalent (with label for TPP)	Notes
23	Spirotetramat	Movento 250gai	Movento OD 150gai	Adults (reduces egg laying) Nymphs
5	Spinetoram	Success Neo	Sparta 120gai	Adult, Nymph
6A	Abamectin	Stealth 18gai	Avid	Adult, Nymph
28	Cyantraniliprole	Benevia (AU)	Benevia	Adult, Nymph (more active on nymphs)
1A	Methomyl	Lannate L	Orion Methomyl 200SL	
3A	Lambda-cyhalothrin	Matador	Karate Zeon	Works on adults only
1 + 3A	Chlorpyrifos & Lambda-cyhalothrin	Cobalt Advanced	Cobalt Advanced	Adult & Nymph

ZEBRA CHIP DISEASE (POTATOES)

Figure 5 Zebra Chip symptoms in cooked potatoes

TPP can carry a bacteria called *Candidatus Liberibacter solanacearum* in its gut, which can cause Zebra chip (ZC) in potatoes. Along with psyllid feeding damage, ZC is a major problem for potato growers. An infected psyllid can pass along the infection to a healthy plant within a few hours of feeding (Munyaneza, 2012). ZC infected plants exhibit 'psyllid yellows' symptoms and upward rolling of leaves. Tubers of infected plants rarely sprout, and if they do they produce hair sprouts or weak plants. Infected tubers exhibit collapsed stolons and browning of vascular tissue. This browning becomes an economic issue as it becomes more evident during frying, making the potatoes commercially unacceptable. The symptoms in fresh potato are less noticeable, but yield in negatively impacted and there is a perception that the infection affects taste. For process crops, the bacteria lowers the "… specific gravity that increases the water content of tubers, thus rendering them more expensive to process as French fries." (Walker PW, 2015). AUSVEG reports that "in New Zealand an average of 1.5-2% ZC will result in rejection by the factory of the entire crop" (AUSVEG)

Currently all potato varieties are susceptible to ZC, and the only way to effectively control the disease is to control the host, TPP. (Munyaneza, 2012)

"Some pesticides, including plant and mineral oils and kaolin, have shown some substantial deterrence and repellence to TPP feeding and oviposition could be useful tools in integrated pest management programs to manage zebra chip" (Munyaneza, Buchman, Sengoda, Fisher, & Pearson, 2011)

PSYLLID YELLOWS

Psyllid yellows are another consequence of the arrival of the TPP. Psyllid Yellows symptoms are present with ZC disease, but can also be present without. Symptoms include 'yellowing and upward rolling or cupping of leaves' and defective tubers in potatoes (AUSVEG).

Psyllid Yellows is an economic issue in tomatoes and capsicums. Tomatoes show the classic yellowing, and curling/cupping of leaves as well stunting of the growing point. Infected plants produce misshapen fruit and many flowers abort off the trusses. Both tomatoes and capsicums smaller, less abundant fruit and changes in their skin texture when infected. (New Zealand Biosecurity, 2011)

Figure 6 Psyllid yellows (source: EPPO Global Database)

CURRENT SITUATION IN WA

On the 10th of February 2017, DAFWA announced they had detected TPP. "A pest has been detected in a capsicum crop in a commercial property north of Perth, backyard tomatoes and eggplants in Belmont and backyard tomatoes at two properties in Mount Hawthorn and in chillies at a property in Palmyra,". Of main concern is the bacterium that causes Zebra chip disease in potato that gets transmitted via TPP. To date, (9/3/17) this disease has not been found in WA.

DAFWA reports the psyllid has been confirmed in the Perth metropolitan area in commercial and residential properties, and retail outlets. A small number of detections have been increased, to outside of the metropolitan area including Gingin, Yarloop and Busselton (9/03/17).

A Quarantine Area Notice (QAN) has been put in place due to the presence of this harmful pest (see figure 1). The aim of the QAN is to restrict the spread of this pest to other parts of the state.

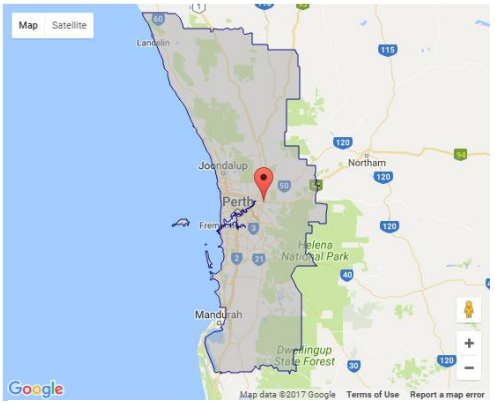

Figure 7 Quarantine area as of 9/3/17, marked is the location of Elders Midland, Bellevue

Movement guidelines

For product of the solananceous or convolvaceous fruit/vegetables to be moved out of the quarantine area it must be fumigated. This must happen no more than 60 hours before movement, and be evidenced by records which include details of treatment, transporters and consignees.

Fumigation with methyl bromide for two hours at the rates in the figure 5.

Flesh Temperature (°C)	Methyl Bromide (g/m3)
21 - 31.9	32
16 - 20.9	40
11 - 15.9	48
10 - 10.9	56

Figure 8 as per DAFWA 2/3/17

Pest Control Notice

Figure 9 Yellow sticky trap distributed by DAFWA (source: DAWFA News & Media)

DAFWA have distributed yellow sticky traps to monitor for the spread of TPP. "We are asking people to collect a trap and host it on their property, then return the trap seven days later in sealed plastic bags provided" (Ian Guthridge, Manjimup). If TPP is believed to be found on a property, a Pest Control Notice (PCN) will be distributed.

PEST CONTROL NOTICE ISSUED/REVISED

- Knockdown Treatment to be commenced within 24 hours of PCN being received:
  - Paddock borders with weeds are to be treated (insecticide & herbicide);
  - 24 hours after treating paddock borders, treat crop to control nymphs and adults (see control measures under notes/critical issues).
  - Next day (24 hours later) spray crop to control eggs (see control measures under notes/critical issues).
- Movement on property should be confined to the owner, the occupier and essential personnel until treatments are completed.
- No further inspection and/or trapping by DAFWA staff and property released from PCN after being notified by grower of completion of treatment
- Fruit moved within QA after this treatment
- Fruit movement OUTSIDE QA requires treatment as per QAN

Continue to test psyllid trapped for CLso as per current.

Seed Potatoes

- 300 tuber samples to be taken and PCR tested for CLso,
- Seed potatoes are not to be removed from the property and if harvested are to be stored separately until CLso test results are available
- Movement on property should be confined to the owner, the occupier and essential personnel until treatments are completed and test results received negative.
- If CLso test is negative, seed potatoes may be harvested and moved provided free of above-ground plant material.
- No further inspection and/or trapping by DAFWA and property released from PCN after being notified by grower of completion of treatment.

Processing Potatoes

- Knockdown Treatment to be commenced within 24 hours of PCN being received
  - Paddock borders with weeds are to be treated (insecticide & herbicide);
  - 24 hours after treating paddocks borders, treat crop – systemic (*spirotetramat*) – if not sprayed off
- 300 tubers samples taken and PCR tested for CLso
- Processing potatoes may be harvested and free of above-ground plant material; securely packaged, transported in sealed trucks and delivered directly to the processing plant.
- Movement on property should be confined to the owner, the occupier and essential personnel until treatments are completed and test results received negative.

- No further inspection and/or trapping by DAFWA and property released from PCN after being notified by grower of completion of treatment.

NOTES/CRITICAL ISSUES

NOTE: Spray treatment depends on the age of the crop and withholding periods.
NOTE: Existing IPS – once a DAFWA Inspector is satisfied that required treatments have been completed, this will allow the Notice to be signed off.

Control Measures

1. **Paddock borders**

- Paddock borders with weeds are to be treated with 50mL/100L of *bifenthrin* (100g/L) mixed with 450mL/100L of Starane Advanced* herbicide (333g/L *Fluroxypyr* as the methyl heptyl ester) plus 2% spray oil

2. **Capsicum crop**

- 24 hours after treating paddock borders, to control nymphs and adults on capsicum, use 800mL/ha of the 100g/L *bifenthrin* (APVMA PER13567 for fruit fly in QLD).
- Next day (24 hours later) spray to control eggs using 200ml/100L of the 225g/L active of *methomyl* (the highest registered on sweet peppers – capsicum).

3. **Tomato crop**

- 24 hours after treating paddock borders, to control nymphs and adults on tomatoes, use 60ml/100L active *bifenthrin* (the highest registered on tomato for native budworm and mite species).
- Next day (24 hours later) spray, to control eggs, use 200mL/100L of the 225g/L active of *methomyl* (the registered rate for Native budworm on tomato). Note: *methomyl*, has a restraint that it is not to be used in protected cropping situation (shade houses, tunnel houses).

4. **Eggplant crop**

- 24 hours after treating paddock borders, to control nymphs and adults on eggplant use 280mL/ha of the 100g active of *alpha-cypermethrin* (APVMA PER80099 for fruit fly control on fruiting vegetables)
- Next day (24 hours later) spray to control eggs use 200mL/100L to max of 1-2L/ha of 225g/L active *methomyl* (APVMA PER82428 for various pests specified on fruiting vegetable crops).

5. **Chilli crop**

- 24 hours after treating paddock borders, to control nymphs and adults on chilli, use 280 mL/ha of the 100g/L active *alpha-cypermethrin* (APVMA PER80099 for fruit fly control on fruiting vegetables).
- Next day (24 hours later) spray to control eggs, use 200mL/100L to a maximum of 1-2L/ha of the 225g/L active of *methomyl* (APVMA PER82428 for various pests specified fruiting vegetable crops).

6. **Seed & Processing Potatoes**

- 24 hours after treating paddock borders, spray growing potato crops with 400mL/ha of the 240g/L active of spirotetramat (Movento 240SC label). Repeat treatment every 6 weeks* for a maximum of 3 sprays to control TPP nymphs, adults and reduce egg lay. Treat crop for other pests as required as part of normal cropping program.

**Contact your local Elders agronomist for specific control advice*

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