

Best Management Practice of Nitrates in Process Cropping

Milestone Report 3: January 2023

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Ministry for Primary Industries
Manatū Ahu Matua



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Contracted Milestone

Date: 31 January 2023	Milestone 3
Milestone description	Year 2 crops established
Target Outcome	Year 2 crops established and monitoring underway.
Activities undertaken	<p>Team meeting and paddock selection: 2 each of Sweetcorn, Beans, Tomatoes and Beetroot</p> <p>Grower survey – follow up or new growers’ current nutrient management practices (based on Fert Association BMPs)</p> <p>Soil testing – pre-plant by treatment in depth bands to rootzone depth</p> <p>Planting – grower task</p> <p>Fert application equipment calibrations – if grower has not done</p> <p>Monitoring – agronomic crop walks to observe</p> <p>Pre-planting Nutrient budgets – estimated nitrogen balance and fertiliser need</p>
Deliverables / evidence of completion / achievement of Outcome	<p>A Milestone Report as per Schedule 1 clause 8, and detailing achievements and calibration summaries</p> <p>Team meeting minutes</p>
MPI Funding amount	\$24,042
Co-Funding cash	\$14,398
Co-Funding in-kind	\$5,000
Total	\$43,440

Activities Undertaken

The 2022-23 season has been very challenging for growers, the processors, and our research. Constant rain and saturated soils made it impossible to follow planned planting schedules, and severe weather events destroyed some crops. Planted areas are much lower than required, and plantings are delayed. Similarly, crop harvests have been difficult, with machinery unable to access many paddocks, adding to problems.

We greatly appreciate the support we have received from the processor field managers, farmers, and contractors, which has enabled us to achieve the majority of project goals.

Team Meeting and Paddock Selection

The project management team members have met regularly in person and by email. These meetings finalised details of project aims and the crop selections and confirmed eight paddocks/crops for monitoring this season.

Key meeting dates:

Date	Person/Organisation	Meeting notes
4/10/2022	Wayne MacDonald Heinz Watties	Discussion on paddocks for tomato and beetroot trial placement and determined best growers to work with. Late planting to be confirmed but will have beetroot at "Trevettes- Sears Road", and Watties own tomatoes at "Raikes" to start.
12/10/2022	Allan Machakaire McCains	Discussion on paddocks for sweetcorn and bean trial placement. Allan gave us a detailed list of growers and rough timing windows. One of last season's sweetcorn trial growers is now growing with Watties, but still want to work with, so will have one McCains sweetcorn crop at "Washpool Station", and the other will be "Nuco Produce" who are growing sweetcorn with Watties. Beans to be confirmed later in the season
15/11/2022	Allan Machakaire McCains	Determined bean trial areas, will have one crop at "Ludlow Farms, and one of McCains own paddocks in Ongaonga. Planting dates mid-January so will be last crops planted. Given wet season, planting windows have been disrupted, meaning these crops will be planted later.
28/11/2022	Wayne MacDonald Heinze Watties	After a site visit to Raikes tomatoes, discovered that both A and B plots in the trial were looking very unhealthy compared to rest of the paddock, this was first runs of tomatoes planted in Watties first tomato paddock for the season so something likely to have gone wrong early in the season. Decision to abandon trial and move to one of the last tomato paddocks "Trevettes- Chesterhope". Was planning on using Watties own crop for late beetroot, but this didn't go ahead, so late beetroot trial was set up in "Holmes Carrick Road".
Ongoing	Process field managers, farmers and contractors	In-person and phone meetings continued through December and January as weather events and changes to process schedules altered planting dates.

Paddock/Crop Selections

The very wet spring and associated regional planting delays impacted selection of sites. Eight sites were confirmed, and eight trials have been established: two tomatoes plus a replacement trial, two beetroot (Heinz-Watties), and two sweetcorn (one for McCain Foods, and one Heinz-Watties) and one bean planting. The second green bean planting scheduled for 29 January 2023 was again delayed after 120mm rain fell in one day, and is now expected by 7 February.

One tomato trial was abandoned when plants in the “farmer rate” treatment showed very poor growth unrelated to fertiliser treatment. A third tomato crop was chosen, and a new trial was established. This replacement tomato crop was flooded out when Cyclone Hale moved down the East Coast, leaving only one tomato crop for this year.

Tomatoes



Figure 1 Turamoe Rd Tomatoes – Trial Abandoned



Figure 1 Rosser Road Tomatoes



Figure 3a and 3b: Chesterhope Tomatoes – Trial Abandoned

Sweetcorn



Figure 4 NUCO Sweetcorn



Figure 5 Washpool Sweetcorn

Beetroot



Figure 5 Holmes Beetroot



Figure 6 Trevettes Beetroot

Green Beans



Figure 7 Ongaonga Beans

Grower Survey

This season we have three new growers participating in the trial. Two have completed the survey and data is recorded. One has very high levels of management including detailed nutrient budgeting and detailed records including GPS tracking of variable rate equipment when used. The other tends to use a set of standard rates and practices on each crop. Both have good practices around transport storage and handling fertilisers and take weather and other factors into account when making applications. The third has been sent the nutrient management survey, and responses are being sought.

Soil Testing

At each site, four sets of paired plots have been established with “Grower Rate” fertiliser applied to one set and an “Alternative Rate” to the other. Soil was sampled to three depths, and where possible, a fourth depth (0-150 mm, 150-300 mm, 300-450 mm, and 450-600 mm) and combined subsamples sent to Eurofins at each depth for lab analysis.

The first round of lab testing at planting included base soil fertility at 0-150mm depth (standard cropping depth), as well as PAN and Mineral N testing at all depths. Every plot had soil nitrate assessed at planting at each depth using the Nitrate Quick Test.

During the growing season, before side dressing, soil samples were again completed to determine nitrate concentrations at time of nitrogen fertiliser application. Again, Nitrate Quick N tests were completed, and composite samples were sent to Eurofins for laboratory determinations. There has been good correlation between the laboratory and Nitrate Quick Test results which are calibrated using the FAR calculator to convert concentration to kg N/ha.

Planting

Planting was carried out by processors, contractors, and growers depending on crop type. Planting dates were impacted by a wet winter and spring. Together with the grower we established how best to adjust N rates at planting where needed. An example of this is in tomato planting, which typically incorporates an NPKS compound fertiliser ahead of the planter, and then applies fertiliser which will contain N on the planter.

Where we wanted to exclude N from our Alternative Treatment, we worked with machinery operators to turn off fertiliser applicators where possible. If N was excluded by removing application of an NPKS product, we applied the missing nutrients (i.e., PKS) by hand.

Pre-plant Nutrient budgets

Pre-planting nutrient budgets were completed using collected data and the online LandWISE Nutrient Budget Calculator (<https://nutrient.landwise.org.nz>). Completed budgets were discussed with the relevant processors and growers and alternative fertiliser rates agreed. Information used to determine N application rates were a combination of Potentially Available N and Quick N, or Potentially Mineralisable N if used by the grower.

“Nutrient Management for Vegetable Crops in New Zealand” by Reid and Morton uses Potentially Available N (PAN) tests to determine recommended N rates. Where possible this data was collected before planting, at paddock level, to determine approximate N rates, so we could vary N at planting if needed. Samples were then collected at or slightly after planting to determine plot level PAN, and adjust recommendations where required. In cases where fertiliser is not applied until after planting i.e., beetroot, samples were taken after planting, and recommendations made after results were available.

Results are summarised in Table 1. 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.

Table 1 Summary of Pre-plant Nutrient Budgets and Fertiliser Plans

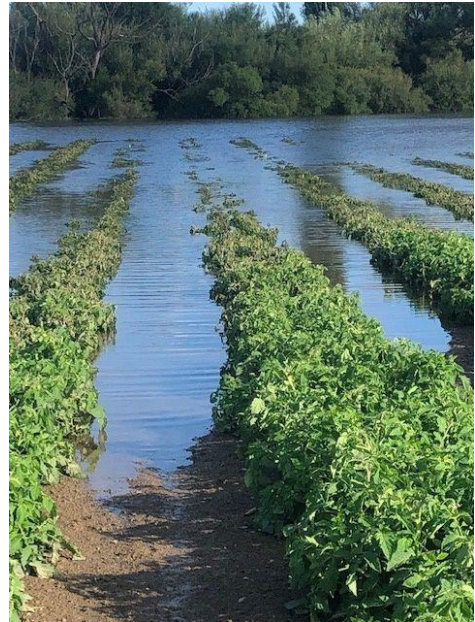
Crop	Farm	Treatment	Budget Yield t/ha	Test	Sample Depth cm	Soil N kgN/ha	Recom. N kgN/ha	Planned N Fert kgN/ha	Planned Variance kgN/ha
Sweetcorn	Swamp	Farm	25	PMN	15	124	65	115	46
Sweetcorn	Swamp	Alternative	25	PMN	15	124	65	69	4
Sweetcorn	Washpool	Farm	30	PAN	15	120	130	182	52
Sweetcorn	Washpool	Alternative	30	PAN	15	120	130	136	6
Tomato	Rosser Rd	Farm	90	PAN	15	101	0	90	0
Tomato	Rosser Rd	Alternative	90	PAN	15	85	0	0	0
Tomato	Chesterhope	Farm	110	PAN	15	121	-36	105	141
Tomato	Chesterhope	Alternative	110	PAN	15	121	-36	14	50
Beetroot	Sears Rd	Farm	70	PAN	15	88	186	225	39
Beetroot	Sears Rd	Alternative	70	PAN	15	70	186	175	-11
Beetroot	Carrick Rd	Farm	60	PAN	15	33	185	TBC	TBC
Beetroot	Carrick Rd	Alternative	60	PAN	15	29	185	TBC	TBC
Green Bean	Ludlow	Farm	18	PAN	15	234	0	50	50
Green Bean	Ludlow	Alternative	18	PAN	15	234	0	0	0
Green Bean	Ongaonga	Farm	15	PAN	15	76	46	60	14
Green Bean	Ongaonga	Alternative	15	PAN	15	76	46	17	-29

Monitoring

Regular site visits are being completed over the summer, with repeat sampling before any planned fertiliser applications. Most crops grew well, there have been some issues through the season.

- Beetroot at Sears Road had a higher-than-expected germination and a much higher population due to the multi-germ seed. This is considered good for baby beet maturity sizes but lead to the crop becoming N deficient in early stages. This made the crop susceptible to fungal disease. This was overcome by N applications timed over a four-week period, as well as four fungicide applications.
- Unexplainable growth differences in the first tomato crop planted (Raikes), where the full rate plants failed to show normal growth and were different to the rest of the crop. The trial was abandoned and replaced with another later planting.

- In Washpool sweetcorn, there was scalding on the tallest leaves from covering with black polythene sheets, to exclude broadcast N application. The Canapeo canopy cover app was used to determine green cover of the crop and found no statistically significant difference in canopy cover in the weeks following damage.
- Our tomato trial at Chesterhope Road, which replaced the Raikes trial, flooded during Cyclone Hale. The entire site went under water, plants died and the trial was abandoned. There were no subsequent crops, so no alternative was possible.
- In our remaining tomato paddock, plants have been affected by a fungal infection. Watties have been applying regular sprays, however are applying N to try to support the crop through the infection. This requires a change from 0kgN/applied to our Alternative Treatment. To save the crop, we are applying 30kgN/ha (same as the Grower Treatment). There is still a 60kg/ha difference in N applied between the treatments.



Fertiliser Application Equipment Calibrations

All fertiliser application equipment used had been calibrated by the operators. We did recalibrate one machine and captured video footage for a calibration training online course.

The calibration (See Appendix 3) showed the equipment was applying banded fertiliser evenly to each of three beds (six paired outlets), but the applicatoin rate we calculated based on measured output and speed was higher than the rate the operator reported. Because the total amount applied to the paddock was as expected, we believe the driver speed or suggested target rate was incorrect.



Appendix 1: Pre-Plant Nutrient Budget and Fertiliser Plan - Grower rate

LandWISE **Nitrogen Budget - Fertiliser Plan**

Created on 16-12-2022

Admin		Crop	
Grower/ Agronomist	Alex Dickson	Crop name	Tomatoes (high)
Trading name	LandWISE	Expected yield	110 t/ha
		Planting date	02-12-2022
		Potentially Available N	121 kg N/ha
		Recommended N	-36 kg N/ha
Paddock			
Paddock name	Chesterhope		
	Grower Rate		
Area	20 ha		

Inputs

Residue N 0 kg N/ha

Fertiliser planned	Total	%N	Rate		N rate
Yaramila 8-11-20	3,600 kg	8	180 kg/ha	+	14 kg N/ha
Yaramila 8-11-20	3,400 kg	8	170 kg/ha	+	14 kg N/ha
Yaramila CAN	4,000 kg	27	200 kg/ha	+	54 kg N/ha
Yaramila Nitrobor	3,000 kg	15.4	150 kg/ha	+	23 kg N/ha

Total input = 105 kg N/ha

Total input 105 kg N/ha
Recommended N -36 kg N/ha

Planned Nitrogen Variance = 141 kg N/ha
Positive = N surplus
Negative = N deficit

Development of this calculator was supported by funding from MPI Sustainable Farming Fund, Horizons Regional Council, Potatoes NZ, Balance 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 2: Pre-Plant Nutrient Budget and Fertiliser Plan - Alternative rate



Nitrogen Budget - Fertiliser Plan

Created on 16-12-2022

Admin

Grower/ Agronomist Alex Dickson
Trading name LandWISE

Paddock

Paddock name Chesterhope Alt
Rate
Area 20 ha

Crop

Crop name Tomatoes (high)
Expected yield 110 t/ha
Planting date 02-12-2022
Potentially Available N 121 kg N/ha
Recommended N -36 kg N/ha

Inputs

Residue N 0 kg N/ha

Fertiliser planned	Total	%N	Rate		N rate
Yaramila 8-11-20	3,600 kg	8	180 kg/ha	+	14 kg N/ha

Total input = 14 kg N/ha

Total input					14 kg N/ha
Recommended N				-	-36 kg N/ha

Planned Nitrogen Variance = 50 kg N/ha

Positive = N surplus
Negative = N deficit

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Appendix 3: Fertiliser Calibrations - Tomato Planter



Fertiliser Spread Analysis & Calibration Report

<p>Company Name: Kraft-Heinz</p> <p>Site Tested: Rasmussons</p> <p>Test Date: :</p> <p>Tested By: Wayne McDonald</p> <p>Vehicle: John Deere</p> <p>Registration #: 6155R</p> <p>Spreader Type: placement-ptd</p> <p>Spreader Make: Frontmount</p> <p>Spreader Model: Tomato Base dressing</p> <p>Spreader Age: 0</p> <p>Spreader Condition: Good</p> <p>Discharge Height: 255</p> <p>Revs(RPM):</p> <p>Door: Hydraulic 2.52 L/min</p>	<p>Product: Yaramila 8-11-20</p> <p>Nitrogen: Y</p> <p>Bulk Density: 1.11 kg/L</p> <p>Particle Size Distribution</p> <p>Pan: 0 %</p> <p>0.5 mm: 0 %</p> <p>1.0 mm: 0 %</p> <p>1.9 mm: 0 %</p> <p>2.9 mm: 0 %</p> <p>3.7 mm: 0 %</p> <p>4.7 mm: 0 %</p> <p>5.8 mm: 0 %</p> <p>7.0 mm: 0 %</p> <p>SGN: 0</p> <p>UI: 0</p>	<p>Particle Size Distribution</p> <p>100%</p> <p>50%</p> <p>0%</p> <p>-50%</p> <p>-100%</p> <p>Pan 0.5 1.0 1.9 2.9 3.7 4.7 5.8 7.0</p> <p>Aperture Size (mm)</p>
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Set Bout: 6.00 m

Outlet Spacing: 1.00 m

Measured Rate: 483 kg/ha

CV %: 5.1413

Set Rate: 400 kg/ha

