

Sustainable Vegetable Systems

Quarterly Report - Programme Governance Group

Quarter 2, October – December 2022

Contract Agreement Number: 21859



**Sustainable
Vegetable
Systems**

Ministry for Primary Industries
Manatū Ahu Matua



1.1 Summary of progress during this quarter

Workstream 1 – Controlled experimentation to quantify nitrate leaching

- Ryegrass seed crops in Rotation 1 and 2 (Lincoln) have been harvested. These fields have been left in pasture after the seed harvest.
- Data continues to be collected for the ryegrass hay crop in Rotation 3.
- A sequential harvest plan was implemented for the cauliflower harvest, to meet commercial standards. Advice on commercial quality of cauliflower curds for harvesting was provided by the commercial grower and agronomist.
- Data continue to be gathered and analysed as planned.

Workstream 1 - Trial crop rotations

| Crop experiment and rotation outline - LINCOLN | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|-------|-----|---------------------|-----|-----|--------|------------------------------|------------------|-----|-----|--------|---------|------------------|-------|------|-----|-----|-----|--------|----------|--------|-----------------------|-------|---------|--|
| | 2020 | | | | | | 2021 | | | | | | | | | | | | 2022 | | | | | | |
| | 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 - Shanghai | | | Fallow | Cover crop (ryegrass / Oats) | | | | Fallow | | Potatoes - Fresh | | | | | | Fallow | ryegrass | | | | | |
| Crop experiment and rotation outline - Hawke's Bay | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2020 | | | | | | 2021 | | | | | | | | | | | | 2022 | | | | | | |
| | 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 | | | | | | | | | Fallow | | | | | |

Workstream 2 – Crop rotations (continued)

| Site No. | 2022 | | | | | | | | | | | | 2023 |
|----------|------|--------|-----------------------|-------------|--------|-------------------------------------|--------|--------|-----|------------------|------------------|--------------------|------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan |
| 1 | | Fallow | | | | Cover Crop (ryegrass cut and carry) | | | | | | | |
| 2 | | | | Cauliflower | | | | Fallow | | | | Potato | |
| 3 | | | | | | | Onions | | | | | | |
| 4 | | | | | | | Onions | | | | | | |
| 5 | | | | Grass | | | | | | | | Potato | |
| 6 | | | | | Fallow | Grass | | | | Fallow | Water melon | | |
| 7 | | | | | | | | | | | Butternut squash | | |
| 8 | | | | | | | | | | peas (27th Sept) | | | |
| 9 | | harv. | grass - sheep grazing | | | | | | | | | Broccoli (end Nov) | |

Workstream 2 – Regional on-farm monitoring

- Field sampling is ongoing. Plant sample processing by the PFR laboratory for N content analysis is in the process of being shared.
- 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.
- An additional site, winter grown potato crop in Auckland, was added as an identified crop gap. This crop has been harvested and the soil is continuing to be monitored.

Workstream 3 – Farmer facing tool(s)

- Rezare provided a proposal for the tool's interface development and associated API.
- The proposal includes:
 - 1. Open source – through a Software Development Kit (SDK).
 - 2. Standalone visual interface.
 - 3. Application Programming Interface (API). This is an essential component of the visual interface, while also allowing third parties to use the SVS model within their own in-house systems.
- An excel version of the tool was developed by Agrilink NZ, for the purposes of rapidly demonstrating how the tool could function. This incorporated feedback from previous workshops where the alpha version of the tool was demonstrated by PFR.
- The excel version created a much more responsive way of demonstrating that SVS had heard and incorporated previous feedback. It also made an expanded Technical Panel Workshop held in November considerably easier to structure the discussions about nitrogen budgets and soil nitrogen testing.
- The aim is to have the externally accessible version of the tool ready for limited testing from May 2023.
- Discussions have begun with an external interface developer, although progress is subject to reaching agreement with Overseer on the most expedient pathway forward.
- It has been agreed by the Workstream 4 leadership team to put more emphasis on developing case studies. As the case studies can be developed using an internal version of the SVS tool, this is seen as a way to both engage with grower champions prior to the tool's release, while further refining the tool without the constraint of IP issues further delaying development.

Workstream 4 – Developing a change landscape

- With the imminent availability of the SVS tool in a form that can be made available for use by a limited number of growers (July 2023) considerable planning is going into supporting it and making it a valuable iterative next step.
- The Workstream 4 leaders met in Wellington on the 18th of October to start planning and putting in place the elements that will later support the roadshows (Q4 2024).
- Grower tool engagement (see gantt chart) and feedback through:
 - Case studies in the main growing regions
 - FOLKL collecting tool prototype feedback
 - Community of Practice (some will be part of the case studies)
 - Technical Panel
 - Workstream 3 – model user workshops
- NZ Grower articles:
 - November – SVS programme Update, by Andrew Barber & Henry Stenning
 - December – Soil Mineral and Mineralisable Nitrogen: Acknowledging and Reducing Variability, by Andrew Barber & Henry Stenning
- A conference paper was presented to the New Zealand Society of Soil Science Conference in Blenheim in November 2022.

1.2 Key highlights and achievements

- Engaged Rezare to develop the tool's interface and functionality
- Progressed the options for the tool's crop model and associated soil nitrogen. The options are ready for final review by the Project Governance Group on the 23rd February
- An expanded Technical Panel met on the 24th November in Wellington and on Zoom to workshop what the minimum standards look like for nitrogen budgets and soil nitrogen testing.
- The rapid development of an excel version of the tool has been used to demonstrate the tool's concepts, and to demonstrate that previously provided feedback has been incorporated as part of the iterative tool development process.
- The SVS videos were released and are now available through the PNZ YouTube channel:
 - <https://www.youtube.com/@potatoesnewzealandinc.8524/videos>
 - Video 1 – Programme Overview
 - Video 2 – Case studies and monitoring
 - Video 3 – The Science – trials, labs, and monitoring
 - SVS: Nitrate Quick Test explained

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 95 th 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

- Development of the gamma version of the tool – including what the Entry Level looks like, data requirements, what modelling it draws on, and outputs
- N balance discussions and development will be ongoing, and data from Workstream 1 and 2 further evaluated for N balance development
- PFR’s incorporation of soil leaching and crop residue into the tool
- Continuing to collaborate with Horizons on a Risk Scorecard that has N-budgets and N-testing at their heart
- Engaging with Levin growers on a Nitrogen Risk Scorecard
- Case study development using an early version of the tool prototype
- NZ Grower articles:
 - Tool development update
 - A Quarterly project update

1.5 Investment (Cash & In-kind)

| Investment period | Co-investor contribution | MPI contribution | Total investment |
|--------------------------|---------------------------------|-------------------------|-------------------------|
| During this quarter | \$0.133m | \$0.372m | \$0.506m |
| Programme to date | \$1.563m | \$3.679 m | \$5.242m |