

# Sustainable Vegetable Systems

## Quarterly Report - Public

### Quarter 1, July – September 2021

Contract Agreement Number: 21859



Ministry for Primary Industries  
Manatū Ahu Matua



## In partnership with:



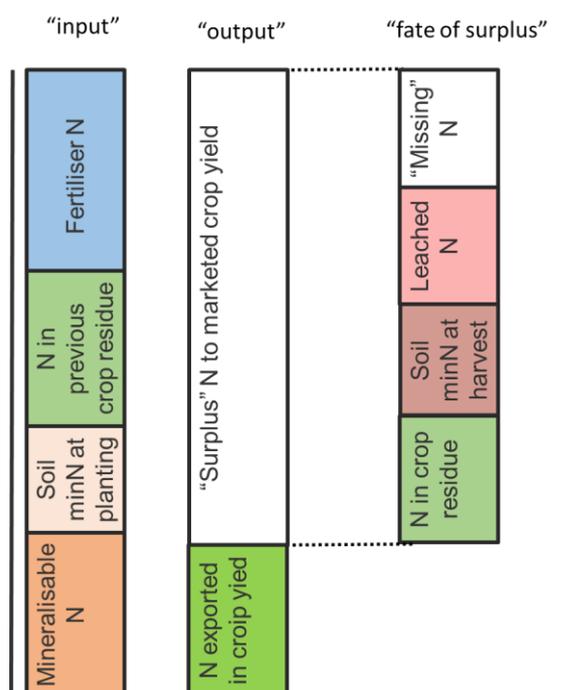
## Contents

2. PROGRAMME MANAGER SUMMARY .....	<b>Error! Bookmark not defined.</b>
3. RECOMMENDATIONS/DECISION POINTS .....	<b>Error! Bookmark not defined.</b>
4. PROGRESS SUMMARY .....	<b>Error! Bookmark not defined.</b>
5. PROGRESS TOWARDS OUTCOMES .....	<b>Error! Bookmark not defined.</b>
6. FINANCIALS .....	<b>Error! Bookmark not defined.</b>
7. PROGRAMME ISSUES.....	<b>Error! Bookmark not defined.</b>
9. ENVIRONMENTAL SCAN .....	<b>Error! Bookmark not defined.</b>
10. APPENDIX.....	<b>Error! Bookmark not defined.</b>

## 1.1 Summary of progress during this quarter

### Workstream 1 – Controlled experimentation to quantify nitrate leaching

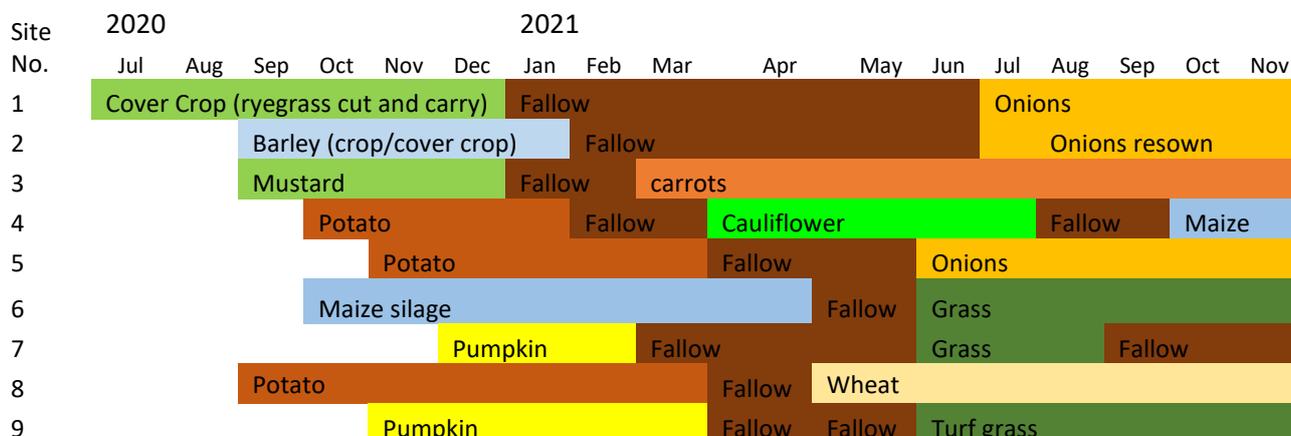
- Plant & Food Research (PFR) completed final harvests of broccoli and oats in the Lincoln rotations, and pak choy in the Hawke’s Bay rotation.
- Lettuces and onions were sown in Hawke’s Bay, and onions in Lincoln. Land is being prepared for potato planting at Lincoln.
- Buried suction cups were installed in all rotations at both sites.
- A framework to describe a nitrogen (N) balance was developed for further discussion and illustrated with the broccoli crop data. The net change in soil N across the potato – wheat – broccoli rotation is also being worked on.
- The generalised nitrogen budget is shown in Figure 1 with the actual figures for the broccoli crop trial included in the PFR quarterly report.



**Figure 1.** Framework for N balance. This balance identifies the ‘surplus’ N over and above that exported in marketable yield, and where that ‘surplus’ N is allocated within the system, what has leached and what is at risk of leaching.

## Workstream 2 – Regional on farm monitoring

- Monitoring continues on the 9 regional sites. All sites have now had fallow periods with a following second crop planted.



**Figure 2.** Regional monitoring sites – crop rotations

- The monitoring protocol has been further refined with additional testing during the fallow periods (often the highest leaching risk).
- 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.
  - Weather station performance at each site continues to be inconsistent. NIWA’s Virtual Climate Station Network, previously used as a backup, has been taken offline. NIWA have not yet determined the access cost, although they will be considerable as data extraction has become a manual process.
  - SVS is now using a combination of weather stations at each site and local stations accessed through the HortPlus network. Rainfall, and any associated drainage below the active rootzone, is a key component in leaching.
  - Covid-19 Level 4 movement restrictions caused a 2-to-3-week delay at the 3 Auckland and 1 Waikato monitoring sites. At Level 3 monitoring resumed in Auckland. However, boarder restrictions further delayed monitoring the Waikato site. As the boarder remained closed monitoring was conducted twice by the grower’s agronomist. A boarder exemption has now been acquired, with monitoring reverting back to the regional monitor.
  - 7 of 9 Site Agreements have been signed and returned. The 2 remaining continue to be followed up.
- The database of monthly soil mineral nitrogen has been integrated with the soil bulk density readings and therefore the ability to convert into the grower relatable unit of kg N/ha. Lab results are in mg N/kg.
- An example individualised benchmarking report (Figure 3) has been socialised with the Regional Monitors. The individualised reports have, or are about to be, sent to the regional growers for their feedback and improvement. This first individualised report focuses on how soil mineral N levels change down through the soil profile and across time. Highlights from the report include:

- Crop residues (unharvested plant tops and roots) can be a key source of nitrogen to feed the next crop. In the example below, the soil nitrogen spikes following cover crop incorporation and cultivation.
- Nitrogen levels in the top 60 cm range between 20 to 120 kgN/ha over the first 9 months, none of which were driven by fertiliser. This demonstrates the significant role that crop residue, cultivation, temperature, and soil microbes play. This also points towards potential mitigations, such as crop selection, cultivation timing, and residue management.
- While we can see the impact of crop residues, there are currently no well-established methods for predicting the supply of N from these residues. This knowledge gap is being progressed in a separate concurrent project.
- Well-tuned benchmarking can be a very powerful tool, which has been incorporated into this report. A key metric being the nitrogen levels pre-harvest and over the fallow period. These levels can inform decisions on paddock management, including the following crop choice, cultivation timing, and fertiliser management.
- The reports incorporate links to learning resources, which are more likely to be accessed when a person can see their own data and are therefore engaged in the topic. In this report there is a link through to a recent SVS article on nitrogen soil testing terms and nitrogen flows.
- Beyond nitrogen other data can be pulled through into these reports. By way of demonstration the grower's organic matter and Olsen P levels were benchmarked against national averages.
- PFR is currently conducting the plant analysis. Once this is available, the results will be incorporated into a nutrient budget. This fills out the nitrogen picture further and gets closer to the goal of better understanding and informing decisions around nitrogen leaching risk and mitigations. The intention is to incorporate this into a similar individualised report.

### Workstream 3 – Farmer facing tool(s)

- An SVS modelling workshop attended by modellers working in science and industry model users identified some key issues to consider in developing useful tools from modelling. Key steps for interactive exchange of information and grower input were identified.
- Modelling simulations are being updated with data from crops that have been recently harvested in the rotations. Work continues to refine soil parameters for accurate estimation of soil water as this determines accurate prediction of drainage and leaching.

### Workstream 4 – Developing a change landscape

- Grower interviews to understand the practices, knowledge and issues faced with N management of crops were conducted by phone or video conference because of COVID-19 restrictions.
- A report is being prepared from the interviews to help inform modelling discussion and tool development. This will feed into the next Workstream 3 meetings in December.

# Soil Nitrogen Tracking & Benchmarking Report Year 1 - October 2020 to October 2021

Season	2020/21
Farm Name	
Region	

## How does this affect me?

Nitrogen leaching and runoff is an important issue in New Zealand's horticulture and wider agriculture industry. Leaching into aquifers and runoff into surface water can lead to large decreases in freshwater quality and can be destructive to the freshwater environment. A summary on soil nitrogen is available on the Potatoes NZ website - <https://tinyurl.com/soilN>.

As part of the Sustainable Vegetable Systems (SVS) program, you will have access to a large series of soil and plant test results over the course of the project. This will help increase your knowledge of nitrogen flows on your farm system across your different crop types. This report summarises the soil test results from your property up to this point in time, and benchmarks these results to the average results from the program.

This report will continue to be refined throughout the project to reflect grower feedback and incorporate changes.

## 1 Grower soil test results - your average, range and monthly tracking

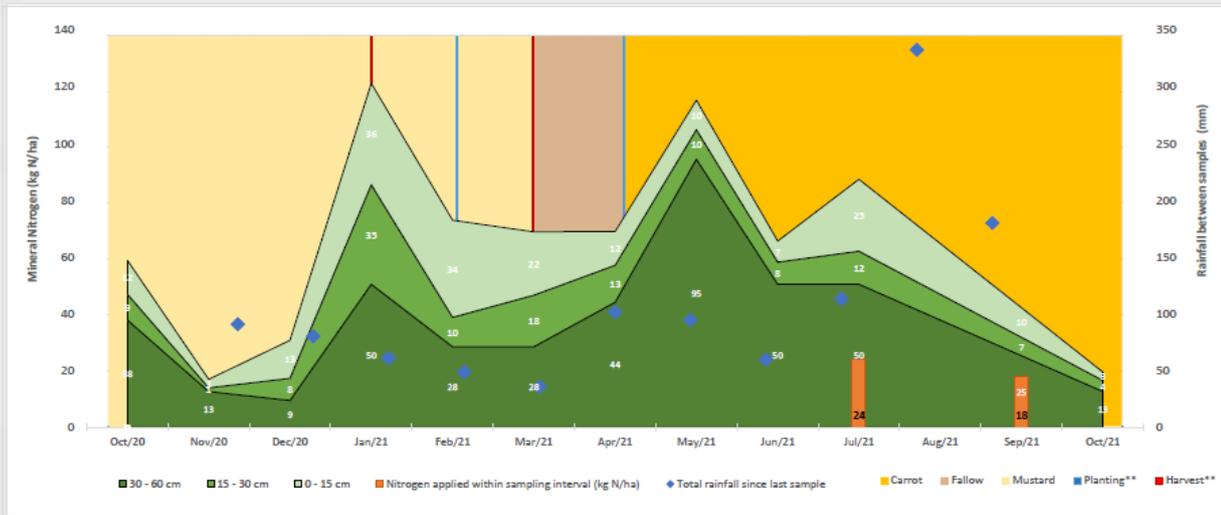
Crop	Total samples	Mineral N (kgN/ha)							
		0 - 15 cm		15 - 30 cm		30 - 60 cm		60 - 90 cm	
		Average	Range	Average	Range	Average	Range	Average	Range
Mustard	18	20	3 - 36	13	1 - 35	28	9 - 50	47	19 - 63
Fallow	4	22	22 - 22	18	18 - 18	28	28 - 28	32	32 - 32
Carrot	23	11	3 - 25	9	4 - 13	46	13 - 95	50	16 - 72
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

### Other Benchmarks:

Olsen-P	Your average	National average
0 - 15 cm	76.1	87.6
15 - 30 cm	68.9	70.7

Organic Matter (%)	Your average	National average
0 - 15 cm	4.1%	4.6%
15 - 30 cm	3.8%	4.0%



\*Note: rainfall is collected using in-field weather stations which can sometimes go offline. Rainfall is substituted with virtual stations if in-field rainfall collection is low. The weather station used for data in this graph was operational for 65% of the project.  
 \*\*Planting can include re-emergence and harvest can include incorporation or cutting down (e.g. for cover crops). This data comes from grower surveys so is not always up to date.

## 2 Benchmarking by growth stage

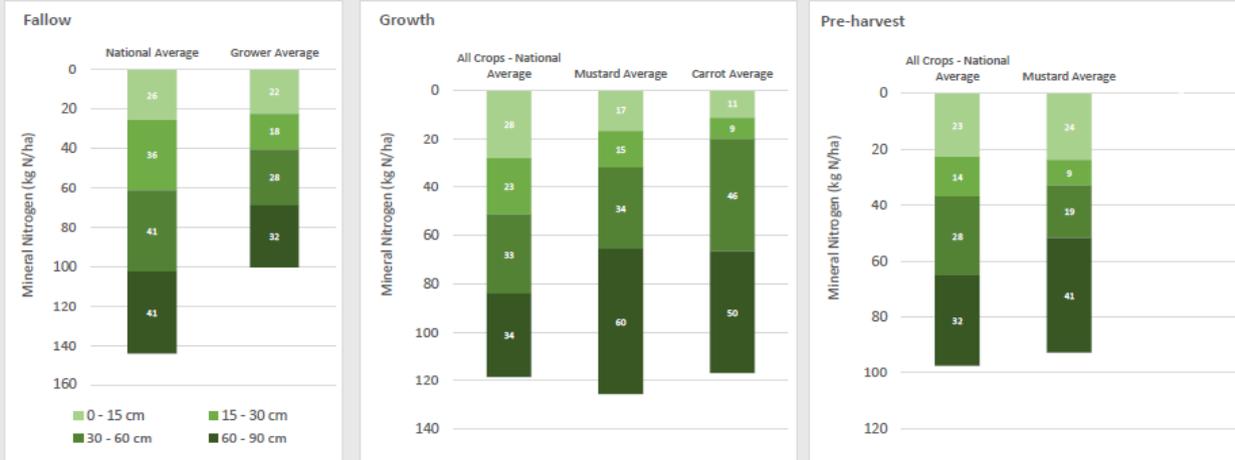


Figure 3. Individualised Benchmarking Report - Soil mineral nitrogen

## 1.2 Key highlights and achievements

- Completion of broccoli and oats in the Lincoln rotations, and pak choy in Hawke's Bay. Following lettuce, onion, and potato crops planted.
- The development of the nitrogen budget and illustrated with the completed broccoli crop.
- The regional monitoring data aggregation reaching a point where reporting can begin back to growers. The connections and questions raised in this regional monitoring are now starting to be fed back into the discussion with scientists and the dissemination team. One of the first key aspects to be discussed has been the effect of crop residues on soil mineral nitrogen levels (see above).
- Uncertainty over the originally reported hot water extractable organic N (HWEON) to predict potentially mineralisable N (PMN) and the soup of names, lead to deeper collaboration with other PFR scientists and a subsequently planned article on PMN.
- Adapting to Covid-19 restrictions, developing safe protocols, and in the main continuing on. Special mention and appreciation needs to be extended to the work conducted by PFR staff to get trials established and monitoring equipment installed during this time. Also, the field monitoring conducted in Auckland and the Waikato after Level 4 restrictions were lifted.
- An extremely successful model developer and model user meeting. This group is now underway, with strong connections forming between the different groups within this team. There was a lot of appreciation expressed for the opportunity of bringing together the scientists and model users.
- The dissemination team, led by Gemma Carroll (PNZ), has delivered the baseline survey and brought that through into an NZ Grower article, along with a regular slot for SVS in the monthly magazine. Plans are being developed for stories and case studies that can be told using podcasts and video, recognising that face to face meetings have greater uncertainty.

### 1.3 Collaboration with other programmes *(optional)*

Project name	Industry lead / Researcher	Description	Link to SVS
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.	<p>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.</p> <p>Plant &amp; 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.</p>	<p>SVS sampling protocol includes this hot water test in both the trials and regional monitoring sites.</p> <p>Mike Beare (PFR) is indirectly involved (Tech Group) in SVS and there is discussion on further collaboration.</p>
Crop residue N project	VR&I, PNZ, FAR / PFR	Taking the small-scale laboratory trials conducted last year by Trish Fraser (PFR) into a larger scale field trial and literature review. This is at the draft project proposal stage.	Essential for the nutrient budget. Direct industry and researcher connections.
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.

Project name	Industry lead / Researcher	Description	Link to SVS
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.	An Auck Univ. trial measuring nitrate levels in tile drains is being conducted in one of the Regional Monitoring sites. The grower is sending through further information and contacts.	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. <a href="https://www.hortnz.co.nz/assets/Environment/National-Env-Policy/JR-Reference-Documents-/MPI_2020-42078-Pukekohe-Modelling-Report-Final-Sanitized.pdf">https://www.hortnz.co.nz/assets/Environment/National-Env-Policy/JR-Reference-Documents-/MPI_2020-42078-Pukekohe-Modelling-Report-Final-Sanitized.pdf</a>	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 95 <sup>th</sup> percentile concentration of 9.8 mg/L. All are located 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. Lysimate was originally prototyped by Landcare Research, developed into a product by NIWA. <a href="https://niwa.co.nz/publications/isu/instrument-systems-update-21-november-2015/remote-soil-water-measurement">https://niwa.co.nz/publications/isu/instrument-systems-update-21-november-2015/remote-soil-water-measurement</a> . 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. <a href="https://www.agmatters.nz/">https://www.agmatters.nz/</a>	Collaborate on dissemination and case studies.

## 1.4 Upcoming

- Lettuce harvest will be completed in Workstream 1. Data from the onion crops sown will continue to be collected, and the potato crop sown.
- N balance discussions will be ongoing, and data from Workstreams 1 and 2 further evaluated for N balance development.
- Modelling workshop to be held. What does the farmer facing tool need to deliver and look like?
- Scenario testing of data is ongoing.
- Ongoing interviews and approaches to focus groups developed. Articles for communication of concepts and developments continue.
- Additional plant analysis to be conducted on crops prior to harvest. Allowing both a more robust data base and wider grower engagement.
- Reference Group members to be selected and briefed. Leadership of this group naturally fits with HortNZ.

## 1.5 Investment (Cash & In-kind)

<b>Investment period</b>	<b>Co-investor contribution</b>	<b>MPI contribution</b>	<b>Total investment</b>
During this quarter	\$0.135m	\$0.380m	\$0.515m
Programme to date	\$0.805m	\$1.866m	\$2.671m