Potatoes
NEW ZEALAND

Fruitfed Supplies

Sustainable Growth

2021 Potato Industry Forums

Ashburton 13th August
Pukekohe 19th August & PNZ AGM

A message from CEO & Chairman

Dear Members, Sponsors and Guests,

Welcome to the inaugural Potatoes New Zealand 2021 Industry Forums. These events in Ashburton and Pukekohe have come about due to the 18 months of global pandemic and a need to run smaller more resilient events. 2021 would have been the year for our biennial conference which usually attracts 180-200 delegates from here and abroad however we deemed this too risky in the current climate of unknown, last minute change.

This year's events promise to be a collaboration of great science, market expertise and inspiring international and domestic presenters.

It's our pleasure to host you at these forums, in our North and South Island great growing regions. If there is anything we can do to make it more enjoyable for you, please ask Gemma or Nicola at the conference registration desk.

We would like to extend a special welcome to our platinum lead sponsors Fruitfed Supplies as well as our other sponsor support from **Inta-Ag**, **Wyma**, **Trust Alliance New Zealand**, **Corteva**, **Leicesters**, **Ray Mayne**, **Almac**, **Landpower**, **Penergetic**, **Plant and Food Research**.

Their generous support is truly appreciated.

Today you will hear about the latest challenges, R&D and market trends.

If you are on Facebook, Twitter, Linkedin or Instagram, please add the hashtag **#PIF2021** in your posts so we can all follow each other.

The conference is a great chance to make new contacts with fellow growers, agronomists and trade suppliers. We encourage you to network throughout the conference and afterward.

Thanks for coming and please enjoy.

Chris Claridge
CEO PNZ

Stuart Wright
Chair of PNZ Board

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Trust Alliance New Zealand

Emergency Evacuation Plan

Example emergency procedures

Evacuation procedures

1. Follow warden's instructions.
2. Walk to the nearest exit.
3. Keep together with the nearest people around you.
4. Use the stairs (not the lift)
5. Do not go back to collect personal items.
6. Meet at the assembly area _____ and report to wardens.

DO NOT LEAVE THE ASSEMBLY AREA UNTIL YOUR WARDEN HAS SAID YOU CAN

Armed robbery

1. Keep calm, make no sudden movements.
2. Do what the offended asks.
3. Try to memorise as many details about the offender as possible.
4. Note the direction and method of escape.
5. Notify police as soon as it is safe to do so. Leave the phone line open until the police arrive.
6. Provide first aid to victims, and lock outside doors.

Earthquake

In an earthquake:

1. Keep calm.
2. Move away from windows, equipment and shelves that may fall.
3. Take cover under solid furniture such as tables and desks.

When the shaking stops:

4. Keep calm and help those that need assistance.
5. Warden to turn off all electrical sources and gas taps.
6. Wait for orders from your warden.

If you need to evacuate or if the fire alarm sounds:

7. Use evacuation procedures to leave the building.
8. Keep together.
9. Follow the warden's instructions.
10. Meet at the assembly area _____ and report to wardens.

DO NOT LEAVE THE ASSEMBLY AREA UNTIL YOUR WARDEN HAS SAID YOU CAN

Fire

If you discover a fire:

1. Activate the alarm and dial 111.
2. Alert people in your area and the warden.
3. Do not extinguish the fire unless there is no personal danger to you or anyone else.
4. If time permits and there is no danger, close all doors and windows.
5. After evacuation meet at the assembly point in teams.

If the fire alarm sounds:

6. Walk quickly to your nearest exit.
7. Do not stop to take personal items with you.
8. Meet at the assembly area _____ and report to wardens.

DO NOT LEAVE THE ASSEMBLY AREA UNTIL YOUR WARDEN OR THE FIRE SERVICE HAS SAID YOU CAN

Hospitality The Voice of Hospitality NEW ZEALAND

WorkSafe

Contents

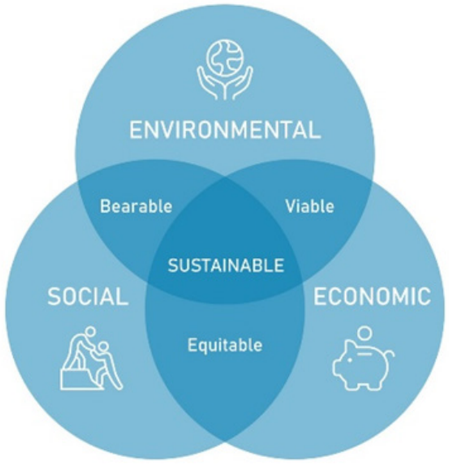
Sustainable Growth
2021 Potato Industry Forums

Sustainability: What does it really mean?

The UN Brundtland Commission's 1987 report to the UN General Assembly called for "meeting the needs of the present without compromising the needs of future generations" (UN General Assembly, 1987). This is the principle underpinning the idea of sustainability.

Sustainability should influence:

- Economic Outcomes
- Social Outcomes
- Ecological Outcomes



To influence all these areas and continue to grow as an industry we need a complex and systemic plan.

The team at PNZ exist to remove the barriers to our industry maintaining sustainable growth.

We collaborate with the PNZ Inc. board on strategy, policy, targets, and overall industry vision as driven by the growers' needs.

We achieve the targets and maintain the overall strategic vision by working to the business plan which is reviewed every 6 months.

Currently there is no clearly stated Strategic Vison for PNZ and the NZ Potato Industry. We would like feedback from industry on the vision. Talk to one of our team or the board to share your thoughts on the following statement.

Strategic Vision: PNZ are here to sustainably grow the NZ Potato Industry.

PNZ do this by working towards these 3 targets:

1. **Double the value of fresh & processed exports by 2025.**
   - Aligned with objectives of the government's business growth agenda
   - Implies volume and value growth
2. **Enhance the value of the domestic market by 50% by 2025.**
   - Implies value growth on stable volumes above CPI
3. **Zero net nutrient and GHG emissions by 2035**
   - Aligned with the objectives of the government's emission targets
   - To be achieved in order of priority via reduction, mitigation, and offsetting

We work towards these targets by following the agreed Business Plan themes, initiatives, and activities.

Ashburton Programme 13th August

Time	Theme	Topic	Speaker(s)	Sponsor
9.30am	Markets	**Economic Outlook for Agriculture**	Bernard Hickey	TANZ
		Domestic Market/ Supermarkets	Katherine Rich NZ Food & Grocery Council	
		NZ Potato Industry Volumes & Values	PNZ: Gemma Carroll	
		NZ Industry Overview	PNZ: Gemma Carroll	
		Tariff Application Update	PNZ: Chris Claridge with Simon Crampton	
10.30am		MORNING TEA		CORTEVA
	Industry Good	**PNZ Biosecurity Emissions & Levy Information System (BELIS)**	PNZ team: Nicola Loach & Chris Claridge	
		Blockchain, Integrated Farm Planning & Data Interoperability	Trackback Team: Klaeri Schelhowe	
		Health & Safety on farm	Onside Team: Ryan Higgs	
		Future Proofing Vegetable Production Project Conclusion	Potatoes NZ & Landwise	
		Grower Feedback Session: future projects Q&A	PNZ team: Gemma Carroll, Iain Kirkwood and agronomists.	
12.30pm		LUNCH		WYMA
	R&D & Environ-ment	**Sustainable Vegetable Systems project update**	SVS PROJECT LEADER: Andrew Barber with PFR: Bruce Searle & PNZ's Iain Kirkwood	Horticulture NZ VR&I PNZ MPI (PFR)
		He Waka Eke Noa: HWEN overview, calculation & cost advice	PNZ: Iain Kirkwood	
		Farm Environment Plans	Agrimagic: Charlotte Glass	
		Spray Resistance Management TBC	PNZ: Iain Kirkwood	
2.20pm		**SHORT BREAK**		
	Quality	**PNZ Seed Scheme: restructuring and database**	PNZ: Iain Kirkwood & Paula Lleras	
		WYMA Sponsor Topic: Sustainable Food Production	Dr. Kent Stewart	WYMA
		Powdery Scab	UNIVERSITY TASMANIA: Calum Wilson	WYMA
		Psyllid & Liberibacter: IPM & other projects with Q&A	PNZ: Iain Kirkwood, PFR: Jessica Dohmen-Vereijssen, and agronomists	
		Platinum Sponsor Session: Overview of TPP in Canterbury/product & timing	FRUITFED SUPPLIES: Daniel Sutton	FRUITFED SUPPLIES
4pm		**SOCIAL DRINKS & NIBBLES**		LEICESTERS

Pukekohe Programme 19th August

Time	Theme	Topic	Speaker(s)	Sponsor
9.30am	Markets	**Economic Outlook for Agriculture**	Bernard Hickey	TANZ
		Domestic Market/ Supermarkets	Katherine Rich NZ Food & Grocery Council	
		NZ Potato Industry Volumes & Values	PNZ: Gemma Carroll	
		NZ Industry Overview	PNZ: Gemma Carroll	
		Tariff Application Update	PNZ: Chris Claridge with Simon Crampton	
10.30am		MORNING TEA		CORTEVA
	Industry Good	**PNZ Biosecurity Emissions & Levy Information System (BELIS)**	PNZ team: Nicola Loach & Chris Claridge	
		Blockchain, Integrated Farm Planning & Data Interoperability	Trackback Team: Klaeri Schelhowe	
		Health & Safety on farm	Onside Team: Ryan Higgs	
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		He Waka Eke Noa: HWEN overview, calculation & cost advice	PNZ: Iain Kirkwood	
		Farm Environment Plans	MY ENVIRO: David Pool	
		Spray Resistance Management TBC	PNZ: Iain Kirkwood	
2.20pm		**SHORT BREAK**		
	Quality	**PNZ Seed Scheme: restructuring and database**	PNZ: Iain Kirkwood	
		WYMA Sponsor Topic: Sustainable Food Production	Dr. Kent Stewart	WYMA
		Powdery Scab	UNIVERSITY TASMANIA: Calum Wilson	WYMA
		Psyllid & Liberibacter: IPM & other projects with Q&A	PNZ: Iain Kirkwood, PFR: Frances MacDonald, and agronomists	
		Potato Tuber Moth	PNZ: Iain Kirkwood, PFR: Frances MacDonald and agronomists	
		Platinum Sponsor Session: Overview of TPP in Canterbury/product & timing	FRUITFED SUPPLIES: Daniel Sutton	FRUITFED SUPPLIES
4.30pm		**SOCIAL DRINKS & NIBBLES**		LEICESTERS
4.30pm		**AGM for Potatoes NZ Inc.**		

SPEAKERS & TOPICS

Economic Report & Outlook for Agriculture

Bernard Hickey economic commentator for The Spinoff and Stuff.co.nz kicks off the day with his inimitable wit and astute observations of economic tracking, delivered in an engaging manner. Bernard will detail the wider economic and political drivers around global trade, local environmental and economic policy. He will look at trends for interest rates, the currency, water and climate policy, and politics more generally.

Domestic Markets

New Zealand Food & Grocery Council Chief Executive Katherine Rich looks at the supermarket duopoly and the Commerce Commission's Market Study.

Katherine Rich is Chief Executive of the New Zealand Food and Grocery Council, an industry association that advocates on behalf of the manufacturers and suppliers behind New Zealand's food, beverage, and grocery brands. The sector generates more than $40 billion sales in the domestic market, and $34 billion in export revenue from 195 countries – representing 65% of total merchandise exports and 46% of total exports. Food and beverage manufacturing is New Zealand's biggest manufacturing sector in, representing 45% of total manufacturing income and employing one in five of the workforce.

Katherine was a Member of Parliament 1999 – 2008 and prior to that held several agribusiness marketing roles. She is Chair of the New Zealand Parliamentary Education Trust, and a Board member of the International Business Forum and children's charity Bernardo's. She is a former New Zealand member of the APEC Business Advisory Council, Chair of Fairtrade Australia New Zealand, Deputy Chair of the Food Safety Advisory and Assurance Council, and Board member of the Health Promotion Agency.

2020 Potato Industry by Volume

	Total 2020	Seed 2020	Table 2020	Processed 2020
Area (ha)	9,775	1,075	5,500	5,500
Production (MT)	497,634	20,434	147,200	330,000

Seed (MT)	**2020**
Export	25
Domestic Sales	20,408
Total	20,434
% of total Grown	4%

Table Potatoes (MT)	**2020**
Export	25,352
Domestic Sales*	105,000
Foodservice*	5,000
Total	135,352
% of total grown	27%

* assumed

Crisps (MT)	**2020**
Raw Potatoes	57,907
Domestic Mfg	12,739
Import	2,122
Total	14,862
Export	849
Retail	14,012
Total	14,862
% of total grown	12%

Frozen/Fries (MT)	**2020**
Raw Potatoes	272,093
Domestic Mfg	139,656
Import	18,158
Total	157,814
Export	60,249
Retail	25,989
Total	157,814
% of total grown	55%

Potatoes NEW ZEALAND

2020 Potato Industry by Value

	Total 2020	Seed 2020	Table 2020	Processed 2020
Area (ha)	9,775	1,075	5,500	5,500
Production (MT)	497,634	20,434	147,200	330,000

Seed ($000)	**2020**
Export	$18
Domestic Sales	$16,327
Total	$16,345
% of total Grown	1%

Table ($000)	**2020**
Export	$20,016
Domestic Sales	$234,413
Foodservice	$30,000
Total	$284,429
% of total grown	25%

Crisps ($000)	**2020**
Export	$6,844
Retail *	$237,411
Total sold	$244,254
% of final industry value	21%

*assume extra 10% value above Scan Data

Frozen/Fries ($000)	**2020**
Export	$78,960
Retail*	$107,245
Food Service	$429,462
Total Sold	$615,667
% of final industry value	53%

*assume extra 10% value above Scan Data

	2020
Domestic	$1,054,857
Export	$105,838
Total Industry Value ($000)	$1,160,695

2020 Total Industry Value: $1,160 million p.a.

Potatoes NEW ZEALAND

Notes: Currency is NZD.

NZ Potato Industry Values & Volumes for the year ended December 2020

Industry Overview

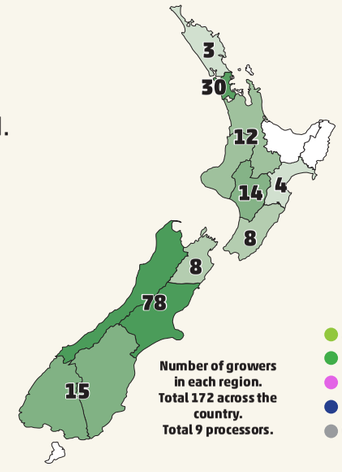
Potatoes are grown across Aotearoa and harvested year round.

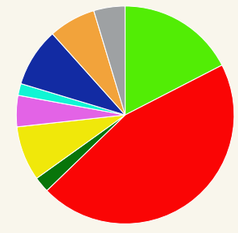
Values

In 2020:

*1 metric tonne = 1000kgs

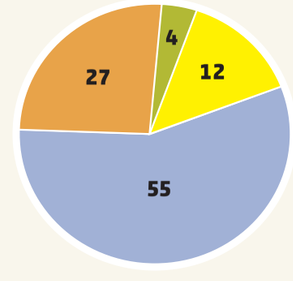
- **498,634 MT*** produced from **9,775 hectares**
- NZ 2020 average yield = **51,000kgs per hectare**
- Farmgate value **$181,516,000**
- **Export** value **$10,827 per hectare**
- **Total Export** value **$105,838,000**
- **Domestic Retail** value **$107,913 per hectare**
- **Total Domestic Retail** value **$1,054,857,000**
- **2%** of value was **seed**
- **20%** of value was **crisps**





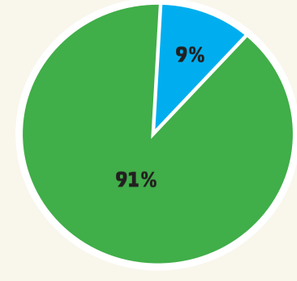
Auckland
Hawkes Bay
Nelson/Marlborough
Otago/Southland
Wairarapa
Canterbury/Westland
Manawatu
Northland
Taranaki/ Waikato

% of total industry value



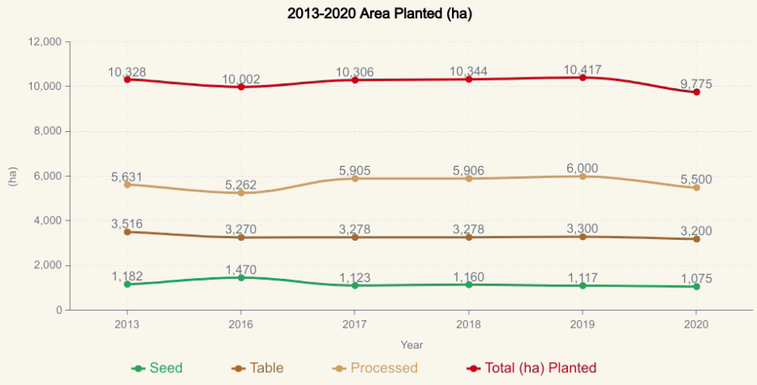
seed
crisps
processed frozen
fresh/ware

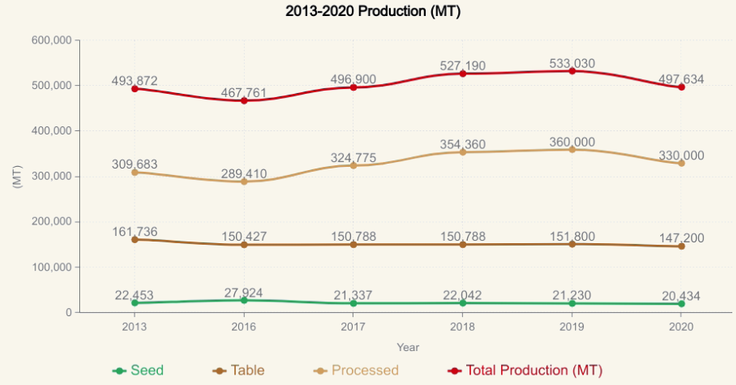
Industry value $1,160,695,000

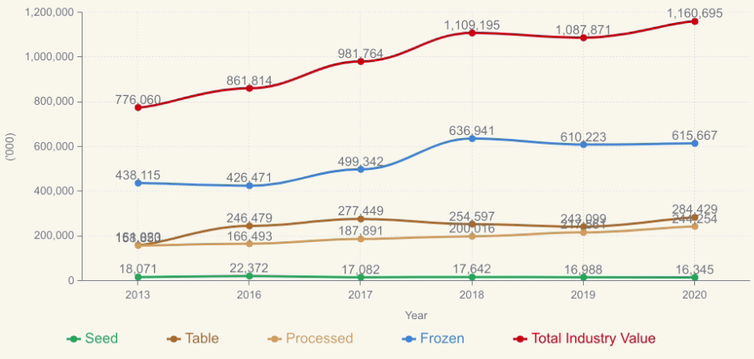


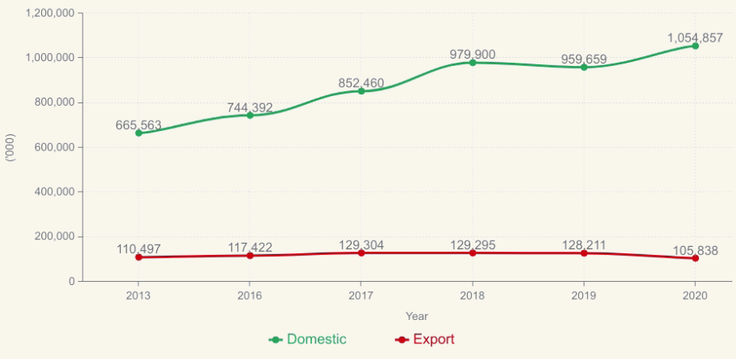
export wholesale value
domestic retail value

2013-2020 Potato Industry Charts

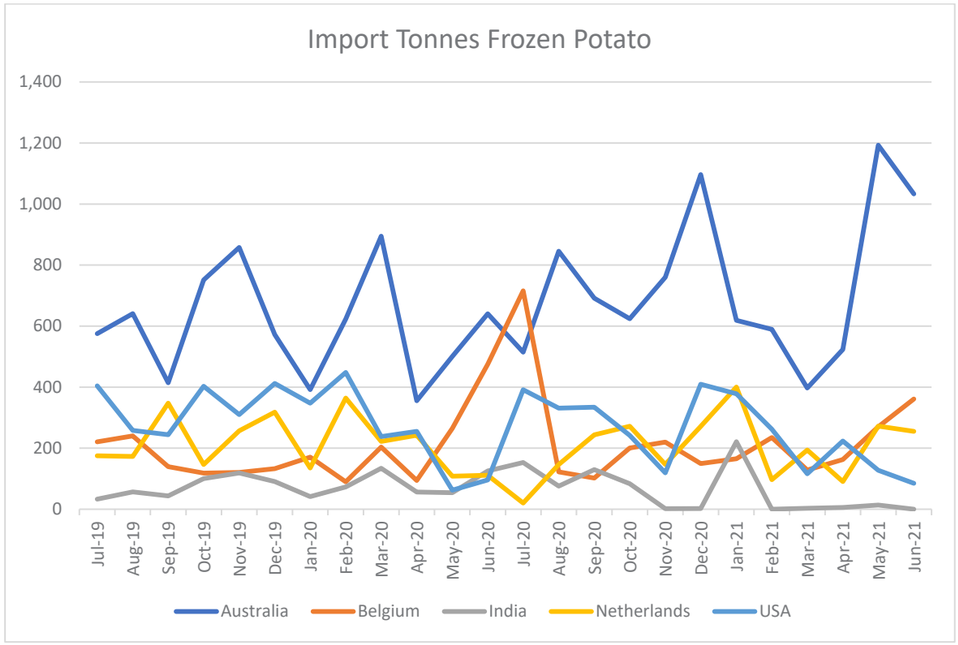


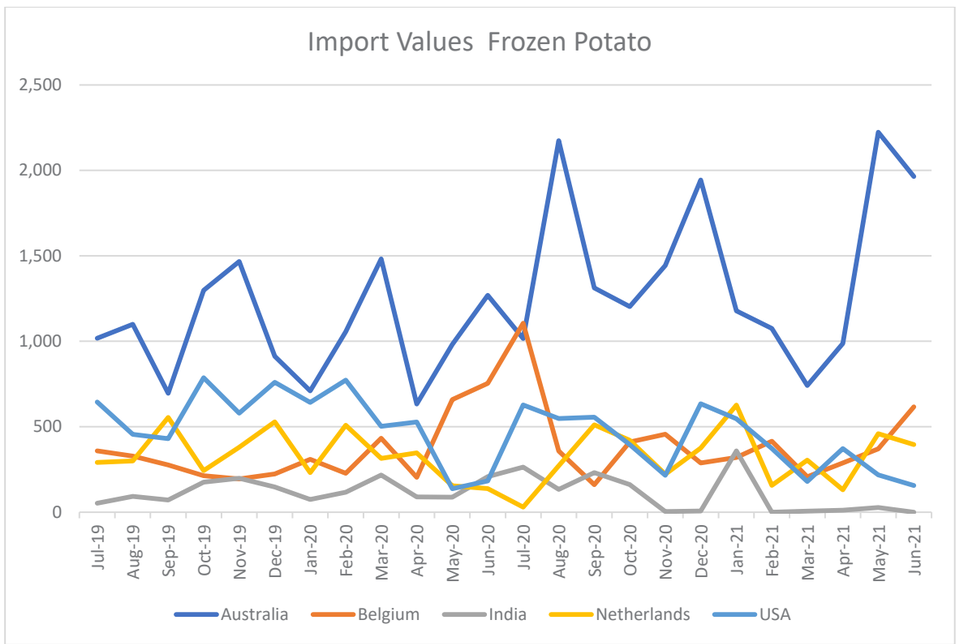






Update on Domestic Processing Market and Tariff Application





PNZ Biosecurity, Emissions & Levy Information System

How has it helped so far?

Blockchain & Data Interoperability

Why should farmers be excited about this?

Trust Alliance New Zealand (TANZ)

New Zealand's first National Blockchain Consortium for the Primary Industries

Who is Trust Alliance New Zealand (TANZ)

The Trust Alliance NZ is a non-profit Primary Industry consortium with members from both the private and public sector, looking to solve the challenges around data interoperability.
The Trust Alliance NZ is building New Zealand's digital infrastructure which will be owned and governed by the community. Focused on the Primary sector where New Zealand farmers, producers, growers, processors, service providers, exporters, retailers & consumers can easily capture, protect and share trusted data. This technology happens in the background and will enable and empower all value chain participants to simplify administration and compliance efforts, reduce data input, so no need to fill in multiple forms numerous times. And then share and permission their data as they want to with an aim to:

- Enhance sustainable farming by providing better decision-making tools
- Provide consumers with improved information to verify product quality, safety and attributes
- Increase efficiency & productivity across the value chain through better measuring and reporting
- Mitigate risk for all stakeholders in the ecosystem with controlled transparency

Why the Trust Alliance New Zealand

Today, farmers, growers and primary sector value chain participants will provide the same data elements, multiple times, into multiple systems for compliance purposes. For example: Name, address, paddock location and crop data multiple times for compliance purposes.
This leads to enormous inefficiency, data redundancy and unnecessary administration work. It is estimated to cost over 900 hours per annum of redundant work.

Existing data processes are siloed, centralised, risky, inefficient, unproductive and time wasting and there is no easy mechanism to easily capture, maintain and provide the data required by government, value chain stakeholders or buyers in a controlled and permissioned way

What do we want to achieve with TANZ?

- Enable everyone to capture data once
- Share data where required, in a permissioned way
- Protect data always
- Turn compliance into value

Trust Alliance Key Initiatives & Workstreams

The current TANZ key initiatives and workstreams provide an environment where the Primary sector; from farmer & grower to exporter has a voice in what the future of NZ Agritech will look like. This collaboration shapes the development of the TANZ platform!

Workstream 1

IoT Sensor Network for Sustainable Farming

Real time data for water, soil, air, animals and produce. For example; Emissions, animal welfare, nitrates

Ready to share in an easy, secure way

Capture data once via IoT device

Provide evidence of specific criteria

Turn compliance, environmental data in a quality criteria

Workstream 2

Digital Farm Environmental Plan

Enhance sustainability for business and environment

Re-purpose compliance data into value for buyers and consumers

Reuse Digital Farm Environmental Plans to mitigate risk and improve financial / credit rating

Ability to provide collective consensus with an option to provide environmental data to CRI's

Workstream 3

Provenance and Consumer Engagement

Improve communication via packaging direct to consumers

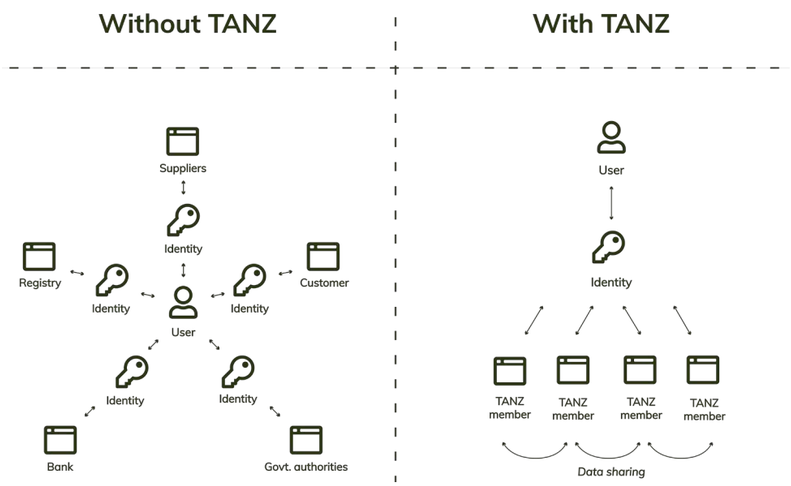
Establish a feedback loop to improve yield rates and environmental impact

Enhance sustainability

Build, improve and retain trust with end consumers

Trust Alliance New Zealand Identity Solution

The TANZ identity solution enables farmers, growers and all value chain participants to provide trustworthy data in a simple way to unlock value. Digital Identity is key to enable innovation, rapid process improvement, higher trust and simple, secure data sharing.



The key opportunity is achieving data interoperability which is easy to use and controlled by the data providers and owners. This will strengthen NZ's Primary Industries and drive sustainability through productivity and improved decision making. It will also assist consumer purchasing with improved information regarding provenance, evidence of sustainability, food safety and other attributes that influence buyer behaviour. TRUST

Capture data once! Share data when required, in a permissioned way. Protect data always!

How can you benefit from TANZ?

- Increased profitability
- Simplify admin and compliance
- Improved consumer engagement
- Mitigate risk

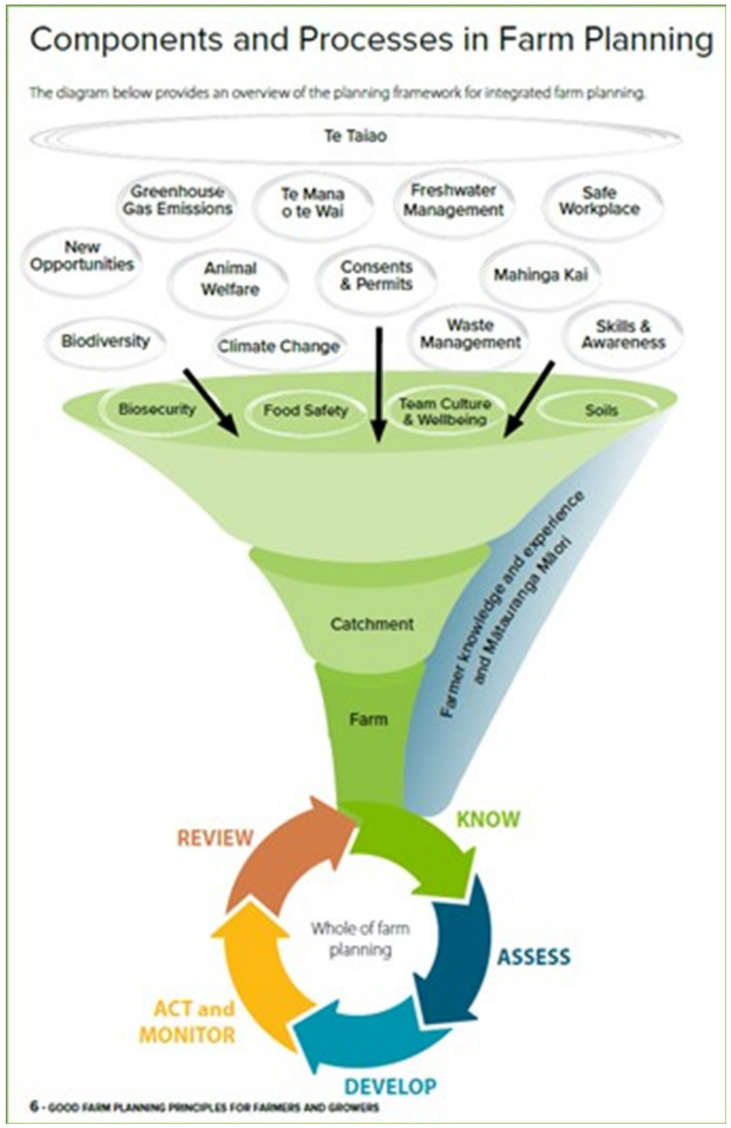
Contact us to join TANZ

Semanie Cato
Membership Services Director
021 803 137

Twitter.com/trustalliancenz
Trustalliance.co.nz

And how do we manage to funnel all the policies coming our way?

Integrated Farm Planning Project Overview



Permissioned use from MPI 'Good Farm Planning Principles: Towards Integrated Farm Planning'

Health & Safety on farm - A presentation from ONSIDE

onside

Property Managers

Access Management

Health & Safety

Onside is packed with world-leading technology, making it the **No.1 choice for rural property managers**.

Visitor Management

Always be in the know.

Get instant notifications when someone checks-in or out of your property, see who is onsite in real-time and view reports on previous visits.

Health & Safety

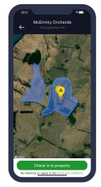
Stay on top of safety.

Access preloaded risk registers, management actions and reporting to make compliance easy - no more lost paperwork.

Real-time Risk Register

Make risks visible to everyone.

View and report risks from anywhere, anytime using your phone - your risk register is available where you need it, when you need it.



Visitor Contact

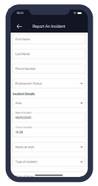
Inform every visitor.

Share the rules and general information for your property with anyone checking in with Onside, in real-time. Group message or call visitors if anything changes.

Incident Reporting

Log incidents in an instant.

Report and manage incidents or near-misses as they happen using your phone, wherever you are - allowing everyone onsite to be updated instantly.



Emergency Planning

Prepare for everything.

Ensure everyone has the information they need on hand in a crisis. Onside allows for fast communication of vital updates for your team and visitors.

onside

Rural-Based Teams

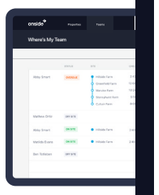
The ultimate resource for you & your team.

Onside is packed with world-leading technology, making it the **No.1 choice for managing rural-based teams**.

Team Locator

Know where your team is.

See which properties your team is visiting via a real-time dashboard. Export reports later to support billing process.



Purpose of Visit

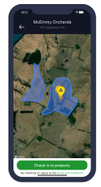
Tell customers why you're there.

Let customers know what job you'll be doing on their property and how long you expect to be there.

Property Maps

Map every place.

Get all of the properties you visit mapped, so you have relevant safety information logged for your team's next visit.



Lone Worker

No one left behind.

Get preset alerts back to base if anyone is onsite longer than expected and doesn't respond to safety prompts - providing extra monitoring of your team's safety.

Text Messages

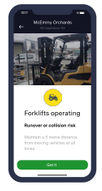
Reach customers outside of Onside.

Check-in notifications can easily be sent to customers in text format via the Onside system, allowing enhanced customer communication.

Risk Maps

See every risk & hazard.

Ensure your team is kept safe by having access to each property's risk map information wherever they are.



onside

Background

Onside was founded by Ryan Higgs, Juliet Maclean and Michael Falconer to provide a technology-based system to support farmers, growers and contractors managing their operations. The concept came from the challenges faced by the founders running a large agricultural business with dozens of farms, hundreds of employees and thousands of people coming and going from the farms for work. There was no simple way to know who was on their farms in real-time, what they were doing, how to get in touch with them and how to know they had all the information they needed to get on with the job quickly and efficiently, but also safely. Onside began as a simple check-in, visitor management and H&S tool but has since evolved into a comprehensive operations software for all rural sectors globally, including viticulture, horticulture, agriculture and contracting businesses servicing the rural sector.

Onside has been awarded competitive grants from Callaghan Innovation and AGMARDT to support their cutting-edge R&D programme and millions in investment from some of New Zealand's leading venture funds to drive the business forward. Today, Onside is used by over 28,000 people, 10,000 properties and 4,000 rural businesses to improve operations, communications and compliance.

Key Areas

OPERATIONS
Tired of not knowing who's doing what, where and when? Onside lets you see what's happening as it happens – with smart visitor management, job tracking, mapping and more.

COMMUNICATIONS
Connect and collaborate with anyone on site to get the job done, with messaging, notifications and contact information. No more unexpected arrivals.

COMPLIANCE
Onside digitises the way you look after your people and property. Get rid of paperwork, sign in books and hazard boards and bring it together with one smart, user-friendly app that ticks all the boxes.

BIOSECURITY
Take control and protect your business and industry from the spread of pests and disease. Ensure everyone knows what to do when they arrive to help stop the spread.

Technology

Onside is an app-based solution used to digitally check-in to a property. When checking in, the user can access all property and hazard information needed to get the job done efficiently and safely. Users can see who else is on site, what job they're doing and can communicate with them directly. Onside can also be used for team and job management, compliance management and lone worker safety.

onside

Free App Features:

- Property Geofencing
  - Map all of the properties you own, manage or visit
- Digital Check-in
  - Check-in and out from anywhere on the property
- Current Visitor Contact
  - Group message or click-to-call anyone on site
- Visitor Notifications
  - Get instant alerts when visitors check-in
- Visit Reporting
  - Digitally manage H&S and Biosecurity responsibilities

Paid Subscription Features:

- Team Dashboard
  - Access a live dashboard of where your team are working
- Progress Reporting
  - Get timestamped reports of completed tasks* and jobs
- Shared Risk Management
  - Allow everyone to log mapped risks for you to review
- Incident Management
  - Allow everyone to instantly report incidents in-app
- Emergency Plan
  - Make your Emergency Plan accessible to everyone in-app
- H&S Notifications
  - Get instant notifications when someone logs a risk or incident
- H&S Reporting
  - Store accurate risk and incident records for your OH&S systems
- Lone Worker Safety
  - Get overdue alerts when a team member hasn't responded
- Task Management *(To be released July 2021)*
  - Allocate location pinned tasks and keep track of progress

Coming Soon

Onside continues to evolve from its roots as a health and safety application with product feature development covering many aspects of rural business operations. Features such as task management (i.e. planting new plants or chopping down dead trees), contractor pre-qualification and block/facility mapping to streamline audits are all on the radar. The ability to track who has been on your site and where they have come from is going to be a crucial measure in combating the looming pest and disease risks to the industry. Onside recently won the Bio-protection Research Centre Science Award of the 2020 New Zealand Biosecurity Awards for their work in this space.

Future Proofing Vegetable Production: project conclusions

Dan Bloomer and the Landwise team deliver their final report & findings

As we wrap up the Future Proofing Vegetable Production project, we reflect on what we have achieved. At the start of the project, grower surveys showed growers were typically following industry good practice with their nutrient transport, storage and application but few had any documented processes or fertiliser plans.

We tested current tools such as Overseer to estimate nutrient losses from farm systems but found these tools poor for engaging with growers and of limited value for assessing potential nutrient losses. Our solution is the LandWISE Nutrient Budget Template which compares planned fertiliser applications with expected nitrogen use based on a grower's expected yield and a soil nitrogen test. The Budget process allows growers to identify crops that are likely to have a large post-harvest nutrient surplus and to put in place effective mitigations.

The nutrient budgets highlighted doubts about the current industry guidelines for nitrogen use in process tomato crops. A series of trials were setup with growers in Gisborne and Hawke's Bay to compare grower's current practice versus industry good practice based on "*Nutrient management for Vegetable Crops in New Zealand*" (Reid and Morton, 2019).

Summer crop trials with growers in Gisborne and Hawke's Bay evaluated the Nitrate Quick Test as a tool to support nitrogen side-dressing decisions in sweetcorn. We found the Nitrate Quick Test was a valuable tool for growers to make an informed nitrogen application decision and showed that growers could reduce their potential N leaching by targeting nitrogen applications appropriately.

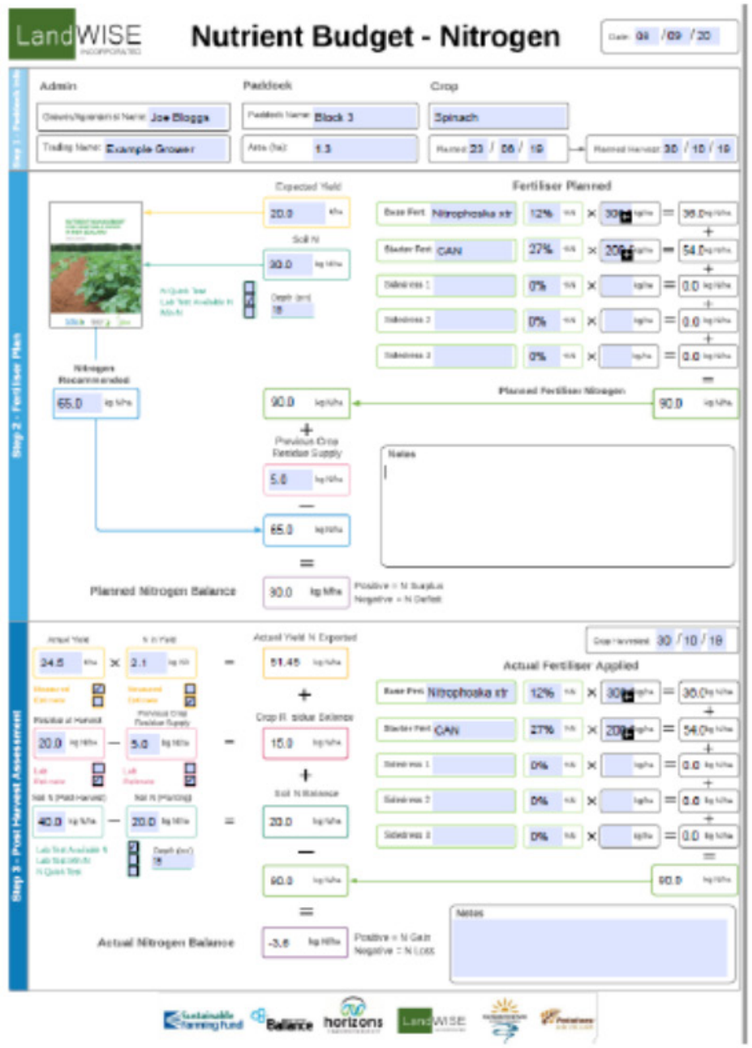
Trials with the four key tomato process growers, compared the guidelines published in "*Nutrient Management for Vegetable Crops in New Zealand*" with a higher rate more aligned with grower practices, and found the higher rates justified. The nutrient guidelines appear inadequate, probably due to assumptions made in the initial modelling. Although this has raised questions, it was helpful with the growers to better understand nitrogen accumulation in their crops.

Following completion of LandWISE Nutrient Budgets with growers in Levin, Hawke's Bay and Gisborne, we created a user document to give clear direction on the LandWISE Nutrient Budget's function, scope and application. Nutrient budgets should be completed for all crops and can be used as a risk assessment tool to show which crops or fields have a higher risk of nutrient loss. By identifying high risk fields, growers can target nutrient management mitigations more effectively to higher risk areas.

A nutrient budget is not a fertiliser recommendation. A fertiliser recommendation identifies how much fertiliser is required to successfully grow a given crop to meet yield and quality targets. A nutrient budget accounts for nutrient inputs and outputs, and identifies a nutrient surplus or deficit.

We note the appearance of the LandWISE Nutrient Budget Template as a recommended tool in NZ GAP EMS, and its presentation to Commissioners in the Hawke's Bay Plan Change 9 (TANK) hearings as evidence of Good Farm Practice.

4.3 Nutrient Budget



The LandWISE project, Future Proofing Vegetable Production, has developed single page nitrogen and phosphorus budgets that integrate with the nutrient management guide and soil testing –laboratory, quick-N test, and hot water N.

An example is given below. This template provides evidence that a process has been followed that involves reference to the industry guide and does it in a way that documents on a single page the fertiliser plan.

The nutrient budget has both a planning (step 2) and review or assessment of performance (step 3) components.

The planning step documents what may have previously occurred informally between a fertiliser adviser and the grower prior to placing an order.

The crop type, target yield, and soil nitrogen availability prior to planting is used to determine the crop nitrogen requirements. This plus a target surplus at the end of the crop determines the nitrogen fertiliser requirement.

Two key drivers are the guideline crop requirements and the level of risk reflected in the planned nitrogen surplus at the end of the crop. A low surplus assumes very little leaching, which runs a higher risk of crop failure. A high surplus has an elevated leaching potential and possible crop quality issues. The guidelines provide an average, tuned against a range of factors such as soil mineral nitrogen levels, yields, and location. They should however not be used as a maximum, and naturally can not account for seasonal variability.

In the nutrient budget, Step 2- Fertiliser Plan can be used as evidence in the NZGAP FEP (Nutrients: 7C – 1 Plan fertiliser inputs for the crop).

R&D: PNZ future projects panel discussion with Q&A from the floor

In 2020 PNZ collected just over $1.5 million in levy and spent $1.12 million on R&D. In other words, the levy spend is very efficient and focused on R&D.

RD&E comprises sustainability, breeding, on-farm productivity and manufacturing innovations. The specific objectives for 2020-2021 activities were to provide growers with the tools to deal with existing pests and diseases and ensure they are protected from biosecurity incursions, as well as helping growers develop infrastructure and methods to improve water and nitrogen use efficiency. We are keen to hear directly from members and trusted advisors in the field as to whether we are meeting all challenges and where there might be opportunity for new R&D projects for the year ahead.

Sustainable Vegetable Systems Project

An update and how will the outcomes benefit farmers?

Ministry for Primary Industries Manatū Ahu Matua · Potatoes New Zealand · Vegetable Research+Innovation · Horticulture New Zealand · Plant & Food Research Rangahau Ahumāra Kai

Sustainable Vegetable Systems Overview

- Accurately monitoring and managing nitrate leaching requires reliable tools
- Current tools have limitations and MPI would like to help solve this
- Data will refine either Overseer/other tools or develop new ones

Accurate data → Fit for purpose tools → Mitigation → Compliance

- Builds on ‘Protecting our Ground Water’ and ‘Future Proofing Vegetable Production’ projects

Ministry for Primary Industries Manatū Ahu Matua · Potatoes New Zealand · Vegetable Research+Innovation · Horticulture New Zealand · Plant & Food Research Rangahau Ahumāra Kai

SVS Goals and outcomes

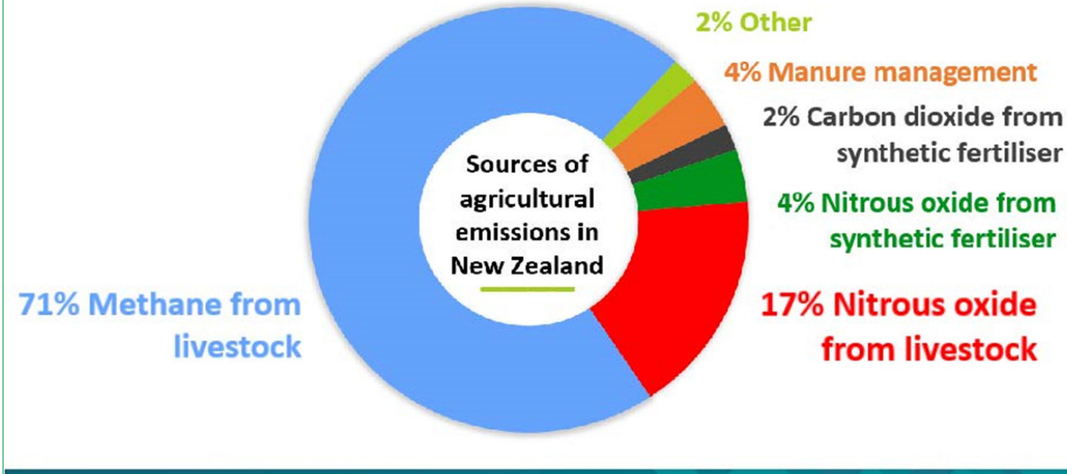
Outcomes
Greater understanding of nitrogen management to reduce the risk of nitrate leaching
Informed means of measuring environmental impact based on sound scientific data
Help growers improve their nutrient use efficiency through the adoption of good/or best management practices.
Overarching goals
Reduce the impact of crop farming practices on the environment and water quality while maintaining grower license to operate through national, regional and farm programmes
Enhance industries’ ability to grow, process and export products, while meeting environmental standards and maintaining international competitiveness
Maintain social licence to operate for vegetable growers and industries.

He Waka Eke Noa

Horticultural Carbon Calculator: how it works and what’s the pricing?

He Waka Eke Noa partnership

APICULTURE NEW ZEALAND · beef+lamb new zealand · DairyNZ · DCANZ · Deer Industry New Zealand · Ministry for the Environment Manatū Mō Te Taiao · FOMA · FAR · Federated Farmers · Horticulture New Zealand · Irrigation New Zealand · mia Meat Industry Association · Ministry for Primary Industries Manatū Ahu Matua

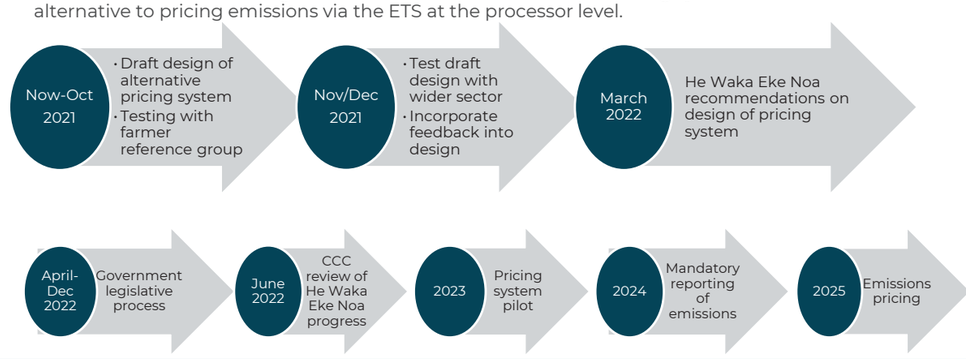


NZ Targets

- All gases 30% below 2015 levels by 2030
- 10% reduction in methane below 2017 levels by 2030
- Net zero long lived gases by 2050
- 22-42% methane reduction by 2050.

Farm level pricing system – timeline

He Waka Eke Noa is making recommendations on a farm level pricing system that is an alternative to pricing emissions via the ETS at the processor level.



Calculation - Pricing

Pricing options now being considered

Ag in ETS (processor level): Baseline	The inclusion of agriculture in the ETS, using two prices ($40 & $70/t CO_2e) from 2025 and 95% free allocation declining by 1 percentage point per year
Ag in ETS (farm level): Baseline	The inclusion of agriculture in the ETS but at farm-level
Fully exposed split-gas (all emissions face a price)	Full exposure with separate prices for CH_4 and N_2O/CO_2e (8 price combinations)
Fully exposed with a proportional discount of 95% (5% of emissions face a price)	Proportional with 95% allocation phasing out 1 percentage point per year and two prices ($40 and $70/t CO_2-e)
Fully exposed with an output-based structured rebate	Output-based with two prices ($40 and $70/t CO_2-e)
Fully exposed with a land-based structured rebate	Land-based with two prices ($40 and $70/t CO_2-e)

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Farm Environment Plans

AGRIMAGIC's Charlotte Glass in Ashburton

Farm Environment Plans and You

Farm Environment Plans have become the most favoured option for assisting farmers to understand and demonstrate good farming practices.

The Essential Freshwater Package that was released in August 2020, along with new National Environmental Standards outlines the circumstances where Freshwater Farm Plans will be needed. In addition to these, farmers will also need to operate within the rules of their Regional and District Council, meet the rules outlined for stock exclusion and wintering and operate within the bounds of any consents.

Most Canterbury farmers are already familiar with the FEPs that their farming land use consents require them to provide and update.

Some aspects of those existing FEPs will remain within the new Freshwater farm plans but there will be some other aspects to cover off as well.

Where are the regulations at now?

The content of Freshwater Farm Plans is available now for consultation (26th July – 12th September). The regulations will specify what each freshwater farm plan must contain, showing how the plan will:

- achieve the 'regulated outcomes'
- provide an assessment of the impacts and risks of farming activities for waterways
- identify specific and measurable actions the farm operator will take to avoid, remedy and mitigate those impacts and risks
- comply with any consent requirements or regional or national rules
- provide the 'base information', such as maps, and details of landowner, farm operator, etc.

What should you be doing now?

Freshwater farm plans will need to deliver outcomes to cover catchment values and context, ecosystem health and your farm practices.

You can make a start now. If you already farm with an audited FEP, the next steps will be easy. If you haven't started yet, it's time to act. Don't be afraid to seek help, especially for your first plan. It makes everything easier if you start well and understand the logic and principles around each part.

1. Take steps to learn about the history of your place/farm.
2. Identify any aspects that may be "special"
3. Familiarise yourself with the rules and regulations that may apply specifically to your farm
4. A nutrient budget is a useful tool to help you understand how your farming practice might impact on diffuse nutrient loss to the catchment. Use a certified nutrient management advisor (CNMA) to assist with this. Not all of these advisors are familiar with cropping systems and rotations – choose carefully.
5. Consider how your farming activities could increase the risk of nutrient losses – your CNMA should be able to help with this too.
6. Use maps to identify the location of key risks and /or mitigations, waterways, significant features etc
7. Seek information about the state of water quality within your wider catchment
8. Build an understanding of what good ecosystem health looks like within the habitats on or close to your farm. Start to think about the broader biodiversity
9. Start thinking about how you might calculate your farm emissions associated with biogenic methane and nitrous oxide (including that from nitrogen fertiliser). From 2025 there will be a levy on these emissions and you should be considering your options to reduce emissions.
10. Definitely think about broader risks to your business that may become more likely as our climate changes. While we think about freshwater outcomes we also need to be able to operate within a changed climate.

If some of these steps seem new or scary, please don't waste energy worrying about it. It really isn't that bad once you get started. The sooner you start, the better. There are still gaps in understanding about how our farm practices impact the environment, but we have learnt a lot in recent years.

Good farmers are good stewards of the land. As you already know, the two go hand in hand. A Farm Environment Plan helps articulate the steps you take to ensure your footprint is light while you produce healthy food.

Get someone to get you over that first bit by giving you a hand to start, but after you have the first plan completed, the updates become a piece of cake!!

Farm Environment Plans

MY ENVIRO's David Poole in Pukekohe

Topic: Farm Environmental Plans and You

An overview of where the Govt, and Regulators are at with regards to Farm Environmental Plans currently, and what you should be doing right now to help yourselves.

Please complete the PNZ FEP survey inserted in this handbook and return to PNZ team.

PNZ Seed Scheme: restructuring and database

Certification of seed potatoes in New Zealand is provided by the New Zealand Seed Potato Certification Authority. The Authority is a subcommittee of the Potatoes New Zealand Board.

The Authority establishes the seed potato certification rules, including disease tolerances, and has the task of ensuring seed potatoes are true-to-type. The operation of the scheme is managed by the Secretary and the Administrator.

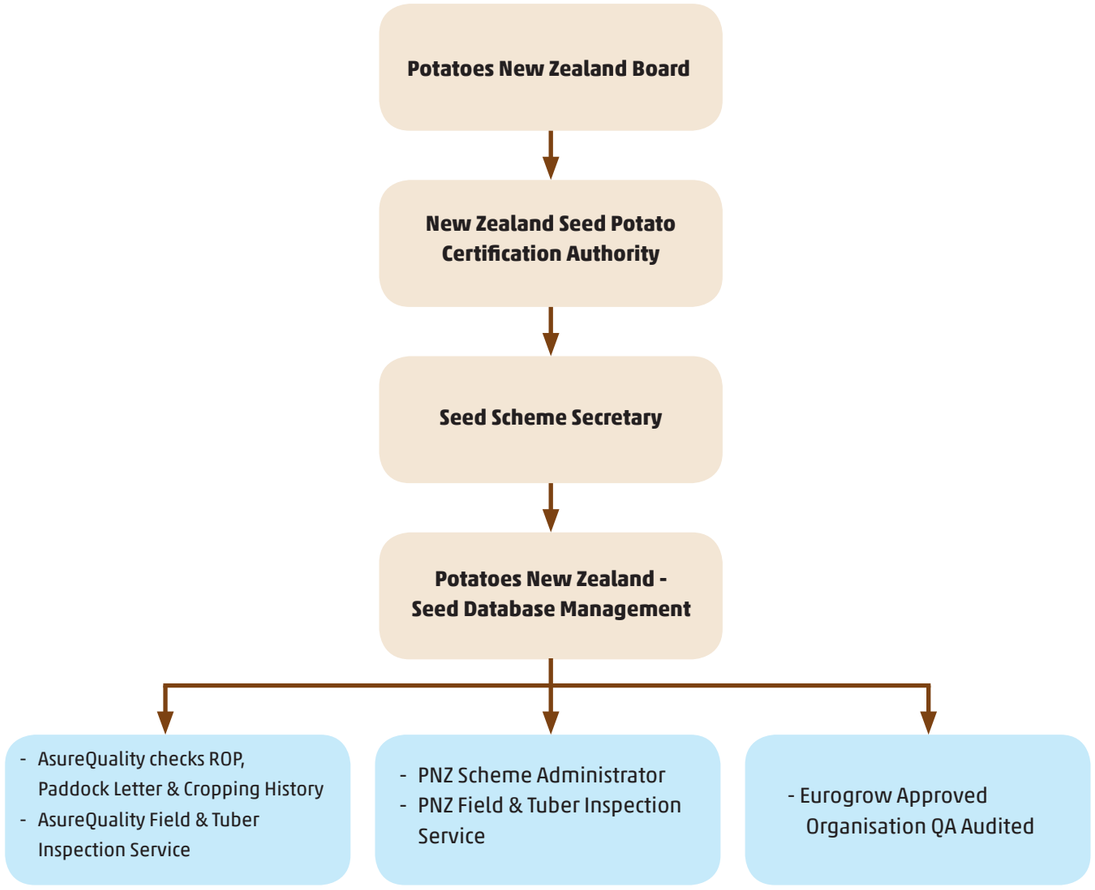
The Secretary manages the operation of the Authority and is the contact point for the Authority. The role includes preparing agendas and papers for Authority and Technical Panel meetings, maintenance of the Scheme document, providing technical support for the Authority, managing the Authority's work programme, managing finances and preparing accounts for Authority meetings, and for communications with members.

The Administrator manages the day to day operation of the Scheme. This includes registering growers, merchants and crops into the scheme, managing the database of seedlines, recording virus test results, recording inspection outcomes, handling appeals, and reporting to the Authority.

Over the last three years, New Zealand Seed Potato Authority has been reviewing the structure and delivery of the Seed Scheme.

Firstly, Potato New Zealand Inc took over the Secretary role which was previously provided by an external contractor. The following year PNZ assumed responsibility for the Seed Scheme Administration and initiated the development of their own seed database. The next step of the review focused on the delivery of Field and Tuber Inspection services, which were previously provided by contracting independent, specialised inspectors from international quality assurance companies. In order to provide this service in the South Island PNZ has recently employed two new crop inspectors. These changes have resulted in a more efficient and streamlined service, providing better value to growers.

Potatoes New Zealand is developing a new seed potato certification database as part of BELIS (Biosecurity Emission Levy Information System), to replace the aging AsureQuality system, which is no longer fit for purpose. The system will incorporate on a geospatial /GIS component and a grower interface allowing growers to enter their own certification data and to view the results of the certification process. It will also allow seed buyers to view the certification results for any seedline they intend to purchase. The new system will form part of a wider potato tracking system allowing full traceability from Tissue Culture lab to the consumer.



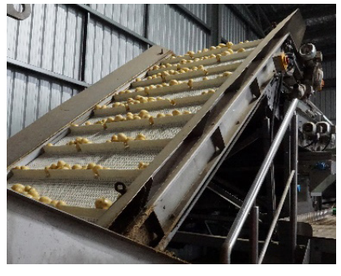
WYMA: Sustainable Food Systems & Industry Pressures

Short description:

Wyma Solutions is a world-leading post-harvest handling company with equipment that can be found in packhouses from Japan to Newfoundland. Based in Canterbury, Wyma has built a reputation for quality, hard-wearing equipment that performs season after season.

Our experience in the handling of potato crops is unrivalled, beginning with the development of the original Vege-Polisher™ in the early 1990s. We have since expanded our product range to encompass all aspects of post-harvest crop handling, including innovative ways to reduce waste and maximise commercial crop yield.

The key to sustainable food production is to maximise efficiency and reduce waste. By 2050, the global population will likely grow by 35%, increasing the demand on food production by 50-70%. The United Nations has implemented 17 Sustainable Development Goals to provide direction to sustainable efforts. This short presentation introduces how some of these goals relate to packhouse management and emerging technologies and methods that are aiding to address them.



wyma
THE BEST FROM EVERY HARVEST
wymasolutions.com

Powdery Scab

Professor Calum Wilson, University of Tasmania

Professor Wilson works at the Tasmanian Institute of Agriculture at the University of Tasmania. He has over 25 years' experience in research with a particular focus on those that induce significant disease in potato. He has a passion for the realisation and application of quality research by industry and is actively involved in connecting research and industry to deliver real-world benefits.

Powdery scab is a major economic impediment to the global potato industries with infections resulting in both yield losses and cosmetic damage to saleable tubers. The causal pathogen can reside in cropping soils for many decades rendering fields less productive or even unsuitable for potato crops, and current controls during cropping are not always effective.

This presentation describes studies to develop new approaches for control by reducing the persistence of the pathogen in cropping soils and reducing infections during potato production.

The controls revolve around the twin concepts of:

"Germinate-to-Exterminate" where the pathogen in cropping soils is targeted through strategic applications of stimulants, forcing premature germination leading to its death in absence of a suitable host plant. This could be used to remediate infested land.

"Diffuse-to-Confuse" where we disrupt the pathogen ability to detect and find potato roots is resulting in less infection. This is proposed to reduce the critical early phases of disease during potato cropping.

Psyllid & Liberibacter

A continuing problem for growers. Where to next?

Potato Tuber Moth

An update from the PNZ project with
Dr. Iain Kirkwood & Frances MacDonald (Plant and Food Research)

Control of Potato Tuber Moth, *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae)

Prepared by Dr Paul Horne,
IPM Technologies Pty Ltd.
July 2020

Contents

Introduction

The Pest

Potato tuber moth (*Phthorimaea operculella* (Zeller)) (referred to from here in this document as PTM) is a cosmopolitan pest that originated in South America (Kroschel and Lacey 2008; Rondon and Gao 2018). It has now been recorded in over 90 countries worldwide (Kroschel and Schaub 2013). It is in the family Gelechiidae as is the related pest tomato leafminer or tomato pinworm (*Tuta absoluta*). *T. absoluta* is a serious pest of tomatoes in many parts of the world and is resistant to many insecticides but it is not found in either Australia or New Zealand (CABI 2019a). There is possible confusion with the common names as PTM is known as tomato leafminer in northern Queensland (Abbott and Abbott 1999). In the USA PTM is also known as potato tuberworm (Rondon and Gao 2018).

Larvae of PTM feed either on tubers of potato or within the leaves of potato plants. The leaf-mining aspect makes them difficult to control with many insecticides and control failures have been reported many times. This is in part because of where they feed but also because of insecticide resistance. Also, spraying the foliage may kill caterpillars but damage can still be serious (Foot 1974; Rondon 2010).

In Australia and New Zealand PTM is primarily a field pest of potatoes as harvested tubers are kept in cool stores (Foot 1979, Horne 1990). However, in countries where cool storage is not available it is a more serious pest after harvest as populations of PTM continue to develop. Research has been conducted for both in-field control and reducing damage in warm-stores.

PTM is believed to not develop when temperatures are constantly below 10°C (Beukema and Zaag 1990) but other authors have found the lower threshold for development to range between 4.25°C and 13.5°C (Rondon 2010; Rondon and Gao 2018).

Host Range

PTM feeds on a range of food plants, mainly those in the family Solanaceae. Das and Raman (1994) reported PTM feeding on 60 species of plants worldwide. The main crops attacked are potato (*Solanum tuberosum*), tomato (*Solanum lycopersicum or Lycopersicon esculentum*), and tobacco (*Nicoitana tabacum*) but the pest also attacks eggplant (*Solanum melongena*), bell pepper (*Capsicum annuum*) and Cape gooseberry (*Physalis peruviana*). Also attacked are wild species of Solanaceae, including weeds (eg, black nightshade (*Solanum nigrum*), apple of Peru (*Nicandra physalodes*) and thornapple (*Datura spp*). However, they have also been reported as feeding on non-solanaceous plants such as sugar beet (*Beta vulgaris* L.) in the family Chenopodiaceae while other host plants belong to the families Scrophulariaceae, Boraginaceae, Rosaceae, Typhaceae, Compositae and Amaranthaceae (Das and Raman 1994).

Although there is a wide host range, potato, followed by eggplants are the preferred hosts on which the female moths oviposit (Meisner et al 1974). Also, although there are records of PTM on this wide range of hosts, field studies have demonstrated that it can only reproduce if caterpillars feed on potato, tomato and eggplant (Rondon 2010; Rondon and Gao 2018).

Control options

Control measures for any agricultural pest can be broadly categorised as either 1. Biological (invertebrate natural enemies and pathogens), 2. Cultural or management techniques or 3. Pesticides. The use of a compatible set of measures from these three categories is described as Integrated Pest Management or IPM. These categories are used to arrange the results of the review.

Biological controls (invertebrates)

PTM is not native to either Australia or New Zealand and although it is attacked by generalist predators such as damsel bugs (*Nabis kinbergii*) (Horne et al 2002), parasitoid wasps were introduced into both countries as classical biological control agents. In Australia, three species of wasps – *Orgilus lepidus, Apanteles subandinus* and *Copidosoma koehleri* are well established and provide significant levels of control (Horne 1990 and 1993; Horne and Page 2008). CABI (2019b) lists these species as being present in New Zealand but Herman (2008a) records that of 17 species introduced as biological control agents for PTM, only *A. subandinus* became established. *A. subandinus* has been recorded as reaching parasitism rates of over 80% in New Zealand potato crops where broad-spectrum insecticides are not applied (Herman 2008a).

Biological controls (pathogens)

Microbial control of PTM was summarised by Lacey and Arthurs (2008) and the use of biopesticides including microbial pesticides for control of potato pests was reviewed by Sporleder and Lacey (2013). The main pathogens studied have been the bacteria *Bacillus thuringiensis* (Bt) and granulosis virus. Bt is sold commercially for control of a range of caterpillars under several different trade names including “Dipel”,” Delfin” and “XenTari” and with two subspecies (*Bt kurstaki* and *Bt aizawai*).

Bacteria and Viruses

Bt

Although some publications report that Bt has been successfully used against potato moth (Lacey and Arthurs 2008; Sporleder and Lacey 2013) others such as Rondon (2010) concludes that it is not particularly effective under field conditions because of degradation by UV and wash-off by irrigation or rainfall. It is a stomach poison and must be ingested. So, an additional problem with it in the field is that PTM caterpillars feed for almost all of their life protected within the leaf and would not be exposed to a surface application except briefly in the first instar stage. Given the rapid degradation of Bt and PTM populations producing almost continuous batches of eggs (and first instars), it would require multiple applications of Bt to target newly hatched caterpillars before they enter the leaf.

Another use of Bt has been to isolate the gene for the Bt toxin and genetically modify potato plants to produce varieties containing this toxin. When it was discovered that there were genes responsible for the production of crystal proteins (the toxins) these were given the abbreviation “cry proteins” for (crystal proteins). As more types of proteins were discovered, those active on lepidopterans were given the numbers 1 and 2, with major variations allocated uppercase letters and minor variations designated by lowercase letters. Eg Cry1Aa, Cry1Ab. In 1995 the EPA in the USA approved the commercial production of four Bt crops; corn, cotton, tobacco and potato. However, the bulk of production is corn and cotton (Abbas 2018).

There have been varieties of potatoes producing Bt that are effective on PTM (Douches et al 2002) and another strain of Bt (*Bt tenebrionis*) for control of Colorado potato beetle. GM potato varieties such as Spunta G2 have been developed and although they are approved in some countries including the USA, many other countries have progressively banned the use of such varieties (Abbas

2018). Although they may be effective on PTM the varieties have not been used widely because of issues with differing perceptions about the safety of GM crops on humans (Abbas 2018).

Granulosis virus

Viruses have been developed as commercially available products for some caterpillar pests such as "Madex" and "Cydex" for codling moth, "Gemstar" and "Vivus" for *Helicoverpa* and "Spod-X" for *Spodoptera exigua*. Sporleder and Lacey (2013) have reviewed the potential of different biopesticides and there are granulosis viruses that have been used against potato moth but there has been no large-scale production. It is commonly referred to as *PhopGV or Po*GV and some trials report over 90% mortality in laboratory trials (Lacey et al 2011). In some cases (eg in Peru), government agencies have produced this as a pesticide for use by potato farmers. Granulosis viruses have spread around the world with potato moth and has been found in Australia and New Zealand (Teakle 1998). Trials have largely been focused on potato storage in developing countries (Lacey and Arthurs 2008; Sporleder and Kroschel 2008) but also in the field in Australia (Reed and Springett 1971).

Granulosis viruses used as insecticides have similar problems to Bt, with degradation by UV and wash-off by water. However, it has also been shown that there is the potential for PTM to rapidly develop resistance to granulosis virus (Briese and Mende 1981).

Fungi and Nematodes

Several species of fungi and nematodes have been shown to be effective in killing PTM (Rondon and Gao 2018). Sporleder and Lacey (2013) summarise the available products against PTM and list *Beauveria bassiana* as being commercially available in Europe and the USA. Other fungi tested against PTM are *Isaria fumosorosea* and *Metarhizium flavoviride* (Sabbour 2015).

Nematodes *Steinernema carpocapsae, S. feltiae* and *Heterorhabditis bacteriophera* have been shown to kill PTM larvae in laboratory trials (Hassani-Kakhki 2012; Sporleder and Lacey 2013; Kepenecki et al 2013) but these have not been commercially produced.

Cultural controls

In a review of PTM control it is stated that although current methods of control rely heavily on the use of pesticides, early control of this pest should focus on cultural methods (Rondon 2010). Such methods have been known for many years and include variety selection, deeper planting of seed, producing a large hill, irrigation to prevent soil cracking and early harvest. Rowe (1993) states in a manual on potato production (in the USA) that "the moths cannot reach tubers covered with more than 2 inches of soil, unless it is deeply cracked". Goldson and Emberson (1985) recommended that in New Zealand deeper planting should be done to help control PTM. Some of the best-known work on cultural control of PTM was conducted in New Zealand by Marion Foot (1974, 1976). Other cultural controls include elimination of cull piles, controlling volunteer potatoes, and rolling (Rondon 2010).

Pesticides

Pesticides are often applied to control pests of potatoes including PTM and this has long been the case. Herman (2008a) reported that in the North Island of New Zealand where PTM is a major pest, control was "dominated by applications of broad-spectrum insecticides at 10 – 14 day intervals".

Insecticides targeting PTM in the foliar stage can be effective but many studies (summarised by Rondon 2010) have shown that this does not ensure that there will be no damage to the tubers. Kuhar et al (2013) describe the efficacy of insecticides on PTM as "unpredictable". This is because caterpillars can access the tubers through cracks in the soil and so soil conditions are critical in determining the level of control (see section on cultural controls). In New Zealand it has been found that crops with bad tuber infestations sometimes had relatively little foliar infestation (Herman 2008b) and it is the same in Australia (Horne – unpublished data). As noted by New Zealand researchers, (Foot 1974, 1976 and Herman 2008a,b), even if there is control of a PTM population in the foliar stage, there can still be significant damage to tubers if appropriate cultural controls are not utilised.

Insecticide resistance

Resistance by PTM to insecticides is known to occur in various parts of the world. This includes the USA (Kuhar et al 2013) where resistance to insecticides including fipronil and synthetic pyrethroids has been reported. PTM was one of the first pests that became resistant to DDT in the 1950's including in Australia (Champ and Shepherd 1965). In Queensland, Australia, while not saying PTM was resistant, Abbot and Abbot (1999) stated that the currently registered insecticides (at that time) were unable to provide an acceptable level of control. In Egypt, PTM was recorded as resistant to several organophosphates, carbamates, synthetic pyrethroids and imidacloprid (El-Kady, H. 2011).

A recent review of resistance to diamide insecticides (eg "Belt" and "Coragen") recorded resistance by several lepidopteran species, but this does not include PTM (Richardson et al 2020). However, the related species *Tuta absoluta* has developed resistance to this group.

In a recent review of Bt genetically modified crops (Abbas 2018) it was suggested that their use was probably nearing the end, partly because of concerns about human safety but also because of the development of resistance to GM crops by some species of caterpillars.

Attract and kill

The use of pheromones to attract PTM to a container with insecticide ("attract and kill") has been developed (Kroschel and Zegarra 2010) and commercialised by CIP in Peru (Sporleder and Lacey 2013). The insecticide used is usually a synthetic pyrethroid with rapid knock-down, but it is not disruptive to biological control as it is not sprayed over the crop. This approach catches only male moths and so would need to be done on a district-wide basis to be effective in suppressing a population. This is because female moths that have already mated could fly into paddocks where the males have been trapped.

IPM

Integrated Pest Management (IPM) is simply using biological, cultural and chemical control options in a compatible manner, rather than relying on insecticides as the mainstay of pest control. IPM involves trying to use these options in a compatible way and using biological and cultural options as the mainstay of control with chemical options used only as support tools when necessary (Horne and Page 2008; Page and Horne 2012). Selecting the pesticide that will cause least disruption to biological control agents is important rather than selecting a product that might be most effective against the target pest but is disruptive to biological control agents.

However, to develop an IPM strategy to suit a farmer in any crop the first thing to be done is to look at the range of pests present. This will be different in different locations and can also differ between farms in the same locality due to different perceptions of "what is a pest of importance". IPM needs to deal with all pests that the farmer is worried about, not just one pest (FAO 2000; Trumble 1998). Therefore, there is IPM for potatoes but not, for example, IPM for aphids.

An IPM strategy for potatoes was described by Horne and Page (2008) and such an approach can be built for any potato grower in any region in the world. Once the list of pests is established then all of the available control options can be listed. It is often important to emphasise that all options, despite the possible costs, be listed, as the expenditure changes markedly (reduced) when there is little requirement for insecticides. This means a single expensive insecticide may be far more cost-effective if it is the only intervention required and it supports biological controls.

In a recent (2019) article in Potatoes Australia magazine, a grower described his experience of using IPM, starting in 1995. (https://ausveg.com.au/app/uploads/publications/PA%20Feb%20Mar%202019%20Web.pdf).

His conclusion to the article is the most telling, where he states, “In the last 20 years I have used fewer insecticide applications on all paddocks than I might have used in a single season per crop before IPM”. His experience is typical of growers in Australia who have changed to using IPM from regular applications of insecticides (he previously sprayed insecticides every 10-14 days). Another grower with the same experience estimated that he had saved $55,000 in five years (from 1995 to 2000) by adopting IPM and using much less insecticide without compromising quality (O’Sullivan and Horne, 2000).

The point is that insecticide applications similar to those currently being applied in North Island potato crops were the standard practice in Australia 20 years ago. This has been turned around by adoption of IPM in Australia.

Summary

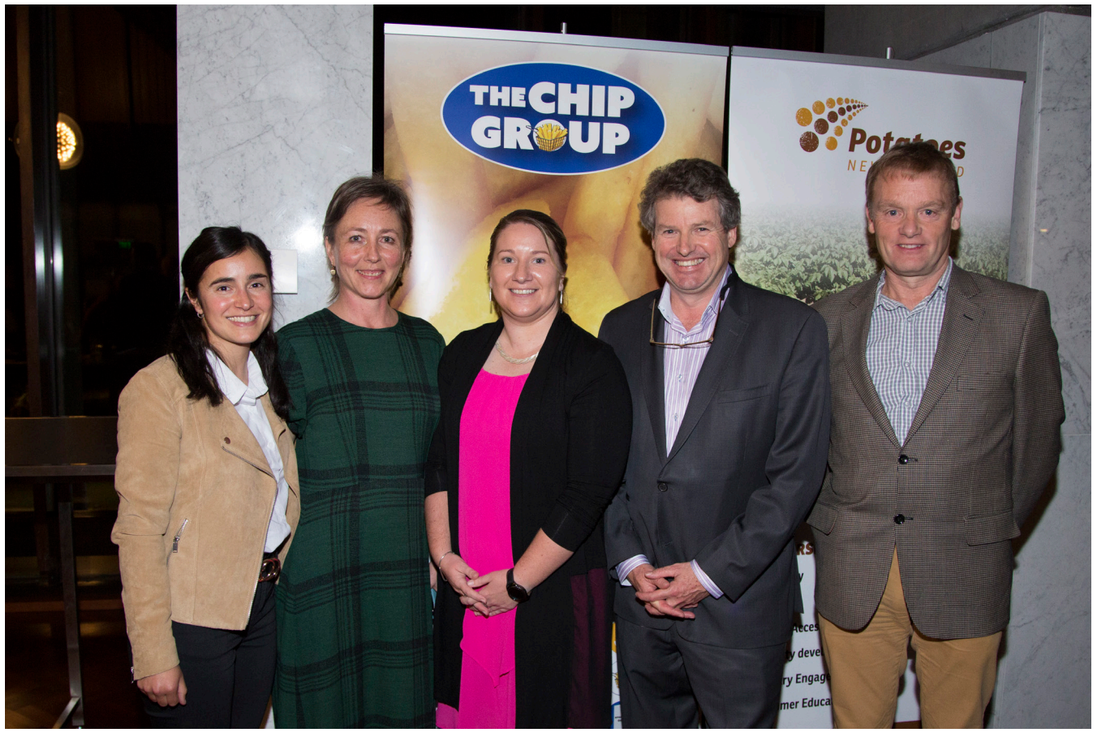
Scientific studies around the world have documented that there are options for controlling PTM in all three available methods – biological, cultural and pesticides. In developing countries without access to cool stores, losses to PTM are more serious after harvest while in developed countries with access to cool stores damage is more likely to be in-field.

Biological control options include parasitoid wasps, and these have been shown to be present and able to contribute significantly to control of PTM in New Zealand. However, they are highly disrupted by non-selective insecticides. Other species such as *Orgilus lepidus* could be introduced, but this would not improve control unless changes in pesticide applications were widely adopted.

Other biological control options have been shown to have some potential (pathogens and nematodes) but have not been made commercially available in most countries, including New Zealand.

Researchers have repeatedly stressed that if cultural controls (in particular soil management and irrigation) are ignored then pesticide applications in the foliar stages of the crop cannot be expected to provide acceptable levels of control. This research has been conducted and confirmed in New Zealand as well as in other countries.

PTM is capable of developing resistance to insecticides but so far there is no evidence to suggest that PTM is resistant to the newer insecticides of the Group 28. Control of PTM in the foliar stage of the crop is likely to be good. Instead, crop protection failures are more likely to be attributable to failures in cultural controls. This conclusion is the same as what New Zealand entomologists Marion Foot and Tim Hermann have previously described. The need to adopt an IPM strategy that involves using all three control options and not just a reliance on pesticides during crop growth is once again emphasised.



PNZ Team are here to help you

Special Presentation

Fruitfed Supplies

Daniel Sutton is the Technical Specialist -Vegetables for Fruitfed Supplies. Part of PGG Wrightson, Fruitfed Supplies is the largest horticultural supply business in New Zealand. Fruitfed has been in operation for over 100 years and works with growers of every crop from the top of the North Island to the bottom of the South. Fruitfed works closely with potatoes growers particularly around the Pukekohe, Ohakune, Manawatu, wider Canterbury and Southland regions. Daniel has been working in vegetable crop protection for over 10 years and has a extensive background in crop monitoring and product development for the potato industry. He also sits on the R&D Technical Panel for Potatoes NZ. In response to Potato tuber moth pressure around Pukekohe, Fruitfed launched a regional monitoring survey to track numbers, movement and pressure across the wider Pukekohe region to help growers make informed decisions around control options, the key outcomes of this will be presented at the Pukekohe event. Tomato potato psyllid (TPP) continues to be a major issue for potato growers in Canterbury, Daniel will cover some of the work going on behind the scenes at Fruitfed to help manage this pest, including the value of multi-seasonal pest monitoring data, research into new control options and factors to consider when selecting control options.

Fruitfed Supplies Crop Monitoring personnel play a key role in collecting accurate field data for the Pukekohe potato tuber moth survey

Potato tuber moth survey underway

Potato Tuber Moth (PTM) has been a significant pest in the Pukekohe region in recent years. Control measures have been successful on an individual grower level, but the team at Fruitfed Supplies Pukekohe recognised that a regional response was required to gather more detailed information and assist with controlling this pest and its impact on potato crops around the region.

The Pukekohe team launched a regional monitoring survey to identify pest arrival, development and spread across the region. Pheromone traps are used to monitor PTM numbers and Tomato-Potato Psyllid (TPP) populations are also being tracked with yellow sticky traps. The survey utilises Fruitfed Supplies Crop Monitoring scouts who deployed the first traps in late October in crops being grown by survey participants which include several mid to large growers.

Fruitfed Supplies Pukekohe Area Sales Manager, Andrew Luxmoore, says the survey is intentionally independent. "The survey is primarily an in-house initiative although we have had support from suppliers around the wider use of the information, and UPL, crop solutions provider, has helped with sourcing the pheromone caps used in the monitoring."

Data is collected weekly with individual growers receiving their paddock information on the day of monitoring. Regional survey results are shared with all participants the day after all paddocks have been monitored. Grower meetings offer another way to share and discuss the data.

Vegetable Technical Specialist Daniel Sutton says, *"the data we get from this is highly valuable. It gives overall trends of pest and disease in a standardised format, allowing comparisons to be made between different growing areas within the wider Pukekohe region, growing practices and control strategies. It also means we can track the response to our recommendations and adjust crop management accordingly."*

The first survey data report went out to participants early in November, showing that higher than expected PTM numbers were present early in the season. This information helped growers, in consultation with their local Fruitfed Supplies Technical Horticultural Representative, to make informed decisions around control measures and identify high-risk paddocks requiring particular attention.

As the survey continues through summer and into autumn, Daniel says a trend is starting to emerge. *"We are finding growing areas, that are separated by only a few kilometres, are showing big differences in PTM and TPP numbers. This is really useful information for us as the numbers aren't as consistent as we thought they'd be."*

The knowledge gained from the survey will add to the already considerable expertise the Fruitfed Supplies team have in terms of PTM lifecycle and modern control programmes. *"In-field insecticide control is only one facet of a robust control strategy. Our team is looking toward a more holistic pest management approach including companion planting to boost biological control agents,"* Andrew explains.

"Management factors such as soil moisture, irrigation and overall mound integrity to better protect tubers are also a consideration in helping prevent PTM damage, as well as post-harvest storage. We are also working with our Research and Development team to identify new control options. Overall, a combination of these factors alongside greater communication between growers and Fruitfed Supplies regionally is leading to greater control of PTM," says Andrew.

Bharat Jivan, Managing Director of Jivan Produce in Pukekohe, joined the survey group in early December. *"We struggled with PTM in last season's dry conditions and want to better understand PTM numbers from the survey's weekly monitoring. This will also help us see the efficacy gained from the insecticides we apply. The data graphs received to date are useful to see population trends in different areas around Pukekohe and the data feeds into our integrated pest management programme so we are not spraying for the sake of it."*

Pukekohe Technical Horticultural Representative Jesse Clark has had several interested growers discuss the survey with him. *"This survey highlights Fruitfed Supplies' strengths in terms of crop monitoring and agronomy. It has gained considerable support from many large scale potato growers who have previously struggled with PTM in recent years and seen considerable losses in harvestable yield. They have indicated how grateful they are that Fruitfed Supplies is front-footing a response this season to help growers contend with this damaging pest."*

For more information contact Andrew Luxmoore (0274 914 664) or Jesse Clark (0272 228 259), or visit fruitfedsupplies.co.nz to find out more about Fruitfed Supplies' range of products and services or to find a store near you.

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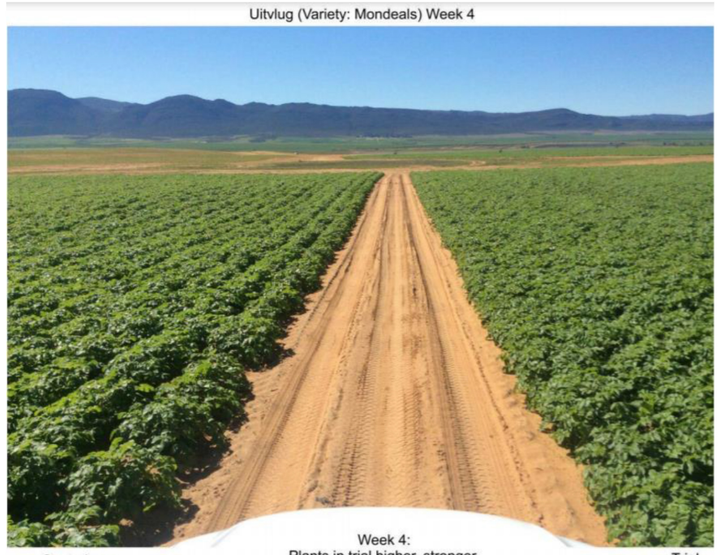
Addressing the root causes – not just the symptoms!

This profound piece of wisdom applies to growing potatoes just as much as to other aspects of life.

Potato growers facing stagnating crop yields, smaller tuber sizes, pests & diseases, rising input costs, and/or ecological regulations, may be interested in what Penergetic have been achieving globally over the past few decades in addressing root causes behind these problems.

The Swiss - headquarted company's approach is based on values: respectful interaction with humans, animals, plants, and the environment, focussing on making a positive contribution to address future challenges.

Penergetic technology relies on bio-stimulation, using selected combinations of low-frequency electromagnetic fields copied from pure, natural substances.



Biological systems are open systems. In complex processes they form a large complete organism in our eco-system. Penergetic products stimulate biological systems through natural impulses. This enables the optimisation of cycles and the enhancement of individual processes.

The Penergetic product system comprises six areas of application: soil, plants, compost, effluent, animals and water. The individual products are cycles within themselves and interact with one another. The products are optimised continuously and their efforts compliment each other.,

All products are compatible with most existing inputs, are non-toxic, and support all plant types and all soil types. They can be used to transition your entire system towards regenerative or organic in a safe and low-risk way.

Penergetic soil and plant products are recommended for potato growing to activate soil biology / mycorrhizal fungi, promote humus development, increase nutrient availability and uptake, optimise photosynthesis, and enhance root development.

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- Lower input costs
- Less attention from environmental regulators

Penergetic products can increase yields, improve quality, reduce inputs and be beneficial for the environment

Penergetic New Zealand was established mid 2020 by Stuart Chaney, who comes from an extensive corporate management and financial background in Australasia. Taking up the Penergetic distribution rights for New Zealand Stuart says "Our mission is to provide our agricultural community with new tools to transition away from chemical inputs to more natural products that do an equivalent or better job, because they stimulate the natural processes,"

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