What's happening overseas?

International potato pest and disease R&D scan

2020

Hort Innovation
Strategic levy investment

POTATO – PROCESSING FUND

Hort Innovation
Strategic levy investment

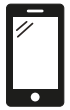
POTATO – FRESH FUND

RMCG

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

RMCG

This guide has been prepared by RM Consulting Group on behalf of Hort Innovation

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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:

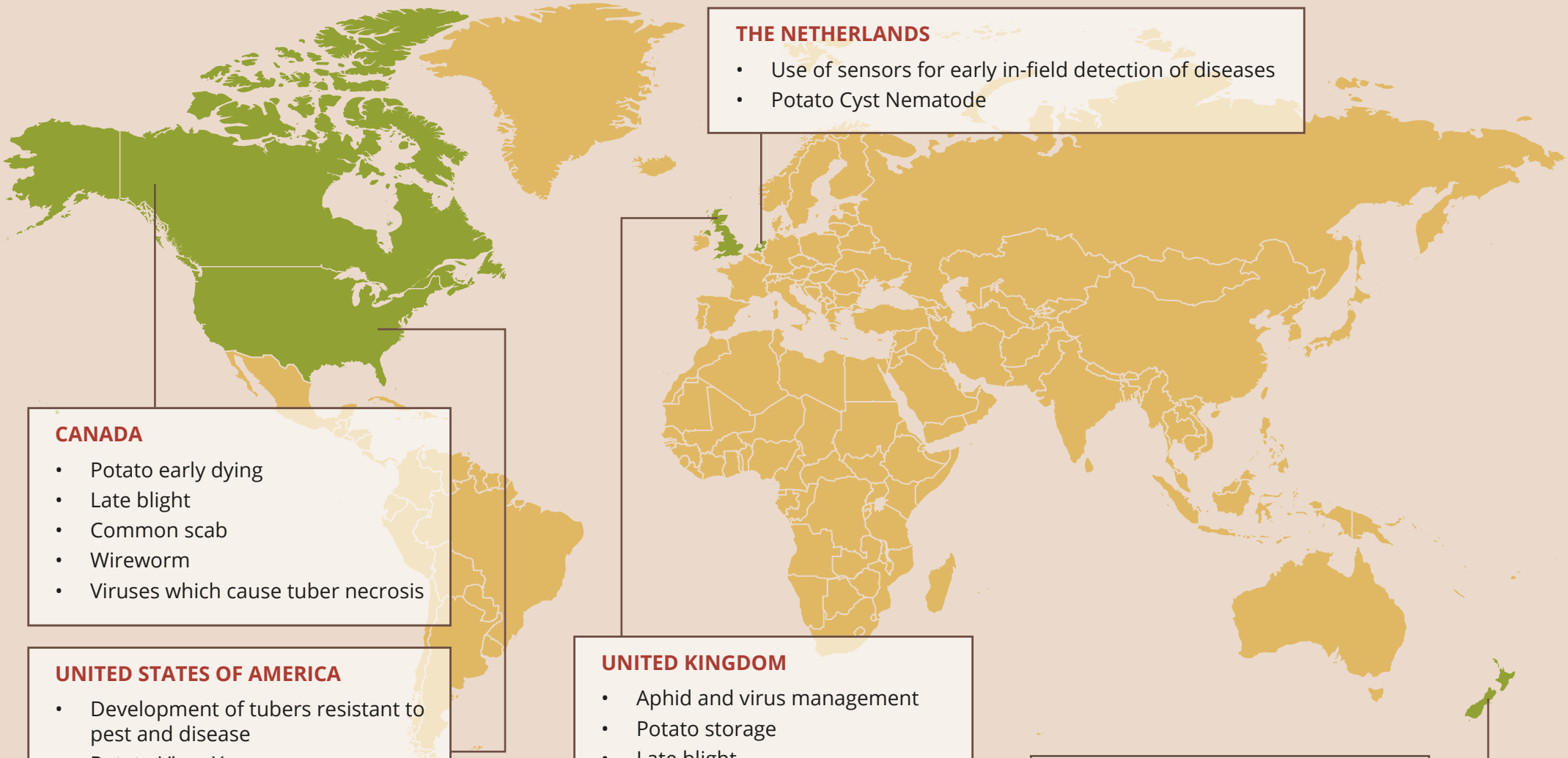
- The disease identification smartphone App 'Buntata' (James Hutton Institute)
- Resources to identify the diseases and defects that impact on the quality of tubers during storage (AHDB)
- Aphid and virus management resources (AHDB)
- TPP Pocket Book (NZ).

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).

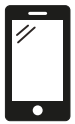
"Buntata has been designed to help users identify plant pests and diseases with no apriori knowledge," says Sebastian Raubach, a Bioinformatics Software Developer at Hutton, involved in the development of the app. "Buntata provides a visual key for the identification of diseases by displaying images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

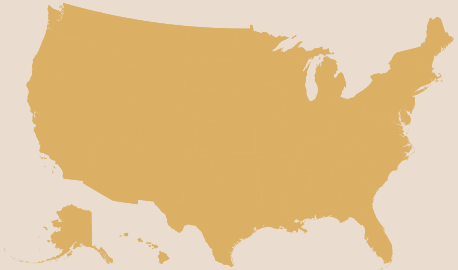
"Diseases can exhibit similar symptoms," Raubach says. "Differentiating between say powdery and common scab requires experience. Buntata displays diseases with similar symptoms together, allowing easy comparison to help users identify the correct one."

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

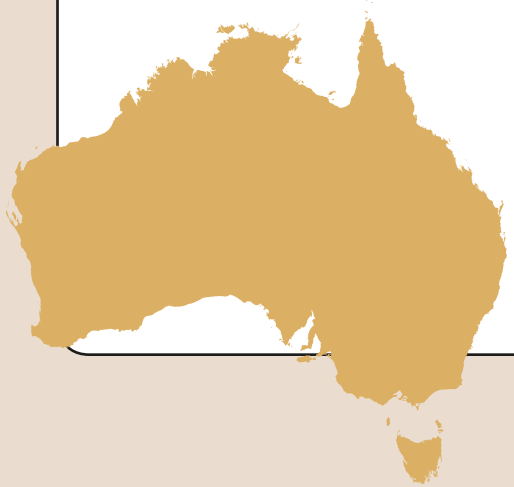
WUR will study wild potato varieties for resistance to a wide range of potato diseases and pests. This broad approach should yield breeding material that can be used to develop disease resistant potato varieties capable of contributing to sustainable potato production. The research is commissioned by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

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.

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.

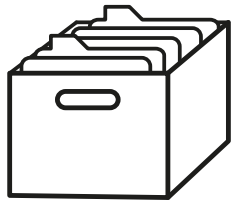
Soil and plant samples were collected from 77 potato fields from South Australia, Victoria, New South Wales, Queensland and Tasmania. Both *Verticillium* and *Pratylenchus* were widespread, with the pathogens found in 90% of the fields sampled. Soil populations of *Verticillium* at levels that caused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

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SUMMARY

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UNITED STATES OF AMERICA

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APS Publications, Development of the Automated Primer Design Workflow Uniqprimer and Diagnostic Primers for the Broad-Host-Range Plant Pathogen Dickeya dianthicola
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CANADA

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THE NETHERLANDS

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Hort Innovation Strategic levy investment | POTATO – PROCESSING FUND

Hort Innovation Strategic levy investment | POTATO – FRESH FUND

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