

# Future Proofing Vegetable Production Milestone 7 Progress Report



D Bloomer, L Posthuma and G O'Brien

LandWISE Inc

31 March 2020

## Table of Contents

Executive Summary .....	2
1. Introduction .....	3
2. Project Team Meeting & Status Report .....	3
3. COVID-19 Response .....	3
4. Fallow Minimisation Field Events .....	4
5. On-farm Trials .....	4
5.1 Potato – alternative fertilisers and leaching rates .....	5
5.2 Tomato – reduced starter fertiliser for tomatoes .....	5
5.3 Sweetcorn – Liquid N at side-dressing .....	5
5.4 Sweetcorn – Starter phosphate fertiliser trials .....	5
5.5 Sweetcorn – Nitrogen soil tests to determine side-dressing rates .....	6
5.6 Planned Winter Trials .....	6
6. Monitoring Nitrogen Mitigation Trials .....	6
7. Removing Nitrates from the System .....	7
8. References .....	7

## Executive Summary

This report describes progress made and deliverables met for **Milestone 7 Monitoring farm and environment progress** of Future Proofing Vegetable Production completed on 31st March 2020.

LandWISE is pleased to report that there has been significant progress since the last milestone report in January with targets generally met and all but one of our grower summer crop trials harvested. Our trials have shown the value of tools such as the *Nitrate Quick Test*, the *Nitrate Quick Test Mass Balance Tool*<sup>1</sup> and the *Nutrient Management for Vegetable crops in New Zealand*<sup>2</sup> guidelines.

We do note that COVID-19 has created huge uncertainty. Many growers communicated to us in early March they were working on essential tasks only, some banning visitors to their site to minimise unnecessary face-to-face contact. We are all complying with Level 4 protocols, and thus all events and visits are postponed at this time.

At this stage we believe we can amend our plans and continue to deliver high quality advice and support to growers changing management to reduced losses of nitrate and nutrients. The government response to COVID-19 has meant our annual conference was cancelled, and field days and field work for which we travel outside of Hawke's Bay have been postponed.

Field events on cover crops and fallow minimisation scheduled for late March are on hold until the COVID-19 threat level decreases. As an alternative we are re-creating the material as a handout and info sheets for growers. We are extending this thinking to how we prepare and deliver all our information resources and engage with our LandWISE community. Since the last milestone report, we have been investigating how to deliver conference content in remote ways, targeting platforms that are most convenient and accessible to relevant audiences.

Grower trials have progressed well with five trials in Gisborne harvested over the last two months. One trial in Gisborne may be lost depending on its harvest date, but it is a replica of another successfully completed trial. Trials planned to start the last week of March and through April have been delayed until travel restrictions as part of the COVID-19 response are lifted.

As we previously reported, for a bioreactor to be effective, we need a concentrated supply of nitrogen rich water that has a reasonably constant or regular flow. We have not found this in any catchment. Most drainage systems in horticulture cropping ground flow rather irregularly and to date the surface water nitrate flows are much lower than expected.

Through modelling various vegetable growing scenarios, we have identified that high levels of crop residue may be a significant contributor to nitrate leaching losses and that by managing these crop residues, we could reduce the surplus of mineral nitrogen in the soil and thus reduce the nitrate leaching. This approach would help keep the stable door shut, rather than chase the horse after it has bolted.

Much of our group and grower support has been delivered through on-going on-farm trials in Levin and Gisborne. Additional activities include presentations at FLRC and at Potatoes NZ field days.

We thank our co-funders for on-going project support with practical advice and resources that allow us to engage more fully with growers and implement trials more easily.

## 1. Introduction

This report covers progress of the *Future Proofing Vegetable Production* project from February to March 2020. The actions undertaken to meet milestone deliverables are detailed under their respective headings. LandWISE is pleased to report that there has been significant progress since the last milestone report in January with all but one of our grower summer crop trials harvested. Our trials have shown the value of tools such as the *Nitrate Quick Test*, the “*Nitrate Quick Test Mass Balance Tool*” and the *Nutrient Management for Vegetable crops in New Zealand*<sup>2</sup> guidelines to manage nutrient use better and considerably reduce fertiliser use in some circumstances.

Commercially sensitive and in-confidence information has been excluded. Further details may be provided upon request.

## 2. Project Team Meeting & Status Report

Milestone 7 **Monitoring farm and environment progress** includes reviewing options for fallow minimisation, establishing growers’ trials and monitoring nitrogen mitigation trials. Growers were to be given support through field days for general audiences run in Arawhata and Gisborne and the groups and individual farmers supported to build capacity and capability.

Project progress was discussed with growers at the Levin Liquid Fertiliser field event. Feedback was that the ongoing communications, with field events, group meetings and one on one information sharing are useful. Growers support continuing with local on-farm trials. We have noted this gives the intense one-to-one discussion that is the key to actual change occurring.

We have also maintained conversation about the project with the Levin and Gisborne communities and our co-funders as individual dialogues. While we had planned to have a more formal meeting, this was cancelled as the implications of dealing with COVID-19 became more evident.

We have met Milestone 7 targets, but Bioreactor work remains in limbo. There has been insufficient rain to generate significant surface drainage and we have been unable to identify a suitable site because drainage nitrate monitoring is on hold. Early results suggest nitrates are more likely to be in subsurface drainage. With the added implications of COVID-19, we seek to discuss amendments to future milestones with MPI and project co-funders.

We have been approached by growers and industry people in other regions and are investigating a project extension to enable the lessons from Levin and Gisborne to be shared more widely.

We thank our co-funders for on-going project support with practical advice and resources that allow us to engage more fully with growers and implement trials more easily.

## 3. COVID-19 Response

The last three weeks have introduced a number of challenges to our normal operation. The government response to COVID-19 has meant our annual conference was cancelled, and field days and field work for which we travel outside of Hawke’s Bay have been postponed. Many growers communicated to us in early March they were working on essential tasks only, some banning visitors to their site to minimise unnecessary face-to-face contact. We are all complying with Level 4 protocols, and thus all events and visits are postponed at this time.

Instead, we are adapting how we prepare and deliver our information resources and engage with our LandWISE community. Since the last milestone report, we have been investigating how to

deliver conference content in remote ways, targeting platforms that are most convenient and accessible to relevant audiences. The Grower magazine is on hold pending relaxation of rules as it is considered a non-essential publication.

Growers/farmers have told us that they are too short of time to sit down for a webinar style presentation but would be able to listen to a podcast while they are driving or otherwise occupied. In partnership with Radio Kidnappers, a local Access Radio station, we will record interview style audio clips to be broadcast locally on AM and FM Radio, and made available nationally on platforms such as Apple Podcasts and Spotify and our own LandWISE website. We aim for a series of 11 podcasts throughout the next 12 months.

For our more technically minded audience, we are proposing 4 – 5 webinars on technical topics where data and visuals are critical to the presentation. We are looking at recorded webinar formats for these presentations.

We are scripting and will record a series of short instructional videos on practical sustainable production topics. Planned topics are:

- How to: Soil Sample a Cropping Paddock
- How to: Take a Yield Sample
- How to: Calibrate your Fertiliser Placement Machine
- How to: Use the LandWISE Nutrient Budget Template

We believe this package of resources will provide growers with useful information they can apply on-farm as well as expose our community to the exciting and left-of-field ideas that are emerging from the agritech space. We feel positive this group of resources will have a more lasting impact on sustainable production and add a vegetable specific perspective to precision agriculture information and processes. When field events begin again, we will have a better resource base on which to call.

#### 4. Fallow Minimisation Field Events

We were planning field events for late March regarding cover crops and fallow minimisation. These are on hold until the COVID-19 threat level decreases. As an alternative we are re-creating the material as a handout and info sheets for growers. This material will be distributed to growers and made available on our website. The handout discusses general ideas and lessons on cover cropping and reasons to minimise fallow. We are working on a suite of cover crops fact sheets that will discuss pros and cons of common species available in New Zealand, informed by local research.

We did run an extra workshop in Gisborne on 4 February addressing the Nitrate Quick Test and its application to make decisions before side-dressing with nitrogen fertilisers. This was attended by 14 growers and industry representatives.

#### 5. On-farm Trials

Grower trials have progressed well with five trials in Gisborne harvested over the last two months. Trial reports will be distributed with project partners and the wider LandWISE network of growers within the next month pending the growers' reviews. Levin potato trials are ongoing.

Due to the COVID-19 lockdown, we have one trial in Gisborne that may be lost depending on its harvest date. The trial investigated using the Nitrate Quick Test to determine side-dressing rates in late-season sweetcorn crops. Its harvest is scheduled for the 3<sup>rd</sup> week of April. If the COVID-19 alert

level decreases to Level 2, by this time we will be able to travel to collect data at harvest. We do however have data from a replica trial also run in Gisborne this season.

Trials planned to start the last week of March and through April have been delayed until travel restrictions as part of the COVID-19 response are lifted.

### 5.1 Potato – alternative fertilisers and leaching rates

These trials are a collaboration with Massey University and PhD student Fernando Avendano. A meeting on the 3<sup>rd</sup> February in Levin with John Saarup with Dr Ian Kirkwood from Potatoes NZ gave good feedback on two trials trialling slow release Nitrogen (SmartFert) in potatoes. Harvest for these blocks is planned for July.

### 5.2 Tomato – reduced starter fertiliser for tomatoes

The trial was harvested on the 25<sup>th</sup> February with results showing that the grower could reduce the base fertiliser applications considerably without impacting on yield. The trial demonstrated the value of regular soil testing and checking fertiliser budgets against good practice as recommended in the *“Nutrient Management for Vegetable Crops in New Zealand”* book. We are pleased to have a case study of the newly released Nutrient Management guidelines in tomatoes and will be relaying the trial results with other growers we interact with.

### 5.3 Sweetcorn – Liquid N at side-dressing

Current practice in sweetcorn is to apply considerable rates of nitrogen fertiliser as a side-dressing at V5-V7, 4-6 weeks after planting in anticipation of crop requirements. Sweetcorn plants are quite short, and it is possible to late apply nutrition and sprays with high clearance sprayers. The question of the trial was to test whether liquid urea banded with a Y-drop system will achieve the same yields and maturity timing as dry urea knifed into the soil. The purpose was to identify additional tools growers can use to manage in-season nitrogen decisions.

In this trial, no yield response to either a full rate or half rate applied in either a dry or liquid form was measured due to the reasonable levels of nitrogen in soil at the time of side-dressing. The trial showed the potential for in-season soil testing to determine appropriate rates of fertiliser. Using the Quick N Soil test kits allows growers to optimise fertiliser rates and apply nitrogen where required to maximise yield. Using a high clearance sprayer, growers can further delay side-dressing on sweetcorn and apply nitrogen if required in a liquid form.

### 5.4 Sweetcorn – Starter phosphate fertiliser trials

Past work in New Zealand has shown that there is likely to be no significant yield gain in sweetcorn by applying phosphate where the Olsen P in a paddock is over 30 as demonstrated in the *“Nutrient Management for Vegetable Crops in New Zealand”* guide. This trial was repeated twice in Gisborne to test whether growers with high Olsen P soils could remove all phosphate from the fertiliser applications without effecting either the sweetcorn yield or delaying maturity.

Both the trials were harvested on the 20<sup>th</sup> February and showed that where the paddock Olsen P levels are above the recommended nutrient levels, you are unlikely to see any yield response to additional phosphate fertiliser. A large number of cropping and horticultural blocks through Gisborne have elevated Olsen P levels above 30, so the key message to growers is *“Regularly soil sample all your blocks and adjust your fertiliser program to match the paddocks fertility.”*

## 5.5 Sweetcorn – Nitrogen soil tests to determine side-dressing rates

(Repeated across two paddocks in Gisborne)

Trial #1 was harvested on the 20<sup>th</sup> February. The planned harvest date for Trial #2 is late April.

We tested both the potentially available N test taken before planting, the Nitrate Quick Test at emergence and the Nitrate Quick test prior to side-dressing.

Grower #1 had planned to side-dress Urea at 200kg/ha at V6. Using the potentially available N test pre-planting together with the “*Nutrient Management for Vegetable Crops in New Zealand*”<sup>ii</sup> guide, the recommended fertiliser rates were considerably higher at 300kg/ha urea at side-dressing. The Nitrate Quick Test at emergence indicated the grower’s normal practice of 200 kg/ha urea would be sufficient. Prior to side-dressing, the final Nitrate Quick test combined with the FAR “*Nitrate Quick Test Mass Balance Tool*”<sup>1</sup> recommended that no additional fertiliser be added.

The trial showed no yield or quality benefit from applying any nitrogen at side-dressing. Thus, the trial demonstrated the value of soil testing just prior to side-dressing to determine optimum side-dressing fertiliser rates. The Nitrate Quick Test, readily available kits and supporting tools make this easy for a grower.

## 5.6 Planned Winter Trials

We have planned a range of trials in autumn and winter vegetable crops. These trials are on hold with COVID-19 having interrupted our fieldwork. While in lock-down and restricted to one region, we are creating digital tutorials on nutrient budgeting and increasing the accessibility of the information resources we have been and are creating.

Planned autumn/winter trials include:

1. Using Nitrate Quick test strips to determine fertiliser rates for Baby lettuce. Grower currently applies considerably more nitrogen than is removed by the crop.
2. Using Nitrate Quick test strips in Cauliflower and Broccoli crops to determine side dressing rates over winter with 2-3 growers keen to replicate the trials on their farms.
3. Using Nitrate Quick test strips in Asian brassica crops to determine side dressing rates over Autumn. These crops can have shallow rooting systems and require high rates of fertiliser.
4. SmartFert Generation 2 slow release nitrogen fertiliser in Cauliflower and cabbage crops to see whether the grower can eliminate side-dressing in winter.
5. Liquid fertiliser applied over the top of Spinach to assess rates of liquid N that can be applied through the fertiliser nozzle system.

## 6. Monitoring Nitrogen Mitigation Trials

Our project plan includes investigation and testing of edge of field treatments including bioreactors and wetlands. As we previously reported, for a bioreactor to be effective, we need a concentrated supply of nitrogen rich water that has a reasonably constant or regular flow. We have not found this in any catchment. Most drainage systems in horticulture cropping ground flow rather irregularly and to date the surface water nitrate flows are much lower than expected (Monitoring will be continued when COVID-19 rules permit). There is some evidence in Levin that much of the excess nitrogen leaving blocks goes into the shallow ground water and not surface water bodies. That is subject to increased Horizons Regional Council research activity. We are yet to find a clear opportunity to treat surface drainage, but minimal summer drainage and now COVID-19 has provided few opportunities

to test water. In Gisborne, one grower is planning reactor treatment of nutrients waste flows from a seedling nursery and we have been supporting their research.

A novel approach we identify is that the high levels of crop residues typical in fresh vegetable production may be a significant driver of leaching. This is discussed in Section 7: Removing Nitrates for the System.

## 7. Removing Nitrates from the System

Through modelling various vegetable growing scenarios, we have identified that high levels of crop residue may be a significant contributor to nitrate leaching losses. These residues are inevitable as only a proportion of a vegetable crop is saleable, the rest gets recycled in-situ. The modelling suggests that by managing these crop residues and using Quick N test strips prior to side-dressing, we could reduce the surplus of mineral nitrogen in the soil and thus reduce the nitrate leaching. This appears able to reduce losses by more than would applying the current good practice guidelines outlined in *“Nutrient Management for Vegetable Crops in New Zealand”*.

We have begun framing a variation with growers, and a set of trials to assess how practical and beneficial increased focus on residue management might be. We are unaware of significant research into crop residue management so getting baseline data is a good first step. This would involve regular soil testing to depth in a range of crops in each region (10-20 blocks every 4 weeks to 1.5 m). Other trials being considered are removal of residues for animal feed or managed composting, mulching to increase speed and predictability of breakdown and nutrient release, and various cover and catch crop options.

This approach would help keep the stable door shut, rather than chase the horse after it has bolted.

## 8. Supporting Groups and Growers

Much of our support has been delivered through on-going on-farm trials in Levin and Gisborne. This close, repeated contact has grown relationships and trust and has seen very significant change occurring on farms. Much has been due to growers understanding new knowledge and how it can be applied. Some growers leap ahead only occasionally seeking advice or a discussion. Others require more coaching and encouragement, but as confidence builds change can be rapid.

We worked with a Gisborne grower and Gisborne District Council to identify elements required in a Farm Environment Plan and with New Zealand GAP to update the Environment Management System Add-on<sup>iii</sup> to include Gisborne specific requirements. We also assessed options for nursery wastewater nutrient stripping to remove nitrates and phosphates and identified a commercial provider to assist.

Additional activities spread the lessons from our research wider and gain input from a wider pool of experts. We benefit from the FLRC “Nutrient Management in Farmed Landscapes” Conference in February, where we presented a paper “Engaging to Change: Constraints to On-Farm Adoption”<sup>iv</sup> discussing dissemination, technology transfer and adoption of new management practices. This used the on-farm trials with growers as case studies. We also presented two posters, seeking any advice or experiences from the collected wisdom: “Liquid Fertiliser Application for Vegetable Cropping”<sup>v</sup> and “Back of an Envelope Nutrient Budgeting”<sup>vi</sup>.

We presented project information at a PotatoesNZ field day in Levin on 3 February. This was well attended, and we appreciate the benefits to all of collaborating for such events.

Unfortunately, the LandWISE “Back to the Future” Conference in May has been cancelled, but we are seeking to get many of the presentation recorded and delivered in alternative ways.

## 9. References

---

- <sup>i</sup> Mathers, D., Norris, M., & Hunt, A. (2019). *The Nitrate Quick Test Mass Balance Tool*. <https://www.far.org.nz/assets/files/blog/files//e7b9c43f-c4f6-52cb-b0f9-1e9e6539bb91.pdf> Accessed 28 March 2020
- <sup>ii</sup> 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.
- <sup>iii</sup> NZ GAP. 2020. “Environmental Management System (EMS) Add-on” [https://www.nzgap.co.nz/NZGAP\\_Public/Scope/Environment/NZGAP\\_Public/Scope/Environment.aspx?hkey=ff09efae-13bb-4905-b258-0e01821fb5a9](https://www.nzgap.co.nz/NZGAP_Public/Scope/Environment/NZGAP_Public/Scope/Environment.aspx?hkey=ff09efae-13bb-4905-b258-0e01821fb5a9) Accessed 07 April 2020.
- <sup>iv</sup> Bloomer, D. J., Posthuma, L. A. and O’Brien, G. K. A. 2020. Engaging to Change: constraints to on-farm adoption. In: *Nutrient Management in Farmed Landscapes*. (Eds. C.L. Christensen, D.J. Horne and R. Singh). <http://flrc.massey.ac.nz/publications.html>. Occasional Report No. 33. Farmed Landscapes Research Centre, Massey University, Palmerston North, New Zealand. 5 pages.
- <sup>v</sup> Posthuma, L., O’Brien, G. K. A., and Bloomer, D. J., 2020. Liquid Fertiliser Application for Vegetable Cropping. In: *Nutrient Management in Farmed Landscapes*. (Eds. C.L. Christensen, D.J. Horne and R. Singh). <http://flrc.massey.ac.nz/publications.html>. Occasional Report No. 33. Farmed Landscapes Research Centre, Massey University, Palmerston North, New Zealand. 2 pages.
- <sup>vi</sup> O’Brien, G. K. A., Bloomer, D. J., Posthuma, L. A. 2020. Back of an Envelope Nutrient Budgeting. In: *Nutrient Management in Farmed Landscapes*. (Eds. C.L. Christensen, D.J. Horne and R. Singh). <http://flrc.massey.ac.nz/publications.html>. Occasional Report No. 33. Farmed Landscapes Research Centre, Massey University, Palmerston North, New Zealand. 6 pages.