Hort Innovation

## Final Report

# Program approach for pest and disease potato industry investments

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**Delivery partner:**

RMCG

**Project code:**

PT17002

**Project:**

Program approach for pest and disease potato industry investments PT17002

**Disclaimer:**



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# Content

# Summary

The program approach for pest and disease potato industry investments was initiated in late 2018. Initial activity focused on introducing the program and its coordinators (Kristen Stirling and Doris Blaesing) to the potato industry. This included face to face meetings or telephone conversations with:

- Regional and sector specific associations
- The Communications Program Team at AUSVEG to discuss communication options to ensure delivery of regular content through their main communications channels
- The current potato Strategic Investment Advisory Panel (SIAP) to discuss the program approach and their expectations of the program
- Current research leaders to discuss program approach, their expectations of the program and how we can best work together.

These meetings assisted with the planning phase of the program to ensure the most effective delivery of Research and Development (R&D) outcomes to industry. Program activities were structured to ensure that:

- Industry is informed of pest and disease research outcomes
- Pest and disease R&D program is coordinated and collaborative
- Investment in potato pest and disease R&D program is effective and efficient.

An information flyer about the program was developed for wider distribution to the industry via AUSVEG Communications.

## Industry is informed of pest and disease research outcomes

Potato R&D Forums

Two R&D Forums were held in 2019 and 2021. The 2019 forum was held face to face in Melbourne and the 2021 forum was held online due to COVID travel restrictions. The Forums provided attendees with:

- The latest information on pest and disease research of relevance to the potato industry
- Case studies on how it is used or will be used in the industry
- An opportunity to provide feedback on future R&D priorities
- A chance to network with other industry members.

Each Forum featured presentations from:

- Researchers (both national and international)
- Service providers or growers who discussed their experiences with R&D outputs in the field
- Panels to discuss management of key endemic and exotic pests and diseases.

The 2021 Forum was recorded and posted online to inform those industry members who couldn't attend. The 2021 Forum can be viewed via this link:

Day 1 recording https://www.soilwealth.com.au/resources/webinar-recordings/potato-rd-forum-2021-day-1-recording/
Day 2 recording https://www.soilwealth.com.au/resources/webinar-recordings/potato-rd-forum-2021-day-2-recording/

Webinar

The coordinators liaised with McCains and the Soil Wealth/Integrated Crop Production team to deliver a webinar to McCain producers on biological products and advances in phosphorus nutrition for potato productivity which included:

- R&D project update: activities and resources for potato growers – Kristen Stirling, RMCG
- Activities and resources for potato growers from the Soil Wealth and Integrated Crop Protection Project VG16078 – Donna Lucas, RMCG
- Improving productivity via biological products and improved P availability – Michael Darling (AU) and David Hernandez (US), Nutrien
- How do you know biological products work? – Michael Rettke, SARDI.

The webinar was well attended by 20 growers plus field officers and agronomists. Feedback was positive, leading to a recording of the webinar being sent to individual potato growers. The webinar can be viewed via this link.

Regional Presentations

Updates on the pest and disease R&D program were provided by either Kristen Stirling or Doris Blaesing at:

- The South Australian potato annual industry update in Loxton, SA in October 2019
- A WA potato industry event in Manjimup, WA in March 2020
- Two soilborne pest and disease and biosecurity industry events in the Northern Adelaide Plains, South Australia, August 2019 and March 2021
- A soilborne pest and disease and biosecurity event in North-West Tasmania, August 2019
- A soilborne pest and disease and biosecurity event in Atherton, QLD in June 2021.

Prior to each regional presentation each of the research leads were contacted for an update on project progress and recent outcomes.

While not funded by the coordination project, a couple of activities by Doris Blaesing helped raise awareness of the program and its capabilities. These included:

- Providing updates on R&D outcomes for managing regionally important soil borne diseases as part of the AUSVEG led and funded biosecurity workshops1 in South Australia and Tasmania
- Assisting AUSVEG in developing the National Biosecurity Surveillance Plan for the Potato Industry - codesigning and delivering two major industry workshops in Melbourne and contributing to the content and industry focus of the strategy
- Contributing to a discussion between Hort Innovation, Simplot Australia and a Potato SIAP member on current knowledge and R&D needs for Pink Rot management in Australia.

Communication of research outcomes

A schedule was developed to ensure regular and ongoing contribution of articles from the R&D projects to the Potatoes Australia magazine. Whilst researchers were encouraged to provide additional articles at other times of the year and through other communication avenues, the schedule ensured there was a consistent flow of information from the research projects out to industry (via the primary industry magazine). The schedule was broadly aligned with the milestone outputs for each project.

When the Potatoes Australia magazine ceased to be published articles and outputs were communicated via:

- The AUSVEG weekly e-newsletter
- The Soil Wealth and Integrated Crop Protection project
- Directly to industry stakeholders.

[1] The biosecurity surveillance workshops were part of a DAW funded project delivered by PHA and AUSVEG to develop a national biosecurity surveillance strategy for the potato industry.

The project also communicated relevant international R&D resources such as the International Potato Congress (IPC) webinars.

Pest and disease management resources

Based on feedback from the SIAP and the Project Reference Group (PRG), the program coordinators developed three facts sheets on managing pink rot, black leg and powdery scab in potatoes. These fact sheets provide industry facing guidance on current R&D knowledge and best practice management. The fact sheets were reviewed by industry experts/researchers, desktop published and then sent to industry associations and stakeholders directly. They were also promoted via the AUSVEG weekly e-newsletter and housed on the AUSVEG and Soil Wealth/ICP website.

A global scan of international R&D focused on pests and diseases impacting on potato production was developed. The review identified current research projects conducted by a range of research organisations in five of the major potato producing regions in the world. Links within the report provide access to detailed information on these projects and available resources. Identification of some of the research that has been conducted in Australia on the pests and diseases mentioned in the scan is also provided. The scan was promoted via the AUSVEG weekly e-newsletter and is housed on the Soil Wealth/ICP website.

## Pest and disease R&D program is coordinated and collaborative

Research Project Lead Meetings

Collaboration between program researchers was facilitated through the delivery of annual meetings organized and chaired by the coordinators. These meetings provided an opportunity to discuss progress, outcomes, opportunities for collaboration and communication between the research projects. Based on the presentations provided and a review of recent milestone reports, an update on the program was developed and provided to industry members.

Researcher workshop

A workshop between Australian pest and disease researchers involved in the project, as well as those working for universities and government organisations, was organized in collaboration with the R&D Forum in 2019 to:

- Share project findings
- Identify outputs for extension to the potato industry
- Discuss next steps and challenges
- Identify R&D needs for the potato industry leading to the development of an integrated R&D plan.

## Investment in potato pest and disease R&D program is effective and efficient

Industry Liaison

Governance of the program and liaison with industry was facilitated through the development of a program reference group (PRG) which met every six months over the life of the program. Meetings with the PRG provided an opportunity for industry members to advise the coordinators on how to:

- Maximise industry engagement and value from the R&D Forum
- Best communicate R&D outcomes to industry
- Address pest and disease issues through R&D activity.

Presentations to the SIAP

The coordinators were asked to keep the SIAP informed on potato pest and disease activities, plans and challenges. This included several presentations to the SIAP during meetings held in 2018 and 2019. Over the last two years the SIAP has not met as regularly, and the coordinators were not asked to present on program progress.

## Keywords

Potato, pest, disease, biosecurity, research, development, communication, coordination, resource development.

# Introduction

This project has provided oversight and coordination of pest and disease R&D for the fresh and processing potato industries. The objectives were to:

- Facilitate a model of integrated research and collaboration between delivery partners
- Drive improvements in communication between stakeholders across all geographic regions, research projects and organisations
- Foster the uptake of pest and disease research outputs by end users using multiple channels of communication
- Ensure that the pest and disease management R&D program design is flexible enough to adapt existing research in Australia and overseas to maximise benefits to end users and be responsive to emerging research needs.

The Program Coordinators worked closely with Hort Innovation, the PRG, the research leads, industry associations such as AUSVEG and state-based bodies, and relevant external experts and extension projects/providers as required, in order to deliver on the above objectives.

# Methodology and Outputs

The achievements and outputs of the potato pest and disease R&D program are discussed below and framed according to the three key objectives which are that:

- Industry is informed of pest and disease research outcomes
- Pest and disease R&D program is coordinated and collaborative
- Investment in potato pest and disease R&D program is effective and efficient.

## Industry is informed of pest and disease research outcomes

### Potato Industry R&D Forums

Two R&D forums were held for the Australian potato industry focused on pest and disease management. The first was held face to face on the 26 June 2019 in Melbourne during the Hort Connections Convention. The second forum was held online (due to COVID restrictions) on the 29 and 30 July 2021. Further detail on the individual Forums is provided below.

### 2019 R&D Forum

As guided by the PRG the Forum was a half day event (9am – 2pm) and provided attendees with the opportunity to hear about recent research outcomes, learn management options for key pests and diseases, provide feedback on future RD&E needs and network. A booklet with a biography of each of the presenters and the R&D they were discussing was provided to attendees. Approximately 83 people attended the Forum representing a wide range of industry members such as growers, service providers, researchers, supply chain members and industry associations. The communication, approach and sessions for the Forum are discussed further in (Table 1).

**Table 1: 2019 Potato pest and disease R&D Forum**

| Aspect | Detail |
|---|---|
| **Forum Communication** | The Forum was advertised for a period of 8 weeks prior to the event via the AUSVEG weekly e-newsletter, the Potatoes Australia magazine, direct emails to agronomists and service providers, industry and state associations, extension projects such as Soil Wealth/Integrated Crop Protection and VegNET, the AUSVEG and RMCG websites and social media (Young Potato People Facebook, Twitter and LinkedIn). |
| **Forum Approach** | The program for the pest and disease forum included a mixture of research presentations, project updates, panels and facilitated discussion to provide attendees with current information using an engaging and interactive format. All presentations were limited to 10 minutes with time allowed at the end of each session for Q&A. Presentations focused on relevance to the potato industry and provided the 'So what does it mean on farm?'. Panel discussions were allowed up to an hour in length to allow for in-depth discussion of key issues.<br>The program was designed to provide information of relevance to the potato industry on a number of key pest and disease themes as outlined below. |
| **Sessions** | **Tomato Potato Psyllid**<br>This session explored the potential impact of TPP in Australia, what we can learn from the incursion of TPP in New Zealand and Western Australia, and how we best manage TPP and the risk of it spreading in the future. This session used a panel format where panel members were provided with 5 minutes to introduce themselves and their experience with TPP. Set questions provided by the panel moderator included: |

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| | How can growers and farm advisers contribute to managing the risk?<br>▪ How will we know if we have it?<br>▪ What will be the impact if we do get it?<br>▪ What can we learn from incursions in other areas?<br>▪ Why do we have a biosecurity levy and how does it work?<br>▪ What is the Owner Reimbursement Scheme?<br>▪ What are some of the other biosecurity pests we need to be aware of and what is being done to prevent exotic pests entering the country and those endemic in some areas moving? |
| | **Panel on TPP Management**<br>Panel members were invited based on their experiences with TPP incursions in other areas, current surveillance activities or research on TPP.<br>▪ Duncan McLeod (NZ Seed and Field Services) and Chris Claridge (Potatoes NZ)<br>▪ Paul Horne - IPM Technologies<br>▪ Alan Nankivell – TPP Coordinator<br>▪ Callum Fletcher – AUSVEG Biosecurity program manager<br>▪ Darryl Smith – WA grower (his was the first commercial farm detection)<br>Questions to the panel were invited from the audience. This topic generated a lot of questions and discussion by attendees and there is clearly confusion/concern around the risk of TPP, and potentially CLso spreading in Australia and how this would be managed. The main issues raised and discussed included:<br>▪ How the TPP outbreak was handled in WA and lessons learned for the handling of similar situations; of special concern was the lack of communication to industry (by regulators) leading to a high level of uncertainty and stress<br>▪ The make-up of the 'Eastern Block' and what the arrangements actually mean for growers<br>▪ The New Zealand TPP/CLso management approach and how it could work in Australia, given the federal system<br>▪ The lack of actual preparedness and vigilance on farms, i.e. responsibility for biosecurity is mostly seen as an issue for regulators, not individual businesses.<br>▪ Monitoring for TPP and CLso, methods and whether it is adequate<br>▪ The reluctance of growers and agronomists to report 'something unusual' given the potential short-term repercussions.<br>The discussion had to be cut short to be able to deliver the program in time and in full. It clearly showed that those present had many unanswered questions about TPP/CLso and biosecurity arrangements in general. |
| | **Managing Disease Risk**<br>This session highlighted how soil testing using the PredictaPT service can reduce risk and increase profitability. The session outlined the ever-widening range of diseases which can now be identified, how PredictaPT has been used to create disease maps in the paddock and discusses the interactions between beneficial and pathogenic soil organisms. Frank Mulcahy discussed how tools like PredictaPT has been used by Simplot to measure, map and monitor disease risk in the field. This was an interactive session with presentations from:<br>▪ Mike Rettke (SARDI)<br>▪ Frank Mulcahy (Simplot). |

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| | **Soil Health**<br>This session focused on how producers can improve their soil health in order to suppress diseases. This session featured:<br>▪ Carl Larsen (RMCG) discussing how tools and resources developed within the Soil Wealth and Integrated Crop Protection Project can benefit the potato industry<br>▪ Chad Hutchinson discussing how research in the US has demonstrated the benefits of good soil health in suppressing potato diseases. |
| | **Soilborne Diseases**<br>There is a significant volume of research occurring both in Australia and New Zealand to better understand common soilborne diseases affecting potato production and how producers can manage or reduce their impact. This session featured:<br>▪ Calum Wilson (TIA) discussing a new project investigating the infection of potato roots with powdery scab<br>▪ Richard Falloon (PFR-NZ) providing the key outcomes of research in NZ on powdery scab suppressive soils<br>▪ Tonya Wiechel (Agriculture Victoria) discussing common scab suppressive soils and powdery scab suppressive soils in NZ<br>▪ Mee-Yung Shin (Agriculture Victoria) on the outcomes of her PhD on Verticillium Wilt.<br>These presentations were followed by a panel session allowing forum attendees to ask specific management questions. |
| | **IPM Extension**<br>IPM Technologies have conducted on-farm demonstrations of how to manage potato pests using an integrated approach across Australia. A number of these demonstrations were facilitated with input from agronomists. Paul Horne/Jessica Page (IPM Technologies) and David Oddie (DJ Services) discussed the benefits, challenges and opportunities to using an IPM approach using experiences from this project and working with potato growers on Kangaroo Island. This discussion included an invitation for questions from the audience. |
| **The Future** | The program coordinators then invited attendees to identify the three pest and disease issues keeping them up at night and what they thought could be done about it. Attendees were provided with a summary of pest and diseases issues from the Strategic Investment Plan and APRP 1&2.<br>Attendees were asked to break into groups based on their location (state) and discuss these issues and solutions as a group and then report back to the whole forum. The key pest and disease issues identified by state are discussed in the report attached as Appendix 1. |
| **Forum Evaluation** | Attendees at the Forum were provided with an evaluation form to provide feedback on the Forum and their suggestions for the 2020 event. This feedback was to be used to design the 2020 event. In general, the feedback was very positive with attendees feeling they got value out of attending. |

### 2020 R&D Forum

Planning for the 2020 Forum involved extensive discussions with industry members, the SIAP and the PRG to determine the best options for communication of the pest and disease R&D program in 2020. Feedback from participants at the 2019 Forum and the PRG indicated a preference to hold the Forum in conjunction with Hort Connections (HC) again as this is the main industry event for horticulture facilitating high attendance at related events such as the Potato R&D Forum. However, given that HC was to be held in Brisbane in 2020 there was concern that attendance by members of the potato industry could be low. AuSPICA (seed potato certification organization) were intending to hold a conference in Melbourne in August 2020 and it was considered likely that a number of the potato researchers would be asked to present at this event. Given these considerations it was decided to not hold the Potato Industry R&D Forum in 2020 and focus on regional updates for the potato industry instead to ensure good reach and regional relevance, especially in key production areas. Given the impacts of COVID-19, the decision to focus on alternative communication avenues worked well.

*The budget provided to deliver the 2020 R&D Forum was refunded to Hort Innovation.*

### 2021 R&D Forum

The coordinators liaised with the PRG and other industry members to inform the design of the Forum for 2021. Based on feedback from the PRG, it was decided to hold the event online and stage it as two afternoon (3 hour) sessions. The forum provided participants with the opportunity to hear about recent research outcomes, learn management options for key pests and diseases, and have individual Q&A opportunities with researchers. Background reading material was sent out to participants prior to the forum. Approximately 150 people registered to attend the Forum with 88 participants attending the first session and 71 people attending the second session. Participants represented a wide range of industry members such as growers, service providers, researchers, supply chain members and industry association members.

**Table 2: 2021 Potato pest and disease R&D Forum**

| Aspect | Detail |
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| **Forum Communication** | The Forum was advertised for a period of 4 weeks prior to the event via the AUSVEG weekly e-newsletter, the Soil Wealth e-bulletin, social media and website, the VegNet e-updates, direct emails to agronomists and service providers, industry and state associations, the AUSVEG and RMCG websites and social media (Young Potato People Facebook, Twitter and LinkedIn).<br>The Forum was recorded and can be viewed at:<br>Day 1 recording https://www.soilwealth.com.au/resources/webinar-recordings/potato-rd-forum-2021-day-1-recording/<br><br>Day 2 recording https://www.soilwealth.com.au/resources/webinar-recordings/potato-rd-forum-2021-day-2-recording/<br>The recordings have been hosted on the Soil Wealth and ICP website and communicated to industry via the Soil Wealth e-bulletin, the AUSVEG weekly e-newsletter and emailed to all Forum participants. |
| **Forum Approach** | The program for the pest and disease forum included a mixture of research presentations, project updates, panels and facilitated discussion to provide attendees with current information using an engaging and interactive format. All presentations were limited to 10 minutes with time allowed at the end of each session for Q&A. Presentations focused on relevance to the potato industry and provided the 'So what does it mean on farm?'. Panel discussions were 30 minutes in length to allow for in-depth discussion of key issues. Breakout groups allowed participants to join just one presenter.<br>The program was designed to provide information of relevance to the potato industry on a number of key pest and disease themes as outlined below. |

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| **Day 1 Sessions** | **Seasonal Update**<br>An update on the key pest and disease issues was provided for each of the main production regions by:<br>▪ Sam Taylor (Nutrien) for Western Australia<br>▪ Allan Smith (Snackbrands Australia) for Queensland<br>▪ Josh Opas (McCains) for Victoria<br>▪ Stuart Millwood (Nutrien) for Tasmania<br>▪ Jack Westhuizen (E.E. Muir & Sons) for South Australia. |
| | **Precision Agriculture (PA) and potato production**<br>Ben Fleay and Greg Hall from Precision Agriculture presented information on EM38 soil survey and other PA techniques that help potato producers manage soil constraints and inherent spatial variability. |
| | ***Tamarixia triozae*: – a small parasitoid with a big future**<br>Sally Anderson from Market Access Solutionz discussed the release and monitoring trials they had conducted in New Zealand on the parasitoid *Tamarixia* and what impact this has had on TPP. |
| | **New smartphone technologies for pathogen detection**<br>This video developed by the Grains Research and Development Corporation (GRDC) highlighted research on technology developed in the USA to identify late blight in potatoes<br>This video can be viewed at: https://www.youtube.com/watch?v=3gPxXZKCVjE) |
| | **Emerging pests**<br>Callum Fletcher and Shakira Johnson from AUSVEG provided an update on:<br>▪ TPP and emerging pests of relevance to potato production<br>▪ the iMAP pest and disease monitoring project and what this means for the potato industry. |
| | **Crop protection products overview**<br>Tim Belleville from E.E. Muir & Sons provided an overview of trends in crop protection products and reviewed some recent products for the potato industry. |
| | **Panel Session**<br>All speakers were then invited to be part of a panel session on how new technology and products will help us manage pests and soil health. This provided participants with an opportunity to ask further questions of the speakers. |
| | **'Break out' sessions**<br>Each speaker then entered a 'break out' room and participants were invited to move into one of these rooms if they wanted to ask more detailed questions of any of the speakers. |
| **Day 2 Sessions** | **Promoting soil health**<br>Julie Finnigan from Serve-Ag presented the outcomes from recent research on biostimulants, biofumigants and other soil amendments and discussed how these can be used to improve soil health and marketable crop yield. |
| | **PREDICTA Pt**<br>Michael Rettke from SARDI provided an update on the PREDICTA Pt service and discussed how this service can be used to identify risks before they become a problem. |

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| | **Pink Rot**<br>Robert Tegg from the Tasmanian Institute of Agriculture provided an update on recent results from the R&D levy project on 'Investigating soil pH and nutrition as possible factors influencing pink rot in potatoes'. |
| | **R&D on potatoes in Tasmania**<br>Audrey Leo from Simplot outlined the research trials Simplot has been conducting in Tasmania to identify factors associated with pink rot development in potatoes and possible management options. |
| | **Powdery Scab**<br>Calum Wilson from the Tasmanian Institute of Agriculture provided an update and recent results from the R&D levy project on 'mechanisms and manipulation of resistance to powdery scab in potato roots'. |
| | **Panel**<br>All speakers were then invited to be part of a panel session on practical options and approaches for managing soil borne disease and promoting plant health. This provided participants with an opportunity to ask further questions of the speakers. |
| | **'Break out' sessions**<br>Each speaker then entered a 'break out' room and participants were invited to move into one of these rooms if they wanted to ask more detailed questions of any of the speakers. |
| **Forum Evaluation** | Participants at the Forum were emailed an evaluation survey at the end of the second session to provide feedback on the Forum and their priorities for future pest and disease R&D. This feedback has been collated and provided to Hort Innovation to inform future R&D projects. In general, the feedback was very positive with participants feeling they got a lot of value out of attending. |

### Pest and Disease R&D Communication

Meetings were held initially with the Potato Communications Program (managed by AUSVEG) to discuss opportunities to coordinate and promote potato R&D outcomes. Following the meeting, a schedule was developed to ensure regular and ongoing contribution of articles from the R&D projects to the Potatoes Australia magazine. Whilst researchers were encouraged to provide additional articles at other, additional times of the year, and through other communication avenues, the schedule ensured there was a consistent flow of information from the research projects out to industry (via the primary industry magazine). The schedule was broadly aligned with the milestone outputs for each project.

**Table 3: Articles from the pest and disease R&D program published in Potatoes Australia**

| Author | Edition | Title |
|---|---|---|
| Kristen Stirling | December/ January 2019 | Coordinating potato pest and disease R&D to benefit growers |
| Paul Horne | December/ January 2019 | Project Reflection: Two decades of integrated pest management |
| Alan Nankivell | February/ March 2019 | TPP business continuity arrangements in NSW, QLD, SA and VIC |
| Michael Rettke | April/May 2019 | Soil testing service continues to evolve for potato growers |
| Victoria Ludowici | June/July 2019 | Developing a plan to protect Australia's potato industry |
| Richard Falloon | October 2019 | Exploring *Spongospora* suppressive soils in potato production |
| Alan Nankivell | October 2019 | Know where TPP is and where it isn't: The 2018-19 edition |
| Kristen Stirling | October 2019 | Tackling the Australian potato industry's biggest issues (Potato R&D Forum) |

**Table 4: Links to the Potato Australia magazine editions**

| Edition | Weblink |
|---|---|
| December / January 2019 | https://ausveg.com.au/app/uploads/publications/Potatoes-December-January-2018_Web.pdf |
| February / March 2019 | https://ausveg.com.au/app/uploads/publications/PA%20Feb%20Mar%202019%20Web.pdf |
| June / July 2019 | https://ausveg.com.au/app/uploads/publications/AUSVEG_Potatoes-Australia_2019_October_Web-150DPI_F01v3.pdf |
| October 2019 | https://ausveg.com.au/app/uploads/publications/AUSVEG_Potatoes-Australia_2019_October_Web-150DPI_F01v3.pdf |

The communications program for potatoes concluded in 2019 with a final edition of the Potatoes Australia magazine published in October. However, several articles from the pest and disease program continued to be published and promoted via AUSVEG communication channels online and through the weekly e-newsletter. These included:

- Insights into *Spongospora* root diseases and its management (PT14002) https://ausveg.com.au/articles/insights-into-spongospora-root-diseases-and-its-management/
- Potato growers urged to test now to minimize soilborne disease risk (PT15008) https://ausveg.com.au/articles/potato-growers-urged-to-test-now-to-minimise-soilborne-disease-risk/
- Andrew Wilson: Planting the seed for identifying disease (grower profile) (PT15008) https://ausveg.com.au/grower-profiles/andrew-wilson-planting-the-seed-for-identifying-disease/
- Research on soils that suppress *Spongospora* root galling and powdery scab of potato (PT16002)

- https://ausveg.com.au/articles/research-on-soils-that-suppress-spongospora-root-galling-and-powdery-scab-of-potato/
- National TPP surveillance program delivers first season results (MT16009) https://ausveg.com.au/articles/national-tpp-surveillance-program-delivers-first-season-results/

The AUSVEG team also assisted in promoting several of the R&D extension products developed by the project. These included fact sheets on pink rot, powdery scab and blackleg management, the international scan of potato pest and disease R&D, and products from the research projects (such as the pest field guide developed by IPM Technologies). Examples included:

- Management of blackleg in potatoes: https://mailchi.mp/ausveg/ausveg-weekly-update-5glmaswav7-1057718?e=fe131d1c63.
- International R&D Scan: https://mailchi.mp/ausveg/ausveg-weekly-update-5glmaswav7-1057490?e=fe131d1c63.
- New R&D project on pink rot investigating soil pH and nutrition: https://mailchi.mp/ausveg/ausveg-weekly-update-5glmaswav7-1057322?e=fe131d1c63.

### Regional Presentations

A number of regional presentations were delivered as part of the program.

**Table 5: Updates on the pest and disease R&D program provided at regional events**

| Date | Region | Detail |
|---|---|---|
| October 2019 | South Australia | Kristen Stirling provided an update on the potato pest and disease R&D program at Loxton, South Australia. The update was provided as part of the Industry Update Day which is an annual event organized by SA Potatoes. Prior to the presentations, attendees visited Solan's Mini Tuber production facility at Waikerie. Attendees then traveled to Loxton for a range of R&D presentations. The event was well attended by a range of SA potato growers, service providers and researchers. Prior to the presentation, Kristen contacted each of the research providers individually to understand recent progress in the projects and relevant outputs. This information was delivered to industry in an engaging presentation followed by a Q&A session. |
| 23 August 2019 | South Australia and Tasmania | Doris Blaesing provided information on R&D outcomes from APRP2, with updated information where available, for managing regionally important soil borne diseases. This was part of AUSVEG led and funded biosecurity workshops in South Australia and Tasmania. The biosecurity surveillance workshops were part of a DAWE funded project delivered by PHA and AUSVEG to develop a national biosecurity surveillance strategy for the potato industry. The focus in SA was on common scab and blackleg, in Tasmania it was powdery scab, pink rot and blackleg. The relevant fact sheets and the international R&D scan were distributed during the workshops. |
| March 2020 | Western Australia | Kristen Stirling provided an update on the potato pest and disease R&D program in Manjimup, Western Australia. The update was provided as part of the AGM and industry dinner for Potatoes WA. The meeting was attended by a range of WA potato growers and service providers. Prior to the meeting Kristen also met with Rachel Lancaster (industry service provider) in Bunbury and Sam Taylor (agronomist) in Busselton to discuss the program and other industry related R&D. |

| Date | Region | Detail |
|---|---|---|
| | | Prior to the presentation, Kristen contacted each of the research providers individually to understand recent progress in the projects and relevant outputs. This information was delivered to industry in an engaging presentation followed by a Q&A session. |
| March 2021 | South Australia | A regional presentation and field walk was held on the 25 March in the Northern Adelaide Plains on integrated pest and disease management for potato and potato producers. This workshop was planned and co-delivered in collaboration with AUSVEG. It focused on pest and disease management with an emphasis on understanding conditions that foster pests and diseases, monitoring, data capture and diagnostics. It covered endemic and biosecurity pests and diseases of potatoes and potatoes. |
| June 2021 | Queensland | A field day for potato growers was held in near Atherton to update local growers on the R&D project and its outputs and discuss specific issues they are experiencing. A focus was on blackleg in potatoes because local growers had realised that this disease has been a problem over the past years based on this project's publication on blackleg in potatoes in the Potatoes Australia Magazine and the factsheet. The field day was initiated by a local grower who invited growers, agronomists, and local researchers to attend (about 20 people joined the field day). The event day also covered emerging pest threats, the need to report incursions and the owner reimbursement scheme explained by Calum Fletcher, Biosecurity Coordinator, AUSVEG. This was very relevant given incursions of Fall Army Worm and exotic Serpentine Leafminer, and because local growers feared that the blackleg symptoms, they observed was an incursion of a new strain of Late Blight which would have to be reported as an incursion. The well attended field day was appreciated given that the region and its specific challenges are often not considered because of the relatively low production volume. |

During 2020 it was planned to provide further regional presentations at the:

- AuSPICA conference in Melbourne in August 2020
- TIA field day at the Forthside Potato Research Station in October 2020.

No regional presentations were possible during August 2020 – February 2021 due to COVID-19 restrictions.

### Webinar

Discussions with Josh Opas (McCains) in 2020 identified the need and opportunity to deliver a workshop to local potato producers on a range of topics impacting on the health of potato producing soils, and pest and disease management. Due to COVID-19 it was decided to hold an online webinar instead of a face-to-face workshop. The coordinators worked with Josh Opas to identify the topics of interest and organized a number of speakers. The webinar focused on biological products for potato productivity and included:

- R&D project update: activities and resources for potato growers from this project and the Soil Wealth/ICP projects – Kristen Stirling and Donna Lucas, RMCG
- Improving productivity via biological products and improved P availability – Michael Darling (AU) and David Hernandez (US), Nutrien
- How do you know biological products work? – Michael Rettke, SARDI.

The webinar was well attended by McCain potato producers (approx. 20) and a recording of the webinar was put onto the Soil Wealth website; it can be viewed at: https://www.soilwealth.com.au/resources/videos-and-apps/biological-products-and-new-phosphorus-fertiliser-technology-for-potato-productivity/.

Audrey Leo from Simplot was approached regarding interest in running a similar event for Simplot growers on topics of interest (that are pest and disease related). While they were interested, it was necessary to wait until a less busy time of year (winter). The timing coincided with the planned 2021 R&D Forum so it was decided not to proceed with a separate event. The potato processing association (APPA) was also approached to identify if other members might be interested in a similar event.

### Pest and Disease R&D Factsheets

Information on management of key soilborne diseases ready for communication and extension from the APRP2 program was identified and recorded in word format during PT13013 (Extension Potential and Gap Analysis of Australian Potato Research) in 2014. Diseases covered by the APRP program and summarised for extension were: Powdery Scab, Common Scab Pink Rot, Rhizoctonia, Verticillium, Black Dot, Nematodes, Bacterial Wilt, PVY, TSWV, PVX. Almost none of the information from PT13013 has been communicated or extended to the potato industry. Discussions with the PRG and the SIAP confirmed the value of communicating this information to the potato industry.

Three fact sheets were developed for the Australian potato industry to assist in managing:

- Pink rot https://ausveg.com.au/app/uploads/2020/06/Pink-Rot-FINAL.pdf
- Powdery scab https://ausveg.com.au/app/uploads/2020/07/Powdery-Scab-FINAL.pdf
- Blackleg https://www.soilwealth.com.au/imagesDB/news/Blackleg2020-09-07FINAL.pdf

These fact sheets (Appendix 2, 3 and 4) were distributed directly to a range of growers, service providers and industry association across Australia. It was also published and promoted through AUSVEG communication channels.

### International Scan of potato pest and disease R&D

While the Program focused on the key pest and disease issues for Australian producers, it is important to maintain an awareness of the issues faced by producers in other countries and the current R&D occurring to assist industry in managing these issues. While Australia is currently free of several economically significant potato pests and diseases, recent biosecurity breaches have shown that Australian growers and the RD&E providers should be prepared.

During the development of the R&D program coordination role, the SIAP requested that the coordinators maintain a watching brief on international R&D activity on potato pest and disease management. Where there are similar problems, it may be possible to collaborate with researchers in other countries or learn from the outcomes of their projects to identify prevention and management options which could be used in Australia.

To meet this objective, the coordinators identified and reviewed pest and disease research currently occurring internationally in key potato production regions of relevance to the potato industry. The review identified relevant research projects conducted by a range of research organisations in five of the major potato producing regions in the world. Links within the report provide more detailed information on these projects and available resources. Identification of some of the research that has been conducted in Australia on the pests and diseases mentioned in the scan is also provided. The scan includes information on what the research findings mean in the Australian context**.** A copy of the scan is provided in Appendix 5.

## Pest and disease R&D program is coordinated and collaborative

At the commencement of the program, a Project Plan (including a Stakeholder Engagement Plan and Monitoring and Evaluation Plan) was developed to guide program activities.

State and sector associations were contacted to introduce the program approach and coordinators. Contact was made either face to face, by telephone or via email. Discussions focused on outlining the purpose, approach, and desired outcomes of the Program Coordination role. Expectations and opportunities for collaboration were also discussed.

To improve coordination and collaboration, annual meetings were organised and facilitated between the research project leads to discuss project progress, recent outcomes and opportunities for communication and collaboration.

**Table 6: Annual research leader meetings**

| Year | Purpose |
|---|---|
| 2019 | ▪ Getting to know projects currently focused on potato P&D management, and their project leads<br>▪ Understanding the scope of Program Coordination role<br>▪ Identifying opportunities for Industry Forum events<br>▪ Identifying opportunities for industry communication<br>▪ Establishing expectations. |
| 2020 | An online meeting was organised between the providers of the current potato pest and disease R&D projects to discuss project progress, recent outcomes and opportunities for communication and collaboration. All of the service providers were invited to the meeting. Alan Nankivell was unable to attend as his project was suspended during COVID-19. Paul Horne from IPM Technologies was also unable to attend.<br>Michael Lang, the new Hort Innovation R&D Manager for the potato pest and disease R&D program, was invited to attend and this provided an excellent opportunity for Michael to learn about the individual projects within the program and for the service providers to meet Michael.<br>Based on the presentations and discussions during this meeting, and review of recent milestone reports, an update on progress and outcomes from the program was developed and distributed to key industry associations and stakeholders (Appendix 6). |
| 2021 | An online meeting was organised between the providers of the current potato pest and disease R&D projects to discuss project progress, recent outcomes and opportunities for communication and collaboration. All of the service providers were able to attend.<br>Peter O'Brien, the new communication and extension coordinator for the potato industry was invited to attend the meeting. The purpose was to provide an overview of the new C&E program and to hear how the R&D projects are progressing.<br>Based on the presentations and discussions during this meeting, and review of recent milestone reports, an update on progress and outcomes from the program was developed and distributed to key industry associations and stakeholders (Appendix 7). |

## Research Workshop

In collaboration with the 2019 R&D Forum a facilitated workshop was held with researchers and service providers currently delivering pest and disease R&D of relevance to the Australian potato industry.

During the workshop, researchers currently delivering R&D funded by the R&D levy provided attendees with a presentation of project progress, key outputs to date and future steps. Other researchers working in the area of pest and disease management also provided an update of key activities related to the potato industry. There are a number of non-levy funded diagnostic and surveillance projects being conducted including:

- iMapPESTS
- Use of loop-mediated isothermal amplification (LAMP) to detect Potato spindle tuber viroid on-site
- Surveillance of CLso distribution
- Surveillance on distribution and identification of the potato mop-top virus in New Zealand – potential to use diagnostic test from the United States.

Attendees at the workshop included Tonya Wiechel (Agriculture Victoria), Dolf de Boer (Agriculture Victoria), Chris Claridge (Potatoes NZ), Callum Fletcher (AUSVEG), Paul Taylor (The University of Melbourne), Mee-Yung Shin (The University of Melbourne), Alan Nankivell (AUSVEG), Phil Frost (Peracto), Brendan Rodoni (Agriculture Victoria), Kathy Ophel-Keller (SARDI), Alieta Eyles (TIA), Calum Wilson (TIA), Cathy Todd (SARDI), Richard Falloon (PFR-NZ), Mike Rettke (SARDI), Ian Kirkwood (Potatoes NZ), Jane Wightman (Hort Innovation).

Following the presentations, attendees were invited to form small groups to discuss key pest and disease issues facing the potato industry and how we might develop a more integrated RD&E program to address these issues. The outcomes of this discussion were presented in the document 'R&D priorities for pest and disease management in the Australian potato industry' (Appendix 1).

## Investment in potato pest and disease R&D program is effective and efficient

The effectiveness of the potato pest and disease R&D program was facilitated by regular liaison with industry members to ensure the program was focused on providing maximum value and responsiveness to industry needs. Liaison occurred regularly in an informal manner with industry association members and growers. Two formal avenues for industry liaison included:

- A Program Reference Group (PRG)
- The Strategic Investment Advisory Panel (SIAP) for the Australian potato industry.

**Program Reference Group meetings**

A PRG for the program was formed and managed using a Terms of Reference (TOR). Over the life of the program five meetings were held.

### Table 7: PRG meetings

| Timing | Purpose |
|---|---|
| February 2019 | The first PRG meeting focused on getting to know the PRG members and outline how they would guide the program. This meeting was also a great opportunity to seek input from the group on what topics they would like included in the Potato R&D Forum and how they would like this information delivered. |
| August 2019 | The second meeting sought feedback from the group on the 2019 Potato R&D Forum and how the 2020 Forum could be delivered. |
| January 2020 | The January 2020 meeting discussed options for communication of R&D outcomes in 2020 and how this could be best achieved. This included seeking confirmation to produce factsheets and deliver regional presentations instead of a R&D Forum in 2020. |
| August 2020 | During the meeting the coordinators updated the PRG members on progress and activities within the program over the last six months and discussed plans for communication and coordination over the next six months of the program. Given the ongoing impacts of COVID-19 options for online workshops and webinars were discussed as an option for communication of pest and disease R&D outcomes. |
| April 2021 | PRG members were updated on progress and activities within the program over the last six months, plans for communication and coordination over the remaining six months of the program was also discussed. PRG input into the design of the 2021 R&D Forum was also sought. |

**Presentations were made to the SIAP as discussed below**

The coordinators were asked to keep the SIAP informed on potato pest and disease activities, plans and challenges. This included a number of presentations to the SIAP during meetings held in 2018 and 2019. Over the last two years the SIAP has not met as regularly, and the coordinators were not asked to present on program progress.

**Table 8: Presentations made to the SIAP on the pest and disease R&D program**

| Date | Purpose |
|---|---|
| November 2018 | A presentation was made to the SIAP on the program role, coordinators, and suggested activities. The presentation was also an opportunity to understand the expectations of the SIAP and how the program might work towards achieving these expectations. |
| May 2019 | This presentation focused on informing the panel about activities, approaches, plans and challenges. Issues to resolve that have been brought to the SIAPs attention have been:<br>▪ Managing the project portfolio – it is not clear how new projects in pest and disease management/biosecurity are going to be brought into the portfolio. The process has not been defined with Hort Innovation<br>▪ One objective is to ensure the development and delivery of an Integrated Pest and Disease Management R&D Program for potato production systems. However, it is not clear how the coordinators should communicate identified RD&E priorities (e.g. from the R&D meeting and the Forum) to Hort Innovation and the SIAP.<br>Another issue discussed with the SIAP was the fate of outputs from APRP2. They had been summarised ready for extension in 2012. |
| November 2019 | The presentation covered:<br>▪ Delivery of the R&D Forum including feedback from participants and PRG<br>▪ Costs associated with delivery of R&D Forum and Service Provider Meeting<br>▪ Program update provided in South Australia<br>▪ R&D priorities for the Australian potato industry (based on priority setting session held during R&D Forum). |

# Outputs

The key outputs of the coordination program have been:

- Facilitation of ongoing meetings between research project leads to identify communication and extension opportunities and promote collaboration between projects
- Presentations to the SIAP on program performance and opportunities
- Formation and ongoing management of a PRG
- Delivery of two well attended Potato R&D Forums
- Identification of future R&D priorities for pest and disease management in the Australian potato industry
- Coordination and delivery of articles for the Potatoes Australia magazine
- Regional presentations of the pest and disease R&D program outcomes to WA, SA, TAS and QLD potato industry
- Development and distribution of three pest and disease management fact sheets
- Webinar for McCain potato producers
- Development and distribution of review of international pest and disease R&D for potatoes

# Outcomes

The key outcomes of the pest and disease R&D program are:

- Increased awareness by the Australian potato industry of pest and disease research of relevance and how this information might apply to their business; this covered levy funded, non-levy funded and international R&D
- Increased awareness of biosecurity threats, activities by researchers and service providers and resources to help preparedness and control in case of incursions
- Improved collaboration between researchers and service providers currently conducting research of relevance to the Australian potato industry and a better understanding of the activity in this area
- Improved connection and coordination between research activity and outputs and the potato industry
- An understanding of RD&E needs in the areas of pest and disease management and biosecurity in the potato industry.
- Effective engagement and communication of pest and disease R&D with the Australia potato industry
- Furthering of good networks and relationships with state and national peak industry bodies, researchers, service providers, agribusinesses, agronomists, and individual growers.

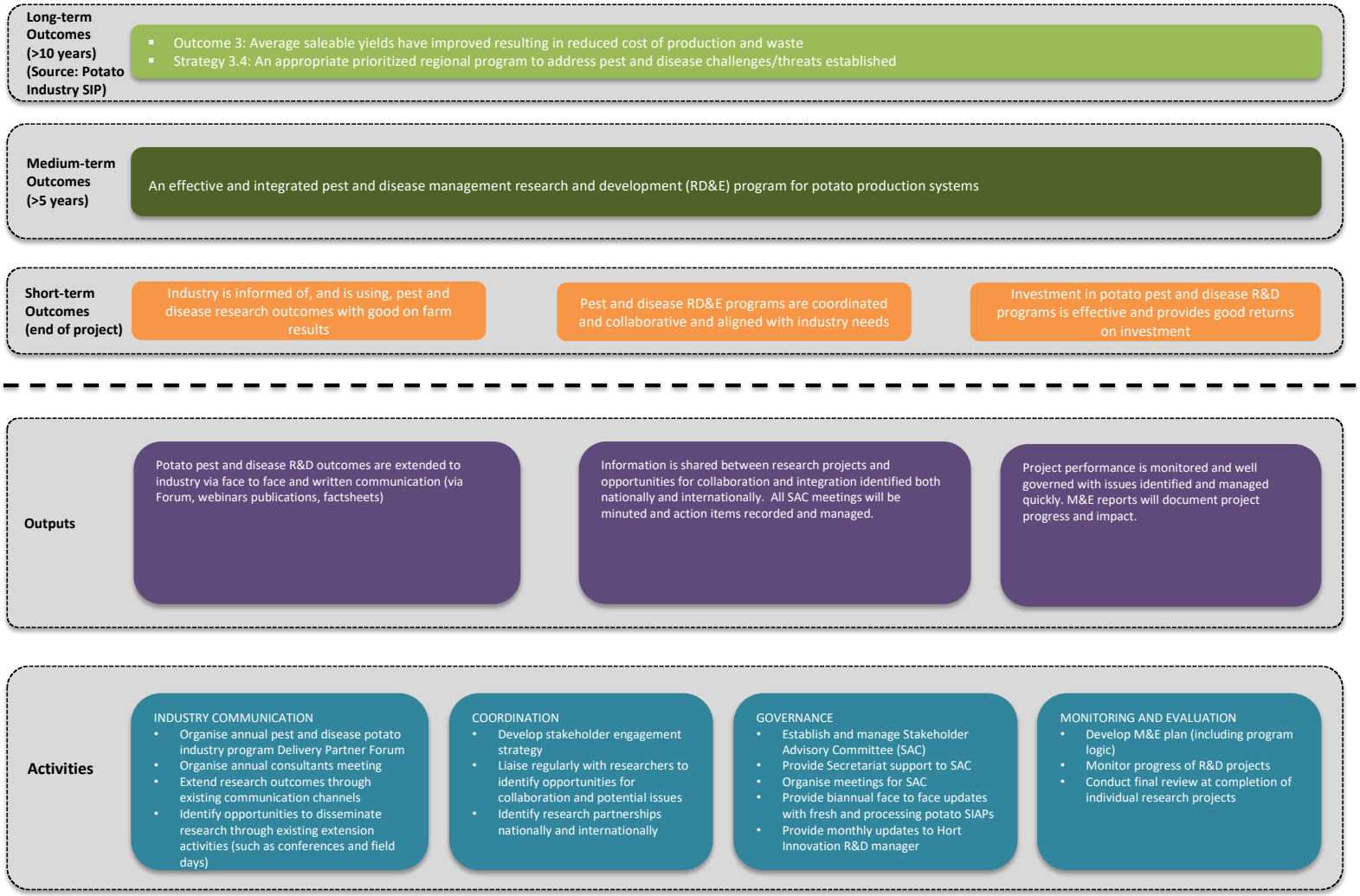
# Monitoring and evaluation

The program logic for Program Approach for Pest and Disease Potato Industry Investments is outlined in Figure 1 below.

The program logic forms the high-level framework for the delivery of the Program and governs the subsequent MERI framework, based on the hierarchy and connection between:

- Activities: undertaken from August 2018 to August 2021.
- Outputs: results that will be delivered by the end of the program
- Short-term outcomes (measured at end of the program): directly influenced by the program, including the following:
    1) Industry is informed of, and using, pest and disease research outcomes with good on-farm results
    2) Pest and disease RD&E programs are coordinated and collaborative and aligned with industry needs
    3) Investment in potato pest and disease R&D programs is effective and provides good returns on investment.
- Medium-term outcomes (>5 years): impacts of the program on potato industry RD&E with the next decade
- Long term outcomes (> 10 years): long-term impacts of the program, aligned to Australian Fresh and Processing Potato Industry Strategic Investment Plan.

## PT17002: Program Approach for Pest and Disease Potato Industry Investments



Performance expectations, including indicators and measures, were set to assess the performance of the project in achieving its intended outcomes. The Key Performance Indicators (KPIs) for the outputs and outcomes of the program are described in (Table 9).

**Table 9: Achievement of stated KPIs**

| Logic level | Performance expectation (KPI's) | Achievement |
|---|---|---|
| Activities | ▪ Regular and ongoing liaison with project leads<br>▪ PRG meetings held every six months<br>▪ Program updates provided to SIAPs biannually<br>▪ Three final reviews of R&D projects<br>▪ Regular and ongoing review of potato R&D<br>▪ Milestone reports provided every six months | ▪ Liaison with project leads completed.<br>▪ PRG meeting held every 6 months.<br>▪ Program updates provided to SIAP when possible and invited. Potato SIAP did not meet regularly during 2020 and 2021.<br>▪ Final reviews of R&D projects not completed at request of HI manager.<br>▪ Ongoing review of potato R&D completed.<br>▪ Milestone report provided every six months. |
| Outputs | ▪ Three annual industry forums<br>▪ Three annual researcher meetings<br>▪ One R&D article provided per edition of PA magazine<br>▪ R&D opportunities are identified and acted upon. | ▪ Two annual industry forums held. Third forum not held due to COVID and requests from industry to focus on regional presentations in 2020, which were held.<br>▪ Three annual researcher meetings held.<br>▪ Articles provided to PA magazine on a regular basis when operating or through other means when magazine not being published.<br>▪ R&D needs identified. |
| Short-term outcomes | ▪ Industry and research community feel that R&D is collaborative and responsive to industry needs<br>▪ Greater awareness by 50% of potato industry of pest and disease R&D and how this can be used on-farm<br>▪ Potato SIAP feel that investment is effective and generating a good ROI | ▪ Achievement of short-term outcomes need to be assessed through independent evaluation at conclusion of program.<br>▪ General feedback from industry and PRG has been very positive regarding delivered outputs. This has been evidenced through evaluation surveys of forums. |
| Medium-term project outcomes | ▪ Changes to on-farm practices<br>▪ Increased reputation of potato pest and disease R&D | ▪ To be assessed after conclusion of program. |

**Table 10: Response to key evaluation questions**

| Question | Response |
|---|---|
| **Effectiveness** | |
| 1. To what extent has the project achieved its expected outputs and outcomes? | Expected outputs and outcomes have been achieved as detailed in Table 8 above. |
| **Relevance** | |
| 2. How relevant was the project to the needs of industry? | Project was very relevant to the needs of industry. There is an ongoing interest and need for pest and disease related R&D in the potato industry. |
| **Process appropriateness** | |
| 3. How well have key stakeholders been engaged in the project? | Key stakeholders have been engaged well in the project. This has been evidenced by effective PRG, SIAP and industry engagement and input into the program and its outputs. It has also been shown by high levels of attendance at program events such as the R&D Forums and regional meetings. |
| 4. To what extent was the coordination process appropriate to the target audience/s of the project? | Coordination processes were highly appropriate as evidenced by the effective liaison between the program, the researchers, industry and the PRG and SIAP. |
| **Efficiency** | |
| 5. What efforts did the project make to improve efficiency? | The program coordinators regularly communicated with industry members to identify opportunities to improve efficiencies. This is particularly evident with the decision to not hold an R&D Forum in 2020 based on advice from the SIAP. The funds allocated to hold the 2020 forum have been returned to Hort Innovation. |
| **Impact** | |
| 6. What impact will the program approach to pest and disease investments have on industry? | The program has achieved the key short-term outcomes of:<br>▪ Informing industry of pest and disease research outcomes<br>▪ Coordinating pest and disease RD&E programs<br>▪ Ensuring investment in potato pest and disease R&D programs is effective and provides good returns on investment.<br>The impact on industry of achieving these short-term outcomes will need to be assessed on farm at the conclusion of this project. |

# Recommendations

During the project, it became evident that there is a lack of strategic pest, disease and weed management R&D for the potato industry. The projects appeared to be mostly reactive, i.e., dealing with problems rather than dealing with risks and prevention using a coordinated integrated crop protection approach.

Based on our experience in R&D delivery and coordination, and our understanding of the Australian potato industry we provide the following recommendations on how R&D should be delivered in the future. These include:

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

These recommendations are discussed in further detail below.

## Understanding the case for investment

R&D in soil and plant health is important for delivering economic, environmental, and social sustainability outcomes for the potato industry. It contributes to food security, and human nutrition and health. The following points underpin the importance of investing in R&D in this area:

1. The risks of crop losses to pests, weeds and diseases if not adequately controlled is high and consequences can affect the entire value chain
2. The costs of plant health and crop protection management are high
3. Plant protection products (PPPs) have the potential to cause environmental or health issues if not used appropriately
4. Incursions of exotic pests, diseases or weeds can have serious economic consequences
5. New production methods, technologies, and production inputs (e.g., biological products) need to be tested under the diverse Australian conditions
6. Climate change can affect the industry in many ways including via soil and plant health impacts.
7. Government policies and regulations, deregistration of PPPs and international phytosanitary requirements may impact on soil and crop health management options.

## Understanding the pest and disease threats and opportunities for the Australian potato industry, and the delivery of R&D

The soil and plant health threats facing the Australian potato industry, and the R&D community, are outlined in the table below.

| Threats | |
|---|---|
| **Industry** | **R&D** |
| ▪ Market pressure requiring balance between profit maximisation and intensification<br>▪ Future economic viability of industry - increased costs (e.g. labour) and price pressures | ▪ Silo approach to R&D which lacks integration and collaboration<br>▪ Competition for limited R&D funds<br>▪ Decreased capacity in undertaking of R&D due to retirements and deployments |

| Threats | |
|---|---|
| ▪ Continued use of old technology and practices<br>▪ Conflicting market demands including changes in market and consumer requirements<br>▪ Changes in market access rules e.g. MRLs and regulation (e.g. environmental issues)<br>▪ Lack of whole industry approach with minimal collaboration<br>▪ Lapse in biosecurity with introduction of new pests/diseases/weeds in different regions<br>▪ Poor or slow responsiveness to acute issues<br>▪ Loss of current 'simple' field control e.g. resistance, product deregistration<br>▪ Minimal capability to develop integrated methods without R&D<br>▪ Not embracing new technologies e.g. precision agriculture. | ▪ Lack of agronomic skills to integrate R&D into potato productions systems<br>▪ Reluctance to build on current knowledge<br>▪ Inability or reluctance to change the way R&D is undertaken<br>▪ Lack of involvement of whole industry including service providers. |

Some key issues for the potato industry associated with plant health and crop protection include:

- Increasing levels of regulation concerning the use of chemical pesticides
- Expectations of growers to use integrated pest management
- Pressure from markets demanding 'chemical-free' foods
- Consumers' growing concerns about health and environmental issues due to chemical pesticides requiring consideration of alternatives.

The soil and plant health opportunities facing the Australian potato industry, and the delivery of R&D, are outlined in the table below.

| Opportunities | |
|---|---|
| **Industry** | **R&D** |
| ▪ Increasing use of new technologies and Integrated Crop Protection (ICP)<br>▪ Aligning industry focus on risk management, good decision making and long-term profitability of ICP<br>▪ Consideration of the entire production system and focus on economics of these systems<br>▪ Improvements in practices and technologies e.g. spray technology, resistance management<br>▪ Positive culture developing towards use of innovative methods and implementation of IPM/ICP – 'time is right'<br>▪ Influence of younger farmers with education<br>▪ Increased potential for training and capacity building<br>▪ Interest by consumers and markets in ICP<br>▪ Need for biosecurity measures and protection of industry<br>▪ Strong industry representation | ▪ Integrated, coordinated research program<br>▪ Potential to integrate R&D with a focus on extension and route to market<br>▪ Inclusion of economic analysis and market needs in R&D programs<br>▪ Potential to utilise service providers and consultants to inform and support R&D and industry to use new technologies and ICP<br>▪ Increased relevance of applied research including regional demonstration and participatory research approach (linking with growers and supply chain)<br>▪ Collaborative utilisation of existing R&D structures and substantial knowledge base<br>▪ Potential to link with other RDC's, international organisations and regional bodies (e.g. NRM bodies, SW/ICP program)<br>▪ Potential to foster/mentor students |

The analysis of the current position and future threats has highlighted areas for improvement in relation to plant and soil health and crop protection R&D for the Australian potato industry. These include:

- Consideration of the whole potato production system rather than aspects or disciplines (e.g. pests, weeds and diseases) in isolation and the understanding of the associated complexity which affects decision making processes on-farm
- Consideration of the complexity of the industry with a wide range of crops, growing environments, business sizes, structures, and profitability, different networks, supply chain partnerships, alliances, skills, knowledge, attitudes, expectations and other attributes
- Generation and utilisation of knowledge for the industry through R&D (old and new) and the requirement to focus on the needs of growers and the supply chain
- Consideration of the potato business as a whole and as part of a supply chain including business and market analysis rather than just the agronomic aspects
- Integration of relevant disciplines in the undertaking of R&D to include economics and market understanding
- Inclusion of all industry participants such as agronomists, seed companies, agribusiness, advisors and crop protection companies
- Improving the skills of all industry participants including service providers through training and regional demonstration
- Improving the capacity for delivering multidisciplinary, collaborative research and development
- Fostering education and training of industry members and R&D providers, current and upcoming
- Reforming the means for and approach to determining R&D priorities and delivering on industry needs under consideration of external drivers (economics, markets, policies).

## Developing a strategic and coordinated plan for delivery of future R&D

### Approach

A well-coordinated, collaborative, and participatory national approach to soil and plant health and crop protection R&D should be developed that:

- Responds to market failure
- Commits to move along the ICP/IPM continuum (from adhering to regulations to fully applied ICP)
- Considers economic and market imperatives
- Is flexible enough to deal with emerging and acute issues efficiently
- Focuses on adoption of known and newly developed technologies
- Continuously improves through the plan-do-review cycle (incorporating planning and evaluation)
- Commits to capacity building in industry and the R&D community.

### Delivery

R&D projects delivered as part of this approach should:

- Align with the Strategic Investment Plan
- Have clear goals and include evaluation of outcomes i.e. documentation of changes in knowledge, practices or conditions, both technically and economically to enable cost: benefit analyses of R&D.
- Focus on outcomes on farms and or the supply chain, remembering that outputs, i.e., communication pieces, do not necessarily achieve outcomes without adequate extension and adoption support
- Be technically correct, building on the latest knowledge and avoiding duplication, this includes but may not be limited to:
    - Getting advice from technical experts and preventing researchers from conducting trials that are not within their area of expertise (e.g., pathologists designing crop nutrition or irrigation trials)

    - Ensuring that synergies are recognised and used to get better outcomes.
- Include review of project plans and progress against plans to ensure that projects are efficient and keeping on task, with a focus on achieving KPIs as planned
- Cooperation between R&D and communication, extension, and adoption projects

## Objectives

The objectives for an R&D investment plan should be:

- Understanding key pest, weed and disease risks for major potato production systems from the view of those who must manage them and their prioritisation including economic considerations
- Application and development of technologies and management practices that identify, quantify and reduce risks in production systems
- Increasing the capacity of industry to make well-informed decisions about integrated management practices through concerted extension that include economic information and consider market pressures
- Targeted, coordinated R&D investment decisions and programs, with effective extension being part of the program planning and delivery
- Improving feedback mechanisms on the efficacy of R&D programs and R&D needs through making evaluation a part of R&D programs.

## Priorities

Review of relevant national documents and discussion with industry members and researchers over the last three years have identified the following priority pest (insects and diseases) for the Australian potato industry:

- Powdery scab (need to understand why it's an issue in some areas more than others, develop tools to manage it, and work with industry to Minimise its impact)
- Black leg (disease complex)
- Zebra chip (CLso)/Tomato potato psyllid (TPP)
- Nematodes (further information is required to extend control options).

The key opportunities identified during consultation were:

## Biosecurity

- Improving Australia's biosecurity preparedness for pests such as TPP through developing a national response plan, greater surveillance, and collaboration/learning from other countries such as New Zealand who are already managing this pest.
- Managing pest incursions through better forecasting particularly in view of climate change and greater unpredictability of weather conditions.
- Improving surveillance and diagnostic ability to detect, monitor and manage pests through the development and application of new technology such as:
    - Automated 'smart' traps for rapid detection and early warning of pests
    - Loop-Mediated Isothermal Amplification (LAMP) and Next Generation Sequencing (NGS) for rapid identification of pests
    - Decision support tools such as CropScout app

## Integrated management

- Increasing the uptake of an integrated (IPM) approach to insect and weed management (particularly in view of increasing resistance to key chemical groups or deregistration of products) and focusing on:
  - Improved soil health (through controlled traffic, organic amendments, better root health)
  - Understanding pathogen/root interactions and mechanisms of resistance
  - New technology such as iRNA as an alternative control method.
- Up-skilling service providers/agronomists (their knowledge needs to be spread across a range of crops to help increase the benefit to the industry. Due to the distance between and isolation of growers, information exchange can be difficult).
- Improving seed quality (by addressing the gap between growers and the seed scheme, communicating/extending current guidelines and harvest protocols better, and providing better 'care' for seed once it leaves the paddock).

Common issues that could also be addressed include:

- Seed potato quality and supply chain management / traceability
- Soil health management in general (compaction, loss of carbon and soil life)
- Herbicide resistance especially for ryegrass and wild radish
- Apathy towards better biosecurity (farm hygiene) management despite the threat of TPP, fall army worm and leaf miner

Crop management by leading growers that could be promoted in the potato industry through collaboration with the Soil Wealth and Integrated Crop Protection project include:

- Use of cover crops
- Use of biological products / bio-pesticides
- Use of compost
- Change in crop nutrition e.g., using more liquids and higher quality fertilizers as part of crop/site specific approaches
- Application of precision agriculture approaches for nutrition and drainage management.

# Refereed scientific publications

No refereed scientific publications have been developed as part of this project.

## Intellectual property, commercialisation and confidentiality

No project IP, commercialisation or confidentiality issues to report.

# Appendices

Appendix 1: Identification of future R&D priorities for pest and disease management in the Australian potato industry

Appendix 2: Powdery scab fact sheet

Appendix 3: Pink Rot fact sheet

Appendix 4: Blackleg Factsheet

Appendix 5: International R&D Scan

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Appendix 7: 2021 R&D Program Update

RMCG

AUGUST 2019

# Research and development priorities for pest and disease within the potato industry.

Potato pest and disease program

Hort Innovation

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# Summary

The coordinators of the potato pest and disease R&D program were asked to identify the future priorities for an integrated research and development program that will address the key pests (insects, weeds and diseases) impacting the Australian potato industry.

Review of relevant national documents and discussion with industry members and researchers have identified the following pest (insects and diseases) of main concern:

- Powdery scab (need to understand why it's an issue in some areas more than others, develop tools to manage it, and work with industry to minimise its impact)
- Black leg (disease complex)
- Zebra chip (CLso)/Tomato potato psyllid (TPP)
- Nematodes (further information is required to extend control options).

A comprehensive list of the high priority pests identified in the national documents and during industry consultation are detailed in Figure 1-1 (on next page). The key opportunities identified during consultation were:

**Biosecurity**

- Improving Australia's biosecurity preparedness for pests such as TPP through developing a national response plan, greater surveillance and collaboration/learning from other countries such as New Zealand who are already managing this pest.
- Managing pest incursions through better forecasting particularly in view of climate change and greater unpredictability of weather conditions.
- Improving surveillance and diagnostic ability to detect, monitor and manage pests through the development and application of new technology such as:
  - Automated 'smart' traps for rapid detection and early warning of pests
  - Loop-Mediated Isothermal Amplification (LAMP) and Next Generation Sequencing (NGS) for rapid identification of pests
  - Decision support tools such as CropScout app.

**Integrated management**

- Increasing the uptake of an integrated (IPM) approach to insect and weed management (particularly in view of increasing resistance to key chemical groups or deregistration of products) and focussing on:
  - Improved soil health (through controlled traffic, organic amendments, better root health)
  - Understanding pathogen/root interactions and mechanisms of resistance
  - New technology such as iRNA as an alternative control method.
- Up-skilling service providers/agronomists (their knowledge needs to be spread across a range of crops to help increase the benefit to the industry. Due to the distance between and isolation of growers, information exchange can be difficult).
- Improving seed quality (by addressing the gap between growers and the seed scheme, communicating/extending current guidelines and harvest protocols better, and providing better 'care' for seed once it leaves the paddock).

Further details on the R&D priorities identified are presented in this report.

| | | NATIONAL | | | REGIONAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SARP REPORT | POTATO BIOSECURITY GROWER MANUAL AND PLAN* | SIPS | SA | TAS | VIC | NSW | WA | QLD |
| Diseases | Bacterial soft rot - Post harvest Erwinia spp | ✓ | | | | | | | ✓ | |
| | Common scab - Streptomyces scabies | ✓ | | | | | ✓ | ✓ | | |
| | Irish (Late) blight - Phytophthora infestans (new pathotypes) | ✓ | ✓ | | | | | | | ✓ |
| | Pink rot - Phytophthora erythroseptica | ✓ | | ✓ | | ✓ | | | | |
| | Powdery scab - Spongospora subterranea | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | Rhizoctonia rot / Black Scurf - Rhizoctonia solani | ✓ | | ✓ | | | | | | |
| | Sclerotinia rot - Sclerotinia sclerotiorum & S.minor | ✓ | | ✓ | | ✓ | | | | |
| | Silver scurf - Helminthosporuim solani | ✓ | | | | | | | | |
| | Target spot / Early Blight - Alternaria solani | ✓ | | | | | | | | |
| | Bacterial wilt (Ralstonia solanacearum) | | ✓ | | | | | | | |
| | Black dot - Colletotrichum coccodes | | | | | ✓ | | | | |
| | Black leg – Dickyea and Pectobacterium spp. | | | | ✓ | ✓ | ✓ | | | ✓ |
| | Zebra chip (CLso) / Tomato Potato Psyllid (TPP) | | ✓ | | ✓ | ✓ | | ✓ | ✓ | |
| | Potato spindle tuber viroid (PSTVd) | | ✓ | | | | | | | |
| | Potato virus Y | | | ✓ | | | ✓ | ✓ | | |
| | Tomato spotted wilt virus (TSWV) | | | ✓ | | | | | | |
| | Potato leafroll virus | | | | | | ✓ | | | |
| Insects | Black field cricket - Teleogryllus commodus | ✓ | | | | | | | | |
| | Australian mole cricket - Gryllotalpa australis | ✓ | | | | | | | | |
| | Redlegged earth mite – RLEM - Halotydeus destructor | ✓ | | | | | | | | |
| | Whitefringed weevil - Naupactus leucoloma | ✓ | | | | | | | | |
| | African black beetle Heteronychus arator | ✓ | ✓ | | | | | | | |

| | | NATIONAL | | | REGIONAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SARP REPORT | POTATO BIOSECURITY GROWER MANUAL AND PLAN* | SIPS | SA | TAS | VIC | NSW | WA | QLD |
| | Cluster caterpillar | | ✓ | | | | | | | |
| | Potato tuber moth | | ✓ | | | | | | | |
| | Colorado potato beetle | | ✓ | | | | | | | |
| | Serpentine leaf miner, Vegetable leaf miner, American serpentine leaf miner, potato leafminer. | | ✓ | | | | | | | |
| | Black bean aphid, Cotton aphid, melon aphid, black peach aphid, green peach aphid, potato aphid. | ✓ | ✓ | | | | | | | |
| | Pale potato cyst nematode, golden potato cyst nematode, root knot nematode. | | ✓ | | | ✓ | ✓ | | | |
| Weeds | Amaranths - Amaranthus spp | ✓ | | | | | | | | |
| | Blackberry nightshade - Solanum nigrum | ✓ | | | | | | | | |
| | Fat hen - Chenopodium album | ✓ | | | | | | | | |
| | Fleabane Conyza spp | ✓ | | | | | | | | |
| | Marshmallow - Malva parviflora | ✓ | | | | | | | | |
| | Nut sedge / Nutgrass - Cyperus rotundus | ✓ | | | | | | | | |
| | Pigweed - Portulaca oleracea | ✓ | | | | | | | | |
| | Thistles carduus spp | ✓ | | | | | | | | |
| | Sowthistle - Sonchus oleraceus | ✓ | | | | | | | | |
| | Spear thistle - Cirsium vulgare | ✓ | | | | | | | | |
| | Stemless thistle - Onopordum acaulon | ✓ | | | | | | | | |
| | Tumbleweed / Russian Thistle - Salsola australis | ✓ | | | | | | | | |
| | Turnip weed - Rapistrum rugosum | ✓ | | | | | | | | |
| | Wild radish - Raphanus raphanistrum | ✓ | | | | | | | | |

**Figure 1-1: High priority pests (diseases, insects and weeds) identified in national documents and by state (during industry consultation)**

* Biosecurity pests, weed and diseases are either endemic in certain regions or exotics i.e. not in the country.

# 1 Introduction

The coordinators of the potato pest and disease R&D program were asked to identify the future priorities for research and development activities that will address the key pests (insects, weeds and diseases) impacting the Australian potato industry.

To identify these priorities, relevant national industry documents/plans that have already identified key pests through consultation with industry were reviewed. These documents included:

- The Strategic Agri-chemical Review Process report (2017)
- The Strategic Investment Plans for the fresh and processing industry
- The National Biosecurity Plan for the Australian potato industry.

An issue and R&D priority setting session with industry members who attend the Potato R&D Forum in June 2019 was facilitated by the national coordinators. Attendees were divided into groups based on their geographical location to identify the pests (and potential solutions) that were of greatest importance to their state.

Researchers conducting R&D on pests and diseases of relevance to the Australian potato industry were also asked to identify what they thought were the main research priorities facing the potato industry during a meeting held in June 2019.

The information from the national plan review and the outcomes of the facilitated workshops were analysed to develop the key priorities provided in this document.

The key audience for the feedback is Hort Innovation and the potato SIAPs.

# 2 National R&D priorities

There are a number of national plans for the Australian potato industry which list, amongst other things, the high priority pests (insects, diseases and weeds) that are currently, or potentially in the future, impacting industry profitability. The key issues identified have been developed from consultation with industry members and help to set the direction of future R&D activity to mitigate and manage these pests.

To identify future R&D priorities we reviewed the three national plans discussed below and aligned this information with the regional issues identified during the facilitated workshops.

## 2.1 STRATEGIC AGRICHEMICAL REVIEW PROCESS (SARP)

The SARP identifies diseases, insect pests and weeds of major concern to the Australian potato industry. Against these threats, available registered or permitted pesticides, along with non-pesticide solutions, are evaluated for overall suitability in terms of IPM, resistance, residues, withholding period, efficacy, trade, human safety and environmental issues. Where tools are unavailable or unsuitable the process aims to identify potential future solutions. Any potential new risks to the industry are also identified.

The results provide the potato industry with a clear outlook of gaps in existing pest control options. The SARP report is not a comprehensive assessment of ALL pests and control methods of potatoes but attempts to prioritise the major problems. The SARP occurred in 2006 with an update and revision occurring in 2016.

The pest, weed and disease considered to be a high priority to the Australian potato industry during the SARP are identified in Table 2-1 below.

**Table 2-1: High priority insects, diseases and weeds for the Australian potato industry**

| DISEASES | INSECTS | WEEDS |
|---|---|---|
| Bacterial Soft Rot - Post harvest *Erwinia* spp. | ▪ African Black Beetle - *Heteronychus arator.* | Amaranths - *Amaranthus* spp. |
| Common Scab - *Streptomyces scabies.* | Aphids<br>▪ Black Peach Aphid - *Brachycaudus persicae*<br>▪ Green Peach Aphid - *Myzus persicae*,<br>▪ Potato Aphid - *Macrosiphum euphorbiae.* | Blackberry Nightshade - *Solanum nigrum.* |
| Irish (Late) Blight - *Phytophthora infestans.* | Crickets<br>▪ Black Field Cricket - *Teleogryllus commodus*<br>▪ Australian Mole Cricket - *Gryllotalpa australis.* | Fat Hen - *Chenopodium album.* |
| Pink Rot - *Phytophthora erythroseptica.* | Potato Moth / Potato Leafminer - *Phthorimaea operculella.* | Fleabane *Conyza* spp. |
| Powdery Scab - *Spongospora subterranean.* | Redlegged Earth Mite – RLEM - *Halotydeus destructor.* | Marshmallow - *Malva parviflora.* |
| Rhizoctonia Rot / Black Scurf - *Rhizoctonia solani.* | Whitefringed Weevil - *Naupactus leucoloma.* | Nut Sedge / Nutgrass - *Cyperus rotundus.* |
| Sclerotinia Rot - *Sclerotinia sclerotiorum & S.minor.* | | Pigweed - *Portulaca oleracea.* |

| DISEASES | INSECTS | WEEDS |
|---|---|---|
| Silver Scurf - *Helminthosporuim solani.* | | Thistles *Carduus* spp<br>▪ Sowthistle - *Sonchus oleraceus*<br>▪ Spear Thistle - *Cirsium vulgare*<br>▪ Stemless Thistle - *Onopordum acaulon.* |
| Target Spot / Early Blight - *Alternaria solani.* | | Tumbleweed / Russian Thistle - *Salsola australis.* |
| | | Turnip Weed - *Rapistrum rugosum.* |
| | | Wild Radish - *Raphanus raphanistrum.* |

## 2.2 POTATO BIOSECURITY GROWER MANUAL AND PLAN

The Potato Industry Biosecurity Plan is developed in consultation with an Industry Biosecurity Group (IBG), a select group of plant health and biosecurity experts. The IBG is coordinated by Plant Health Australia and included representatives from AUSVEG, relevant state/territory agriculture agencies and research organisations.

A key role of the IBP is the completion of the Threat Summary Tables (TST), a list of more than 70 exotic plant pests and the potential biosecurity threat that they represent to the potato industry. Each pest is given an overall risk rating based on four criteria; entry, establishment, spread potential and economic impact. Through this process, and further consultation, the highest priority pests are identified and highlighted for possible future research activity, surveillance, on-site biosecurity and awareness activities.

The highest priority pests (both exotic and established) for the Australian potato industry identified during the development of the biosecurity plan are listed in Table 2-2.

**Table 2-2:High priority insects and diseases (both exotic and established in some regions) for the Australian potato industry**

| EXOTIC INSECTS AND DISEASES | ESTABLISHED INSECTS AND DISEASES |
|---|---|
| Colorado potato beetle. | African black beetle. |
| Serpentine leaf miner, Vegetable leaf miner, American serpentine leaf miner. | Green peach aphid. |
| Black bean aphid, Cotton aphid, melon aphid. | Tomato potato psyllid. |
| Zebra chip. | Cluster caterpillar. |
| Late blight (A2 mating type). | Potato tuber moth. |
| Pale potato cyst nematode. | Bacterial wilt. |
| Root knot nematode. | Golden potato cyst nematode. |
| Potato spindle tuber viroid (PSTVd) (exotic strains). | Potato spindle tuber viroid (PSTVd). |

## 2.3 STRATEGIC INVESTMENT PLANS FOR THE AUSTRALIAN FRESH AND PROCESSING POTATO INDUSTRIES 2017 – 2022

The Strategic Investment Plans (SIPs) developed for the Australian fresh and processing potato industries are the roadmaps that guide Hort Innovation's oversight and management of individual levy industry investment programs. The SIPs lay the foundation for decision making in levy investments and represents the balanced interest of the potato industry. The very important function of the SIPs is to make sure that levy investment decisions align with industry priorities.

The SIPs are informed by an industry consultation process which identify the priorities of the Australian potato industry. In relation to pest and disease the key strategies identified in the SIPs to manage risks and realise opportunities are outlined in Table 2-3.

**Table 2-3: Strategies, Risks and Opportunities listed in the Australian potato SIPs relating to pest and disease**

| | LISTED IN SIP |
|---|---|
| Strategies | ▪ "Invest in R&D, extension and marketing activities that deliver crop production, pest and disease management sustainability improvements and address the everyday needs of industry".<br>▪ "Integrate precision ag, integrated pest management (IPM) and soil health as core elements of the potato extension program".<br>▪ "Establish appropriate, prioritised R&D and extension programs for highly rated pest and diseases" – involve agronomists as key information providers".<br>▪ "Establish an appropriate prioritised regional program to address pest and disease challenges/threats".<br>▪ "Integrate IPM as a core subject area in the regional field days program".<br>▪ "Expand pest trapping program and develop national response plan and biosecurity manual for psyllid (TPP) and other threats (as per Tasmania)".<br>▪ "Encourage use of PreDicta Pt and support R&D to extend application to pink rot and PCN".<br>▪ "Review current soil surveillance systems".<br>▪ "Initiate project with chemical companies to gain a better understanding of chemical efficacy and compatibility of active ingredients". |
| Risks/Issues | ▪ "Biosecurity risks and pest and disease incursions".<br>▪ "Pest and disease pressures/load".<br>▪ "Shift from chemicals to genetics by global 'AgChem/Life Science' companies to control pest and disease".<br>▪ "Changed pest and disease profile" due climate change.<br>▪ "The performance of seed, for vigour and disease resistance and use of not certified seed, as well as seed handling and storage".<br>▪ "A large part of the reduced and variable yield problem is due to persistent pests and disease issues, which vary by region and season. They also limit which markets growers can trade into for biosecurity reasons. It is therefore critical that the industry has adequate responses to those that pose the biggest challenges".<br>▪ "IPM has proven to be a powerful and cost-effective tool in pest and disease control, which is not used as widely as it could be. Relying on agronomists to transfer this particular knowledge maybe problematic when many are incentivised to sell chemicals, so multiple communication strategies will be required". |

| | LISTED IN SIP |
|---|---|
| Opportunities | ▪ "To take advantage of the world's best scientific knowledge in potato agronomy and pest and disease management".<br>▪ "New technology, pest and disease management and new business models and other ideas that have been proven overseas".<br>▪ "Losses from pest and disease are reduced, resulting in improved quality and increased marketable yield".<br>▪ "Continued work on the pest and disease challenges prioritised in PPAA member survey:<br>  ▪ Powdery scab<br>  ▪ Pink rot<br>  ▪ Potato virus Y<br>  ▪ Rhizoctonia and also<br>  ▪ Sclerotinia<br>  ▪ Tomato spotted wilt".<br>▪ "Soil health issues have been identified as a major contributor to reduced yield and the PreDicta Pt has proven to be a powerful diagnostic tool. This tool now needs to be expanded to cover other diseases and geographic areas (and potentially viruses). Its application to PCN could provide important evidence for area freedom" - "Current soil surveillance systems need reviewing".<br>▪ "Tank mix interaction between chemicals and compatibility of active ingredients requires more work and consultation with chemical companies". |

# 3 R&D priorities for pest and disease management identified by industry members (by state)

During the Potato Industry R&D Forum held on the 26 June 2019 in Melbourne, industry members were asked to identify the three pest and disease issues keeping them up at night and what they thought could be done about them. Attendees were asked to break into groups based on their location (state) and discuss these issues and solutions as a group and then report back to the whole forum. The key pest and disease issues identified by state are shown in Table 3-1.

**Table 3-1: Key insects and diseases by state**

| PEST / DISEASE | SA | TAS | VIC | NSW | WA | QLD |
|---|---|---|---|---|---|---|
| Black dot | | ✓ | | | | |
| Black leg | ✓ | ✓ | ✓ | | | |
| Common scab | | | ✓ | "Scab" | | |
| Late blight | | | | | | ✓ |
| Leaf roll | | | ✓ | | | |
| Nematodes | | ✓ | ✓ | | | |
| Potato virus Y | | | ✓ | ✓ | | |
| Pectobacterium | | | | | | ✓ |
| Pink rot | | ✓ | | | | |
| Powdery scab | ✓ | ✓ | ✓ | "Scab" | ✓ | |
| Sclerotinia | | ✓ | | | | |
| Soft rots – Erwinia | | | | | ✓ | |
| TPP/CLso | ✓ | Is a threat | | ✓ | ✓ | |
| Viruses | ✓ | | | | | |

Additional comments regarding pest and disease management for the Australian potato industry are provided in Table 3-2.

**Table 3-2: Pest and Disease R&D Priorities by state**

| STATE | COMMENT |
|---|---|
| South Australia | ▪ Biosecurity – needs to be greater resources, education and management, as well as a greater focus on grower profitability.<br>▪ Greater succession planning research, and access to this information.<br>▪ There needs to be greater access to independent research.<br>▪ Fertiliser management – independent nutrition trials. |
| Tasmania | ▪ TPP is a serious threat to the industry. There needs to be more collaboration with areas that have already been affected by it such as New Zealand and Western Australia.<br>▪ Climate variability – unseasonable conditions are becoming more frequent – there needs to be greater forecasting.<br>▪ Nematodes are an issue, especially in dry seasons. Chemical drought. Literature review required to extend control options.<br>▪ There needs to be global collaboration to address all issues. |
| Victoria | ▪ Greater education on 'getting the basics right' - including soil health and nutrient/water management on farm, and inputs vs outputs.<br>▪ Interaction between pathogens.<br>▪ Plant/soil health.<br>– Nutrition<br>– Bio-stimulants<br>– Biocontrol.<br>▪ There is increasing fungicide resistance – to combat this there needs to be greater industry education on the usage of chemicals and IPM. As well as this, there should be a survey on potential chemical resistance. |
| New South Wales | ▪ Potato virus Y is a problematic issue and relates directly to seed quality. Along with this, scab is also a reoccurring problem for growers.<br>▪ Lack of trained agronomists.<br>▪ Water access and water use efficiency.<br>▪ Good, consistent, and reliable labour. |
| Western Australia | ▪ TPP – develop a best management plan.<br>▪ Biosel – comms – regulatory approach.<br>▪ 'Stitching' is an issue – it leaves bad blemishes.<br>▪ Powdery scab – mainly in the northern growing areas.<br>▪ Variable seed outcomes – there's a gap between growers and the seed scheme.<br>▪ Doris' manual is very good, but needs communication.<br>▪ Summer harvest protocols for seed producers - WA has done a manual for this. |
| Queensland | ▪ The skillsets and knowledge of agronomists and service providers needs to be increased. Their knowledge needs to be spread across a range of crops to help increase the benefit to the industry. Due to the distance between and isolation of growers, information exchange can be difficult.<br>▪ Disease expression due to the environment, and differing seasons, can be quite different to southern seasons and must be addressed accordingly.<br>▪ *Pectobacterium* is increased through humidity, temperature, and seasonally (mainly through winter). There needs to be better knowledge and resources on this to educate growers.<br>▪ Late Blight – this can happen under some conditions. Although a rare occurrence, greater knowledge of this disease would be beneficial, as well as more resources to help with management.<br>▪ There is a risk of disease-infected material coming into Australia, which may become problematic without control methods in place. |

# 4 R&D priorities for pest and disease management identified by researchers

A meeting was held on 25 June between researchers currently conducting pest and disease R&D projects relevant to the Australian potato industry. During the meeting attendees were asked to identify what they considered to be the key priorities for R&D in the future. The responses are provided in Table 4-1.

**Table 4-1: Future R&D priorities for pest and disease management as identified by researchers**

| PRIOTIY | COMMENTS |
|---|---|
| Weed management | ▪ There is currently a strong reliance on group C herbicides.<br>▪ There needs to be increased integrated management of weeds and increased integrated pest management across all production systems.<br>▪ RNAi: Technology applied as an alternative to chemical treatments. |
| Powdery scab | ▪ Understand why it's an issue in some areas more than others.<br>▪ Develop tools to try and manage it.<br>▪ Work with industry to try and minimise its impact. |
| Pink rot | ▪ There's still a heavy reliance on Metalxyl for pink rot management. There needs to be a more integrated approach towards management. |
| Soil health and management | ▪ Improve soil health practices - drainage, etc.<br>▪ Focus on seed tuber health.<br>▪ "Yield gap" (productivity) – what are the causes?<br>▪ Holistic approach to major pathogens using:<br>– Biocontrol's<br>– Controlled traffic<br>– Soil additives (bio-stimulants)<br>– Organic amendments<br>– Focus on root growth<br>– Pathogen interactions and understanding mechanisms of resistance (the use of potato genetics as a tool). |
| TPP/CLso | ▪ Plant surveillance must be increased.<br>▪ Native Liberibacters (critical for diagnostics). |
| Diagnostics/forecasting | Better disease screen tools for breeders, researchers and the industry. Potential to conduct further research and extension on new technology such as:<br>▪ RNAi (to reduce impact of pests who have developed resistance to chemicals<br>▪ Rapid detection tools (automated traps)<br>▪ Rapid diagnostic tools (NGS and LAMP)<br>▪ Rapid decision-support tools. |
| Greater education and collaboration particularly with international partners (i.e. NZ) who have insight into means of control and prevention would benefit the industry. | |

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# MANAGING THE RISKS OF POWDERY SCAB IN POTATOES

This guide is based on current knowledge on management of powdery scab, highlighting key factors that affect the risks of this disease and opportunities for effective disease management.

## WHAT IS POWDERY SCAB?

Powdery scab is caused by *Spongospora subterranea*. This pathogen can survive for long periods in the soil (greater than 10 years). The pathogen is both seed tuber and soil borne. Disease development and the severity of symptoms vary depending on a range of factors, including inoculum levels in soil or on seed tubers, soil and atmospheric conditions, cropping history, and potato cultivar.

The disease can cause major losses of marketable yield from fresh market potato crops, and substantial rejections in processing for French fries or crisp production. Tubers with powdery scab lesions are also susceptible to other diseases. The scab lesions can be infection points for other pathogens, and powdery scab has been implicated in increasing susceptibility to tuber late blight (*Phytophthora infestans*), pink rot (*Phytophthora erythroseptica*), dry rot (*Fusarium caeruleum*) and tuber rot caused by *Colletotrichum atramentarium*.


**Figure 1.** *Spongospora subterranea galls on stolon*

## WHAT DOES IT LOOK LIKE?

- *Spongospora subterranea* can form small white to dark brown growths (galls) on potato roots and stolons. (see Figure 1 left)
- Cankers may deform tubers.
- Scabs on tubers erupt to disperse a fine powder of spores leaving ragged edged scabs. (see Figure 2 right)
- Non-erupting scabs may develop surrounding areas of discoloured tuber tissue which is variable in size.
- Depending on temperature and progeny, tuber scabs may take 6 to 8 weeks to develop, and may not be evident in growing crops.
- Common scab and powdery scab lesions look similar. Common scab lesions tend to be more corky in appearance and angular in shape, and can be raised or pitted.


**Figure 2.** *Ragged edged scabs on tuber*

## FACTORS THAT ENCOURAGE SPONGOSPORA INFECTIONS

Potato crops are especially susceptible to powdery scab;

- During the tuber initiation phase of crop growth
- When temperatures are between 9°C and 17°C (optimum is approx. 12°C)
- When soils are wet
- In poorly drained soils (due to compaction, soil pans or over-working).


*Ragged edged scabs on skin of tuber*


*Spongospora subterranea galls on stolons*

## SPONGOSPORA LIFE AND DISEASE CYCLE

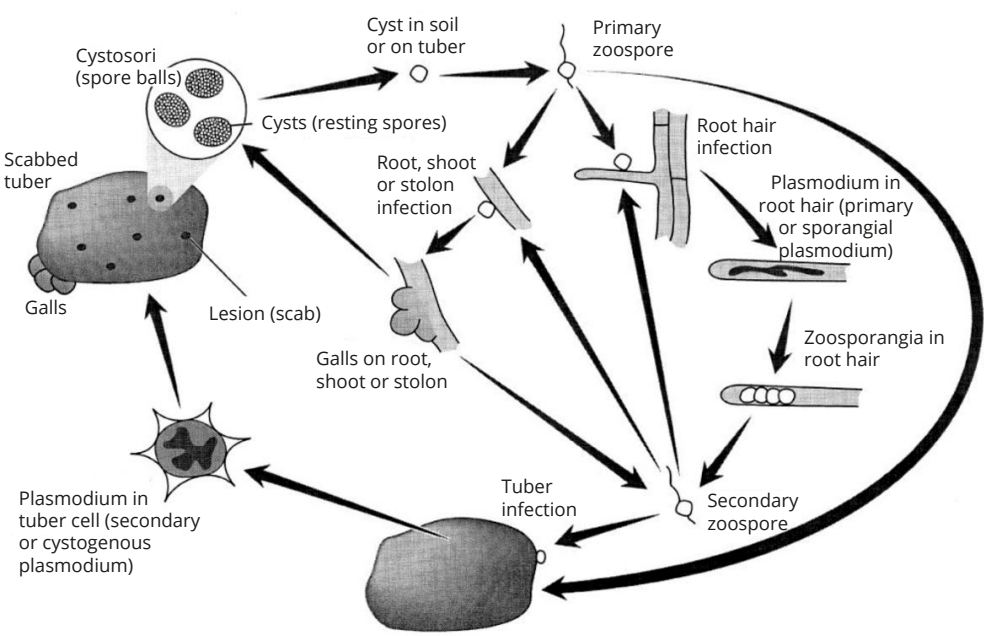


**Figure 3.** *Diagram of the Spongospora subterranea life and disease cycle. [Harrison JG, Searle RJ, Williams NA, 1997. Powdery scab disease of potato – a review. Plant Pathology 46, 1–25.]*

## HOW CAN THE RISK OF POWDERY SCAB BE REDUCED?

### SITE SELECTION AND FARM HYGIENE

**Risks**

- Previous field history of powdery scab.
- Volunteers.
- Solanaceous weeds.
- Poor drainage.
- Rotation.

**Actions to manage the risk**

- Consider paddock disease history when developing a rotation plan. Use PreDicta® Pt DNA testing to assess risks from pathogen levels in the soil.
- Avoid short rotations (less than 5 years) between potato crops.
- Control volunteers and weeds to minimise pathogen build-up.
- Plant at soil temperatures above the optimum (12°C) for infection. This results in rapid plant growth and less chances for infection.
- Plant high risk crops (based on varieties or market) on uncontaminated and well-drained land.
- Use uninfected, certified seed tubers.
- Do not transfer soil from paddock to paddock.
- Do not allow contractors and visitors with dirty machinery, shoes and vehicles onto paddocks.

### SOIL CONDITIONS

**Risks**

- Cold, wet soils (particularly at tuber initiation).
- Soil compaction.
- Excessive cultivation/tillage.

**Actions to manage the risk**

- Avoid soils that are compacted (>2,000 kPa with a penetrometer at field capacity), and try to contol traffic through paddock.
- Use of elemental sulphur (S) and maintaining zinc (Zn) at the upper end of its soil range have reduced powdery scab in the Ballarat region of Central Victoria.
  - » Results with Zn applications have been highly variable. Routine soil testing will indicate whether Zn fertiliser applications may help. High levels of phosphorus can reduce Zn uptake.
  - » Caution with S use is required as applications may cause nutrient imbalances and significant decreases in soil pH.
- Biofumigation using mustards has shown positive results when combined with less susceptible cultivars and clean seed tubers.
- Drain paddocks that have large areas prone to water logging.
- Ensure good seed beds to promote rapid and even plant emergence.
- More information on good soil management can be found at www.soilwealth.com.au

## HOW CAN THE RISK OF POWDERY SCAB BE REDUCED?

### CROP GROWTH

**Risks**

- Protracted tuber initiation periods in cold soils containing either seed or soil inoculum.
- Over irrigation and/or poor drainage during tuber initiation.

**Actions to manage the risk**

- Manage nutrition appropriately.
- Schedule irrigation correctly to avoid water logging and water stress (especially during tuber initiation).
- Be aware that the risk of powdery scab will increase after excessive rainfall.
- Planting tubers at shallow depth in the ridges may help reduce risk, as do other practices that encourage rapid plant emergence.
- Monitor soil moisture and keep it below field capacity (FC) during tuber initiation. If water runs from soil after irrigation or can be squeezed out of a soil sample, the soil is above FC.

### POTATO GRADING

**Risk**

- Inoculum can contaminate grading lines and be transmitted to subsequent healthy seed tuber lines, which could infect the subsequent crop.

**Actions to manage the risk**

- Wash and evaluate samples of all seed tuber lines intended for grading to assess whether they are infected.
- Grade seed tubers before fresh market lines. Give priority to higher seed grades.
- Wash/disinfect grading lines at appropriate times during grading and between lines/crops.
- Fully wash down and disinfect grading lines at the end of each season (at least).
- Removing infected tubers from seed lines does little to diminish the risk for remaining tubers, as resting spores will contaminate remaining tubers.

### CULTIVAR/VARIETY

**Risk**

- Highly susceptible cultivars.

**Actions to manage the risk**

Check cultivar resistance to powdery scab with your seed tuber supplier.

- Knowing cultivar resistance ratings for powdery scab along with intended market tolerances can help with paddock selection and crop management (esp. irrigation).
- Resistant cultivars can be used to reduce occurrence and severity of powdery scab. However, in seasons conducive to disease development, cultivar resistance will have reduced impacts.
- Refer to the research paper written by Genet *et al*. which provides a list of over 130 cultivars and their resistance/susceptibility to powdery scab.

### STORE HYGIENE

**Risk**

- Dust in potato stores can be contaminated with *Spongospora* inoculum. This can be transmitted on to clean tubers in poorly cleaned stores (e.g. by forklift traffic).

**Actions to manage the risk**

- Ensure strict store hygiene is in place with your seed supplier.

### MARKET

**Risk**

- Markets with zero tolerance for powdery scab, e.g. for particular seed export or fresh/ware potato markets.

**Actions to manage the risk**

- Check your customer/intended market tolerance to powdery scab levels. Use low risk land for markets with tight tolerances.
- Wash seed tuber samples and inspect as required.

### CHEMICAL CONTROL

- In the USA and New Zealand, fluazinam can be used for powdery scab control. In Australia, this chemical is only registered for control of late blight and *Sclerotinia* in potatoes.
- Do not use unregistered pesticides or use pesticides for uses not specified on the labels. Always follow label instructions.

### SEED TUBER HEALTH

**Risk**

- Infected seed lines, particularly when planted in uncontaminated land.

**Actions to manage the risk**

- Use certified disease-free seed tubers when planting into uncontaminated land.

## REFERENCES AND FURTHER RESOURCES


- Potato Growers' Biosecurity Manual (2018) https://www.farmbiosecurity.com.au/wp-content/uploads/2019/06/Potato-Growers-Biosecurity-Manual.pdf
- Prof Calum Wilson (TIA, UTAS) discussing powdery and common scab - video https://youtu.be/ryHPrvWcF8o
- Falloon, R.E., Merz, U., Butler, R.C., Curtin, D., Lister, R.A., Thomas, S.M., 2016. Root infection of potato (Solanum tuberosum) caused by Spongospora subterranea: knowledge review and evidence for decreased plant productivity. Plant Pathology 56, 422–434. https://bsppjournals.onlinelibrary.wiley.com/doi/full/10.1111/ppa.12419
- Genet, R., Paget, M., Braam, F., Falloon, R., 2017. Susceptibility of potato cultivars and breeding lines to powdery scab in New Zealand: updated results from 25 years of field evaluations. Potato Research 60, 208–210. http://www.spongospora.ethz.ch/SA_2014/docus/day2/2nd%20Int%20PScab%20Workshop%203_%20Genet%20et%20al.pdf
- 2013 Potato PreDicta® Pt manual (ed. M Rettke, SARDI) [provided as part of Predicta® Pt Training/Accreditation Course]


A number of relevant final reports can be found on the AUSVEG website (https://ausveg.com.au/infoveg/infoveg-database/) and the Hort Innovation website (https://www.horticulture.com.au/delivery-partners/resources-for-delivery-partners/research-reports-and-more/).


1996 PT303 Epidemiology and control of powdery scab in potatoes
https://ausveg.com.au/app/data/technical-insights/docs/PT303.pdf

2003 PT96032 Influence of rotation and biofumigation on soil-borne diseases of potatoes
https://ausveg.com.au/app/data/technical-insights/docs/PT96032.pdf

2004 PT98018 Cleaning and disinfestation strategies on farms
https://ausveg.com.au/app/data/technical-insights/docs/PT98018.pdf

2008 PT04001 Understanding the implications of pastures on the management of soil-borne diseases of seed potatoes
https://ausveg.com.au/app/data/technical-insights/docs/PT04001_complete.pdf

2014 PT09039 (https://ausveg.com.au/app/data/technical-insights/docs/PT09039.PDF) which includes the following APRP2 programs: PT09026- Soil health disease mitigation program, PT09026A(i) - Soil amendments and nutrients, PT09026(ii) - Impact of rotations, PT09019 - Comparison between DNA testing and visual methods for assessing seed tuber health

2018 PT14002 Spongospora infection of potato roots – ecology, epidemiology and control
https://ausveg.com.au/app/uploads/technical-insights/PT14002v2.pdf


## ACKNOWLEDGEMENTS


This factsheet has been adapted from:

- Managing the risk of powdery scab (2007) Mark Prentice, Rob Clayton, Jeff Peters and Stuart Wale. British Potato Council
- A review of knowledge gaps and compilation of R and D outputs from the Australian Potato Research Programs (2015) Kevin Clayton-Greene. Horticulture Innovation Australia (https://ausveg.com.au/app/data/technical-insights/docs/pt13.PDF).





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*Phytophthora erythroseptica*

# MANAGING PINK ROT IN POTATOES

Pink rot is a soil-borne disease caused by the pathogen *Phytopthora erythroseptica*. This fact sheet provides information on the pathogen, its lifecycle and management options.

## MANAGEMENT OPTIONS

Use the following options to help manage pink rot:

- Use Metalaxyl and Metalaxyl-M (mefenoxam)* according to label instructions
- Keep soil moist (between field capacity and above wilting point) but without excess moisture.
- Use the PreDicta Pt service to identify areas that are infected with the pink rot pathogen
- Avoid planting into soils that are compacted (> 2000 kPa with a penetrometer) and/ or waterlogged. Consider using controlled traffic and/or minimum tillage practices to improve soil condition.
- Remove all volunteers and weeds that can act as potential hosts.
- Avoid mixing tubers from contaminated areas with other tubers during storage or better still avoid harvest of contaminated tubers.
- Rotate potatoes with other crops (for at least 4 years)
- Use clean, certified seed.

## POTENTIAL MANAGEMENT OPTIONS

Research has shown that:

- Biofumigants such as mustards can be effective. Biofumigants should be used according to best practice advice.
- Low soil pH (<5) in the rootzone and low levels of free calcium in the soil solution may increase pink rot severity.[1] Liming and soil application of soluble calcium fertilisers may alleviate this risk (by increasing the pH and the soluble calcium). Further research is required to better understand this relationship.

Photo: Jordan Eggers, Oregon State University

## THE PATHOGEN AND DISEASE

Pink rot of potato is an important soil-borne storage disease of potatoes worldwide. It is caused by the fungus *Phytophthora erythroseptica* and sometimes by *Phytophthora cryptogea*. Pink rot infection is often associated with secondary infection by anaerobic soft rot bacteria. Key features of pink rot are that:

- Infections vary in virulence
- Some cultivars are less susceptible than others but can still get the disease to some extent
- It can survive for long periods in the soil (up to 7 years)
- It can be spread by tubers, water and soil
- It develops rapidly at soil temperatures from 10 to 30°C with 25°C optimal for infection
- It resembles blackleg in early infection stages
- There are many plants that act as hosts including many weed species
- High humidity along with poor ventilation can cause heavy losses of stored potatoes.

*Metalaxyl is effective in Australia but resistance has been identified in the US where the active ingredient has been over-used in the crop rotation. Metalaxyl is a chemical which has been shown in certain soils to develop enhanced biodegradation (i.e. the soil microorganisms use it as a food source and thus it is rapidly degraded before it can be effective). This is more likely to occur with repeated usage on many crops.

## SYMPTOMS

Diseased plants are first observed in poorly drained (waterlogged) parts of the field and late in the season, near harvest. Disease symptoms are mostly characterized by stunting and wilting of plants. Wilting starts from the base of the stem and progresses upward, causing leaf yellowing, drying and defoliation. Vascular discoloration and blackening of the underground stems may also be observed. Similarly, roots may turn brown to black, and occasionally aerial tubers may develop.

Symptoms on tubers are more obvious and characteristic of the disease. Tuber decay begins at or near the stem or stolon end of the tuber. Infected tissue becomes rubbery but not discoloured in the early stages of infection, and when infected tubers are cut open the rotted portion is bordered by a dark line visible through the tuber skin (Figure 1). The tuber skin (periderm) over the rotted portion is light brown in white-skinned cultivars.

Pink rot is not a slimy soft rot, and rotten tissues remain intact but spongy. When rotten tubers are cut open, the internal tissues are cream-colored and usually odourless. The tough, leathery, rubberlike texture of infected tubers distinguishes pink rot from bacterial rot disease where the diseased tissue becomes soft and pulpy and contains numerous cavities. However, infected tissues are easily invaded by secondary pathogens, such as soft rot bacteria (*Pectobacterium* spp.), which produce the slimey symptoms often found in potatoes with pink rot (Figure 2).

As tubers are exposed to the air, the colour of the infected tissue progressively changes from cream to salmon pink within 15 to 30 minutes (Figure 3). After about one hour, the tissue gradually turns brown and then black. If the cut tuber is squeezed, a clear liquid may ooze out of the cut surface.

Photo: P.S. Wharton

**Figure 1.** *In the early stages of pink rot infection, the rotted portion of the tuber is delimited by a dark line.*

Photo: P.S. Wharton

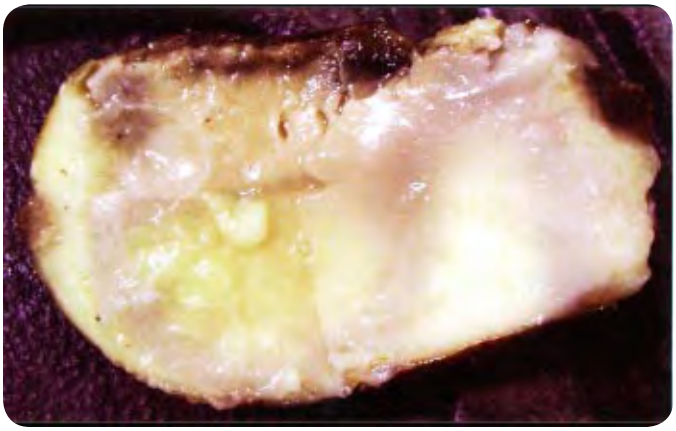

**Figure 2.** *Pink rot infection is usually followed by secondary infection by anaerobic soft rot bacteria. These turn the tuber tissue soft, creamy and mushy.*

Photo: P.S. Wharton

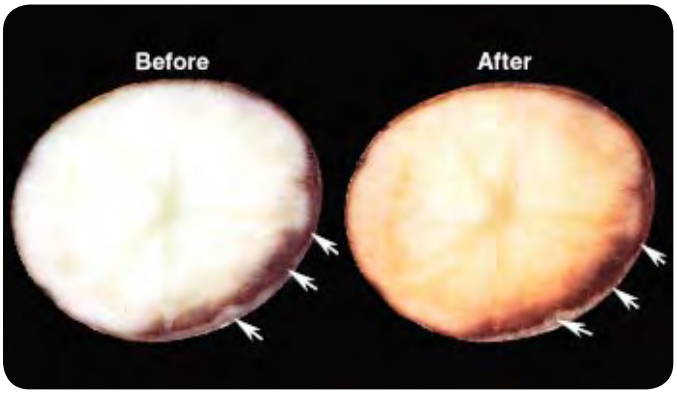


**Figure 3.** *Tubers infected with pink rot turn pink after exposure to air for 15 to 30 minutes. Arrows indicate diseased tissue.*

## DISEASE CYCLE

The disease cycle of pink rot is shown in Figure 4. The pathogen can be transferred by:

**Soil** - to new fields via farm machinery and bins, and within an infested field during cultivation.

**Tuber** - the surface of healthy tubers may be contaminated with oospores from infected tubers that were missed during harvest (volunteer potatoes) or in cull piles that will end up in the soil after deterioration of the tubers.

**Water** - irrigation water is also an important source of movement of the oospores from one location to another within a field and among nearby fields.

Photo: Michael Rettke, SARDI
Illustrations: Marlene Cameron

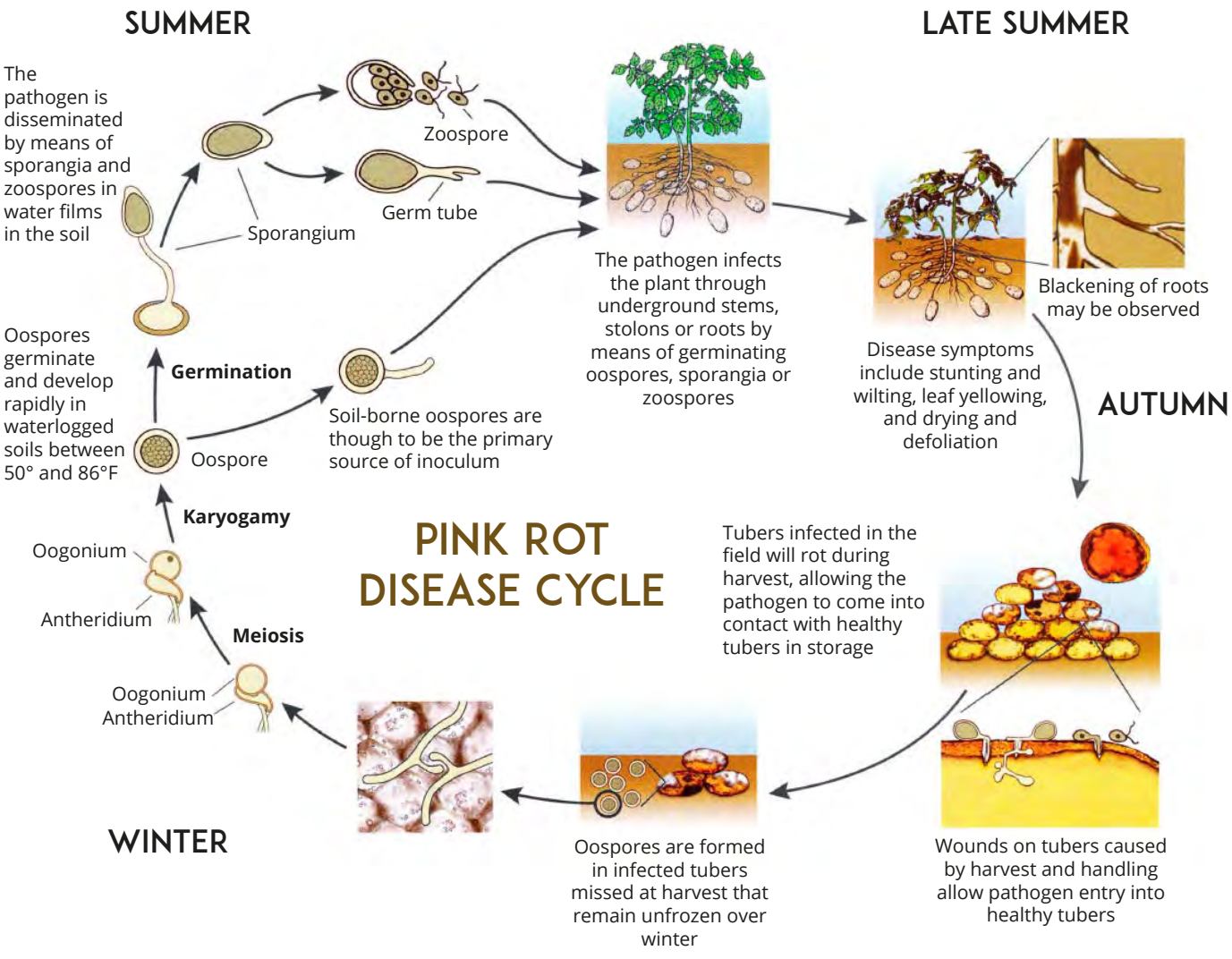


**Figure 4.** *The disease cycle of the pink rot pathogen, Phytophthora erythroseptica*

## FURTHER READING

**Management strategies including chemical control:**

- https://www.syngenta.com.au/news/potatoes/reducing-risk-pink-rot-infection-season
- https://www.syngenta.com.au/news/potatoes/controlling-pink-rot-potatoes
- https://millerresearch.com/research-library/pink-rot/*
- https://www.croplife.org.au/resources/programs/resistance-management/fact-sheet-fungicide-resistance/

**Hort Innovation reports**
The following reports can be found on the InfoVeg webpage at https://ausveg.com.au/infoveg/infoveg-database/

- 2000 PT97026 Developing soil and water management systems for potato production on sandy soils in Australia https://ausveg.com.au/app/data/technical-insights/docs/PT97026.pdf
- 2001 PT97004 Potato pink rot control in field and storage https://ausveg.com.au/app/data/technical-insights/docs/PT97004.pdf
- 2002 PT01042 Potato pink rot control in the south east of South Australia https://ausveg.com.au/app/data/technical-insights/docs/PT01042.pdf

**Fungicide activity groups:**

- https://www.croplife.org.au/resources/programs/resistance-management/fungicide-activity-group-table-2/fungicide-activity-group-table-2-draft/

* Products mentioned in this factsheet may not be registered for use in Australia.

Photo: istock.com/oticki

**References**

Content used with the permission of Michigan State University © 2015 Michigan State University, All Rights Reserved
https://www.canr.msu.edu/uploads/resources/pdfs/michigan_potato_diseases_-_pink_rot_(e2993).pdf

A review of knowledge gaps and compilation of R&D outputs from the Australian Potato Research Programs PT13013 (2015) Dr Kevin Clayton-Greene Horticulture Australia Ltd

[1] Benson, Jared H., "Effect of Ca and pH on Disease Severity of Pink Rot Phytophthora erythroseptica in Russett Norkotah Potato Solanum tuberosum" (2008). All Theses and Dissertations. 1455.
https://scholarsarchive.byu.edu/etd/1455



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# MANAGING BLACKLEG IN POTATO

## WHAT IS IT?

This fact sheet provides information on managing Blackleg in potato crops, the bacteria which commonly cause the disease and what you can do to prevent and manage it.

Blackleg on potato can be caused by either *Pectobacterium* or *Dickeya* species, and they often work together in different combinations to cause this disease. Both bacteria species belonging to the *Pectobacteriaceae* family. In Australia, bacteria causing Blackleg was previously classified as *Erwinia* species.

## WHAT DOES IT LOOK LIKE?

Blackleg causes stem decay, often extending several centimetres above the ground. Damage to the inside tissue continues even higher up inside the stem (**Figure 1** right). Plant leaves may turn bright yellow and/or curl and the plant will eventually wilt and die (**Figure 2 lower** right). Infected plants produce few or no tubers.

Blackleg can also cause severe seed decay and lack of plant emergence in severe cases (**Figure 3** below).

**Figure 1:** Blackleg internal symptoms where the two plants on the left are infected by soft rot bacteria, causing blackened internal symptoms and crop wilt, compared with a healthy plant on the right (© 2020 DPIRD)

**Figure 2:** Potato plant in field infected with Blackleg (Dr Nandita Pathania, QDAF)

**Figure 3:** Signs of non-emergence in infected seed lot in the United States (©2017 Dr Steven B. Johnson, Ph.D. University of Maine Cooperative Extension)

## HOW DOES IT DEVELOP AND SPREAD?

*Pectobacterium* and *Dickeya* are not commonly found on minitubers grown in greenhouses or glasshouses. Infection of seed tubers generally occurs once planted in the ground or can also occur during grading. Each generation of potato multiplication tends to increase the risk of *Pectobacterium* and *Dickeya* incidence on potato tubers. The bacteria can live in tuber lenticels without causing disease (asymptomatic) so it is not possible to visually assess seed potato lots for risk.

It is not possible to determine visually whether plants are infected with *Pectobacterium* or *Dickeya* as the symptoms are so similar. Confirmation of which pathogen is present can only be confirmed through laboratory testing. Laboratory testing for these bacteria can be done in Australia but is expensive.

Blackleg development is highly dependent on the environment and is unpredictable. It can occur at any time during the growing season and development is favoured by cool, wet conditions at planting followed by warmer weather. Temperatures above 30°C during the growing season appear to be particularly conducive to disease development.

When infected tissues break down, bacteria are released into the soil and travel in soil moisture to other plants. Blackleg causing bacteria do not survive in the soil for more than a few months, however they may survive in crop debris, weeds, volunteer potatoes and water. They can also be transmitted by insects.

The main spread of both these bacteria occurs at harvest. Bacterial numbers increase dramatically on dying vines and the bacteria will contaminate harvest equipment and may become air-borne during harvest.

*Pectobacterium* can enter daughter tubers through the stem or through wounds caused by insects, mechanical damage, or harvest equipment. Once inside a tuber, it will decay the inside of the tuber, but not the tuber skin, causing bacterial soft rot (**Figure 4a and 4b above**).

**Figure 4a:** External view of a tuber showing a water-soaked lesion with bacterial ooze (© 2020 DPIRD)

**Figure 4b:** Cross-section of infected tuber showing internal rot (© 2020 DPIRD)

The bacteria will also decay stems damaged by cultivation equipment or severe weather, causing above ground stem rot. It is common to find multiple *Pectobacterium* species or *Pectobacterium* and *Dickeya* together when blackleg, aerial stem rot, or soft rot symptoms are present.

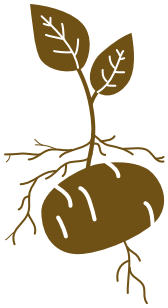
## HOW CAN I MANAGE IT?

Below are some steps that can be taken to reduce the risk of Blackleg. Most of these management principles will also help to prevent other tuber diseases.

### TO REDUCE THE RISK OF DISEASE AT PLANTING:

- Use certified seed which has been inspected for disease symptoms during their production.
- Plant whole seed rather than cut seed, particularly in regions where tuber soft rot and blackleg diseases have been a problem (such as in warm or wet soils).
- Fully suberize seed (form a permanent wound barrier) if using cut seed.
- Do not plant cold seed into wet ground.
- Schedule planting to avoid periods when extremely wet or high temperatures prevail.
- Practice long crop rotations (4 – 8 years), particularly for seed production.

### TO REDUCE THE RISK OF DISEASE DURING CROP GROWTH:



- Irrigate with non-contaminated water and avoid over-irrigating to minimise water flow in crops.
- Do not over-fertilise with nitrogen and maintain optimal calcium and magnesium levels in plants.
- Do not rouge (remove) infected plants as this is likely to spread the disease.
- Avoid the risk of cross-contamination between alternative host crops such as ornamental bulbs grown in the same paddocks and weeds.
- Practice good farm hygiene and avoid the movement of machinery or personnel between contaminated and non-contaminated areas on farm and/or disinfect equipment between paddocks.

### TO REDUCE THE RISK OF DISEASE DURING AND AFTER HARVEST:

- Quickly kill potato vines (the bacteria will multiply on the vines as they senesce, so limiting senescence may reduce disease incidence the following year).
- Avoid physical damage to tubers, roots and stems which provide entry points to bacteria during harvest and grading.
- Tubers should be allowed to suberise (curing) before going into storage.
- Ensure storage conditions are suitable for reducing soft rot development including good airflow, high humidity and appropriate levels of oxygen and carbon dioxide, do not overfill stores.

## WHERE CAN I FIND MORE INFORMATION?

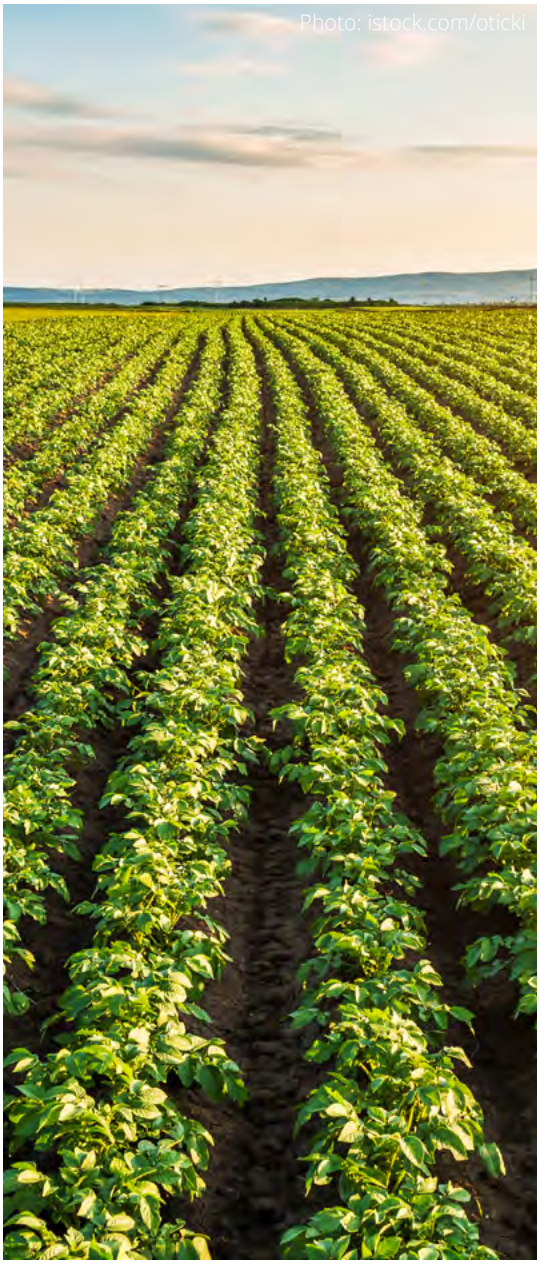


Photo: istock.com/oticki


**Acknowledgements and references:**

**The Potato Crop Its Agricultural, Nutritional and Social Contribution to Humankind** (2020) Hugo Campos and Oscar Ortiz (eds) Chapter 10 Bacterial Diseases of Potato by Amy Charkowski, Kalpana Sharma, Monica L. Parker, Gary A. Secor, and John Elphinstone

**Review Bacterial Blackleg Disease and R&D Gaps with a Focus on the Potato Industry** PT18000 (2018) Len Tesoriero, Crop Doc Consulting

Dr Rachel Mann *personnel communication*

**Soft rot diseases of potatoes** (2017) Andrew Taylor, Department of Primary Industries and Regional Development


**Further resources:**

**Control of black leg, black scurf and other postharvest storage rots of seed potatoes** PT105 (1996) Dolf de Boer, Agriculture Victoria

**Effect of calcium nutrition on decay of summer sown seed potatoes** PT98011 (2003) G. Howell, A. Boulton, A. Watson, NSW Agriculture

**Blackleg on Potatoes in Australia** (2019) S.B. Johnson, AuSPICA

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# What's happening overseas?

## International potato pest and disease R&D scan

2020

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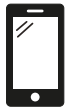
Throughout this document you will find links to external resources as indicated by the three icons below. For a full list of web addresses please see the resources section on page 17.

Website, resource database or online tools

Research paper, article, guide or manual



Smartphone application

What's Happening Overseas? International potato pest and disease R&D scan, October 2020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This guide has been prepared by RM Consulting Group on behalf of Hort Innovation



# Contents



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# Introduction

**This document is a scan of pest and disease research currently occurring internationally in key potato production regions of relevance to the potato industry. It identifies current research projects conducted by a range of research organisations in five of the major potato producing regions in the world. Links are provided to more detailed information on these projects and available resources. Identification of some of the research that has been conducted in Australia on the pests and diseases mentioned in this scan is also provided.**

Pest and diseases can cause significant economic losses in potato production. Significant time and money is spent researching ways to prevent, and if required, manage pest and diseases to avoid loss of marketable yield. Most soilborne diseases persist in the soil for many years and can be spread by soil and water leaving an infected paddock. Therefore, disease prevention is a key concern.

Potato producers in Australia pay a levy for research, development and extension to keep up-to-date on best practices to help them preventing and managing key pest and diseases. This levy is matched by contributions from the Australian Government and managed by Horticulture Innovation Australia under the Australian Potato Pest and Disease R&D program. A Strategic Industry Advisory Panel (SIAP) assist Hort Innovation in making funding decisions and reviewing programs.

There are currently six projects in this Pest and Disease Program which are focussed on:

- Biosecurity
- Powdery scab
- Soil and tuber diagnostic tests
- Tomato Potato Psyllid
- Integrated Pest Management
- Pink Rot.

The Program focuses on the key pest and disease issues for Australian producers; however, it is important to maintain an awareness of the issues faced by producers in other countries and the current R&D occurring to assist industry in managing these issues. While Australia is currently free of several economically significant potato pests and diseases, recent biosecurity breaches have shown that Australian growers should be prepared. This includes being vigilant on their own farm and understanding risks and management options of exotic pests and diseases that could affect them in the future. For information on important pests and diseases that pose a risk to the Australian potato industry, download the “New Biosecurity Manual for Potato Growers”.

**Potato Growers’ Biosecurity Manual**

Where there are similar problems it may be possible to collaborate with researchers in other countries or learn from the outcomes of their projects to identify prevention and management options which could be used in Australia.

The Australian Potato Pest and Disease Program PT17002 is coordinated by Drs Kristen Stirling and Doris Blaesing from RMCG. For further information regarding this document or the Program please contact the RMCG office on 03 9882 2670.

# Summary

## INTERNATIONAL RESEARCH

International potato research is currently focussed on the following pests and diseases:

- Tomato Potato Psyllid (TPP)
- Aphid and virus management (Potato Virus Y and mop top virus)
- Late blight
- Potato Cyst Nematode
- Blackleg
- Potato early dying
- Powdery and Common scab
- Wireworm.

## KEY OPPORTUNITIES FOR AUSTRALIA

A number of the pests and diseases studied internationally are not currently present in Australia (these include Colorado potato beetle, late blight, pale potato cyst nematode). While Australian producers do not have to manage these pests, it is important to understand research advances so that if these pests do become a threat, management techniques used in other countries could be readily applied in Australia. A key example is learning from New Zealand's experience with TPP and applying the management options developed there if TPP becomes a widespread issue.

Where research is conducted on pests currently found in Australia, we should keep a 'watching brief' on R&D progress and investigate opportunities to apply research findings to the Australian context. This could include:

- Assessing whether newly developed varieties with increased resistance to pest and disease have potential for the Australian market and could be imported for further testing under local conditions
- Reviewing the findings of research on blackleg, powdery and common scab, wireworm, and identifying which management practices could be applied to production systems in Australia
- Using the outcomes of international research on precision agriculture and predictive modelling to inform research conducted within the Australian potato pest and disease program.

A number of the international projects discussed in this scan have developed resources that are ready for use by Australian producers to assist in managing pest and disease. These include:

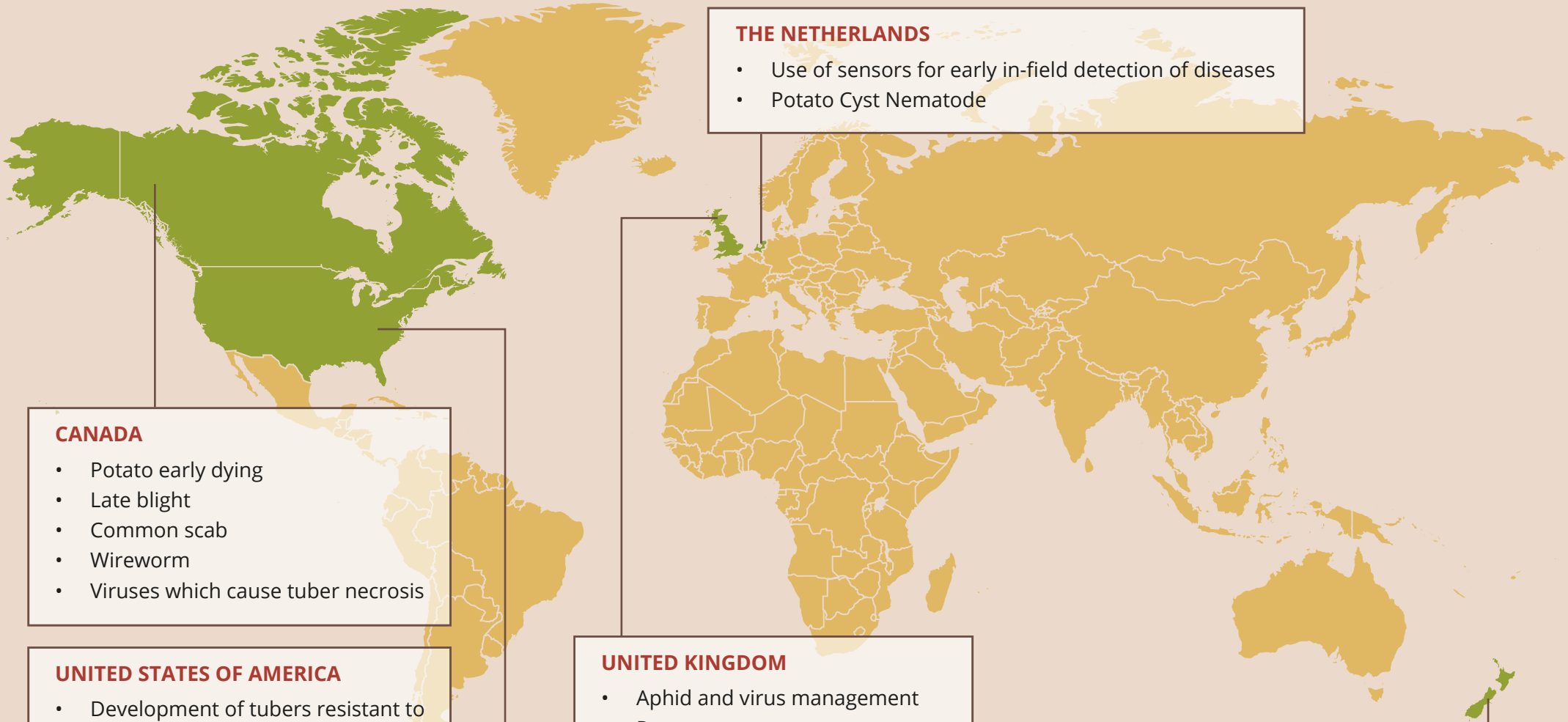
- The disease identification smartphone App 'Buntata' (James Hutton Institute)
- Resources to identify the diseases and defects that impact on the quality of tubers during storage (AHDB)
- Aphid and virus management resources (AHDB)
- TPP Pocket Book (NZ).

## RESEARCH IN AUSTRALIA

Some of the research that has previously been conducted in Australia on pests and diseases mentioned in this scan are discussed at the end of this scan. Where ready to use resources have been developed these are also identified. For a comprehensive list of research conducted for the Australian potato industry using the R&D levy go to the InfoVeg Database.

**InfoVeg Database**
Over 1,400 levy-funded reports, tools and fact sheets for vegetable and potato growers, agronomists, researchers, academics and other industry members

# International Research



### THE NETHERLANDS

- Use of sensors for early in-field detection of diseases
- Potato Cyst Nematode

### CANADA

- Potato early dying
- Late blight
- Common scab
- Wireworm
- Viruses which cause tuber necrosis

### UNITED STATES OF AMERICA

- Development of tubers resistant to pest and disease
- Potato Virus Y
- Powdery scab and mop top virus
- Blackleg

### UNITED KINGDOM

- Aphid and virus management
- Potato storage
- Late blight
- Potato Cyst Nematode
- Blackleg

### NEW ZEALAND

- Tomato Potato Psyllid (TPP)

# New Zealand

## KEY PEST FOCUS

- Tomato Potato Psyllid (TPP)

## KEY OPPORTUNITIES FOR AUSTRALIA

- Learn from New Zealand's experience of managing TPP populations in potato production areas
- Use the NZ resources available for TPP management
- Investigate if *Tamarixia* could be used in Australia as a BCA if TPP became an issue.

## PLANT AND FOOD RESEARCH NEW ZEALAND

Plant & Food Research is a New Zealand government owned Crown Research Institute providing research and innovation to ensure sustainable growth of land and marine-based food industries in New Zealand.

## IMPROVED CONTROL OF TPP WITH THE TPP PARASITOID TAMARIXIA TRIOZAE

The goal of this project is to establish self-sustaining populations of the tomato potato psyllid (TPP) parasitoid *Tamarixia*, in New Zealand.

Multiple releases will then be made around the country to ensure the establishment of *Tamarixia* in New Zealand horticultural environments. The project will evaluate the establishment of *Tamarixia* as a Biological Control Agent (BCA) of TPP in these horticultural environments through post-release monitoring. Information gathered on *Tamarixia* distribution, survival and parasitism rates from these pilot releases will be used to assist growers from all industries to integrate *Tamarixia* into each of their pest management programmes.

Plant and Food Research have carried out a number of releases at multiple sites in the Hawkes' Bay and Canterbury. The target to rear 5,000 *Tamarixia* was well and truly met, with a total of 6,700 *Tamarixia* being released over a 4-month period to a number of growers.

PFR have established that *Tamarixia* will survive over winter. PFR recovered the parasitic wasp from two sites in Hawke's Bay and both sites in Canterbury. Where *Tamarixia* were recovered, percent parasitism ranged between 4 and 40%[1].

### Potatoes New Zealand document library

Resources available from the Potatoes New Zealand website include:

- TPP Pocketbook 2020
- Pest and Disease Handbook 2018
- 2019 Pest and Disease Poster.

[1] https://potatoesnz.co.nz/rd-project/improved-control-tpp-tpp-parasitoid-tamarixia-triozae/

# United Kingdom

## KEY PEST FOCUS

- Aphid and virus management
- Potato storage
- Late blight
- Potato Cyst Nematode
- Blackleg

## KEY OPPORTUNITIES FOR AUSTRALIA

- Use the UK resources available to manage aphids and viruses in the field, and diseases and defects during storage
- Download and use the smart phone app 'Buntata' to identify potato diseases in the field
- Keep a 'watching brief' on the development of a decision support tool for blackleg management and investigate its potential for use in Australia
- Keep a 'watching brief' on the development of Maris Piper and Agria varieties with resistance to Potato Cyst Nematode (PCN) and potential import of these varieties (if successful) into Australia in the future *(noting that import of new varieties for production in Australia can require 5 – 10 years).*

## AGRICULTURE AND HORTICULTURE DEVELOPMENT BOARD (AHDB)

In the United Kingdom (UK) research and development (R&D) for the potato industry is funded through a grower R&D levy which is administered by the Agriculture and Horticulture Development Board (AHDB). The current R&D program for the UK potato industry is discussed below.

### APHIDS AND VIRUS DISEASES

Currently the main virus species in UK potato crops is the aphid transmitted Potato Virus Y (PVY), which also occurs in Australia.

**Scottish Aphid Borne Virus Working Group update** on virus and aphid management in seed potatoes

**Aphid forecasting and monitoring tools** developed by the AHDB

**AHDB website** containing further information on aphid and virus in UK potatoes, including the symptoms, the role of aphids and how viruses are transmitted

### POTATO STORAGE

The **AHDB Potato Storage Hub** has tools and resources to provide guidance on good, cost effective storage to deliver high quality potatoes.

Research focuses on sprout suppression and best practice storage. The Potato store managers' guide contains advice and data on airflow analysis, respiration rates, sprout suppression, disease identification, condensation control, storage temperatures, pull-down rates and more.

**The Potato Store Managers' Guide**

The **AHDB Potato defects and diseases** page has information and resources to identify the diseases and defects that impact on the quality of tubers during storage

**Common potato diseases and defects poster**

## LATE BLIGHT

Late blight remains the single most important potato disease in the UK, costing the industry an estimated £50M annually in crop protection chemicals in a typical blight pressure season.

Genotypes or 'strains' of blight evolve over time and require monitoring. New 'aggressive' strains can go through a reproductive cycle quicker than a spray program, while occasionally strains can develop resistance to recognised fungicides. These strains pose a biosecurity risk.

AHDB funds the British involvement in Euro Blight in order to track strains as they develop in the continent and share research and information on treatment and resistance.

**Late Blight tools and resources**
**AHDB website**

## UNIVERSITY OF EAST ANGLIA AND UNIVERSITY OF LEEDS

### NEW UK POTATO VARIETIES WITH LATE BLIGHT AND POTATO CYST NEMATODE RESISTANCE, REDUCED BRUISING AND IMPROVED PROCESSING QUALITY[2] 2015 – 2020

Susceptibility to many diseases and pests, particularly late blight caused by *Phytophthora infestans* and root damage caused by potato cyst nematodes, are major problems for potato production in the UK. This project aims to genetically engineer potato varieties Maris Piper and Agria with resistance to late blight (LB) and Potato Cyst Nematode (PCN) and test performance in the field.

The goal is to select plant lines that are suitable for subsequent commercialisation. During these experiments, the project will also generate useful information about the efficiency with which multiple genes can be delivered in one event, and still all function. This information will be useful to others setting out to simultaneously deliver multiple useful genes by GM methods in other crops.

*Please note that potato tubers cannot be imported into Australia. Any new varieties need to be imported as in-vitro plantlets and then propagated in approved quarantine facilities. It takes at least 5-6 years before a commercial crop can be grown from imported stock and then tested under Australian conditions, especially in hot dry areas like South Australia for fresh market production. Selection made under temperate conditions like the UK climate, and for a UK market may not be suitable for Australia.*

[2] https://gtr.ukri.org/projects?ref=BB%2FM017834%2F1
[3] https://gtr.ukri.org/projects?ref=BB%2FT010533%2F1

## DURHAM UNIVERSITY, UNIVERSITY OF STRATHCLYDE, NATIONAL INSTITUTE OF AGRICULTURAL BOTANY, UNIVERSITY OF GLASGOW, THE JAMES HUTTON INSTITUTE

### A DECISION SUPPORT TOOL FOR POTATO BLACKLEG DISEASE[3] 2020 - 2023

Unpublished data has shown that a causal agent of blackleg disease (*P. atrosepticum* (Pba)) can infect potato plants and cause disease directly from the soil, not only via infected tubers. This is exacerbated by the presence of free-living nematodes (FLN) and excess water, providing new possibilities for research and disease control. This project will investigate the role of vectors, irrigation and crop rotation on Pba infection working from field and mesocosm scales to rhizosphere microbial communities. The project will assess how large-scale changes in the field impact on root architecture and exudate production and what influence this has on rhizosphere microbial communities and competition. The latest bacterial genomics, bioinformatics, imaging and GC-MS tools will be used.

The research team have access to national datasets that have not previously been linked with blackleg disease research. These include over 10,000 national soil samples with FLN data, synthetic aperture radar (SAR) soil moisture data, the National Soil Archive and several other data sets. With these, and data from the project, the project will use machine learning, game theory and other modelling approaches to find relationships between these data and blackleg and bring the information together in a decision support tool for the potato industry.

*P. atrosepticum (Pba) has been identified as a causal agent of blackleg in Australia.*

## THE JAMES HUTTON INSTITUTE

### DISEASE IDENTIFICATION SMARTPHONE APP

Buntata, the Gaelic word for potato, is an Android app developed by The James Hutton Institute, and funded by the University of St. Andrews, SEFARI (Scottish Environment, Food and Agriculture Research Institutes) and the BBSRC (Biotechnology and Biological Sciences Research Council).

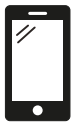
"Buntata has been designed to help users identify plant pests and diseases with no apriori knowledge," says Sebastian Raubach, a Bioinformatics Software Developer at Hutton, involved in the development of the app. "Buntata provides a visual key for the identification of diseases by displaying images of symptoms and offers solutions to aid identification of the causes.

With the help of Buntata, a user can visually select the part of the plant that is affected, and Buntata will then display images of recorded symptoms for matching diseases. Picking the image that most closely resembles the symptoms shows the user detailed information about possible causes, background information, diagnostics and control methods that can help growers deal with the causes.

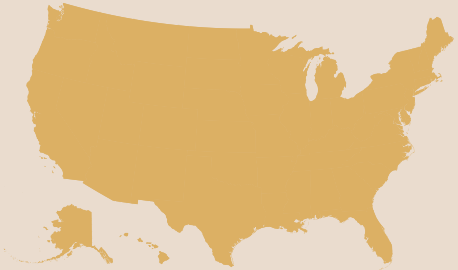
"Diseases can exhibit similar symptoms," Raubach says. "Differentiating between say powdery and common scab requires experience. Buntata displays diseases with similar symptoms together, allowing easy comparison to help users identify the correct one."

Once the cause has been identified, users can then keep a record of this – tagged with the current location, notes and images stored locally on the device – for future reference. Buntata was originally developed for small holder farmers but can be used by anyone who grows potatoes as a handy mobile resource.

Buntata is a flexible and customisable application for aiding in the identification of plant diseases in the field. Buntata offers datasets which can be downloaded before going out to the field. This means that it is not necessary to have a network connection while out and about making it particularly useful for users in countries or areas where mobile networks connections are limited.



**Buntata Smartphone Application**
Available for Android phones only



# United States of America (USA)

## KEY PEST FOCUS

- Development of tubers resistant to pest and disease
- Potato Virus Y
- Powdery scab and mop top virus
- Blackleg

## KEY OPPORTUNITIES FOR AUSTRALIA

- Assess whether the predictive model being developed by Washington State University for *S. subterranean* could inform Australian research on powdery scab.
- Keep a 'watching brief' on the development of varieties with enhanced disease resistance and tuber quality. New varieties which are potentially suitable for the Australian market could be imported for further testing under Australian conditions *(noting that import of new varieties for production in Australia can require 5 – 10 years)*.

## AGRICULTURAL RESEARCH SERVICE (ARS)

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's chief scientific in-house research agency. ARS deliver cutting-edge, scientific tools and innovative solutions for American farmers, producers, industry, and communities. Their scientists frequently collaborate with research partners from universities, companies, other organisations, and other countries.

ARS Research is organised into National Programs. The National Programs serve to bring coordination, communication and empowerment to approximately 690 research projects carried out by ARS. National Programs focus on the relevance, impact, and quality of ARS research.

The current ARS programs focused on the American potato industry are presented below.

### POTATO GENETIC IMPROVEMENT FOR ENHANCED TUBER QUALITY AND GREATER PRODUCTIVITY AND SUSTAINABILITY IN WESTERN U.S. PRODUCTION 2018 - 2023

This project intends to produce improved potato germplasm and varieties with emphasis on the predominant market class for the western U.S. which is characterized by long tubers and russet skin. Improved varieties will be suitable for potato processing, as well as fresh consumption.

The project will use conventional and genomic technologies to develop improved potato germplasm and varieties representative of the primary market classes grown in the western U.S. with the following enhancements:

- Improved Disease and Pest Resistance
- Improved Tuber Qualities for Processing and Fresh Use
- Reduced Production Inputs
- Enhanced Nutritional Value.

The project will also accelerate breeding for resistance to potato pathogens and pests using genomic technologies. It will also identify and utilize pathogen and pest resistance specific to potato cyst nematode (PCN) and tuber necrotic viruses (Potato virus Y, Potato mop-top virus, and Tobacco rattle virus), and characterize foliar and tuber responses of potato varieties and germplasm to the tuber necrotic viruses.

Desired traits will be acquired from wild relatives of cultivated potato and from improved germplasm developed by other potato breeding programs worldwide. Parental material will be hybridised with potato breeding clones and varieties adapted to the irrigated environments of the western U.S. Progenies will be evaluated systematically, and superior individuals selected and advanced for release as potato varieties. Marker-assisted selection protocols will also be devised to facilitate selection for resistance to viruses and cyst nematodes. Characterisation of foliar and tuber responses of potato varieties to infection by newly identified strains of Potato virus Y and the identification of new sources of resistance will also be conducted to address this increasingly problematic potato pathogen.

*Please note that potato tubers cannot be imported into Australia. Any new varieties need to be imported as in-vitro plantlets and then propagated in approved quarantine facilities. It takes at least 5-6 years before a commercial crop can be grown from imported stock and then tested under Australian conditions, especially in hot dry areas like South Australia for fresh market production. Selection made under temperate conditions like the UK climate, and for a UK market may not be suitable for Australia.*

## CULTURAL PRACTICES FOR REDUCING POTATO VIRUS Y IN SEED POTATO CROPS[4] 2019 - 2021

This project will study the reduction of Potato virus Y (PVY) in seed potato crops treated with a mineral oil (crop oil) to deter aphid transmission. This will be done using field trials that incorporate the use of crop oil, insecticide and crop oil/insecticide treatments to reduce the amount of PVY infection via aphids that occurs during the growing season. Additional studies will be done with different PVY isolates in the greenhouse to determine PVY movement under different environmental conditions.

[4] https://www.ars.usda.gov/research/project/?accnNo=437125

## INTEGRATING PREDICTIVE DIAGNOSTICS AND DISEASE MANAGEMENT STRATEGIES FOR POWDERY SCAB AND POTATO MOP TOP VIRUS IN THE PACIFIC NORTHWEST (UI) 2020 - 2021

The objectives of this research are to:

- Validate for diagnostic methods for *S. subterranea* and Potato Mop Top Virus and determine inoculum thresholds for disease in soils.
- Develop optimum sampling strategy for *S. subterranea* and PMTV for field soil
- Determine the relative importance of seed and soil-borne inoculum
- Evaluate integrated management strategies for the pathogen.
- Creating a decision support system integrating diagnostic results, chemical applications, varietal resistance and cultural methods.

**Research Project: Integrating Predictive Diagnostics and Disease Management Strategies for Powdery Scab and Potato Mop Top Virus in the Pacific Northwest (UI)**

## WASHINGTON STATE UNIVERSITY[5]

### MOP TOP VIRUS

Washington State University scientists are researching a destructive complex of diseases, with support from a joint program of the National Science Foundation and USDA's National Institute of Food and Agriculture.

Mop top is spread by a protist (*S. subterranea*), a fungus-like microorganism of the family *Plasmodiophoraceae* that causes powdery scab of tubers. Infected tubers can infect roots of neighbouring plants or, if on seed tubers, infect the emerging plant. *S. subterranea* is present in many fields in the Washington region, and there is no effective control measure. Mop top virus and *S. subterranea* together, is a challenging disease complex to manage.

The scientists are using genomics and systems biology tools to gain insights into the cooperative relationship between the *S. subterranea* and the virus, and how the two attack and damage potato plants.

Specifically, they will investigate the molecular basis of potato's response to attack by the virus and *S. subterranea*. They will also perform computational genomics and create systems-level models, to help identify additional genes that underlie the disease. They will expand computational biology tools created through the National Science Foundation's SciDAS cyberinfrastructure project, with the goal of creating a predictive model in the plant-protist-virus pathosystem. The predictive model could also be useful for other host-parasite pathosystems causing important diseases.

This research will provide a better understanding of the three-way interaction between potatoes, powdery scab, and mop top virus, and their common vector. This work could provide new clues to effectively control these diseases.

## COLORADO STATE UNIVERSITY

### BLACKLEG

*Dickeya dianthicola* is one pathogen species that causes blackleg and soft rot. This bacterium cannot be detected when seed potatoes are screened for pathogens using traditional DNA-based tests. However, scientists in the USA have developed a user-friendly online tool called Uniqprimer, which quickly and automatically designs species-specific DNA tags (also known as primers) for detecting pathogens using DNA testing.

To test the Uniqprimer, the scientists screened 116 field samples for the presence of *D. dianthicola* and found it in samples from nine different states. The Uniqprimer was able to detect the bacterium when other more commonly used tests did not.

While Uniqprimer was developed with blackleg disease and potatoes in mind, it can be applied to any pathogen and in any geographic area. It can also be used by anyone with an internet connection, even those with no background in bioinformatics.

**JOURNAL ARTICLE: Development of the Automated Primer Design Workflow Uniqprimer and Diagnostic Primers for the Broad-Host-Range Plant Pathogen *Dickeya dianthicola***

[5] https://spudman.com/news/wsu-professors-grant-potato-mop-top-virus-pmtv/

# Canada

## KEY PEST FOCUS

- Potato early dying
- Late blight
- Common scab
- Wireworm
- Viruses which cause tuber necrosis

## KEY OPPORTUNITIES FOR AUSTRALIA

- Review the findings of research evaluating methods to control common scab and assess if they could be used in Australia.
- Review the findings of research generating and evaluating integrated pest management tools for wireworm and click beetles and assess if they could be used in Australia.
- Review the findings of research into Potato Early Dying (PED) (Verticillium Wilt) and assess how outcomes could inform management practices in Australia.

[6] https://spudsmart.com/working-together-on-research
[7] A biosecurity pest, refer to: https://www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Colorado-potato-beetle-FS.pdf
[8] Canada has Metalaxyl resistant strains of Irish blight

## AGRICULTURE AND AGRI-FOOD CANADA (AAFC)[6]

The Canadian Potato Council (CPC), part of the Canadian Horticultural Council (CHC), started its third cluster of research projects on April 1, 2018. The third round contains eight research projects which will go through until March 31, 2023. The research projects are led by Agriculture and Agri-Food Canada (AAFC) and funded through the Canadian Agricultural Partnership.

Projects included in the program are:

- the development of regional management strategies and decision-making tools for control of **Colorado potato beetles (CPB)**[7].
- evaluating several methods to control **common scab** under a range of environmental conditions and soil types across Canada.
- determining various biological characteristics of isolated strains of **late blight** (Irish blight) pathogen including fungicide sensitivity, with the overall goal of improving disease management and economic returns[8].
- developing and evaluating smart farming practices suitable for application in several major Canadian potato production areas.
- investigating the occurrence and distribution of potato tuber **necrosis-inducing viruses** in Canada. This project will also study varietal responses to the viruses in order to minimize economic losses.
- generating and evaluating integrated pest management tools for **wireworm** control. The project plans to test the effectiveness of new insecticides for control of wireworms and **click beetles**; evaluate an integrated approach for management of wireworm damage; find and use click beetle monitoring tools; and monitor click beetle expansion in Canadian potato growing regions.
- assess the performance of advanced breeding selections and recently released varieties. The project is comparing recently released AAFC varieties and newer varieties from other breeders to standard potato varieties grown in each region of Canada to judge their potential as viable varieties.
- Potato fields will be surveyed to determine **Potato Early Dying (PED)** (Verticillium Wilt) levels and evaluate how PED is controlled through growers' cropping systems, best management practices and control products.

**ARTICLE: Large research project looks to combat major potato disease**

# The Netherlands

## KEY PEST FOCUS

- Use of sensors for early in-field detection of diseases
- Potato Cyst Nematode

## KEY OPPORTUNITIES FOR AUSTRALIA

- Investigate the potential to use OBIA methods for in-field pathogen detection using low-altitude imagery acquired with a drone.
- Keep a 'watching brief' on the development of varieties with resistance to Golden Potato Cyst Nematode that could be grown in Victoria.

## WAGENINGEN UNIVERSITY AND RESEARCH (WUR)

### EARLY IN-FIELD DETECTION OF DISEASES[9]

In the Netherlands, pests and other pathogens account for roughly 40% of pre-harvest loss in potatoes. This project is investigating sensor-based methods to support the identification of diseases in potatoes at an early stage. Pathogens in potato plants, like the *Erwinia* bacteria and the Potato Virus Y (PVY) for example, exhibit symptoms of varying severity that are not easily captured by pixel-based classes (as these ignore shape, texture, and context in general). This research aims to develop an object-based image analysis (OBIA) method for trait retrieval of individual potato plants that maximises information output from drone imagery to be used for disease detection of the potatoes. It also shows that low-altitude imagery acquired with a commercial UAV is a viable off-the-shelf tool for precision farming, and potato pathogen detection.

**JOURNAL ARTICLE: Object-Based Image Analysis Applied to Low Altitude Aerial Imagery for Potato Plant Trait Retrieval and Pathogen Detection**

### THE CHEMICAL COMMUNICATION BETWEEN POTATO AND POTATO CYST NEMATODES AS A BASIS FOR SUSTAINABLE IMPROVEMENT OF POTATO YIELD 2018 - 2023

Sustainable potato production in the Netherlands is threatened by the potato cyst nematodes *Globodera pallida* (Pale Potato Cyst Nematode) and *G. rostochiensis* (Golden Potato Cyst Nematode), causing an estimated EUR 460 million loss in Europe alone. They are obligate endoparasites, so totally dependent on their host, and live in and from the roots of potato causing growth retardation, damage to the roots and early senescence of plants. Both nematodes are listed as biosecurity threats in Australia. *G. rostochiensis* has been found in Victoria and is under biosecurity management restrictions.

In the past, large amounts of pesticides were used in the Netherlands to protect potato crops against these nematodes but many of these pesticides have been banned. Therefore, there is a need for alternative control methods based on natural plant resistance. This project will study the chemical communication between potato and potato cyst nematode (PCN) to develop alternative approaches to improve PCN control in potato.

[9] https://www.mdpi.com/1424-8220/19/24/5477/htm

WUR will study wild potato varieties for resistance to a wide range of potato diseases and pests. This broad approach should yield breeding material that can be used to develop disease resistant potato varieties capable of contributing to sustainable potato production. The research is commissioned by Holland Innovative Potato (HIP) and the Ministry of Agriculture, Nature and Food Quality (Dutch acronym: LNV).

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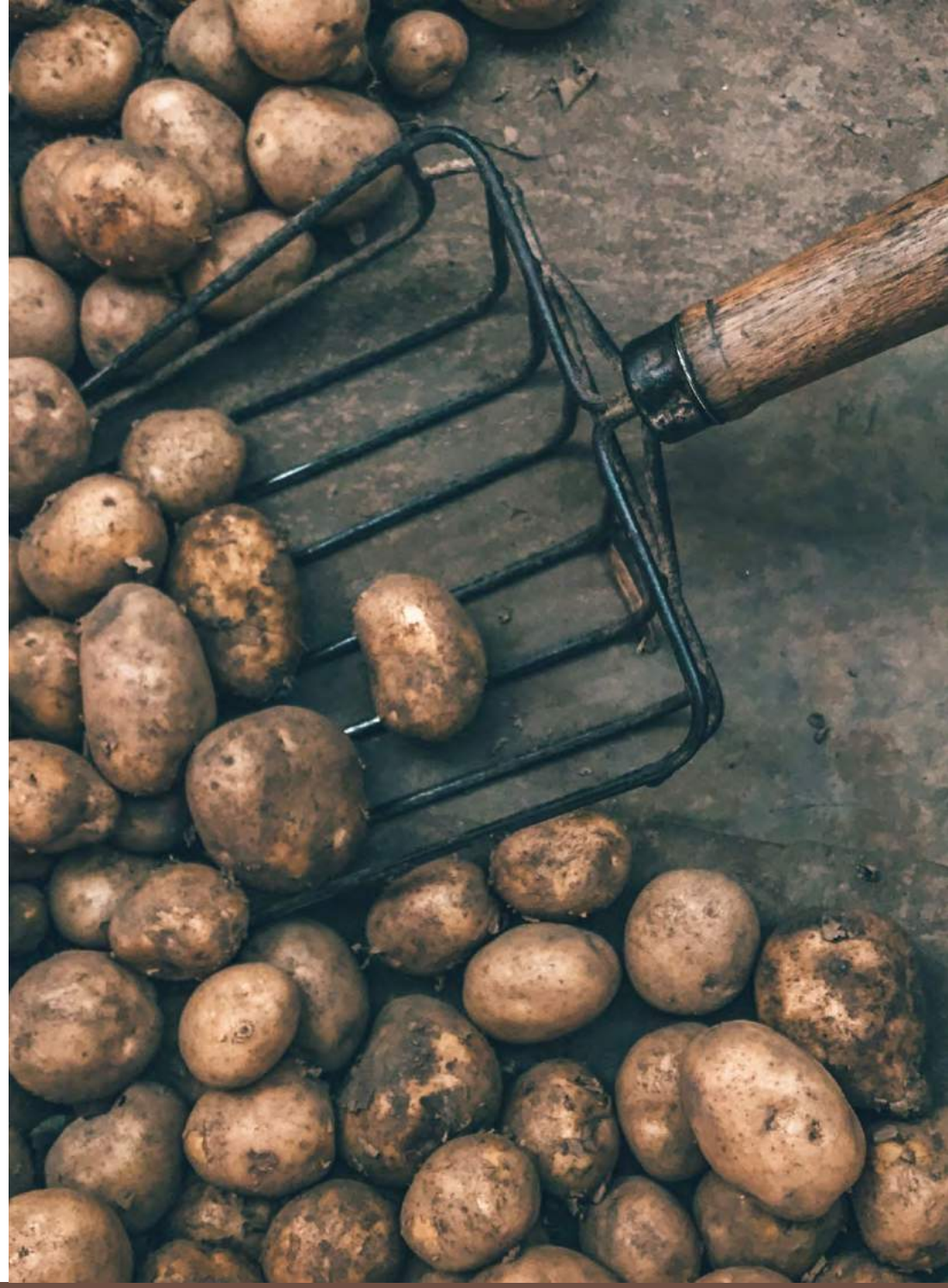
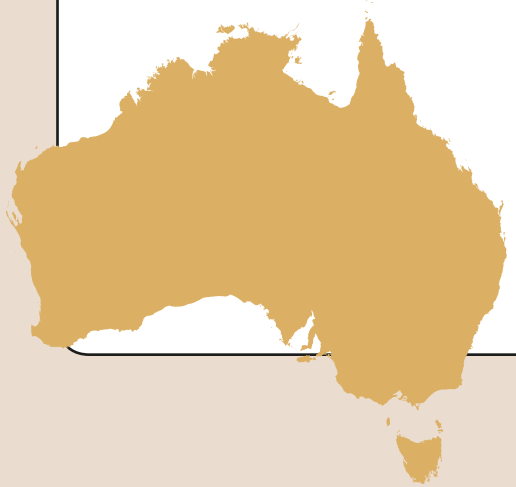


# Australian Research

This section identifies some of the research that has previously been conducted in Australia on pests and diseases mentioned in this scan. Where ready to use resources have been developed these are also identified.

The **InfoVeg Database** has a comprehensive list of research conducted for the potato industry using the R&D levy.



Tomato Potato Psyllid (TPP)

Potato Cyst Nematode

Aphid and Virus Management

Blackleg

Potato Early Dying (PED)

Late Blight

## TOMATO POTATO PSYLLID (TPP)

Australian resources available on TPP include:

The TPP Monitoring Guide

How to manage TPP in potatoes using IPM

CASE STUDY: IPM delivers Tomato Potato Psyllid control in New Zealand Potato Crops

## APHID AND VIRUS MANAGEMENT

FACT SHEET: Tomato Spotted Wilt Virus (TSWV) in potato crops

This 2-page fact sheet provides information on the background, symptoms, incidence and control of Tomato spotted wilt virus (TSWV) and the thrips species that spread it, including Western flower thrips (WFT).

RESEARCH REPORT: Improving Virus Control In Seed Schemes By Combining Aphid Monitoring And Virus Testing (2005)

This project introduced an improved method of virus detection as well as a preventative strategy by operating a pest monitoring service for Western Australian seed potatoes.

## LATE BLIGHT

### RESEARCH REPORT: Late Blight management (2006)

A Pest Risk Analysis and a Pest-Specific Contingency Plan developed through this project put Australia in good stead to deal with potential incursions of exotic strains of the potato late blight pathogen Phytophthora infestans. This was the first pest-specific National response plan for the Australian potato industry. Specific recommendations to the industry to raise awareness and preparedness for potential incursions included simulated incursion responses, development of national diagnostic protocols and surveillance programs to increase the likelihood of early detection of new strains and provide base-line data for pest-free area status to support market access.

### RESEARCH REPORT: Characteristics of Australian isolates of Phytopthora infestans and planning to manage new and more aggressive strains of the fungus (2002)

This investigation characterised the Australian late blight fungus against other strains from around the world, thus allowing for reference to test population in the future in light of the risk of introducing new strains and provide a basis for developing management strategies for new strains.

## BLACKLEG

### RESEARCH REPORT: Review of bacterial blackleg disease and R&D gaps with a focus on the potato industry

### RESEARCH REPORT: Control of blackleg, black scurf and other postharvest storage rots of seed potatoes

## POTATO CYST NEMATODE

### FACT SHEET: Potato cyst nematodes *Globodera rostochiensis* and *G. pallida*

### RESEARCH REPORT: Identification of Potato Cyst Nematode Pathotypes

This report details the research undertaken to aid in the differentiation of biological variants or pathotypes within the potato cyst nematode (PCN) species complex. This work is of direct relevance to the potato industry in Australia as PCN is a quarantine soilborne pest of potatoes which has now been detected in two Australian states, including Victoria, the largest potato producing state. The best strategy for control of PCN is to plant resistant potato cultivars, combined with long crop rotation schedules.

### RESEARCH REPORT: Characterisation and detection of potato cyst nematode

Potato cyst nematode (PCN) has been found in Western Australia and Victoria. Populations of PCN that were studied by this project belonged to one species (Globodera rostochiensis). Extensive testing of a range of resistant potato genotypes showed that the populations did not have any potential to develop virulence. This finding will enable Australian potato breeders to focus on a specific set of resistance genes. A sensitive, specific PCR-based test was developed to detect the presence of both species in a mixture of nematodes. The test is also capable of determining which species of PCN is present.

## POTATO EARLY DYING (PED)

In Australia PED is more commonly known as 'Verticillium Wilt' which is caused by two species of *Verticillium* (*V. Dahliae* and *V. albo-atrum*). The two fungal pathogens alone, or in conjunction with root lesion nematode, Pratylenchus spp., cause PED. Past research conducted by the University of Melbourne in 2012[10] showed that:

- Infection of tubers by Verticillium was widespread in seed lots tested for their project
- Australia has three species of Verticillium (*V. dahliae, V. albo-atrum, V. tricorpus*)
- Surveys of seed lots for this project provided the first report of *V. albo-atrum* from potato in Australia for 40 years
- *V. dahliae* is the most important pathogen in Australia
- There were differences in the virulence of *V. dahliae* isolates from seed lots tested during this project
- Survey during this project identified the pathogenicity of *V. tricorpus* on potatoes for the first time in Australia.

### RESEARCH SUMMARY: Seed tuber incidence and pathogenicity of *Verticillium* species infecting potatoes in Australia

Research conducted by Agriculture Victoria in 1998 sought to:

- determine the incidence of *Verticillium* spp. and *Pratylenchus* spp. in potato crops in Australia
- quantify the levels of the pathogens in potato soil and plants
- develop rapid techniques to predict the occurrence of disease and to evaluate methods of control.

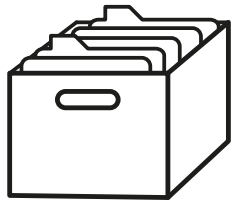
Soil and plant samples were collected from 77 potato fields from South Australia, Victoria, New South Wales, Queensland and Tasmania. Both *Verticillium* and *Pratylenchus* were widespread, with the pathogens found in 90% of the fields sampled. Soil populations of *Verticillium* at levels that caused crop loss overseas were found in 40% of the sites and *Pratylenchus* were found in 75% of the sites sampled.

Overall this project has shown that **potato early dying** is an unrecognised disease complex widespread in Australia and that the problem could be significantly depressing yields by up to 30% in some areas. Further studies are required to source and test cultivars and to evaluate chemical, biological and cultural methods for control[11].

### RESEARCH REPORT: Potato Early Dying in Australia

[10] Seed tuber incidence and pathogenicity of Verticillium species infecting potatoes in Australia (2012) Prakash Vijayamma Ramakrishnan Nair. University of Melbourne
[11] PT412 Potato early dying in Australia (1998) Trevor Wicks and Robin Harding et al Agriculture Victoria

# Resources



Below are the full website addresses of all external links used in this document. Links are correct at the time of publication.

## INTRODUCTION

Plant Health Australia Ltd, 2018, Potato Growers' Biosecurity Manual
https://www.farmbiosecurity.com.au/wp-content/uploads/2019/06/Potato-Growers-Biosecurity-Manual.pdf

## SUMMARY

AUSVEG, InfoVeg Database
https://ausveg.com.au/infoveg/infoveg-database/

## NEW ZEALAND

Potatoes New Zealand, Library
https://potatoesnz.co.nz/library/?mdocs-cat=mdocs-cat-10&mdocs-att=null

## UNITED KINGDOM

Scottish Aphid Borne Working Group, 2020, Virus management in seed potatoes 2020
https://projectblue.blob.core.windows.net/media/Default/Potato%20knowledge%20library/Scottish%20Aphid%20Borne%20Virus%20Working%20Group%20aphid-virus%20recommendations%20for%202020%20-%20Virus%20management%20in%20seed%20potatoes%202020.pdf

Agricultural and Horticulture Development Board, Aphid and virus management in potatoes
https://ahdb.org.uk/knowledge-library/aphid-and-virus-management-in-potatoes

Agricultural and Horticulture Development Board, Aphid and virus: potatoes
https://ahdb.org.uk/knowledge-library/aphid-and-virus-potatoes

Agricultural and Horticulture Development Board, Potato Storage Hub
https://ahdb.org.uk/storage-hub

AHDB Sutton Bridge Crop Storage Research, 2019, Potato Storage Managers' Guide
https://projectblue.blob.core.windows.net/media/Default/Potatoes/PotatoStoreManagersGuide3214_191021_WEB.pdf

Agricultural and Horticulture Development Board, Potato diseases and defects
https://ahdb.org.uk/disease-defects

AHDB Sutton Bridge Crop Storage Research, 2018, Diseases and defects of potatoes
https://projectblue.blob.core.windows.net/media/Default/Potatoes/Disease%20and%20defects/DiseasesDefectsPoster_2018-06-28_WEB.pdf

Agricultural and Horticulture Development Board, Late blight
https://ahdb.org.uk/late-blight

The James Hutton Institute, Buntata Android App
https://play.google.com/store/apps/details?id=uk.ac.hutton.ics.buntata

## UNITED STATES OF AMERICA

USDA Agricultural Research Service, Research Project: Integrating Predictive Diagnostics and Disease Management Strategies for Powdery Scab and Potato Mop Top Virus in the Pacific Northwest (UI)
https://www.ars.usda.gov/research/project/?accnNo=438195

APS Publications, Development of the Automated Primer Design Workflow Uniqprimer and Diagnostic Primers for the Broad-Host-Range Plant Pathogen Dickeya dianthicola
https://apsjournals.apsnet.org/doi/10.1094/PDIS-10-18-1819-RE

## CANADA

PotatoPro.com, Large research project looks to combat major potato disease
https://www.potatopro.com/news/2020/large-research-project-looks-combat-major-potato-disease?taxonomy=149&region=1843

## THE NETHERLANDS

MPDI, Object-Based Image Analysis Applied to Low Altitude Aerial Imagery for Potato Plant Trait Retrieval and Pathogen Detection
https://www.mdpi.com/1424-8220/19/24/5477/htm

## AUSTRALIAN RESEARCH


AUSVEG, InfoVegDatabase
https://ausveg.com.au/infoveg/infoveg-database/

IPM Technologies, Tomato Potato Psyllid Monitoring Guide
http://ipmtechnologies.com.au/wp-content/uploads/2017/05/TPP-pocket-guide.pdf

IPM Technologies, How to manage Tomato Potato Psyllid in potatoes using IPM
http://ipmtechnologies.com.au/2017/08/23/how-to-manage-tomato-potato-psyllid-in-potatoes-using-ipm/

IPM Technologies, Potato IPM case study 3: IPM delivers Tomato Potato Psyllid control in New Zealand Potato Crops
http://ipmtechnologies.com.au/2016/12/01/potato-ipm-case-study-3-ipm-delivers-tomato-potato-psyllid-control-in-new-zealand-potato-crops/

Agriculture Victoria, 2004, Tomato spotted wilt virus in potatoes
https://ausveg.com.au/app/data/technical-insights/docs/TL134.pdf

Horticulture Australia Limited, 2005, Improving virus control in seed schemes by combining aphid monitoring and virus testing
https://ausveg.com.au/app/data/technical-insights/docs/PT03061.pdf

Horticulture Australia Limited, 2006, Late Blight Management
https://ausveg.com.au/app/data/technical-insights/docs/PT04010.pdf

Horticulture Australia Limited, 2002, Characteristics of Australian isolates of Phytopthora infestans and planning to manage new and more aggressive strains of the fungus
https://ausveg.com.au/app/data/technical-insights/docs/PT98009.pdf

Hort Innovation, 2018, Review Bacterial Blackleg Disease and R&D Gaps with a Focus on the Potato Industry
https://ausveg.com.au/app/uploads/technical-insights/PT18000.pdf

Horticulture Australia Limited, 1996, Control of blackleg, black scurf and other postharvest storage rots of seed potatoes
https://ausveg.com.au/app/data/technical-insights/docs/PT105.pdf

Department of Agriculture Western Australia, 2005, Potato cyst nematodes *Globodera rostochiensis* and *G. pallida*
https://ausveg.com.au/app/data/technical-insights/docs/TL31.pdf

Horticulture Australia Limited, 1996, Identification of potato cyst nematode pathotypes
https://ausveg.com.au/app/data/technical-insights/docs/PT346.pdf

Horticulture Australia Limited, 1998, Characterisation and detection of potato cyst nematode
https://ausveg.com.au/app/data/technical-insights/docs/PT436.pdf

Prakash Vijayamma Ramakrishnan Nair, The University of Melbourne, Seed tuber incidence and pathogenicity of *Verticillium* species infecting potatoes in Australia
https://www.appsnet.org/publications/Potato_Diseases_Workshop/6.%20Nair_Seed%20tuber%20Verticillium.pdf

Horticulture Australia Limited, 1998, Potato Early Dying in Australia
https://ausveg.com.au/app/data/technical-insights/docs/PT412.pdf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This project has been funded by Hort Innovation, using the potato – fresh and potato – processing research and development levies and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

Hort Innovation Strategic levy investment | POTATO – PROCESSING FUND

Hort Innovation Strategic levy investment | POTATO – FRESH FUND

RMCG

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JUNE 2020

# Australian Potato Pest and Disease R&D Program

Project Updates for Potato Industry Stakeholders

Level 1 East, 1100-1102 Toorak Road, Camberwell Victoria 3124
rmcg.com.au — ABN 73 613 135 247 — RM Consulting Group Pty Ltd
Victoria — Tasmania — ACT — NSW

# Table of Contents

# EXTENSION OF THE PREDICTA PT POTATO DIAGNOSTIC SERVICE

MICHAEL RETTKE, SARDI

2016 - 2020

**Project Overview**

This project builds on the existing PREDICTA Pt service that enables growers to identify fields (or parts of fields) that are at risk of soilborne diseases. Proposed enhancements include; the development of new tests for soil and seed borne pathogens of potatoes; greater knowledge on interpreting results of existing PREDICTA Pt tests over a wider range of environments; introduction of a commercial service for quantifying pathogen levels in the peel of seed tubers.

**Update**

**New tests:**

**Silver scurf** (*Helminthosporium solani*) is mainly of concern to fresh market potato growers and seed producers. Inoculum on seed tubers is the main source of disease. A peel test was developed for *H. solani* in addition to the PREDICTA Pt soil test. It has been evaluated to enable testing of peel samples from seed tubers. The results show the test provides a useful indication of the risk of infection of daughter tubers. This test will be an important addition to the PREDICTA peel testing service under development.

**Verticillium wilt** (*Verticillium dahlia)* causes yield loss of potatoes across Australia. Symptoms cannot always be clearly identified in the field. Therefore, the disease impact can be underestimated. Inoculum in the soil is the main source of disease for potato crops. Sufficient information has now been obtained to establish risk thresholds for the PREDICTA Pt *V. dahlia* test. This will assist growers to better manage this challenging disease in the short and long term. Seed tubers can also be tested, if *V. dahlia* infection is of concern when planning to plant potatoes in paddocks known to be free of *V. dahlia*.

DNA based assays developed previously by SARDI for *Globodera pallida* (**pale potato cyst nematode**) and *G. rostochiensis* (**golden potato cyst nematode**) were evaluated to determine the detection limits, which is critical information for biosecurity use of the test.

**Peel testing:**

In response to resistance to establishing a PREDICTA Pt service based on submitting correctly obtained and dried peel samples, the options to preserve and transport fresh peel samples is being reviewed. A food technologist has proposed a preservation system for wet samples. Laboratory evaluation of the new preservation method is progressing.

**Upgraded PREDICTA Pt training manual**:

Information has been gathered, with chapter outlines and keys points drafted for each pathogen reported in the “under evaluation” section on PREDICTA Pt reports.

**Training:**

PREDICTA Pt is delivered through a network of accredited agronomists, with 51 participants added to this group since project commencement. Training of agronomists continues to extend the geographic range covered by PREDICTA Pt. New tests and greater knowledge on interpreting results of existing tests over a wider range of environments, is delivering benefits to more producers in the potato industries.

# SPONGOSPORA SUPPRESSIVE SOILS IN NEW ZEALAND


## RICHARD FALLOON, PFRNZ


## PROJECT WILL CONCLUDE JUNE 2020

### Project Overview

This project aimed to identify disease suppressive factors in soils that inhibit potato root infections by *Spongopora subterranea* and subsequent development of root galling and powdery scab lesions on potato tubers caused by *S. subterranea*. Results may indicate potential manipulation of soil physical, chemical and/or microbial factors for improved disease management.

This project, which is now being wrapped up, is concentrated on volcanic soils from the Pukekohe region of South Auckland, New Zealand. Some soils in the region have been shown to suppress the development of root galling and powdery scab lesions, even where long-term potato cropping has been carried out with *Spongospora*-susceptible cultivars. A multi-disciplinary approach, using expertise in plant pathology, soil science and microbial bioinformatics, has been carried out encompassing intensive pot experiments and detailed multivariate analyses of the chemical and physical characteristics of several suppressive soils, and of their microbial populations.

### Update

In the first year, a greenhouse pot trial assessed 12 field soils collected into large pots. These were each planted with a seed tuber of a *Spongospora*-susceptible potato cultivar, and treatments of *Spongospora* inoculation or non-inoculation were applied to the pots. Subsequent plant growth, disease incidence and severity, and tuber yields were assessed. Different amounts of *Spongospora* root galling and powdery scab on harvested tubers occurred in the different soils, indicating that some of the soils were suppressive, while others were disease-conducive. In the second year, six of the original field soils were again assessed and the ability for suppressiveness to be transmitted from one soil to another examined. This worked for one soil but not for another indicating that there is more than one aspect to *Spongospora* suppressive capacity of soils. In the third year twelve field soils, with low to very high natural manganese (Mn) levels were assessed and four treatments applied of:

- Nil inoculation (control)
- *Spongospora* inoculation
- Soil-applied Mn
- Soil + foliar-applied Mn.

### Outcomes

- The three pot trials did not indicate consistent responses or trends to treatment
- Analysis of chemical and biological attributes of soils did not indicate a clear reason for suppression of *Spongospora* infections and or expression
- Soil biology did appear to be partly responsible for some suppression of *Spongospora* but results were not consistent
- Volcanic soil with low levels of natural manganese did show improved levels of *Spongospora* suppression when manganese was added
- Volcanic soils with extremely high levels of Manganese were not suppressive to *Spongospora*
- The findings did not lead to a practical outcome for growers but is a very important step to understanding disease suppression.

# REVIEW OF THE NATIONAL BIOSECURITY PLAN FOR THE POTATO INDUSTRY AND DEVELOPMENT OF A BIOSECURITY MANUAL FOR POTATO PRODUCERS

VICTORIA LUDOWICI, PHA

2016 - 2021

**Project Overview**

Biosecurity planning and implementation of plans by governments and growers is a key risk mitigation strategy that gives an industry the best chance to prevent or eradicate incursions. This project is reviewing the biosecurity plan for the potato industry to support the industry in satisfying their biosecurity obligations (shared responsibility) under federal and state legislations and the Emergency Plant Pest Response Deed.

As a part of this project exotic pests (insects, nematodes and pathogens [diseases]) were assessed by technical experts to identify those of highest risk (i.e. likelihood of incursions and economic consequences) and thus priority to the potato industry. Established pests and weeds of biosecurity significance under official control (e.g. TPP, PCN) were included. After the pests that pose the greatest threat to the potato industry were identified, an expert group (Biosecurity Reference Panel, BRP) was convened from government and industry to agree on mitigation measures to protect against them. These implementation activities form a key part of the biosecurity plan. Over the life of the project the plan will continue to be reviewed annually through the BRP.

The information gathered in the planning process was used to inform the development of the Potato Growers' Biosecurity Manual, which was published in consultation with industry, government and Hort Innovation. This document was sent out to 3000 growers with the Potatoes Australia Magazine in June 2018.

**Update**

- Version 3.1 of the Biosecurity Plan for the Potato Industry was completed in February 2019
- Version 3.1 required minor changes to the exotic high priority pest list and implementation table
- Green peach aphid and potato tuber moth were removed from the list of established pests of biosecurity significance; they are now considered endemic nationally
- Due to travel restrictions imposed as a result of the COVID-19 pandemic as well as the reprioritisation of time among key stakeholders during this period a Reference Panel meeting for 2020 has not yet been held and an update to the Plan not completed for 2020. PHA is still in contact with all stakeholders and will organise a meeting as soon as possible.

# MECHANISMS AND MANIPULATION OF RESISTANCE TO POWDERY SCAB IN POTATO ROOTS

CALUM WILSON, TIA

2019 - 2021

**Project Overview**

This project aims to: (a) determine the nature of *Spongopora subterranea* attachment to potato roots, (b) characterise public cultivars for resistance to pathogen attachment to potato roots and root disease (galling), (c) examine manipulation of attachment sites through binding blockers or similar approaches, (d) develop and screen variants of important public cultivars with altered root attachment capacity and analyse variants for the genetic changes associated with reduced binding that will be useful for rapid screening of new germplasm.

This project will lead to benefits for the fresh and processing Australian potato industries by reducing potato crop losses and input costs as follows:

- Reduced losses due to root disease caused by infections with *Spongospora subterranea*. This will be achieved by deployment of resistant cultivars and/or blockers to reduce pathogen root binding
- Reduced requirements for agronomic inputs (fertiliser, water) needed to compensate for reduced root function in diseased plants and greater quality tubers with better storage capability due to reduced lesions
- Development and adoption of more efficient resistant screening technologies to test new varieties of interest to industry for resistance to root disease.

**Update**

- Histological studies of zoospore attachment have been completed with preferential binding sites across susceptible and resistant cultivars determined within root hairs associated with the root elongation zone. This has provided a target region for examination of root surface proteins
- Preliminary studies have examined the most appropriate and efficient methodologies for extraction of quality proteins from small sample sizes. The team have determined empirically that a S-trap protein column provides the most efficient means for extraction and purification of proteins from samples. This provides quality protein suitable for LC/MS analysis within the UTAS CSL. Dr Richard Wilson (CSL) a proteomics expert, has been engaged to assist with the protein analyses
- An article on the PhD student (Xian Yu) who is associated with the study and wider project aims was published by AUSVEG in the weekly e-newsletter and available on their website at insights-into-spongospora-root-diseases-and-its-management/
- Experimental refinement of screening methodologies have been completed in order to efficiently screen the large numbers of cultivars and breeding materials to be examined in this project
- Screening of the large variety collection has commenced to ascertain efficiency of differentiation of susceptible and resistant cultivars. Screening will take 2-3 further months to complete with sufficient rigor to report outcomes. This delay is a result of the significant delay in contracting and commencement of the project.

# NATIONAL TOMATO POTATO PSYLLID (TPP) COORDINATOR PROJECT


## ALAN NANKIVELL, AUSVEG


## 2017 - 2020

**Project goals**

- Growers will have the necessary knowledge to use biologicals and chemicals to mitigate the impact of TPP in field
- That an ongoing national surveillance program will be coordinated to provide ongoing evidence of where TPP is and where it isn't
- That a sustainable potato industry will prevail which ensure the continuation of business across state borders
- That the strengthening of relationships between industry stakeholders and regulatory bodies continues and is maintained.

**Update**

- TPP web portal created and maintained
- Enterprise Management Plans completed
- Research and Development Plan completed and under constant review
- Implemented a national trapping and monitoring program for TPP across the nation in the 2019-20 season
- Regained market access for WA to other states
- Regulatory commitment and movement requirements to enable business continuity for eastern states now in place for ware and processing potato tubers even if CLso is detected
- The impact of COVID19 on the TPP project has been significant. Firstly, the seed potato risk workshop scheduled for the 23rd March was cancelled and subsequently a series of grower meetings scheduled for April and May were put on hold. Both these activities were very important to the completion of the TPP project. After discussions with key stakeholders across the industry, the Chair of PHC and Hort Innovation, it was concluded that the seed potato risk workshop was an essential achievement to be completed as part of the project. It was the view of key stakeholders that it was best that this workshop be undertaken using a face to face format. The other deliverables such as the national management plan are on hold till that to can be informed by the outcomes of the seed workshop. Upon further reflection it has been decided to suspend the project to 30th June 2020 and then if the wider circumstances permit it will recommence the project on 1st July 2020 to be completed by 30th September 2020
- An article reporting on the first year of operation of the national TPP surveillance project due for publication in June 2020.

# AN IPM EXTENSION PROGRAM FOR THE POTATO AND ONION INDUSTRIES

PAUL HORNE AND JESSICA PAGE, IPM TECHNOLOGIES PTY LTD

## 2016 - 2021

**Project Goal**

This project aims to demonstrate IPM in potato and onion crops in all major production regions of Australia during the life of the project.

**Update**

Ongoing backup support was provided to collaborators (both farmers and agronomists) from years 1 and 2 of the project as required. This included farmers and agronomists in SA, Tasmania and Victoria. Most commonly this advice concerned insect identification and the selection of insecticides.

Training sessions were presented, and field visits have commenced or are scheduled for summer 2019/20 in each of the following locations:

- SA – Nuriootpa; Langhorne Creek
- Vic – Gippsland (Boneo, Warragul, Thorpdale and KooWeeRup swamp) and Ballarat
- Tas – Locations near Launceston, Devonport and Wynyard.

One important additional result is the commencement of training with the seed certification body AUSPICA. A training workshop specifically for seed inspectors was planned for early 2020 and some in field training and backup has already commenced.

New field training locations at present include Langhorne Creek (SA) with Farmer Johns agronomist and farmers; Thorpdale (Vic) with Elders, EE Muir and Sons and AUSPICA agronomists and farmers; Boneo (Vic) with independent advisor and farmer; Kooweerup with Elders agronomists and farmers; various location on north coast Tasmania with EE Muir and sons; Roberts, Serve-Ag; independent advisors and farmers.

Field visits will continue to be timed to see different stages of the crops and demonstrate how decisions on pest management were made using an IPM approach.

Demonstrations will continue in new regions in the next 12 months but will also consolidate the achievements made to date by running further demonstrations and training in some regions where there have been requests for further support. The next likely groups for training and demonstrations are growers and advisors in Queensland and NSW.

This report has been prepared by:

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**Document review and authorisation**

**Project Number: #509**

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|---|---|---|---|---|---|---|---|
| 1.0 | Draft | 02/06/20 | K. Stirling | | | | Project leads |
| 2.0 | Final | 10/06/20 | K. Stirling | D. Blaesing | J. Longford | D. Blaesing | Potato industry stakeholders |

# Pest and Disease R&D program for potatoes

## Program Update 2021

Six projects looking at:

- Powdery scab
- Pink rot
- TPP
- IPM
- Biosecurity
- Diagnostics.

COVID-19 has impacted delivery of a number of these projects.

# Predicta PT

Michael Rettke (SARDI) 2017 – 2021

- This project is nearing completion.
- The Predicta PT Manual has been updated with 3 modules at the start, and a chapter on every pathogen. Large manual with full-page pictures which is provided to trained agronomists.
- An awareness guide has also been developed for growers which focusses on what information the tests provide, and what symptoms look like. It provides growers with greater understanding/information to facilitate discussion with agronomists.
- Agronomist training by SARDI may be expanded to include an online training module however face to face appears to be preferred.
- The peel service now uses a desiccant system to keep samples usable. The Predicta PT service can test stems and roots, apart from soils, providing more flexibility for clients. There has been an increased uptake by research providers for in-crop testing.

# Mechanisms and manipulation of resistance to powdery scab in potato roots

Calum Wilson (TIA) 2019 – 2022

- Project will now be completed in 2022 (delays due to CVOID-19 restrictions).
- Rapid resistance screening of 100 varieties underway. Process involves incubation of root tissue with pathogen and then counting number of zoospores which have developed. Public and private varieties are listed from highly susceptible to low susceptibility to powdery scab. Varieties are then assessed for gene markers which identify level of resistance. This component of work, to be completed by PFRNZ, has been delayed by COVID. New varieties have been sourced from Australia. Phenotyping and DNA extraction is well underway.
- Development of new resistant varieties using somaclonal selection has previously been done for common scab, and this project aims to do it for powdery scab. Consultation with industry has identified relevant varieties. Callus has been developed and variants currently being tested.
- Project is also investigating how/where root encystment occurs. Root hairs in the elongation zone are the primary targets for zoospore attachment. The project is undertaking a comparison study of root proteins using a proteomics approach to understand attraction and attachment of the pathogen.

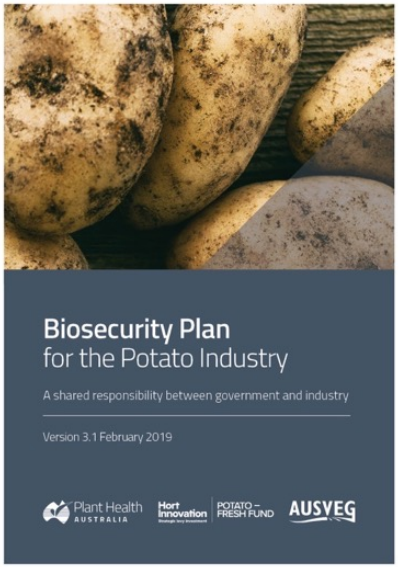
# Pink Rot: Impact of soil pH and nutrition

Robert Tegg (TIA) 2020 - 2021

- This pilot study, which started 6 -7 months ago, is investigating pink rot, which has been prevalent in Tasmania over the last 3 years.
- The study will investigate the impact of soil pH and nutrition, especially Calcium, but also typical nutrition programs on pink rot incidence and severity (survey approach). Soil moisture impacts will also be noted. An initial draft of the literature review has been completed.
- Research will include:
  - Field/industry survey of 20 sites over 2 years looking at:
    - Soil parameters
    - Historical information from growers, processors and agronomists
    - landform assessment with a focus on drainage.
  - Pot trials to investigate factors identified in the literature review and survey.
- Symptom identification of pink rot is not that easy as you don't always get 'textbook' symptoms. You can see rot, but it doesn't always turn pink. It can also be associated with other rots (such as Pectobacterium).

# Biosecurity Plan Update and Manual

Stuart Kearns (PHA) 2016 - 2021




- The Hort Innovation funded project for updating the Biosecurity plan for the Potato industry will conclude on the 30 June 2021.
- An industry meeting was held in November 2020 via teams to identify any changes to High Priority Pests and priority R&D areas for biosecurity management in both potato and other vegetable crops. The updated implementation table was put forward to the committee for endorsement early in 2021. Based on endorsement by the committee the plan will be finalised. Changes have included:
  - Addition of serpentine leaf miner and fall army worm to the established pest list
  - Additional information has been added for cluster caterpillar.

# National TPP Coordination Project

Alan Nankivell (AUSVEG) 2017 - 2021

- Project has been suspended during COVID-19.
- Focus in on business continuity if TPP present, and what industry needs to do to mitigate risk of spread.
- Final workshop will be held with stakeholders from seed, ware and processing sectors and focussed on identifying hazard points, current practices and gaps for mitigating CLso.
- Final report will be developed and PHC will have ultimate responsibility for TPP and CLso prevention via education about on-farm practices and risks.

# IPM in Potatoes

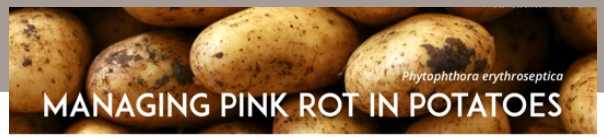
Paul Horne and Jessica Page (IPM Technologies) 2016 - 2021

- Approach for project has been to focus on regions and for each region identify pests of concern and the control options (chemical, biological and cultural) available for those pests.
- COVID-19 has resulted in reduced travel.
- Working in Tasmania with agronomists and field officers (particularly Simplot) where there has been good adoption of IPM for all vegetable crops
- In SA, prior to COVID-19 working with an agronomist face to face, which has been continued online.
- One online session via zoom with Gawler River Produce who quickly adopted IPM principles.
- Pesticide toxicity guide for beneficial insects www.biologicalresearchguidecompany.com.au developed for vegetables but also relevant for potatoes.

# Resources

- Pink rot
- Powdery scab
- Blackleg

- International scan of pest and disease R&D



*Phytophthora erythroseptica*

## MANAGING PINK ROT IN POTATOES

Pink rot is a soil-borne disease caused by the pathogen *Phytopthora erythroseptica*. This fact sheet provides information on the pathogen, its lifecycle and management options.

### MANAGEMENT OPTIONS

Use the following options to help manage pink rot:

- Use Metalaxyl and Metalaxyl-M (mefenoxam)* according to label instructions
- Keep soil moist (between field capacity and above wilting point) but without excess moisture.
- Use the PreDicta Pt service to identify areas that are infected with the pink rot pathogen
- Avoid planting into soils that are compacted (> 2000 kPa with a penetrometer) and/ or waterlogged. Consider using controlled traffic and/or minimum tillage practices to improve soil condition.
- Remove all volunteers and weeds that can act as potential hosts.
- Avoid mixing tubers from contaminated areas with other tubers during storage or better still avoid harvest of contaminated tubers.
- Rotate potatoes with other crops (for at least 4 years)
- Use clean, certified seed.

Photo: Jordan Eggers, Oregon State University

### THE PATHOGEN AND DISEASE

Pink rot of potato is an important soil-borne storage disease of potatoes worldwide. It is caused by the fungus *Phytophthora erythroseptica* and sometimes by *Phytophthora cryptogea*. Pink rot infection is often associated with secondary infection by anaerobic soft rot bacteria. Key features of pink rot are that:

- Infections vary in virulence
- Some cultivars are less susceptible than

### POTENTIAL MANAGEMENT OPTIONS

Research has shown that:

- Biofumigants such as mustards can be effective. Biofumigants should be used according to best practice advice.
- Low soil pH (<5) in the rootzone and low levels of free calcium in the soil solution may increase pink rot severity.[1] Liming and soil application of soluble calcium fertilisers may alleviate this risk (by increasing the pH and the soluble calcium). Further research is required to better understand this relationship.

## MANAGING BLACKLEG IN POTATO

### WHAT IS IT?

This fact sheet provides information on managing Blackleg in potato crops, the bacteria which commonly cause the disease and what you can do to prevent and manage it.

Blackleg on potato can be caused by either *Pectobacterium* or *Dickeya* species, and they often work together in different combinations to cause this disease. Both bacteria species belonging to the *Pectobacteriaceae* family. In Australia, bacteria causing Blackleg was previously classified as *Erwinia* species.

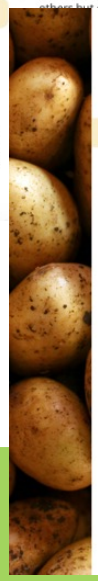
### WHAT DOES IT LOOK LIKE?

Blackleg causes stem decay, often extending several centimetres above the ground. Damage to the inside tissue continues even higher up inside the stem (Figure 1 right). Plant leaves may turn bright yellow and/or curl and the plant will eventually wilt and die (Figure 2 lower right). Infected plants produce few or no tubers.

Blackleg can also cause severe seed decay and lack of plant emergence in severe cases (Figure 3 below).

**Figure 1:** Blackleg internal symptoms where the two plants on the left are infected by soft rot bacteria, causing blackened internal symptoms and crop wilt, compared with a healthy plant on the right (© 2020 DPIRD)

plant in field infected
Nandita Pathania,



*Spongospora subterranea*

## MANAGING THE RISKS OF POWDERY SCAB IN POTATOES

This guide is based on current knowledge on management of powdery scab, highlighting key factors that affect the risks of this disease and opportunities for effective disease management.

### WHAT IS POWDERY SCAB?

Powdery scab is caused by *Spongospora subterranea*. This pathogen can survive for long periods in the soil (greater than 10 years). The pathogen is both seed tuber and soil borne. Disease development and the severity of symptoms vary depending on a range of factors, including inoculum levels in soil or on seed tubers, soil and atmospheric conditions, cropping history, and potato cultivar.

The disease can cause major losses of marketable yield from fresh market potato crops, and substantial rejections in processing for French fries or crisp production. Tubers with powdery scab lesions are also susceptible to other diseases. The scab lesions can be infection points for other pathogens, and powdery scab has been implicated in increasing susceptibility to tuber late blight (*Phytophthora infestans*), pink rot (*Phytophthora erythroseptica*), dry rot (*Fusarium caeruleum*) and tuber rot caused by *Colletotrichum atramentarium*.

Photo: Richard Falconer

**Figure 1.** *Spongospora subterranea galls on stolon*

### WHAT DOES IT LOOK LIKE?

- *Spongospora subterranea* can form small white to dark brown growths (galls) on potato roots and stolons. (see Figure 1 left)
- Cankers may deform tubers.
- Scabs on tubers erupt to disperse a fine powder of spores leaving ragged edged scabs. (see Figure 2 right)
- Non-erupting scabs may develop surrounding areas of discoloured tuber tissue which is variable in size.
- Depending on temperature and progeny, tuber scabs may take 6 to 8 weeks to develop, and may not be evident in growing crops.
- Common scab and powdery scab lesions look similar. Common scab lesions tend to be more corky in appearance and angular in shape, and can be raised or pitted.

Photo: Robert Lamberts

**Figure 2.** *Ragged edged scabs on tuber*

### FACTORS THAT ENCOURAGE SPONGOSPORA INFECTIONS

Potato crops are especially susceptible to powdery scab;

- During the tuber initiation phase of crop growth
- When temperatures are between 9°C and 17°C (optimum is approx. 12°C)
- When soils are wet
- In poorly drained soils (due to compaction, soil pans or over-working).

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