

Sustainable vegetable systems — quarterly report October to December 2020

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1 Summary

This report summarises activity carried out from 1 October to 30 December 2020 (Quarter 2). Activity this quarter focused on setting up trials and collecting field data. The analysis and presentation of these data will be provided in the next quarterly report (July 2021).

1.1 Workstream 1

Literature review completed, this is separate to this report.

Wheat continues in Rotation 1 at Lincoln (Figure 1). From planting on 19 May 2020 to now there have been:

- Eight soil samplings for mineral N soil analysis to a depth of 90 cm, carried out monthly since planting in May.
- Six biomass samplings for growth analysis and N analysis. These were carried out at monthly intervals from August. The most recent samples were taken on 12 January 2021. The final crop harvest is anticipated towards the end of January or early February.
- Two drainage events have occurred during growth of the wheat crop so far, and samples have been collected from the suction cups.

First crop – pak choy – of Rotation 2 at Lincoln is sown. Shanghai Pak Choy was sown on 7 December 2020 (Figure 2).

- The site was previously in oats that were cut and carried, before the crop was sown. Good support has been obtained from the Technical Working Group agronomists.
- There have been two soil samples to a depth of 90 cm, one in December 2020 just after sowing and one in January 2021.
- Two harvests have been collected, again in December 2020 and January 2021, for biomass measurement and crop N measurement.
- There have been no drainage events in this crop yet. Six suction cups per plot were installed on 15 December 2020.



Figure 1. Wheat trial at The New Zealand Institute for Plant and Food Research Lincoln farm. Drone images obtained 20 August and 22 November 2020. The suction cup sampling sites for each plot can be seen as the white posts in the image taken on 20 August (left).



Figure 2. Aerial images of pak choy field on sowing date, 7 December, and on 29 December 2020. Suction cup tubes are visible in the image taken on 29 December (right). Note the wheat field of Rotation 1 adjacent to the pak choy planting.

Preparation for planting first crop of Rotation 2 at Hawke's Bay:

- Land for establishing pak choy has been prepared — the previous oat cover crop has been cut and sprayed.
- We are looking for technical support from the Technical Working Group to address key decisions regarding preferred cultivation, planting, fertiliser treatments and agrichemical management.

Soil physical baselines obtained for Lincoln and Hawke's Bay rotation area:

- Soil pits to 1.2 m were dug in two distinct regions of each rotation block for soil physical sampling (Figure 3). Samples were taken to 1.2 m depth and were used to categorise the soil physical properties including water retention curves, wilting points, upper water limit, bulk density and soil structure. Manaaki Whenua - Landcare has completed analysis defining soil layers and textural properties of each layer.



Figure 3. Images of soil physics sampling pits.

1.2 Workstream 2

- In this Workstream, inputs and outputs are being monitored across different commercial farms through a continuous period to calculate the nitrogen (N) balance from a range of rotations including vegetable crops. The data will be used alongside Workstream 1 and Workstream 3.
- Nine sites have been selected in the following areas: Pukekawa, Pukekohe, Tuakau, Matamata, Manawatu (two sites), Hawke's Bay, and Canterbury (two sites).
- Each site is following a different crop rotation during the monitoring period. The rotations include vegetable crops of interest for this project such as onions, broccoli, pumpkin, potato, lettuce, carrots, cabbage, spinach, beetroot and peas.
- Each monitoring site, except the one in Matamata, has been visited at least once to date by staff from The New Zealand Institute for Plant and Food Research (PFR) to collect data. It is important to note that the permanent monitoring area has been designed to ensure that a location bias is not created (for example, by selecting different areas of the paddock for each of the crops within the rotation).
- Data being collected include:
 - Monthly soil mineral N to 60 cm depth (90 cm depth every second sampling);
 - Monthly biomass production and N content of the crop (same time as soil mineral N);
 - Management inputs (especially N fertiliser).



Figure 4. The two commercial fields monitored in Canterbury currently host a pumpkin (left) and a potato crop (right).

Details of site visits

Site	Region	Crop	Date visited	Activities
1	Pukekawa	Ryegrass cover crop	22 October 2020	<i>Visited site.</i> Approximately 100 m x 100 m area marked as monitoring area. <i>Discussions</i> to establish sampling methodologies and protocols. Soil corers demonstrated. Protocols for soil bulk density measurements also discussed. <i>Soil sample.</i> Took 10 cores along straight line transect (diagonal): 0–5, 15–30, 30–60 and 60–90 cm depth. Samples randomised from between wheel tracks.
2	Pukekohe	Barley cover crop	16 November 2020	<i>Visited site.</i> Approximately 100 m x 100 m area marked as monitoring area. <i>Discussions</i> to establish sampling methodologies and protocols. Soil corers demonstrated. Protocols for soil bulk density measurements also discussed. <i>Soil sample.</i> Took 10 soil cores along straight line transect (diagonal). Sample depths were 0–15, 15–30, 30–60 and 60–90 cm. Samples randomised from between wheel tracks. <i>Protocols</i> for bulk densities discussed, developed and provided. <i>Biomass sample.</i> Five biomass cuts of 0.5m ² were taken across the monitoring area. Number of plants, total weights for each component. Plant samples taken to PFR for dry weight assessment and N analysis (N analysis will be on a bulk sample across the three sampling areas).
3	Tuakau	Mustard cover crop	16 November 2020	<i>Visited site.</i> Approximately 100 m x 100 m area marked as monitoring area. <i>Discussions</i> to establish sampling methodologies and protocols. Soil corers demonstrated. Protocols for soil bulk density measurements also discussed. <i>Soil sample.</i> Took 10 cores along straight line transect (diagonal). Sample depths were 0–15, 15–30, 30–60 and 60–90 cm. Samples randomised from between wheel tracks. <i>Biomass sample.</i> Five biomass cuts of 0.5m ² were taken across the monitoring area. Number of plants, total weights for each component. Plant samples taken to PFR for dry weight assessment and N analysis (N analysis will be on a bulk sample across the three sampling areas).
4	Matamata	Potato		Visit has not been able to be organised.

Site	Region	Crop	Date visited	Activities
5	Manawatu	Potato	4 December 2020	<i>Visited site.</i> An area of approximately 150m x 150m was marked. Decided to set up three sampling points where biomass, soil are to be collected. <i>Discussions</i> to establish sampling methodologies and protocols. Soil corers demonstrated. Protocols for soil bulk density measurements also discussed. <i>Soil sample.</i> Took 10 cores along straight line transect (diagonal). Sample depths were 0–15, 15–30, 30–60 and 60–90 cm. Samples randomised from between wheel tracks. Soil bulk density samples were collected using a modified corer to sample at 0–15 and, 15–30 cm depths at three points in the field.
6	Manawatu	Summer maize	4 December 2020	<i>Visited site.</i> An area of approximately 150 m x 150 m was marked. Decided on the three sampling points where biomass, soil are to be collected. <i>Discussions</i> to establish sampling methodologies and protocols. Soil corers demonstrated. Protocols for soil bulk density measurements also discussed. <i>Soil sample.</i> Took 10 cores along straight line transect (diagonal). Sample depths were 0–15, 15–30, 30–60 and 60–90 cm. Samples randomised from between wheel tracks. Soil bulk density samples were collected using a modified corer to sample at 0–15 and, 15–30 cm depths at three points in the field. <i>Biomass sample.</i> 1 m length of 2 adjacent rows taken at each of the 3 monitoring areas. Number of plants, total weights for each component. Plant samples taken to PFR for dry weight assessment and N analysis (N analysis will be on a bulk sample across the three monitoring areas).
7	Hawke's Bay	Squash	23 November 2020	<i>Visited site.</i> An area of approx. 150 m x 150 m was marked out. Decided on the points for biomass and soil sampling. <i>Discussions</i> to establish sampling methodologies and protocols. Soil corers demonstrated. Protocols for soil bulk density measurements also discussed. <i>Soil sample.</i> Took 10 cores along straight line transect (diagonal). Sample depths were 0–15, 15–30, 30–60 and 60–90 cm. Samples randomised from between wheel tracks. Soil bulk density samples were collected using a modified corer to sample at 0–15 and, 15–30 cm depths at three points in the field.
8	Canterbury	Potatoes	20 November 2020	<i>Visited site.</i> An area of approximately 150 m x 150 m was marked and a transect marked with GPS. Decided where to set up three sampling points where biomass, soil sampling and bulk density were to take place. <i>Biomass sample.</i> 1 m length of 2 adjacent rows taken at each of the 3 monitoring areas. Number of plants, total fresh and dry weights for each component were recorded. A bulk sample of plant material was sent for plant N analysis to the Plant and Food lab. Rhizoctonia stem canker present. Crop just past tuber initiation. <i>Discussions</i> to establish sampling methodologies and protocols. <i>Protocols</i> developed to take representative soil samples across the wheel track, ridge and furrow. Five cores taken at each sampling site: 0–15, 15–30, 30–60 and 60–90 cm. <i>Soil sampling</i> – bulk densities taken at each sampling site. One from 0–15 (from ground zero from the side of the ridge) and 15–30 cm (from ground zero from the furrow).
			26 November 2020	<i>Visited site.</i> Crop had just been drilled. Hard to distinguish drill rows/fertiliser banding. Approximately 100m x 100 m area marked as monitoring area. <i>Soil sample.</i> Took 10 cores along straight line transect (diagonal). Sample depths were 0–15, 15–30, 30–60 and 60–90 cm. Samples randomised from between wheel tracks. Soil bulk density samples were collected using a modified corer to sample at 0–15 and, 15–30 cm depths at three points in the field.
9	Canterbury	Pumpkin	7 January 2021	<i>Biomass sample.</i> Biomass from three sampling points. Each sample area was 2m length of 2 adjacent rows. Plants variable in size. 1.6 m row spacing and approximately 30 cm seed spacing. <i>Protocols</i> developed for biomass sampling. <i>Discussions</i> to establish sampling methodologies and protocols. <i>Soil sample.</i> 0–15, 15–30, 30–60 cm soil samples taken. Four cores per biomass plot (12 cores in total). Two in row, one in the middle between two rows and one halfway between row and middle of two rows.

1.3 Workstream 3

Modelling communities of practice

- A community of practice has been defined and a meeting held to discuss the modelling priorities and start to identify an approach to the modelling.
- Initial focus will be on testing Overseer with the aim of building confidence in its coefficients and outputs. The data collected in Workstream 1 and 2 are key for this.
- Further modelling needs and approaches will be identified as work proceeds. This will look toward any improvements in predictions, and in particular in developing the farmer facing tool.

Modelling design and development

- Some initial meetings with crop experts to determine the crop coefficients for use in Overseer have been conducted.
- This work is ongoing.

1.4 Workstream 4

- A meeting with stakeholders was held to discuss the programme of work.
- A draft stakeholder analysis was developed and presented to the Workstream 4 group for review. From this an approach of how to develop impact and include stakeholders in the process will be developed.
- A design of methodology has been started and is in progress.

1.5 Key highlights and achievements

Workstream 1. Wheat crop nearing harvest, pak choy crop established at Lincoln.

Workstream 2. Eight out of the nine sites visited, useful discussion around tailoring protocols and sampling procedures for crop and site. Sampling started.

Workstream 3. Meetings held to start to identify the approach used; initial meetings to define crop coefficients for vegetables crops that at the moment do not have coefficients or use proxies in Overseer.

Workstream 4. Draft of stakeholder analysis presented for further discussion.

The PFR Field operations team has been collecting video and photos as they undertake trial work. They are working on potential internal PFR and external communication of these resources and will connect with the Workstream 4 group regarding communication pathways.

1.6 Collaboration with other programmes (optional)

- Real time N-losses – Rural; Professional fund through Our Land and Water, looking at real time measurement of nitrogen losses under vegetable production in Hawkes Bay. PFR is providing data analysis support.
- Residue incubation– SSIF funded (PFR) project looking to quantify the rate of decomposition of different vegetable residues and the rate of nitrogen release from the residues into the soil. Some residues will be obtained from crops in Workstream 1.
- Process Vegetable Coefficients – looking to quantify some of the coefficients needed for nitrogen uptake and use by processing crops within Overseer.
- Mineralisable N to improve management – a SFFF project looking to improve the measurement and prediction of the amount of biologically mineralized nitrogen in a field. This pool of nitrogen is a key component for understanding crop nitrogen requirements, together with measurements of mineral nitrogen (nitrate and ammonium).

1.7 Upcoming

- Workstream 1 in Hawke's Bay will be planted with the first vegetable rotation.
- Data from Workstream 1 and 2 will begin to be analysed.
- Crop model coefficients will be evaluated for use in Overseer.
- Stakeholder plan for engagement developed.

2 Recommendations/decision points

Recommendations of changes to the programme plan and any decision points for the Programme Governance Group (PGG). If no recommendations or decision points just state that

None for this quarter.

3 Progress against workplan

Key: Project status

Completed	
On Track: no change to outcome(s) or milestone date; < 10% variance to budget	
Slight Variation/Delay: adverse change to expected outcome(s); > 3 month delay to milestone; 10-25% variance to budget	
Attention Required: outcome(s) not expected to be achieved; > 6 month delay to milestone; >25% variance to budget	

3.1 This quarter

Workstream	Financial	Timing	Outcome	Progress against work plan – comments
1.				1.1 – Literature review The literature review was delayed and has been completed. This is a separate report. 1.2 – Field experiments Experiments are underway in Hawke's Bay and Lincoln according to plan. Data collection is underway.
2.				2.1 – Review and input of methodologies PFR has reviewed methodologies. PFR researchers visited each Workstream 2 site to provide guidance and ensure protocols are suitable. PFR has used almost all of its available resource allocated to this part of the project in visiting individual sites and guiding sample collection methodologies and protocols. 2.2 – Data analysis Data analysis will be undertaken following data collection. <i>Note: PFR contract for analysis of Workstream 2 plant samples to be completed. This was outside the scope of the PFR contract 38739. This is a planned addition.</i>
3.				3.1 – Model design and development Community of practice meetings and discussion have started with a focus on Overseer parameter evaluation.
4.				4.1 – Report on facilitating implementation – data collection and analysis is underway 4.2 – Stakeholder analysis – meeting and discussion to initiate the analysis
Gov Mgmt				PFR Project Leader and Business Manager attended the Governance Group meeting. PFR will submit a response to the MPI RfP regarding Mitigation in vegetable systems.

3.2 Next quarter

Workstream	Financial	Timing	Outcome	Activity in the next quarter – comments
1.				- Establish pak choy at Hawke's Bay site - Data collection continues - Data analysed for crop rotations and provided to Workstream 3 - Quarterly reporting
2.				Data analysed and contribution toward reporting completed
3.				Scope of farmer facing tool determined and detail required for baseline prediction and design options considered. Contribution to report on model progress. IP plan updated.
4.				Report on facilitating implementation
Gov mgmt				Governance Group meeting in February 2021

4 Progress towards outcomes

These have been taken from The Programme – Schedule 5 and KPIs in the contract. There is a bit of repetition. Guidance on what is useful.

Outcome	Target	Actual	Status	Comment
WS1 Literature review	30 Sept	5 Feb 2021		Separate report produced. The delay allowed for a thorough review.
WS1 Trial sites established at PFR Hawke's Bay and Lincoln	30 Nov	30 Nov 2020 for Lincoln		- Wheat crop in Lincoln Rotation 1 is almost ready for harvest. - Pak choy crop in Lincoln Rotation 2 has been planted. - Data collection in these two crops is ongoing, including soil sampling, biomass sampling and soil solution samples collected from suction cups. - HB Rotation 2 (pak choy) will start in March 2021 – field preparation is underway.
WS2 Development of a Technical Working Group	30 Sept	30 Sept 2020		Complete
WS2 Regional on farm monitoring sites established	30 Sept			One site not yet visited. The Programme Manager to advise on progression of this site.
WS3 Development of a community of practice made up of current Overseer users	30 Nov	30 Nov 2021		Complete
WS4 Development of extension activity plan	30 Oct			Ongoing
KPIs				
1.1 & 2.3 Methodology is developed and approved by Technical Panel	31 Oct			Complete
2.2 Technical Panel is established and met	30 Sept			Complete
3.1 Agreement on monitoring data requirements and links to WS2	31 Oct			Complete
3.2 Agreement with Overseer on model access and working relationship	30 Nov			Underway
4.1 Development of extension activity plan	30 Oct			Underway

Key: Outcome status

Completed: The outcome has been delivered	
On Track: The outcome is on-track to be delivered	
Variation/Delay: There is a delay expected or a change to the outcome	
Attention Required: It is likely that the outcome won't be achieved or the benefits associated with it will be significantly reduced if changes aren't made	

5 Programme issues or risks

A risk is the timeliness and effectiveness of technical support to the agronomy input of Workstream 1 projects. This is working well in the South Island so far; not as effective in the North Island. In part it is a capacity and location issue with current Technical Working Group members. A suggestion is to co-opt other agronomists that are within the region but not on the technical working group for this support.

6 Communications and engagement

The PFR Field operations team has been collecting video and photos as they undertake trial work. They are working on potential internal PFR and external communication of these resources and will connect with the Workstream 4 group regarding communication pathways.

Miriam Hall, Business Manager, presented SVS programme to the Vegetable Research and Innovation Forum 1 December 2020.

7 Health and safety

Health and Safety protocols have been implemented when visiting fields and conducting experimentation.

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