LandWISE

Best Management Practice of Nitrates in Process Cropping

Milestone Report 2: 28 June 2022

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Table of Contents

Contracted Milestone

Date: 29 June 2022	Milestone 2
Milestone description	Year 1 complete
Target Outcome	Year 1 crops harvested and monitoring complete.
Activities undertaken	Team meeting Yield and residue assessments by mass and nutrient Post-harvest nutrient budget: Using actual fertiliser, crop yield etc. Presentations at a conference (e.g. LandWISE)
Deliverables / evidence of completion / achievement of Outcome	A Milestone Report as per Schedule 1 clause 8, and detailing achievements, trial reports and presentation abstracts Team meeting minutes
MPI Funding amount	$25,096
Co-Funding cash	$15,029
Co-Funding in-kind	$3,800
Total	$43,925

Activities

Team Meeting

Communications have been mainly by email or phone with directly involved parties such as the growers and process company field staff and agriculture managers. A post-season meeting is scheduled for 13 July 2022, ensuring that preparations for the 2022-23 season are complete in a timely fashion.

Yield and residue assessments

Yield and residue assessments were made for all crops and treatments except the beetroot crop did not receive an alternative fertiliser rate. Trial crops generally grew well but were impacted by weather and seasonal variability. Sweetcorn yields were good, green beans reasonable, tomatoes had high rates of rotten fruit and the beetroot crop, while excellent, was by-passed due to factory constraints. Details for each is contained in the nutrient budget summary (Appendix 1).

Crop yields and returned biomass for each plot were determined. While treatments usually showed average differences, these were not statistically significant when tested using ANOVA. The high within treatment variability overshadows between treatment differences. An example is shown in the charts in Table 1. This variability is being discussed with the Project Team and advisors, and sampling practice may be adjusted for the coming season.

The tomato harvest showed patchiness in crops, and that wet weather harvest delays severely impacted yields, with about half of fruit being rotten.

Soil Testing

Soil was sampled and sent to Eurofins for testing. Individual plots nitrate concentrations were determined using the Nitrate Quick Test at three depths to the full root depth of the crop. This varies depending on soil type and crop, extending to either 450 mm or 600 mm depth.

As a calibration, composite samples were sent to Eurofins for laboratory determinations. There was good correlation between the laboratory and Quick Test nitrate results processed using the FAR calculator to convert concentration to kg N/ha. However, in very wet soils, the FAR processed Quick Test results appear more prone to error.

A response about wet soil testing from Matthew Norris (Plant & Food Research) who conducted Nitrate Quick Test calibrations on New Zealand soils noted:

- *The correction factors were developed using generic soil textural data (SMAP derived) to estimate the amount of water in samples taken at various moisture contents, the 'maximum' moisture content being field capacity (i.e. the 'wet' QT correction factor category).*
- *'Very wet' samples may well exceed field capacity, which probably explains any odd results obtained*
- *Generally speaking, the 'wetter' the sample, the less sensitive the QT approach becomes because you are extracting less soil per 10 cm3 field moist soil added.*
- *Sampling wet soils is fraught with difficulty (and frustration!) so the general recommendation is to wait a few days until the soil has 'drained' to field capacity. Also worth noting is that it's risky to inform N management decisions from samples taken during drainage events as 'what you measure today' may well 'be gone tomorrow'.*

Figure 1 Series of video screenshots showing an attempt to take deep soil samples in a sweetcorn paddock at harvest after a period of wet weather

Post-harvest nutrient budget

Post-harvest nutrient budgets were completed using collected data and the online LandWISE Nutrient Budget Calculator (https://nutrient.landwise.org.nz). Completed budgets have been

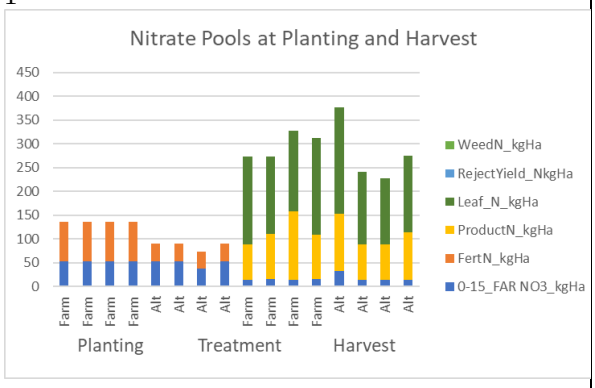
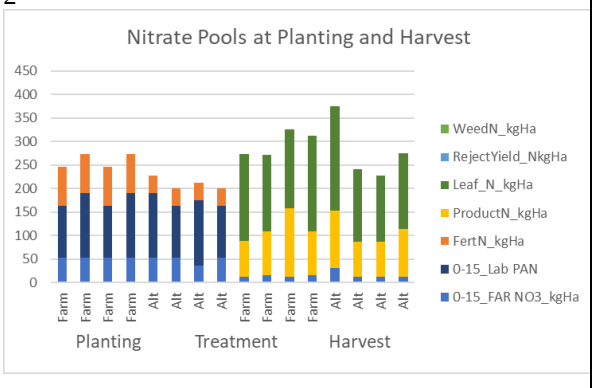
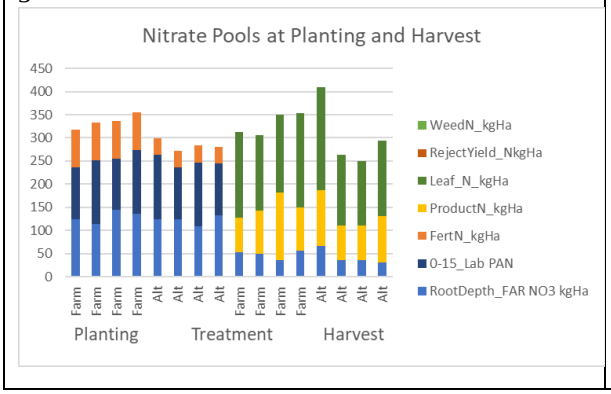
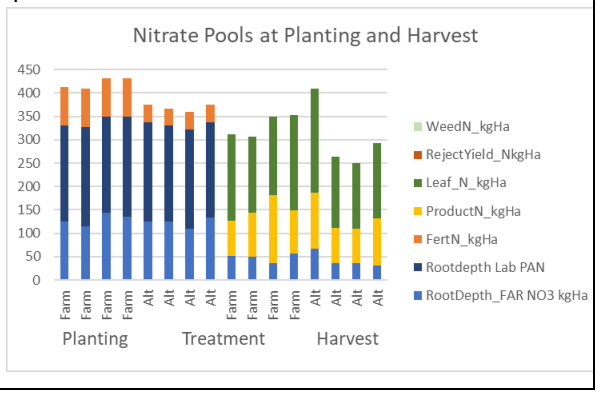
provided to the relevant processors and growers and are summarised in the attached table. An example is presented in Appendix 2.

The calculator uses recommendations drawn from “Nutrient Management for Vegetable Crops in New Zealand” by Reid and Morton. This is understood to be in review. It was noted that the online calculator can recommend a negative nitrogen application. This has been adjusted in the summary table so that a recommendation is not less than zero. The calculator itself will be reviewed and if possible corrected.

A key issue is deciding what soil depth to measure and which nitrogen supplies to include when determining extra nutrient needs. The standard practice of 15 cm deep samples is clearly limited when assessing nitrogen stocks. Depending on whether potentially available nitrate, available nitrate or mineral nitrogen values are used, the fertiliser recommendations are remarkably different. In the nutrient budget summary in Appendix 1, alternative budgets are presented using either nitrate nitrogen in the upper 15 cm of soil, or nitrate nitrogen and Potentially Available nitrogen in the root depth (0-45 cm).

Table 1 is an example from the Tiko Road sweetcorn paddock. Chart 1 shows planting-time nitrogen pools, including applied fertiliser (orange bars) and the available NO3-N (blue bars) in the top 15 cm of soil determined using the Nitrate Quick Test and FAR calculator. At harvest, the chart considers soil NO3-N to 15 cm, exported yield N, and N contained in crop residues. There is clearly a significant increase, with a much greater amount identified at harvest than at planting. Chart 2 adds the potentially available nitrogen (PAN) in the top 15 cm, tripling the soil pool at planting. Chart 3 increases the soil depth for NO3-N to 45cm at planting and at harvest. Chart 4 considers soil NO3-N and potentially available nitrogen to 45 cm at planting together with applied fertiliser N. Now the planting pool is much greater than the harvest pool, even when NO3-N is considered to 45 cm at harvest. The significance of these differences is that Chart 1 generates a fertiliser recommendation of 250 kg N/ha, whereas Chart 4 recommends no fertiliser be applied.

Table 1 Charts showing Tiko Road Nitrogen Pools at planting and harvest considering a range of nitrate sources.

1 	2 
3 	4 

Presentation at a Conference

The findings from the first year of the project were presented to the LandWISE AGM and Seminar at the Centre for Land and Water on 22 June 2022. (The 2022 LandWISE Conference was cancelled due to Covid restrictions and grower reluctance to release staff, an issue hopefully not repeated.) A copy of the PowerPoint used is presented as Appendix 3.

Appendix 1: Nutrient Budget Summary Table

Crop	Farm	Treatment	Budget Yield t/ha	Test	Depth cm	PAN kgN/ha	Soil N kgN/ha	Recom. kgN/ha	Fert kg N/ha	Plan'd Var kgN/ha	Pop'n plant/ha	Yield t/ha	Yield kgN/ha	Residue kgN/ha	Soil kgN/ha	Variance kgN/ha
Sweetcorn	Swamp	Farm	24	Quick	15	-	50.5	250	208	-42	59,602	24.28	94.7	189.5	17	43
Sweetcorn	Swamp	Alternative	24	Quick	15	-	51	250	130	-120	60,149	23.27	82.4	173.9	14	91
Sweetcorn	Swamp	Farm	24	Quick+PAN	45	204	136	0	208	208	59,602	24.28	94.7	189.5	69.8	-193
Sweetcorn	Swamp	Alternative	24	Quick+PAN	45	171	130	0	130	130	60,149	23.27	82.4	173.9	63.3	-110
Sweetcorn	Tiko Rd	Farm	24	Quick	15	-	53	250	82	-169	55,227	27.95	101.6	179.9	14.5	162
Sweetcorn	Tiko Rd	Alternative	24	Quick	15	-	49	250	38	-212	58,235	24.43	92.5	169.7	17.8	193
Sweetcorn	Tiko Rd	Farm	24	Quick+PAN	45	209	130	0	82	82	55,227	27.95	101.6	179.9	130	-8
Sweetcorn	Tiko Rd	Alternative	24	Quick+PAN	45	209	123	0	38	38	58,235	24.43	92.5	169.7	123	15
Tomato	Rosser R	Farm	140	Quick	15	-	77	21	88	67	24,000	63.08	92.9	84.6	10	23
Tomato	Rosser R	Alternative	140	Quick	15	-	77	21	36	15	24,000	55.61	76.3	92.0	10	69
Tomato	Rosser R	Farm	140	Quick+PAN	45	85	145	0	88	88	24,000	63.08	92.9	84.6	25	-115
Tomato	Rosser R	Alternative	140	Quick+PAN	45	101	157	0	36	36	24,000	55.61	76.3	92.0	26	-100
Tomato	Pivot	Farm	140	Quick	15	-	75	24	88	64	24,000	92.12	123	188	7	155
Tomato	Pivot	Alternative	140	Quick	15	-	75	24	36	12	24,000	79.53	104	131.2	8	132
Tomato	Pivot	Farm	140	Quick+PAN	45	238	150	0	88	88	24,000	92.12	123	188	16	-148
Tomato	Pivot	Alternative	140	Quick+PAN	45	209	152	0	36	36	24,000	79.53	104	131.2	17	-194
GreenBean	Pivot	Farm	12	Quick	15	-	32	28	46	18	274,657	11.98	40	86	22	71
GreenBean	Pivot	Alternative	12	Quick	15	-	35	28	22	-6	271,734	12.78	42.3	93	20	98
GreenBean	Pivot	Farm	12	Quick+PAN	45	163	78	0	46	46	274,657	11.98	40	86	99	21
GreenBean	Pivot	Alternative	12	Quick+PAN	45	176	90	0	22	22	271,734	12.78	42.3	93	90.5	-63
Beetroot	Sears Rd	Farm	80	Quick	15	-	48	247	196	-51		106	247	161.9	11	176
Beetroot	Sears Rd	Farm	80	Quick+PAN	45	59	137	89	196	107		106	247	161.9	28	51

Appendix 2: Example Nutrient Budget

Nitrogen Budget - Post Harvest Assessment

Admin

Grower/ Agronomist: Dan#2
Trading name: LandWISE

Paddock

Paddock name: Tiko Pivot Farm Rate
Area: 20 ha

Crop

Crop name: Sweetcorn (high)
Expected yield: 24 t/ha
Planting date: 26-11-2021
Harvest date: 28-03-2022
Recommended N: 250 kg N/ha

Inputs

Fertiliser applied	Total	%N	Rate	N in application
Cropzeal 16N	4,000 kg	14.8	200 kg/ha	30 kg N/ha
CropMaster DAP	1,000 kg	17.6	50 kg/ha	9 kg N/ha
Cropmaster 15	5,800 kg	14.8	290 kg/ha	43 kg N/ha
			Fertiliser input	81 kg N/ha

Measured data	Harvest		Planting		
Crop Residue N balance	179.9 kg N/ha	-	0 kg N/ha		179.9 kg N/ha
Soil N balance	14.5 kg N/ha	-	53 kg N/ha	+	- 38.5 kg N/ha
	Actual Yield		**N in Yield**		
N exported in Yield	27.95 t/ha	x	3.64 kg N/ha	+	102 kg N/ha
			Subtotal	=	243 kg N/ha
			Applied fertiliser	−	81 kg N/ha
			Actual Nitrogen Variance	=	162 kg N/ha

Positive = N gain
Negative = N loss

Development of this calculator was supported by funding from MPI Sustainable Farming Fund, Horizons Regional Council, Potatoes NZ, Ballance AgriNutrients, Gisborne District Council and LandWISE Inc. It uses information from "Nutrient Management for Vegetable Crops in New Zealand" by JB Reid and JD Morton, published in 2019. Book preparation was jointly funded by Plant & Food Research (Sustainable Agricultural Ecosystems Programme), the Fertiliser Association of New Zealand, and the Vegetable Research and Innovation Board of Horticulture New Zealand Incorporated.

Appendix 3: Presentation to LandWISE AGM and Seminar

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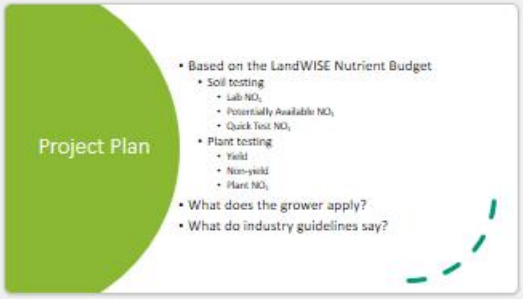

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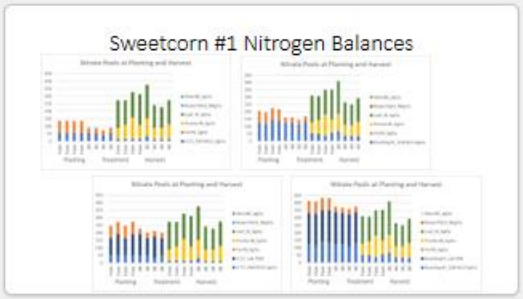

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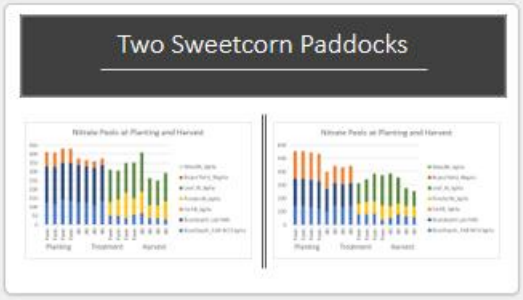

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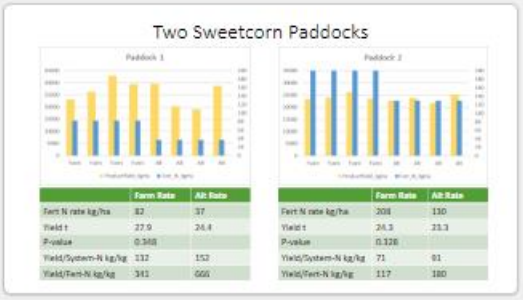

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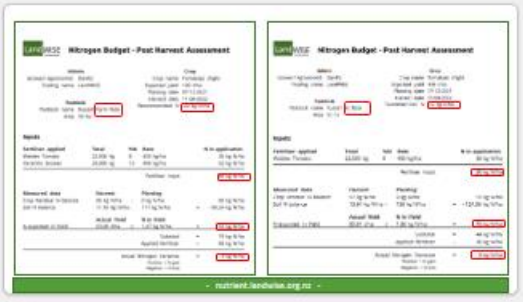

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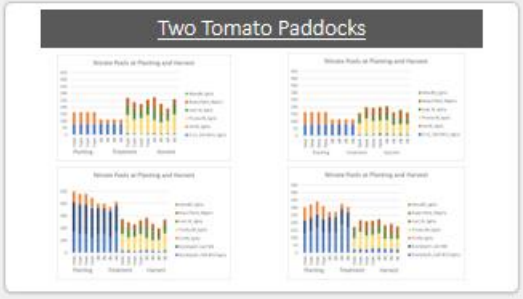

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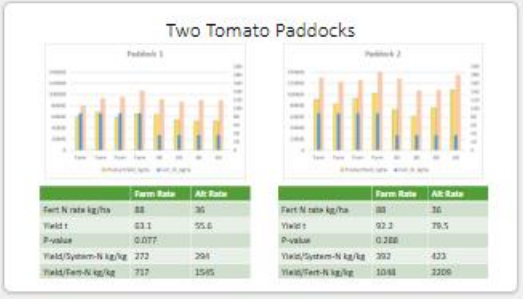

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Confounding Factors

17


Green Bean Paddock

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Beans and Beetroot

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Lessons
• Get started earlier!
• Increase the sample sizes (better discrimination)
• Get Potential Available Nitrate at end of crop?
• Have one person do Nitrate Quick Testing
• Check soil type and moisture

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