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Sustainable Vegetable Systems – quarterly report July–September 2022

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Summary

Workstream 1 – Field experiments:

- Data have continued to be collected from the 'Nui' ryegrass seed crops in Rotation 1 and 2 sown in Lincoln and the 50:50 mix of 'Asset' and 'Tama' ryegrass sown in Hawke's Bay Rotation 3.
- 'Casper' cauliflower has been growing in Hawke's Bay Rotation 4, and a plan for sequential harvest to meet commercial standards has been developed.
- Heavy rainfall in both Canterbury and Hawke's Bay has meant that there have been several leachate samples. We have adapted N management to the heavy rainfall conditions, attempting to minimise N losses.

Workstream 2 – Regional monitoring:

- Field sampling and lab processing is ongoing.
- A plan to discuss the data and clarify structure and integrity for use by different parties in the programme is being developed.

Workstream 3 – Modelling:

- Structure of the tool, to provide for different needs of growers has been discussed and implementation plans developed.

Workstream 4 – Technology transfer:

- Filming for production of SVS videos was carried out in Canterbury and Hawke's Bay.
- Meetings were held to discuss and plan SVS roadshows for 2023, to increase awareness and information sharing.

1 Workstream activity

1.1 Workstream 1: Field experiments

Activity this quarter focused on collecting crop, soil and leaching data for the ryegrass crops in Rotations 1, 2 and 3, and the cauliflower crop in Rotation 4 (Figure 1). These rotations are implemented at the New Zealand Institute for Plant and Food Research Limited (PFR) farms at Lincoln, Canterbury and Havelock North, Hawke's Bay.

Data on crop nitrogen content and soil nitrogen levels are still being processed, and these data will be reported once available and analysed.

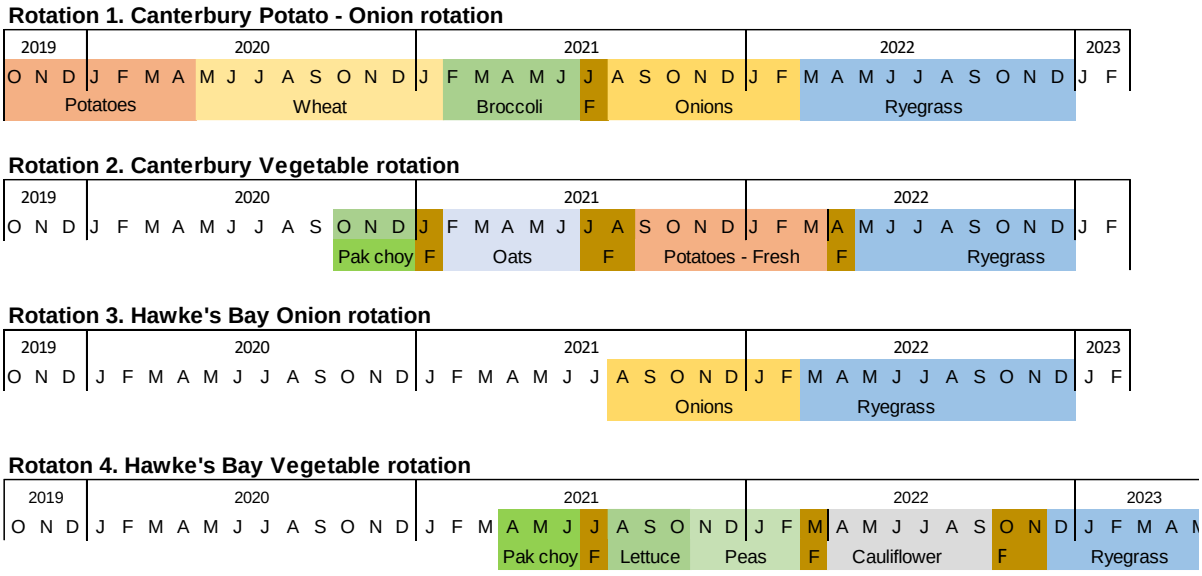

Figure 1. The four crop rotations implemented at PFR research sites in Canterbury (Lincoln) and Hawke's Bay (Havelock North).

1.1.1 Canterbury rotation 1 and 2

- A ryegrass seed crop of 'Nui' was sown at a rate of 25 kg/ha on 6 May 2022 for both rotations.
- Rainfall has been high with a total of 351 mm falling since the ryegrass crops were sown. Of this, a total of 294 mm fell from May to end of July, with 57 mm total falling in the months of August to September (Figure 2).
- There were several times where the amount of rainfall exceeded the soil moisture deficit in the top 60 cm of soil for both rotations (Figure 3). Leachate samples were collected (Figure 4) at three times in the July to early August period.
- The heavy rain did cause some surface ponding on one plot of Rotation 2 (Figure 5), observed on 13 July. This followed a total rainfall of 47 mm on 12 and 13 July; however this had drained away within two days. There were surface ponding events following heavy rainfall on 26 and 27 July, but no further surface ponding, even with other rain events.

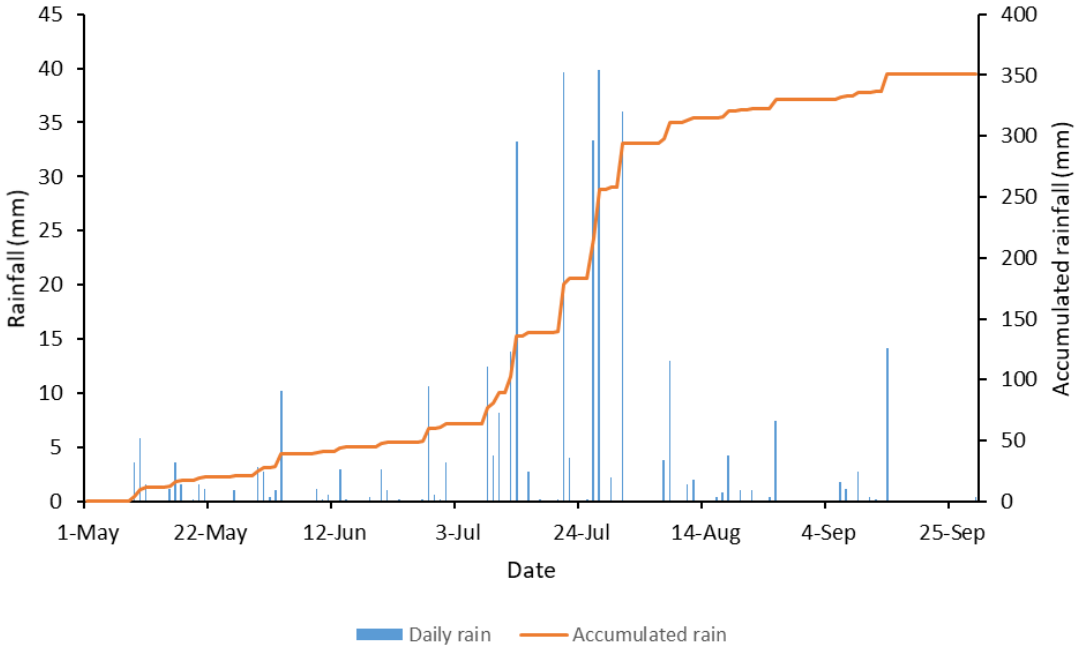

Figure 2. Daily and accumulated rainfall from sowing of ryegrass crops and until the end of September 2022, in Rotation 1 and 2 at the PFR farm in Lincoln.

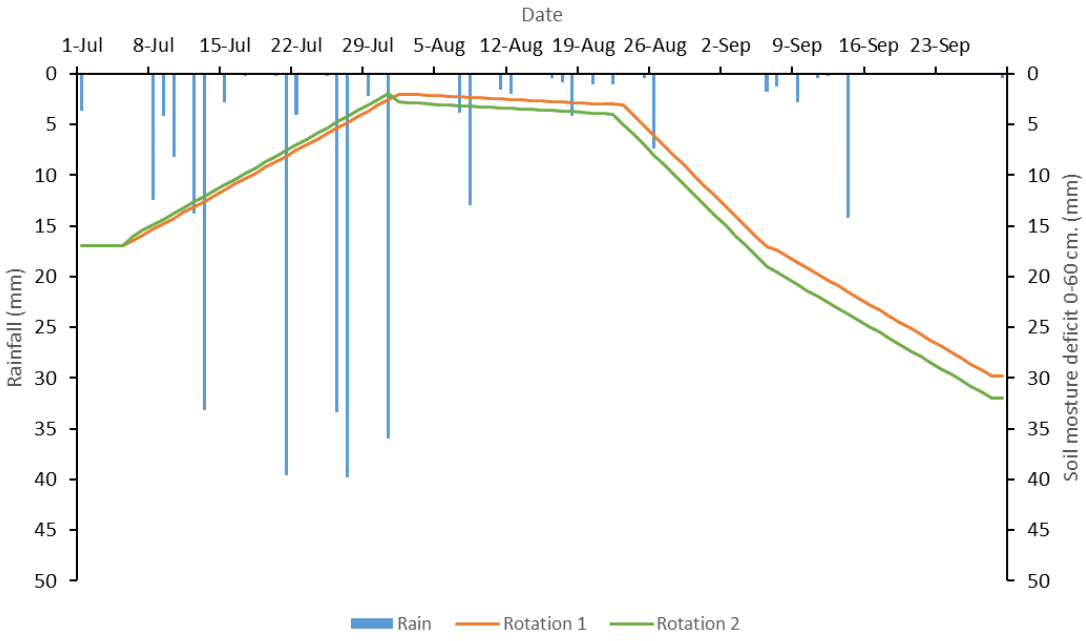

Figure 3. Rain and soil moisture deficit in the top 60 cm during growth of ryegrass crop in Rotation 1 and 2 at the PFR Farm in Lincoln.

Figure 4. Leachate sample collection in ryegrass crop sown at PFR Lincoln.

Figure 5. Surface ponding in Rotation 2 ryegrass crop. Rotation 1 crop on the right hand side has no surface ponding.

- The nitrogen (N) fertiliser management for both ryegrass was guided by FAR requirements (FAR 2013) and was originally an application of 30 kg N/ha at planting, with two side-dressings of 50 kg N/ha. However, due to the increased rain, it was decided to put on three side-dressings to reduce leaching risk. The first side-dressing was 40 kg N/ha applied on 1 September 2022.
- The rate of the second side dressing (27 September: GS1 of the wheat and key N application time for seed crops see Figure 6) was estimated using soil N measurements, keeping in mind that the next application was to be in one month's time. Soil mineral N in the top 30 cm at this date was 15 kg N/ha, and it was estimated that 15 kg N/ha would mineralise during the month. It was decided that an application of 30 kg N/ha – giving a total of 60 kg N/ha supplied for the month would be sufficient. Any need to increase N supply would be made at the next application date (30 October).

Figure 6. Ryegrass crop condition on 27 September 2022, for Rotation 1 and 2 sown at PFR Lincoln.

1.1.2 Hawke's Bay rotation 3: Onion rotation

- A catch-crop of 'Asset' and 'Tama' ryegrass was sown at a rate of 25 kg/ha on 20 May 2022. This ryegrass mix is common in the region as a grazing or silage/hay crop. We have treated this as a catch crop and not applied N fertiliser.
- Rainfall has been high with a total of 461 mm falling since the crops were sown. Of this, a total of 231 mm fell from May to end of July, with 230 mm total falling in the months of August to September (Figure 7).
- There were several times where the amount of rainfall exceeded the soil moisture deficit in the top 60 cm of soil for both rotations (Figure 8, Figure 3). Leachate samples were collected at eight times for this rotation.

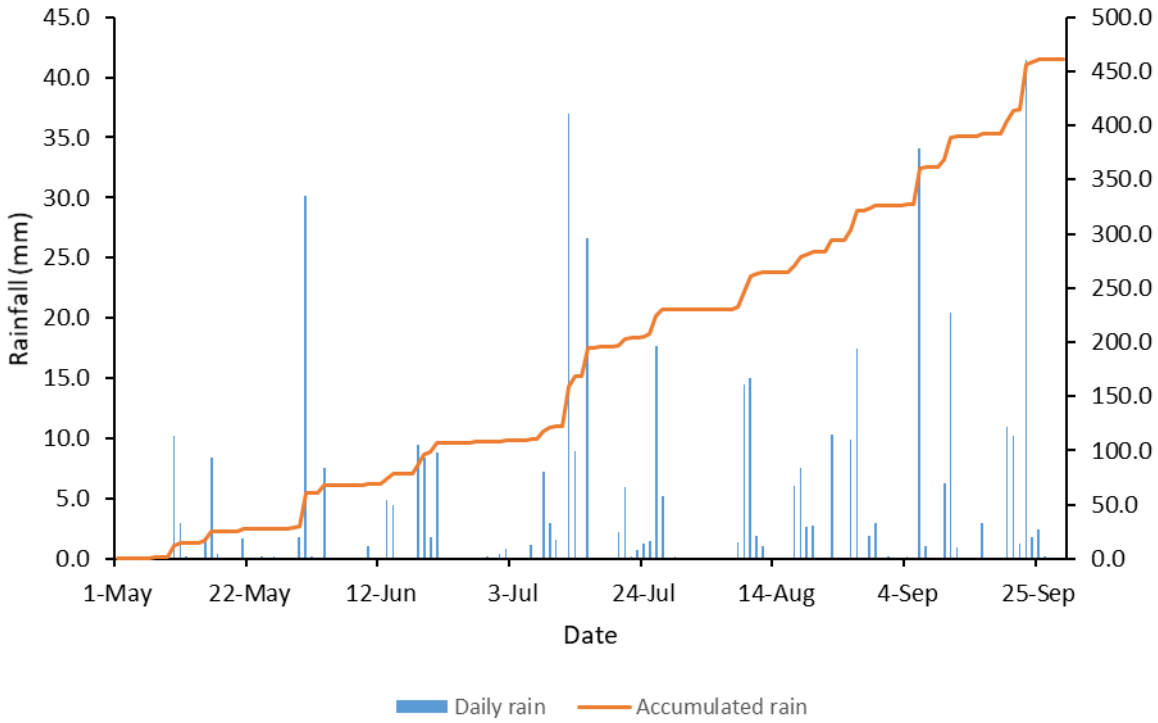

Figure 7. Daily rainfall and accumulated rainfall from sowing of crops and until the end of September 2022, for Rotation 3 and 4 at the PFR farm in Hawkes Bay during the July to September period in Hawke's Bay.

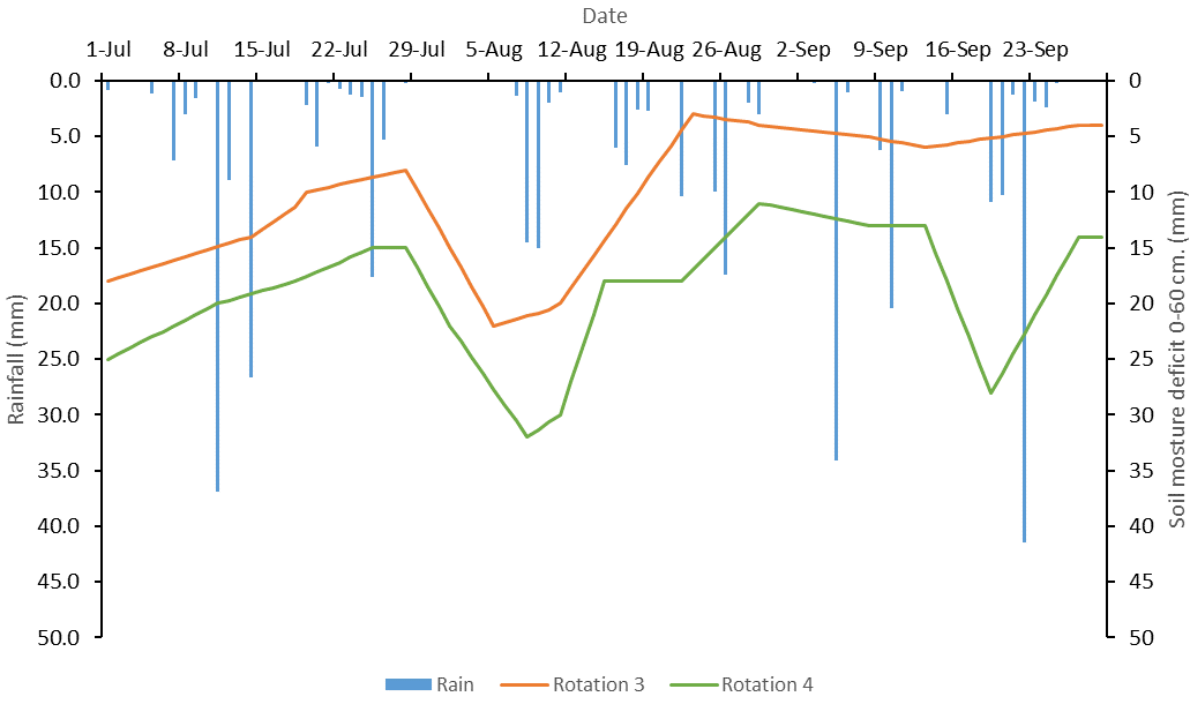

Figure 8. Rain and soil moisture deficit in the top 60 cm of soil during growth of ryegrass (Rotation 3) and cauliflower (Rotation 4) at the PFR farm in Hawke's Bay.

- The heavy rain did cause some surface ponding across two plots of Rotation 3 (Figure 9, Figure 5). This occurred when accumulated rainfall over a 2- to 3-day period exceeded 60mm. Surface ponding had drained within 48 hours.

Figure 9. Surface ponding of ryegrass crop in Rotation 3 sown at PFR farm in Hawke's Bay.

1.1.3 Hawke's Bay rotation 4: Vegetable rotation

- A cauliflower crop of variety 'Caspar' was transplanted on 12 May 2022.
- With the heavy rainfall during the growth of this crop (Figure 7), there were several times where the amount of rainfall exceeded the soil moisture deficit in the top 60 cm of soil (Figure 8, Figure 3) and eight leachate samples were collected for this crop.
- The cauliflower crop had a higher soil moisture deficit than the ryegrass crop (Figure 8, Figure 3), indicating it had a higher water use than the ryegrass.
- The good management practice N was estimated at 200 kg N/ha (Reid & Morton 2019). This was to be applied at 50 kg N/ha at sowing, and the remainder in three side-dressings. The very high soil N in July (on average 100 kg N/ha in top 30 cm) meant that a second side-dressing was delayed as there was sufficient N supply for the crop at the time. The heavy rain meant

that a third side-dressing was not able to be completed, and a so a final side-dressing was applied on 12 September of 100 kg N/ha.

- A protocol was put in place to harvest the cauliflower sequentially, collecting cauliflower curds as they reached commercial size and quality. This harvest is expected to occur from mid-October onwards.

1.2 Workstream 2: Regional monitoring

- Data have continued to be collected on the regional farms by the regional monitors. The biomass data have been processed by PFR and samples are at the lab for completion of N content analysis.
- There is variability in data formatting across the regions, and the data are not yet set up to be easily usable and fir for purpose. A workshop is planned for the third quarter of this year to finalise data structure and integrity, for:
    - Analysis of N balances at each regional site
    - Ability to share and discuss data with growers
    - Data are available for modellers.

1.3 Workstream 3: Modelling

Model design and implementation

- The prototype tool has been further developed and an approach to designing with different levels of complexity, depending on grower needs has been discussed.
- Discussions around the IP licensing and using some of the underlying algorithms are ongoing and need resolution in order to progress this side of the work.

Model development

- The data from Workstream 1 crops completed have been collated for analysis using APSIM-SCRUM. This is a necessary step for development of the farmer-facing tool.

1.4 Workstream 4: Technology transfer

- Filming for production of SVS videos was carried out in Canterbury and Hawke’s Bay.
- Meetings were held to discuss and plan SVS roadshows for 2023, to increase awareness and information sharing.

2 Key highlights and achievements

Workstream 1

- Data have been collected for ryegrass crops in Rotation 1, 2 and 3.
- The good management N treatment of ryegrass crops in Rotation 1 and 2 has been evaluated at each side-dressing using soil mineral N content and rates have been adjusted based on these.
- Cauliflower has been managed and grown in Rotation 4. Fertiliser management was adapted to the difficult growing conditions of constant rainfall. A plan for a sequential cauliflower harvest, to meet commercial standards has been developed.
- Data continue to be gathered and analysed as planned.

Workstream 2

- We have continued to process samples for biomass and crop N content.

Workstream 3

- Approaches for structuring the farmer-facing tool to meet different grower demands have been identified and are being developed.

Workstream 4

- Videos were filmed in Canterbury and Hawke's Bay.
- Planning under way for a SVS roadshow in 2023.

3 Collaboration with other programmes

- Realtime N-losses – Rural Professional Fund through Our Land and Water, looking at real-time measurement of N losses under vegetable (onion) production in Hawke's Bay. PFR is providing data analysis support.
- Residue incubation – 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. Some residues were be obtained from crops in Workstream 1.
- Process Vegetable Coefficients – Process Vegetables New Zealand-funded project quantifying some of the coefficients needed for N uptake and use by processed vegetable crops within OVERSEER.
- Mineralisable N to improve management – an SFFF project looking to improve the measurement and prediction of the amount of biologically mineralised N in a field. This pool of N is a key component for understanding crop N requirements, together with measurements of mineral N (nitrate and ammonium). PFR leads this project which includes the Vegetable Research & Innovation Board and Potatoes New Zealand.
- Asparagus N budgeting (Our Land and Water National Science Challenge) – LandWise project looking to quantify N budgets for asparagus crops. This project is using many of the same

measurements as SVS of soil N and crop N uptake, and similar outcome is being produced. PFR has an advisory role in this project.

4 Upcoming

- Ryegrass and cauliflower harvests will be completed, together with soil sampling in Workstream 1.
- The final ryegrass crop in Rotation 4 is to be sown.
- Statistical analysis of outcomes in individual crops and across the rotation will continue.
- N balance discussions and development will be ongoing, and data from Workstream 1 and 2 further evaluated for N balance development.
- Model development ongoing. Scenario testing of data ongoing.
- Ongoing interviews and approaches to focus groups developed. Articles for communication of concepts and developments continue.

5 Acknowledgements

The growing of crops in Workstream 1 relies heavily on the input of agronomists and growers for advice in terms of management, in particular the timing and types of different agrichemicals that need applied for crop protection and producing quality product. We have also had excellent support from agronomists and growers around the commercial harvest of the cauliflower, which has helped ensure good planning. The data are being implemented into models and can only proceed with helpful discussion for which we thank the many participants, growers, industry representatives who contribute to this. And a big thank-you to the Regional Monitors, who collect arguably the most representative data of current practice, which is key to the outcome of this work. And finally, a huge thanks to the lab team who work tirelessly analysing the countless samples collected.

6 References

FAR 2013. Cropping Strategies - Nitrogen in Perennial Ryegrass Seed Crops.

Reid J, Morton J 2019. Nutrient management for vegetable crops in New Zealand. Edition 1.0. Wellington. Horticulture New Zealand.

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PUBLICATION DATA

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