

BEEF



**Financial benefits
from using
LIME IN NORTHLAND**

Why use lime?

The most important benefit of liming is that it **increases pasture production**. Increases in pasture production lead to increases in animal production – as **liveweight gain** or as **increased milk solids**.

Lime:

- **increases the activity of soil organisms**, which in turn increases the mineralisation of organic matter, releasing nitrogen
- **encourages earthworms**, which have beneficial effects on soils – from the breakdown of dead plant material, improved soil aeration, increased water holding capacity and improved water infiltration rates.

Liming **stimulates vigorous clover growth** – probably through an increase in the availability of **molybdenum** essential for nitrogen fixation.

Molybdenum is a critical trace element needed for maximum rhizobial activity for fixing nitrogen.

Liming helps **overcome aluminium toxicity** in soils. Aluminium toxicity inhibits root growth which can lead to a major restriction in short-term pasture growth – but, more importantly, can be a cause of longer-term lack of plant persistence.

Liming encourages **better pasture utilisation and more even grazing**. Through changes in sward species composition, liming increases the palatability of pastures to stock.

Many old-time farmers say: “Lime sweetens the grasses my stock are eating.”

Liming continues to be effective in the long term. While this will depend on application rates, benefits from higher rates of lime (e.g. 3 to 4 tonnes per hectare) can last up to 5–6 years.

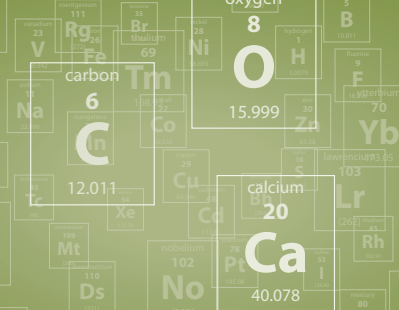
Liming to an optimum pH increases the **availability of important nutrients** – phosphorus, nitrogen, potassium, calcium and magnesium; plus trace elements, like molybdenum and boron.

The calcium in lime can help **break up clay particles**, improving both **soil structure** and **soil aeration**.

Liming increases the **base saturation of the soil**, creating more opportunity to retain nutrients (calcium, magnesium and potassium, etc.) in the soil. If the base saturation of the soil is low to very low, a significant proportion of any fertiliser applied may be lost through nutrient leaching and runoff into waterways.

$$\text{Base saturation} = \frac{\text{Amount of basic cations}}{\text{Cation exchange capacity (CEC)}}$$

Basic cations are calcium ions, Ca^{++} ; magnesium ions, Mg^{++} ; potassium ions, K^{+} , and sodium ions, Na^{+} . If basic cations don't occupy cation exchange sites, then hydrogen ions, H^{+} , will, causing acidic soils.



Results from using lime in Northland

Improvement in pasture production from increases in pH from applications of lime, are the same in Northland as the rest of the country.

The major points relating to increasing pasture production resulting from lime applications are:

- what the starting point pH is – the lower the pH starting point, the greater the response
- what rate of lime is applied (e.g. 1 or 3 tonnes of lime per hectare).

Northland trials have shown that by knowing the initial soil pH, responses to lime may be predicted with good accuracy – but there will be some variation, depending on soil type, climate and quantity of lime applied.

Pre-liming soil pH	% response
5.0	10.0
5.2	7.5
5.4	6.0
5.5	5.5
5.6	3.8
5.7	3.5
5.8	2.0
5.9	0

Comprehensive, on-farm trial results in Northland through the 1990s show that:

- if soil pH is close to or above 5.9, the improvement in annual pasture production will be modest or negligible

Raising the pH from 5.8 to 5.9, the increase in pasture production is just 2% ...

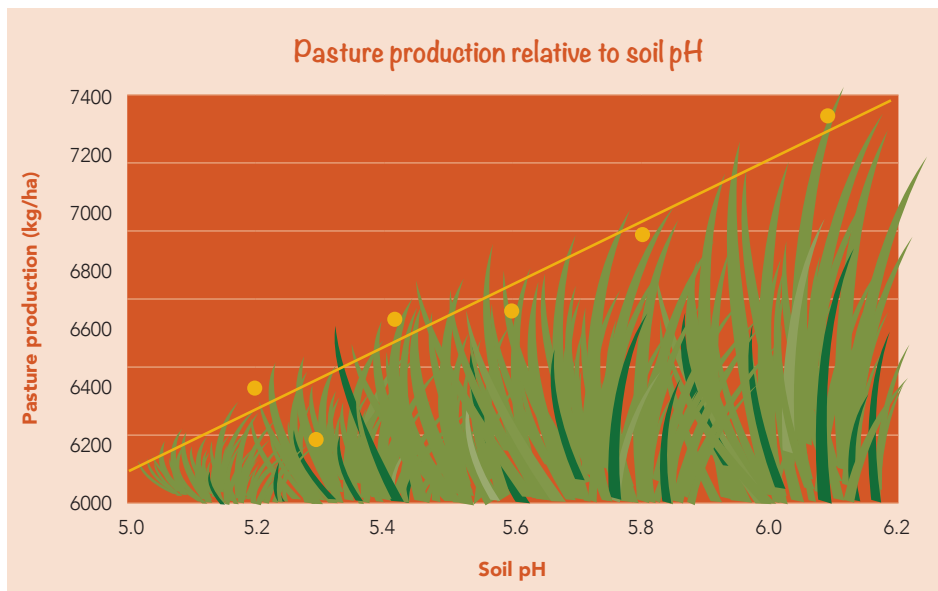
- if soil pH is low, then the improvement in annual pasture production is high to very high.

Raising the pH from 5.0 to 5.9, the increase in pasture production is a whopping 10%!

Liming trial results – Waiotira, Northland

Waiotira, between Dargaville and Whangarei, is typical Northland beef and sheep hill country.

Waiotira is not only a district, but it is also a soil type.



The graphed data clearly show the positive responses to lime application; the trials also showed that:

- the quicker the pH could be raised to the optimum level (pH 6.0–6.2), the better pasture growth response
- low rates of lime applied annually when the pre-liming pH was just 5.2 were not as beneficial as larger, once-only applications – because they had little effect on pH.





Financial returns from using lime

The financial analysis that follows is based on various assumptions.

Assumption 1

Average pasture production is 8,500 kg dry matter per hectare per year

Pasture production of course varies tremendously throughout Northland, due to major differences in climate, soil type, soil fertility, pasture species and contour.

Assumption 2

Starting point pH is taken as a (relatively) low 5.4.

The Northland research shows raising pH from 5.4 to 5.9 gives a response of 6% per year for a 4-year (or possibly 5-year) period.

Assumption 3

85% of the extra pasture grown is utilised.

85% is the **expected utilisation figure** for pasture grown throughout a year.





Financial benefits from using lime

Pasture production

Base pasture production is 8,500 kg DM/ha/year.

A 6% increase in an annual pasture production of 8,500 kg DM/ha, gives 510 kg DM/ha/year extra growth; over a 4-year period, this amounts to **2,040** kg DM/ha.

$$8,500 \text{ (kg DM/ha per year)} \times 0.06 \text{ (6\%)} \times 4 \text{ (4-year period)} = 2,040$$

Feed conversion

85% pasture utilisation of 2,040 kg DM/ha over a 4-year period gives:

$$0.85 \text{ (85\%)} \times 2,040 = \mathbf{1,734} \text{ kg DM/ha}$$

A critical factor in feed conversion into kg of meat is the growth rate of the beef animal there will also be slight differences (e.g. 10%) in feed conversion between steers, heifers and bulls.

For example, for a 300 kg steer:

- **very rapid** growth – 1.5 kg per day (1.5 kg LWG/day) – results from just 6 kg DM producing 1 kg of liveweight gain
- moderate growth – 0.5 kg LWG/day – results from 12 kg DM producing 1 kg of liveweight gain
- **slow to very slow growth** – 0.25 kg LWG/day – results from 18.2 kg DM to produce 1 kg of liveweight.



$$\frac{1,734 \text{ kg DM/ha}}{8.8 \text{ kg DM to produce 1 kg liveweight}} = 197 \text{ kg meat production}$$

Thus a beef animal that grows fast not only gets to killable weight quicker, it also makes the most efficient conversion of pasture to meat!

Cattle liveweight growth rate of **0.75** kg/day and feed conversion efficiency of **8.8** kg DM to produce 1 kg liveweight are **averages** for **300 kg steers**.

Note that the analysis:

- ignores the long-term advantage from an improved legume content and its associated improvement in feed quality – of particular importance with younger cattle
- ignores the seasonality of the lime response
- ignores any interest costs associated with lime application.

Improved legume content and thus better feed quality also of particular importance for lambs.

The Northland research showed major pasture growth response being in late autumn, winter, early spring period – the dollar value of extra feed this time of year is generally far greater than extra feed in summer.



Beef development — Lime and superphosphate

Trial work at Kamo, over a 3-year period, showed a 45% improvement in pasture growth by the third year from joint applications of lime plus superphosphate.

It was not until the third year that a suitably high pH (of 5.8) was reached from the extremely low starting point of pH 4.7.

Other results — Other soil types

A combination of lime and superphosphate being superior to either on its own applies to all Northland soils ...

Kaipara clay — Ruawai district

A trial on Kaipara clay in the Ruawai district, Olsen P 16, showed improvements in pasture growth from lime despite an already very good starting point pH of 5.9. When lime alone was applied at 5 tonnes/ha in Year 1, an increase of 20% pasture production was measured.

The increase in pasture production was attributed to the lime rendering phosphate already present in the soil more available to plants – this effect is called a **phosphate sparing effect**.

Kaipara clay — Dargaville

A Dargaville property on the same Kaipara clay showed a similar phosphate sparing effect. With a starting pH of 5.5 and Olsen P of 15, there was:

- a 15% increase in dry matter response to phosphate alone
- a 16% response to lime alone
- a 25% response to phosphate and lime together.

The **phosphate sparing effect** is known to operate in Kaipara clays and similar soils, but its presence is unknown on other Northland soil types since no trial work has been done to date.

It is very likely that the response to lime of Kaitaia and Waipu clays will be the same as was shown for Kaipara clay, since they are all the same soil type.

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