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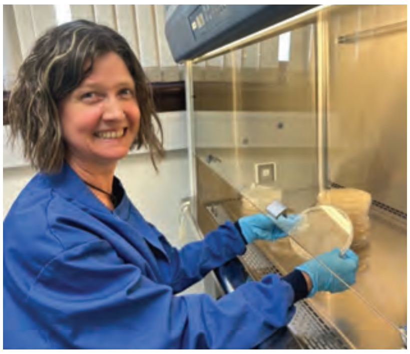


POTATO LINK
AUSTRALIAN POTATO INDUSTRY
EXTENSION PROJECT

NEW RESEARCH FROM THE JAMES HUTTON INSTITUTE, SCOTLAND

When you think about potato production, most people will likely think immediately of Ireland. However, if it is seed potatoes that you're after, you are more likely to think Scotland. Scotland has a reputation as being the world's best producer of seed potatoes. So why is that? Is it the pure waters of the highlands, the famously damp weather, the resonance of bagpipes in the air or simply hard graft and science. Dr Jenny Ekman reports

Scots eat a lot of potatoes. Annual consumption of potatoes in the UK is 60 – 70kg per person annually, compared to a mere 17kg/pp in Australia. More than 90% of Scots are said to eat potatoes at least once a day, and chips (or hash browns) are offered with pretty much every meal.

Although a small country, approximately 28,000 ha of Scotland is planted to potatoes[1]. Nearly half of this is high value seed (approx. 12,000 ha). The potato industry not only contributes at least £250 million directly to the Scottish economy, but also supports potato growing in Britain valued at £928 million, with multipliers for processing running into billions[2].

Until Brexit, the Irish and potato industry also largely relied on Scottish seed potatoes. However, EU regulations struck as part of the 'soft border' agreement meant that Scottish seed potatoes were not only prohibited from export to Ireland, but even to Northern Ireland – despite it being still part of the UK. Fortunately, this was recently reversed, and Scottish seed can again be grown in Northern Ireland. Moreover, new export markets were found, with Scottish product now finding its way to a diverse range of countries including Türkiye, Kenya and even Saudi Arabia.

Given the importance of potatoes in Scotland, it is unsurprising that it also hosts major potato research and extension activities.

Research and development is focussed at the James Hutton Institute, Dundee.

THE JAMES HUTTON INSTITUTE (JHI)

JHI is internationally renowned for potato science, with a focus on breeding programs, integrated pest and disease management, sustainability in a changing climate and other applied research. They are also custodians of the Commonwealth Potato Collection, a unique source of potato germplasm.

In July this year I was fortunate to visit JHI and meet some of the potato researchers. The institute is currently expanding; JHI is not only a leader in potato R&D, but also soils, barley, crop development and environmental research. A massive new construction was underway which will house the International Barley Hub as well as an Advanced Plant Growth Centre.

THE NATIONAL POTATO INNOVATION CENTRE - PROFESSOR IAN TOTH

Excitingly for the potato industry, the next proposed development is a National Potato Innovation Centre (NPIC). Based in Dundee but expected to include national and international partners, the NPIC is planned as a state-of-the-art innovation centre. The three pillars of the NPIC are:

1. **Breeding new cultivars** with traits to address climate, disease and quality issues
2. **Sustainable and climate resilient production systems** using precision agriculture, below ground phenotyping, improved disease management and reduced waste
3. **Innovative potato products** such as functional foods, plant based medicines and plastic alternatives

The NPIC will be headed by potato pathologist Professor Ian Toth.

“Although funding for the NPIC has not been confirmed, there is a strong economic case for the project and we have had much positive feedback on the plan. We see the NPIC as a creative cluster for potato research and innovation, building on the existing potato R&D at JHI.”

The Centre would be similar in scale to the International Potato Centre (IPC) in Lima.

“However, whereas the IPC is focussed primarily on potatoes for development, the NPIC would be involved in commercial, applied research,” explains Prof. Toth.

“Examples include application of new technologies for rapid development of improved potato varieties, net zero production strategies to reduce waste, and high value functional foods”.

Plans for new facilities include a greenhouse complex, a pilot processing plant and below ground phenotyping systems.

Future opportunities

With its exit from the EU, the UK Government is looking to partner up in research projects with other countries, especially those that operate similarly.

"There are lots of opportunities, and possibly even Government funding, for collaborative arrangements that would allow UK academia and industry to work with Australian academia and industry on joint projects.”

That would give Australian researchers the opportunity to use and work at the JHI facilities, to the benefit of both. A great adaptation in the current cost-saving climate.

Prof. Ian Toth, Director of the proposed National Potato Innovation Centre, inspects some of the other construction currently occurring at the James Hutton Institute, Dundee.

POTATO GROWTH AND STORAGE - PROFESSOR DEREK STEWART

In the meantime, other new facilities are already going in. Derek Stewart is Director of the Advanced Plant Growth Centre, a £27 million flagship project hosted at JHI. As Derek explains, the project has four pillars:

Postharvest storage

Six sparkling new cold rooms had just been installed at the time of my visit. The rooms have been designed to mimic the conditions inside large potato storage environments, each room being sized to store eight half tonne Standard Potato bins.

They can be used for either seed potato trials, or for extending the storage life of fresh and processing potatoes. Potential projects include testing the effects of different cooling rates, storage times and storage temperatures on seed potato ageing and performance, as well as examining the cold tolerances of different processing varieties. The first planned trial involves a comparison of different anti-sprouting agents (see box out on page 7 for further detail).

Prof. Derek Stewart in the new storage facility.

Controlled environment facility

While the JHI already has some plant growth chambers, this new facility will enable much finer control of environmental conditions, as well as greatly expanding capacity. Everything can be controlled – the atmosphere, light intensity, even rain and wind.

The focus of research here will be adapting to climate change; subjecting plants to heat, drought, flooding and other stresses, then seeing how this affects development.

“The objective is to look at today’s varieties, and how they will cope with tomorrow’s environment. We aim to find plants which can survive difficult conditions and put that information into breeding programs,” explains Derek.

“We can even look at disease problems, as todays’ bugs and microbes might not be the same ones as cause problems in the future”.

Plant phenotyping centre

This centre is also currently under construction. It is designed to allow potatoes grown in the controlled environments to be examined in incredible detail. A whole array of sensors will be integrated to monitor growth and development including infra-red, hyper-spectral, chlorophyll fluorescence, a 3D laser image scanner and possibly others.

"CO_2 and temperature effects on potatoes are really interesting," comments Derek.

"The potato plant likes a bit of warmth, but the tipping point where productivity falls away is sharp. I think that this needs a lot more work. Scientifically, you're juggling all these different effects from temperature and atmosphere, and how plants respond to those".

Vertical farming

Vertical growth towers are indoor ecosystems that allow extremely high plant densities and fast growth rates. They have found commercial application for city production of leafy greens and herbs. They are definitely not normally associated with potatoes.

However, Derek has other ideas.

"The system is fantastic for seed potato production," says Derek.

"Even with the need for energy to power it, the system is so productive that the costs balance out. The sums are even more appealing if renewable energy can be generated onsite. We are not talking microtubers but seed perhaps 30 to 50mm diameter."

When the vertically farmed seed were planted in the field they proved indistinguishable from conventionally produced seed.

"The other thing about vertical farming is plant health," explains Derek.

"You can pretty well eliminate viruses and other diseases from the system. I could imagine a grower group partnering on one of these systems to produce all their own seed".

SUPPRESSING SPROUTS

Up until 2020, 90% of all potato sprout suppression applications used worldwide included CIPC (Chlorpropham). CIPC is cheap and extremely effective. A single application can prevent sprout growth for up to 5 months, with second applications extending this period even longer[3].

However, breakdown products of CIPC have been associated with human and environmental toxicity. Compounds produced during thermal fogging are not only present in fresh potatoes, but are retained after processing and cooking. They are also highly persistent in the environment[4].

In 1996 the USA reduced the amount of CIPC residue allowed on fresh potatoes from 50ppm to 30ppm. The European Union banned use of CIPC outright in 2020, with this same legislation preventing use in the UK. Older storage facilities now cannot be used, due to contamination by this product. While CIPC is still registered for use in Australia, it seems possible that use patterns may be restricted in the future.

In response, a number of new sprout suppressants have become commercially available. These include 1,4-Sight/Dormir (1,4-dimethylnaphtalene), hydrogen peroxide, ethylene and a range of essential oils – clove, spearmint, caraway and orange oil to name a few. While there are individual efficacy trials on each, it is difficult to find data which compares these treatments against each other and for different potato varieties.

With new cold rooms ideal for this purpose, trials at JHI will examine the performance of different sprout suppressants on several of the most important potato varieties.

Prof. Derek Stewart in the vertical farm.

THE MANY FORMS (OR NOT) OF LATE BLIGHT – DR DAVID COOKE

For many people, when you think of potato diseases, you think of *Phytophthora*. Dr David Cooke is a late blight specialist at JHI. He has collaborated extensively in the past with our own Dolf DeBoer, recently retired from the Victorian DPI.

One of his key roles is genotyping samples that come in on FTA cards. These simple cards are used to collect samples of the disease by simply squishing a lesion into the FTA matrix, then sending it through the post. No plant material is included, so there are no issues with import or export.

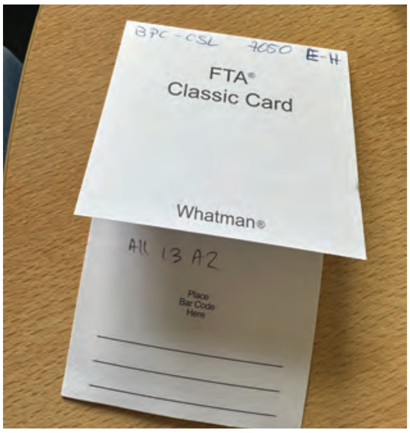
It is through David that we have been able to confirm that Australia still only has the asexual form of late blight.

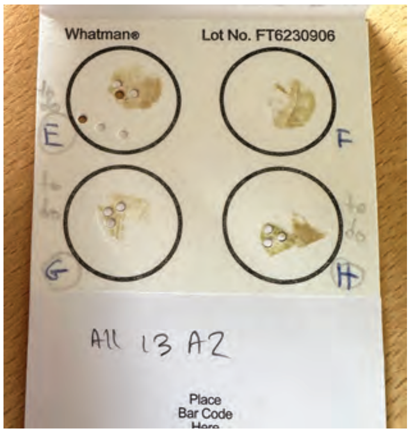
"The last introduction of late blight to Australia was probably before the 1940s," comments David.

"My message to your industry is don't soften the approach, as you're definitely doing a good job of keeping the new strains out".

Dr Cooke suggests every agronomist or agrochemical rep should keep a few FTA cards in their pocket, just in case.

"It's just good to keep checking that the population hasn't changed, and the existing fungicides will still be effective".





FTA cards are used to take and stabilise samples of pathogens. As no plant material is included, they can be readily posted without affecting quarantine.

The cards themselves cost around $2, while the lab testing is about $55 for the four lesions included on each card.

SHEDDING LIGHT ON LATE BLIGHT - DR ELEANOR GILROY

Dr Eleanor Gilroy is a molecular plant biologist with a special interest in how the late blight pathogen infects potato plants. *Phytophthora* is sensitive to UV light, so mainly infects potato plants at night.

Dr Gilroy has discovered that the late blight pathogen is not only affected by UV light, but that infection is reduced by exposure to red light. Her theory is that these wavelengths, which would normally occur at dawn and dusk, trigger plant defence responses.

While using light to control disease in field crops sounds futuristic, this is already a commercial prospect, at least for fruit crops. The company Thorvald provides commercial services in the UK, California and Norway. UV-C emitting robots that look like mobile sun beds are used to control powdery mildew in orchards and polytunnels. In the case of strawberries, a one minute treatment with UV-C light, when followed by a 4 hour dark period, has been demonstrated to almost fully control grey mould in greenhouses[5].

"In the case of *Phytophthora*, UV-C light kills it within a minute. During a blight period, maybe the irrigation boom arm could also carry UV-C lights which would kill the pathogen," suggests Dr Gilroy.

"Alternatively, red light could help prime the plant to fight disease."

Dr Ellie Gilroy is investigating the mechanisms by which late blight infects plants.

SOIL BORNE DISEASES AND THEIR HOSTILE NEIGHBOURS - DR JENNIE BRIERLEY

Dr Jennie Brierley works on soil borne potato diseases, including diagnostics, and has strong links with Australian researchers. Dr Brierley collaborated with the team that developed Predicta PT as part of an international diagnostics project, and has worked a lot on linking detection to disease risk.

"Actually, the South Australian group is ahead of us in some ways now, as they have commercialised the service. Here, commercial adoption is still relatively limited," she explains.

"More recently I've been looking at soil health and how that affects different diseases."

This is part of a major, long term project. The JHI has a site where they are growing potatoes on a six-year rotation. Each field has two halves, one with organic amendments added each year and reduced cultivation (integrated), whereas the other half is normal practice (conventional).

"So far differences have been hard to find, largely because the long rotations are doing a great job at controlling disease".

On the positive side, this suggests that adding organic matter doesn't **increase** disease, as some have thought it might.

Dr Brierley is now taking a different approach, screening soil samples from the different plots against pathogens in pot trials.

"We've found that soil from some of the plots does seem to suppress diseases like *Rhizoctonia* and common scab. So now I'm looking at all the different organisms which are in that soil, and the differences we can find in the soil microbiome".

It's still early days, but the objective is to find new ways to control those most elusive of pathogens – soil borne diseases.

Aerial view of the Centre for Sustainable Cropping site at JHI. Each half field is assigned to either conventional or integrated management.

Pot trials are being used to screen soil from conventional and organically amended plots against soil-borne pathogens such as Rhizoctonia and common scab.

WHERE DO TUBERS COME FROM? - DR ROBERT HANCOCK

It's the sort of question you usually need a child to ask – how does the potato plant decide it's time to make tubers?

Potatoes are perhaps the ultimate preppers of the plant world. From the plant's point of view, tubers are not meant to be eaten, but rather to allow it to survive a hostile winter, re-emerging once warmth returns to the cold soil.

For the original potato plant growing in South America, this was relatively straightforward – they responded to daylength. Shortened days trigger production of a protein signal called SP6A. This travels from leaves to stolons, effectively saying 'winter is coming; time to form tubers'.

However, modern varieties are day neutral, so can be grown at any time of year and any latitude.

"We still don't know exactly how that SP6A signal is integrated in day neutral plants. Presumably it relates to developmental age," explains Robert.

"One thing we do know is that high temperatures stop it in its tracks. As there's no production of SP6A, there are no tubers, no matter how well the plant is growing".

From an evolutionary point of view, flowering is a much better way to reproduce. Forming a tuber is essentially plan B. This may explain why warm, well-nourished, well-watered plants fail to form tubers.

"For example, we found that day/night temperatures of 28°C/18°C almost totally prevented tubers forming for Desiree," states Robert.

"But it's not really heat that's the problem for the plant, as they were still growing well. It seems likely that varieties considered 'heat stress tolerant' actually just have a stronger tuberisation signal."

Dr Rob Hancock at work in the lab, measuring photosynthesis using infrared gas exchange.

"What we're working on is finding the genetic triggers that either increase formation of SP6A or increase sensitivity to low levels of SP6A. Breeding programs can then select plants with genes that will trigger stronger or earlier tuberisation, increase yield, or allow tuberisation at high temperatures."

One of the other promising results Dr Hancock has had is working with Germin-like-proteins (GLPs).

High levels of GLPs make it easier for the plants to shift carbohydrates from the leaves into the tubers. Effectively, they open the gates of tuberisation wider, increasing the rate of tuber bulking.

While this research is still lab based, genes that up-regulate GLPs could be an important part of a future breeding target. They also increase our understanding of how and why potatoes form tubers. Potentially, we can help the 'preppers', but to our own advantage.

REFERENCES

1. Scottish Agricultural Census, June 2020
2. Toth, I. 2022. Delivering a sustainable potato industry for Scotland through management of Potato cyst nematode (PCN) Year one project report. https://www.pcnhub.ac.uk/sites/www.pcnhub.ac.uk/files/2023-05/year_1_summary_report_-_sustainable_potato_industry_for_scotland.pdf
3. Thoma J, Zheljazkov VD. 2022. Sprout suppressants in potato storage: conventional options and promising essential oils – A review. Sustainability 14:6382
4. Boivin M et al. 2020. Sprout suppressive molecules effective on potato (Solanum tuberosum) tubers during storage: A review. Am J. Pot. Res. 97:451-463
5. Janisiewicz WJ et al. 2016. Dark period following UV-C treatment enhances killing of Botrytis cinerea conidia and controls grey mould of strawberries. Postharvest Path. Mycotoxins. https://doi.org/10.1094/PHYTO-09-15-0240-R

POTATO BREEDING AND VARIETY SELECTION

Understanding potato genetics. By Dr Jenny Ekman

Drs Hein, Sharma and Chen work on potato genetics, genomics and breeding. Potatoes are particularly difficult to breed as they have four different copies (alleles) of each gene (tetraploid) instead of the normal two (diploid). This means there are a lot more possible outcomes from crossing varieties, with outcomes frequently unpredictable.

"A really big moment for us was the release of the potato genome in 2011. Sanjeev was an author on this publication, which was a big international effort with many institutes and researchers involved. It's a really big genome. If you were to print it out on paper, you would cover a distance of 2,600 kilometres, nearly the length of the Australian east coast," explains Ingo.

According to Dr Sharma, breeding before the potato genome was known was a bit like going to a library blindfolded and trying to find a book. Now, through genome sequencing, we know which book is where.

One of the puzzles the group has been examining is the genetics behind disease resistance.

"We've examined the genetics of 700 different potato varieties from around the world. We found that only a handful of genes are providing resistance to late blight, nematodes, viruses and other diseases. Most have these have been deployed since the 1960s, which is why resistance is often breaking down."

However, it's not all bad news, as the team has also identified many more genes that could be used. That means there's a huge opportunity to improve resistance by breeding these genes into new varieties.

This process is now easier due to the development of genetic markers for these resistance genes such as Single Nucleotide Polymorphisms (SNPs).

Potato breeders necessarily produce hundreds, if not thousands of new plants a year. Traditional screening by growing the plants, then exposing to disease or stress, requires space, time and lots of work. If we know what gene is wanted, it would be much more efficient to test if the desired gene was present through gene sequencing. This may be quicker, but the data is huge and cost still too high.

"Now we can simply scan for these SNPs," says Dr Chen.

"The markers we have developed are nearly 100% effective at detecting whether the desired gene is present. These are now being used by commercial companies. If the marker is detected, then that gene will certainly be expressed."

The trend now is to try to breed in as many resistance genes as possible. While a single gene may be able to protect the plant from a specific disease, such resistance is fragile. A tiny change in the pathogen may overcome it. Including a range of different resistance mechanisms makes resistance more durable.

According to Dr Sharma, many of the commercial traits of potatoes are controlled by multiple genes.

"Flesh colour, tuber shape, eye depth; these traits are mainly controlled by a single, dominant locus (gene). However, features such as yield and tuber dry matter are more complex, with many genes involved, each contributing a small amount to the trait. This is where machine learning and new genomic prediction models can help direct breeding programs".

Such advances are expected to massively increase the speed of new potato breeding. Such genomic data can be combined with growth information produced through the new JHI Advanced Plant Growth Centre (APGC). As a result, selection processes that used to take more than 10 years could now potentially be completed in two or three.

Dr Sanjeev Sharma (left) with Dr Glenn Bryan, on the sequencing of the potato genome.

COMMONWEALTH POTATO COLLECTION

One advantage specific to the team at JHI is that the institute hosts the Commonwealth Potato Collection (CPC). The collection has at least 1,500 potato accessions, stored as true potato seed. Every year 60 to 80 of these are grown, which means it takes around 20 years to refresh the whole collection.

This process also provides an opportunity to screen each accession against diseases and determine whether resistance is due to a known or novel gene.

Visiting the CPC greenhouse feels a bit like going to a botanic garden, yet all of the plants are *Solanum*. The range is truly extraordinary.

There are long, leggy plants with ridged stems, adapted to climb from the forest floor in their search for light. There are dwarf plants that come from cold, high mountains. Some plants are smudged dark purple, others are pale. Flower colours range from white to pink, purple and almost blue. Many are almost unrecognisable as potato plants, their leaves being anything from pointed daggers to broad ovals to fern like tassels and a wealth of others.

Many of the plants here are diploid, so they only have two copies of each gene. While this makes crosses more predictable, diploid potato flowers are typically not self-compatible. In order to preserve the diversity within accessions, one of the jobs of the staff here is therefore to collect pollen from plants within an accession and use it to pollinate the others. This is labour intensive but necessary.

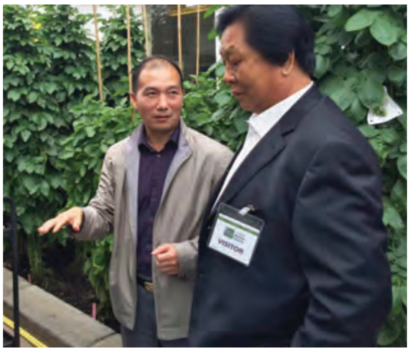
The variability of plants grown from cross pollinated seed within each accession was quite noticeable, with a range of flower colours and leaf shapes.

The only way to ensure a chosen plant propagates true-to-type is to clonally maintain it through cuttings or tissue culture, or re-grow it from tubers. Regrowing from tubers is not realistic, so that leaves tissue culture and cuttings. *More on that later in this issue.*

Staff at work in the Commonwealth Potato Collection (CPC). Each plant is carefully trimmed and staked, and the flowers hand pollinated using pollen collected from a plant within the same accession.

Some of the incredible diversity of potato plants on display at the CPC.

However, there may now be a fourth option. The potato community has found a way to overcome self-incompatibility in diploid plants by taking advantage of the 'SLI gene' used by Dr Chen. Introducing this gene allows a diploid variety to be self-pollinated. After a few generations of selfing, the plant becomes 'homozygous' that is, genetically more pure. When this variety is crossed with another such line the results will be predictable. This contrasts with the 'herding cats' approach in



Dr Chin (left) exchanges potato breeding strategies with Mr. Xisen Liang, the Chairman of Xisen Potato Group Ltd.

conventional potato breeding. Tomato breeding also uses homozygous lines.

"Developing such material is very useful, especially adapting the diverse genetic resources that we have here at the CPC so they can be used in hybrid breeding programs, explains Dr Chen."

Of course, the outcome of any breeding program is to produce that's not only productive and easy to grow, but also that consumers want to buy. For example, there are potato varieties available that are highly resistant to potato cyst nematode. Unfortunately, they are not well liked by Scottish consumers so farmers don't grow them.

"I personally think this will change if supermarkets have to put a carbon footprint on products," suggests Ingo.

"If a variety uses less nitrogen, less water, less pesticide, and so has a smaller footprint, then we will see a shift where consumers are more willing to adopt them. At the moment farmers want to grow these new varieties, but they have trouble getting them into the supermarkets."

Dr Ingo Hein in the CPC greenhouse.

THE ROAD TO COMMERCIALISATION - DR JONATHAN SNAPE

James Hutton Ltd is the commercial arm of JHI. This structure has the advantage that it keeps business separate from research, yet lets the two work together.

Director Dr Jonathan Snape explains further: "Our program works closely with the researchers at JHI. So, for example, we can use the genetic markers that Ingo's team has found, taking them from where the science stops to where commercialisation begins."

JH Ltd employs two potato breeders, who work with customers to develop potato varieties with the characteristics they want.

"One thing we do is breed specifically for McCain frozen fries, working with them to determine the characteristics they want." says Dr Snape.

"Once selected, we can send germplasm to McCain trial sites around the world, and they decide which ones suit that environment."

Mayan Gold is one of the varieties developed at the JHI which was – briefly – commercialised in Australia. Unlike most commercial strains, Mayan Gold was a diploid (like the accessions growing in the CPC) and belongs to the cultivated group of Phureja. Phureja potatoes are the direct descendants of potatoes that grew in the Andes Valley, South America, and have little or no tuber dormancy. Compared to commercial tetraploid varieties, Phurejas also generally have lower yield and smaller tubers. However, they also have colour, flavour and texture combinations not found in their tetraploid cousins.

"The feedback we got from our partners in Australia was that Australian consumers aren't that interested in potato flavour, so Mayan Gold couldn't get the premium prices it needed."

"In contrast, one of our other varieties – Nadine – has been very successful in Australia. Nadine is incredibly productive. It wasn't popular here because it didn't have a strong 'potato' flavour. However, if you put tomato sauce on it then it's fine."

I guess Australians just like different kinds of tatties to the Scots!

FROM COMMERCIALISATION BACK TO RESEARCH – GAVIN PRENTICE, AGRICO UK

Just down the road from the JHI are the offices of Agrico UK, one of the many subsidiaries of Agrico BV. Agrico is an interesting company. Formed 50 years ago in the Netherlands, the company remains a co-operative, with more than 1,200 grower members. They now hold the licences of 80 different potato varieties, with a huge range of growing characteristics. One Agrico variety familiar to us is 'Carisma' low GI, otherwise known as Almera.

The company certainly invests strongly in its breeding programme. Agrico Research has its own 4,000m² greenhouse complex in Bant, the Netherlands. Here is where the research produced by Ingo's team really hits the road, as Agrico relies strongly on using DNA markers to test seedling DNA. The ability to test a tiny bit of organic material, instead of growing whole plants through to maturity, is clearly a game changer.

Current breeding programmes are focussed on resistance to PCN, PVY and late blight, as well as producing fast maturing varieties for the "early fries" processing market. There's no point breeding potatoes consumers don't like, so it's not surprising they conduct taste testing too.

In total Agrico BV produces more than 450 kT of seed potatoes annually, contracting an area of over 14,500ha. This sounds impressive, but still represents only 6% of the global market. Nearly all (92%) of this production is exported, and Agrico now has licensed potatoes growing in 80 countries on all continents.

Seed potato production in Scotland has declined slightly in recent times. However, according to Agrico UK's Technical and Procurement manager Gavin Prentice, they still count 60 growers among their members, producing up to 25kT annually of conventional seed, plus a smaller amount (150t) of organic seed.

Research to commercialisation then circling back to research, great to see.

Gavin Prentice, Agrico (right) with Prof. Ian Toth (left) and grower David Pate (centre) in Wester Meathie Farm's current seed storage facility; the company is currently constructing a much larger facility next door.

THE SASA POTATO STOCK COLLECTION

Disease control starts with clean seed. While this sounds obvious, the process of getting there is by no means short or easy. With multiple generations required from the time a new variety is produced to when it reaches a retailer shelf, every step must be carefully scrutinised to ensure no pathogen has crept in.

By Dr Jenny Ekman

In June this year I was fortunate enough to visit SASA – the Scottish Agricultural Science Agency. SASA staff are involved in a range of activities, from wildlife and environment to EU trade guidance. Importantly, they are also they key authority responsible for the Scottish seed potato classification scheme, as well as the keepers of the nuclear stock collection.

NUCLEAR POTATOES??

In this case nothing to do with energy or uranium, but rather the establishment of a core collection of 'motherstock' plant material, from which all else can be derived.

It is incredible to think that 95% of the potato seeds grown in Scotland have their origin in the tiny, test-tube-grown microplants held in the SASA Nuclear Stock collection refrigerators. The collection includes over 1,000 different varieties, each of which has been rigorously tested for a huge range of diseases. This ensures that the starting material is absolutely pathogen-free.

Nuclear Stock Manager Jackie Gibson explains how the system works

“Every year we get in around a hundred new breeding lines and varieties. Material from Scotland is usually supplied as tubers, whereas the European community tend to send microplants.”

Tubers are initially tested for bacterial diseases, mop top virus and others using plugs taken from the heel ends. Eye plugs are also scooped out, these being grown into full size plants in the glasshouse. Similarly, if microplants have been supplied, the plant tissues are tested directly as well as grown into larger plants in clean growing media.

The glasshouse grown potato plants are then screened further, particularly for viruses. Scotland is free of many important viruses as well as potato spindle tuber viroid, ring rot and brown rot. It is essential that such diseases are not introduced, let alone spread on seed.

“Brown rot was detected in one of the tributaries to Loch Tay 20 odd years ago. Fortunately, it was eradicated, mainly by removing all the nightshade plants from the riverbanks. There are still surveys of all the rivers and tributaries every year to check that it’s not there. A lovely job in good weather,” smiles Jackie.

“Actually, PVY is the most common virus, but we can pick it up really early, so it’s not a problem.”

Virus testing uses ELISA (an enzyme-based assay) as well as indicator plant techniques. The latter involves taking

SASA Export Liaison Officer Jacquie Gibson with a small selection of the SASA seed potato nuclear stock collection.

samples of plant sap and spraying onto lightly damaged capsicum, tobacco and *Chenopodium* species, including quinoa.

Similarly, bacteria can be detected both by using plates of selective media and by directly injecting macerated tuber into young eggplant (ring rot) and tomato (brown rot) plants. This really does literally involve using a syringe to inject the stems of young plants.

“The plant-based assay is really useful for a couple of reasons,” explains Jackie.

“As it’s less specific than ELISA, it will pick up things not otherwise tested. For example, if a new virus strain is present, we still see symptoms in the test plants.”

“Secondly, if only tiny amounts of the pathogen are present, it will bulk up in the indicator plants. The symptoms then become more obvious, making the pathogen easier to detect."

MAKING ONE INTO MANY

Once the source material gets the all-clear, it can be micropropagated. Sprouts from the tubers are dissected into nodes, each then planted into agar at a rate of six per tube. Placed under grow lights, each node develops into a microplant. After four to six weeks, the tiny plant can be re-subdivided and transferred to fresh medium, the process being repeated until a few plants become hundreds.

The microplants are then sent to the next stage of the multiplication process. This is performed by private micropropagation laboratories and ‘pre-basic’ growers. They grow on the tiny plants in sterile media in polytunnels or using aeroponics, producing millions of mini-tubers ready to plant in the field.

A few precious microplants are also added to the nuclear stock collection. At 14°C with 3% mannitol (a type of sugar) added to the media, the microplants can survive for up to a year before re-subdivision and addition to fresh media.

“Some of these plants might look dead, but once they are cut and given a dose of nutrients they come back to life,” observes Jacquie.

“What’s more, most varieties will throw microtubers. These tiny little dried brown things will all grow, no problem. It’s amazing really.”

It's quite a job though. With four tubes each of 1,000 accessions, it takes the three staff two months to replenish the collection each year.

And that’s not the only task. Every year, half of the stored varieties are re-grown at SASA’s field site to check that no genetic changes have occurred during storage. The plants are grown right through to tuber bulking, with inspection at every step to make sure they remain true to type.

It’s a lot of work. However, it’s still a better and more efficient way to maintain varieties than annually replanting tubers in the field.

PLANTLETS ON THE MOVE

While most of the material generated by the unit goes to pre-basic growers, others are used by researchers, or exported overseas.

“These plants here are going to Indonesia” says Jackie, indicating a group of 20 tubes, “and these are for Africa.”

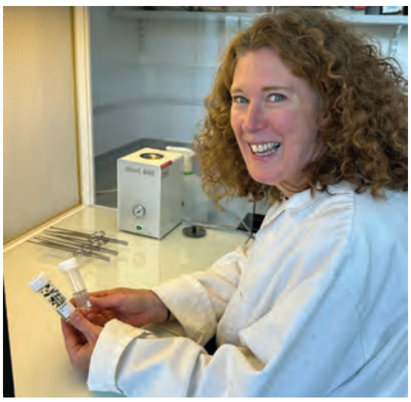
The breeders at James Hutton have developed a lot of varieties for Kenya and other places in Africa.

“In this case, we’re just sending 20 plants of each variety. They have to multiply them locally using tissue culture, then plant them in the field.”

Amazing to think that those 20 tiny plantlets in their small glass vials could hold the key to potato production in Kenya, generating thousands of tonnes of PCN resistant potatoes.

From such a tiny thing, to one so large.

Microplants ready for propagation. The tube at right also contains sprouting microtubers (circled).



Microplants are cut into nodes, with six nodes planted into each new tube of media; Jackie Gibson demonstrates the tiny pieces of material used as initial plugs and the finished tube.

KEEPING SCOTTISH SEED CLEAN

By Dr Jenny Ekman

Another important role of SASA is to act as the Certifying Authority for seed potatoes. They also manage and administer the Seed Potato Classification Scheme. In this, they perform a role similar to our own AuSPICA, but are Government based.

In Scotland, all stages of seed production are regulated. These rules are stricter than countries within the European Union and certainly contribute to Scotland's excellent reputation; only the highest quality pre-basic and basic classes of seed are produced here.

Land must be tested and found free of potato cyst nematode before planting any seed crop. Rotations of seven and five years are mandated for pre-basic and basic category seed potatoes respectively, with virtually all paddocks de-stoned to ensure perfect soil conditions.

As in Australia, crops are regularly inspected for symptoms of virus, bacterial diseases, or failure to grow true to type. SASA employs around 80 inspectors, supervised by 30 Agriculture Department staff. Every seed crop is inspected at least twice, with officers searching for symptoms of virus, blackleg, varietal discrepancies, or other issues suggesting the seed is not as it should be.

New inspectors go through a rigorous seven-day training programme. Even existing inspectors need to undergo four annual days of refresher training. This training is conducted at the SASA Gogarbank Farm and – lucky me – was in progress at the time of my June visit.

The training plots are truly an amazing thing to behold. The site has over 3,000 individual plots with more than 1,200 potato cultivars, 150 examples of off types, 150 examples of viruses and mixtures of diseases with other disorders, including herbicide injury.

I was shown around by Dr Triona Davey, Head of SASA's Potato, Virology and Zoology, as well as the SPCS and Export Manager John Ellicott.

The Seed Potato Certification Scheme Inspector training plots at SASA's Gogarbank Road farm. Each tag indicates a different cultivar or other treatment.

"What we've got here are plots with all the varieties that are commercially grown in Scotland," explains John. "And these are our new inspectors. This year we've got 27 doing the course. They're a mixture of temporary summer staff and permanent staff who also do other jobs - such as inspecting cattle."

"New inspectors have to be able to identify the top 30 varieties by looking at the foliage alone. They also need to recognise symptoms of key diseases and disorders. Next Tuesday the returning inspectors come back for their refresher, and some of them can recognise up to 1,000 varieties! Knowing what each variety is meant to look like means the inspectors have the skills to spot differences, diseases, and rogues in the crop."

The trainees are quizzed daily to check how well they are going with their variety recognition skills. To me all the plants look a bit the same, but John is a great teacher.

"So this is Maris Piper, which was our biggest variety last year. And this is Cara. They're both lime-green on top, but Cara looks more like a palm tree and Piper is a bit more coarse, corrugated even. Hermes, the leaves tend to turn over when it's windy, as the stems are a bit twisted, so you see the pale underneath."

Triona helps as well.

"Desiree, Rooster and Lady Rosetta are the only red varieties, so have red stems. Rooster has the darker green leaves. Then there's Innovator which has stiff terminal leaves a bit like a shuttlecock," she explains.

Incredibly, I find I can soon tell the difference between the shuttlecock and the palm tree. However, even a seasoned inspector can find themselves duped by unusual rogues.

John tells the story.

"We had a case a few years ago where the entire crop was affected. It was an unusual variety the inspector hadn't seen before. It was only after two years multiplication that somebody, just by pure chance, knew the variety and said, this looks funny. Even though an initial DNA test came back as the correct variety, a small variation was picked up. That meant the crop could not be used for seed".

Dr Triona Davey (left) and John Ellicott (right) teach me how to tell my shuttlecocks from my palm trees.

ABOUT THE SCOTTISH AGRICULTURAL SCIENCE AGENCY

SASA is a division of the Scottish Government Agriculture and Rural Economy Directorate. Their primary role is to provide scientific services and advice in support of Scotland's agriculture and wider environment.

SASA occupies a world class laboratory, glasshouse and experimental farm facility on the outskirts of Edinburgh with a community of 100 scientists and their support staff.

More information available here:

https://www.sasa.gov.uk

Even more important is recognising the early signs of virus infection.

"You can see the leaf rolling at the bottom of the plant" observes John "then there's the shape of the whole plant. It can go a bit star shaped, pale, even hungry looking. You've got to have your wits about you."

The demonstration plots include so many cultivar plus virus combinations, and sometimes multiple viruses, that it's hard to get your head around. Inspectors also need to check for aphid vectors; if they exceed specified counts, then the seed may have to be tested for virus after harvest.

Detecting bacterial infections is also important. The bacteria block the vascular system, so the plants look soft and slightly wilted. This becomes most obvious under wet conditions.

"You can see it at the base there" says John, "even easier if you pull the plant out."

Then there are mutations caused by herbicide damage. These can easily look like a virus infection or a cultivar variation. However, in this case the crop may be able to grow through normally in the following generation, still producing good quality seed.

Being able to recognise the difference between symptoms, and having the testing service to back it up, can be the difference between a profitable crop and one that's dumped.

I came away with huge respect for the job seed inspectors do. The amount of knowledge they must keep in their heads, as well the different cultivars, diseases, and growth abnormalities they must be familiar with – it's quite a challenge.

Photographs, videos, diagrams have all been tried, but nothing is able to replace experience. Perhaps as John said, the best way is not to overthink it, but use first impressions.

One thing is sure, this is not a job that's going to be taken over by AI any time soon.



PVY symptoms in cultivars Marfona (left), Charlotte (centre) and Desiree (right).


Symptoms of damage by the herbicide Aminopyralid (left) and blackleg disease (right).

A NEW POTATO VIRUS VECTOR MONITORING PROGRAM BY AUSPICA[1]

AuSPICA has introduced an innovative solution to monitor insect vectors in potato crops. Passive suction traps installed in the field take samples of potential virus vectors, which are then sent to Intertek laboratories for rapid DNA analysis. The data developed builds information on the presence of potato virus vectors during the growing season and in the long term builds trends on vector populations in potato growing regions. By Barry Strahan* and Dr Nigel Crump

1. Australian Seed Potato Industry Certification Authority (AuSPICA)
*Corresponding email: barry.strahan@auspica.org.au

Viruses can potentially reduce both yield and tuber quality of potato crops. In Australia, three viruses are of particular significance: PVY (Potato virus Y), PLRV (Potato leafroll virus) and TSWV (Tomato spotted wilt virus). All are spread by insect vectors; PVY and PLRV by aphids and TSWV by thrips. Monitoring and controlling these insects is key to limiting virus spread and loss of marketable crop yield.

POTATO VIRUS Y

Visual symptoms of PVY can vary greatly from variety to variety. In some cases infection is impossible to detect visually when walking through the potato crop, as infected plants may be asymptomatic and show no symptoms of disease. If present, symptoms can include mosaic or mottling of the leaves (Figure 1), stunting, and uncharacteristically rough or distorted leaves. With low level PVY infection, tuber symptoms may be minor with minimal yield loss and tuber cracking.

When PVY is present in seed, the effects on yield on subsequent commercial crops can be severe. A study in the US found that for every 1% of PVY in the seed, the yield of the subsequent crop decreased by 0.18t/ha. PVY impacted both marketable yield and tuber size[1]. PVY^{NTN} strain can sometimes cause necrotic rings on tubers (Figure 2), but not all PVY^{NTN} infections show this symptom. Conversely, tuber necrosis is not a definite indicator of PVY infection. Tubers, and plants, with no apparent visual symptoms can also be infected with PVY.

The best control for PVY and the other viruses discussed below is to use clean certified seed with known low virus levels, where feasible use resistant varieties, adjust planting and desiccation times to avoid periods of high vector insect pressure, maintain an effective management program which includes, scout crops for vector insects, and rogue out infected plants during the growing season. It is also important to properly dispose of crop waste and control self-sown potatoes as these can act as a source of infection. Weed populations should also be considered as possible virus hosts and can provide a safe harbor for insect pests.

Seed cutting is considered to be a contributing factor spreading PVY, so effective disinfection of cutting equipment and the priority cutting of known clean seed lots before cutting seed lots with known levels of PVY can reduce the spread of virus across seed lots.

Figure 1. PVY symptoms in Atlantic. Photo by Barry Strahan

Figure 2. PVY^{NTN} tuber necrosis. Photo by Nigel Crump

TOMATO SPOTTED WILT VIRUS (TSWV)

Like PVY, TSWV impacts the marketable and total yield of crops. TSWV causes a general reduction in tuber size. In some cases necrotic spots occur internally on tubers. These can extend to the skin as concentric rings.

Symptoms of TSWV in the field (Figure 3) include necrotic leaf spots. These can have concentric rings, sometimes leading to a misdiagnosis as target spot, a fungal disease caused by Alternaria species. Severely affected stems and even whole plants can die. Plants grown from infected tubers are often most severely affected, with stunted growth in the form of a rosette.

POTATO LEAFROLL VIRUS (PLRV)

PLRV (Figure 4) causes reduced tuber set and size. In some varieties, PLRV can also cause necrotic brown flecks in the tuber vascular tissue, affecting marketability.

Visual symptoms can vary depending on whether it is a new/primary or seed borne/secondary infection. Primary infection tends to be concentrated in the young leaves, which appear pale and dry or brittle with rolled leaf margins, sometimes with a hint of red or purple.

Seed tubers from infected plants carry the disease and will cause secondary infection. Such secondary symptoms are similar but more severe, showing first in the lower leaves before progressing to the new growth. Plants with secondary infection can, in some cases, be stunted and hidden under the canopy of neighbouring plants as the infected plants are out competed and over shadowed. Crop walks prior to row closure are therefore important to identify the disease and rogue infected plants.

Figure 3. Tomato spotted wilt virus. Photo by Nigel Crump

Figure 4. Potato leafroll virus. Photo by Barry Strahan

TARGETING THE VECTORS OF POTATO VIRUSES

Regular scouting of potato crops, particularly seed crops, is the best way to identify and monitor insect pests and/or beneficials as part of an IPM (Integrated Pest Management) strategy. However, it can be hard to get a bigger picture of insect presence and movement across a wider region. Traditionally, yellow sticky traps or water traps have been used to monitor aphids and thrips. However, getting the insects identified to species level and subsequently counted is difficult and expensive. Obtaining a quick result, as to what insect is present, particularly at species level, is not always possible, however the application of new DNA diagnostic technology provides a valuable solution.

AuSPICA have collaborated with diagnostic laboratory Intertek to develop a passive suction trap that can be installed in field to capture flying insects, including aphids and thrips. The total capture of insects is sent to Intertek for DNA analysis to identify and quantify which insect species are present. This is done quickly – in a matter of days of the laboratory receiving the sample – allowing informed decisions to be made by growers, including correlating with recent localised crop scouting activities.

The team at AuSPICA has been working hard over the past couple of years to bring this program from concept to field implementation. The team has built and tested the passive suction traps and worked with Intertek Laboratories to develop and validate a testing procedure. This enables the DNA of target insect species to be identified in the trap samples. Currently we can detect three species of thrips and two species of aphids, with more insects to be included in the future.

The large Macquire traps (Figure 5) are mounted just above canopy height in potato fields and spin to track the wind, acting as a funnel. Insects are attracted by the traps yellow colour, then drawn into the sample tube though passive suction. The solution contained within the tube preserves the insect DNA, ready for collection and delivery to the laboratory for testing.

For the 2022-23 season, with financial support from Seed Potatoes Victoria, AuSPICA installed four traps strategically located around the Ballarat district, two in the Otway's and another two in the Portland district. Samples were collected weekly. Sites for the traps were chosen to provide a snapshot of insect movement across each district from week to week.

Once testing is completed each week, certified seed growers and AuSPICA affiliated members in the respective district receive an SMS text message to notify them of trap results. The message includes information on insect species detected and the quantity of insects measured at each site, reported as low, medium, or high (Figure 6).

As the program progresses, data can be plotted year on year and cross referenced to highlight high risk periods seasonally, helping growers plan planting and desiccation dates, along with making informed decisions as to the appropriate management of target insect vectors.

The traps are provided as a commercial service to all growers. Please contact AuSPICA if you are interested in having insect monitoring included in your crop next season.

In the coming seasons, the test will be expanded to include detection and quantification of Serpentine Leaf Miner as well as other insect pests. This will further improve the application of this technology for use by the Australian potato industry.

Figure 5. Macquire trap. Photo by Barry Strahan

AuSPICA
Potato Virus Insect Vector
Population Monitoring
3/4/23

TOWN 1
Green peach aphid – Low
(1-10)

No Target species detected for the following trap locations.
TOWN 2
TOWN 3
TOWN 4

Target Species
Western flower thrips
Common blossom thrips
Onion thrips
Green Peach aphid
Potato aphid
It is always recommended to scout crops for localized insect pressure.

Figure 6. Example of SMS message

Insect trap results at a given site – early detection of Onion thrips the vector for TSWV and aphids (Green Peach Aphid) vector for potato virus PLRV and PVY. Note: CT value shown in the graph relates to the level of insect DNA in a given sample.

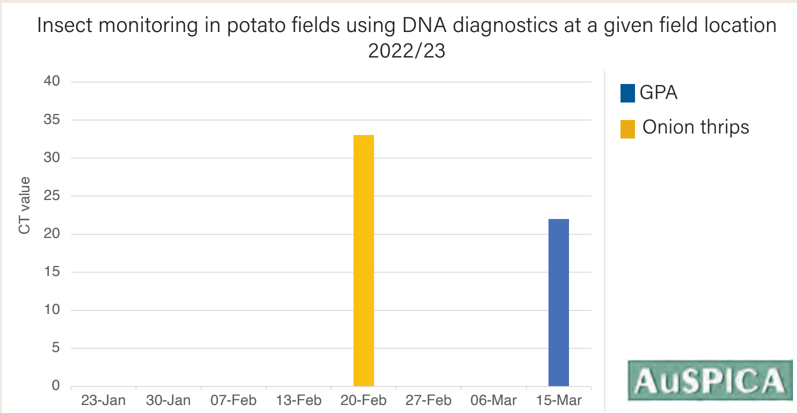


Figure 7. Example of trap data

REFERENCES

1. Phillip Nolte, Jonathan L. Whitworth, Michael K. Thornton, and Christopher S. McIntosh. 2004. Effect of Seedborne Potato virus Y on Performance of Russet Burbank, Russet Norkotah, and Shepody Potato Plant Dis. 88:3, 248-252

USING BIOLOGICALS IN A COMMERCIAL FARM SETTING

A demonstration by PotatoLink

A recent demonstration trial at Springbank near Ballarat (Victoria) investigated the impact of farm practices on the effectiveness of biologicals, including the application of fungicides, the influence of soil nutrient availability, and fertiliser applications.

PADDOCK CHARACTERISTICS AND CROP HISTORY

- Clay soil type.
- Olsen P 44ppm and Colwell P 150ppm.
- Paddock history: oat crop (saia oats) grown before planting of the Innovator potato crop in December 2022.
- Innovator crop harvested in mid-late August 2023.
- The crop received a base fertilisation of croplift 800 at 650kg/ac, supplemented with 10kg of humic acid.
- Additionally, in-furrow applications of sulphate of ammonia and fungicide (Metalaxyl and Azoxistrobin) were applied at planting.
- The same seed source was used in the entire paddock.

Amid high input costs, any opportunity to maximise nutrient use by the crop is worthy of further investigation.

A demonstration trial was established with the aim of improving crop health, quality and yield while also reducing inputs. To achieve this, we strived to increase the populations of beneficial microbes – mycorrhizal fungi – in the soil, which can help to improve nutrient availability to plants.

With many new biological products on the market, it can be a challenge for growers to effectively test the products in their farming system. Often, promising results are observed in pot trials, but the real challenge lies in scaling up these results to a commercial farming operation.

The demonstration explored the impact of in-furrow fungicides, and the influence of soil nutrient availability and fertiliser applications on the effectiveness of biologicals.

Given the many products available to growers, navigating and identifying the most suitable and effective options for their specific farming systems can be challenging. Although one demonstration trial is not enough, as we generate more data across seasons and soil types, the resulting database will help farmers make more informed decisions.

REMIND ME AGAIN – WHAT ARE ARBUSCULAR MYCORRHIZAL FUNGI AND WHY ARE THEY WORTH INVESTIGATING?

Arbuscular mycorrhizal fungi (AMF) play a vital role in plant ecosystems, forming mutually beneficial relationships with the majority of plant species. This unique partnership is a give-and-take arrangement, where both the plant and the fungi derive benefits. The plant provides food for the fungi, while simultaneously evaluating what the fungi can offer in return. The plant essentially acts as the gatekeeper of this relationship, deciding whether it's worth investing in.

AMF bring a multitude of benefits to the ecosystems they inhabit including disease suppression by protecting plant roots from various diseases.

Notably, different species of mycorrhizal fungi exist, and native mycorrhizal species may perform differently and be better adapted to specific environmental conditions. One crucial factor influencing AMF performance is the availability of phosphorus.

When phosphorus levels are high, plants may decide not to support AMF, making it more common to observe significant colonisation of the roots by mycorrhizae in soils with high phosphorus-fixing capabilities. Furthermore, AMF are not particularly fond of cultivation and do not like fumigation, although they can bounce back.

Additionally, AMF support a stable soil structure by excreting compounds through their hyphae, effectively helping to bind soil particles together. AMF also play a critical role in nutrient availability, particularly when it comes to phosphorus synchronisation.

THE TREATMENTS

Using the grower's standard practice, EndoPrime was applied and the following treatments were tested (Figure 1):

- EndoPrime (product containing mycorrhizal fungi, applied to whole paddock)
- No Endoprime strip
- No phosphorus strip + EndoPrime
- No base fertiliser strip + EndoPrime (rest of paddock received croplift 800 at 650kg/ac + 10kg humic acid)
- No fungicide strip + EndoPrime (rest of paddock received Metalaxyl and Azoxistrobin) applied in furrow)

ASSESSMENTS

The following were harvested and assessed to determine the effects of a particular treatment:

- Harvested 3 x 3m plots for EndoPrime, no EndoPrime, and no fungicide treatments
- Harvested 2 x 3m plots for no P and no base fertiliser
- Within the plot area, collected:
  - Number of plants
  - Number of stems
  - Number of tubers
  - Weight of tubers
  - Size of tubers in grades below, where <50 is considered out of spec for processing
    - » <50mm
    - » 50-100mm
    - » 100-150mm
    - » 150-200mm

RESULTS

In this field trial, the application of EndoPrime exhibited fascinating effects on potato crop characteristics.

The areas where EndoPrime was applied showed a reduction in both the number of stems per plant (Figure 2) and the number of tubers per plant (Figure 3).

Interestingly, despite these differences, the overall yield remained consistent across all treatments summarised as follows and in Figure 4:

- EndoPrime, no fungicide = 59t/ha
- EndoPrime = 55t/ha
- No EndoPrime 51t/ha
- EndoPrime, no P 49t/ha
- EndoPrime, no base fert 37t/ha

Notably, the EndoPrime-treated areas displayed larger-sized tubers, (100-150mm), while the no EndoPrime areas had a lower proportion of larger tubers (Figure 5).

Unsurprisingly, mycorrhizal root colonisation levels were notably higher in the treatments with no fungicide, no base fertiliser, and no phosphorus, compared to no EndoPrime and EndoPrime areas that both had the other inputs applied (Figure 6).

Additionally, treatments involving EndoPrime exhibited higher specific gravity, ranging from 1.079 to 1.088, in contrast to the no EndoPrime treatment, which had a specific gravity of 1.073 (Figure 7).

These results give some insights into the dynamics of plant-fungi symbiotic relationships. Root colonisation appears to be a reliable indicator of whether this partnership is genuinely established and how it impacts the plant's functionality.

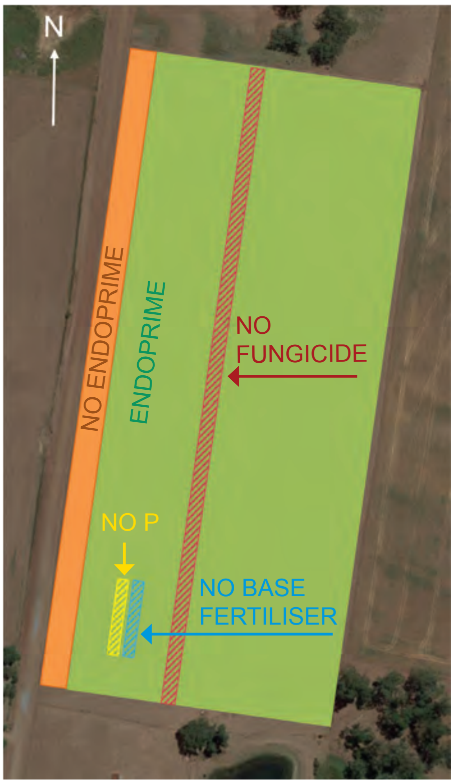


Figure 1. Demonstration treatment layout

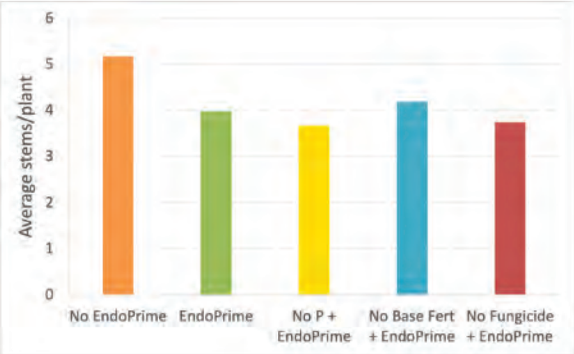


Figure 2. Stems per plant across different treatments - treated areas had 4 stems/plant compared to 5 stems/plant in the no EndoPrime areas.

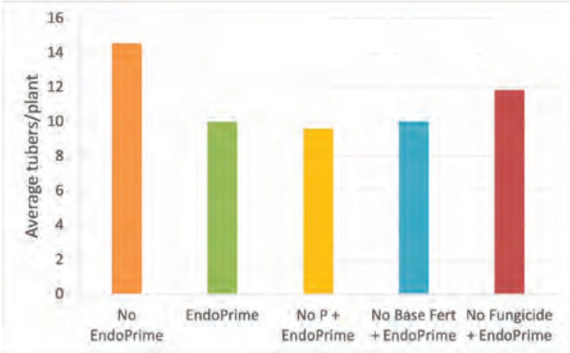


Figure 3. Tubers per plant – EndoPrime treated areas had less tubers with 10 tubers/plant compared to 14 tubers/plant in the no EndoPrime area.

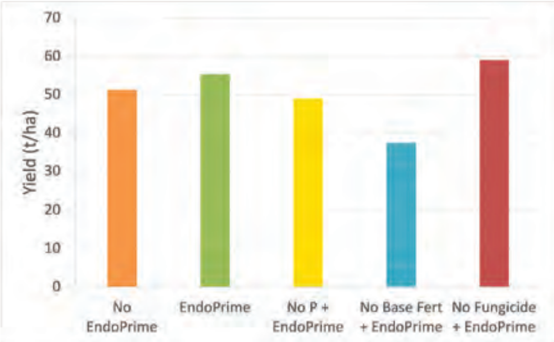


Figure 4. Average yield (t/ha) across different treatments.

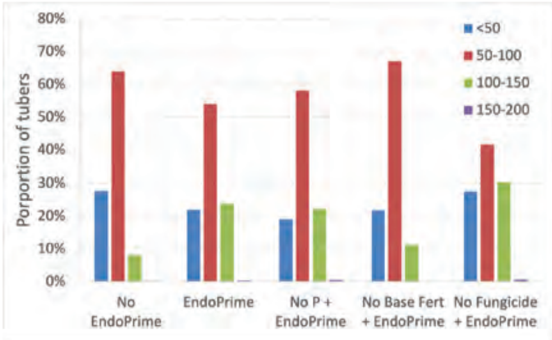


Figure 5. Proportion of average tuber size (mm) across treatments.

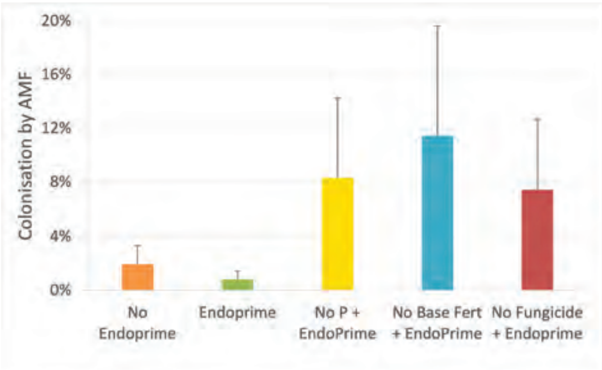


Figure 6. Average root colonisation by AMF across treatments – bottom to middle paddock. Bars indicate the standard error of each mean value.

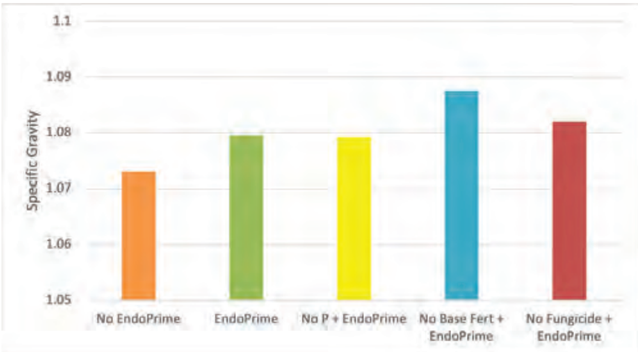


Figure 7. Specific gravity across different treatments.

THOUGHTS FROM THE GROWER

Demonstration site host and grower Neville Quinlan has observed similar trends across his whole farm in terms of tuber numbers and size. He notes that EndoPrime's inclusion of humic acid may have contributed to the promising results, particularly in terms of improved specific gravity, however this requires further investigation. The notable improvements in tuber size observed has led to Neville's strong inclination towards continued use of EndoPrime.

For growers, it is important to consider the following:

- It can be challenging to discern small, incremental improvements in the field, necessitating precise measurements.
- Understanding whether a product contains live organisms the appropriate storage and handling through the supply chain and before application is crucial.
- The quality of seed potatoes can significantly influence trial outcomes.

And a word of caution: changes observed in one strip may not solely be due to the treatment but could also be attributed to other factors including seed source and handling.

It's important to note that not all conditions may lead to observable changes, as outcomes are contingent on the specific environmental conditions. For a more complete and comprehensive understating of the impact of AMF on potato yield and quality, it is best to accumulate data from different farms and across different seasons.

Building a broader picture over time can provide valuable insights into the effectiveness of various agricultural practices and products.

KEY POINTS

- Where EndoPrime was applied showed a reduction in both the number of stems per plant and the number of tubers per plant.
- Overall yield remained consistent across all treatments.
- EndoPrime-treated areas displayed larger-sized tubers.
- The no EndoPrime area had a lower proportion of larger tubers and a higher proportion of smaller tubes.
- Treatments involving EndoPrime exhibited higher specific gravity.
- In this trial, the application of EndoPrime resulted in a decrease in stem and tuber numbers per plant, and an increase in tuber size. Similar patterns have been observed at other sites.

The PotatoLink team would like to thank grower Neville Quinlan for access to his farm and assistance in the trial, and PotatoLink regional representative Stuart Grigg who has worked with us to carry out the trial and interpret the results.

Hort Innovation POTATO – PROCESSING FUND

This project has been funded by Hort Innovation using the potato – processing 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 – FRESH FUND

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

PotatoLink team member Steph Tabone evaluating the trial results.

Trial paddock - left two rows between the bucket lids are no P + Endoprime, and the right two rows are no base fert + EndoPrime. Image date: 03 Feb 2023. Photo by Ryan Hall

Trial paddock when data was collected. Image date: 25 Apr 2023. Photo by Steph Tabone

POTATOLINK R&D FORUM 2023

PotatoLink held a research and development forum in June 2023. Seven speakers covered a range of topics including diseases, irrigation, monitoring technology and more.

RESEARCH PROJECTS

Digital Remote Monitoring

Henry Hyde from Applied Horticultural Research (AHR) presented his work on the Smart Farming project, where he discussed soil moisture monitoring, irrigation management and automated record keeping.

Operating with unpredictable weather within sensitive environments, Australian primary industries have always been at the forefront of innovation. With a specific focus on the Great Barrier Reef's (GBR) delicate ecosystem, the Digital Remote Monitoring project aims to support horticultural operations to improve efficiency and sustainability.

To showcase the potential benefits of a purpose made Hitachi Control Tower system, four pilot smart farms have been established at the northern and southern border of the GBR, each representing a different crop.

Pilot smart farm sites

PRECISION WEATHER MONITORING

On-farm weather stations are an integral part of the Hitachi Control Tower's infrastructure, providing farmers with accurate, real-time information on crucial weather parameters. These include rainfall, temperature, humidity, and wind speed and direction. By combining this on-farm data with forecasts from the Bureau of Meteorology, farmers can make informed decisions, ensuring optimal irrigation practices and water usage. This precise weather monitoring is crucial in mitigating the high spatial variability of weather conditions in Queensland, ultimately leading to improved potato yields and resource efficiency.

OPTIMAL SOIL MOISTURE MANAGEMENT

Farming is inherently dependent on water resources, making efficient irrigation management a top priority. The implementation of soil moisture probes across all pilot smart farms allows farmers to remotely monitor soil water content accurately. Armed with this information, they manage water efficiently for maximum yield and minimum waste. Using soil moisture probes can also lead to reduced nutrient leaching. The automatic alerts generated by the Hitachi Control Tower ensure timely interventions, preserving crop health.

DATA FUSION FOR ENHANCED INSIGHTS

The true power of the Digital Remote Monitoring project lies in its ability to combine data from various sensors. By combining information from soil moisture probes and weather stations, the Hitachi Control Tower generates highly accurate forecasts of soil water content up to five days ahead. This foresight plays a critical role in reducing plant stress by allowing farmers to optimise irrigation management and anticipate water needs. The visual representation of this data on the interactive dashboard provides a clear roadmap for timely and informed decision-making.

SUSTAINABLE NUTRIENT MANAGEMENT

The Australian banana industry's experience with fertiliser regulation has inspired the adoption of a real-time nitrate photometer on the banana pilot farm. The photometer has been positioned to measure the concentration of nitrate leaving the property via subsurface leaching. This approach has been able to verify that the farm's fertiliser program is sufficient and meets best practice.

While the real-time nitrate photometer is a highly accurate sensor useful in environmentally sensitive areas, it is quite costly. A more cost-effective monitoring option is the full-stop wetting front detectors. These full-stops capture a sample from water that moves down through the profile. This sample can then be extracted and analysed immediately using a portable photometer.

The results from the full stops are also being used to validate a nutrient loss model, which will be used to provide recommendations regarding the application timings of fertiliser.

EFFICIENT HARVEST OPERATIONS

The introduction of GPS trackers on farm vehicles at the banana pilot farm is being used to locate bunches during harvest, increasing efficiency while reducing far traffic and therefore reducing fuel and erosion.

The GPS location of vehicle activity is tracked and displayed on the Hitachi Control Tower.

AUTOMATED RECORD KEEPING

The GPS activity of chemical applications is automatically saved and linked to other key certification data. These certification data include activity start and end times, weather conditions (temperature, humidity, and change in temperature) during application, operator name, chemical type, and withholding period. The system aims to further develop and facilitate more cost-effective and efficient Freshcare environmental audits.

RELEVANCE TO THE POTATO INDUSTRY

The implementation of digital remote monitoring through the Hitachi Control Tower offers numerous advantages to the potato industry. By incorporating weather and soil moisture monitoring, irrigation efficiency can be enhanced, leading to precise water application and ultimately promoting optimal potato yield. Additionally, nutrient monitoring helps minimise input usage.

Through GPS activity tracking, harvest operations become more efficient, resulting in reduced labour requirements. Automated record-keeping feature significantly cuts down on the time and cost associated with certification audits.

This project has been funded by Hort Innovation, using the Hort Innovation nursery products research and development levy and the Australian Government's National Landcare Program. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Read more https://ahr.com.au/digital-remote-monitoring

Nitrate photometer

GPS tracking for efficient harvest operations

Mechanisms and manipulation of resistance to powdery scab in potato roots

In his presentation, Professor Calum Wilson of the Tasmanian Institute of Agriculture (TIA) at the University of Tasmania discussed the major outcomes from the recently completed Hort Innovation project *Mechanisms and manipulation of resistance to powdery scab in potato roots* (PT17003). Professor Wilson highlighted a new rapid cultivar screen for disease resistance and new resistant varieties being developed as a result of the project, as well as potential new disease controls targeted towards plant roots.

Potato powdery scab can cause significant yield losses and impact quality of crops. The infection targets both the tuber and root phases, with root infection playing a crucial role in hampering nutrient uptake and water absorption.

RAPID SCREENING: A BREAKTHROUGH IN EVALUATING RESISTANCE TO ROOT INFECTION

Traditionally, evaluating a variety's resistance to powdery scab has been time-consuming and resource-intensive, involving lengthy field or glasshouse trials and focussed on tuber disease, ignoring the yield debilitation root infection phase. However, the research team has developed a new screening method for root infection that takes less than a week.

By taking a small piece of a plant's root and exposing it to the pathogen to measure how much pathogen sticks to the root hairs, the team could determine resistance within 48 hours. This innovative approach has highlighted that susceptibility to root disease is not always evident in tuber diseases. In other words, some varieties have good tuber resistance, but poor resistance to root infection, for example Nicola potatoes.

Diseased roots (right) vs non-diseased roots (left). Photo by M. Balendres

NEW RESISTANT VARIETIES

Another significant breakthrough lies in enhancing resistance of commercial cultivars through tissue culture techniques. The group has already succeeded in generating variants with enhanced disease resistance in laboratory and glasshouse testing. These new variants have displayed promising resistance to root infection, indicating a potential path towards developing highly robust resistance traits. The team aims to further test disease resistance and the agronomic potential of these variants in the field with a view to commercial exploitation.

Results from quick screening of different varieties.

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		

UNRAVELLING THE ROLE OF ROOT EXUDATES

Root exudates, the secretions from plant roots, play a vital role in attracting pathogenic organisms like powdery scab. The research team has explored the differences in root exudate profiles between susceptible and resistant varieties and discovered that certain exudates attract the pathogen, while others repel it. Manipulating these attractants and repellents may offer a novel strategy for screening and breeding resistant varieties in the future.

LOOKING AHEAD: TARGETING THE ROOT INFECTION PROCESS

Understanding the root infection process is crucial for devising effective strategies to combat powdery scab. The research team has examined the surface proteins on the potato root, aiming to identify the receptors that the pathogen binds to. This work is still in its early stages, but the potential to develop a variety that resists the binding and infection of the pathogen, and therefore halting the disease, is a promising prospect.

The project's findings have far-reaching implications for sustainable potato farming. The rapid screening method allows farmers to rapidly assess varieties susceptibility to root infection and choose the most appropriate variety for their disease risk. Additionally, the development of resistant variants of commercial cultivars, the identification of putative pathogen binding targets on roots and the understanding of interactions of the pathogen with plant root exudates open up new possibilities for future breeding programs.

Read more about this research in previous issues of PotatoLink Magazine

https://bitly.ws/X2kX

https://bitly.ws/X2m8

Other speakers

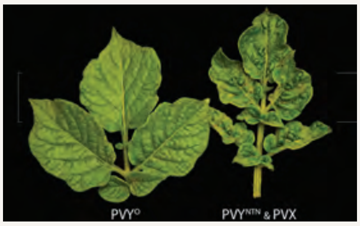
TETAAN HENNING ON MOBILE DRIP IRRIGATION

Tetaan Henning of Eco Water Management discussed the mobile drip irrigation technology Dragon Line, providing an overview of how it works and uses examples to highlight the benefits for use in Australian potato crops.

Extra resources: Mobile drip irrigation webinar https://bitly.ws/X2q7

TIM NEALE ON REMOTE SENSING AND YIELD MAPPING

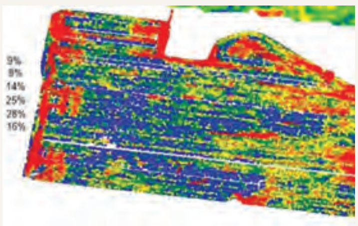
Tim Neale of Data Farming discusses remote sensing and yield mapping in potatoes. He explains high-resolution satellite imagery and talks about how it can be used in crop management and yield mapping to assess overall performance.



NIGEL CRUMP ON VIRUSES

Dr Nigel Crump from AuSPICA highlighted the impact of viruses on yield, the importance of seed certification to ensure you 'don't plant a problem', and other research and initiatives of AuSPICA.

DAVID ODDIE ON SOIL NUTRIENT VARIABILITY - MAPPING AND APPLICATION



David Oddie from Precision Agriculture discussed the use of mapping to understand soil nutrient variability. He highlighted the importance of regional and paddock-level variability in soils and compares different methods of soil testing to create nutrient maps and variable rate applications.

Re-visit the R&D forum - a selection of speaker recordings are available on the PotatoLink website. https://bitly.ws/X2ql

Hort Innovation POTATO – FRESH FUND

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

YIELD MAPPING

For potato growers, predicting yield, and determining paddock variations or disease occurrence, can be a guessing game. New technology that combines gaming algorithms with agricultural science might (literally) be a game-changer, writes Dr Jenny Ekman.

WHY MAP YIELD?

Every morning, when a hydroponic grower enters their greenhouse, they confidently scan a flat ocean of uniformly green, uniformly sized, and uniformly productive plants. Counting the size and weight of cucumbers in one section should, in theory, provide a good estimate of the yield from an entire half hectare glasshouse (assuming it is well managed).

Growing in soil however is a lot less uniform. Added to this is the challenge of a crop developing unseen, below-ground.

An apple orchardist can inspect size, quality, and quantity of fruits on trees. They can visually inspect and identify which areas of the orchard are less productive, have disease issues, or physical damage due to wind or hail.

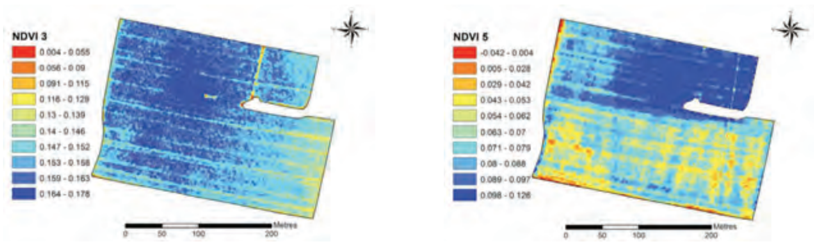
For the root crop grower, yield and quality are often first known at harvest. While every grower will have dug out a few plants here and there to look how the tubers are developing, extrapolating a few plants to a whole pivot is unreliable.

Associate Professor Brett Whelan, University of Sydney, is an expert in precision agriculture. In 2016 he completed a study (Project PT13000 Understanding spatial variability in potato cropping to improve yield and production efficiency) taking some of the lessons from grain and applying them to Tasmanian potatoes[1].

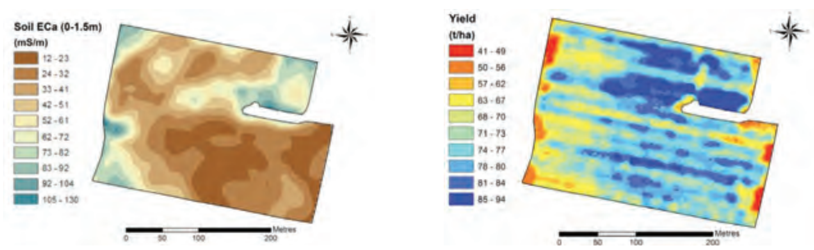
"We found that yield ranged from 28t/ha to 96t/ha, averaging around 64t/ha."

"Such three-fold variations in yield within a paddock aren't that unusual. We sometimes see similar results in grain crops."

"However, growing potatoes is expensive. At the time of our study the break-even point for potato production in Tasmania was around 42t/ha, so margins are extremely tight. Avoiding cropping unproductive areas could really help lift profitability of the whole crop."



NDVI maps of a Tasmanian potato field taken 14 (left) and 19 (right) weeks after planting. Source: Whelan and Mulcahy, 2015



Apparent soil EC (left) and yield map (right) of a Tasmanian potato field. Source: Whelan and Mulcahy, 2015

Yield maps can help identify these unproductive areas, either for remediation or removal from production. The maps can also be used to examine changes over time, and the effects of different agronomic treatments where these have been broadly applied.

YIELD MAPPING FROM ABOVE

Canopy measurements can provide clues as to what is going on underneath. For example, the NDVI (Normalised Difference Vegetation Index) produces a measure of crop greenness.

Several researchers have used multispectral and hyperspectral satellite images to generate NDVI values. Machine learning models combine this with weather and irrigation data, plus previous local yield information to predict total yield.

The method has been applied to estimate potato yield in diverse environments, including Mexico[3], Spain, Bangladesh and even Saudi Arabia (Figure 1). These models can also be used to detect water or nutrient stress, estimate nitrogen use, and alert growers to areas of disease.

Many of these studies have also concluded that images taken during tuber initiation and bulking are more predictive that images taken later during crop development[2].

In Dr Whelans' study, they found that NDVI measurements corresponded well with yield when taken at weeks 14 and 16. The images were less predictive early in crop growth as well as close to harvest (week 19).

The researchers also examined the influence of elevation, soil texture and apparent electrical conductivity (ECa). ECa varied most in the top part of the soil and tended to be higher in low parts of the paddock. ECa was negatively related to NDVI, meaning the crop was often greenest at high points in the field, where ECa values were low.

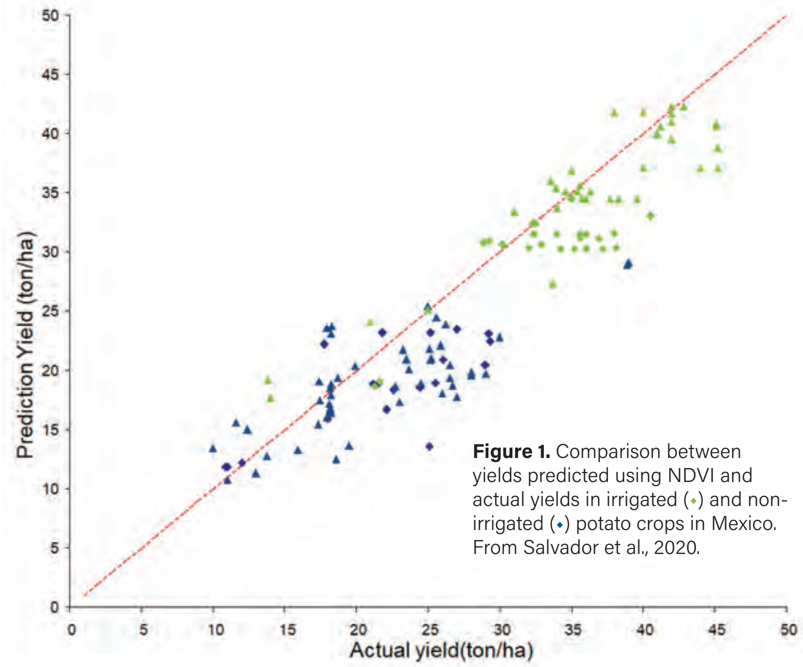
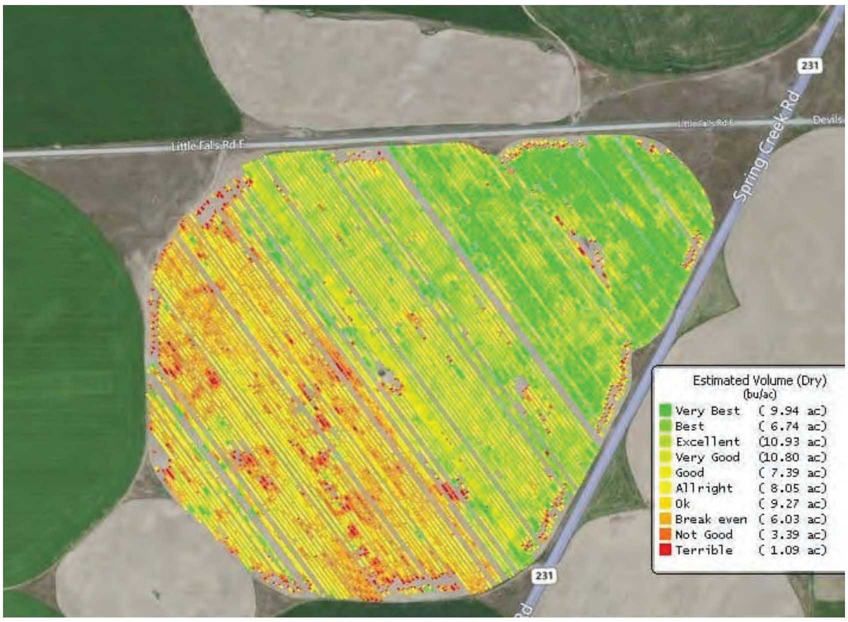


Figure 1. Comparison between yields predicted using NDVI and actual yields in irrigated (•) and non-irrigated (•) potato crops in Mexico. From Salvador et al., 2020.

Potato weight is usually recorded using a load cell on the harvesting belt. This is combined with GPS tracking data and conveyor speed to calculate total yield and generate a yield map.



Example of a harvest yield map created using a load cell system. Image by RiteYield (greentronics.com/products/riteyield/).

Despite this, only 36% of the crops studied had a statistically significant relationship between elevation and yield, with both positive and negative outcomes. In other words, none of these factors individually was a good predictor of yield.

YIELD MAPPING AT HARVEST

Pre-harvest estimates can be useful, but in the end there is no substitute for measuring potatoes dug out of the ground.

The most common method of measuring and mapping actual yield is using a load cell on the harvester machine. Data is combined with GPS tracking and conveyor speed, generating a yield map. Results may be viewed on a screen in the cab in real time and/or sent to the cloud for later analysis. Examples include

- The Casma Yield Monitor by HarvestMaster
- RiteYield by Greentronics
- YieldTrak by Topcon
- Advanced Technology Viticulture

Yield mapping using such systems is common for grain crops, and it has also been adapted to other mechanically harvested products, including tomatoes, grapes, almonds, and carrots.

Calibration of the yield monitor is one of the most important steps in ensuring data collection is accurate. It is not uncommon for the load cells to record weights significantly different to the actual weights recorded in bins. This can increase during harvest, as dirt builds up on the harvest belt.

For example, O'Halloran and van Sprang (2020)[4] tested the accuracy of yield monitoring of carrots. In this study, yield was consistently 20% lower than indicated by the load cell.

Calibration data for yield monitor. From O'Halloran and van Sprang, 2018.

Actual yield	Yield monitoring output (kg)	Accuracy
4043	5110	79
4161	5280	79
4074	5490	74
4202	5270	80

Project PT13000 also mapped yield using a load cell on the harvesting machine. Actual yield/paddock was compared with monitored yield. In 45% of fields the difference between the two was 3t/ha or less. However, in others it was 10 or even 15t/ha. In one paddock, total yield was underestimated by over 100T, a substantial difference.

According to Dr Whelan, load cells work well for grain crops. However, with potato crops there can be rocks and rejects, plus the tubers bounce around on the belt, making them harder to measure. He also noted that occasionally the harvester had to stop or backtrack, or even quit harvesting part way through a block due to weather or loading. All these factors make yield mapping far more difficult.

KEEPING AN EYE ON SIZE

When considering potatoes, it is not just yield that is important. The size and count of potatoes may often be a better indicator of crop value than simple tonnage.

Estimating the number of potatoes in different size bands effectively excludes unmarketable oversize and undersize potatoes from total yield. It can also help the grower determine the best markets, particularly if they have a mixture of contracted supply and 'freebuy' on the open market.

Understanding size and frequency may be particularly useful when harvesting seed.

"One of the biggest problems we have in managing seed supply is knowing what we have and where we have it," comments Abe Montano, Elders Sales Manager for seed potatoes.

"Knowing what size range we've got helps us market that as best we can."

Relatively new to the market, the HarvestEye system uses a camera mounted on the harvesting machine to monitor incoming potatoes. Machine learning and artificial intelligence are used to detect, count, size and calculate per tuber weight.

Applying camera technology during potato harvest is far from simple. The cameras need to operate in a harsh, dusty environment with a shaking belt. Furthermore, the 'harvest' is not potatoes alone, but likely includes clods, rocks, roots, and soil. Nor are the potatoes in a convenient single layer but sometimes stacked and come in many odd shapes.

The HarvestEye system uses AI to identify and separate objects within a single image. Vidyanath (Vee) Gururajan from HarvestEye gives an example of how a computer can be trained to identify the number of cows in a herd.

"We use instant segmentation technology that can identify individual cows, rather than just blobs, using instance segmentation. The same machine learning principal can be applied to potatoes. This allows us to differentiate 'potatoes' from 'not potatoes', such as stalks, soil and the hands of workers," Vee explains.

"One of the biggest challenges is stacking. If there are several layers, the system may count something as a small potato when it is actually the top of a big potato. In this situation the system can be optimised for size accuracy. The size accuracy setting only uses clear images for size band distribution but uses the full count to estimate yield."

Instead of a load cell, the HarvestEye system uses a camera mounted over the belt, plus control panel in the tractor cab.

With thousands of potatoes streaming past the camera, the computer processing power needed is immense. According to Vee, the graphical hardware developed for gaming have proven a game-changer for this technology.

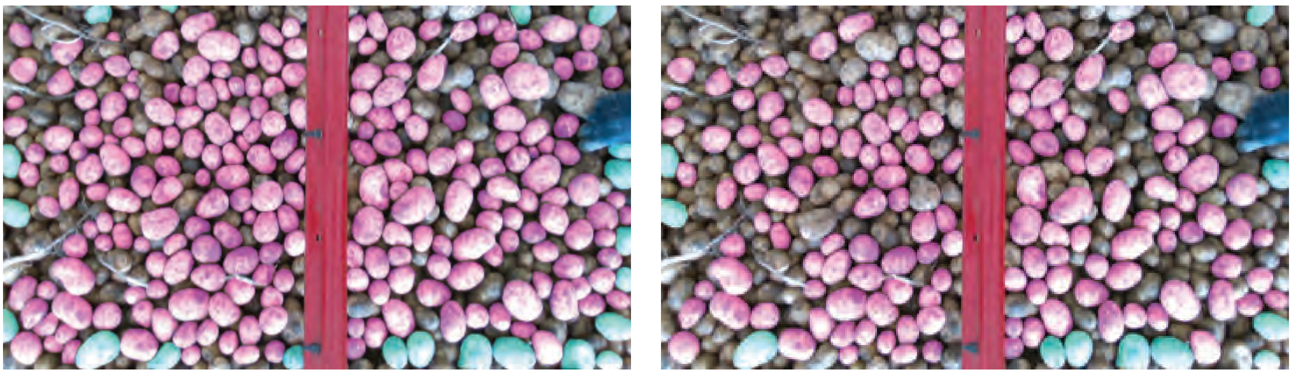
"This is what provides the computing power needed to process millions of pieces of data. The AI system has now been trained with about 2 billion data points, allowing it to accurately model weight from size."

While camera detection occurs on the harvester and monitored using a tablet in the tractor cab, most computing takes place in the cloud. The company claims that detection accuracy is 98% to 99.9%, while the per tuber sizing accuracy is around 98%.

The software allows the user to compare the number of tubers in each size band by year, by variety, and within different areas of the paddock. According to Abe Montano, using this data to decide the best variety for a specific location is a significant benefit.

"We can start to see the varieties that work best in different locations,

The HarvestEye system uses AI to separate potatoes within an image, then applies an algorithm to estimate size and weight.



Stacking is an issue for the HarvestEye system, as it is impossible to know whether what looks like a small potato is actually the tip of a much larger potato. To overcome this, the system combines the full detection image for count (left) with one that only records the size of clearly visible tubers (right). This size-band distribution can be used to estimate total yield.

The HarvestEye system can provide detailed information on tonnage by size band, as well as distribution of different sizes within the paddock.

especially in terms of marketable yield. It also helps with agronomy, working out which areas have been waterlogged, or underwatered, or where a spray has been missed."

The result may not only be better variety selection, but also understanding what parts of the farm need more input in terms of improving soil health, managing irrigation, or better plant nutrition. Alternatively, the grower may choose to cut their losses, and simply not grow potatoes in difficult parts of the paddock.

It may seem a long stretch from the virtual *World of Warcraft* to real life potato yields, however in this instance, farmers have the gamers to thank for significant technology advancements.

It is often said that you cannot manage what you cannot measure. With increasingly sophisticated tools available, growers can have more insight into costs and benefits than ever before.

LEARN MORE ABOUT YIELD MAPPING AND PRECISION AGRICULTURE

Webinar: Yield mapping with HarvestEye
https://bitly.ws/X7X6

Webinar: Precision Ag for the potato industry - Imagery is more than just pretty pictures
https://bitly.ws/X7Xd

Webinar: Precision Ag for the potato industry - practical soil mapping and adoption
https://bitly.ws/X2pQ

REFERENCES

1. Whelan B, Mulcahy F. 2016. Understanding spatial variability in potato cropping to improve yield and production efficiency. Hort Innovation Final Report PT13000.
2. Sun C et al. 2022. A review of remote sensing for potato traits characterisation in precision agriculture. Front. Plant Sci. 13:871859. doi: 10.3389/fpls.2022.871859
3. Salvador P et al. 2020. Estimation of potato yield using satellite data at a municipal level: A machine learning approach. Int. J. Geo-Inf. 9:343. https://doi.org/10.3390/ijgi9060343
4. O'Halloran J and van Sprang C. 2018. Yield monitoring in vegetables using load cells. Queensland Department of Agriculture and Fisheries Fact Sheet. HIA Project VG16009 Adoption of precision systems technology in vegetable production.

Dear Spud GP

What is causing these holes in my plant leaves? I've had a look and couldn't see any culprit. Lee F Chew

ASK THE SPUD GP

Dear Lee

While there are a lot of insects that can cause this sort of damage, in this case I suspect looper caterpillars (*Chrysodiexis* spp.). They start off really tiny, and are expert at hiding along the underside of leaf veins, making them hard to detect.

Looper eggs are laid singly on the leaf undersides by a rather stout, brown moth with patterned wings.

They are easy to distinguish from other caterpillars due to their – you guessed it – looping movement. This is because, unlike Heliothis, they don't have central prolegs.

Loopers can reach 40mm long when mature. They then form a cocoon within a silky chamber case, often encased in rolled or webbed leaves.

Loopers are most active during the summer months. They can skeletonise leaves, leaving behind the central veins. While they have a very wide range of hosts loopers are usually a fairly minor problem.

If a significant part of the leaves are being eaten (e.g. >15%), biological insecticides based on the stomach poison BT (*Bacillus thuringiensis*) can be an effective control.

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?

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- General info, project updates and more

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DISPATCH FROM ... WESTERN AUSTRALIA

This issue, our dispatch comes from PotatoLink regional rep Rachel Lancaster in Western Australia.

EVENTS

In August the PotatoLink team held an event in Jindong WA for local growers. The event commenced with presentations in the Kaloorup Fire Shed, where nearly 30 participants heard from a range of speakers including Rachel Lancaster (EATS and PotatoLink's local rep in WA), Andrew Taylor (DPIRD), who gave a summary of potato diseases, and an update on biosecurity from Shakira Johnson, (AUSVEG).

Following the presentations, local potato growers Tom Payne and Keith Taylor discussed their experiences with cover cropping during a field walk on each of their properties. Keith has been utilising cover crops as part of his potato growing system for many years.

During the field walk, attendees looked at a mixed sward of pasture species that had regrown from previous years (photo top right) and a regrowth paddock of forage sorghum (photo bottom right).

At Tom Payne's property, a mixed cover cropping sward was growing that included tillage radish, oats, turnips and vetch. Tom has been incorporating cover cropping with his potato growing for the past three years and is starting to see the benefits, including better water infiltration into the soil, less water runoff and reduced erosion during heavy rainfall.

Both Keith and Tom noted that planning and preparation is key to cover cropping within the potato cropping system. It is important to plan at least 12 months ahead where cover crops are to be planted, taking into consideration future potato crops.

Keith also noted that cover cropping combined with reduced tillage/ controlled traffic practices has been beneficial on his property. He has observed many positive results from improving soil conditions through cover cropping including increasing organic matter in the soil, which is a practice that growers can influence.

EXTRA RESOURCES

PotatoLink Webinar: Cover crops for fresh market and processing potatoes in Australia (https://bitly.ws/WZBG)

CONTACT

For more information about PotatoLink activities in Western Australia, contact Rachel

rachel@eastwa.com.au

HORT INNOVATION PROJECTS

Project name	Code	Lead organisation	Description	Fund	Start and end date
Potato industry minor use program	PT16005	Hort Innovation	Used to submit renewals and applications for new minor use permits for the potato industry.	Fresh & Processing	Ongoing
Australian potato industry communication and extension project (PotatoLink)	PT20000	Applied Horticultural Research	Supports growers in adopting improved practices on-farm and communicating new information, research and technology.	Fresh & Processing	08/12/2020 – 30/11/2025
Management strategy for serpentine leafminer, Liriomyza huidobrensis	MT20005	Queensland Department of Agriculture and Fisheries	Delivering targeted R&D specifically for serpentine leafminer in response to the incursions detected in late 2020.	Multi fund including Fresh & Processing	19/03/2021 – 30/11/2023
Regulatory Support & Response Co-ordination	MT20007	AKC Consulting Pty Ltd	Provides key information regarding domestic and international pesticide regulation	Multi fund including Fresh & Processing	30/06/2021 – 01/07/2024
Consumer behavioural data program	MT21004	Nielsen	Provides regular consumer behaviour data and insight reports, through the Harvest to Home platform (www.harvesttohome.net.au)	Multi fund including Fresh	20/01/2022 – 20/11/2026
Feasibility/scoping study: Surveillance and diagnostic framework for detecting soil-borne pathogens in vegetable industries	MT21016	NSW Department of Primary Industries	Examining the potential to develop a national surveillance and diagnostic framework for soilborne pathogens of vegetable crops including potatoes	Multi fund including Fresh & Processing	11/10/2022 – 31/08/2023
Generation of data for pesticide permit applications in horticulture 2022	ST22001, ST22003 and ST22004	Agreco, Eurofins Agroscience Services and Kalyx	The generation of pesticide residue, efficacy and crop safety data to support label registration and minor use permit applications and renewals made to the APVMA.	Multi fund including Fresh	16/05/2022 – 15/12/2025
People development strategy for the vegetable, potato, onion, and banana industries	MT22002	RMCG	Building a People Development Strategy to guide future investment in building capacity and capability within a range of industries including potatoes	Multi fund including Fresh & Processing	12/12/2022 – 01/07/2023
Horticulture trade data	MT22005	IHS Global	Provides Hort Innovation with a subscription to the Global Trade Atlas Database.	Multi fund including Fresh & Processing	14/12/2022 – 01/12/2025

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ahr applied horticultural research

Hort Innovation POTATO – FRESH FUND

Hort Innovation POTATO – PROCESSING FUND

POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT