Sustainable Vegetable Systems

Quarterly Report - Programme Governance Group

Quarter 3, January – March 2023

Contract Agreement Number: 21859

1.1 Summary of progress during this quarter

Workstream 1 – Controlled experimentation to quantify nitrate leaching

- Rotation 1 and 2 in Canterbury have been completed. Measurements in Rotation 3 in Hawke's Bay will no longer continue due to effects of Cyclone Gabrielle; this means some data from the ryegrass crop will not be collected. However, Rotation 4 can continue and has been sown in the final crop of ryegrass; measurements continue.

- Data collection and analysis is ongoing in this Workstream. Here we summarise soil N and the N balance of Rotation 1 and 2.

- Reasons for differences in the N balance between the two potato crops in each of Rotation 1 and 2 are evaluated. The N balance and amount of potential environmental N loss (PENL) varied significantly between the two crops even at good management practice N fertiliser rates. This seems partially due to a difference in yield between the two crops and N uptake pattern, but further direct comparison is needed. An implication is that good management practice can have different N balance outcomes indicating that target values of losses do not reflect the whole system integration of growth, supply, and uptake.

Workstream 1 - Trial crop rotations

Crop experiment and rotation outline - LINCOLN

	2020						2021												2022				May...	...Oct
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May...	...Oct
Rotation 1	Wheat →							Broccoli mid Feb →					Fallow	Onions →							Fallow	Cover crop (ryegrass) →		
Rotation 2			Pak choi - Shanghi →				Fallow	Cover crop (ryegrass / Oats) →					Fallow →			Potatoes - Fresh →					Fallow	ryegrass		

Crop experiment and rotation outline - Hawke's Bay

	2020						2021												2022				May...	...Dec
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May...	...Dec
Rotation 3														Onion →							Cover crop (ryegrass) →			
Rotation 4									Pak choi →			Fallow	Lettuce →		Peas →				Fallow →			Caul.	

Workstream 2 – Crop rotations

Site No.	2020				2021												2022					
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Cover Crop (ryegrass cut and carry) →				Fallow →						Onions →							Fallow →			Grass	
2	Barley (crop/cover crop) →					Fallow →					Onions resown →							Fallow →		Cauliflower →		
3	Mustard →					Fallow →	Carrots →									Fallow →						
4		Potato →					Fallow →	Cauliflower →				Fallow →	Maize →							Fallow		
5		Potato →						Fallow →		Onions →								Fallow →		Grass →		
6		Maize silage →						Fallow	Grass →							Fallow	Cabbage →			Fallow	Grass →	
7			Pumpkin →			Fallow →			Grass →			Fallow →			Butternut Squash →					Fallow		
8	Potato →						Fallow	Wheat →												Fallow →		
9			Pumpkin →			Fallow	Fallow	Turf grass →		Grass – sheep grazing →												

Workstream 2 – Crop rotations (continued)

Site No.	2022 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023 Jan	Feb	Mar
1	Onion	Fallow			Cover Crop (ryegrass cut and carry)										
2	Onion	Fallow		Cauliflower				Fallow			Potato				
3	Fallow						Onions							Fallow	
4	Maize						Onions							Fallow	
5	Onion		Fallow	Grass							Potato				
6	Cabbage				Fallow	Grass				Fallow	Watermelon				
7	Squash		Fallow								Butternut squash – cyclone damaged			Fallow	
8	Wheat	Fallow							Peas					Oats	
9	Turf grass	grass - sheep grazing									Broccoli				

Workstream 2 – Regional on-farm monitoring

- Field sampling is ongoing. Plant sample processing by the PFR laboratory for N content analysis is on a shared Google Drive with appropriate access.

- The collated data have been made available to the Workstream 2 to develop N budgets for each crop. The data are also available for use in Workstream 3.

- Monitoring continues at the 9 regional sites. The regional monitoring sites crop rotations are shown above.

- The regional monitors meet on the last Monday of the month, along with PFR, and covers H&S, progress update, and discusses any issues and ideas amongst the nationally dispersed monitoring group.

Workstream 3 – Farmer facing tool(s)

- Based on discussions with growers, the tool has been implemented with layers. The underlying algorithms are the same – the layers require different levels of data to be entered by the user to. The layers are:
    - The first layer, or basic layer – uses standard parameters for most inputs, but users can alter crop type and sowing date and expected yield. The tool provides a fertiliser application rate, timings of applications and a nitrogen balance.
    - The second layer or scheduling layer – maintains some standard parameters, but users can input more information such as soil test values and the number of fertiliser side-dressings they want to apply. Users who take soil tests throughout growth can input these values when available to evaluate changes in recommendations.
    - The third layer or advanced layer – places the crop in the context of the previous crop; the supply of N that comes from residues is crop specific rather than using default.

- Additional work has been progressing on improving the parameters of the model and in particular prediction of crop N use and leaching across all the crops in the rotations.

- Work was done to collate a database of crop residue characteristics and crop information to provide information for a 'draft' crop residue model that can be incorporated into the grower facing tool

- Gaps in knowledge about modelling residue decomposition were evaluated and steps to address them identified.

- Rezare has been working closely with Hamish Brown from Plant and Food Research, WSP, and Agrilink NZ to develop the beta version of the tool.

- This is a desktop tool that interacts with the tool's model that is hosted on the internet through an Application Programming Interface (API).

- The tool more or less looks and functions similar to the excel prototype, which has been used concurrently as part of Workstream 4's case study development.

- A potato focused workshop began the development of cultivar specific crop factors for use in the model. This will allow potato growers to select their specific cultivars, rather than more generic potato types.

- The tool will be available for testing and refining from late June.

- Testing will occur through the latter half of 2023, with feedback incorporated into the final first-generation tool. This will be available for general release in June 2024.

Workstream 4 – Developing a change landscape

- Presentation of the tool on a one-to-one basis have been ongoing and provided guidance in developing the framework and 'layers' approach.

- Considerable planning has gone into how the final Year 4 dissemination programme looks and is timed. Details can be found in the Year 4 Annual Plan and Gantt Chart.

- The first case study was prepared and has been used as a template for a further 6 to 10 cases studies. These have proven to be extremely valuable, both from a grower engagement perspective, but also as part of the tool testing and ensuring that it meets the needs of growers.

- Potatoes NZ held 2 regional grower research and development breakfast briefings, in Christchurch and Pukekohe. SVS presented an overview and how the tool functions.

- NZ Grower article:

  - March – SVS Tool Development Update, by Andrew Barber & Henry Stenning

1.2 Key highlights and achievements

- Rezare's co-development with PFR and SVS partners on the tool's interface and functionality

- The development of the first case study and the interest that this has generated with these growers and advisers

- The collation of a shared database amongst PFR and SVS monitors that pulls together a single source for all soil and plant analysis. The data is then extracted, sliced and diced as required by the users. This includes the regional benchmarking reports, and model developers at PFR. Most recently this has included butter understanding the characteristics of different potato cultivars that were collected as part of the additional crop monitoring.

1.2 Key highlights and achievements

1.3 Collaboration with other programmes *(optional)*

Red font is new text this quarter.

Project name	Industry lead / Researcher	Description	Link to SVS
Regenerative management systems for New Zealand vegetable production	SFFF Countdown NZ, Leaderbrand Produce	Countdown and Leaderbrand are working with Plant & Food Research to explore regenerative farming practices, into intensive vegetable production. The project will include composting, cover crops, and biodiverse perennial plantings.	PFR and growers – Leaderbrand. Crop residue breakdown.
Future Ready Farms	SFFF Ballance	This programme aims to trial and develop 12 farm nutrient technologies that will help meet national environmental targets for reducing greenhouse gas emissions, agricultural chemical use, and nutrient loss to waterways. Products and tools for reduction of nitrogen emissions from the horticulture [kiwifruit] and arable sectors are identified. [FRF's will collaborate with SVS, but not looking to develop vegetable focused tools]	Scott Champion (Ind. Chair)
MPI SFF - Mineralisable N to improve on-farm N management	PFR led, funded by MPI, FAR, VR&I, Environment Canterbury, HBDC, Waikato Regional Council, Ravensdown, Hill Laboratories, Eurofins Food Analytics Ltd.	The productivity of broad acre cropping depends on supplying sufficient nitrogen to meet crop demand; however, farmers often do not know how much N will be mineralised during the growing season. Plant & Food Research have developed a new laboratory test (published 2017) that can be used to predict in-field N mineralisation. The new test is faster and more accurate than existing commercial tests. This project will conduct on-farm demonstration trials with different crops, soils, and climates to demonstrate the benefits of the new test to improve N management on farm.	SVS sampling protocol includes the hot water (HW) test in both the trials and regional monitoring sites. Mike Beare (PFR) is involved in SVS through the Tech. Panel. Soil samples are being split and sent to both Eurofins and PFR to test HW result consistency and Mineral N vs hot water extractable inorganic M.
Crop residue N project	VR&I, PNZ, FAR / PFR	PFR-funded project looking to quantify the rate of decomposition of different vegetable residues and the rate of N release from the residues into the soil. Taking the small-scale laboratory trials conducted last year by Trish Fraser (PFR) into a larger scale field trial and literature review.	Essential for the nutrient budget. Direct industry and researcher connections. Some residues will be obtained from crops in Workstream 1.

Project name	Industry lead / Researcher	Description	Link to SVS
Measuring real time nitrate leaching from a Hawke's Bay onion field	Ravensdown / PFR	The purpose of this research was to compare data from two nitrate sensors installed in a sump measuring nitrate-nitrogen concentrations in situ, with data from grab samples that were taken immediately to a laboratory for analysis.	Problem recognition. Direct industry and researcher connections.
Future Proofing Vegetable Production	VNZ & PNZ / LandWISE	Completed MPI SFF project. On farm trials in Levin and Gisborne. Developed a simple nitrogen budgeting tool designed specifically for vegetable production systems.	Picking up on the nitrogen budget and further developing the components and deliverable tool. Direct industry and researcher connections.
Process Vegetable Coefficients	PVNZ / PFR	Quantify some of the coefficients needed for N uptake and use by processing crops within Overseer.	Direct industry and researcher connections.
Protecting our groundwater: Fluxmeter	FAR, VR&I / PFR	A network of tension fluxmeters were installed on commercial arable and vegetable farms around New Zealand to directly measure losses of nitrogen and phosphorus in drainage water. Completed. Now being extended by FAR & VR&I.	Problem recognition. Direct industry and researcher connections.
Measuring nitrate in drains	Auckland Univ.	A Massey Univ. trial measuring nitrate levels in tile drains is being conducted in one of the Regional Monitoring sites. Now have the contact details and will follow up. The student trial has been running since 2019.	Trial is on a regional grower's site.
Modelling to reduce nitrogen in Pukekohe (Whangamaire stream)	MPI	Indicative environmental-economic modelling to investigate the potential scale of impacts on commercial vegetable growing from the annual median nitrate in Pukekohe. Considerable change in productive land use may be required to achieve the NPS-FM 2020 national bottom line. https://www.hortnz.co.nz/assets/Environment/National-Env-Policy/JR-Reference-Documents-/MPI_2020-42078-Pukekohe-Modelling-Report-Final-Sanitized.pdf	Aware of
Asparagus N budgeting	LandWISE, Asparagus product group / PFR	Previous survey work identified a very wide range of fertiliser practices. Preparation of FEP's highlighted the need for better information that can be fed into asparagus nutrient budgets.	Using sampling protocols developed by SVS. Direct industry and researcher connections.
Freshwater Management Tool	Auckland Council	AC is currently in the process of developing a Freshwater Management Tool. This tool will provide a more sophisticated assessment of water quality in the Auckland region. 2% of waterways in the Auckland region are predicted to exceed the 95th percentile concentration of 9.8 mg/L. All are in the vege rich sub-catchments of the Franklin aquifer.	HortNZ is working with AC.

Project name	Industry lead / Researcher	Description	Link to SVS
Global Literature Review on nitrogen mitigation options in vege. prod.	MPI / PFR	Literature review of mitigation technologies and their potential impact. Not yet available beyond MPI and PFR.	Important background for beyond SVS when mitigations are investigated.
Remote soil water measurement	NIWA	Remote auto sampling of soil leachate. Lysimeter was originally prototyped by Landcare Research, developed into a product by NIWA. https://niwa.co.nz/publications/isu/instrument-systems-update-21-november-2015/remote-soil-water-measurement. Researcher says progress has been slow and expensive (Andrew correspondence 2020).	Watch progress, along with other emerging technology.
Ag Matters	NZ Ag GHG Research Centre	Dissemination of practical information, backed by science, to help farmers and growers get to grips with climate change. https://www.agmatters.nz/	Collaborate on dissemination and case studies.

1.4 Upcoming

- Completion of the gamma version of the tool. The tool will then be a in a form that can be tested by growers and their advisers.

- Case study development using the excel version of the tool prototype.

- Grower survey and tool testing by the social science team at FOLKL.

- SVS celebration hui in Levin.

- Planning with a wide range of stakeholders for what SVS 2 looks like.

- NZ Grower articles:

    o Crop residue and fallow risks

    o A Quarterly project update

    o Learnings from controlled trials in WS1

1.5 Investment (Cash & In-kind)

Investment period	Co-investor contribution	MPI contribution	Total investment
During this quarter	$0.183m	$0.167m	$0.351m
Programme to date	$1.746m	$3.846m	$5.592m

Note: this is the end of the public section of this Quarterly Report