BallanceEx Future Farming

Innovation Update

March 2025

Sustainable Food & Fibre Futures

Future Ready Farms Programme

Future farming

New Zealand's agriculture and horticulture sectors are built on the back of a culture of innovation and 'can do.' However, the world is changing, and it's essential to build on this heritage and continue to evolve so we can retain and enhance our global advantage. Collectively, we need to acquire, translate, combine and apply knowledge and technologies to solve today's problems, and prepare the ground for solving tomorrow's. We need to continue to innovate to make sure our farms and orchards are ready for the future.

This Innovation Update showcases just some of the exciting innovations and research information already produced by the Future Ready Farms programme. You can expect to hear more from Ballance Agri-Nutrients on this successful programme as well as other great innovations that are underway.

FUTURE READY FARMS
Creating a lower emissions future

MPI

Ballance

From the Chair

Since late 2020, Ballance Agri-Nutrients has been working on the Future Ready Farms programme, a partnership with the Ministry for Primary Industries (MPI), through the Sustainable Food and Fibre Futures fund. It's been a great privilege to work alongside the Ballance team and MPI in my role as Independent Chair of the Programme Governance Group.

Future Ready Farms aims to support both profitable and sustainable farming and growing, enabling New Zealand's strong reputation to be further enhanced in key export markets, as well as underpinning continued confidence in the quality and low impact of New Zealand food production here at home. To achieve these big picture outcomes, Future Ready Farms is focusing on using sound science and innovation to:

- support farmer and grower profitability
- reduce greenhouse gas emissions
- improve water quality
- reduce agrichemical use.

As you'll see here, Future Ready Farms is complex, with 13 different projects underway, each looking to create novel products and new tools to support New Zealand's farmers and growers. Individual projects focus across a wide range of areas and sectors including fertiliser

manufacture, livestock production, forestry, horticulture and arable. Getting these products and tools into the hands of farmers and growers is built into the design of Future Ready Farms, with extension and support through the Ballance team and more broadly, an important part of the programme and its individual projects. This ensures the investment from both Ballance and MPI makes a positive difference to farmers and growers. Early project outcomes have already been delivered or are in later stages of evaluation, prior to making them available for use.

We're looking forward to seeing the contributions from the final years of the programme to the future of New Zealand's vital food and fibre sector. In the meantime, I trust you'll find this update on Future Ready Farms both interesting and valuable.

Scott Champion
Independent Chair
Future Ready Farms Governance Group

Innovation supporting Future Ready Farms

The Future Ready Farms is a 7 year, $25 million programme which aims to deliver new sustainable technologies, products and knowledge to the primary industry to support farmer and grower profitability while decreasing the environmental impact of food and fibre production in New Zealand. The programme comprises 13 projects as well as associated extension and community engagement, which will benefit the dairy, sheep and beef, forestry, horticulture, arable and fertiliser manufacturing sectors. Once implemented, it's estimated the programme will provide over $1.06 billion of economic benefit as well as significant environmental gains to NZ farmers and growers. **Table 1** outlines each project's contributions to the programme's goals and sectors.

Critically the programme taps into some of the extraordinary science capability we have in New Zealand and we'd like to acknowledge the enormous contribution of our research partners in co-developing the programme's outputs.

The programme is currently in year 5, with numerous projects already starting to deliver exciting practical outcomes. This Innovation Update gives a quick snapshot of some of the great science and development that has already been completed in this Sustainable Food and Fibre Futures funded programme.

Table 1 **The environmental goals and sectors benefitted by Future Ready Farms projects**

Project	Goals			Sectors to benefit				
	Reduce greenhouse gas emissions	Improve water quality	Reduce agrichemical use	Sheep & beef	Hort & arable	Dairy	Forestry	Fertiliser manufacturing
1	▼	▲		●	●	●		
2	▼	▲		●	●	●		
3	▼	▲		●	●	●		
4		▲	▼		●			
5	▼	▲	▼				●	
6	▼							
7	▼			●	●	●		●
8	▼	▲				●		
9	▼	▲	▼	●		●		
10	▼		▼	●				
11	▼	▲		●	●	●		
12	▼	▲		●	●	●		
13				●	●	●		●

Coming soon: the future of dairy effluent management

In conjunction with Plucks Engineering and Southwater, Ballance is developing an innovative dairy effluent management system designed to help farmers improve on-farm effluent practices and reduce environmental impact. Currently in the final testing phase, this innovative technology addresses a significant environmental and regulatory challenge in New Zealand's dairy sector.

This new effluent management system, first conceptualised in 2020, offers dairy farmers an easy way to retrofit a practical solution to meet both current and future effluent storage and regulatory demands. As regulations evolve, farmers often need to renew their consents and invest in upgrading effluent systems to ensure adequate storage, control and mapping. Additionally, current regulations cap nitrogen application from effluent at 150 kg N/ha/year, meaning farmers must carefully manage their land area to avoid overapplication per hectare. This effluent system has been developed to aid farmers to specifically meet these requirements.

This advanced system assists farmers by separating the solids from liquids, leaving farmers with cleaned water coming out of the system. The effluent solids are captured, contained and slowly dewatered for later use giving farmers greater control over when they apply the nutrients to their land. The separated liquid/water can be reused and recycled, reducing the volume of fresh water being turned into effluent every day. This system offers farmers greater control over their nutrient and water management and further supports responsible land stewardship.

Following the completion of commercial trials, it is anticipated the technology will be rolled out for broader market availability later this year, delivering an effluent management solution that helps New Zealand's dairy sector meet its compliance and sustainability goals.

Southwater DREDGING & WATER TREATMENT

PLUCK'S DAIRY EFFLUENT SYSTEMS

DAIRY

Enhancing animal health and productivity

Ballance and AgResearch are making great progress in developing a novel animal remedy with a unique point of difference.

When fed to animals, the product will improve animal wellbeing and welfare, increase productivity, reduce production costs and chemical use, and reduce the environmental footprint of pastoral ruminant livestock farming.

Work to date has shown the product works in dairy cattle, meat sheep and reared calves and lambs. For example, our most recent studies have aimed to evaluate its benefits to milk reared dairy calves' wellbeing and productivity, due to improved physiological development and function. These benefits were linked with a significant reduction in the incidence and severity of scours, the leading health issue in commercial calf rearing and a cause of substantial illness and death.

We have also demonstrated that supplementation to dairy cows during the transition period (late pregnancy to early lactation) can improve the cow's ability to cope with physiological stress, with potential wellbeing and productivity benefits for the cow and calf.

Evaluation of this supplement over the last 7 years has also revealed potential benefits for supporting high-fecundity ewes, with improved animal performance to weaning, resulting in reduced chemical inputs on-farm and improved animal survival and wellbeing.

We are currently working to gather the information required to support registration and path to market for use in both pre-ruminant and ruminant livestock.

agresearch āta mātai, mātai whetū

SHEEP & BEEF

DAIRY

SHEEP & BEEF

DAIRY

HORT & ARABLE

Helping to ensure healthy soil

The soil health initiative aims to increase Ballance customers' knowledge and information on soil and soil health, from both an environmental and production perspective.

The project's first aim was to upskill the Ballance team in measuring and monitoring soil health. The next aim was to develop additional analyses of soil health metrics which could be conducted as part of standard soil fertility monitoring. This has resulted in the Ballance Soil Health Check tool.

The Ballance Soil Health Check is a biochemical assessment. It provides information on soil's biological properties (such as soil microbial activity and organic matter) as well as chemical properties measured by standard soil fertility testing (such as Olsen P and pH). Results from the Soil Health Check are measured against soil health target ranges used for national (and regional) soil health monitoring programmes. These targets take into account the farm system and soil type, and provide benchmarks or 'target' ranges for each of the measured parameters. The national soil health target ranges reflect results expected from a sample collected to a depth of 10 cm (the depth to which soil health samples are generally collected). As Soil Health Check samples are aligned with soil fertility sampling (collected to 7.5 cm or 15 cm deep) the target ranges are corrected to allow for more accurate comparison.

As the Soil Health Check was designed to align with the existing fertility sampling protocols, the samples do not allow for soil physical health, such as compaction, to be assessed. While the Soil Health Check does not comprehensively assess soil health, it does indicate land use's impact on soil health by monitoring changes in certain indicators over time. The results can therefore guide farmers to be more mindful in managing their soil's overall health. Ballance can also provide recommendations for managing and improving soil health, based on the results and some understanding of the farming system.

The soil health initiative continues to look to use innovative methods to help Ballance customers understand the impact of land use on soils, as well as the services that soil provides. This includes tools such as machine learning and imagery for rapidly assessing soil health metrics with a focus on soil physical health. As well, eDNA and other molecular biological approaches are being explored to provide a more in-depth understanding of soil biology, both beneficial and harmful impacts (pests and diseases) and how they might affect subsequent crop planting success and/or growth.

Benefits of healthy soil

- Provision of food, fibre & fuel
- Nutrient cycling
- Carbon sequestration
- Flood regulation
- Water purification & soil contaminant reduction
- Habitat for organisms
- Climate regulation

What's 'healthy' soil?

Healthy, functioning soil is essential for food and fibre production, and provides significant economic, ecological and cultural benefits. Accordingly, soil health is of great interest to farmers, landowners, environmentalists and policy makers.

Soil results from the interaction of the lithosphere (rock), atmosphere (air), hydrosphere (water) and biosphere (living things). This interaction, coupled with the effect of human management, is the essence of soil health. Soil is therefore a functioning ecosystem rather than an inert substance, and soil health in farming systems goes well beyond just nutrient fertility.

Soil ecosystems are remarkably resilient to the changes humans make to manage soil for our needs. But there is a limit to that resilience. In some situations, severe degradation of soil occurs, often associated with land use change and how the soil is managed.

The meaning of healthy soil may vary with intended land use, so a precise definition is difficult. The most commonly used definition is "the continued capacity of the soil to function as a vital, living ecosystem that sustains plants, animals and humans"[1]. Regardless of the definition used, soil health is well recognised as playing a significant role in farm sustainability.

[1] *Soil Health [accessed November 2020] https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/*

Manaaki Whenua Landcare Research

A new tool to help farmers control livestock parasites

This world leading project brings together the expertise of Ballance and AgResearch to develop a novel pasture dressing – an agrichemical formulation to reduce livestock parasite populations on pasture, while also providing nutrient to plants.

Gastrointestinal nematodes are a significant problem for the pastoral industry, impacting livestock health and productivity and placing a considerable economic burden on farmers.

Traditional control methods such as anthelmintics (anti-parasitic drugs) which target parasites inside the animal (using oral drenches) are increasingly compromised by drug resistance, resulting in triple drench resistance and reduced treatment options.

This pasture dressing targets the free-living phase of the parasites, outside the animal. Reducing larval contamination on pasture has been shown to lower infection rates of grazing livestock, and improve overall animal health and production.

Since its initiation in 2013, this project has undergone a rigorous development process, and several formulations have shown potential for practical application. If successful, this innovation will provide a valuable tool for the pastoral industry to improve animal health, reduce economic losses, and contribute to more sustainable farming practices.

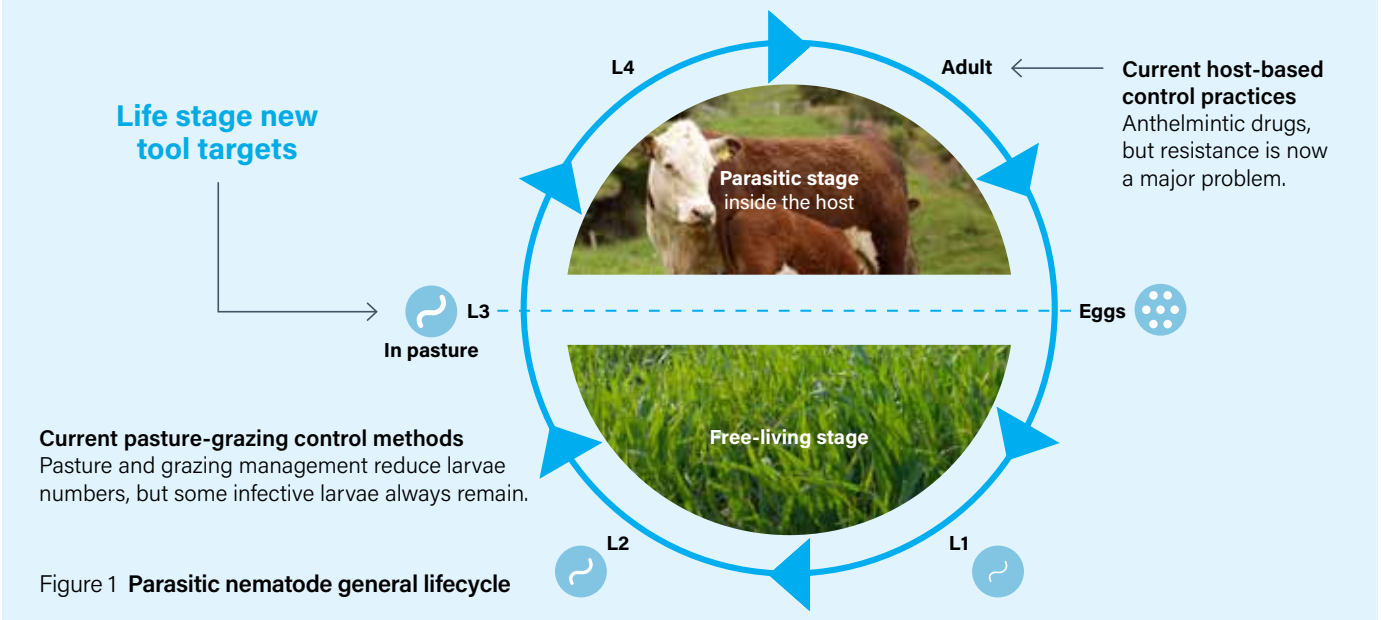

Figure 1 **Parasitic nematode general lifecycle**

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āta mātai, mātai whetū

Two birds, one stone: a dual purpose solution for forestry and beyond

Urea manufacture creates a byproduct known as biuret, a form of nitrogen (N) which negatively affects many plants but has recently been shown to be of significant nutritional benefit to many conifer species.

Because of biuret's adverse effects (such as leaf dieback and stunted growth) on pasture, fruit crops and many plants, a lot of investment has gone into developing processes to prevent it forming during urea manufacture. However, this project aims to quantify the positive response of radiata pine to biuret application and explore options for utilising it.

Initial research has shown that radiata pine and some other plant species actually respond very positively to receiving N in the form of biuret (based on measurements of growth, nutrient uptake and other key parameters). Trees that received biuret as their N source grew faster and were more effective at capturing nutrients such as phosphorus and boron compared to trees that received standard fertiliser. Biuret treated trees in large scale operational trials have also exhibited enhanced tolerance to disease, reducing the need for copper applications.

Trials have also shown that biuret's negative effect on other plants could provide a second benefit in pine forest plantations. The targeted use of biuret could have a herbicidal effect on unwanted plants (weeds), reducing the need for herbicide treatments while allowing for the dual benefit of production gains on pines.

SCION
FORESTS • PRODUCTS • INNOVATION

Getting the most from controlled-release fertilisers

Crop nutrient supply

Slow or controlled-release fertilisers (S-CRFs) can enhance nutrient use efficiency by preventing excessive soil nutrient concentrations during vulnerable periods such as winter and autumn. However, if the rate of nutrient supply from S-CRFs is too slow, soil nutrient concentrations can limit crop yields.

To help inform the selection and design of S-CRF products for NZ cropping systems, Ballance commissioned a Plant & Food Research study to identify nutrient supply requirements for wheat, onions and potatoes.

The study used a modelling framework to generate a suite of crop nitrogen (N) and phosphorus (P) uptake curves under different production scenarios. The scenarios used weather data from 1990 to 2015 and included crops established in autumn and spring across Canterbury and Pukekohe under dryland and irrigated management. For N uptake, the modelling also accounted for soil N supply accounting for low, medium and high background N supply scenarios. **Figure 2** shows an example of the N uptake data generated for the irrigated and dryland winter wheat scenario.

Overall, results indicated that an array of slow-release fertiliser options would be required to meet representative N and P supply requirements for wheat, onions and potatoes. Data from the study is being used to inform the use of existing product lines and to assist in developing new products.

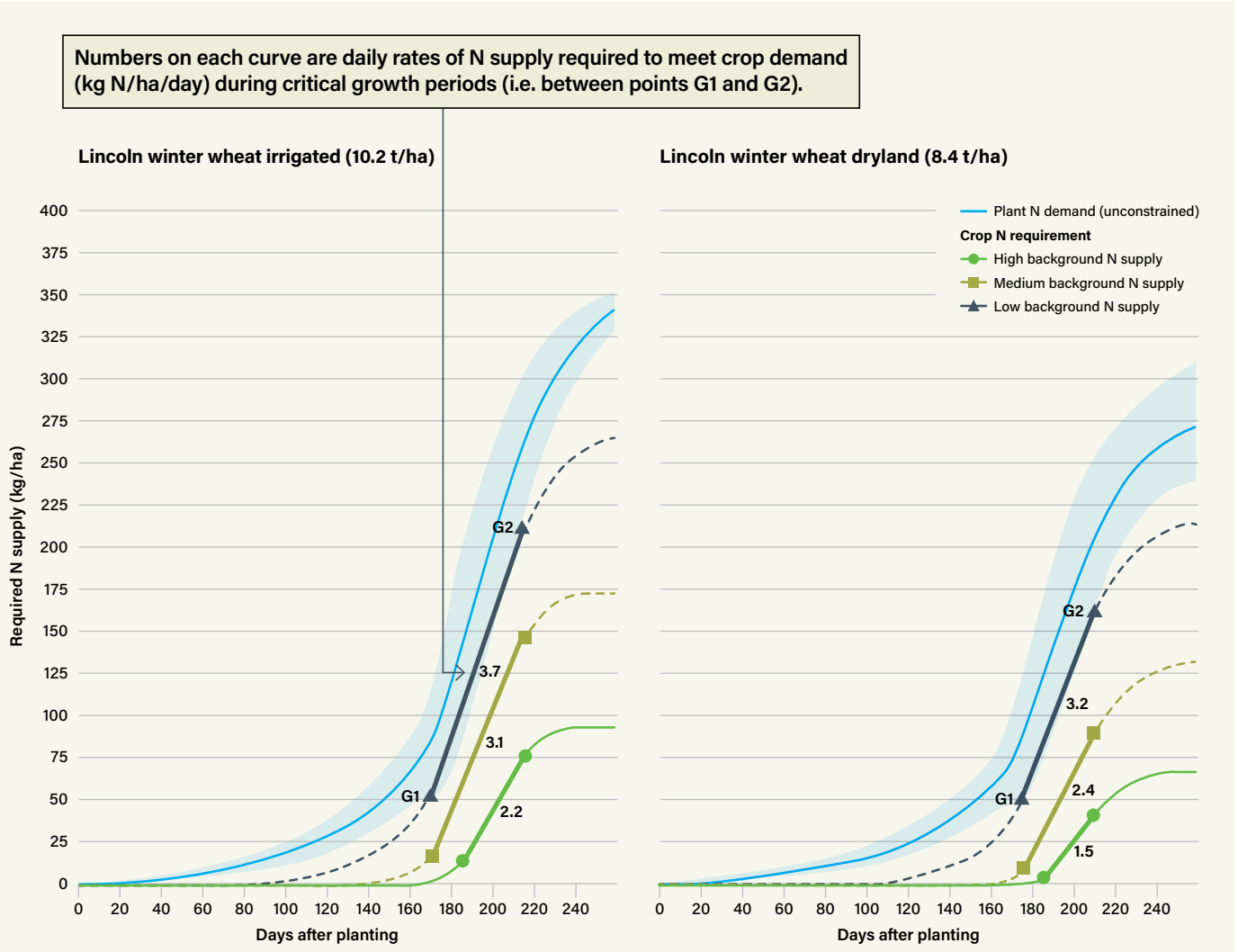

Figure 2 **Example of modelling outputs for Canterbury winter wheat scenarios**

Winter potatoes

Ballance commissioned Plant & Food Research to establish a field trial to evaluate the effectiveness of slow and controlled-release fertiliser (S-CRF) products on a commercial winter potato crop in the Northern Waikato. The trial, in winter 2022, aimed to determine whether applying the entire seasonal nitrogen (N) allocation as S-CRF products at planting could maintain crop yields and improve N use efficiencies.

The five products tested – PlantoSan® (PSN), solid urea formaldehyde (UFS), liquid urea formaldehyde (UFL), Nutricote® (NC) and Proscape EXPO® (PSC) – were contrasted with a control grower (CG) treatment where N was applied at planting and in side dressings.

At final harvest, results indicated N supply was significantly constrained in the S-CRF product treatments compared to the CG treatment (**Figure 3 A**). However, this did not significantly reduce yield for the UFL and NC treatments, but it did for the PSN, UFS and PSC treatments (**Figure 3 B**). Fertiliser use efficiency was low across the trial, although higher in the CG treatments compared to the S-CRF treatments, reflecting incomplete N release from the S-CRF products.

Findings highlighted that while S-CRF products have potential, further work is required to derive or design products with N supply characteristics better suited to winter potato production.

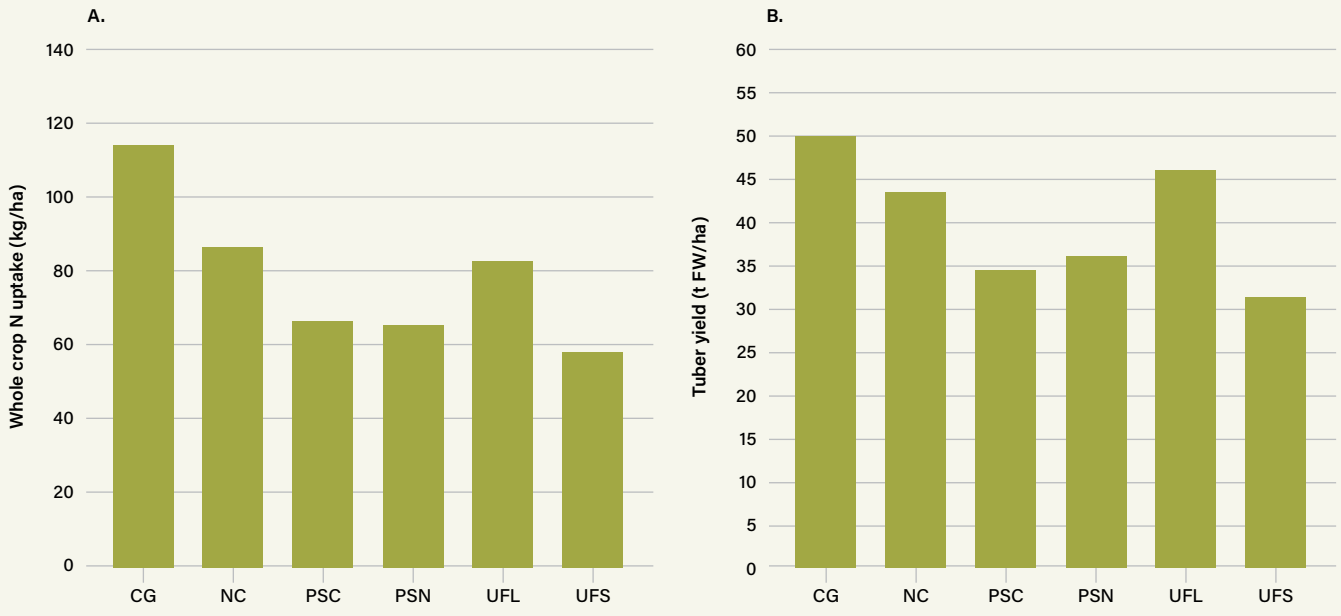

Figure 3 **Harvest results from the potato S-CRF trial including (A.) whole crop N uptake and (B.) tuber yields**

Does foliar nitrogen work?

A Plant & Food Research field trial at Te Puke examined foliar potassium nitrate (KNO_3) as a partial substitute for soil applied nitrogen (N) in kiwifruit production. The study sought to determine the effects of foliar KNO_3 on fruit size, quality and pest insects.

In 2023, control (0 N) and foliar KNO_3 treatments (up to 25 kg/ha of N) were applied to 'Hayward' and 'Zesy002' cultivars. Canopy vigour was included in the treatments in 2024 (as high vigour canopies may need more N to maintain growth).

Foliar KNO_3 appeared to not affect leaf N concentrations, fruit size (**Figure 4**) or quality, nor thrips survival or reproduction. This suggests foliar KNO_3 is of limited use as an N source for commercial kiwifruit production in the Bay of Plenty. Further work is required to optimise ground application rates and methods of application in high and low vigour cultivars.

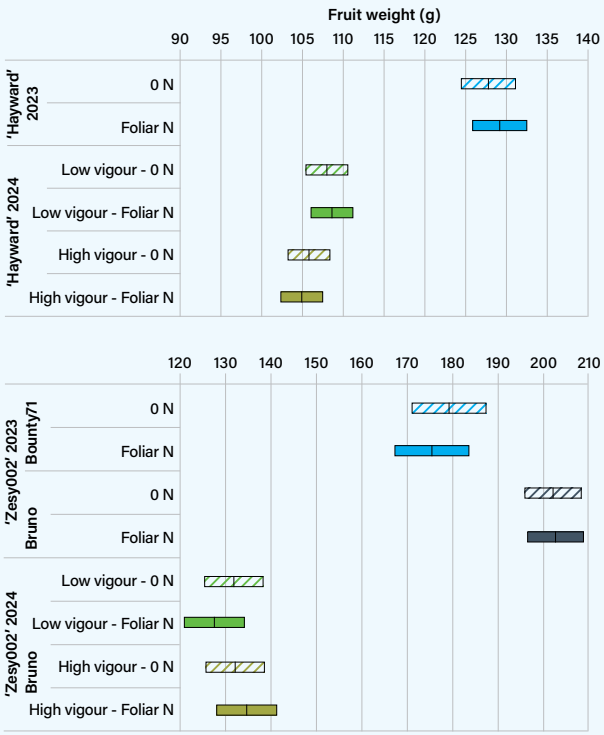

Figure 4 **Weight of 'Hayward' and 'Zesy002' fruit harvested in 2023 and 2024.** Data bars represent the 95% confidence intervals and the vertical line in the centre of each bar is the mean value.

The right information to optimise nitrogen use

New Zealand cropping systems often have to balance nitrogen (N) requirements to maximise production and profitability with the environmental risks of an oversupply of N. Reliable, meaningful estimates of soil N supply can help to refine fertiliser N inputs and achieve this balance.

To help inform N management decisions, Ballance commissioned Plant & Food Research to review the tests commonly used to assess soil N supply in NZ cropping systems: the Mineral N test, the Nitrate 'quick test' (QT) approach, the Anaerobically mineralisable N (AMN) test, and the recently developed Potentially mineralisable N (PMN) test (as shown in **Figure 5**).

Best practice recommendations generally include assessing both current mineral N content and future N supply, but uptake of soil N testing appears to be variable, and uncertainty around test selection and application persists.

The review synthesised and critiqued current soil N testing approaches, so as to encourage wider adoption of soil N testing across NZ cropping systems. It also addressed practical questions around test method applications and the implications of more recently developed test approaches on nutrient management recommendations. The full review is available on the Farmed Landscapes Research Centre (FLRC) website at bit.ly/3OYy7Yb.

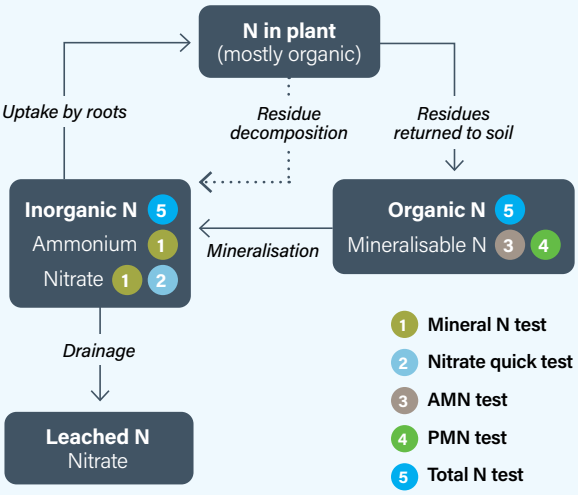

Figure 5 **Simplified soil nitrogen (N) cycle and tests used to quantify soil inorganic and organic N pools**

BallanceEx Future Farming

Plant & Food Research Rangahau Ahumāra Kai

We hope you found this Innovation Update interesting and valuable. For any questions or enquiries, please email innovation@ballance.co.nz.

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