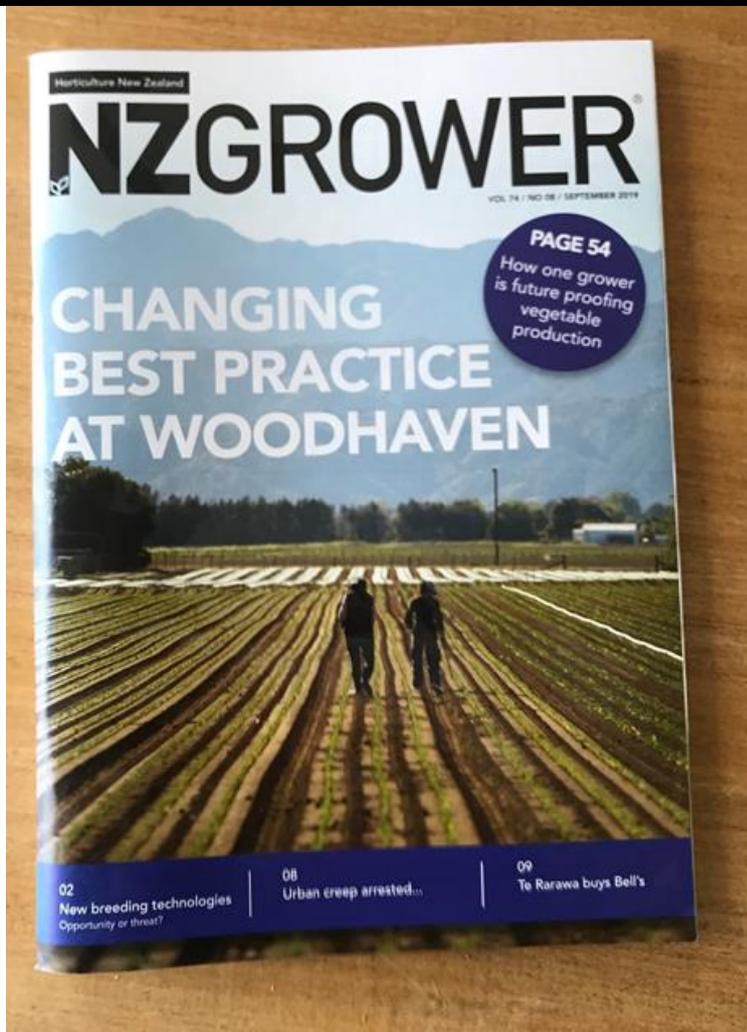


Future Proofing Vegetable Production Milestone 11 Progress Report



D Bloomer & L Posthuma

LandWISE Inc

12 April, 2021

Table of Contents

- 1. Executive Summary..... 2
- 2. Introduction 3
- 3. Grower Engagement 4
 - 3.1 Grower Nutrient Budgets..... 4
 - 3.1.1 Overseer Modelling crop rotations..... 4
 - 3.2 Grower Current Good Practice Survey..... 5
 - 3.2.1 Levin 5
 - 3.2.2 Gisborne..... 6
 - 3.2.3 NZ GAP 6
 - 3.3 Fielddays 7
 - 3.3.1 Levin 7
 - 3.3.2 Gisborne..... 7
 - 3.4 Review tools for Fertiliser Prescription..... 8
 - 3.5 Planned Activities and Project Team 9
- 4. References and Resources 10

1. Executive Summary

This report describes progress made and deliverables met for **Milestone 11, Measuring change of Future Proofing Vegetable Production** completed by 31st March 2021. Through the project, we have spent time setting up tools for growers and coaching them on how to use the tools to address shortcomings around documented nutrient planning and calibrating fertiliser application equipment.

Growers in Levin and Gisborne have been using the LandWISE Nutrient Budget to create a documented fertiliser plan. Nutrient Budgets have shown a wide range of variability between growers' fertiliser use and industry guidelines. This has raised questions about the accuracy of the current industry guidelines for tomato and squash crops. Split paddock trials comparing grower fertiliser use to the industry guidelines have been harvested and are being analysed. This will hopefully provide further clarity on these issues.

Coaching growers on how to complete their own fertiliser equipment calibrations identified maintenance issues in fertiliser application equipment. By showing growers how to complete calibrations themselves, growers are repairing faults which were causing poor quality application and rechecking the equipment in their own time to ensure even fertiliser applications.

The budget and calibration tools have then been included as ways growers can meet their GAP EMS requirements and as such will support ongoing adoption of best practice on farm. Overseer nutrient budgeting is a useful tool to show the potential scale of impact a typical cropping rotation could have on the surrounding environment, but it does little to address the mindset-shift growers need to change how they view and use nutrients within their cropping.

Growers have a good range of nutrient management tools available. Through the project, some growers have started to use Nitrate Quick test to measure the soil nitrogen status routinely before applying fertiliser to a crop. Overall growers have now started to complete formalised nutrient budgets using soil tests and the *Nutrient Management for Vegetable Crops in New Zealand* guide to ensure they are applying the right rate of fertiliser to their crops. With the tools available for growers to take ownership of their cropping nutrient management, and coaching in their use, growers are more engaged in their fertiliser planning and are better equipped to customise their fertiliser plans for each individual crop and paddock.



Figure 1: The crew harvesting sweetcorn nitrogen trials in Gisborne

2. Introduction

At the start of the *Future Proofing Vegetable Production* project, surveys showed that growers were regularly failing to meet industry good practice guidelines around calibrating fertiliser application equipment and documented nutrient planning. The project has addressed these two key areas through further developing the FertSpread online tool to calibrate fertiliser placement equipment and by creating the LandWISE Nutrient Budget.

The FertSpread tool now has templates for placement equipment (planters and side-dressers) to complement the broadcast spreader templates. Growers are using FertSpread to check equipment performance, and to document adherence to industry good practice for their GAP EMS certification.

The LandWISE Nutrient Budget was created as a tool to help drive a mindset shift in growers around nutrient management, with templates for both nitrogen and phosphate. We have spent time both one-on-one with growers in Levin and in a workshop setting in Gisborne covering 80% of the cropping area, supporting growers do their own nutrient budgets. Growers now use it as a simple-to-use nutrient budget and, as with FertSpread, to document adherence to industry good practice for their GAP EMS certification.

The LandWISE Nutrient Budget has been further improved with the nitrogen budget being created into a free, mobile friendly online calculator at nutrient.landwise.org.nz. The budget template has been setup with the aim growers can complete a fertiliser plan while on the go using their phone.

Over the past three months, we have spent a large amount of time field monitoring and harvesting the nitrogen field trials in sweetcorn and tomato crops. We have harvested all 12 sweetcorn trials and six tomato trials. The key purpose of these trials was to coach growers in the use of soil tests and fertiliser planning tools on their own farms, while also field validating those tools and the LandWISE Nutrient Budget.

Through spending time with growers and running replicated trials on their blocks, we have come across a range of issues with current fertiliser prescription tools and are currently working through our final trial harvests before making conclusive recommendations. Preliminary indications are:

- Nitrate Quick tests are quick and reliable at showing an estimated quantity of N in the soil.
- Nitrogen use in sweetcorn may often be reduced significantly if growers use a Nitrate Quick Test and the Quick Test Mass Balance Tool to decide side-dressing fertiliser rates.
- The Quick Test Mass Balance Tool for leafy greens recommends significantly more N than growers currently use.
- The *Nutrient Management for Vegetable Crops in New Zealand* appears to under recommend nitrogen applications for tomatoes while potentially over recommending nitrogen applications for sweetcorn.

These issues will be addressed further as this season's nitrogen trials are fully compiled and analysed over the coming month. Results will be presented at the LandWISE Annual Conference in May.

3. Grower Engagement

3.1 Grower Nutrient Budgets

Through the project, we have sought to identify and develop systems by which growers can be supported to make informed nutrient decisions, ensuring they can confidently apply the correct rate of fertiliser to each block.

The LandWISE Nutrient Budget enables growers to complete nitrogen and phosphate budgets. The simple one page budgets (see Appendix for link) compare a grower's current planned fertiliser applications with the industry guidelines based on a soil test and expected crop yield. The nitrogen budget uses the soil nitrogen and nitrogen supply from crop residues offset against crop requirements to give a planned nitrogen surplus/deficit balance. The nitrogen surplus/deficit allows growers to easily identify crops that they could be over-fertilising.

Where growers regularly have a large nitrogen surplus balance in their nutrient budgets, they have an increased risk of excessive nitrogen leaching. In this situation growers should do a postharvest assessment to address whether they actually required all of the applied fertiliser. Where growers have a nitrogen deficit, growers are applying less than the industry recommended rates and the leaching risk from these crops is lowered. Where growers do have a large deficit, caution should be taken to ensure the growing crop is being adequately fertilised to minimise crop loss from nitrogen deficiency.

Typical nutrient budget results observed for crops in Levin and Gisborne have been listed below:

- **Brassicas:** Summer crops are balanced or have a slight N surplus. Winter cauliflower and cabbage have a large N deficit.
- **Lettuce:** The N balance can vary between growers. Normally balanced or a slight N surplus for summer crops, and a slight N deficit for winter crops.
- **Potatoes:** Budgets generally show a moderate N deficit.
- **Onions:** Slight surplus for early crops. Balanced N application for main season crops.
- **Sweetcorn:** Budgets generally show a moderate nitrogen deficit for main season crops. Late season crops are either balanced or have a slight N surplus. Where Sweetcorn is planted on ground coming out of permanent pasture, there is like to be a large surplus.
- **Tomato:** In almost every case, budgets show a moderate to large N surplus.
- **Squash:** In almost every case, budgets show a moderate to large N surplus.

Based on industry guidelines, phosphate nutrient budgets that have been completed typically recommend no phosphate application. Soil test Olsen P values are typically above the optimum range and growers are regularly applying more phosphate than the crop exports from the paddock.

Work was done this year to validate whether the current fertiliser recommendations for tomatoes is appropriate. Key growers have suggested if they were to drop their fertiliser rates as suggested by the industry guidelines, they would experience significant yield losses. The trial data is still being analysed and results will be reported over the coming months.

3.1.1 Overseer Modelling crop rotations

Over the past couple of months, we have supported a Massey University Masters student completing Overseer budgets, looking at the long-term nitrogen losses under different crop rotations in Levin. The aim of her research project is to identify whether crop sequences can be used to minimise nutrient leaching. Overseer works well in this situation to model potential N losses from different production systems. A useful output from this project, to be published, modelled typical

reference nitrate leaching values from various vegetable crop rotations. These reference nitrate leaching values calculated from Overseer are useful to show the impact of various crop rotations but do little to support current growers trying to improve their nitrogen management decisions between seasons.

3.2 Grower Current Good Practice Survey

Growers in Levin have been re-interviewed, going through the same questionnaire as at the start of the project. The questionnaire was based on the Nutrient Management Code of Practice. At the start of the project, growers were mostly at industry good practice with the exceptions of calibrating their fertiliser application equipment and completing documented nutrient plans.

We have struggled to get responses from growers in Gisborne as they are all in their busy harvest period and face pressures to complete an FEP under a very short timeframe before the GDC May 1 deadline. However, our observations from direct engagement, and from Horticulture NZ workshops is that most growers are aware and are now completing calibrations and budgets.

3.2.1 Levin

Over the past year, growers in Levin have all completed at least a couple of nutrient budgets for their crops and will continue to complete more as they do further soil testing. We have calibrated most of the grower's fertiliser equipment at least twice and found varying degrees of application variability both times. Some of the smaller growers are typically operating older equipment but where it is well maintained, they have good application uniformity. A regular fertiliser calibration allows growers to identify issues before they become a major problem and to address maintenance as required.

Other changes growers have made including further splitting their nitrogen side-dressings. This has little impact through the summer, but some growers were duplicating high application rates through the winter after significant rain events. These growers now routinely split their fertiliser applications around their crop growth and rarely need to increase the total planned fertiliser rate even after significant periods of rain.

The largest grower, covering a large portion of the catchment, is now routinely using the Nitrate Quick Tests prior to side-dressing to decide nitrogen application rates. They have had much success. The majority of the other growers have a nitrate quick test kit and are using the nitrate quick test after rain events to decide whether additional nitrogen is required to complete the crop growth. In the past, these growers would regularly duplicate side-dressings after a major rain event in the chance that the crop would require more. Now, with increased splitting of fertiliser applications and the quick nitrate test, growers are using less fertiliser after rain events.

On the flipside, two growers we have been supporting have now regularly increased their fertiliser application rates to improve their crop quality based on regular low nitrate quick test results. These growers had felt the pressure to reduce their fertiliser usage as it was "all



Figure 2: A proud grower excited to feed Kiwis

leaching”. Completing nitrate tests and doing a nutrient budget showed these growers were under fertilising their crops and they were regularly losing a portion of their crop to nitrogen deficiency. Through using a soil test, they are able to apply an appropriate rate of fertiliser for their crop and reduce the risk of crop loss. This is a key area of success in the project: growers are now actually using soil tests to help inform their nitrogen management decisions.

A couple of growers have also bought seed drills to be able to plant their own cover crops where they have fallow ground. Through the summer, growers would regularly leave the ground fallow as it was not required. Sowing cover crops will mop up any excess nutrients and hold the soil together during significant rain events.

3.2.2 Gisborne

As in Levin, the Gisborne growers typically had no formalised nutrient plan or fertiliser recommendation but used past experience to inform current fertiliser decisions. Our engagement with Gisborne District Council and understanding their requirements was a key driver in our development of the LandWISE Nutrient Budget templates.

Over the last two summers, we have run on-farm trials with all the larger sweetcorn and tomato growers. These demonstrated alternative fertiliser application methods, using a Nitrate Quick Test and using regular soil tests to decide side-dressing rate using the FAR Mass Balance Calculator. Last summer we set up split paddock trials comparing “current grower practice” with “industry good practice” on 12 sweetcorn paddocks (eight growers) and six tomato blocks (four growers). As a result, one large grower has set up a “Soil testing lab” to efficiently complete Nitrate Quick Testing across their operation. The grower started soil sampling this season and is preparing to increase the number of tests the next season.

We have done many side-dresser and planter fertiliser bin calibrations with the growers. The purpose of these was to demonstrate how to do a quick bucket test to check the application uniformity. Where there have been issues with the equipment, growers have spent time over the winter doing maintenance and fixing the identified issues. Where required, we have provided further support as the growers have re-calibrated their own gear.

In conjunction with HortNZ, we have helped the majority of the vegetable and process cropping growers in Gisborne to develop a farm environment plan (FEP) through a series of workshops. These have been attended by 30+ growers covering 80% of the cropping area around the Gisborne area. The workshops were based on the NZGAP EMS template, which is an industry audited FEP template. At the second workshop, we addressed fertiliser equipment calibrations and nutrients and fertiliser planning in detail.

3.2.3 NZ GAP

Although it takes time for growers to shift their mindsets, regulatory pressures are forcing growers to change if they want to keep growing. Almost all of the growers in both Levin and Gisborne have FEP’s through the NZGAP programme. These FEP’s are audited and require growers to have documented nutrient budgets and fertiliser equipment calibrations. A key success for the project is that by creating tools and processes growers can follow, we have created a simple pathway for growers to effectively meet their compliance requirements going forward.

Through the audit process, growers need to be able to demonstrate responsible nutrient management. Where the growers are involved in the decision process, they are more likely to be open to change than when they feel like they are being required to reduce their fertiliser usage without consideration to its impacts on the growing crop.

3.3 Fielddays

3.3.1 Levin

In Levin, a fieldday demonstrating how to complete an irrigation assessment using a practical bucket test was planned but never eventuated as pencilled dates were followed with extensive rain and Covid restrictions late in February. Instead, we met one on one with growers to work through nitrate testing and engaging with them on general nutrient good management questions. These one-on-one visits have covered all of the growers engaged in the project in Levin over the last two months as well as an additional grower with whom we had only had limited prior contact.

We reported on our grower nitrogen trials and demonstrated the Nitrate Quick Test at a Ballance Lower North Island Hort & Arable team training day. One area identified as requiring further support is getting industry to provide more customised nutrient recommendations to growers. Currently, most growers are working with one nutrient budget for each crop type regardless of the soil test results. The advantage of working with industry providers as well as growers is two-fold: we extend the reach of the project to the wider lower North Island, and growers are generally more supportive of trying something new when there is consistent messaging from their “trusted advisors”.

3.3.2 Gisborne

We ran a morning field walk in conjunction with the NZ GAP EMS afternoon workshop. The field day was located at one of the sweetcorn nitrogen side-dressing trial sites and we demonstrated both how to collect a representative soil sample to depth and how to prepare and complete the Nitrate Quick Test.

LandWISE presented at the afternoon NZ GAP EMS session on nutrient management. All the growers completed nitrogen and phosphate budgets for one of their own crops using their own soil tests.

This workshop was part of a series we have been supporting NZ GAP run to get Gisborne growers an active FEP by the 1st of May. The LandWISE Nutrient Budgets were originally setup to support Gisborne growers meet the GDC requirements of having a nutrient budget for each of their crops.



Figure 3. Gisborne NZGAP EMS Workshops

3.4 Review tools for Fertiliser Prescription

Our focus on nutrient prescription saw development of the 1 page LandWISE Nutrient Budgets. These bring together other resources and tools such as the guidelines in *“Nutrient Management for Vegetable Crops in New Zealand”*, the Nitrate Quick Test, the FAR Mass Balance Calculator, and published fertiliser analyses. Growers can determine and document precise prescriptions.

As the fertiliser rates are customised and reduced to just what the crop requires, accurate application is essential to ensure no yield is lost through poor application rate or uniformity. The updated FertSpread app (fertsread.nz) now includes placement equipment.

We are currently finishing our summer trials and reviewing the fertiliser prescription. Over the last 18 months, we have rigorously tested both the Nitrate Quick Test and the *Nutrient Management for Vegetable Crops in New Zealand* guidelines through split paddock trials with growers.

These trials have served two purposes; introducing industry good practice to growers, and to field validating good practice recommendations versus comparable current grower practice. Although we are still completing analyses of these trials, comments we can make include:

- The Nitrate Quick Test is a simple method for growers to measure the soil nitrogen levels.
- The Mass Balance Calculator published by FAR includes some green vegetable crops. The tool recommends considerably more nitrogen than Levin growers are currently using with apparent success. It may not be an appropriate calculator to decide nitrogen side-dressing rates for leafy greens and brassica crops.
- A preview of the 12 split paddock trials would suggest that the nitrate quick test and the *Mass Balance Calculator* does work well for sweetcorn. The preliminary results suggest growers can use considerably less nitrogen than they are, and lower nitrogen rates than suggested in *“Nutrient Management for Vegetable Crops in New Zealand”*.
- Tomato trials still being completed suggest that if growers were to follow the *Nutrient Management for Vegetable Crops in New Zealand* nitrogen recommendations, they would frequently lose significant yield. The nitrogen recommendations in the nutrient guide appear to not fully consider the crops’ potential nitrogen uptake and as such appear inadequate.
- The industry should consider a recommendation system similar to the UK RB209 system which calculates a soil nitrogen supply index value based on soil, climate and crop assumptions.

Recommendations for revising the Code of Practice for Nutrient Management (2014):

- Create a concise document for growers
- Keep a revised version of the current 2014 Code of Practice for Nutrient Management as the supporting document
- Emphasis required on minimum inputs to complete a nutrient budget
- Emphasis required on including a soil nitrogen value to create a fertiliser recommendation for an individual crop
- Create clearer guidance around risk categories, rather than the current subjective low risk/high risk guidance
- Address how to manage and account for crop residues
- Address how to account for animals in the cropping rotation
- Simplify GMP/BMP’s to reduce duplication between crop growth stage categories



Figure 4: Harvesting a Tomato Nitrogen Rate trial with the helpers.

3.5 Planned Activities and Project Team

We were not able to hold a face-to-face Project Team meeting. Key project farmers in Gisborne and Levin have been kept updated and recommendations sought. They have regular project involvement as we work with them on their properties. We also use the LandWISE Board to make sure we address the issues growers face, and regarding the tools developed through the project.

In June, the *Future Proofing Vegetable Production* project will wrap up. We are working on our summer sweetcorn and tomato trials and will report on the findings to the wider project community at the LandWISE Conference, workshops and through written trial reports. Workshops planned for Pukekohe, Gisborne, Hawke's Bay, and Levin will cover key project lessons with the grower community and supporting industry partners.

We have started to draft User Guides outlining minimum requirements for fertiliser application equipment calibrations and nutrient budgeting and will publish these.

The wider project will be presented on at the LandWISE conference.

To finalise the project, we will review with growers the learning that we had taken from the project and at the final project team meeting consider how to take these lessons further as an industry.

4. References and Resources

Reid, J. B & Morton, J. D. (2019). *“Nutrient Management for Vegetable Crops in New Zealand”*. Horticulture New Zealand on behalf of Vegetables Research and Innovation Board and Fertiliser Association of New Zealand, Wellington.

Tools and resources list (accessed 12/04/2021):

LandWISE Nutrient Budget and supporting documents

<https://nutrient.landwise.org.nz/>

<https://www.landwise.org.nz/resources/tools/landwise-nutrient-budgeting-template/>

<https://www.fertiliser.org.nz/site/resources/booklets.aspx>

Fertiliser Equipment Calibrations

<http://www.fertspread.nz/>

Nitrate Quick Test calculator and supplies

<https://www.far.org.nz/articles/1231/quick-test-mass-balance-tool-user-guide>

<https://www.labsupply.co.nz/nitrate-test-kit>

HortNZ Code of Practice for Nutrient Management (2014)

<https://www.hortnz.co.nz/compliance/grower-resources/>

