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Cover: As spring unfolds and the soil warms, planting gets underway in Cowra
- Marc Hinderager

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Contents

EVENTS GUIDE

Project update

From Peter O'Brien

As with so many of the activities we enjoy, the pandemic has clearly interrupted many of our plans for workshops, field days and other events.

However, in the past few weeks, PotatoLink's Frank Mulcahy has been able to pull together a few face to face "townhall" meetings in Tasmania to explore grower concerns and issues. We had a good response considering the short lead time and promotion for the meetings. Thank you to all of you who contributed to those discussions.

Still in Tasmania, on 26 August a Potato R&D/ Industry update in Tasmania event was held at the Forthside Vegetable Research Station. Speakers included Doug Clark (Seed Certification), Calum Wilson (Powdery Scab Update) Robert Tegg (pink rot next steps) Adrian James (Soil Erosion & Soil Carbon) and Frank Mulcahy on varieties.

Unfortunately, with most of the rest of the country impacted by lockdowns and movement limitations, face to face meetings have not been possible. To deal with this, we have moved as much as we can to an online format.

Over 80 registered for our first webinar on Controlling Potato Pests, featuring Dr Paul Horne. This pleasing result perhaps shows just how much we have all adapted to the online medium! We will be following this up with a webinar series on Managing potato diseases and Precision agriculture, Growing right workshops and online events focussed on irrigation and soil biology. These will be on at least every three weeks, so please keep a look out for the registration links when they get put up.

Our NSW Demo site in Cowra managed by PotatoLink's Marc Hinderager has had a delay in planting due to the wet soil conditions. However, planting has now commenced, as it has in other regions. We will keep you updated on this and other demo sites via our website www.potatolink.com.au.

To register for events, as well as for updates on what is happening when, see our website: potatolink.com.au

EVENT	DATE AND TIME (AEST)
Webinar - Irrigation	
Getting your irrigation ready for the summer	23 September, 12:00 – 13:00
Webinars - Managing potato diseases series	
Pink rot	September TBD (see website)
Black dot	October TBD (see website)
Blackleg, and other bacterial diseases	October TBD (see website)
Webinars - Precision ag series	
Practical soil mapping and adoption	28 September, 12:00 – 13:00
Imagery – more than just pretty pictures	25 November, 12:00 – 13:00
Growing right online workshops	
SA - Getting a better crop stand, to optimise quality and yield	16 September, 16:30 – 17:30
Qld - Getting a better crop stand, to optimise quality and yield	23 September, 16:30 – 17:30
Southeast SA - Processing potatoes	30 September, 16:30 – 17:30
Mallee SA - Soil health (calcium and salinity)	21 October, 16:30 – 17:30
SA - Final crop management and canopy recovery	2 December, 16:30 – 17:30
WA - Seed and soil (incl. calcium)	16 December, 16:30 – 17:30 AWST
Tasmania - Final crop management	13 January. 16:30 – 17:30
Potato crop rotation and soil health	31 January, location TBD
Face to face workshops	
Potato virus management	21 December, location TBD
Online workshop	
Getting soil biology working for you	28 October, 13:30 – 15:30
Webinar – Cover crops	
Cover crops for fresh and processing potatoes	24 February, 12:00 – 13:00

POTATO R&D FORUM

Originally planned as a face to face event, the two day Potato Research and Development forum was held over two information-rich afternoons on 29 – 30 July. Hosted by Doris Blaesing and Kristen Stirling (RMCG) as part of their project PT17002 (Program approach for pest and disease potato industry investments), more than 150 registered for the event, with most logging on to watch the sessions live.

The forum featured a diverse range of speakers from across Australia and overseas. Participants heard the latest research on pests and diseases including TPP, pink rot and powdery scab, as well as ways to improve soil health, manage plant nutrition and get the best from biological products.

Although online, the sessions were highly interactive, with speakers bombarded with questions – perhaps an advantage of the online format!

The following articles summarise some, although not all, of the highlights from the event.

Hort Innovation Strategic levy investment | 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 Strategic levy investment | 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

SEASON UPDATES FROM THE REGIONS

POTATO R&D FORUM 2021

WESTERN AUSTRALIA
SAM TAYLOR, NUTRIEN

The west had a fair amount of wet weather late in summer and the early autumn. The result was fairly high levels of *Botrytis* in wine grapes in the capes area. This transferred onto some potato varieties in the Busselton region, which caught us by surprise. There have also been a few issues with bacterial soft rot and a bit of powdery scab across the southwest. Some of the growers have also commented that they find it hard to get consistent supply of good quality seed of the right age for planting. Otherwise, it's been a very wet winter and growers are looking forward to sunshine returning in spring.

QUEENSLAND
ALLAN SMITH, SNACKBRANDS

Growing conditions are generally good, with a frost-free winter and about the right amount of rain. Some of the southern crops were a bit knocked around by heavier rain, but warmer soil temperatures have helped them recover. North Queensland has been particularly warm so insect populations are up and there's a risk of *Sclerotinia* developing in some areas. Also need to keep a watch on Fall Armyworm – although potatoes are not a preferred host, they will eat them if nothing else is available. Control options are limited, so watch for damage.

(Editor's note – large flights of fall armyworm adults can occur when corn or sorghum crops are terminated, so this is the time to watch for damage in potatoes. Females can fly 100km in a single night, so this doesn't just affect the crop next door!)

Haulm kill in the SA Mallee - *Peter Philp*

VICTORIA
JOSH OPAS, MCCAINS

Last season's growing conditions were generally very good. Temperatures were mild with timely rainfalls and there was a long tail into autumn. The result was one of the better seasons for both quality and yield in the past five years. There were extreme low virus levels, so a high rate of seed certification, which is good news for the coming season, although at the moment things are pretty wet. There were no reported detections of PCN or PSTVd and only three detections of *Dickeya dianthicola,* all with known sources outside of the seed scheme. The bulk of the planting will kick off after mid October but as dams are full and ground water recharging, the season is well set up.

SOUTH AUSTRALIA
JACK WESTHUIZEN, E.E. MUIRS

Yields have been above average. We've seen increasing incidence of black dot, largely due to lack of fresh ground. Black dot is probably our biggest problem. There have also been some issues with powdery scab and verticillium wilt, but the available chemistry seems to be having good effects. We've seen low incidence of potato tuber moth, but thrips activity seems to be on the increase, which is a worry for virus transmission.

TASMANIA
STUART MILLWOOD, NUTRIEN

Last spring was a bit wet, which made planting challenging. Some areas had to be ploughed for the first time in 10 years to dry the ground. However, the growing season was generally good. Yields with Innovator and Ranger Russet particularly shone with the cooler conditions and rain leading up to Christmas. Powdery scab occurred early in the season, restricting root growth, but there was less incidence of defects on the finished tubers. The damp conditions increased *Rhizoctonia* as well. However, ongoing issues with pink rot are really our biggest problem, particularly as it makes harvesting inefficient due to the effects on storage quality. The good news was that fungicides were effective against Irish blight and target spot, so there were no issues despite damp conditions.

TAMARIXIA TRIOZAE

A small parasitoid with a big future | **Sally Anderson**, NZ Market Access Solutionz

POTATO R&D FORUM 2021

The detection of tomato potato psyllid (TPP) in Western Australia in February 2017 was a major blow to the local industry, and an alarm call to all Australian growers of *Solanaceae.*

The psyllid itself is a tiny, sap sucking insect that causes mainly superficial damage. The real problem comes from the *Candidatus* Liberibacter solanacearum (CLso) bacterium that it can carry, which causes 'zebra chip' disease. Zebra chip can cause stem cankers and stunt growth in the plant itself. But in the tubers damage is severe, causing dark splotches and stripes strongly visible after cooking (Figure 2).

Figure 1. TPP adult and eggs.
- *Tasmanian Institute of Agriculture*

So far, WA, and Australia generally, have dodged a bullet. Despite extensive sampling, no 'hot' psyllids - carrying the bacterium - have been found. However, this may not always be the case as there is always the possibility of another biosecurity breach. For example, in 2015 both the psyllid and the CLso bacteria were found on Norfolk Island.

Figure 2. Zebra chip affected potato

THE NZ SOLUTION - KILLER WASPS!

New Zealand, unfortunately, has had both the psyllid and its unwelcome companion since 2006. Enter

Figure 3. Tamarixia adult and TPP nymphs
- *R. Lamberts*

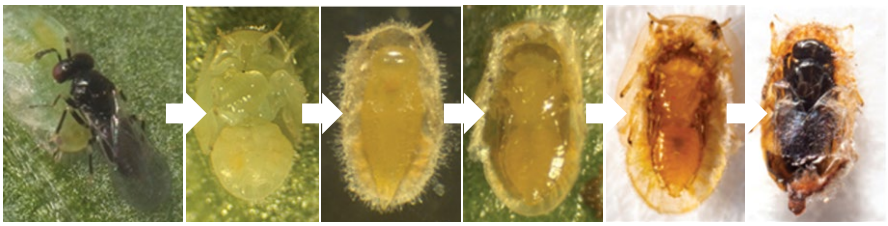


Figure 4. Lifecycle of *Tamarixia triozae*: The female lays a single egg on a psyllid nymph. The wasp larvae burrows into the psyllid, devouring it from the inside. Eventually, the larvae pupates inside the eaten-out cadaver, emerging as an adult wasp. – *R. Lamberts*

Tamarixia triozae. This tiny wasp delivers a double whammy, being both a parasitoid and a predator of TPP.

Like something from the movie Alien, the adult lays a single egg on the underside of the psyllid nymph. After 12 days an adult wasp emerges from the eaten-out cadaver (Figure 4).

Females then go in search of prey. She uses her ovipositor to stab a hole in psyllid nymphs, then feeds on their hemolymph (blood). Like Dracula but with an ice-pick.

A female can lay up to 165 eggs during her lifespan, so that's a lot of dead psyllids.

As Sally explained, "Introducing an exotic insect (from Mexico) to New Zealand involves a lot of hoops. It took around four years to get approval to import this parasitoid into New Zealand. This involved host range testing, an economic analysis and a risk analysis. Approval was granted in 2016 and, following additional quarantine screening, the first releases occurred two years later."

"Our releases ramped up from a modest 1,900 in year one, to a more organised 7,400 in year two and then an all-out effort in year three with more than 20,000 *Tamarixia* released (Figure 5). One of the really encouraging things about the program

Figure 5. Releasing a vial of adult *Tamarixia* into a boxthorn hedge (boxthorn is an alternative host for TPP) - *S. Anderson*

Figure 6. Parasitised TPP nymph, showing the wasp's exit hole. - *R. Lamberts*

was not just the interest shown by growers, but also the enthusiasm from home gardeners, who released more than 10,000 *Tamarixia* in the 2020-21 season," said Sally.

Early observations showed that the psyllid survived over winter, spread significantly from the initial release sites and could achieve up to 40% parasitism of psyllid nymphs (Figure 6).

COULD *TAMARIXIA* BE A SOLUTION FOR AUSTRALIA AS WELL?

While *Tamarixia* is now commercially available in New Zealand, introducing it to Australia would require at least a similar number of hoops as encountered by the Wellington researchers.

Critically, it would need to be shown to be host specific to TPP; nobody wants another cane toad! *Tamarixia* was found to predate on a NZ psyllid, although it was non-preferred compared to TPP. Given the large number of Australian psyllid species, this is likely to prove a challenging task as well as a potential barrier to introduction.

However, even the best biosecurity cannot guarantee Australia will be free of 'hot psyllids' forever. Starting the process sooner rather than later, to determine if *Tamarixia*, or a local species, is a potential control option, may be worthwhile insurance.

NEW SMARTPHONE TECHNOLOGIES FOR PATHOGEN DETECTION

POTATO R&D FORUM 2021

Dr Jean Ristaino, Director of the Emerging Plant Disease and Global Food Security cluster at North Carolina State University

Figure 7. Dr Jean Ristaino, a pathologist and distinguished professor in North Carolina University's Department of Entomology and Plant Pathology

Imagine if you could detect disease even before symptoms develop in the field... and you could do it using your smartphone!

This is what a project run out of North Carolina State University is seeking to achieve.

They are investigating two methods.

One is detection of release of volatile organic compounds (VOCs). A sample of plant leaf is placed in a small glass container for around 15 minutes, then the atmosphere is pumped through a chamber containing a test strip (Figure 8). Chemicals on the strip

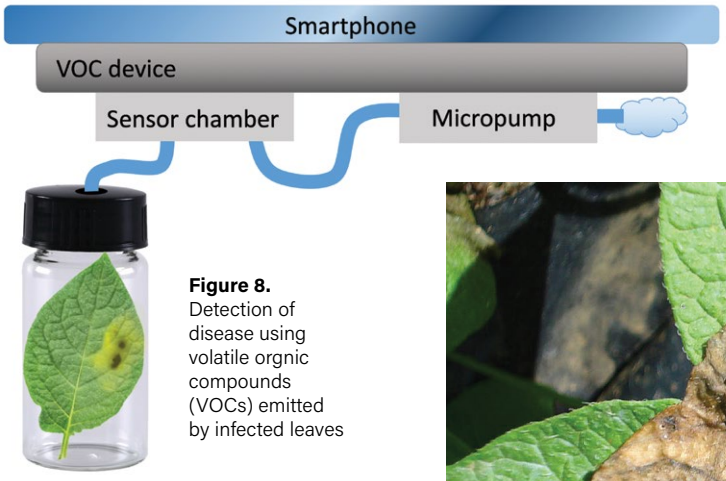


Figure 8. Detection of disease using volatile orgnic compounds (VOCs) emitted by infected leaves

change colour in response to specific VOCs emitted in response to infection. Results have been shown to be 98% accurate.

The second is microneedle patch technology (Figure 9). These are already widely used in human medicine to deliver drugs as well as to diagnose disease and monitor blood sugar levels. The patches cost only a few cents to produce and can even be 3D printed using biodegradable materials.

In this case, the microneedle patches are used to sample DNA from plant leaves. The patch is held against the plant leaf for a few seconds, allowing the tiny needles to pierce the plant tissues. The patch is then immediately washed in a buffer solution to remove the DNA. This is analysed using rapid LAMP (Loop-mediated isothermal amplification) assays to detect specific regions of DNA, revealing the presence of one – or many – plant pathogens.

Figure 10. Late blight (*Phytophthora infestans*) of potatoes could be the first plant disease to be detected using this technology. *- J. Ristaino*

By excluding large amounts of coarse plant material, this method is much faster than more traditional methods of DNA extraction and analysis.

According to Dr Ristaino, "We started off the work with *Phytophthora infestans* ... but now we're planning on scaling the technology into the field, looking at multiple pathogens as they occur in space and time." The ultimate objective is to develop "wearable sensors" that can monitor plant health during the cropping cycle.

"They would have to be resilient to climate, and ideally we want to wirelessly transmit data, rather than having to physically go out and remove the patches or volatile sensors. This is really the next big step, getting field ready," said Dr Ristaino.

As Dr Ristaino observed, "As I read outside the discipline of plant pathology and traditional diagnostics, and learn more about what's going on in the medical community, I'm seeing a lot of opportunities for new applications of this technology in agriculture."

With massive advances in medical technology over the last 18 months, there could be significant spinoff benefits to horticulture. Exciting times, indeed!

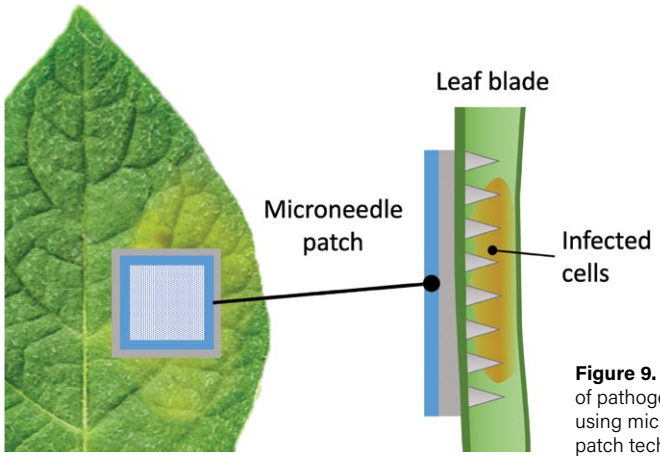


Figure 9. Extraction of pathogen DNA using microneedle patch technology

This work was funded by the NC State Plant Science Initiative. A new video on the technology is available at https://drive.google.com/file/d/13dtnbUdBiPOiFQW47RSr3z0xly7BtTPK/view

OVERVIEW OF NEW CROP PROTECTION PRODUCTS

Tim Belleville, E.E. Muir & Sons

Protecting valuable crops is obviously a top priority for growers. However, there are a number of major trends occurring, both in terms of where products come from and what is available.

COMPANY CONSOLIDATIONS

This is a process driven by increasing costs of R&D, declining profits and shareholder expectations. Whereas there were 10 major agrochemical companies in the US and Europe in 1990, mergers and acquisitions have halved this number, leaving Bayer, Corteva (DowAgro), BASF, Sumitomo, Syngenta Group (now part of China National Chemical Corporation) and FMC corporation (previously part of DuPont)[1].

Larger companies are better able to invest in expensive research, so this may potentially increase, not decrease, products available.

OLDER CHEMISTRY OUT!

The number of chemical groups used in crop protection products has skyrocketed since the 1960s. Whereas, in 1960, farmers had available around 100 active ingredients from 15 chemical groups, today there are at least 600 active ingredients from more than 40 different groups[2].

However, despite continuing high levels of investment in R&D, the rate of new products coming onto the market has slowed considerably. Only 39 new actives came onto the market between 2010 and 2020, compared to more than 100 in each of the previous five decades (Figure 11).

Moreover, concerns about worker safety, food safety and, importantly, environmental safety have seen many products banned. For example, six of the top 10 agrochemicals used in the US in 1968 are now banned. In Europe, changes in regulations have removed more than half (293 of 499) of the crop protection active ingredients previously available[2].

In some cases, companies have voluntarily withdrawn chemicals from sale; there can be substantial legal risks from application, even for registered products demonstrated to be safe, which can be difficult or impossible to insure against (M. Eberius, CropZone, pers. com.). In other cases, a shrinking market, together with increased registration costs, has made sale no longer viable.

BIOLOGICALS IN

There has been a major increase in research on biological options over the last few years, not only by the larger companies but also by small companies and start-ups. Development has been encouraged by easier regulatory processes (at least in the US and the EU), increased

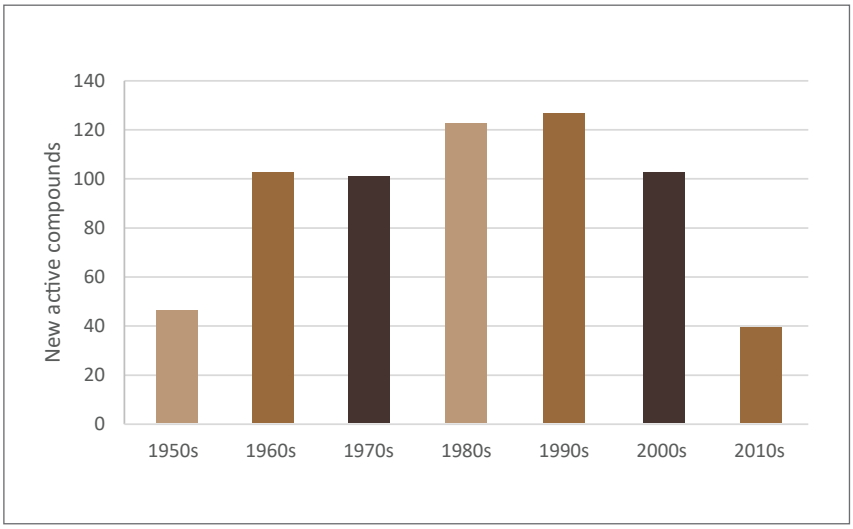


Figure 11. Number of new active ingredients introduced per decade. Derived from Phillips McDougall, 2018

[1] Nishimoto R. 2019. Global trends in the crop protection industry. J. Pesticide Sci., 44:141-147

[2] Phillips McDougall. 2018. Evolution of the crop protection industry since 1960. Report for Crop Life International, 20pp

adoption of IPM and demand for reduced chemical residues by farmers, regulators, customers and consumers.

The number of new biological products now exceeds the development of conventional chemicals, a trend that seems likely to continue.

But what is a 'biological'? They include fertilisers (e.g. rhizobia), stimulants, biochemicals such as plant extracts and pheromones as well as various fungi, bacteria, viruses and predatory organisms that target specific pests or diseases (Figure 12).

According to Tim, "In the past we might have been cautious, but biologicals do seem to be getting more reliable, and we need to look at how we can fit them into our crop protection programs. Changing to biologicals does create challenges. It's not as easy as just see a pest, spray a pest, it requires a broader scope of thinking."

One of the biological products E.E. Muirs has seen good results for is EndoPrime by Sumitomo. EndoPrime contains beneficial mycorrhizal fungi. Mycorrhizal fungi can enhance uptake of nutrients from the soil, as well as buffering plants from stress.

"We've been seeing some really good results with EndoPrime in the field," said Tim, "as well as Serenade Prime. Bayer are continuing to invest in Serenade, and new upgraded products are on their way, so that's one to watch."

"More on the conventional side, we have recently found the new Miravis by Syngenta to be really good against Target Spot. Syngenta have now launched Miravis Prime, a blend of Pydiflumetofen (Group 7) and Fludioxonil (Group 12), so that broadens the spectrum to include diseases such as *Sclerotinia*," commented Tim.

"Another newer fungicide is Amishield by NuFarm. This is a Group 12 with good action against both pink rot and powdery scab. It is a protectant, not a systemic, so it's really important that it's applied at planting and in the right spot."

SIVANTO prime is a still waiting for APVMA approval but, all going well, will be released later this year. The product targets silverleaf whitefly and green peach aphid. "It's Group 4D, and appears to be the only product in this class, so that's a really new chemistry," said Tim. "Like many of the newer insecticides, this is a soft chemical that should be compatible with IPM programs."

The performance of biological products is affected by conditions in the field, and they don't have the long shelf life of conventional chemicals. There can also be problems with availability; it's hard to suddenly increase or decrease production.

However, with a huge research effort behind them, they may well be the way of the future.

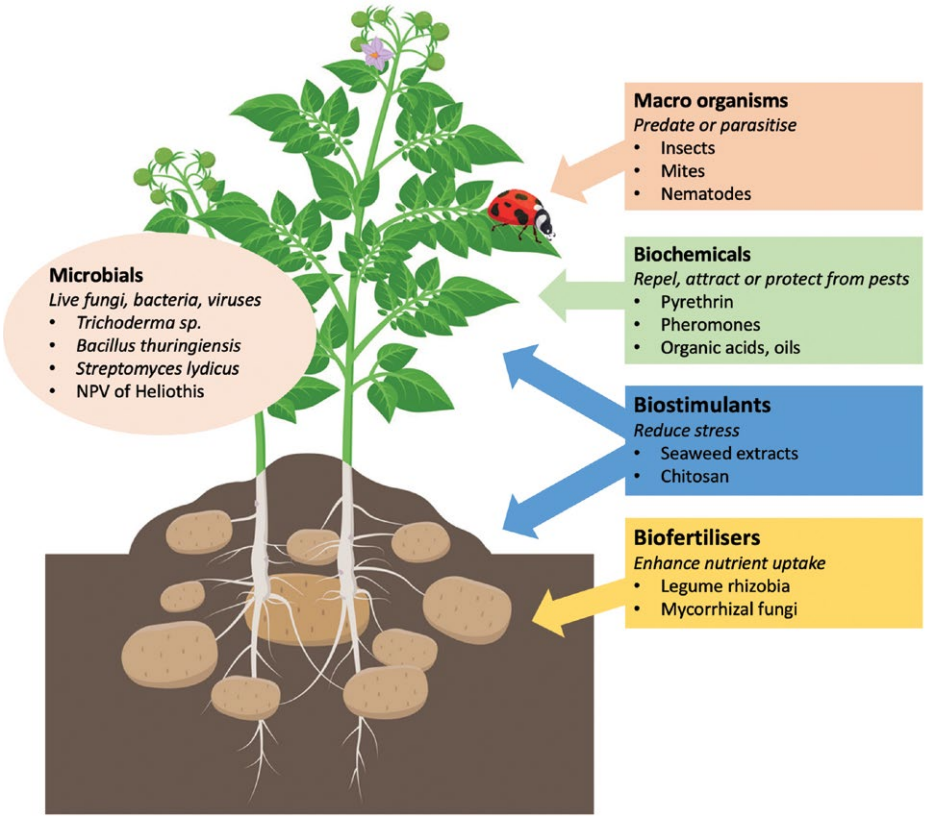


Figure 12. Types of biopesticides

MANAGEMENT OF SOIL CONSTRAINTS IN THE POTATO INDUSTRY

Ben Fleay and Greg Hall, Precision Agriculture

Soil characteristics and nutrient status can vary significantly across the area of a pivot. Varying or matching fertiliser applications to the needs of different zones will result in a more uniform crop, as well as maximising yield and quality. But how to do this?

PUTTING NUTRIENTS WHERE THEY'RE NEEDED

Ben and Greg discussed the benefits of grid-based soil mapping. This high-definition soil sampling technique is used to produce "maps" showing what rates of gypsum, phosphorous and other nutrients need to be applied where, and what soil types are present. Greg showed an example where Colwell P under a pivot ranged from only seven to 66 (Figure 13).

GPS referenced samples (0-20cm) are taken using an automated soil sampler mounted on an ATV. For a standard 1ha grid, 8 – 10 subsamples are collected in a diagonal across different grid lines. These can be tested for pH, nutrients, and other factors (OM%, bulk density, disease etc).

The resulting "prescription file" is supplied with the necessary GPS coordinates to properly apply the nutrients through VR compatible spreaders. This might be used, for example, to alter application of MAP based on phosphorous requirements. So, for the pivot noted above, MAP application ranged from 0 to 600kg/ha. While the average was 230 kg/ha, application was targeted at those areas where it was needed and avoided where it wasn't (Figure 14).

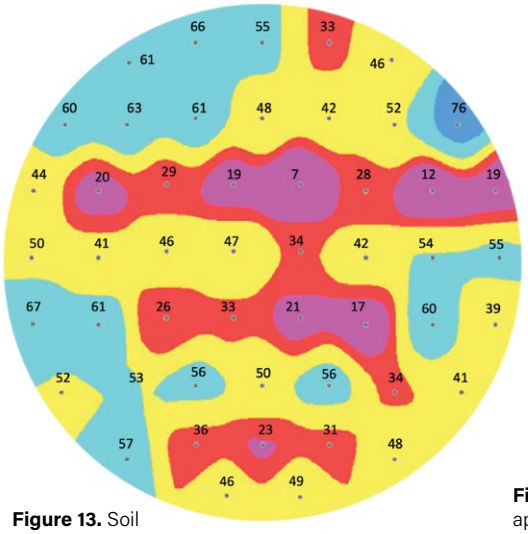


Figure 13. Soil sampling on a 1ha grid – Colwell P

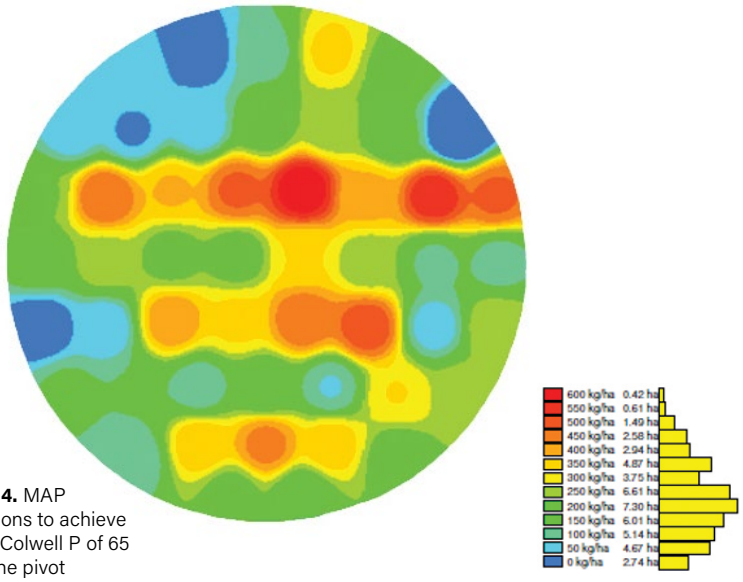


Figure 14. MAP applications to achieve uniform Colwell P of 65 across the pivot

Figure 15. EM38 maps can be used to change seeding rates during planting, with wider spacing on lighter soil types

ELECTROMAGNETIC SOIL MAPPING

Another service Precision Agriculture provides involves measuring soil conductivity (EC) to create an EM38 map. Electrical conductivity is influenced by the water holding capacity of the soil, so can be used as a proxy for different soil textures. "Overwatering or underwatering can have a huge impact on how well potato crops perform," commented Greg. "Using an EM38 map and identifying the different soil textures under a pivot helps us to set up variable rate irrigation on compatible pivots. Not only are there potential water savings, but major improvements in both uniformity and yield which drives better returns."

The previous issue of PotatoLink described how software systems such as John Deere T3RRA Cutta or OptiSurface can be combined with ditch digging hardware to improve water flows under a pivot. Greg confirmed the usefulness of such systems, "You can also combine the EM38 data with elevation to develop drainage maps. Adding drains (surface or subsurface) to remove excess water and prevent ponding can really help overall crop yields and harvestability."

EM38 maps might also be used to change seeding rates – with wider spacings used on light soils compared to heavier areas, allowing all tubers to reach similar sizes (Figure 15). "New systems are available now in the potato equipment scene which adjust planting rates on the go, these are already used quite commonly in broad acre cropping."

SO, HOW MUCH?

The average cost of doing basic soil testing is around $65-70/ha. "This is a cost that could be returned in lime savings alone," states Greg. "Additional savings are likely in terms of reduced fertiliser applications as well as higher crop productivity."

While adoption is still in the early stages, a number of larger potato companies have been trialling the technology, as have other industries such as onions, leafy greens and tree crops.

In an environment with increasing input costs, tight margins, and pressure to grow ever more sustainably, smart farming technology like this is only going to become more important.

COVER CROPS AND SOIL AMENDMENTS TO IMPROVE SOIL HEALTH AND YIELD

Julie Finnigan, Serve-Ag Tasmania

Today's sophisticated potato production systems bear little resemblance to the hand dug spuds of the early 1800s.

Mechanisation, remote sensing, molecular testing for disease, variable rate irrigation and fertilisation, and other developments mean we have more control than ever over the growing environment. Yet, despite these advantages, growers are finding it harder to get the yields they once did.

This may be due to disease pressure, fewer chemical options and difficult weather conditions. Continual cropping can deplete organic matter and soil biology, destroy structure and reduce resilience. In some cases, the pressure to find fresh ground means growers are using increasingly marginal soils.

Yet, according to Julie Finnigan from Serve-Ag: "Healthy soils are the cornerstone of productive and sustainable farming systems. We need these soils to keep producing food for generations to come."

Julie presented some highlights from Serve-Ag's research on Tasmanian potato crops, looking at some of the short- and long-term options available to growers to improve their soils and sustainability.

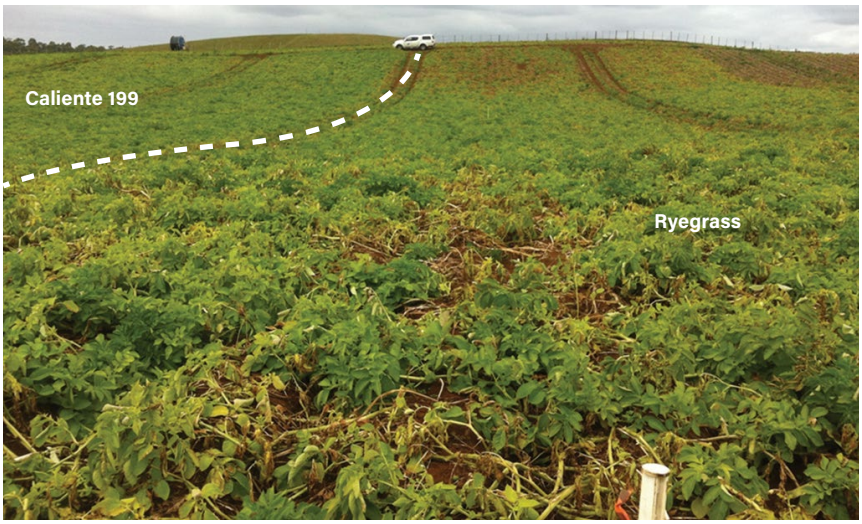


Figure 16. Potato crop growing on a field previously cover cropped with Caliente 199 (left side) or Ryegrass (centre). Note the early die off on the high bank sown to ryegrass, as well as the increased pink rot in the lower lying, wet area in the foreground. *- J. Finnigan*

COVER CROP, CAN DO

Cover crops can serve many purposes. They can help condition soils, suppress nematodes and disease, scavenge nutrients and suppress weeds.

"Many of our growers have found biofumigants to be a really big winner, especially if they outgrow weeds and volunteer potatoes," observed Julie. "A lot of these plants have really strong root systems. By improving soil structure, they not only limit the need for tillage, but make tillage easier, reducing fuel use."

Better soil structure also improves water infiltration, making irrigation more efficient.

For example, a Tasmanian trial compared yield in areas of the paddock sown with either ryegrass (the grower standard) or Caliente 199. Reduced water infiltration at the top of the bank sown to ryegrass resulted in early plant death. At the low, wet end of the paddock there was noticeably less pink rot where Caliente 199 had grown (Figure 16). As a result, yield increased from 67.4 T/ha to 74.8 T/ha, representing a 8:1 return on investment.

When brassica cover crops are macerated, sulphur compounds (glucosinolates) inside the plants react with enzymes to form gaseous isothiocyanates (ITCs). These are natural soil fumigants, demonstrated

to be active against nematodes, as well as suppressing diseases such as *Phytophthora* spp., and *Sclerotinia*.

Effectiveness depends on the variety grown, as glucosinolate content varies considerably. Factors such as plant maturity, soil moisture and how quickly macerated plants are incorporated into soil also affect the amount of ITC released (Figure 17). According to US data, around 80% of ITCs are released in the first 20 minutes after maceration, with high soil moisture and warm temperatures optimising conversion.

Julie is not the only one who is a fan of brassica cover crops; similar results have been reported by Queensland and NSW researchers, as well as overseas. For example, a study by Agriculture and Agri-Food Canada found that mustard cover crops could significantly reduce potato early dying complex (PED) as well as improve soil health. PED in Canada is caused by a combination of disease (*Verticillium dahlia*) and root lesion nematodes (*Pratylenchus penetrans*), both of which can be suppressed by ITCs.

Some biofumigants (e.g. Caliente 199™, Nemat™) can host club root, so if potatoes are rotated with a brassica crop this is an important consideration. In contrast, Terranova oil seed radish is not susceptible to clubroot so may be more appropriate in this situation.

CONDITIONING SOIL

One of the big problems with sandy soils in South Australia, Tasmania and other areas is that they can become very hydrophobic. This reduces water infiltration into the mounds and mound stability.

Serve-Ag has done a number of trials with the Oro-Agri product Transformer. Derived from cold pressed citrus, the product aims to increase water infiltration by dissolving the waxy coating that has formed on soil particles. This increases irrigation efficiency, enabling more uniform wetting of the root zone. It can be applied in-furrow or through fertigation.

Figure 17. Brassica cover crops such as Caliente are best finely macerated and incorporated before the plants bloom, as this is when active compounds and organic mass are highest.
- J. Finnigan

"We have found major benefits in terms of improved mound structure on sandy soils. The improved water infiltration reduces slumping as well as wetting and drying within the mounds. The result is healthier plants with better root growth and fewer green and misshapen potatoes," said Julie.

"In one of our trials in Tassie, we got an increase of 7.8T/ha from applying a total of 7L/ha Transformer. This represents a return on investment of around 15:1."

In a South Australian processing potato trial, Transformer was applied as an in-furrow treatment, blanket spray or both. Although total yield was similar to the control, the percentage of marketable potatoes was nearly doubled (Figure 18). The product can remain active in the soil for up to eight months and does not negatively affect soil biology.

BIOLOGICAL SOLUTIONS

As previously noted, there is an increasing variety of biological products entering the marketplace.

Serve-Ag has trialled a number of these of which the Sumitomo product EndoPrime is a standout. EndoPrime contains four species of arbuscular mycorrhizal fungi (AMF).

Mycorrhizae colonise the root systems of plants, helping them to extract water and nutrients from the surrounding soil. The fungi cannot survive without their host plant, which

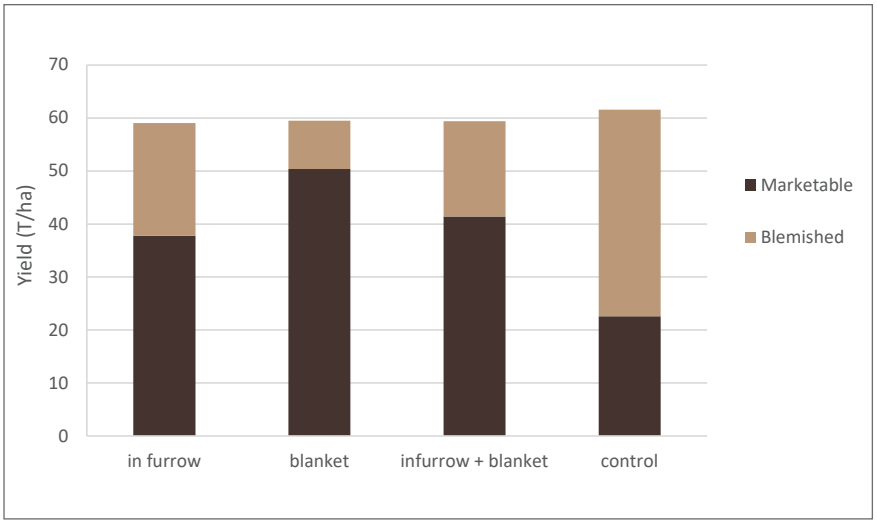


Figure 18. Marketable and total yield of processing potatoes grown in South Australia with the soil conditioner 'Transformer' applied in-furrow, as a blanket spray, or both

supplies them with carbohydrates. Symbiosis between mycorrhizae and plants is one of the oldest relationships on earth, having existed for at least 400 million years.

AMF live inside the roots, and can increase the effective root zone by up to 50 times (Figure 20).

Julie has been impressed by the effects on yield. "We applied EndoPrime at 150g/ha in-furrow on heavier soils at two sites in Tasmania, as well as a site in South Australia. In all cases, we had a significant increase in yield. The gains were mainly by a shift from small to larger tubers, with more in the valuable premium size range." (Figure 19)

"This represents a return on investment of something like 17 to 33 to one. It's not pixie dust, it's good stuff, with excellent longevity and really easy to apply," commented Julie.

Julie has seen major improvements in yield and packout from using biofumigant cover crops, soil conditioners and a number of biological stimulants. These are natural and sustainable options for improving plant performance, not only for the current crop but for ones that follow. As Julie suggests, growers need to look at the data and decide what will work in their situation. However, so far, the results seem very promising indeed.

Figure 19. Compared to the controls (left), plants treated with EndoPrime (right) had more even tuber sizing. *- J. Finnigan*

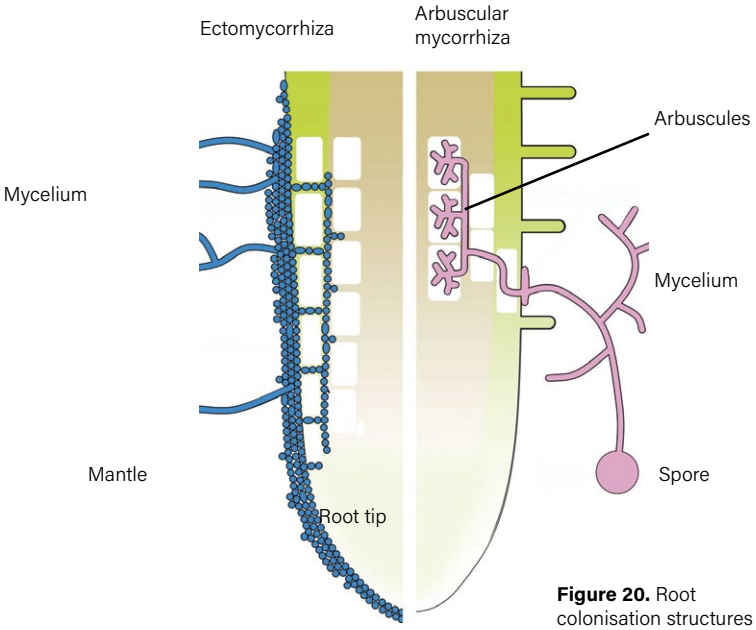


Figure 20. Root colonisation structures in ectomycorrhizal and endomycorrhizal fungi *- P. Bonfante and A. Genre*

Dear Spud GP,

My local council is giving away compost. It looks pretty good and they assure me it is made from tree loppings and other landscape waste, so doesn't contain any plastic or glass. However, I'm worried about how this will affect soil-borne diseases – will it make them better or worse?

ASK THE SPUD GP

Applying composted organic matter is a convenient way to raise soil organic carbon and stimulate soil microbial activity but it does come with some risks.

On the positive side a quality compost can stimulate plant health and growth by improving the physical, nutritional, and biological qualities of soil. In particular, the range of microbes can suppress bacterial, fungal, and fungal-like pathogens.

However, if the compost is not mature and there are partially degraded wood or other organic fragments (such as weed seeds), it could stimulate the growth of fungal pathogens. For example, *Rhizoctonia* species can cause root, stolon and tuber diseases. Introduction of weeds can also be a farm biosecurity problem, especially if they can act as alternative hosts for thrips or other pests.

Partially composted organic fragments also draw down nitrogen. This in turn makes plants more susceptible to foliar diseases such as target spot and similar fungal leaf spots. Heavy metals and human bacterial pathogens can also potentially be introduced with composted organic amendments.

Compost quality is paramount. Even if no manure has been added, composts still need to be heated to over 55°C for three days on three occasions, with the pile turned after each heating event, to meet Australian standards. This is to ensure it is free of weed seeds, fungal pathogens, nematodes and so on.

If the council has added manure, or materials such as abattoir waste, then the heating and turning need to be repeated five times. Even then, if the material has not been certified to Australian Standard 4454, your food safety auditor will consider it equivalent to untreated manure. If you are certified to Freshcare, this means there needs to be a gap of at least 90 days between when the compost is applied and when you harvest the crop.

I would advise caution using composts with unknown constituents and quality controls. There are reputable composters around Australia who can provide a quality product with known nutrient and microbial status to suit your needs. Unlike the council giveaway, it's not free, but it may save you in the long run.

BLACKLEG: PREVENTING A PROBLEM

Ms Nellie Malseed and **Dr Nigel Crump report**

For many years, blackleg in potatoes has been successfully managed through the Australian seed certification schemes. However, detection of new species of bacteria that can cause blackleg, combined with their ability to cause significant crop loss, has demanded a renewed awareness in relation to the management of blackleg. It also highlights the importance of using certified seed.

Traditionally, Australia has only had one type of bacteria causing disease. However, there have now been reports of other bacteria that can also cause blackleg.

WHAT ARE THE PATHOGENS IN AUSTRALIA THAT CAN CAUSE BLACKLEG?

"New blackleg"

- *Dickeya dianthicola*
- *Pectobacterium carotovorum* subsp. *brasiliense*
- *Pectobacterium parmentieri*

"Old Blackleg"

- *Pectobacterium atrosepticum*
- *Pectobacterium carotovorum* subsp. *carotovorum (*common soft rot)

The new bacteria detected in Australia are more suitable to local climatic conditions. Their effects can be devastating, with crop losses of up to 90% reported overseas. *Dickeya, P. caratovorum brasiliense*, and *P. parmentieri* are most damaging in warm environments (>25°C), and can be asymptomatic at cooler temperatures.

This means that seed produced in a cool growing area may be infected but have no symptoms of disease. When this seed is planted in a warm growing area, the disease can be expressed, causing non-emergence, stand losses and subsequent crop loss.

Distinguishing the symptoms in the field caused by the various bacterial species is difficult. Diagnosing the specific bacteria involved often requires a laboratory test.

D. dianthicola was detected in potatoes in Western Australia a few years ago. It is now confirmed as present in other states, including Tasmania and Victoria. In addition, two new bacteria *P. parmentieri*, and *P. carotovorum* subsp. *brasiliense* have been found in some regions of Australia.

Widespread crop losses can occur unless the levels of blackleg pathogen in seed stocks is minimised. Blackleg pathogens can progressively accumulate in the multiplication of seed lots, meaning that undetectable levels of the disease in early generations can contribute to significant disease development in later generations and associated commercial crops.

A RENEWED FOCUS FOR SEED POTATO CERTIFICATION

Blackleg continues to be a major focus of the seed certification system.

The best way to reduce the risk of blackleg is by minimising the chance of the disease pathogens entering your farm. The use of clean, certified seed supported with robust laboratory diagnostics and an on-farm hygiene program are all key in the ongoing management of this disease.

The detection of new bacterial species and the occurrence of crop loss emphasise the importance of using certified seed potatoes that have a known disease status.

Adoption of good biosecurity practices on farm is also essential. Blackleg can be spread rapidly through handling potatoes with contaminated seed cutters or equipment. Equipment for handling potatoes should be thoroughly sanitised between seed lots, such as by using a quaternary ammonium (quat) disinfectant or strong chlorine solution.

Avoid using fields that have been used to grow alternative hosts for the bacterial pathogens that cause blackleg, such as flower bulbs.

WHAT VARIETIES ARE RESISTANT TO BLACKLEG?

Blackleg can infect any potato variety. There are no known resistant varieties.

ARE THERE BACTERIA THAT CAUSE BLACKLEG THAT AUSTRALIA DOES NOT HAVE?

Dickeya solani is a major cause of the disease in Europe. Fortunately it is not known to occur in Australia. *D. solani* has been shown to be one of the aggressive species of the blackleg pathogens, as even a low level of the bacteria can cause severe disease and crop loss.

AuSPICA has developed a diagnostic preparedness strategy for this pathogen. In the 2021 season, seed potato crops with symptoms of blackleg were tested in the laboratory for the presence of *D. solani*. All samples in the survey were negative. While you can't prove absence, this supports the conclusion that *D. solani* does not occur in Australia.

Ongoing biosecurity conditions for the entry of potatoes into Australia provides a robust protection to the Australia potato industry.

DISEASE SYMPTOMS

Above ground symptoms of blackleg include uneven emergence and wilting. Affected plants wilt very quickly and easily.

A symptom of the "new blackleg" is black stem lesions that typically rise from the base. Often, the disease progresses within the crop along the row. The "new blackleg" does not typically have a potent smell and is not slimy or wet to the touch.

For more information on disease symptoms and the history of blackleg, see fact sheet by Steven B Johnson. (https://www.auspica.org.au/wp-content/uploads/2019/02/Blackleg-on-Potatoes-in-Australia.pdf)

In the field, *Pectobacterium carotovorum brasiliense, P. parmentieri* and *D. dianthicola* all express similar disease symptoms and can only be differentiated using laboratory diagnostics. It is also common for more than one bacterial species to be isolated from infected plant material.

IT'S ALL A LOAD OF ROT!

Blackleg is NOT widespread across the current seed potato production regions in Australia. However, being aware of the pathogens involved means that we, as an industry, can take action to prevent the spread of blackleg, and in doing so, mitigate the crop loss that can be caused by this disease.

There are no pesticides available to combat blackleg in potatoes, meaning that prevention is the main defence. Knowing the disease status of the seed lot that is used to produce a potato crop will help make sure you don't plant a problem.

Figure 1. *Dickeya dianthicola* in Australia (left - *Nellie Malseed*) and in Maine, USA (right - *Steven Johnson*)

Figure 2. *Pectobacterium partmentarie* and *Pectobacterium caratovorum* subspecies *brasiliense* - *Nellie Malseed*

NEW POTATO MANUAL IN THE WORKS

Australian potato growers and their advisers will soon have access to a comprehensive new guide to potato production.

The project is being managed and funded by Hort Innovation through the industry's Potato–Fresh and Potato–Processing Funds and contributions from the Australian Government.

The guide, *Innovations in Potato Management: The Australian Potato Manual* is being developed by a multi-disciplinary team of potato industry experts under the guidance of rural communications specialists AgCommunicators.

"This guide will be a particularly valuable tool for growers and advisers who currently grow potatoes and are looking to improve their production systems as well as those looking to add potatoes to their crop rotations," says Hort Innovation Australia Regional Extension Manager, Jason Hingston.

"It will bring together the wealth of information created by potato research over the past few decades, tailored to Australian growing conditions in different regions.

"Our goal is to address those issues as comprehensively as possible."

The new guide is being organised into five major sections – Growth Requirements, Seed Quality, Growing the Crop, Harvest and Storage. A sixth section will cover new and emerging ag technology. For example, soil and crop sensing and mapping, variable rate inputs and irrigation.

The industry has come a long way since potatoes were dug by hand - *Pennsylvania State Archive*

A 1959 field day in the Adelaide Hills - *SARDI*

The chapter material is being written by a group of agricultural scientists, plant pathologists and industry potato specialists. The draft content will then be reviewed by select potato growers, processors, researchers, and extension specialists to ensure industry relevance and suitability.

Finally, interested industry participants will be invited to review the draft and provide their feedback for the final version.

"We're confident this robust process will deliver a highly relevant and useful guide for growers," Mr Hingston says.

"Whether you are considering adding potatoes to your crop rotation for the first time, or you're an experienced grower who wants to catch up on current best practice as well as the latest developments, you'll get real value from this new guide."

Publication of *Innovations in Potato Management: The Australian Potato Manual* is planned for later this year. The guide will be published as an electronic PDF file that can be downloaded and used on almost any desktop or mobile device with a PDF viewer app.

This format means the core content can be used offline, but an internet connection will also provide access to hyperlinked reference documents and more in-depth resources. The PDF format will also make it easier to regularly update the guide, so that it remains relevant as knowledge, technology, growing conditions and production constraints change.

Hort Innovation will make the new guide available to members of the potato industry for free.

This project, *The Australian potato grower's manual* (PT19003) is being funded by Hort Innovation, using the processing and fresh potato research and development levy and contributions from the Australian Government.

TECHNOLOGY TEST DRIVE

CROP.ZONE Integrated weed management

WHAT IS IT?

CROP.ZONE is a weed management system that combines application of conductive liquid with electricity. It can be used to terminate potato crops as an alternative to herbicide.

HOW DOES IT WORK?

The system combines an ionic liquid with electricity (Figure 1).

A 12m wide spray boom is attached to the front of the tractor, spraying the potato plants with "Volt.fuel" conductive liquid. The liquid contains a spreader and dissolved solutes, somewhat resembling a leaf fertilizer but without nitrate or phosphate.

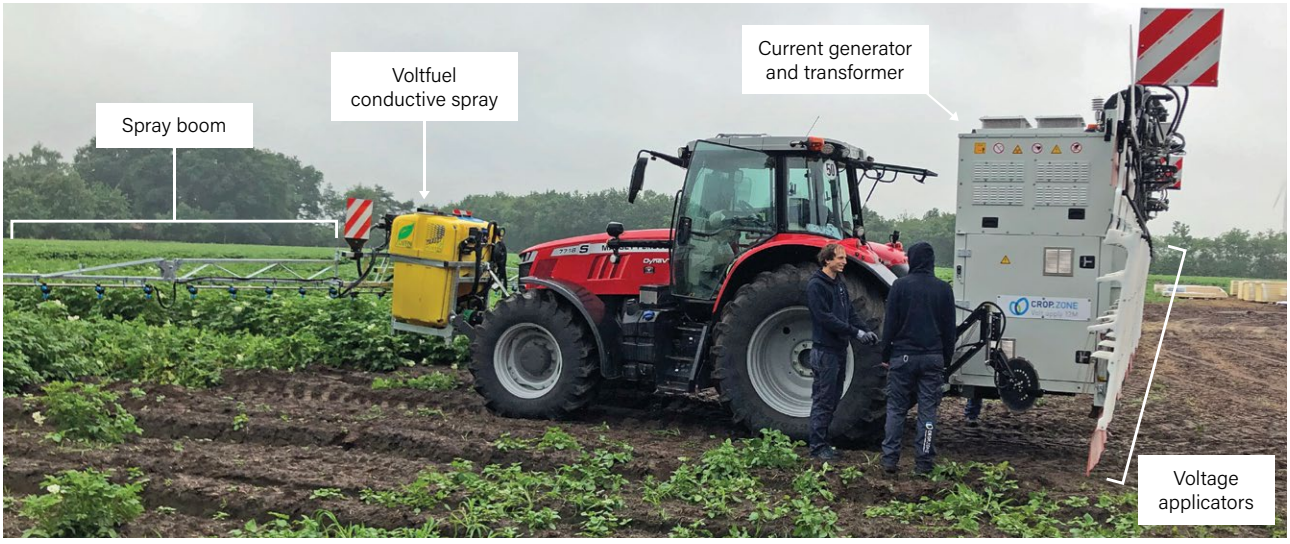
Spraying the plants with Volt.fuel maximises electric conductivity between the applicator electrodes and the waxy, hairy, uneven plant surfaces. This decreases electrical resistance, significantly reducing the voltage required.

Electrical energy is delivered using applicators attached to the rear of the tractor. The system works best if the soil is dry, as electricity passes preferentially through the wet tissues of the plant vascular system. The current collapses the vascular bundles, stopping water and nutrient supply to the plant leaves (Figure 2).

Depending on plant geometry, applicator setting and distances between the electric poles, the electric current is concentrated into the stalks and leaves or delivered through the stems into the roots, penetrating up to 10 cm into the soil.

Tractor speeds of 6-8kmh have been shown to be effective. There

Figure 1. The CROP.ZONE system combines a conductive spray with electrical applicators



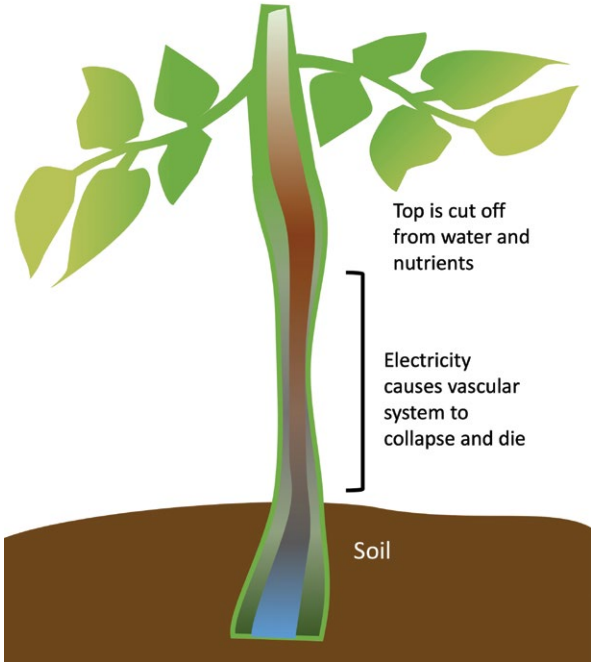


Figure 2. Passing electricity through the potato plant causes the vascular system to collapse and the plant to die

is effectively no consistent dose response, as vascular bundles are either destroyed or not. However, slower driving speeds could potentially allow a larger boom width.

Depending on plant vigour and maturity stage, the treatment may need to be repeated after 3-5 days to achieve complete kill.

Although the CROP.ZONE is still in relatively early stages of development, 15 machines are already operating in Europe. Some units have been purchased by co-operative for use by members, a relatively common model in parts of Europe. Other units are operated by NuFarm and may be leased as either a "full service" or lease arrangement.

WHAT PROBLEM DOES IT SOLVE?

Potato crops are usually desiccated using the powerful herbicide diquat, the active ingredient in Reglone®. Reglone is efficient and highly effective, particularly on broadleaf crops such as potatoes. A contact herbicide, it binds tightly to clay particles in the soil and does not translocate through plant roots. It can persist a long time in the environment in this inactivated state. However, the product presents significant risks to operators, bystanders and birds.

In May 2018, the European Commission voted to ban the use of diquat. Most growers in Europe and the UK had until February 2020 to use up their stockpiles, although a number of temporary permits were given.

In Canada, there have been concerns raised about presence of diquat in drinking water, with the result that last year the maximum concentration was reduced. Although diquat is still registered in the US and many other countries, changing regulations remain a concern.

The CROP.ZONE system enables residue-free crop termination. It does not affect tuber quality and can be adjusted to maximise vine recovery, enhancing tuber size.

Nufarm is currently arranging importation of a test unit. The unit will allow the system to be tested under Australian conditions, both for weed management and potato crop termination.

SHOW ME THE DATA

Company trials in 2020 compared the effectiveness of CROP.ZONE against two herbicides still registered for haulm kill in Europe; Pyraflufen-ethyl (Quickdown) and Carfentrazone-ethyl (Shark) (Figure 4).

The most effective treatment was two passes with CROP.ZONE in opposing directions. This killed >65% of stems, with the remainder yellowed (after three weeks). Although two passes in the same direction increased the number of dead stems to over 80%, around 10% green stems remained, particularly between the hills (Figures 3 and 4).

In contrast, the two herbicides left approximately 20% yellow and 20% green stems. This low efficacy level was surprising. Although both herbicides require sunlight to be effective, conditions in 2020 were ideal. As a result, three herbicide treatments were needed to achieve

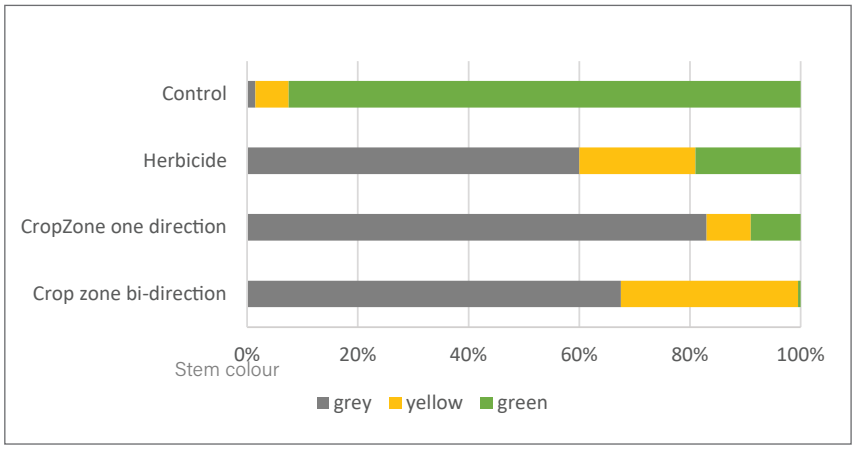


Figure 3. Comparison of haulm termination by Herbicide (Quickdown + Shark), CROP.ZONE applied twice in the same direction, CROP.ZONE applied twice in opposing directions or untreated plants (Control).

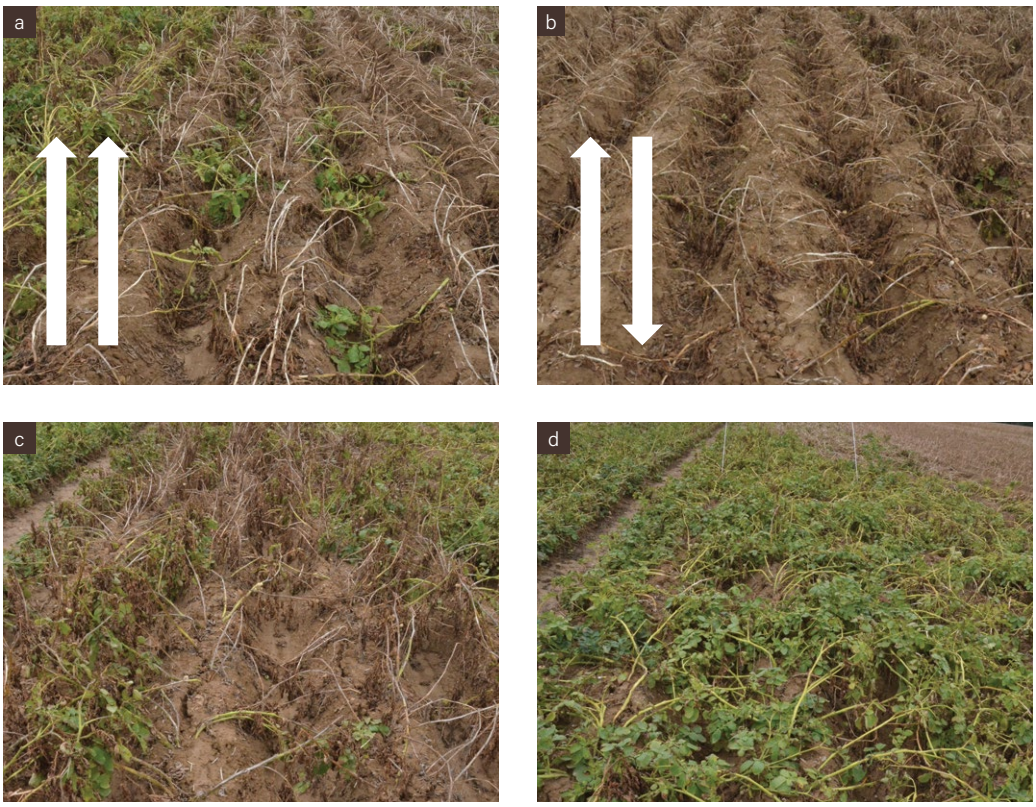


Figure 4. Effect of (a) CROP.ZONE applied twice in the same direction at 6kmh and 4kmh, or (b) twice in opposite directions at 6kmh and 6kmh, compared to (c) crop sprayed with Quickdown® and Shark® and (d) untreated

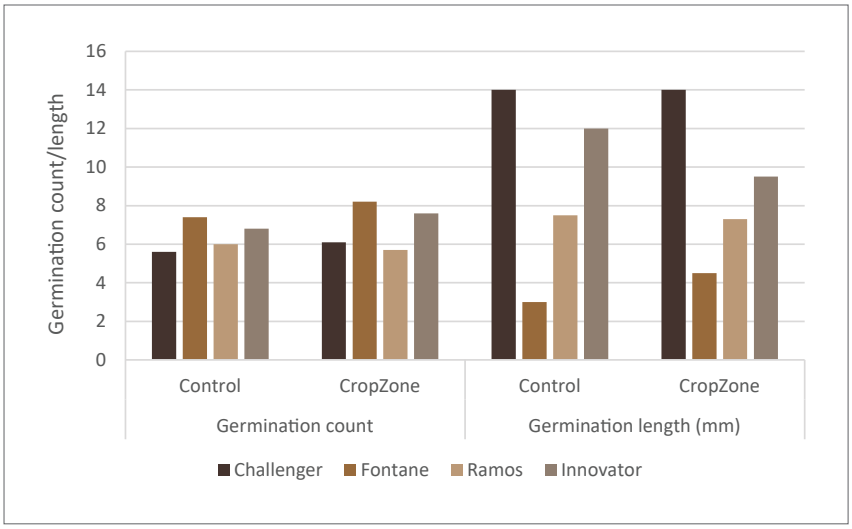


Figure 5. Comparison of quality of seed potatoes from vines terminated using CROP.ZONE with conventionally killed controls

good chemical desiccation, which is the maximum allowed in Europe. Under overcast conditions, this treatment would be even less effective.

The company has made further refinements to the applicators based on these results, with trials ongoing during the European summer.

Other company trials examined the effects on germination counts and sprout length of seed potato varieties Challenger, Ramos, Fontane and Innovator. There was no significant difference due to method of haulm kill, with CROP.ZONE, chemical herbicides and untreated controls all providing similar results (Figure 5). Similar effects were reported for starch content, baking colour and other quality attributes, with no differences between CROP.ZONE and other termination treatments.

COSTS VS BENEFITS

While the requirement for 112 kW electrical power is unlikely to be a problem, the 12m boom width may be limiting for some growers. Wider boom widths are theoretically possibly, but yet to be developed.

The energy footprint of Crop.Zone has been estimated to be approximately 5x greater than herbicide application, but slightly less than haulm topping and less than 25% of the energy used for cultivation.

In Europe, the cost of using CROP.ZONE is similar to using herbicides, excepting potential increased tractor running costs. Although the cost in Australia is unclear, the system may struggle to compete with herbicides on a cost basis alone.

However, there is strong demand by consumers and retailers for reduced residues in food. This has been particularly the case in Europe but increasingly in Australia as well. By reducing pesticide use, as well as avoiding impacts on soil biology, the system could potentially improve sustainability and meet new market demands.

CHIPPING AWAY AT PROCESSING EFFICIENCY

Steam peeling and optical sorting

Dr Jenny Ekman reports

Potato processing, whether for crisps, chips, mash or hundreds of other potato products, is clearly big business. With slender margins and fierce competition, food production companies are constantly trying to find faster, more efficient, more accurate and lower cost ways to process potatoes.

While nobody imagines there are armies of workers peeling potatoes by hand, the technology involved in potato processing is now something to behold. Even better, flexible facilities can process potatoes in the morning, pumpkins at lunchtime and beetroot in the afternoon.

PotatoLink recently talked to Eamonn Cullen, Market Manager, Peeling at TOMRA Food. Eamonn is based in Dublin, but his lab can be accessed remotely from around the world using a network of cameras. His team uses the lab to develop new technology, conduct tests and demonstrate the equipment, providing virtual training to customers located anywhere.

STEAM PEELING

Before development of steam peeling in the 1970s, potatoes were processed using lye. While more efficient than peeling mechanically, the strong caustic solutions used required careful handling, as well as large volumes of water to clean and treat the chemical waste.

Steam peeling provided a major leap forward. With precise control of time, temperature and pressure, the process could be highly automated. Steam

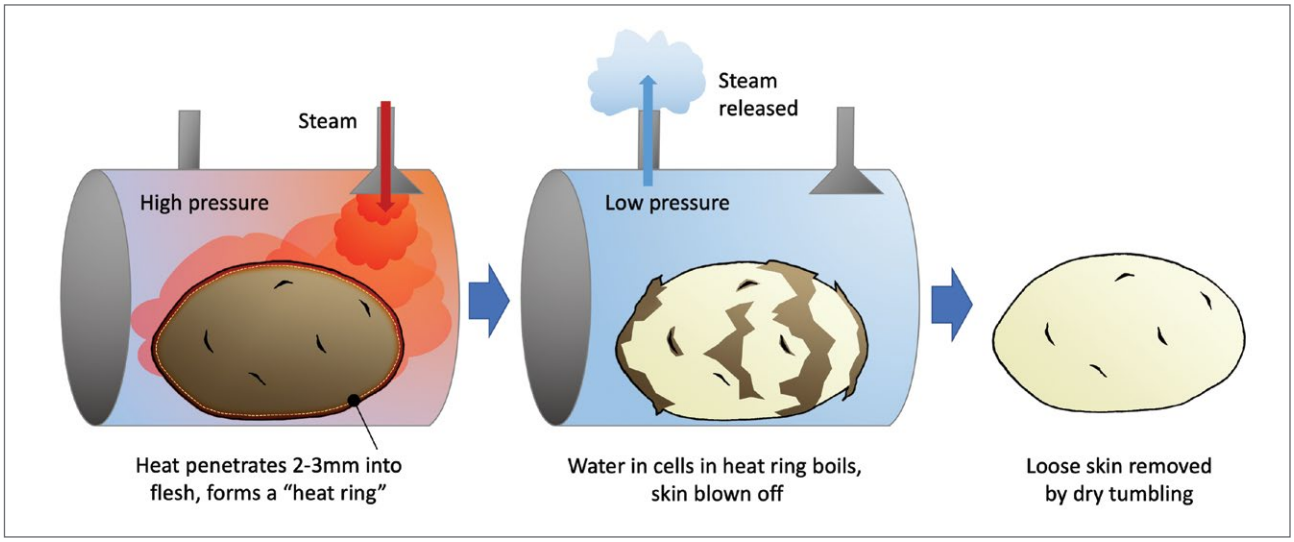


Figure 1. Steam peeling process. Potatoes are sealed inside a chamber and steam is injected. This superheats the cells on the potato surface. The pressure is then released, allowing water inside the cells to boil. This blows the skin away from the underlying flesh. The loose skin is then removed by tumbling.

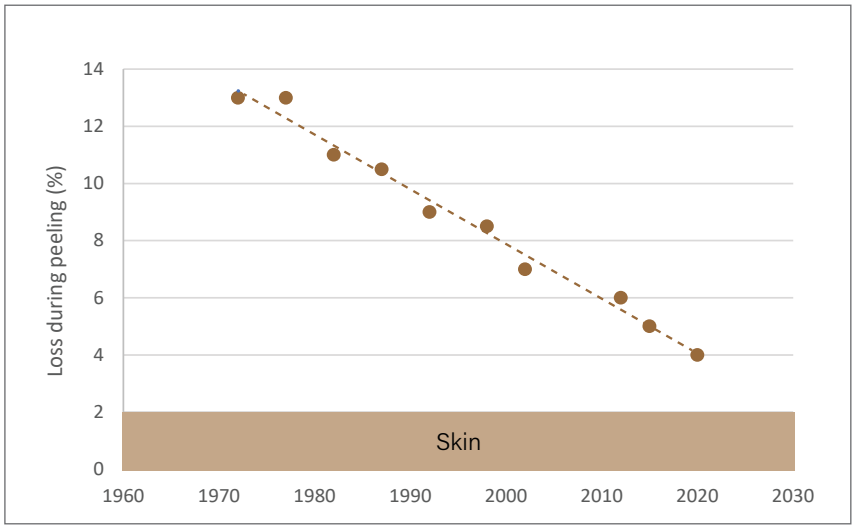


Figure 2. Improvements in peeling technology have reduced waste over time

peeling only reduces environmental impact, but also waste, due to efficient removal of only a few millimetres from the outside of each potato.

It works by exposing the washed potatoes to superheated steam inside a sealed chamber. Water inside the skin heats, building up high internal pressure. The steam is then released, the pressure drops, and water in the skin cells boils. This effectively blows off the skin.

According to Eamonn: "The faster temperature and pressure can be increased and decreased, the shallower the zone of heating in the potato skin, and the less peel is lost". Early systems yielded around 90%; the heat penetrating around 3mm into the potato. Modern systems have increased yield to 94-95%. According to Eamonn, the new TOMRA system yields an astonishing 96%. As 2% of the initial weight is peel, this means only 2% of the flesh is lost as waste.

"We have achieved this by increasing the pressure and temperature of the steam, as well as improved mixing in the chamber," says Eamonn. "Enlarging the delivery pipe is also a way to increase the speed of the cycle. While these results are fantastic, this is a process of continual improvement. We are always looking for ways to refine the system."

Faster peeling also means faster processing. The unit can potentially peel 1,000 potatoes every six seconds. Certainly a lot more than I manage standing by the kitchen sink.

Once the skins are separated, they still need to be removed. The dry peel separator is another recent TOMRA development. Instead of using water to sluice the skins off, skins are removed through tumbling, another strategy to reduce waste.

OPTICAL SORTING

Naturally, not all skins are removed perfectly during steam peeling. Previously, potatoes were passed across grading tables for visual inspection. Now, new optical sorters not only detect adhering skin, but determine size, quality, bruising, green flesh, rots and other defects. They can also detect and remove physical contaminants, such as glass or plastic.

This is not new; optical sorters are relatively common throughout horticulture. What makes the TOMRA system different is that the potatoes are scanned IN MID AIR! The unit can take multiple images, assess and grade up to 40 tonnes/hour. That's more than 11kg/second. Potatoes can be allocated to a secondary, mechanical peeler, rejected, or passed for further processing.

If too many potatoes still have skin adhering, feedback through the system slows down the steam peeler, allowing more skin to be removed per cycle. This means the machine adjusts to the quality of potatoes coming through in real time, minimising waste.

AUSTRALIAN APPLICATION

Australians are, frequently, early adopters of new technology. Whether it's the latest iPhone, electronic gadget or app, many companies use Australia to test the market for their new tech. It seems potato processing is no exception.

The world's newest technology steam peeler is now peeling Tasmanian spuds at Simplot's Ulverstone facility. Additional units are planned for other regions and customers as well.

One of the reasons for this 'world first' is not just that Australians are innovators, but also that we grow potatoes in such a varied range of soil types, climate and environments. These create challenges that are less likely to affect producers in, for example, Idaho or Ireland.

Reducing costs through new technologies could help create opportunities for Australian growers in regional markets. Once dominated by the US and Western Europe, Australia may be able to find additional customers for processed products in growing Asian markets.

New technology like this certainly doesn't come cheap. But, it may also increase yield, reduce waste and improve quality. Better chips all round!

HELPING TO IMPROVE HEALTH AND FOOD SECURITY IN VANUATU

Potatoes may bring important health and economic benefits to the people of Vanuatu, where **AuSPICA** is helping to develop high plant health seed potatoes for sustainable potato production, addressing issues of food security and dietary health.

Ms Nellie Malseed and **Dr Nigel Crump**

POTATOES HELPING TO SAVE LIVES IN VANUATU

Improvements in potato production may hold the key to greater prosperity and better health outcomes in Vanuatu, a country that has been hit hard by devastating cyclones, economic problems and climate change.

Crop losses have led to increased consumption of imported white rice. This has brought with it an increase in serious health issues associated with diabetes, including blindness.

Vanuatu has shown the ability to grow potatoes as a cash crop, providing a locally grown food source for its people. This is essential for sustainable food security in a country where per capita Gross Domestic Product is less than $US3,000.

Food alternatives to white rice are crucial in lowering the incidence of type 2 diabetes and its many serious, debilitating, and even life-shortening complications. Type 2 diabetes is a serious problem in Vanuatu and a major cause of death. The disease causes breakdown of small blood vessels in all parts of the body, often impacting on the eyes, kidneys and body extremities.

Complex carbohydrates help regulate the body's production of insulin, making potatoes an important alternative to the simple carbohydrates found in rice. Increasing potatoes in local diets could therefore help reduce the incidence of type 2 diabetes.

Food security is also a priority for Vanuatu, particularly as it is a high-risk region for cyclones such Cyclone Harold in 2020 and Cyclone Pam in 2015, each wiping out crops and causing widespread damage to infrastructure, devastating an already poor country.

MINITUBERS AND TRAINING

AuSPICA (Australian Seed Potato Industry Certification Authority) is a not for profit, industry-based association that provides professional and technical services to the Australian potato industry. Through collaboration with the Vanuatu Prevention of Blindness Project, in 2019/2020 AuSPICA donated potato minitubers to Vanuatu.

These contributions are intended to advance sustainable potato production, address food security and dietary health concerns in Vanuatu. Potato minitubers are first generation pathogen-tested seed stocks that are effective in reducing crop loss caused by seed-borne disease in production.

To further support potato production in Vanuatu, AuSPICA delivered two workshops in late 2019, in conjunction with the Vanuatu

Dr Nigel Crump and Australian potato grower Mr Allan Condron (Gippsland) at a local grower workshop in Port Vila

Ms Nellie Malseed and Dr Crump at one of the grower workshops

Prevention of Blindness Project and aided by financial support from the Victorian Crawford Foundation. This collaboration provided technical knowledge as well as addressing aspects of food security, sustainability, climate change and human health. Participants in the workshops included growers, community leaders and government agencies, including the Vanuatu Department of Agriculture and Regional Development (DARD). The training provided valuable knowledge to sustain long-term potato production, which will benefit the country's health and economy.

These technical workshops were a catalyst for local farmers and government advisors in further developing potatoes as a sustainable food source for Vanuatu. Since the workshops were delivered, significant advances in potato production in Vanuatu have been achieved.

VARIETY TRIALS

In April 2020, AuSPICA donated foundation seed potato minitubers of 12 varieties. All were considered potentially suitable for production and use in Vanuatu and produced from pathogen-tested tissue culture. The 12 varieties were grown at several sites in Vanuatu and their performance evaluated to determine those more suited to local conditions. This was made possible through collaboration with the Vanuatu Prevention of Blindness Project and DARD, which led the establishment of the evaluation field sites.

Early observations showed that potatoes crops grown from minitubers have been successful, delivering both high yields and quality. Popular and high yielding varieties include Sebago, Toolangi Delight and White Star. A participative evaluation program for the 12 potato varieties has been established involving all the project partners.

Other important goals of the project included proactive engagement with locals, and empowerment of women to be involved in potato production. The project in Vanuatu aligns with several of the United Nation's 17 Sustainable Development Goals:

- No poverty (goal 1)
- Zero Hunger (goal 2)
- Gender equality (goal 5)
- Responsible consumption and production (goal 12)

Although there is a small potato industry in Vanuatu across multiple islands, including Tanna, the ongoing development of a potato industry will make a significant contribution to improving diversity of diets and food security for the country's people.

The development of the local potato industry is especially important to counter the catastrophic damage caused by Cyclone Harold where many food crops were destroyed. The subsequent impact of the COVID-19 pandemic has further devastated the local economy from lack of tourism, a major source of income for many ni-Vanuatu people. The compound effect of these set backs, that led to a 10 per cent reduction in GDP in 2020, is a further reminder of the importance of food security for this vulnerable nation.

AuSPICA will continue to support Vanuatu in developing a sustainable and productive potato production using high health seed potatoes.

AuSPICA

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EYES ON THE WORLD

Recent advances in potato research and innovation

The bacterial pathogen *Dickeya dianthicola* is not spread during cutting and handling of seed potatoes.

Secor, G., Rivera-Varas, V., Johnson, S., Greiner, B., Larson, K., Charkowski, A., Karim, S. 2020. Am. J. Potato Res. 98:64-71.

Dickeya dianthicola infection spreads from the rotting seed through the plant vascular system.
- M. Tuttle McGrath, Cornell University

WHAT'S IT ABOUT?

Bacterial soft rots are a major cause of potato crop loss; it is estimated that 15-30% of all harvested crops worldwide are destroyed by bacterial rots. As noted in the article "Blackleg: Preventing a problem" (p20) in this journal, soft rots can be caused by a number of species of both *Dickeya* and *Pectobacterium* bacteria.

Whereas *D. solani* is a major cause of loss in Europe, it is not found in either Australia or the USA. However, *D. dianthicola* has been a major problem in the USA since 2015, when an outbreak occurred in Maine. It has since been spread throughout the USA in infected seed potatoes and is now found in 22 states as well as parts of Canada. *D. dianthicola* is favoured by warm to hot temperatures (over 25°C), so may become more problematic as the climate warms.

While the infectious dose is lower for *Dickeya* than *Pectobacterium*, it is also more localised within the vascular tissue and has shorter survival in soil and crop debris. For example, one study found that *Dickeya* survived only a week in soil compared to more than two years for *Pectobacterium*.

As noted in the article on blackleg (p20), infection often remains latent in both plant and tuber, with no external symptoms. This is a major issue as non-symptomatic seed potatoes grown in cooler areas may be transplanted to warmer conditions, where disease is expressed. *Pectobacterium* species are known to be spread during handling and cutting of seed potatoes. However, it was unclear whether this also occurred for *Dickeya*.

This detailed study, conducted over three years and four US states, examined whether *D. dianthicola* is spread during seed handling and cutting, as well as effects on crop loss and yield.

WHAT WAS CONCLUDED?

Although laboratory trials demonstrated that *D. dianthicola* could be spread on cutting knives, the study found **no evidence** of increased blackleg disease after simultaneous handling and cutting of *D. dianthicola* infected and healthy seed potatoes. They conclude that spread of *D. dianthicola* during handling and cutting seed is not a major cause of stand losses in the field.

The authors suggest that this is because, although *Dickeya* can be present in the lenticels, it is primarily a vascular disease. The bacteria does not transfer from the lenticels into the vascular system during cutting and handling.

This is different from *Pectobacterium*, which infects and grows within the lenticels, so can readily be spread during handling and cutting. In these trials the only treatment that affected stand (including fungicides) was cutting the seed, which increased decay due to *Pectobacterium* spp..

Soft rot bacteria rarely cause disease on cut surfaces of potatoes. This is likely due to antimicrobial compounds released from the damaged cells. This provides initial protection until the wound heals; suberisation for two to three days is usually enough to prevent infection by soft rot bacteria.

The study highlights an important difference between *D. dianthicola* and *Pectobacterium* spp.. With prevention the only practical option for managing blackleg of potato, understanding how these diseases spread is critical for control.

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