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POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT

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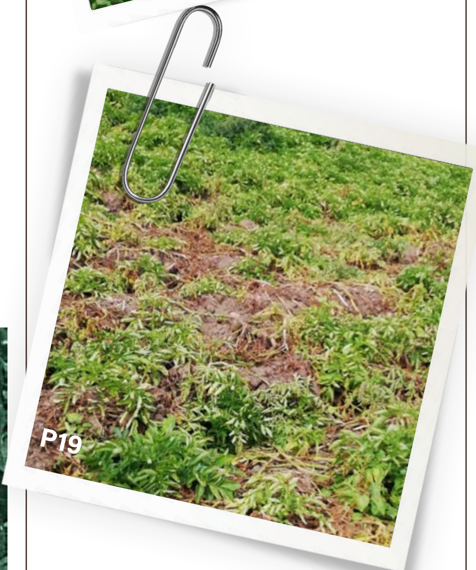

POWDERY SCAB PROJECT UPDATE

If you grow potatoes in Tasmania, you are probably familiar with powdery scab. While sometimes regarded as a southern disease, this devastating pathogen has been detected from Queensland to South Australia, and even parts of Western Australia. Annual losses are estimated to top $13.4 million annually. However, incidence varies hugely by cultivar and area, raising the question – WHY?

Jenny Ekman reports.

Professor Calum Wilson from the Tasmanian Institute of Agriculture (TIA) is a world leader when it comes to managing *Spongospora subterranea*, the cause of powdery scab. He is currently conducting a three-year Hort Innovation project "Mechanisms and manipulation of resistance to powdery scab in potato roots".

Professor Wilson provided an update on the project at the recent R&D Forum in Ballarat.

While the most obvious symptoms of powdery scab are lesions on tubers, the pathogen also causes formation of galls on roots, shoots and stolons (Figure 1).

Figure 1. Galls can form on roots, stolons or shoots. Source: C. Wilson.

However, it is the effects on the roots which have the greatest influence on yield. Symptoms of root infection are not always visible, with the result powdery scab can be an underestimated disease. However, recognition of the importance of this pathogen has been increasing worldwide.

It is also possible that intensification of production, use of susceptible varieties and more frequent irrigation have increased incidence of disease[1].

HOW DOES INFECTION OCCUR?

Infection mainly occurs by zoosporangia binding to and then infecting the root hairs (Figure 2). This early, critical stage can reduce root function by 20% or more, even though no symptoms are outwardly visible. Root infection is often unrelated to the physical symptoms of galls and lesions on tubers and roots. However, it is the most important factor reducing plant growth (Figure 3, Figure 4).

Professor Wilson has therefore focussed primarily on the root hair infection phase, rather than the symptoms on tubers. The aims of the project are to:

- Reduce losses
- Reduce input requirements, including water and fertiliser

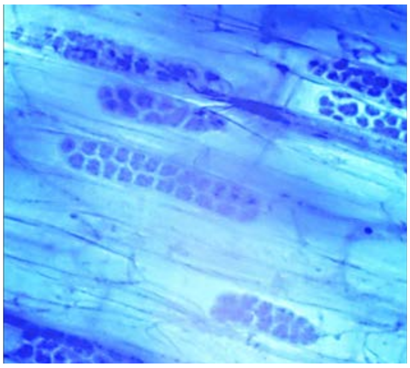

Figure 3. Zoosporangia forming in root cells. Source: C. Wilson.

Figure 4. Healthy potato seedlings (top), compared to seedlings infected with powdery scab (bottom). Although no scab or root galls have formed, there are clear effects on both root and shoot growth of the infected plants. Source: C. Wilson.

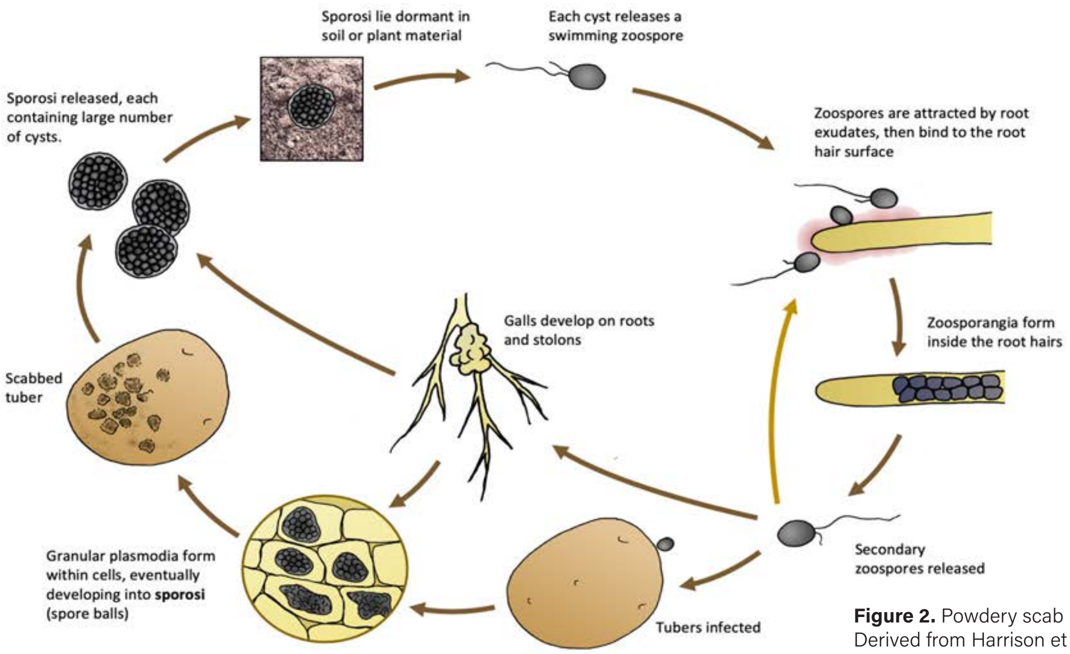

Figure 2. Powdery scab lifecycle. Derived from Harrison et al., 1997 and Falloon et. al., 2015.

- Improve quality and storage life of tubers
- Develop new disease management and resistance screening tools

To achieve this, the project has progressed in a series of activities.

The first was to develop a new way to search for resistant varieties. Traditional screening relies on growing different potato varieties in a glasshouse over many months, then examining root galls and lesions formed on tubers. This is not only time and resource intensive, but may not provide an accurate indication of infection.

Professor Wilson's new method examines the numbers of zoospores able to attach to the potato root hairs. This technique can provide reliable results in as little as 48 hours, potentially allowing hundreds of cultivars to be screened for resistance.

"We wanted to measure how much infection occurs in those roots," said Professor Wilson, "you get varieties where there are almost no symptoms

Table 1. Variety resistance to powdery scab, based on the root attachment assay.

Highly susceptible	Moderately susceptible	Moderately resistant	Good resistance
Nicola	Gold Rush	Russet Burbank	Russet Nugget
Liseta	Yukon Gold	Desiree	Granola
Kranz	Tasman	Dawmore	Tolaas
Shepody	Spunta	Sebago	Tolangi Delight
Shine	Pontiac	Brake Light	
Red Ruby	Frontier Russet	Ruby Lou	
Patrones	Lustre	Fontenot	
Delaware	Wilwash	Purple Congo	
Nooksack	Leven	Cranberry Red	
Coliban	Bintje	Nampa	
Southern Cross	Pentland Dell	Spey	
Kennebec	Mainstay	Banana	
Diment	Cariboo	Pink Eye	
Kipfler	Atlantic	Dutch Cream	
Up-to-Date	Chiefton		
	Sequoia		
	Bismark		
	Yellow King		

on the tubers, but very high levels of infection in the roots – and vice versa (Nicola is an example of this). Our screen directly examines that initial stage of root infection."

The results from the root assays can then be used to select potato varieties that resist infection by the *Spongospora* zoospores.

INDUCING RESISTANCE TO ROOT INFECTION

Professor Wilson's team also looked at a novel tecnique that allows selection of resistant variants of existing cultivars. 'Somaclonal variants' are produced by exposing shoot tips to a stress, then growing the young plantlet in tissue culture. The plantlets often look and behave almost identically to the parent plant, but can have tiny genetic changes.

"Using our new assay we can screen for those variants that have altered susceptibility to root infection" explained Professor Wilson.

The TIA laboratory produced a large number of somaclonal variants, exposed them to the *Spongospora* pathogen, and examined infection of the root hairs by zoospores. As shown in Figure 5, while most are similar to the parental line, some variants proved highly resistant to zoospore binding.

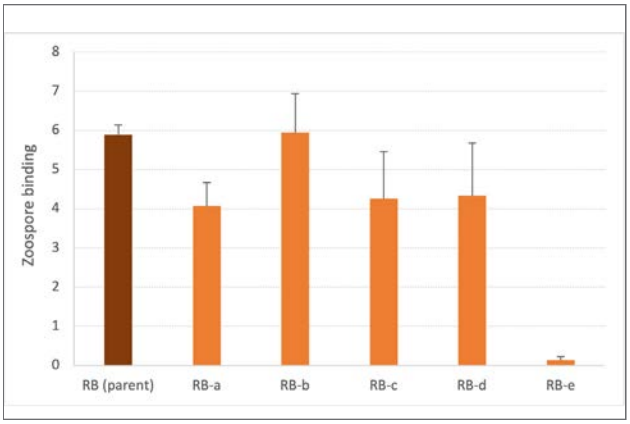

Figure 5. Somaclonal variants, here labelled a to e, were produced from parental line RB. While zoospore binding to most variants was similar to their parent, RB-e was highly resistant.

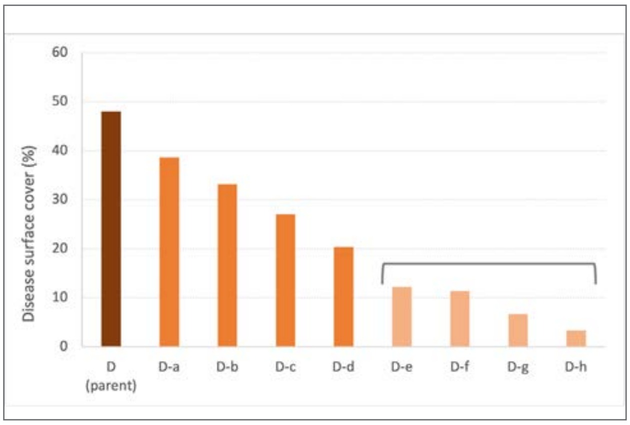

Figure 6. Somaclonal variants (here labelled a to h) that resisted zoospore infection were grown in the glasshouse, then tubers examined for scab. Variants D-e to D-h were significantly different to parental line D.

The next stage was to conduct greenhouse trials with lines that appeared to have resistance. Plants were grown to maturity and tubers examined for signs of disease.

While there was considerable variability, several of the variants that strongly resisted binding by zoospores also had less physical evidence of powdery scab (Figure 6). Of course, these variants still need to be field tested to examine yield and other agronomic characteristics, but such results are highly promising.

PREVENTING INFECTION

The third phase of the project is finding ways to prevent infection in the first place. "We are interested in just how the pathogen attaches to the roots and how we can basically stop it happening," Professor Wilson commented, "one possibility is to find a receptor, something that the pathogen recognises and allows it to bind."

The team compared resistant and sensitive varieties. Sure enough, they came up with a candidate – a 'glycosolated protein receptor.' When they used enzymes to remove glycosylated proteins from a root hair, zoospores no longer attacked it. "We now have a candidate for where the pathogen binds – if we can knock this out, we could have an immune variety," explained Professor Wilson.

Another avenue is to look at the natural root exudates potato plants produce. These can either attract or repel the swimming zoospores.

"What we found was that the resistant varieties had less of the attractants, and more of the inhibitors, so this

Powdery scab symptoms on a tuber

again could be a really useful screen for resistance."

An Australian Research Council (ARC) grant has enabled the TIA team to examine whether a bacterial inoculant could interfere with this process. The bacteria consume the attractant root exudates, reducing potential infection.

A large number of bacteria have been screened for this ability.

"We got one!" announced Professor Wilson, "and not only did the bacteria digest away the key attractant exudates, it also grew bigger potatoes. It both boosted productivity **and** reduced disease." While the bacteria was not a cure for powdery scab, it meant that susceptible varieties produced a better crop in the presence of the pathogen (Figure 7). If the disease was not present, adding inoculant still produced a bigger crop.

NEXT STEPS

Professor Wilson feels the best option is to target the root receptors. "Potentially, we can use genetic approaches to knock those out, and get an immune variety."

Other good options involve improving root health using beneficial bacteria as a seed dressing, helping the plant tolerate infection. It will also be important to examine interactions between interventions for powdery scab and incidence of other root diseases.

One thing is clear. Powdery scab is both a fascinating and challenging organism. However, with these new management tools, plus a better understanding of how it infects the potato plant, we are now developing a range of innovative options to manage this devastating disease.

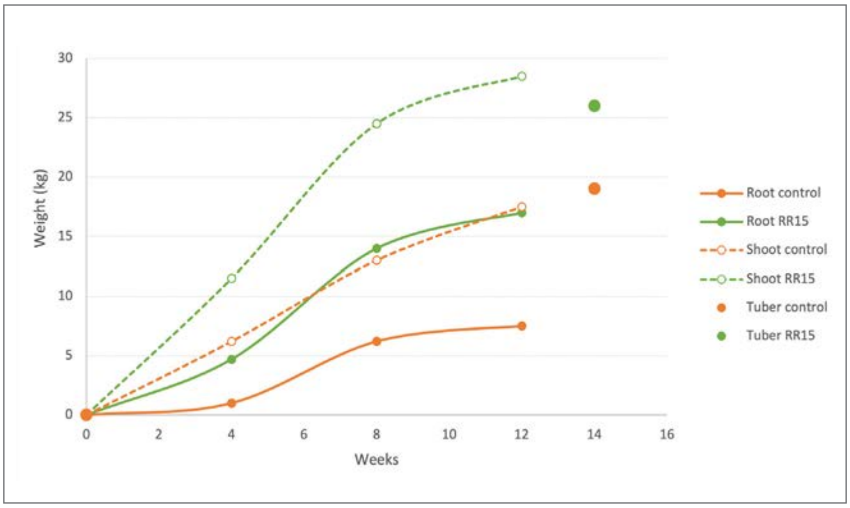

Figure 7. Effect of a bacterial inoculant (RR15) on root growth, shoot growth and tuber weight of potatoes exposed to the powdery scab pathogen. Images at right show the difference between the control (left) and inoculated (right) plants after 12 weeks.

Some of the TIA team

PT17003 - Mechanisms and manipulation of resistance to powdery scab in potato roots has been funded by Hort Innovation, using the potato – fresh and potato – processing research and development levies and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture

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BUG VS BUG WORKING WITH NATURAL ENEMIES

On a fine summer's day, plants fairly buzz with insect life. The vast majority of insects are harmless, some are beneficial, and a very few are damaging to potato crops. Encouraging beneficial insects into the crop can save time and money, avoid negative side effects and prevent development of resistance.

By Ryan Hall

KEY POINTS

- Predators, parasites and parasitoids can all be beneficial
- Beneficial insects occur naturally in Australia; they don't need to be purchased, just provided with food and habitat
- Maintaining a diverse insect population is key to IPM success
- Avoid broad-spectrum insecticides that kill beneficial insects

Most growers will be familiar with the term Integrated Pest Management (IPM). IPM is neither chemical focussed nor organic, but instead chooses the most appropriate management method based on pests and diseases found within the crop.

Strategies can include cultural controls, such as ensuring hills are intact to protect developing tubers from potato tuber moth, and controlling weeds that act as alternative hosts for pests and diseases. They can also be biological, using beneficial insects or pathogens that target pest species. IPM does not rule out chemicals, it just utilises them in a focussed way, supporting other strategies.

The aim of IPM is to bring these controls together to work in a collaborative way.

Beneficial organisms can generally be categorised as:

- Predators
- Parasites, and
- Parasitoids

Some species of predators and parasitoids are sold commercially. However, buying these organisms is not usually necessary. Instead, if you provide a suitable environment, with food and shelter, they will arrive.

Predators eat other organisms. For example, lacewing larvae are

Figure 1. Predators include brown lacewing (left, source: P. Horne) and white collared ladybird (right, source J. Ekman) larvae, both of which prey on aphids.

voracious hunters of aphids. Many species of ladybirds are also efficient predators, especially as both the adult and larvae are carnivorous. While adult ladybirds are easily recognised, their larvae look (and act) a little like tiny crocodiles (Figure 1).

Parasites live in or on their host. Some parasites kill their host, others spread disease or impair proper function. For example, we have heard a lot in recent months about varroa mites, which parasitise honey bees, with devastating impact.

However, there are also beneficial parasites. Examples include entomopathogenic (insect-killing) fungi and nematodes. From the spectacular *Cordyceps* fungus to species of *Metarhizium* (green mould), these fungi grow within the insect, eventually killing it (Figure 2).

There are also several species of entomopathogenic nematodes (*Steinernema* spp., *Heterorhabditis* spp.) which attack soil borne insects. They multiply inside the insect, eventually bursting out and spreading in search of new hosts.

Parasitoids lay eggs in or on their hosts. Like the creature in Alien, the larvae live off their host, eating non-vital organs and bodily fluids as they develop.

Figure 2. Entomopathogenic fungi include *Cordyceps* spp., (left, source: J. Ekman) and *Metarhizium* spp. (right, source: CSIRO)

Generally, parasitoids are host-specific, which means they only target a limited range of prey.

Adult parasitoids are often very small and their larvae are hidden within the bodies of their hosts. This means that they can be overlooked by growers and advisors. Despite this, they can have very significant impacts on pests.

The smallest insect recorded is a parasitoid wasp; the male *Dicopomorpha echmepterygis* wasp is a mere 0.127 mm long (University of Nebraska-Lincoln). Thankfully, most potato pest-focused parasitoids are not this small. Many are around 1 mm long or larger, just big enough to view under a hand lens.

Adult parasitoids are may be tiny, but they are highly mobile. For example, *Trichogramma* wasps are only 0.5mm long but can travel at least 30m during their 2 week lifespan (equivalent to a tall human walking 120km). Moth

Figure 3. Moth eggs parasitised by *Trichogramma* wasps. Source: P. Horne

Figure 4. and an aphid parasitised by *Aphidius colemani*. Source: N. Dimmock, Uni. Northampton, Bugwood.org

Figure 5. A female *Orgilus lepidus* wasp, a parasitoid that attacks potato moth. Source: P. Horne

Figure 6. Potato moth caterpillar parasitised by *Copidosoma* (left) and a non-parasitised PTM pupa (right). Source: P. Horne

eggs parasitised by *Trichogramma* turn black just before the wasps emerge (Figure 3). Other useful species include *Orgilus lepidus* and *Copidosoma* spp., which parasitise potato tuber moth (Figure 4 and 5).

This highlights the difficulty of identifying the insects in action. With lacewings or lady beetles, you can watch them work. It is much harder with parasitoids, with only the mummified remains of host insects left behind.

WHICH BENEFICIAL INSECTS ARE IMPORTANT FOR POTATO GROWERS?

There are many beneficial species that occur naturally in Australia to help control potato crop pests, including:

- *Trichogramma spp.* – targets moth eggs (Figure 3)
- *Aphidius spp.* – targets aphids (Figure 4)
- *Encarsia spp.* – targets whitefly
- Tachinid flies (Tachinidae) – target caterpillars
- *Orgilus lepidus* – targets potato tuber moth (PTM) caterpillars (Figure 5)
- *Apanteles subandinus* – targets potato tuber moth (PTM)
- *Copidosoma spp* – targets potato tuber moth (PTM) eggs and caterpillars (Figure 6)

Maintaining a biodiverse insect population will encourage other native parasitoids and predators in your crop.

The key factor for succesful IPM is to avoid insecticides that kill beneficial insects. Instead, choose selective insecticides, using only once pest populations exceed damage thresholds (Figure 7).

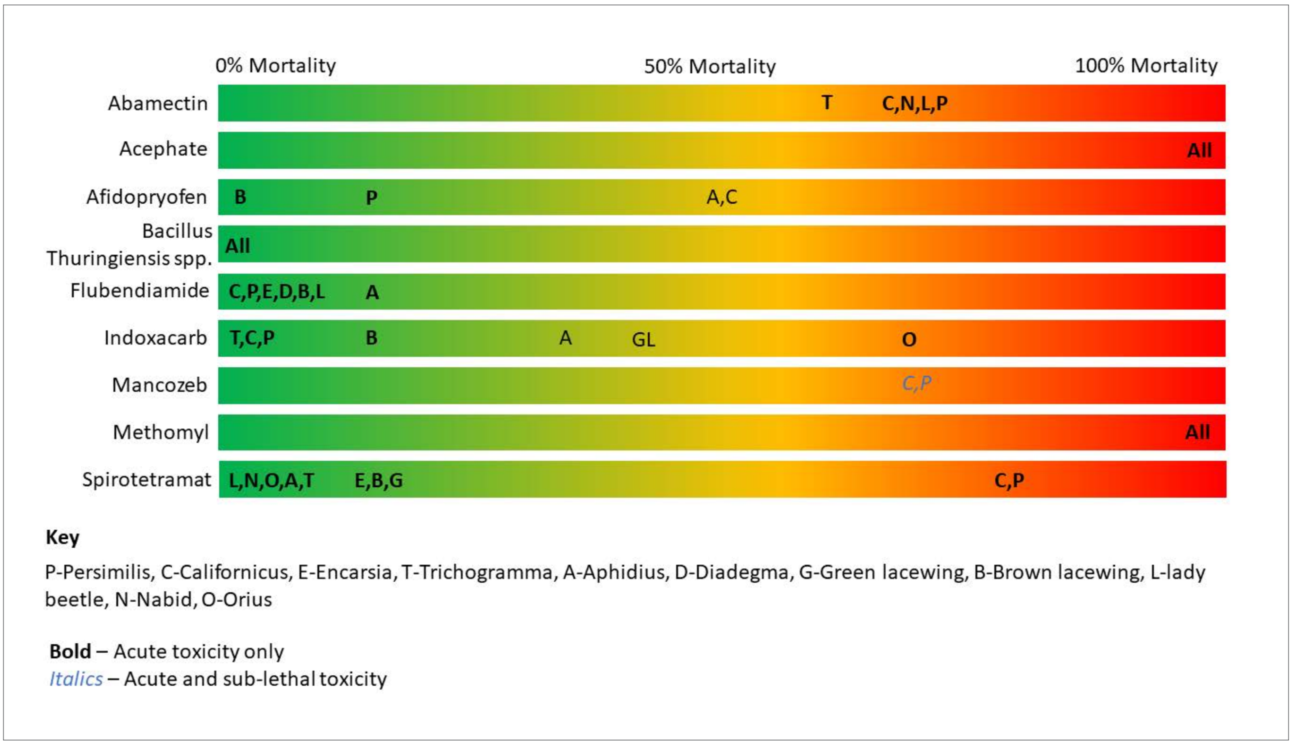

Figure 7. Table of common chemicals and their impacts on various beneficial species including predators and parasitoids

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*Information current as of 2019. Check with the AVPMA website to ensure any chemicals are still registered before use. If in doubt, consult your agronomist.

CONTROLLING SERPENTINE LEAF MINER

Exotic leaf miners have well and truly arrived in Australia, with the first infestation of a potato crop reported this winter in the Lockyer Valley. Focus has now shifted from elimination to finding ways to manage these new pests.

Leaf miners are not fussy eaters. *Liriomyza huidobrensis* (serpentine leaf miner, SLM), *L. sativae* (vegetable leaf miner) and *L. trifolii* (American serpentine leaf miner, ASLM, Figure 1) can attack approximately 200 different host species across 15 families, including potatoes.

Adult leaf miners poke a hole in the leaf and lay their eggs under the surface. This means insecticides need to be systemic (moving through the plant), or at least translaminar (penetrates the outer layers of the leaf), to have any impact against their target. However, over reliance on a limited range of insecticides has already increased resistance by SLM in many countries.

Once SLM eggs hatch, larvae burrow under the leaf surface. As they feed, they leave behind characteristic squiggly white 'mines' through the inside of the leaves. Pupae (Figure 2) re-emerge and, in most cases, drop into the soil, where they can safely over-winter.

Figure 1. American serpentine leaf miner. Source: DAFF

Figure 2. Serpentine leaf miner pupae. Source: DAFF

PARASITOIDS AS A METHOD OF BIOLOGICAL CONTROL

With much of the life cycle occurring within the leaf, a parasitoid wasp that can attack the SLM larvae as they feed provides a neat solution.

There are more than 50 species of parasitoid wasp species that target leaf miners. Many are already present in Australia and provide an effective non-chemical control option.

Four are particularly good at targeting SLM:

- *Opius spp.* (Figure 3)
- *Diglyphus isaea* (Figure 4)
- *Hemiptarsenus varicornis*
- *Zagrammosoma latilineatum*

The tiny parasitoid wasps of the leaf miner prevent further development of the host after initial paralysis. Typically, a wasp attacks SLM larvae and then lays its eggs on or in the larvae. The SLM larvae are often initially paralysed, then die once the wasp larvae hatch and starts to feed. The wasp larvae pupate beside their dead host before emerging from the leaf mine.

Some adult wasp species are also predators, killing and feeding on leaf miner larvae. Not only do these larvae nourish the wasps, they act as a nutrient boost for improved egg development.

A well-managed IPM plan using parasitoids can result in mortality rates of SLM as high as 80 percent[1].

Ongoing project MT20005 (Management strategy for serpentine leafminer, *Liriomyza huidobrensis*) is further refining this control strategy.

Figure 3. Braconid wasps (*Opius sp.*) Source: Bugwood.org

Figure 4. Eulophid wasp (*Diglyphus isaea*). Source: Joseph Berger, Bugwood.org

ATTRACTING PARASITOIDS TO A CROP

Flowering strips

A Hort Innovation study from 2020, led by Charles Sturt University and The Graham Centre for Agricultural Innovation, examined ways to provide suitable habitat for beneficial insects. The focus of the study was to test whether flowering strips could attract beneficials, including wasps.

The project demonstrated that fast-growing, nectar-producing species can increase activity of beneficial insects, providing cost-effective pest control. The team proposed the following steps[2] :

1. To improve beneficial activity in the crop, establish strips of flowering (nectar-producing) plants approximately 30 metres apart.
2. Plant flowering strips that are single-species or mixed-species depending on seed availability and cost.
3. Cornflower (*Centaurea cyanus*, Figure 5) was the best choice for enhancing parasitoid wasps. Cornflower strips also attract some generalist predator species and provide shelter for beneficials even pre-flowering.

Patience

Presenting at the recent R&D forum in Ballarat, Zarmeen Hassan from AUSVEG emphasised the need for patience. Experience has shown that parasitoid wasp populations increase naturally over time. So, while there may be a spike in leaf miner in year 1, avoiding use of insecticides will allow wasps to establish and eventually provide effective control.

Figure 5. Cornflower (*Centaurea cyanus*). Source: Lucy Kral on Unsplash

Figure 6. Hedgerow planted next to a potato field in Dublin, Ireland

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PETIOLE TESTING FOR NUTRIENT ANALYSIS

Petiole sampling and analysis is an effective and simple way to determine the nutrient status of a crop, including diagnosing any deficiencies or toxicities in potato plants. Like any analyses, getting the sampling right is the first step, writes Paulette Baumgartl.

Petioles are the tiny stems that connect potato plant leaflets. They not only provide support, but function like straws, drawing nutrients up from the soil and distributing them to the growing leaves.

Data from petiole analysis offers a window into the nutrient status of a crop. This may be quite different to the nutrient profile revealed through soil testing. Petiole analysis does not replace, but rather complements, soil testing, as together they indicate how available soil nutrients are to the developing plants.

While soil testing provides a good indicator of fertiliser needs before the crop is planted, testing the plant tissue acts as a 'barometer', indicating the success or otherwise of a fertiliser regime. As it measures accumulated nutrients in the plant tissues, it can also indicate where there are nutritional disorders. Nutrition can then be adjusted during the growing season. For example, petiole testing could reveal a need for additional K during tuber bulking. However, most often it provides a guideline for future crops.

Rob Cirocco from Phosyn Analytical agrees that petiole testing is worthwhile for many nutrients, including N, S, P, K, Ca, Mg, Cu, Zn, Mn, Fe, B, Na, Cl, NO_3-N (nitrate nitrogen).

"A regular petiole testing regimen can assess the adequacy of fertiliser programs, diagnose deficiency or toxicity symptoms, and reduce the potential for environmental pollution through excess inputs," Rob said.

As with all testing, the value of the information gained from petiole analysis will be directly related to the effort and attention put into the sampling. It is also important to note that a single test will not provide all answers, with three of four rounds of sampling, a few weeks apart, recommended.

Fortunately, with a few simple steps, it is easy to collect and handle tissue samples ready for analysis in a laboratory.

Analytical laboratories can provide specific instructions on how to sample, handle, store, label, and send the samples.

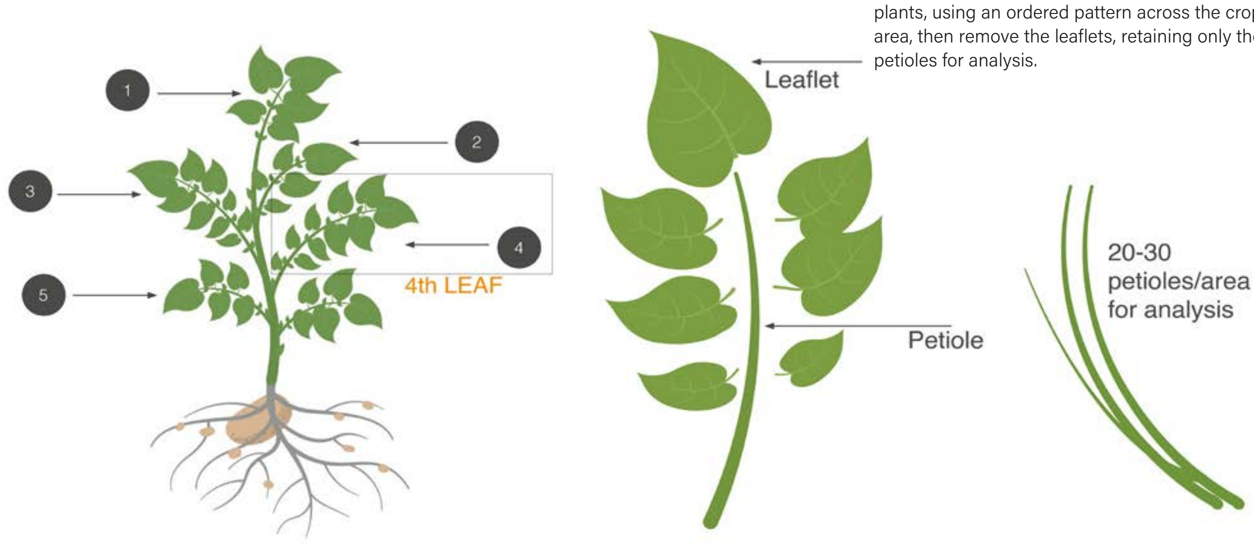


Figure 1. The usual procedure is to collect the youngest mature potato leaf from each of 20 to 30 plants, using an ordered pattern across the crop area, then remove the leaflets, retaining only the petioles for analysis.

WHEN TO SAMPLE

Petiole sampling is best commenced at the S2 growth stage, usually defined as the point where the length of the longest tuber is 10mm. Collect the first petiole sample at the S2 stage and repeat the sampling every two to three weeks as necessary for up to four samples. Take note of the crop stage at sampling.

HOW TO SAMPLE

Commercial plant test kits are available. They include clear instructions on how to collect and manage samples to ensure reliable results from the analysis.

In general, collect the youngest mature potato leaf from each of 20 to 30 plants in an ordered pattern across the crop area to be tested.

Leaf samples may be taken in a zig-zag or a grid pattern; it is important that the whole crop area is sampled comprehensively. As a rule of thumb, collect one sample every 200 square metres, yielding 20 collected samples for every 0.4 hectares.

The youngest mature leaf is the fourth or fifth from the top of the plant. The leaves should be detached from the main stem of the potato plant, with the petioles intact (Figure 1).

Immediately after collection, detach each leaflet where it joins the main stem of the potato plant. Place the 20 to 30 petioles in a labelled sample bag. Note that this is usually paper, not plastic, to avoid increased moisture – again, analytical labs will provide instructions, including whether it is necessary to dry samples before posting.

While analytical laboratories recommend collecting samples from the entire crop, patch sampling can also be carried out to diagnose a potential nutrient disorder in one part of the crop. In this case it is important to take samples of both healthy and unhealthy plants for comparison.

Some laboratories will also request that sample notes include the length of the largest tuber.

HANDLING SAMPLES

Petiole samples should be kept cool and sent to your chosen laboratory service for analysis as soon as possible after collection. They should not be left in the sun or in a hot car.

If there is a delay between time of collecting and submitting samples, keep them in a fridge at 4ºC in the meantime.

Rob emphasises the importance of sending those samples quickly.

"To maximise the integrity of a sample requiring analysis, always send it to the lab using the fastest possible service. In many instances, Australia Post's Express Post service is suitable."

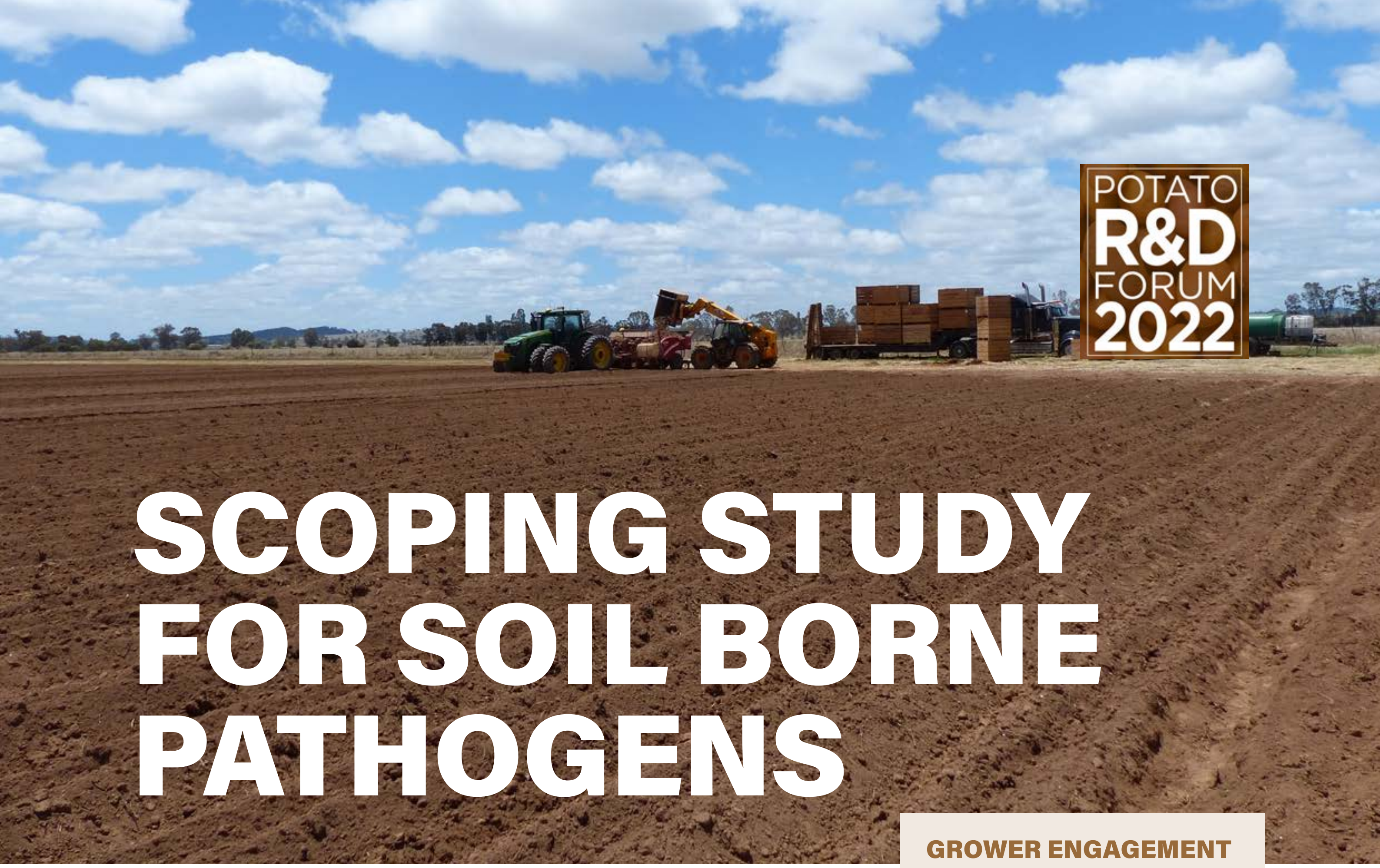
IMPORTANT DOS AND DON'TS OF PETIOLE SAMPLING

Dos

- ✓ Collect tissue samples before 10am.
- ✓ Use clean plastic disposable gloves to sample as sweaty or dirty hands can contaminate the sample.
- ✓ Pull the whole leaf from the plant, then strip the leaflets from the petiole stem.
- ✓ Make a note of growth stage of the plant, including tuber size and if possible, weeks from emergence – specific details should be supplied with a sample.
- ✓ Collect samples in a paper bag, as opposed to a plastic bag, to avoid the sample sweating.
- ✓ Send to the lab as quickly as possible.

Don'ts

- x Avoid sampling 3-5 days after crop has been sprayed with pesticides or foliar nutrients.
- x Avoid soiled, damaged, dead, or dying plant tissue.
- x Do not sample plants stressed by environmental conditions, for example, drought, flood, extreme cold or heat wave conditions.
- x Do not sample plants affected by disease, insects, or other organisms.
- x Avoid atypical areas of the paddock, such as poorly drained areas.



SCOPING STUDY FOR SOIL BORNE PATHOGENS

A new study funded through Hort Innovation will review the feasibility of a national plan ensuring Australian farmers are on the front foot when it comes to risks from exotic pathogens. By Paulette Baumgartl

As an island, Australia has always enjoyed an advantage when it comes to managing biosecurity. Examples are the new, aggressive "A1" strains and sexual "A2" strains of late blight, found in almost every potato growing country of the world but still absent from Australia.

However, globalisation of trade by both air and sea, and the movement of large numbers of people, have increased risk. Added to this is the impact of climate change, which could extend the habitat range of some pathogens.

Nevertheless, Australia remains free of many important plant pathogens. Maintaining this good fortune is critical for continued and profitable market access.

Dr Sophia Callaghan from NSW Department of Primary Industries provided an overview of this new study (*MT21016, Feasibility/scoping study: Surveillance and diagnostic framework for detecting soil-borne pathogens in vegetable industries*) as part of the 2022 R&D forum, emphasising the importance of quick detection.

“If we cannot prevent the arrival of exotic pathogens, then early detection is our best defence,” Dr Callaghan said.

“Early detection, before a crop shows any symptoms, is our greatest chance of containing and eradicating new pests.”

The challenge here is that more often than not, pathogens are only detected once a plant starts showing signs of disease. Pathogens may be there long before symptoms manifest. They may be present in soil or in otherwise

GROWER ENGAGEMENT

There is more to this project than sifting through the literature!

The project team is eager to initiate as many conversations as possible with stakeholders, including growers, agronomists, and industry.

They want to know:

- Do you perform any surveillance/crop monitoring on your farm?
- Do you test soil for chemical, physical or biological properties?
- What are your thoughts on a national surveillance scheme for exotic pathogens?

If you have any thoughts, or would like more information on the project, please contact:

Sophia.callaghan@dpi.nsw.gov.au

Toni.chapman@dpi.nsw.gov.au

asymptomatic plants (known as sub-clinical).

Through systematic soil sampling, Dr Callaghan believes it might be possible to avoid disease spread.

A nation-wide soil testing program is an ambitious undertaking and there are many considerations.

This 12-month project will explore the feasibility of a national surveillance and diagnostic framework for detecting exotic soil-borne pathogens – including fungi, oomycetes, bacteria, viruses, and nematodes – in the potato, melon, onion, and vegetable industries.

Activity 1 of the study is to determine the best methods for soil sampling and diagnostics for early detection. As part of this activity, the team plans to update and extend the lists of exotic pathogen threats, including a review of international literature on new and emerging pathogens.

A critical review of current soil tests used to detect pathogens, from traditional to molecular, and novel technologies is also a priority.

"Australia is a huge country, so understanding how this approach could work at scale will be a major factor in determining its feasibility," Dr Callaghan said.

"Investigating how this could work in practice, as part of a nationally consistent framework for soil surveillance and diagnostics, is our focus for Activity 2."

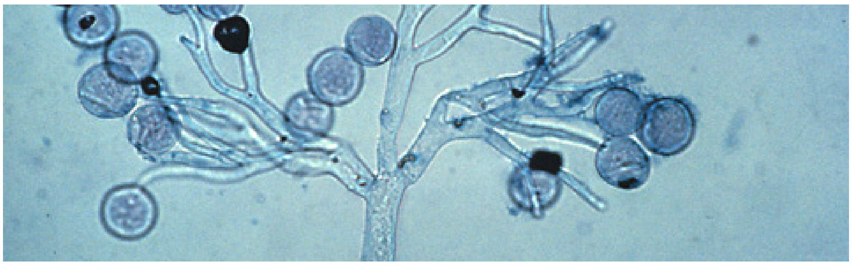
"Any surveillance program needs to be practical at scale, while also being comprehensive enough to be meaningful," Dr Callaghan added.

The team will look to national and international industries for examples of successful surveillance programs, as well as opportunities to leverage existing infrastructure.

Dr Callaghan emphasised the need for the program to make sense economically, which means making the most of any systems already in place and ensuring any program passes a cost benefit analysis.

Finally, the project team will summarise any gaps in Australia's knowledge capability and identify priorities for R&D investment.

Watch for future updates on the project through the PotatoLink bulletins and this magazine.



Left. Root knot nematode (Meloidogyne enterolobii) has an extensive host range, including potatoes. Source: Wikipedia

Below left: Oomycetes are a group of several hundred organisms that include some of the most devastating plant pathogens. Source: https://www.apsnet.org

Below right. Potato infected with late blight pathogen. Source: Dolf de Boer

MT21016 - Feasibility/scoping study: Surveillance and diagnostic framework for detecting soil-borne pathogens in vegetable industries has been funded by Hort Innovation, using the Melon, Onion, Potato - Fresh, Potato - Processing, Sweetpotato and Vegetable Funds with contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

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PINK ROT – PROJECT UPDATE

Pink rot, mainly caused by *Phytophthora erythroseptica*, is a true potato specialist. At first glance this should make it easier to manage. However, the pathogen's long-lived oospores, which can survive in soil for up to 7 years, reduce the effectiveness of crop rotations. Dr Jenny Ekman reports.

THE IMPORTANCE OF PINK ROT

Pink rot loves a wet year. The disease is likely to thrive under the current La Niña conditions, being most active in wet soils between 15 and 25°C.

There are also reports pink rot may be developing tolerance to common fungicides (e.g. metalaxyl). Moreover, the key processing variety Russet Burbank has a long maturation time, making it particularly susceptible to this disease.

These factors may explain why pink rot has risen in importance, especially over the last 3-5 years, and particularly in northeast Tasmania. In this area losses can be up to 30%, despite regular fungicide application. Even if disease rates are low, rotten tubers must be detected and eliminated before storage and processing, adding cost.

For some growers, pink rot is now their most challenging disease. Heavily infected paddocks may yield only 25 t/ha; with 45-56 t/ha required just to break-even, this effectively takes entire paddocks out of potato production.

Unfortunately, symptoms often only appear as the crop approaches maturity. Rotting at the crown area can cause infected plants to wilt and collapse. The tubers develop blackened areas, rubbery feel and a distinctive, highly unpleasant smell. When cut open, the rotten area oxidises, producing the key diagnostic pinkish colour (Figure 1).

MANAGING PINK ROT

Dr Robert Tegg from the University of Tasmania, together with Professor Calum Wilson from TIA, SARDI researcher Michael Rettke, and soil scientist Dr Bill Cotching, have been trying to find ways to manage this devastating disease.

In 2009, American research at the University of Utah (Benson *et al*., 2009a and 2009b) suggested that a pH of 7.0 or higher, together with high levels of available calcium, could significantly inhibit infection of root and stolon tissue by *P. erythroseptica*. However, this research was conducted using a hydroponic system. It also did not follow infection through to mature plants and tubers. IThis made it unclear whether similar effects would be observed under field conditions.

The Hort Innovation project "Investigating soil pH and nutrition as possible factors influencing pink rot of potatoes – a pilot study" was initiated to investigate this research.

Key project aims were to:

1. Examine the impact of soil pH and calcium formulations in field (and pots) on pink rot development
2. Investigate the impact of landform and soil structure
3. Identify knowledge gaps and opportunities from reviewing literature and discussions with industry

The project was timely, as there had been little Australian research on pink rot disease control since SARDI research back in the 1990s.

Figure 1. Pink rot in tubers. Source: R. Tegg

ROT RECONNAISSANCE

The project started with a series of field surveys. Paddocks with a known history of pink rot were surveyed around Sisters Beach, Sassafras, Scottsdale and the Midlands in Tasmania.

Assessments included:

- Pathogen detection using PREDICTA Pt
- Soil chemistry, with a focus on calcium and pH, but also other nutrients
- Soil structure and depth, including variation across paddocks
- Incidence of disease

Analysis of 19 field sites over two years found pH ranging between 5.2 to 6.6 at planting. This sits within the range of pH 4.8 to 6.5 which is normally recommended for potato production. pH tended to decrease slightly during cropping, falling by 0.1 to 0.6 points by harvest.

In season 1, soil calcium treatments such as nanocal (liquid calcium supplement) and calcipril (ultra-fine calcium carbonate) were tested for effects on disease incidence.

"Calcium treatments tended to maintain or slightly raise pH of the soil," commented Dr Tegg." However, they didn't really reduce pink rot disease. Despite this, there were minor yield increases in some cases and, in Season 1, application of nanocal tended to reduce the incidence of hollow heart."

Tasmanian soils used to grow potatoes are primarily ferrosols. These are highly buffered, making it extremely difficult to alter pH. An enormous volume of lime, or other alkaliser, would therefore be needed to increase pH to above 7.0.

"I think we can say that raising pH or adding calcium are definitely not silver bullets for pink rot," concluded Dr Tegg "but there may be other benefits from regular applications of calcium to the soil".

PINK ROT AND SOIL QUALITY

While this result may have been disappointing, the research team identified a number of other soil factors that do influence occurrence of pink rot. This involved using Dr Bill Cotching's expertise in scoring soil quality, assessing its interconnected chemical, physical and biological properties.

According to Dr Cotching, soils that score 4 or less – as shown on the scorecard in Figure 2 – are less suitable for horticultural production than soils with a score of 9 or 10, which have high organic matter and good structure.

Dr Cotching also examined topsoil depth, soil profile changes and topography.

The data confirmed that pink rot can flourish in damp areas of the paddock. In the example shown in Figure 3, 400 tubers from 20 plots on the sloping or low areas of the paddock were assessed for incidence of pink rot. Five plots from the low area had high incidences of disease, whereas the team found only one diseased tuber in one plot on the sloping area.

"This effect of topography is what we expect from pink rot," commented Dr Tegg. "Another site that we sampled had a very boggy area that we assumed would not be planted to potatoes. However, when we returned 4 weeks later, it had been planted. The result was early dieback, significant pink rot, and essentially downgrading of that paddock with much of the crop thrown out."

While topography is important, topsoil depth and quality may be an even better guide to the likelihood of pink rot in some circumstances. This may

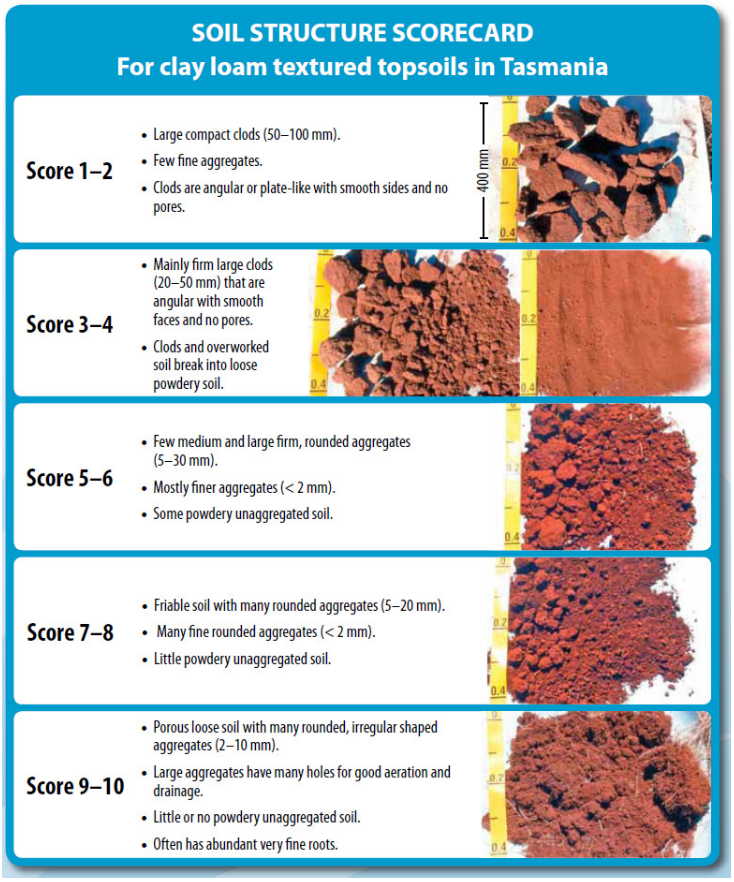

Figure 2. Dr Bill Cotching's soil quality scorecard (Source: soilquality.org.au/factsheets/soil-structure)

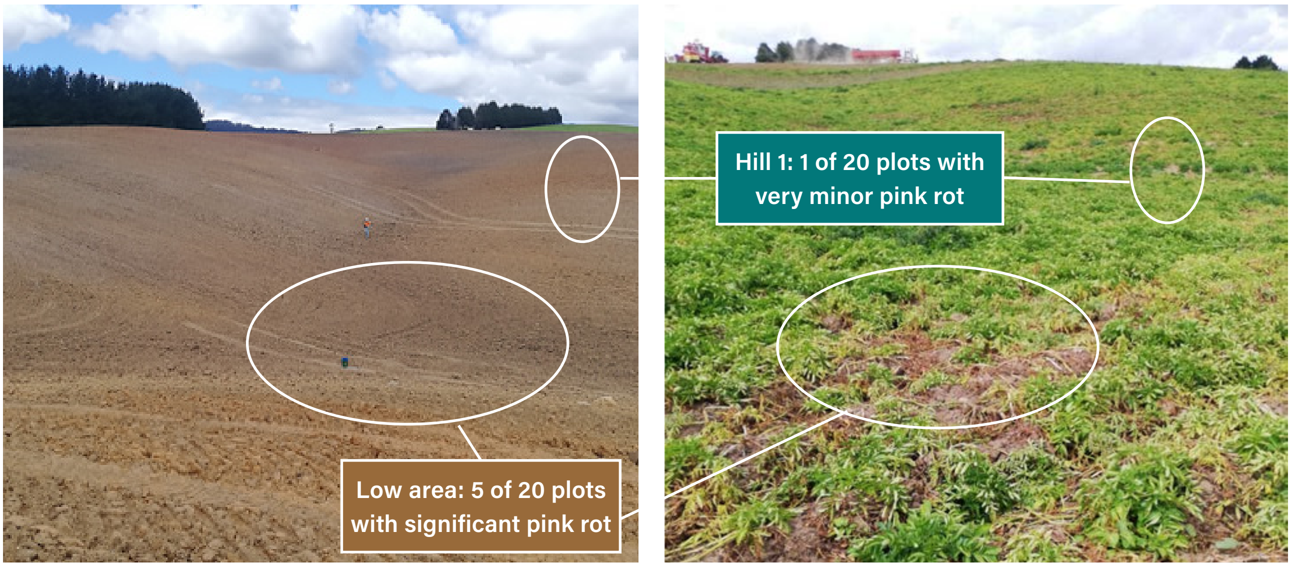

Figure 3. Low areas of the paddock (shown pre-planting at left, and at crop maturity at right) were more likely to stay damp, increasing development of pink rot. Source: R. Tegg.

mean that a flat area with good quality soil is likely to be less susceptible to pink rot than a well-drained, but eroded slope.

For example, the flat area of one paddock sampled at Sisters Creek had 40cm deep topsoil and a soil structure score of 8. In contrast, the headland area was eroded and compacted, the topsoil being only 25cm deep with a soil structure score of 3-4. The lower soil quality score correlated with increased pink rot, early dieback occurring on the headland area (Figure 4).

The team even drilled down to the level of individual rows. Where twin rows are inconsistent height, the smaller mounds have less soil depth and will tend to stay wet for longer in between irrigation events (Figure 5). "Unfortunately, in the smaller mounds, we saw a greater likelihood of pink rot. That was one finding from the work that was obvious across many different paddocks that we surveyed," stated Dr Tegg.

Intersects between rows, where they run at 90° to each other, are another area with increased risk. This can occur due to blockage of water running down one set of rows, causing pooling at the intersection (Figure 6).

Figure 4. The high quality soil in the flat area of this paddock (top) produced an excellent crop, whereas plants growing on the degraded area near the headland (bottom) died prematurely due to significant pink rot. Source: R. Tegg.

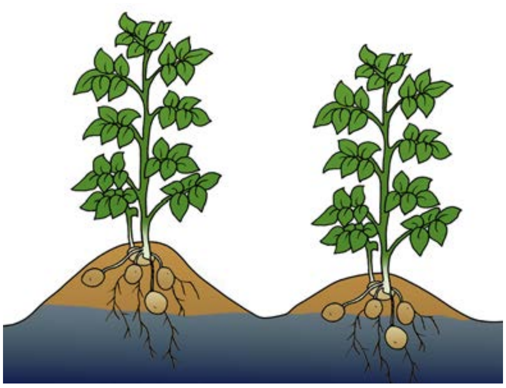

Figure 5. Where pairs of rows are uneven heights, the smaller mounds may have increased risk of pink rot.

Figure 6 (below). There is a greater risk from pink rot where rows intersect at right angles, such as where headland rows cross downward rows. Source: R. Tegg.

USING PREDICTA PT FOR PATHOGEN DETECTION

As well as measurements of soil attributes, regular samples were taken for qPCR detection of the pink rot organism with the PREDICTA Pt service.

PREDICTA Pt provides a reliable indication of risk for a range of pathogens (e.g. powdery scab, black dot) and nematodes.

Unfortunately, pink rot is harder to detect in the soil, and results are not always a good guide to the likelihood of infection.

The pathogen was rarely detected before planting. However, as the soil warmed and irrigation was applied, pink rot was found more frequently. This suggests that pink rot populations in soil fluctuate widely during the growing season, so both sampling strategy and timing are critical for detection.

The other finding is that intensive sampling is needed to be sure of detecting the pink rot pathogen. Current Predicta Pt sampling protocol advises analysing 4 separate samples, each compiled from 30 subsamples taken in a "W" pattern, for a paddock larger than 10ha. However, new modelling by SARDI suggests that at least 10 separate, composite samples are needed to be 90% confident of detecting pink rot within a paddock.

The requirement for a large number of samples, combined with the low probability of detection prior to planting, may make testing uneconomical and impractical in some situations.

QUESTIONS FOR FUTURE RESEARCH

While the research has revealed much, questions remain:

- When is the best time to take soil samples for pink rot detection and risk assessment?
- Is there a way of enriching the soil sample to increase chances of detection?
- While other crops e.g. carrots, cereals, perennial ryegrass are potential hosts for pink rot, do they support the pathogen's full lifecycle?
- To what extent do volunteers during crop rotations contribute to risk of pink rot in temperate areas?
- How does pink rot interact with other pathogens?
    - Potatoes can be infected by powdery scab, *Rhizoctonia* and *Sclerotinia* as well as pink rot – does infection by one of these organisms make the plant more susceptible to the others?
    - What are the potential interactions with bacteria and/ or nematodes?
- Can EM38 mapping identify areas which are more likely to be susceptible to pink rot?
    - These may then be left fallow or planted with an alternative crop such as corn.
- What new or alternative chemistry may become available for management of pink rot?

KEY POINTS

- Calcium amendments and pH modification are very unlikely to offer a practical way to manage pink rot
- Soil characterisation and site analysis can be an effective way to assess risk
- Pink rot is difficult to control, and will require multiple management strategies
- Factors associated with increased risk of pink rot include:
    - Damp conditions in low lying areas
    - Over-irrigation or unseasonal rain, especially late in the season
    - Shallow topsoil and/or poor soil structure
    - Soil compaction, such as in the headlands
    - Short mounds, especially where the neighbouring mound is taller
    - Intersections between rows which prevent water from draining
    - Damage to plants by the irrigator, tractor or windy conditions

PT19000 - Investigating soil pH and nutrition as possible factors influencing Pink Rot in potatoes – a pilot study has been funded by Hort Innovation, using the Potato - Fresh and Potato - Processing research and development levies and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

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CITIZEN SCIENCE SUPPORTING TPP SURVEILLANCE

POTATO R&D FORUM 2022

With the help of hundreds of volunteer gardeners from across Australia, a Hort Innovation project to survey TPP is coming to an end. More than 1800 traps were assessed in each state with no TPP detected outside of WA. By Paulette Baumgartl.

Tomato potato psyllid (TPP) has been established in New Zealand for over 15 years, where it is a major pest. In 2015 a quarantine survey discovered it in Australia's most easterly outpost, Norfolk Island, with the tiny insect detected in Western Australia only two years later (February 2017). This discovery triggered a major emergency response, including a survey of the entire country for the presence of this pest.

TPP carries the bacterium *Candidatus Liberibacter solanacearum* (CLso), a disease of solanaceous plants which can be particularly destructive to the potato industry. The disease is characterised by curled leaves, yellow brown splotches, and a slight purple tinge to the growing tips. Plants shrivel, die early, and yield small tubers which, when fried, are stripy and unpalatable (hence the nickname zebra chip).

SURVEYING AUSTRALIA FOR THE PRESENCE OF TPP

TPP was initially detected in a seemingly innocent back yard vegetable patch in Perth. Primary industry agencies around Australia collaborated with the West Australian Department of Primary Industries and Regional Development (DPIRD) to help monitor and manage this pest.

In 2019 Hort Innovation initiated a 3 year National surveillance project for both the psyllid and the CLso bacterium it could potentially vector (MT18008).

Tasked with the early detection of TPP, and testing for the presence of CLso in trapped TPP specimens, the project leaders put out a call for volunteers.

Due to the likelihood of the pest first ocurring in urban areas, activities focussed on capital cities and their peri urban fringes of the capital cities, except in WA, where regional centres were targeted. Local agencies used social media to advertise the project and attract participants.

KEY POINTS

- No reported cases of infection by the *Candidatus Liberibacter solanacearum* (CLso) bacterium occurred in Australia
- Nearly 14,500 traps were set across Australia over the course of three years
- Thousands of volunteers participated in the program, across Australian capital cities and regional WA
- Almost 6,000 TPP specimens were tested for the presence of CLso in WA

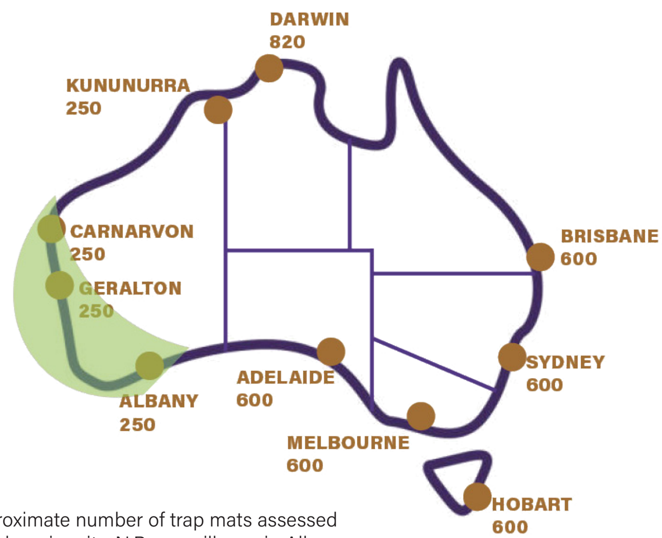


Figure 1. Approximate number of trap mats assessed per year in each major city. N.B. surveillance in Albany, Geraldton and Carnarvon only occurred during season 1. Current range of TPP shown in green

The program, known as 'Adopt a trap' ran all across the country except in the ACT.

Each participant received a trapping kit, which included all materials, instructions, ID stickers, a tomato (host) plant, and return details.

Participants from most states were also asked to monitor their activities via the MyPestGuide app.

With privacy measures in place, the app gave project leaders some oversight, allowing them to verify location and that the volunteers were following correct trapping procedures. This ensured the project retained scientific rigor.

In most states, trapping for the 3 year project concluded in Autumn 2022. However the program will continue in the Northern Territory until the end of this year (2022). More than 1,800 traps have been returned and assessed per state (Figure 1), with no TPP found outside the Western Australian southwest and Gascoyne regions.

Returned traps are assessed under a microscope with all psyllids examined, identified and counted. Any TPP found are circled, and a sample (10-20 individuals per trap) are extracted for analysis of the presence of CLso molecular markers.

The Kimberley in northern WA remains free of TPP, with no specimens found in Kununurra. However, surveillance did detect TPP in Carnarvon, Geraldton and Albany.

Since the first identificaiton of TPP in Perth in 2017, thousands of individual TPP have been analysed for CLso every spring and summer. The bacterium has never been detected. It is concluded that TPP arrived in Australia without bringing the bacterium with it, so mainland Australia is currently CLso free.

HOW TO TEST FOR TPP IN MY CROP

Addressing the R&D forum in Ballarat, Victorian project co-ordinator and diagnostic entomologist Cait Selleck from Agriculture Victoria summarised some of the project findings and what to look out for if you are concerned about TPP on your own farm.

"Visual inspections can be difficult due to the very small size of the insects, however, generally, adults, eggs and nymphs can often be found together on the underside of a leaf," Cait said (Figure 2).

"Another indicator is a pretty dusting of what looks like icing sugar, but is actually psyllid excrement, often referred to as honey dew" (Figure 3).

Cait is one of many entomologists from around Australia who spend hours looking down a microscope hoping not to find a TPP specimen.

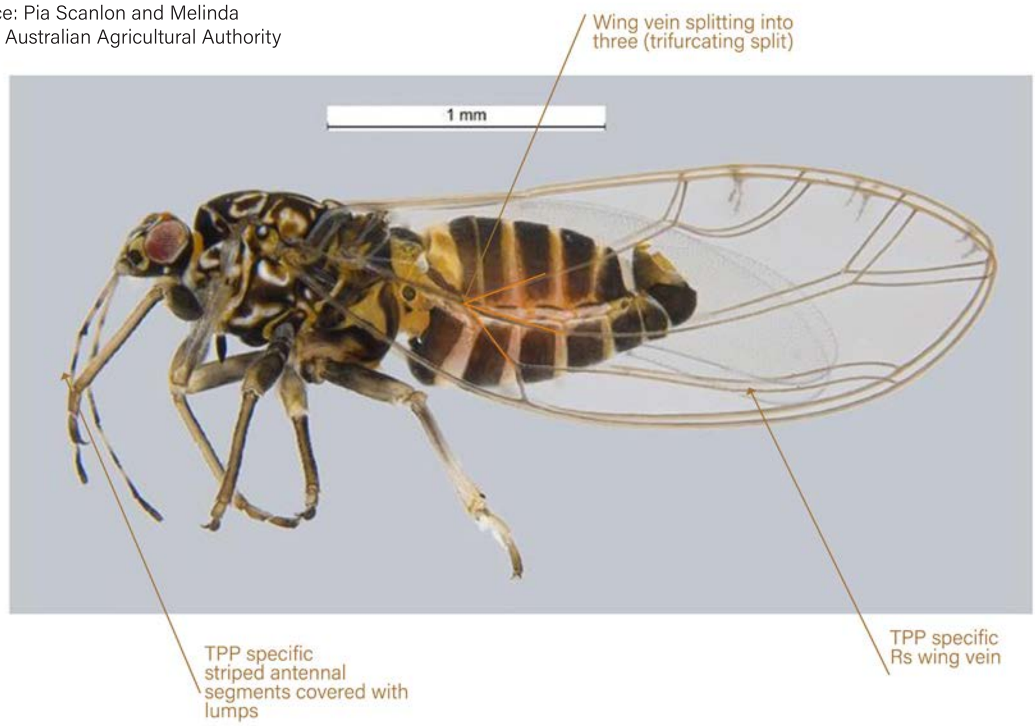
"It is a highly manual process; real people spend hours examining the traps to inspect every psyllid," Cait explained.

"TPP itself has some clear identifying features, making it easy to spot under a microscope, including characteristic veins on its wings (Figure 4 and 5)."

Cait adds that the best way to determine whether TPP is present is with a sticky trap, readily available at a garden or hardware store. It is highly recommended to use the trap with a cage to reduce the risk of vertebrate by-trap.

"It is important to remove the trap after one week" suggests Cait, "this is

Figure 5. Characteristic features of TPP. Source: Source: Pia Scanlon and Melinda Moir, Western Australian Agricultural Authority



enough time to detect whether TPP is present in the crop. In any case, any longer and the trapped insects start to degrade, making correct identification difficult. "

The trap should be mounted on a stake or with a bulldog clip to a fence or similar.

As TPP prefer an ambient temperature of 26 degrees, the best time to set out traps is during the growing season for northern Australia (May to August), summer in Tasmania, and spring and autumn everywhere else.

Traps are best placed in a transparent plastic covering, before posting to the relevant agency.

Check the websites for each state to check their protocols before sampling and sending.

You can learn more about TPP and zebra chip through the PotatoLink webinar on this topic presented by Dr Melinda Moir (DPIRD) and John Jackson (Potatoes New Zealand).

View at potatolink.com.au/webinars.

Right, from top to bottom:

Figure 2. Community of TPP eggs, nymphs and adults. Source: Pia Scanlon, Western Australian Agricultural Authority

Figure 3. 'Honey dew', characteristic icing sugar appearance of TPP nymph excrement. Source: Pia Scanlon, Western Australian Agricultural Authority

Figure 4: Adult TPP. Source: Pia Scanlon, Western Australian Agricultural Authority

MT18008 - National tomato potato psyllid and zebra chip has been funded by Hort Innovation, using the nursery, potato-fresh, potato-processing and vegetable funds and contributions from the Australian Government Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

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EYES ON THE WORLD

RECENT ADVANCES IN POTATO RESEARCH AND INNOVATION

Whole-cell bacterial biosensor for volatile detection from *Pectobacterium*-infected potatoes enables early identification of potato tuber soft rot disease

Veltman, B., Harpaz, D., Melamed, S., Tietel, Z., Tsror, L. and Eltzov, E., 2022. Talanta, https://doi.org/10.1016/j.talanta.2022.123545

WHAT IS IT ABOUT?

Just as one bad apple can spoil a barrel, so one bad spud can spoil a bin. And even though catching rotten tubers early can make all the difference, how can you grade out tubers with no external symptoms?

New research is developing sensing technologies that can detect the volatile organic compounds (VOCs) produced by soft rot bacteria. VOC sensors and detectors, notably the electronic-nose (E-nose), have existed for some time, but have often struggled in practice.

This recent study from Israel took a different approach, developing a biosensor based on the responses of bacteria (various strains of *E. coli*) to the presence of VOCs. A biosensor is a device that can detect a chemical substance (including VOCs) using an enzyme, antibody, or in this case a whole cell bacterium, that binds with the target substance.

WHAT WAS CONCLUDED?

Israeli researchers initially examined whether there were specific VOCs produced by potatoes infected with *Pectobacterium* bacteria. They successfully identified five such compounds using gas chromatography-mass spectrometry (Figure 1).

They then exposed various strains of genetically engineered *E. coli* bacteria to these compounds to see whether they responded. The most responsive bacterial strain was one called TV1061. This fluoresced strongly when exposed to three of the five identified VOCs.

The bacteria were embedded in calcium alginate, enabling them to be made into small tablets. Banks of these tablets could then be placed into jars containing healthy and infected potatoes.

The bacteria were incubated with whole infected/uninfected potatoes for two hours, then their fluorescence was measured using a plate reader. Comparing the fluorescence of bacteria exposed to healthy vs infected potatoes provided a reliable indication of the amount of rot present (Figure 2).

The bacterial panel responses were tested over a period of up to eight days. The response increased markedly by day two, with consistently high readings after day six.

This is an important step toward developing simple and effective tests that will allow for more efficient crop management. The use of tests like this that can "smell" disease before you can see it can help to keep infected tubers away from clean tubers, reducing postharvest losses.

It could also be used to verify that potatoes are soft-rot-free before export or planting. With some further development, it is possible these tests could be available at all stages of the supply chain.

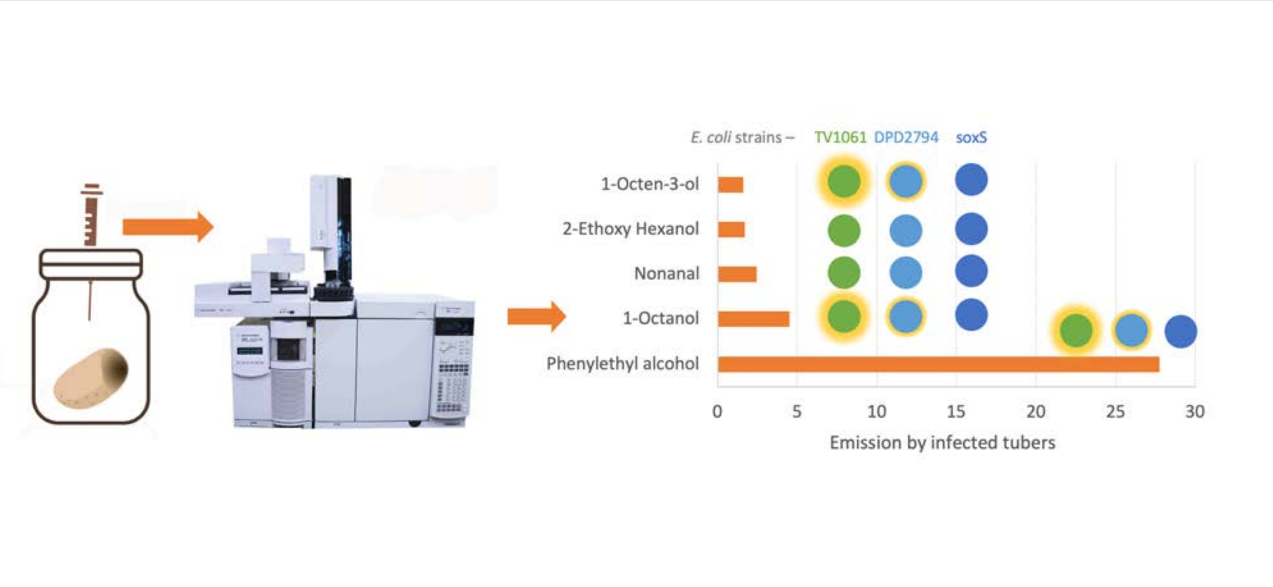

Figure 1. The researchers first identified five volatile organic compounds specifically produced by potatoes infected with Pectobacterium species. They then exposed a number of genetically engineered strains of E. coli to these compounds and measured whether they fluoresced in response. One of the strains (TV1061) fluoresced strongly when exposed to three of the five identified compounds (1-Octen-3-ol, 1-Octanol and phenylethyl alcohol).

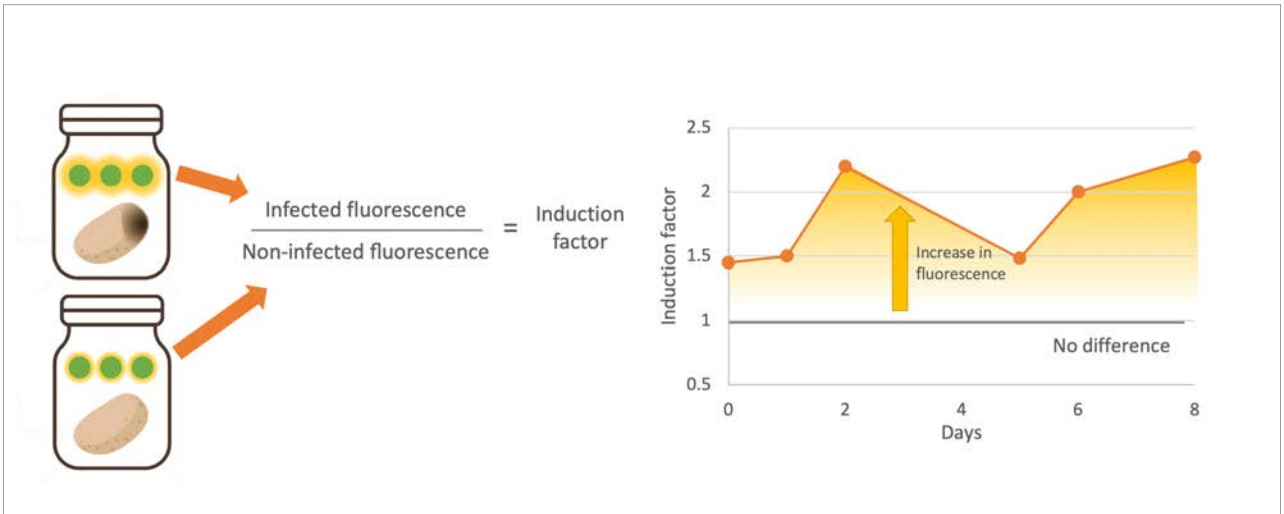

Figure 2. The bacteria were set into calcium alginate, allowing them to be formed into tablets. Banks of tablets were exposed to infected/uninfected potato tubers for two hours daily over eight days. Comparing the difference in fluorescence (induction factor) indicated the amount of disease present. While a response to infection was noted immediately, the fluorescence increased after two days as the disease progressed.

POTATOLINK BULLETIN

Wondering when the next in-person event will be held in your area? Looking for a fact sheet or an update on a demonstration site? Or want to join the next webinar?

For all this and more, subscribe to our monthly newsletter.

The PotatoLink Bulletin is a free e-newsletter emailed to subscribers each month and is brimming with information. The bulletin provides a platform for growers to stay up to date on upcoming events and resources delivered by PotatoLink or other industry groups and projects.

EACH ISSUE INCLUDES

- Upcoming events – webinars, regional in person events, online training and conferences
- New resources – PotatoLink magazine, factsheets and case studies
- Updates from our demonstration sites
- Event reviews for all those who missed out
- General info, project updates and more

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Email info@potatolink.com.au

POTATOLINK PLANS FOR 2023

Following an active and successful 2022, where we could enjoy the benefits of in-person events after many COVID disruptions, we have been busy organising a comprehensive schedule for 2023.

Responding to feedback from the broader PotatoLink community, including participants at in-person events and webinars, project regional representatives and the Project Advisory Group, we are pleased to announce our themes for 2023, including:

- Precision Agriculture
- Management of seed
- Maximising return of inputs- irrigation, nutrition
- Regenerative agriculture
- Weather & disease management

Our regional representatives are fine tuning their plans for the in-person events in their regions and will focus on topics in alignment with the needs of the regions and the themes above.

Tim Walker joins the Potatolink team as our representative in Tasmania.

A NEW FACE IN THE POTATOLINK TEAM

After his successful service as PotatoLink's Tasmanian representative, Frank Mulcahy is retiring from the post. On behalf of the potato growers of Tasmania and the PotatoLink team, we want to express our gratitude for his support and contributions to the project and wish him every success in the future.

We are therefore excited to announce that Tim Walker from Walker Ag Consultancy will be stepping into the role. Welcome to the team Tim!

Tim is passionate about agronomy, with over 20 years' experience in the field, who also manages the family farm growing potatoes, poppies, pyrethrum, grain and rearing livestock.

As a consultant, Tim works closely with land managers on tasks from pre-paddock selection through to harvest. To complement his role as a trusted advisor, he often tries new practices and products out on his own farm to support his recommendations.

Tim was awarded the Rising Star mantle at the 2012 AUSVEG National Convention and the Regional Winner in the 2020 Syngenta Australia Growth Awards Productivity category.

Read more about Tim at walkerag.com.au

DEMONSTRATION SITES

Weather permitting, the demonstration sites will look at

- Seed management- storage and physiological age
- The impact of 'skips' during planting
- The benefits of potassium sulfate topdressed early
- Biologicals
- Integrated pest management
- Soil moisture monitoring

NEW INSIGHTS

Several international pathology, agronomy, and seed management experts are due to visit Australia in early 2023.

This is potentially a great opportunity to hear their insights on topics that are relevant to Australian growers.

Such events also form part of the lead up to the International World Potato Congress, to be held in Adelaide in 2024.

KEEP UP TO DATE

The best way to stay up to date with PotatoLink activities and resources is via our monthly bulletins (see page 28 for more information and subscription link), or our website potatolink.com.au

We look forward to seeing you at an event in your area soon!

NEWS - IN BRIEF

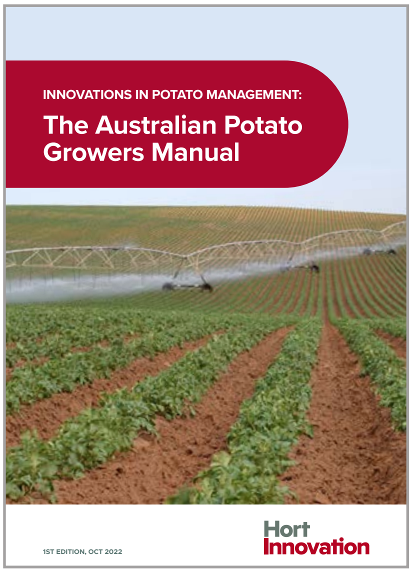
AUSTRALIAN POTATO GROWERS' MANUAL

The much-anticipated growers' manual has been published and is now available to download.

Written and reviewed by experienced plant and soil scientists and industry specialists, the comprehensive guide contains the latest information on best practice potato production in Australia.

Chapters include requirements for potato growth, seed quality, growing a successful crop, harvesting, storage and emerging technologies.

As a digital publication, the manual serves as an online portal, linking to other sources of information for a deep dive into topics which may be of specific interest.



Download your copy at potatolink.com.au

HORT INNOVATION PROJECT WRAP

Project PT17002, Program approach for pest and disease potato industry investments, led by Dr Kristen Stirling and Dr Doris Blaesing, has concluded.

Their final report, including outputs and recommendations, is available online via the Hort Innovation website.

The project had three key objectives, namely, to keep industry informed of pest and disease research outcomes; ensure that the pest and disease R&D program is coordinated and collaborative; and that investment in potato pest and disease R&D program is effective and efficient.

Outputs included two R&D forums (2019 and 2021), regular articles published in Potatoes Australia magazine, webinars, facts sheets, review of international R&D, presentations, and the facilitation of ongoing meetings between research partners.

This project highlighted a lack of strategic pest, disease and weed management R&D for the potato industry, with many projects appearing to be mostly reactive, i.e., dealing with problems rather than with risks and prevention using a coordinated integrated crop protection approach.

Drs Stirling and Blaesing had the following recommendations on how R&D should be delivered in the future. These included:

- Understanding the case for investment
- Understanding the pest and disease opportunities and threats to the Australian potato industry and
- Research and development
- Developing a strategic and coordinated plan for delivery of future pest and disease R&D including identification of the Approach, Delivery, Objectives and Priorities.

Download the final report at http://bitly.ws/wLXJ

HORT INNOVATION PROJECT WRAP

Project PU 19001 Potato Workshop and Market Access Plan was led by Dr David McKinna. The project sought to reach consensus between industry, Hort Innovation, and government, about the market access priorities for potatoes and the next steps for export markets.

Some consensus has been achieved, however Dr McKinna suggests that ongoing collaboration will be required, which will demand cultural change within the industry.

To achieve this, Dr McKinna has recommended the establishment of an informal potato industry export committee. This would be similar to the summerfruit industry's Summerfruit Export Development Alliance (SEDA).

He has also proposed that a short potato industry export forum should be held every 12 months. This would allow centralisation of all market access/improvement applications and ensure they are 'in the national interest.'

The potato industry would also benefit from having a three year, rolling export strategy that is updated annually.

The report revealed a clear need to coach industry for export growth and improve the industry understanding of the drivers of fresh potato consumption.

Download the final report at http://bitly.ws/wLZa

Hort Innovation POTATO – FRESH FUND

This project has been funded by Hort Innovation using the fresh potato research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

Hort Innovation POTATO – PROCESSING FUND

This project has been funded by Hort Innovation using the processing potato research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

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POTATO LINK AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT