Ballance agri-nutrients

Together, Creating the Best Soil and Feed on Earth

Grow

South Island

Spring 2020

Contents

Ballance agri-nutrients

Ballance Agri-Nutrients is one of New Zealand's leading fertiliser manufacturers. A 100 percent farmer-owned co-operative, the company has over 19,000 shareholders and sells around 1.7 million tonnes of product each year, representing a turnover close to $900 million. Its products include imported and locally manufactured fertilisers, the majority of which attract a rebate for shareholders.

ballance.co.nz
0800 222 090

Super Air

Since its inception in the 1980s, Super Air has evolved into one of New Zealand's leading agricultural aviation companies. In addition to aerial fertiliser application, Super Air has developed a world-class reputation for aircraft engineering and innovation. Wholly owned by Ballance, Super Air services most of the North Island.

superair.co.nz
0800 787 372

SealesWinslow

SealesWinslow is a recognised leader in the production of high-performance compound feeds and feed additives. A fully owned subsidiary of Ballance, SealesWinslow has manufacturing sites located in Morrinsville, Ashburton and Wanganui, and supplies custom-blended pelletised feed to farmers throughout New Zealand. It also provides molasses feed blocks, feed supplements and additives.

sealeswinslow.co.nz
0800 287 325

A fine balance

A careful approach to nitrogen will balance yield with protein content in crops such as malting barley.

"Nitrogen (N) is important for driving cereal crop yields, but for malting barley it must be very carefully managed," says Ballance Science Extension Officer Aimee Dawson.

Malting barley is used to make beer, and growers' contracts stipulate protein content must be under 12 per cent. It is mainly grown near malting plants in the Canterbury, Hawkes Bay and Rangitikei-Manawatu areas.

If all other nutrients are optimum, then in cereal crops such as malting barley N is the main driver of grain yield. By improving tillering and stem elongation, and keeping the leaf green, applying N ultimately results in higher yields.

"But N can also increase the protein content of the grain, so for malting barley it's important to carefully manage N fertiliser to maintain grain protein in the appropriate range," says Aimee.

Refining N

"Refine fertiliser N inputs by doing a Mineral N (or deep N) test before crop establishment."

This test determines readily available forms of N in the soil, which go towards meeting malting barley's total N requirement of 15-18 kg N/T of grain.

"Malting barley always needs N at sowing to aid good establishment, with two-thirds of its total N requirement applied at sowing."

Applying N fertiliser at sowing and during early growth stages encourages tillering, leading to strong plant growth and early canopy cover, and limited potential for secondary tillers later. If high application rates are needed, these early applications can be split, but must be applied by GS 22.

"The last N application should be no later than early stem extension (GS 31). Some farmers do a second mineral N test or use the Yara N-Tester (see page 11) before the last N application to further refine the fertiliser application rate."

The amount and timing of N will depend on the crop yield, mineral N test results and whether the crop is dryland or irrigated.

Useful products for malting barley

"Products such as Cropzeal 16N, Cropzeal 20N and Actyva S are ideal for sowing with malting barley as they incorporate N with phosphorus and other essential nutrients such as potassium and sulphur," says Aimee.

For N side dressings, SustaiN is the preferred product to use when 5-10 mm of rain (or irrigation) is not likely to fall in the 8 hours after application. SustaiN contains urea granules coated with Agrotain, an N stabiliser that reduces N loss via volatilisation by 50 per cent compared to uncoated urea. This means more N is retained in the soil for use by the crop.

If sulphur is also needed in the side dressing, Advance SOA or urea-based YaraVera Amidas can be used. Both are compound fertilisers, consisting of even granules, manufactured to be as uniform as possible, making them easily spread.

FOR MORE INFORMATION

Contact your Ballance Nutrient Specialist.

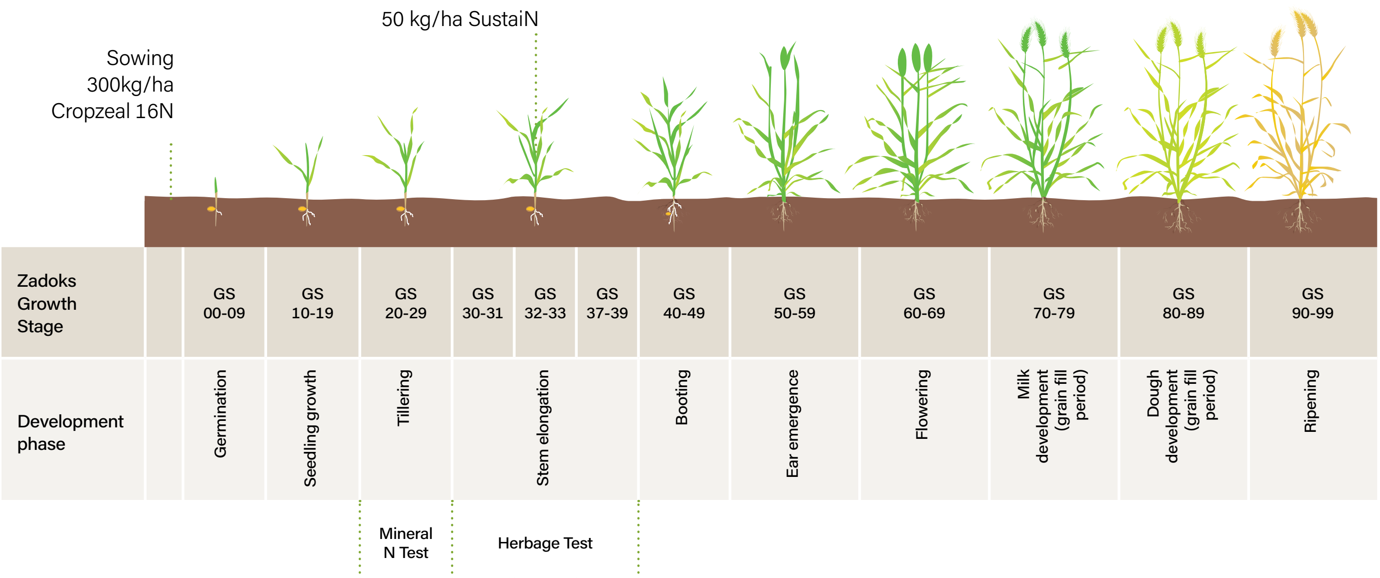


Figure 1 **An example of a typical malting barley recommendation assuming yield is 8T grain/ha and mineral N was 60 kg N/ha.**

Boosts for clean energy

Great news for a Ballance partnership project and a cleaner, greener future.

An innovative $50 million project using renewable energy to produce low-emissions fertiliser and zero-emission transport fuel is making headway.

Ballance Agri-Nutrients' partnership project with Hiringa Energy has received two major boosts this year. The project will harness wind energy to power Ballance's Taranaki-based Kapuni fertiliser plant as well as a green hydrogen plant.

The project received almost $20 million from the Provincial Growth Fund in March 2020, which Ballance CEO Mark Wynne says will be instrumental for advancing the next phase of the project.

More positive news followed with the announcement that global trading and investment enterprise Mitsui & Co. will also come on board. Hiringa Energy and Mitsui & Co. signed a strategic alliance to jointly pursue hydrogen-related commercial projects in New Zealand in June 2020.

This means the project can benefit from Mitsui's considerable experience in large scale energy development and investment, and the expertise, capital and international connections Mitsui brings.

As a result of the project Ballance's ammonia-urea plant at Kapuni will be powered by renewable energy from wind turbines and will manufacture 'green' nitrogen fertilisers with a very low emissions profile. The Kapuni plant is New Zealand's largest producer of nitrogen-rich fertiliser.

"As a farmer-owned co-operative, with more than 18,500 shareholders around the country, Ballance Agri-Nutrients has a strong focus on Kaitiakitanga – the concept of guardianship and protecting the natural environment. This is why the project also represents another important major step for us towards reducing our environmental footprint across the board, for the benefit of future generations," says Mark Wynne.

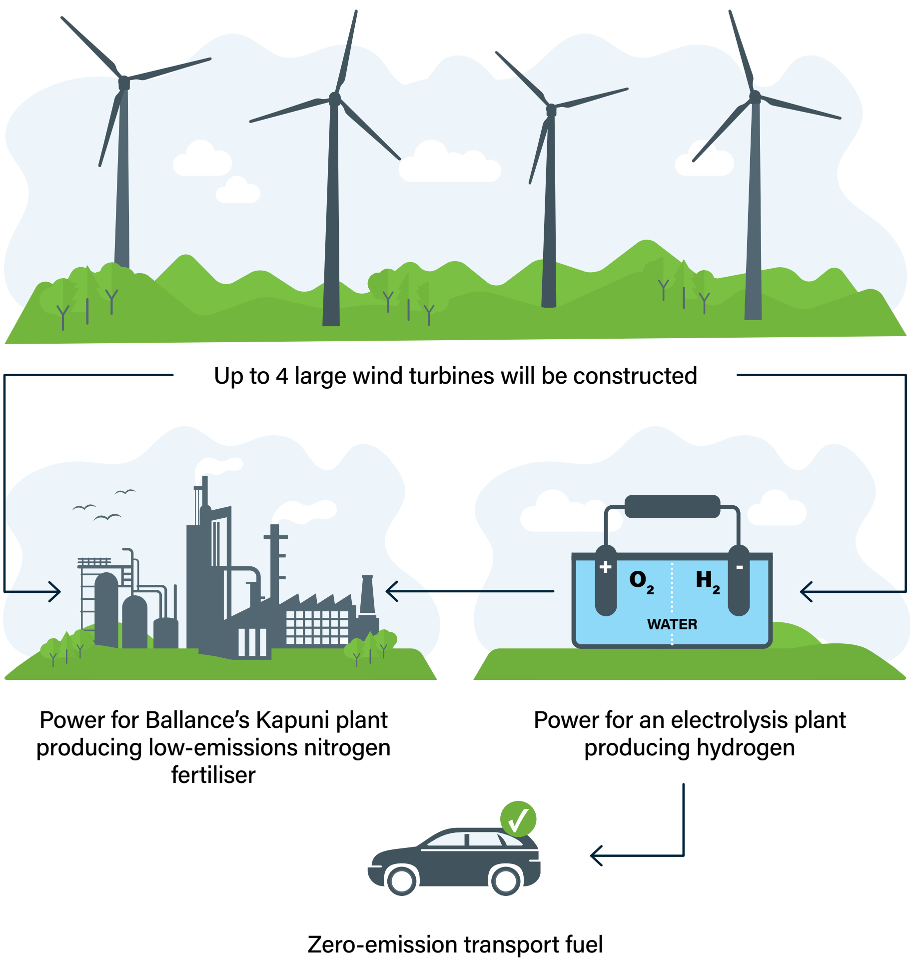
Reducing our environmental footprint

- For Ballance, the manufacture of green ammonia-urea will offset up to 12,500 tonnes of carbon emissions and avoid the import of 7000 tonnes of urea from the Middle East and Asia. Production of green urea would eliminate the equivalent amount of carbon dioxide as taking 2600 cars off the road.
- The project is expected to provide a foundation for a hydrogen market in New Zealand so that, as a nation, we can start more aggressively taking carbon and other pollutants out of heavy transport, and develop other high-value uses for green hydrogen in our economy as part of our low-emissions future.

Ballance CEO Mark Wynne at the Kapuni plant

Deputy Prime Minister Rt Hon Winston Peters announcing the Provincial Growth Fund investment

The investment of $19.9 million from the Provincial Growth Fund will help to futureproof Ballance's Kapuni plant as one the largest employers in South Taranaki, and will provide additional employment opportunities during construction and as the hydrogen market develops.



The clean energy project based at Ballance's Kapuni plant in Taranaki

Green hydrogen

- Green hydrogen is produced from renewable electricity and water, through the process of electrolysis (producing hydrogen and oxygen).
- Hydrogen has the highest energy content of any common fuel (by weight). A hydrogen fuel cell car can refuel in 3-5 minutes and travel up to a range of 600-800km.
- When used in a fuel cell, hydrogen can enable zero-emission transportation (and recombines hydrogen and oxygen to make water).
- For commercial and heavy transport, hydrogen is a zero-emission solution that enables high availability, payloads and range.
- Green hydrogen is complementary to the electrification of transport in New Zealand, with the potential to reduce emissions from heavy transport, industrial processes and chemical production.

Plantain power

Despite originating from a humble weed, modern plantain cultivars pack a powerful punch.

Plantain's potential environmental benefits, coupled with its high nutritional value, make it an increasingly appealing crop.

"Plantain is useful for supporting milk production or for finishing sheep and beef, and if it's important to you, could also reduce nitrogen leaching and greenhouse gas emissions," says Ballance Forage Specialist Murray Lane.

Research underway into plantain's ability to reduce nitrogen leaching has found that the nitrate concentration in the urine of cows grazing plantain was approximately 50 per cent lower than those grazing ryegrass and clover, and 33 per cent lower than those grazing 50/50 pasture-plantain[1].

AgResearch scientists have also found that plantain can help reduce emissions of the greenhouse gas nitrous oxide. A study found that in autumn and winter, nitrous oxide emissions were 39 to 74 percent less where plantain was planted, compared to perennial ryegrass[2].

"Like ryegrass, plantain suffers in summer drought, but its coarse, fibrous root system helps it last into the drought and to respond quickly after summer-dry conditions. This is assuming it hasn't been overgrazed, which affects its crop vigour and longevity," says Murray.

Plantain grows throughout New Zealand, but does not do well in heavy clay soils or those prone to waterlogging. In warmer moist regions it can provide valuable summer feed when pasture quality is poor. It can be grown as part of a mixed pasture, or as a standalone break crop in a pasture renewal programme.

Harness the power

"Even though plantain can tolerate a wide range of soil types, pH and fertility, treating it as you would high value pasture, gets the best from it," he says.

Test soil to a depth of 15 cm, six months before establishing plantain in spring. If sowing plantain as part of a pasture renewal programme, fertility and pH issues should be addressed well before the pasture goes in, as lime in particular takes time to take effect.

"Early weed control is difficult if establishing a crop of plantain and clover, as sprays designed for plantain will kill the clover."

Using a starter fertiliser such as DAP at sowing supports early growth, providing both phosphorus and nitrogen to drive vigorous establishment. Drill around 150 kg DAP/ha with the seed if the drill has a fertiliser box, or 250-300 kg/ha if broadcasting.

If established as a two to three year crop, applying 25-30 kg nitrogen (55-70 kg SustaiN/ha) after each grazing will be useful to maintain crop vigour, especially if weed control has killed off clover.

If it is sown in a mixed pasture sward, less nitrogen will be required because of the presence of clover. Plantain can be used to fill holes in pasture (the result of winter grazing damage), instead of allowing them to fill up with annual weeds and summer grasses.

"Good fertility and early weed control is key, along with drilling with DAP at no more than 10-12 mm deep. And don't forget to apply nitrogen after grazing."

FOR MORE INFORMATION

Contact your Ballance Nutrient Specialist.

"Early weed control is difficult if establishing a crop of plantain and clover, as sprays designed for plantain will kill the clover."

[1] Tararua Plantain Project [accessed July 2020] https://www.dairynz.co.nz/about-us/regional-projects/tararua-plantain-project/

[2] Plantain shows potential for reducing greenhouse gas emissions [accessed July 2020] https://www.agresearch.co.nz/news/plantain-shows-potential-for-reducing-greenhouse-gas-emissions/#:~:text=Plantain%20shows%20potential%20for%20reducing%20greenhouse%20gas%20emissions,-29%20March%20 2018&text=Using%20an%20alternative%20plant%20type,emissions%2C%20AgResearch%20scientists%20have%20found.

Replacing what you reap

Replacing the nutrients removed by hay or silage keeps soil fertile and productive.

When hay or silage is harvested, large amounts of nutrients needed for ongoing pasture quality and productivity are also removed.

Nitrogen (N) is removed in the greatest amounts, followed by potassium (K) and phosphorus (P) (see Table 1). Hay removes less K than silage as it is harvested at a more mature stage, when herbage K levels are lower.

If hay or silage is fed out where it was grown some nutrients are unevenly distributed back into the soil via dung and urine, but if it's fed out elsewhere or exported off farm all its nutrient value goes with it.

Either way, nutrients need to be replaced, in addition to regular maintenance fertiliser requirements. Paddocks that continue to be cropped without doing so can deteriorate over time and become vulnerable to undesirable species such as flat weeds, brown top and poa.

Potassium, removed in the greatest amounts after N, is especially important for post-harvest clovers, which take some time to recover from being shaded out by grasses. If any nutrient is in short supply clovers suffer first as their root system is shallower than ryegrasses' making them a poorer competitor for nutrients. Lack of K can easily limit clover growth, which in turn can affect longer term pasture production and quality and N supply.

Soil testing annually provides an accurate picture of soil fertility status and nutrient requirements. Herbage analysis is also useful when multiple cuts are taken from a crop.

Nitrogen is best added strategically during the crop's growing season. Applying it when the paddock is first shut up aids dry matter response, and gets the paddock back in the grazing rotation faster. If more than one cut is taken, applying N together with maintenance fertiliser after each cut, aids recovery and improves the yield of the next cut.

If Quick K test is under 5, apply K before the paddock is shut up, otherwise apply it post-harvest. Post-harvest K applications can be split if large amounts of K are required to replace K removed and/or achieve the desired soil test range, or if winter leaching is a risk.

Avoid overapplying K, as growing plants take up excess K without converting it into extra growth, elevating herbage K levels. This could reduce the return on fertiliser investment, if potentially elevated K herbage levels in conserved feed and/or regrowing pasture are removed as hay, or silage is harvested.

If Olsen P levels are optimal (20-30 for sedimentary soils or 35-45 for peat soils) maintenance P can be applied at any time. If Olsen P is below optimal, apply P when the paddock is shut up.

Ensure sufficient sulphur (S) is applied annually, and magnesium (Mg) may also be needed if soil test levels are below optimal (8-10). Molybdenum can be checked via herbage testing and applied as required.

Pasturemag Hay & Silage has been developed specifically to replace nutrients removed in hay and silage, and supplies N, P, K (as well as S, Mg and calcium).

Pasturemag 10K is a general purpose fertiliser which supplies N, K, slow release phosphate, sulphur, magnesium and calcium and is typically applied at 500-600 kg/ha.

FOR MORE INFORMATION

Pasturemag Hay & Silage is currently available in the South Island only. For more information, contact your local Ballance Nutrient Specialist.

Table 1 **Average nutrient removal rates (kg/T DM)**

<table>
<tr><th>Nutrient</th><th>Hay</th><th>Silage</th></tr>
<tr><td>Nitrogen (N)</td><td colspan="2">20</td></tr>
<tr><td>Potassium (K)</td><td>15</td><td>20</td></tr>
<tr><td>Phosphorus (P)</td><td colspan="2">5</td></tr>
<tr><td>Sulphur (S)</td><td colspan="2">3</td></tr>
<tr><td>Magnesium (Mg)</td><td colspan="2">2</td></tr>
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Precise benefits

Number crunching has revealed the potential agronomic and economic benefits of using SpreadSmart technology.

Applying fertiliser precisely using SpreadSmart technology provides higher returns than a fixed flow rate, according to scenario modelling.

In the modelling, applying phosphate (P) using either SpreadSmart option (see box) provides better gross margins than a fixed flow rate using standard spreading technology (see Figure 1).

A key benefit of the variable rate application is ensuring the correct rate goes onto easier, most productive areas. These areas are normally the engine that drives the farm's productivity, so maintaining or building their soil fertility is important.

Applying a lower rate to these easier areas will mine them and compromise the soil's ability to maintain ryegrass or clover in the sward in the longer term. Lower fertility grass species can outcompete ryegrass and clover, particularly for P, resulting in a shorter growing season and lower feed quality.

Variable rate application also creates the opportunity to consider lime application to only the most responsive areas, hence obtaining the best responses and improving the economics of its use.

Utilising variable rate is particularly beneficial in summer-dry hill country, or properties where there are large variances in productivity or soil fertility.

FOR MORE INFORMATION

SpreadSmart is available exclusively through Ballance's aerial topdressing company Super Air throughout the North Island. Contact Super Air on 0800 787 372 or email reception@superair.co.nz.

For more on the economics of SpreadSmart, see *The development of variable rate application of fertiliser from a fixed wing topdressing aircraft* at bit.ly/2O05aM2

SpreadSmart variable rate application

SpreadSmart provides a variable flow of fertiliser from the plane, at a:

- **variable ground rate**, based on soil fertility or stocking rate, or a
- **constant ground rate**, applying a uniform rate of fertiliser to the ground, taking into account the plane's speed.

Figure 1 The benefits of applying P using SpreadSmart technology

The three scenarios modelled are all based on:

- a farm with a mosaic of land class: 1/6 easy (zone 1), 2/3 steeper (zones 2-5) and 1/6 hilltop/stock camp/fertile (zone 6), and non-productive exclusion zones
- identical amounts (108 kg) of total P applied (and stocking rates and maintenance P required)
- a plane flying from zones 1 to 6, reducing in speed as it climbs

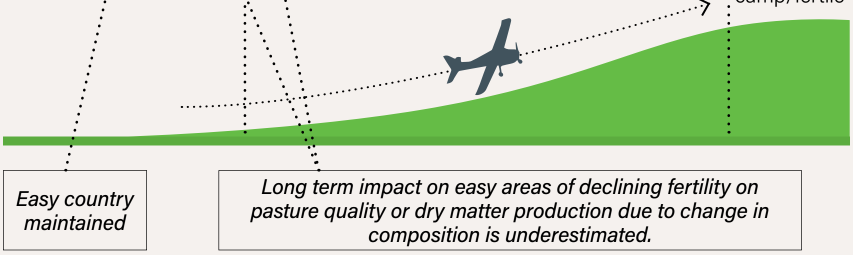
The fixed flow rate scenario has a +/- 20% variation in the actual rate of application.

Overlapping fertiliser spread patterns prevents gaps, so that all parts of a zone receive fertiliser. The scenarios modelled assume GPS tracking is used, and that the bout width and spread pattern are good practice. Fertmark fertilisers and Spreadmark certified aircraft are recommended.

Penalised by fertiliser applied over the whole grazed block

P applied (kg/ha) | Annual soil P | Gross margin

Zone	1 (easy)	2 (steeper)	3 (steeper)	4 (steeper)	5 (steeper)	6 (hilltop/stock camp/fertile)	Gross margin
Fixed flow rate							$119.28
P applied (kg/ha)	15	16	17	19	20	21	
Annual soil P	-14	6	7	8	10	-17	
SpreadSmart variable ground rate							$180.56
P applied (kg/ha)	29	19.75	19.75	19.75	21.25	0	
Annual soil P	0	10	10	10	10	-38	
SpreadSmart constant ground rate							$123.06
P applied (kg/ha)	18	18	18	18	18	18	
Annual soil P	-11	8	8	8	8	-20	



Magnesium for animal health

Research is looking to unlock the potential of magnesium fertiliser for animal health.

A farmer-initiated research project has provided valuable insights for future research into the use of magnesium (Mg) fertiliser for animal health.

In New Zealand, dairy cows traditionally receive Mg supplements by dusting pasture or hay and silage, drenching, water trough treatment and lick blocks before and during calving to prevent hypomagnesaemia (Mg deficiency).

"Using Mg fertiliser to improve soil Mg content, and in turn pasture content, can provide dairy cows with the Mg they require. But lower soil temperatures in winter and early spring, when animals most need Mg, can mean levels of herbage Mg content fall below those required for animal health," says Ballance Science Extension Officer Aimee Dawson.

Canterbury farmer Andrew Barlass was keen to see if a rapid uptake Mg fertiliser might overcome the issue of low herbage Mg content in early spring, as well as provide more consistent amounts of Mg delivered to cows than achieved by dusting magnesium oxide on feed. He had read about kieserite, a Mg fertiliser commonly used in horticulture and containing 16 per cent soluble, fast-release Mg. Andrew approached his Ballance Nutrient Specialist with the idea, and kindly offered Dalkeith Farm in Methven as a location for small plot trials to test it.

Testing the idea

Kieserite was applied to plots of autumn saved pasture on 8 July and 8 August 2019, at varying rates of 0, 25, 50 and 100 kg Mg/ha. Monthly herbage tests were taken over spring (August to November) to determine uptake of Mg, and before and after soil tests were taken to determine changes in soil Mg.

Notable results from the trial were:

- Kieserite applied in July did not significantly increase the Mg pasture content compared to the control (0 kg Mg/ha) in the monthly herbage tests from August to November.
- Kieserite applied in August at both 50 kg Mg/ha and 100 kg Mg/ha significantly increased herbage Mg content. Only the 100 kg Mg/ha treatment increased the herbage into the animal health range (>0.2%), however this was not until November.
- As the soil temperature increased over spring, the herbage Mg content also increased, with highest values seen in November.

In summary, the trial found that the kieserite applied in late winter (July and August) did not sufficiently increase the pasture Mg content into the animal health range for early spring grazing. This is due to the cooler soil temperatures experienced at Dalkeith Farm reducing Mg uptake into the pasture.

Future directions

"This trial involved just one location and year, and further research over multiple years and at different locations will determine if kieserite applied in late winter could increase Mg content sufficiently for animal health purposes," says Aimee. Previous trials completed in warmer North Island climates were able to increase Mg pasture content into the animal health range, so location (and soil temperature) play a key role in early spring pasture Mg content.

"It's possible that in cooler climates, kieserite or other Mg fertilisers applied in autumn may improve the uptake of Mg into the herbage, providing higher Mg in those autumn saved pastures for spring grazing."

Current advice

The recommended Mg level for stock health is Quick Test 25-30, but as this trial has shown, lower soil temperatures in locations with cooler winter conditions can still limit early spring pasture Mg levels. Direct animal supplementation is still the best option for achieving animal health outcomes during early calving and lactation, and more research is required to determine the benefit of kieserite application in late winter for animal health outcomes.

FOR MORE INFORMATION

Contact your Ballance Nutrient Specialist.

Ballance Nutrient Specialist Charlotte Field collects herbage samples from the trial plots to determine Mg uptake.

Behind healthy water

Professor Troy Baisden looks at the key drivers of lake and waterway health.

New Zealanders care about water quality, but last year's Government consultation showed the topic can be contentious. You may have tuned out, but if you were a fish or about to go for a swim, you'd care. And that's the point of water quality – looking after the health of everything in our lakes and waterways.

Let's first imagine being in the water, perhaps fishing, swimming, paddling or gathering food. In that case, the contaminants we need to worry about are faecal pathogens, like the campylobacter that wreaked havoc in Havelock North in 2016. We've learned a lot during the coronavirus crisis about the risks of coming into contact with pathogens.

For water testing, *E. coli* provides a simple low cost indicator of possible contamination risk. High levels mean that even wading creates a risk of getting sick. At near zero levels, water is drinkable. In between, there's a level at which swimming is considered safe. When it rains hard, surface runoff into rivers and lakes can make swimming risky for a couple of days.

The other key contaminants matter most to fish, and what they eat. Life in streams can cope well with natural levels of sediment, but too much can be a major problem in waterways. In many areas, the water quality debate has shifted from sediment to nutrients – phosphorus and nitrogen.

Nutrients in waterways can become too much of a good thing. At low levels, nutrients fuel the algal growth that feeds aquatic life, but increasing nutrients beyond that produces excess algae, often seen as slime.

Excess algae consume oxygen at night and when they die and rot in the water. This unseen loss of oxygen can make water unliveable for iconic fish like trout, and many native species including kōura. The recorded ranges of many species are declining but the best and easiest single measure of healthy water may be the abundance and diversity of invertebrates – all the critters that a fish might like to eat.

By looking at how big the range of life in the water is, the Macroinvertebrate Community Index (MCI) provides a powerful measure of freshwater health. When the MCI looks worse than it should, that means working back to understand how nutrients or sediment may have caused the problem.

Identifying where and how to make improvements to freshwater health is getting increasing focus. The big opportunities are to cut down on nutrient losses, and better soak up or buffer nutrients, sediment and pathogens before they reach the water. The biggest challenge is that problems vary from place to place and so do successful strategies for improvement that can be built into farm plans. Like the rest of farming, it's a great challenge to take on: learn the basics and you'll be hooked?

Troy Baisden, Professor in the Environmental Research Institute at the University of Waikato, Chair in Lake and Freshwater Science and President of the New Zealand Association of Scientists

Ballance's cutting edge-software, MitAgator, is the first tool to singlehandedly deal with on farm nitrogen, phosphorus, sediment and *E. coli* losses. It spatially identifies critical source areas of contaminant losses and finds the best mitigations.

For more information, visit ballance.co.nz/mitAgator, phone 0800 222 080 or email farm.sustainability@ballance.co.nz.

Animal Water Plant Soil

Handy device for wheat

Experiments using a handheld nitrogen reader hold promise for managing N fertiliser for wheat.

Using just enough nitrogen (N) fertiliser to prevent deficiencies in crops helps to optimise yield and return on investment, while minimising N losses to the environment.

But analysis of plant tissues, currently the most widely used way of identifying and preventing nutrient deficiencies in crops, can be time consuming, and the delayed results can hinder timely in-field decision making, especially in rapidly developing crops.

In Europe, chlorophyll meters, such as the Yara N-tester (see box), are used successfully to quickly and easily determine the N status and N fertiliser recommendations of cereal crops.

"As part of Ballance's work in developing new technologies for fertiliser management, we wanted to see if the Yara N-tester could be successfully used on New Zealand wheat, given our different cultivars, soil types and climatic conditions," says Ballance Science Extension Officer Aimee Dawson.

The research

Ballance commissioned Plant & Food Research to test the accuracy of the Yara N-Tester for predicting leaf chlorophyll content, leaf and grain N concentration, and grain yield for the three milling wheat cultivars grown in New Zealand (Discovery, Duchess and Reliance).

Two controlled experiments were conducted during the 2018/19 season.

In the first, each cultivar received six different levels of N (1, 2, 4, 6, 8 and 10 mM concentration of nitrate-N).

In the second, each cultivar received either 0 kg N/ha or 200 kg N/ha. The 200 kg N/ha rate was split into three, with 100 kg N/ha applied at GS 21, 50 kg N/ha applied at GS 32 and 50 kg N/ha applied at GS 39. Nitrogen was applied as urea.

In both experiments the Yara N-tester was used to take chlorophyll readings from the uppermost, youngest fully expanded leaf at GS 21 and GS 32. An additional measurement was taken at GS 39 in the second experiment.

The exact same area tested on each plant was cut out after the chlorophyll reading, so the chlorophyll in each leaf could be extracted, measured and checked against the corresponding Yara N-tester reading.

In the first experiment, the Yara N-tester reading and the extracted chlorophyll measurements were very similar, with the tester reading increasing with N supply. In the second experiment, there were some differences between the Yara N-tester and the extracted chlorophyll, however the overall relationship between the two was still close.

"The research shows the Yara N-Tester can determine the amount of chlorophyll in wheat to detect its N status and N fertiliser requirements, so we're now confident to use it in the field," says Aimee.

Like any test, regularity is key. So testing frequently during stem elongation is important to determine N fertiliser requirements as well as using existing information such as yield expectations, N already applied and soil mineral N tests to refine your N recommendation.

Chakwizira E, 2019. Calibration of a Yara N-Tester chlorophyll meter. A Plant & Food Research report prepared for: Ballance Agri-Nutrients.

The Yara N-Tester chlorophyll meter

How it works

The Yara N-Tester measures light transmittance of the leaf at two different wavelengths, and uses the values to calculate the amount of chlorophyll in the leaf. It will only give a number after it has had 30 leaf measurements. The chlorophyll content of a plant is a good indicator of leaf N concentration, and N fertiliser recommendations based on leaf N concentrations have been determined by many field and glasshouse trials.

Nutrients for animal health

Micronutrients in pasture can support stock through key times.

Micronutrient (trace element) deficiencies can limit not only pasture, but also animal production.

While copper (Cu) is needed by both plants and animals, selenium (Se) and cobalt (Co) only affect animal production. Susceptibility to all three deficiencies varies with livestock type and age.

Identifying deficiencies

One of the most accurate ways to check if levels of these three micronutrients are adequate for animal health is by herbage and feed testing. Testing micronutrient levels in blood and tissue samples can be used to determine if adequate levels are in the animal and complement herbage testing.

Micronutrients for animal health can be monitored by doing a mixed pasture test. This test is taken across a transect in a paddock, with all of the pasture sward taken for the sample. The results will demonstrate the nutrient value of what the stock are actually eating. It can also be analysed to measure other feed values such as nitrate-nitrogen levels, protein content, starch levels and other feed quality tests.

Testing is generally timed prior to the micronutrient animal demand to allow time for application of fertiliser. Late spring is the time to test for Co in anticipation of weaning, Se is usually measured in spring before mating and Cu in early April, before peak demand by deer in autumn and winter when pasture is least able to supply it. Levels in the herbage can vary throughout the year based on pasture uptake and growth, so it is important to take this into consideration when analysing the results.

Addressing deficiencies

A well planned fertiliser programme can elevate levels of Se, Cu and Co in pasture to support sheep, cattle and deer through key times. Stock type may influence approach, with different rates of Se and Cu required.

	Selenium (Se)	Copper (Cu)	Cobalt (Co)
Stock most susceptible to deficiency	Cattle	Deer and cattle Deficiency is more common in young stock.	Sheep Weaned lambs are most susceptible followed by ewes.
Symptoms of deficiency	Calves: • born premature, weak or dead • poor growth • white muscle disease Adults: • decreased milk production • infertility • placenta retention	• joint inflammation • bone fractures • osteochondrosis • loss of hind leg co-ordination (swayback) • chronic diarrhoea in spring (peat scours) • change in hair pigmentation • reduced immunity	• loss of appetite • impaired growth rate • impaired wool growth • crusty ears • watery discharge from eyes • more prone to infections • higher worm burden • anaemia (in severe cases)
Adequate concentration level in mixed herbage test	At least 0.03 ppm Additional animal performance benefits may result from maintaining pasture Se in the range of 0.1-0.3 ppm	Deer: at least 12 ppm Cattle: at least 10 ppm Sheep: at least 5 ppm	Sheep and cattle: over 0.10 ppm

Supplementing pasture to prevent deficiency

Selenium (Se)

NutriMax

Selenium 1%

contains slow release barium selenate and fast release sodium selenate

Maintenance

	Sheep and beef	Dairy and deer
Product rate (kg/ha)	0.5	1.0
g Se/ha	5	10
Timing	annually, spring or autumn	

Graze throughout the year, as Se content is maintained in herbage continually for 1 year post application.

Copper (Cu)

NutriMax

Copper 25%

contains copper sulphate

Capital

Required if mixed herbage levels are under 7 ppm (cattle or deer) or 5 ppm (sheep).

	All stock types
Product rate* (kg/ha)	10
kg Cu/ha	2.5
Timing	autumn

Maintenance

	Deer	Cattle	Sheep
Product rate (kg/ha)	12	10	5
kg Cu/ha	3	2.5	1.25
Timing	every 4-5 years		

Graze stock when Cu levels peak in herbage (1 month after application), so stock build up adequate reserves for the season.

*higher rates needed on deep peat soils

Cobalt (Co)

NutriMax

Cobalt 10%

contains granular cobalt

Capital

Required if mixed herbage levels are under 0.08 ppm (sheep) or 0.05 ppm (cattle).

	All stock types
Product rate (kg/ha)	750
g Co/ha	75
Timing	annually for 5-10 years

Maintenance

	All stock types
Product rate (kg/ha)	200
g Co/ha	20
Timing	October/ November

Graze stock when Co levels peak in herbage (1 month after application), so stock build up adequate reserves for the season.

Vital life of soil

Easily overlooked soil organisms are important for production potential.

Soil's nutrient status is important for producing food, but healthy soil is also physically and biologically healthy.

"The chemical, physical and biological aspects of the soil are all important as they're interrelated. If one's not right it can affect the others," says Ballance Forage Specialist Murray Lane.

"Soil microbes might be miniscule, but they make the difference between soil and dirt. Healthy soil is teeming with life. A teaspoon of healthy soil reputedly holds three to five billion organisms, and soil organisms in 1 ha of land weigh as much as two to three cows."

The roots of a plant pulled out of healthy soil are alive with organisms living, feeding, releasing plant available nutrients, being consumed and ultimately dying in the rhizosphere (root zone).

"Alive and healthy, soil organisms bring tremendous value. They provide ecosystem services that support production potential."

Earthworms, for example, assist with water infiltration and root growth, and also provide soluble nutrients. As they move through the soil they create channels, and ingest soil and organic matter (including dead leaf material and animal dung from the surface) which is ejected as worm castings or dung – fine soil particles, full of bacteria and soluble nutrients.

Fungi attached to plants' roots access nutrients by using long filaments to expand the range of the the roots. These filaments and spores produce a sticky substance called glomalin which contributes to the soil's structure. Glomalin helps the soil form into small clumps called peds, which form the structure of a healthy, free draining, aerated soil.

"Soil microbes might be miniscule, but they make the difference between soil and dirt. Healthy soil is teeming with life. A teaspoon of healthy soil reputedly holds three to five billion organisms, and soil organisms in 1 ha of land weigh as much as two to three cows."

Protect production

"Looking after soil microbes is one way of safeguarding production potential," says Murray.

If soil's not looked after, a large proportion of beneficial microbes die, reducing ecosystem services and production potential.

Four key ways to support healthy productive soil are:

1. Leave it undisturbed (not cultivated). Cultivation destroys peds, disrupts the fungi's glomalin production thus slowing down ped formation. It also upsets the pest/predator balance, potentially resulting in explosions of NZ grass grub, for example. Cultivation also exposes the soil to loss via wind and water erosion and organic matter loss due to mineralisation.
2. Keep soil covered with growing vegetation. This protects the soil, and live roots support soil organisms.
3. Grow a variety of species, as different species support different organisms.
4. Maintain good fertility to enable plants to grow more and produce more waste leaf/root material and to feed more exudates to soil organisms.

FOR MORE INFORMATION

Murray recommends the book "Dirt: The Erosion of Civilizations" by David R. Montgomery.

Life in the soil

Soil organisms include (from smallest to largest) bacteria, fungi, protozoa, nematodes, arthropods and earthworms.

Taking stock of gases

The New Zealand Agricultural Greenhouse Gas Research Centre's Dr Sinead Leahy looks at agricultural emissions.

Almost half of New Zealand's total greenhouse gas emissions (48 per cent in 2018) are from agricultural sources. That's pretty unique – for most developed countries, about 11 per cent of emissions come from agriculture.

Our two main agricultural greenhouse gases are methane and nitrous oxide, and a closer look reveals 92 per cent arise from livestock sources (mainly dairy, sheep and beef) with a further 7 per cent from synthetic nitrogen fertiliser and lime application (see Figure 1).

Methane comes primarily from the digestive system of ruminants, and is produced by 'enteric fermentation.' When microbes in a ruminant's forestomach (reticulo-rumen) break down plant material into nutrients the animal can use, byproducts used by other microbes (methanogens) form methane, which the animal belches and releases to the atmosphere. Methanogens also produce a much smaller amount of methane from manure.

Nitrous oxide emissions come largely from urine patches deposited by ruminants, with smaller amounts coming from dung deposited during grazing, stored manures spread back onto pastures, and from nitrogen fertiliser application. Again, microbes present in the soil act on the nitrogen introduced and produce nitrous oxide. About 1 per cent of nitrogen in the soil, from any source, is lost as nitrous oxide.

What drives emissions

Methane emissions are related to the total amount of dry matter eaten. For predominantly pasture fed livestock, about 21 g of methane are produced per kg of dry matter eaten. This varies only slightly across the typical ryegrass/clover feeds in New Zealand's pastoral systems. Nitrous oxide emissions depend on the total amount of nitrogen going through a farm via feed and fertiliser.

Managing emissions

Right now, it isn't compulsory to know your farm's greenhouse gas number or to reduce your emissions. However, the Government is working with industry and Māori to implement farm-level greenhouse gas measurement and pricing by 2025.

If you want to make a start, understanding your business's greenhouse gas emissions is important. Unless you identify your emissions, you can't assess the effect of management and/or system change. Helpful tools to estimate farm emissions include Lincoln University's carbon calculator and OverseerFM.

Once emissions are known, several on-farm mitigation options are currently available (see Table 1). Striving for further efficiency gains is key.

Implementation on farm isn't as straightforward as we'd like, and what works for one may not work for another. Any management or land use changes made to reduce greenhouse gas emissions also need to consider impacts on the wider system (for example, water quality and animal welfare). So good information on agricultural greenhouse gas emissions is very important for farmers and growers.

FOR MORE INFORMATION

For more on:

- **actions, visit www.AgMatters.nz**
- **the New Zealand Agricultural Greenhouse Gas Research Centre, visit www.nzagrc.org.nz**

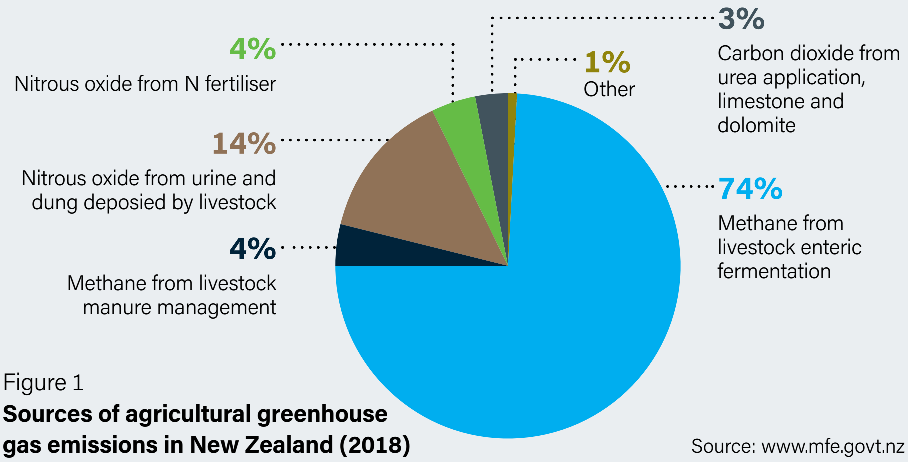


Figure 1
Sources of agricultural greenhouse gas emissions in New Zealand (2018)

Source: www.mfe.govt.nz

Current available now and verified by science	**Potential** available now but further research to fully understand efficacy needed	**Future** under development and showing promise
• Efficiency improvements • Once-a-day-milking • Stocking rate and performance • Reduce N fertiliser and use urease inhibitors • Low emission feeds	• Manure management and storage • Winter housing/stand-off pads • Soil carbon management practices e.g. establishing diverse swards, keeping soils vegetated, modifying grazing regimes	• Breeding low-emitting stock • Methane inhibitor • Methane vaccine • Nitrification inhibitors • Seaweed • Low emissions ryegrass

Table 1 **Practices and technologies for reducing on-farm greenhouse gas emissions**

Playing the long game

When times are tight, is the short term pain of applying phosphorus worth the longer term gain?

Phosphorus (P) fertiliser is vital for farming in New Zealand's naturally P deficient soils, but it's also the costliest fertiliser nutrient, so often the first to go in economically adverse times.

"When funds are constrained, it might seem to make short term financial sense to skip or just partly replace it with half or quarter maintenance amounts. You can do this in the short term so long as your soil test levels are above optimum. But over the longer term, doing this affects production," says Ballance Environmental Management Specialist Ian Power.

"Applying less than maintenance P may not initially impact productivity. But in the longer term as P levels fall below the optimal range, productivity is increasingly affected."

Phosphorus is crucial for plant growth and health, and if it is deficient, desirable pasture species (such as ryegrass and clovers) will decline, making way for an increase in less desirable species (such as browntop and weeds).

Sixty years of science

"Current recommendations are informed by the huge amount of research into New Zealand soils and fertiliser use over more than 60 years. Long term studies have shown that soil fertility and pasture production decline over time when P fertiliser is withheld," says Ian.

A five year study (1983-1988) on Te Kuiti Research Farm[1] compared applying no P fertiliser (after many years of maintenance fertiliser) to applying P fertiliser at 250 kg/ha, and measured the impacts on pasture, clover and Olsen P. Annual applications of P fertiliser maintained pasture production over time, while withholding P fertiliser caused declining Olsen P levels, and a drop in both pasture and clover production (see Figure 1).

A seven year study[2] at Ballantrae Hill Country Research Station also investigated the effect of withholding superphosphate at sites with high and low fertility, based on their P application history. The key results are summarised in Table 1.

Perfecting P

Once the optimal Olsen P range is achieved, maintenance P inputs are required to replace losses so the Olsen P level is maintained (see Table 2). Maintenance P can be applied at any time of the year but applying soluble P fertilisers outside the high risk months of April to October will reduce the risk of P runoff.

Some products also help to reduce P run off risk. Serpentine Super is a phosphate fertiliser containing only a small amount of soluble P, making it ideal for use near rivers, lakes and streams.

FOR MORE INFORMATION

Contact your Ballance Nutrient Specialist for advice on where best to apply P fertiliser if funds do not permit maintenance application across the whole farm.

[1] MB O'Connor, CE Smart and SL Ledgard 1990. Long term effects of withholding phosphate application on North Island hill country: Te Kuiti. Proceedings of the New Zealand Grassland Association 51: 21-24

[2] Lambert MG, Clark DA, Mackay AD 1990. Long term effects of withholding phosphate application on North Island hill country: Ballantrae. Proceedings of the New Zealand Grassland Association 51: 25-28

Further supporting results are in: Gillingham AG, Richardson S, Power IL and Riley J 1990. Long term effects of withholding phosphate application on North Island hill country: Whatawhata Research Centre. Proceedings of the New Zealand Grassland Association 51: 11-16

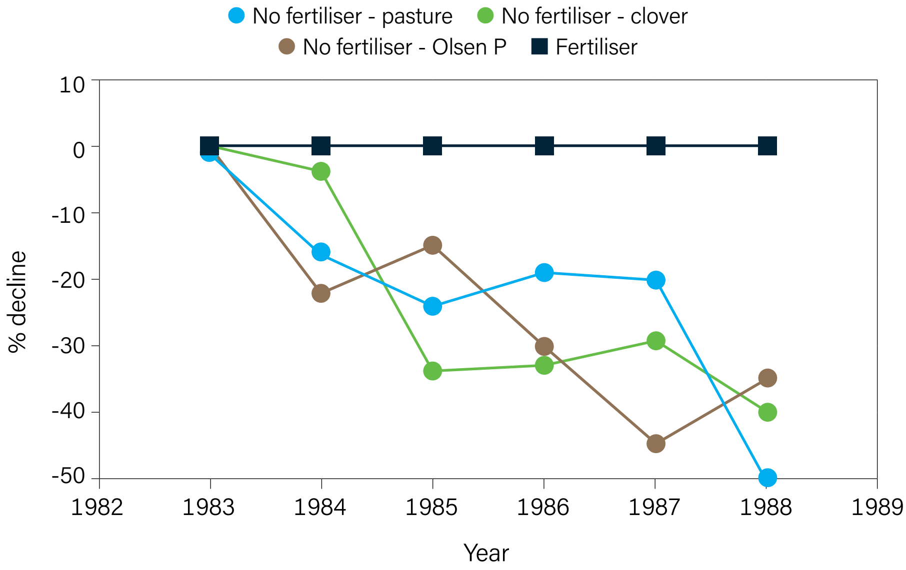


Figure 1 **Effects of not applying P compared to applying it**

Source: Figures derived from MB O'Connor, CE Smart and SL Ledgard 1990. Long term effects of withholding phosphate application on North Island hill country: Te Kuiti

"Applying less than maintenance P may not initially impact productivity. But in the longer term as P levels fall below the optimal range, productivity is increasingly affected."

Table 1 **Effects of not applying P and applying it at low or high rates, on low or high fertility sites**

Site fertility and treatment	Results
No P applied on low fertility site	▪ No effect on Olsen P ▪ Pasture production decreased 1.7% pa compared to low fertility site with P applied (predicted 7 year cumulative reduction of 12%) ▪ Wool production and lamb liveweight reduced
No P applied on high fertility site	▪ Olsen P decreased ▪ Pasture production decreased 4.6% pa compared to high fertility site with P applied (predicted 7 year cumulative reduction of 32%) ▪ Grass decreased, other species increased. ▪ Wool production and lamb liveweight reduced
Low P applied (125 kg/ha superphosphate annually) on low fertility site	▪ No effect on Olsen P ▪ 7 year average pasture production 8.4 t DM/ha
High P applied (375 kg/ha superphosphate annually) on high fertility site	▪ Olsen P increased ▪ 7 year average pasture production 12.9 t DM/ha

Table 2 **Maintenance fertiliser - P requirements and stocking rate**

Stocking rate	Maintenance P requirement (kg/ha)
Sheep and beef (SU/ha)	
7	6-18
10	10-22
13	15-28
16	21-34
19	28-41
22	34-44
Dairy (cows/ha)*	
2	20-28
2.5	27-36
3	34-45
3.5	43-55
4	54-65

*1 cow at 400 kg liveweight producing 290 kg milk solids

Source: Fertiliser Use On New Zealand Dairy Farms and Sheep and Beef Farms booklets, Fertiliser Association of New Zealand

Using soil test results

Soil tests reflect soil's ability to supply nutrients, but what do the results mean?

"Using a professional is the best way to effectively use soil test results, but it's still good to know what the numbers mean," says Ballance Environmental Management Specialist Ian Power.

"Fertiliser is a significant farm expense, and effective use of soil test results means making the most of your fertiliser investment."

Used well, soil test results can help to refine nutrient inputs and ensure fertiliser is providing the right nutrients to optimise production and minimise environmental losses. Applying excess fertiliser wastes money, poses environmental risks and can cause health issues for stock, while underapplying it can result in decreased production and loss of income.

Interpreting results

Like all biological measurements, soil test results can be variable, and this needs to be considered when interpreting them. Regular testing (every two years) over time allows trends in the soil's nutrient status to be identified, which is more useful than a one-off test and can help to make results more comparable.

If soil test trends over time show soil fertility is:

- increasing and nutrient levels are sufficient for the desired level of production, fertiliser inputs can be maintained or in some cases reduced
- declining and current inputs are insufficient to meet nutrient needs, the fertiliser programme should be re-evaluated

Figure 1, an example soil test result sheet, shows:

- pH is below optimum and should be raised to within the range and preferably to 6.0 by applications of lime.
- The Olsen P status is below optimum for pasture growth and should be raised to within the range of 20-30 with a capital application of a phosphate-based fertiliser such as SurePhos (available in the North Island only), Superten or Serpentine Super.
- Potassium is very low and requires a capital application of potassium fertiliser, which could be added as potassium chloride to the capital phosphorus fertiliser application
- Calcium is within the optimum range and requires no more additional applications, as products such as SurePhos, Superten and Serpentine Super will apply enough to maintain this level.
- Magnesium is above optimal for pasture requirements, so only maintenance magnesium is required. However, as animal requirements are higher some magnesium may be needed to raise levels.
- No definitive optimal levels of sodium are available for pasture growth, but at levels of 3-4, sodium is not typically required.
- Sulphur levels are just at optimum and some sulphur may be needed for maintenance. Products such as SurePhos, SuperTen, and Serpentine Super also contain sulphate sulphur, and if applied annually typically supply sufficient for maintenance. However, if capital sulphur is required, fertilisers containing elemental sulphur, such as PastureSure 15S, the Sulphurgain range or PhasedN (in autumn) will help.

"Obviously, soil test results can also help you select the right fertiliser product," says Ian.

FOR MORE INFORMATION

Contact your Ballance Nutrient Specialist to help you use your soil test results to develop a fertiliser recommendation.

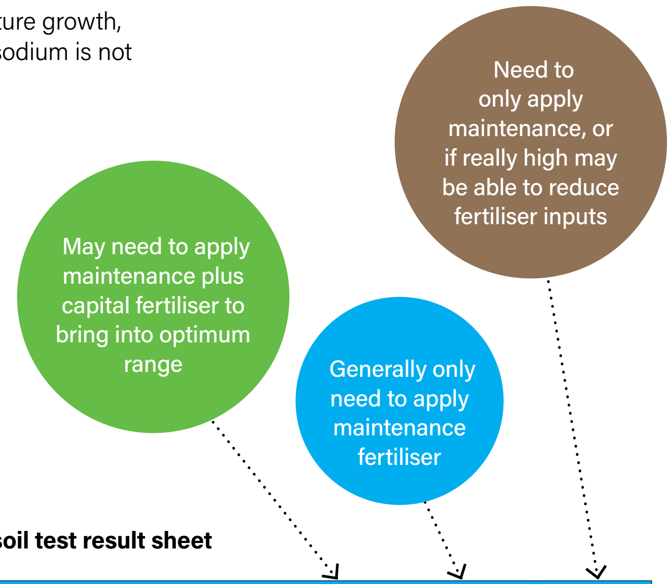


Figure 1 **Example of a soil test result sheet**

Analysis		Level	Optimum	Below	Optimum	Above
pH	pH Units	5.7	5.8 - 6.2			
Olsen Phosphorus	mg/L	17	20 - 30			
Potassium	MAF units	3	6 - 8			
Calcium	MAF units	6	4 - 10			
Magnesium	MAF units	14	8 - 10			
Sodium	MAF units	3				
Sulphate Sulphur	mg/kg	10	10 - 12			
Soil Sample Depth*	mm	0-75				

Ratio or quantity?

Which is the best approach to use for fertiliser recommendations?

Cation exchange capacity (CEC), which is measured in basic soil tests, plays a part in what soil can provide to plants. It is a measure of the soil's ability to bind positively charged cations such as potassium (K), magnesium (Mg) and calcium (Ca), all of which are essential for plant growth.

But is it better to aim for a particular ratio of these three nutrients in the soil, or to ensure they are present in sufficient quantity?

There are two theories on this: a ratio theory and, the theory which Ballance uses, a quantity theory.

Ratio theory

According to the ratio theory – also known as the Albrecht-Kinsey System or the Base Cation Saturation Ratio (BCSR) – the ratio of K, Mg and Ca is important for soil quality, and plant health and growth.

It proposes that plants grow best in a soil with 60-80 per cent of the available cation exchange sites occupied by Ca, 10-20 per cent by Mg and 2-5 per cent by K, with most of the remaining sites occupied by hydrogen, regardless of the amount of each nutrient.

The ratio theory was originally proposed in the United States in the 1940s, and results from preliminary research into it in the 1940s and 1950s have not proved to be replicable, so it lacks robust scientific evidence.

Overseas studies and preliminary findings of local research (see box) into the ratio theory have shown it actually leads to more costly fertiliser recommendations, with no obvious increase in productivity.

An examination of data from numerous studies suggests that the ratios of K, Mg and Ca in the ranges commonly found in soils do not generally influence the chemical, physical and biological fertility of a soil, and concluded that the ratio theory results in inefficient use of resources in horticulture and agriculture[1].

Using the ratio theory could also lead to nutrient deficiencies and overapplication. For example:

- Mg, Ca and K could be present in the prescribed ratio, but at low levels, and without any fertiliser input, production could be impacted.
- Lime could be overapplied if Ca levels were below the required ratio, and this could increase soil pH, creating micronutrient deficiencies, and reduce phosphorus availability and therefore crop yield.

Quantity theory

The quantity theory, which Ballance uses, is based on plants growing best in soils that supply adequate nutrients to meet their needs. As long a minimum quantity of Ca, Mg and K are present, the ratio is irrelevant. This is backed by science.

This theory has been thoroughly tested and calibrated for New Zealand soils. Soil tests such as Olsen P and pH have been calibrated to determine optimum levels to maintain pasture production[3, 4]. Field trials across New Zealand have been completed for each of the soil tests and across different soil types to determine these optimum levels. Similarly, research has been completed on different forage[5], arable[6] and horticultural crops[7].

Soil testing can determine which nutrient is limiting production to enable fertiliser to be applied at optimum rates in line with the quantity theory.

1 Kopittke PM, Menzies NW 2007. A Review of the Use of the Basic Cation Saturation Ratio and the "Ideal" Soil. Soil Science Society of America Journal 71: 259-265

2 Soil nutrient management project [accessed July 2020] http://www.siddc.org.nz/research/soil-nutrition-management-project/

3 Roberts A, Morton J 2016. Fertiliser Use on New Zealand Dairy Farms. Fertiliser Association of New Zealand

4 Morton J, Roberts A 2018. Fertiliser Use on New Zealand Sheep and Beef Farms. Fertiliser Association of New Zealand

5 Morton J, Stafford A, Roberts A 2017. Fertiliser Use on New Zealand Forage Crops. Fertiliser Association of New Zealand

6 Nicholls A, van der Weerden T, Morton J, Metherell A, Sneath A, Craighead M, Stevenson K 2012. Managing Soil Fertility on Cropping Farms. Fertiliser Association of New Zealand

7 Reid JB, Morton J 2019. Nutrient Management for Vegetable Crops in New Zealand. Horticulture New Zealand

Local research

Preliminary key findings from a long term study on a Methven dairy farm comparing the two theories include that the ratio theory required greater fertiliser inputs overall[2]. The nitrogen inputs were lower, which increased clover content, but dry matter grown was similar to using the quantity theory, and the nitrate leaching risks were not reduced by using the ratio theory. In terms of production, both approaches resulted in similar milk yields, but the ratio theory initially had higher costs. After four years both farms had similar financial performance.

Avoid lease land headaches

Including soil fertility in lease land agreements can prevent unpleasant surprises later on.

When land is leased, it is normally expected it will be returned in the same state it was in at the outset. This is fairly straightforward for more obvious features like fences, but what about soil fertility?

Unexpected and difficult discussions can be avoided if both the leasor and the leasee have a shared understanding of the:

- soil nutrient status at the start of the lease
- responsibilities for maintaining soil nutrient status during the lease
- expectations for soil nutrient status at the end of the lease.

Tests over time

At the start of a lease, the ideal is a series of soil test results over multiple years. Soil test results have inherent variability, and results from some soil tests can be more variable than others (such as soil test K). So while one-off soil test results can be useful, they can also be misleading.

Soil test results over several years allow identification of trends in the soil's nutrient status over time. If a series of soil test results is not available, the next best option is to have the soil tested before the lease starts.

Fertiliser history records

Also ideal is a fertiliser application history, which together with soil test trends and a nutrient budget, gives a good idea of the fertiliser strategy required to maintain soil fertility.

If soil test records show fertility has been declining, the fertiliser strategy is likely to have been inadequate, and a capital application may be needed to restore fertility. If so, it should be clear who is responsible for this before the lease agreement commences.

Fertiliser history records are also helpful for agreeing on a maintenance fertiliser strategy for the duration of the lease. Potential changes in land use and production systems, such as changes in stock type or stocking rate, as well as any recent improvements made to the land need to be considered. These changes can affect the rate of nutrient removal, and ultimately fertiliser requirements.

If land leased for cropping is returning to pasture when the lease ends, the agreed fertiliser strategy could be based on the crop's nutrient removal, or on target soil test levels for the subsequent pasture. A nutrient budget would help to support any agreement made on nutrient inputs, and avoid the potential distraction of soil test variability.

It is also a good idea to provide some evidence of what fertiliser has actually gone on (fertiliser type and rate of application) and where, to avoid any potential disagreement around what was applied.

Prepare for the unexpected

Consider what do if the unexpected happens. A flood, for example, could potentially completely change land's fertility, and if it did, who would be responsible for restoring the land? Considering such possibilities when the lease is drawn up provides both parties with more security.

FOR MORE INFORMATION

Contact your Ballance Nutrient Specialist for advice on testing and managing lease land soil fertility.

Get good advice

A lease agreement based on good advice helps avoid acrimony. Just as a lawyer can help with legal advice, your Ballance Nutrient Specialist or trusted farm consultant can provide specialist advice about the soil fertility of the land to be leased and how to best manage it. Both parties should have a clear understanding of their responsibilities and the fertiliser strategy. Ideally, there should be some flexibility, so if key factors change, fertiliser management can respond accordingly.

Boron versus brown heart

Early uptake of boron prevents brown heart in brassicas.

The micronutrient boron (B) is the only element that can prevent brown heart in brassicas.

Boron is deficient in soils across New Zealand, especially in pumice, peat and sandy soils, but deficiency can occur in any soil type.

In brassicas, B plays an important role in the healthy formation of new plant tissue, as well as for flowering and pollination. It is its role in ensuring the structural integrity of cells that helps it prevent brown heart in brassicas, which cannot be remedied once it occurs.

Turnip, swedes and kale are particularly sensitive to brown heart. The main symptoms are rotten-looking (brown and water-soaked) centres of bulbs and skin scaliness (see photos). For kale, stems are internally brown and become hollow.

Brown heart damages cells irreparably, causing them to collapse. Even if the cells were repairable, B is immobile in plants, so cannot move around the plant to overcome deficiency-related problems once they occur.

In order to prevent issues like brown heart, plants need to take up B early in their development. Protection can be achieved if sufficient readily available B is present as early as possible in the crop's lifecycle, at sowing or soon after.

Given that B deficiency is widespread in New Zealand soils, how much B is required to protect brassicas against brown heart and other deficiency-related issues?

Swede science

In a trial on swedes grown in B deficient soils (0.5 ppm B) in Te Anau in Southland, granular B (15 %) applied at a rate of 12 kg/ha was enough to elevate herbage levels above 20 ppm (parts per million) (see Figure 1)[1]. This occurred for the duration of the growing season and largely avoided B-related issues such as brown heart that can develop at lower levels. When granular B was applied at a higher rate of 18 kg/ha, it made little difference to the incidence of brown heart (see Figure 2), but did further elevate herbage levels (see Figure 1).

Stop the rot

Soil testing will determine soil B status, and a B soil test level of greater than 1.1 ppm is sufficient to prevent brown heart rot in brassica crops, according to research carried out by Plant & Food Research[1,2].

Boron deficiency can be overcome by ensuring starter fertiliser includes B. Cropzeal Boron Boost is a compound fertiliser combining B in every granule (as highly soluble, plant available sodium borate), with nitrogen and phosphorus. It can be applied as a starter fertiliser at a typical application rate of 250 kg/ha to provide 12.5 kg of granular B equivalent (1.8 kg B/ha). As the trial on swedes indicated, this is sufficient to overcome most B deficiencies that are likely to be encountered in brassicas.

Another option is using a granular boron such as NutriMax Boron 15%. It can easily be added to a mix and blended (12.5 kg/ha) with DAP or other starter fertiliser to provide the same amount.

FOR MORE INFORMATION

Contact your Ballance Nutrient Specialist.

[1] Gowers RC, Bulter RC, Armstrong SD 2004. Boron fertiliser trial with swedes: Report prepared for Ballance Agri-Nutrients by Crop and Food Research

[2] Bulter RC, Armstrong SD 2004. Boron fertiliser trials with swedes and kale: Report prepared for Ballance Agri-Nutrients by Crop and Food Research

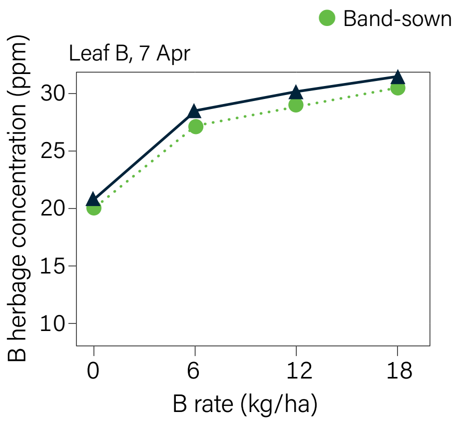


Figure 1 **April B herbage concentration at varying rates of granular B**

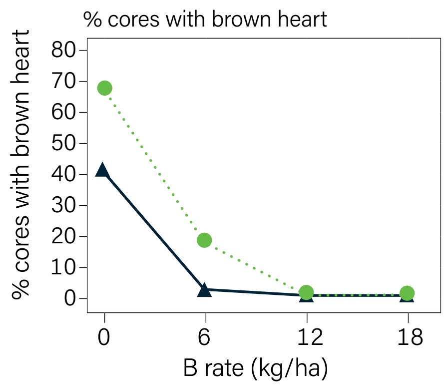


Figure 2 **Percentage of swede cores with brown heart**

Skin scaliness

Brown heart

Leading new thinking

BallanceEx Future Farming

BallanceEx events bring together farmers and rural leaders across New Zealand to focus on the future of farming, providing an opportunity for thought leadership and exchange of ideas. This year's events featured success stories on incorporating land use diversification and indigenous biodiversity into farming.

Passionate about soil health

We need to manage soil health so we can sustainably produce food as well as protect the environment, says the University of Waikato's Prof. Louis Schipper.

He says soil structure can help to reduce nutrient loss and erosion. The right soil structure keeps nutrients in the top soil, and stops nutrient from leaching into groundwater. Good infiltration (the ability of water to enter soil) stores water for plant use and lessens erosion due to water flowing over the surface of land.

The biggest issues he sees on productive land are nutrient levels not being matched to plant needs, and a decline in macroporosity (the big holes in the soil) due to compaction.

Soil health – physical, chemical, and biological – is important for every landowner to be aware of, and is a matter of knowing what shape your soil is in and the applying the appropriate management practices.

Right use, right land

Craigmore Sustainables manages dairy, grazing, forestry and horticultural properties spread over both islands and more than 15,000 ha.

Chief Executive Ché Charteris says Craigmore's philosophy of land use diversification started early, and was driven by finding what is right for the whenua.

Over time, this philosophy has not only seen them through volatile commodity prices. It has also provided experience in multiple crop types, strengthening their ability to match the right use to the right piece of land into the future.

In the future Ché sees more market segmentation, such as greenhouse gas-friendly, plastic free or calf-friendly dairy products, to meet market demand.

FOR MORE INFORMATION

Watch these and other BallanceEx interviews at ballance.co.nz/Ballanceex

The University of Waikato's Prof. Louis Schipper and Ballance Nutrient Science Manager Dr Sheree Balvert

Ballance Innovation Leader Jamie Blennerhassett talks with Ché Charteris from Craigmore Sustainables (right)

Correction to Grow Autumn 2020

In the article 'Detainment for good' on page 3, the figures for the average load reduction achieved by detainment bunds were incorrect due to a data error. Corrected figures are that results indicate "detainment bunds capture around 55 per cent of the annual phosphorus load and 58 per cent of the annual suspended sediment load of storm water, depending on soil drainage conditions."

Submission on biodiversity

Ballance Agri-Nutrients made a submission on the Government's proposed National Policy Statement for Indigenous Biodiversity in March 2020.

Ballance supports the core intent of the policy to "halt further loss and degradation of indigenous species, habitats and ecosystems" throughout New Zealand, and understands the importance of tackling this issue nationally, with farmers and landowners playing their part.

The proposed policy sets out a framework to identify and manage our most significant natural areas (SNAs). Under the policy, regional councils would identify SNAs and work with landowners to manage them and ensure no further degradation or loss, and identify priority SNAs (including wetlands and degraded SNAs) for active restoration and enhancement.

Regional councils would also need to ensure that at least 10 per cent of both rural and urban land area in their region is covered by indigenous vegetation.

The main points in Ballance's submission include:

Managing immediate threats to biodiversity

The policy's goal could be undermined if widely present, rapidly increasing pest species are not first reduced or eradicated.

A prioritised approach to resourcing biodiversity management efforts:

- **Priority 1: Halt decline** - focus on immediate threats e.g. pest species
- **Priority 2: Maintain** - focus on long term pressures e.g. extensive grazing on native tussock land
- **Priority 3: Improve** - focus on restoring and enhancing e.g. restore degraded wetlands

Ambiguity in overall policy

Unclear wording may create confusion in interpretation by the various groups required to implement it.

- Provide clear national direction and guidance.
- Establish national priorities and targets for indigenous species protection and enhancement.
- Ensure alignment with other policies (Essential Freshwater, Predator Free 2050, regional pest plans etc).

Resourcing and expertise

Shortage of specialist knowledge to correctly assess and devise management plans for every SNA.

- Establish a national ecological steering group of experts and relevant stakeholders to advise on priorities, programmes and assessment criteria.
- Prioritise resources towards the most nationally critical areas.
- Define clear responsibilities for resourcing and funding the restoration and enhancement of SNAs.

Managing SNAs

The policy could have a grandparenting effect (penalise landowners with a history of conservation and good practice and reward those with little biodiversity).

- Set 1990 as a land use and restoration baseline to reward those who have protected areas since then.
- Consider potential for rates charge or relief, based on habitat loss or enhancement respectively.

Increasing indigenous vegetation cover

National targets for afforestation do not consider regional variation in landscape or land use intensity.

- Calculate requirements for percentage cover by region, based on national priorities and targets for specific vegetation types/ habitats.
- Consider regional variations in economic impacts on farmers if they have to retire land.

The Government is currently considering the submissions it received. A summary of submissions is expected to be released in late 2020, along with the ministers' decisions version. The timeframe for final delivery of the policy has been extended to April 2021.

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Key Ballance's comment Ballance's recommendation

Ballance agri-nutrients

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