Northland Pastoral Extension: Popular Summary

# Lime Responses

NORTHLAND NATURALLY
FIRST REGION OF NEW ZEALAND

Sustainable Farming Fund

## Summary of Key Findings

- Calcium carbonate reacts with the acids in the soil and in this way increases soil pH.
- Northland's calcium carbonate levels in limestone deposits are a little lower than the rest of the country.
- Responses to lime differ over the four main soil types found in Northland – yellow brown earths, brown granular clays, red and brown loams and yellow brown sands.

## What have we got?

A chemical analysis of a range of sample of limestone from Northland was as follows:

| | % | | ppm |
|---|---|---|---|
| Calcium carbonate | 60-75 | Copper | 14-27 |
| Silica | 15-30 | Cobalt | 10-14 |
| Iron | 0.6-1.1 | Manganese | 100-600 |
| Magnesium | 0.1-0.15 | Molybdenum | 0.2-0.8 |
| | | Zinc | 22-39 |
| | | Cadmium | 3-5 |

The silica in lime is an inert material and has very little agricultural value. The other elements such as molybdenum, copper and cobalt are often required either for pasture production or to improve animal performance. However the low concentrations of these elements means that a normal application of lime at 2.5 tonnes per ha would supply less of these elements than the requirement to correct a deficiency of that element.

## Lime for Pasture Development

Lime is needed on almost all soil types in Northland for pasture establishment in addition to phosphate, sulphur, molybdenum and occasionally potash and copper. The initial objective should be to obtain a pH of at least 5.8 and this would be achieved by, in most cases, an application of 5-7 tonnes per ha of lime applied in a single application.

## Optimum pH Levels

The optimum pH for pasture production is 5.8 to 6.0. On the coastal sandy soil there is some evidence that excessively high pH levels of 6.5+ can induce deficiencies of copper and boron that could adversely affect animal production.

## Frequency of Lime Applications

The frequency of lime applications can be determined from soil test results and for most soil groups in Northland an application of 2.5 tonnes per ha every 4-6 years will maintain the soil pH level. Annual applications adding up to same total amount do not provide any advantages, so it is more economical to apply lime less frequency at the heavier rate due to less application costs.

The research work also indicates that the different soil groups in Northland respond to lime in a similar way in terms of lifting the pH level. For all soil groups therefore to lift the pH level by one point requires 1 tonne of lime per ha. It takes up to 12 months or more for the maximum lift in pH status to be achieved. Pasture responses to lime tend to be seasonal and most of the additional pasture growth occurs in the summer autumn and winter.

## Lime Interactions with Other Elements

Separate and additional benefits can be gained by way of interaction with other elements principally aluminium and manganese. Aluminium toxicity is often associated with acid soils. The limited trial work done in Northland on Marua clay with pH status of 5.2 gave pasture responses of 10-13% by the use of lime. The aluminium levels were above the threshold for Al toxicity and the response achieved to lime applications was partially due to a reduction in the Al levels in the soil.
Manganese is very rarely above the threshold. Thus it is unlikely that Mn is a factor limiting pasture production in Northland.

Liming is able to make some elements more available to the plant, such as molybdenum. As the pH level improves soil molybdenum is more available to the plant and molybdenum deficiency on some soils can be overcome by liming. The possibility that lime can make phosphate more available is of particular interest. The trial work on this has given inconsistent

results. One recent trial in Northland on a Kaipara clay soil indicated that a phosphate sparing affect was measured as a result of applying lime at a pH of 5.9. This effect was due to lime mineralising N and allowing plants to grow better and explore more soil and uptake more P. It is possible that this effect could occur on the other similar marine soil types in Northland.

## Lime and Organic Matter

Mineralisation of organic matter by soil microorganisms is one of the ways by which inorganic N is made available for plant growth. Many laboratory studies have shown the beneficial effect liming has on the mineralisation of organic matter. Only limited work has been done, but nevertheless indications are that lime will be beneficial in this way on many Northland soils. (Limed soils are more readily able to absorb moisture after an extended dry period).

## Lime and Soil Moisture

There is evidence from several trials some of which were done in Northland that lime can result in increased soil moisture levels, especially after rainfall in March-April period. The reason for this may be due to the fact that lime reduces the hydrophobic conditions generated by the organic matter formed by herbage senescence over the summer period.

## Soil types and lime responses

The multitude of soil types that can be found in Northland can be classified into four main groups as follows.

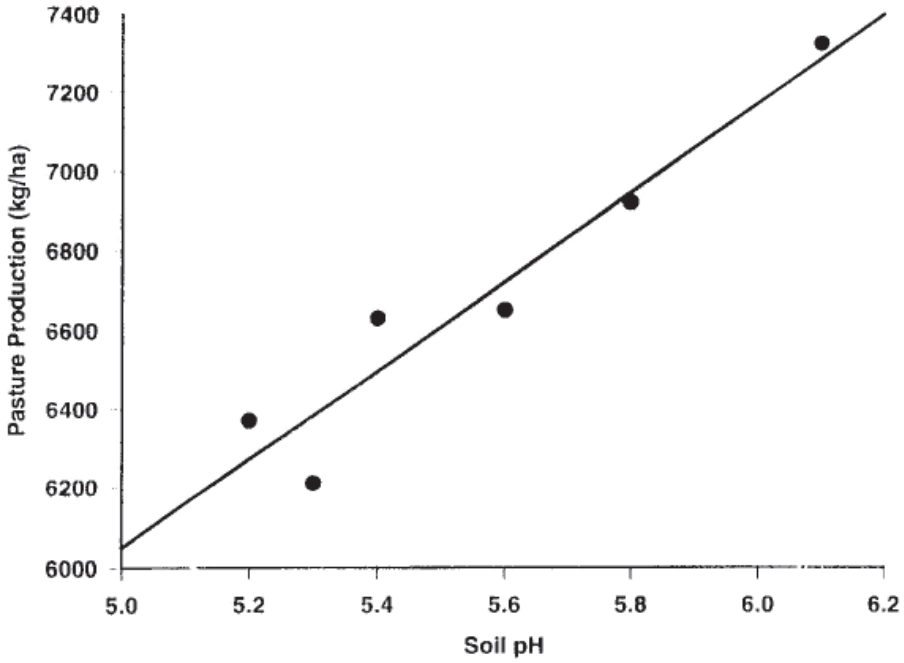
| Soil Group | | Area ha | PR% |
|---|---|---|---|
| Yellow brown earths | YBE | 560,000 | 20-40 |
| Brown granular clays | BGC | 240,000 | 50-60 |
| Red and brown loams | RBL | 77,000 | 60-70 |
| Yellow brown sands | YBS | 40.000 | 30-40 |

*Note: PR-phosphate retention*

Some of the notable results to trial work carried out with lime of the different soil types in Northland is summarised below:

## Yellow brown earths

- The response on average to lime in a Waiotira trial was 100kgDM/ha for every 1000kg of lime applied per ha, and the response did not decline at the highest rate of lime.
- The quicker the pH was raised to 6.0 the greater the response.
- Pasture production response to the lime was greatest during the autumn/winter/early spring period.
- Data indicates that to lift the pH level by one point on this soil type requires about 800 to 1000kg lime per ha.




## Brown granular clays

- On the steep land soils lime is beneficial, but probably not economical if Mo is applied and the pH levels are usually above 5.5.
- On the easier country lime and Mo are needed for maximum pasture production.
- Lime is definitely needed where pH levels are below 5.5 but if Mo is applied on a regular basis less lime is needed.
- In all cases if Mo use is considered pasture samples are needed to confirm the need for Mo and to avoid inducing copper deficiencies.

## Red brown loams

- Results indicate that provided pH is 5.8+ then near maximum pasture production is achieved with an Olsen P of 25-30.
- Pasture response to lime was about 100kgDM/1000kg of lime applied, and 130-140kgDM/1000kg when applied with phosphate.

## Yellow brown sands

- Maintenance applications of lime would be 1.5-2.0 tonnes per ha every 4-6 years.
- Good responses in trial work to lime have occurred at pH levels of 5.5 and 5.6, a fleeting response at 5.7 and no response with pH levels of 5.8.
- Pastures are responsive to molybdenum, applied every 4-5 years.


Compiled by Colin Page, edited by Hugh Stringleman
A project co-ordinated by the Northland Pastoral Farming Development Group.
The complete research stocktake on Lime Responses in Northland is on the Enterprise Northland website: www.enterprisenorthland.co.nz