



# Applying Lime in East Gippsland's High Country

## Lime application in the High Country

Between 2014-15, a survey was conducted across various agricultural regions in East Gippsland to assess soil fertility, which involved both spatial and temporal analysis. Randomly selected soil samples were taken from 214 paddocks revealing that nearly all the paddocks were acidic, with half being strongly or very strongly acidic.<sup>1</sup>

Further analysis of the resampled paddocks indicated that both slightly and moderately acidic soils are acidifying, suggesting that many paddocks previously less acidic may now be strongly acidic. Generally, soil pH in the region ranges from moderately acidic to strongly acidic, with certain parts of the region having soils that severely limit pasture growth.

In 2016, the TopSoils Project conducted independent tests on various lime types and organised workshops for landholders to discuss the different limes, their neutralising value, appropriate application rates and costs. Although lime pits are available to landholders in Gippsland, those in the High Country incur higher costs, with approximately a 25% increase due to product transportation.

In 2020, Craig Lloyd approached the High Country TopSoils Group about examining the effectiveness of two different limes in dealing with acidic soils. A demonstration site was soon established. The demonstration used locally available Buchan Aglime, which incurs high transport costs, and compared it to pelletised lime. The latter can be purchased in bulk bags and spread by the landholder using a super spreader, resulting in cost savings.

*"Applying super in this region is not always working; applying lime could. That's why we wanted to take part in this trial to find out."*

*"Calciprill is more expensive per kilo, but you apply one-third less and you can do it yourself. You can also drill it in with your seed."*



<sup>1</sup> Recent trends in soil fertility across the farms of East Gippsland  
<https://www.publish.csiro.au/sr/pdf/SR19246>

## The demonstration site



Map 1. Demonstration site plan

Craig and Jane Lloyd's property is located in Reedy Flat, East Gippsland. The demonstration paddock had been planted with phalaris 15 years prior and had a history of acidic topsoil. Surprisingly, a deep core soil sample taken in 2022 revealed a pH of 8.1 (measured using  $\text{CaCl}_2$ ) at a depth of one meter.

The site was established in June 2020, using three treatment strips (Map 1). The lime application rates were determined based on the goal of achieving a target soil pH of 5.8 ( $\text{CaCl}_2$ ) to attain 95% potential pasture production. In 2020, crushed Aglime was applied at a rate of 3 t/ha, while pelletised lime was applied at a rate of 1 t/ha. Following soil testing, an additional 1.3 t/ha of pelletised lime was applied in 2021 to reach the target pH.

Each treatment consisted of six monitoring areas per strip. The monitoring areas were adjacent to each other, so essentially became six replicates or 18 plots. This allowed a paired T-Test to occur. Monitoring of pasture production, feed quality and pasture composition were done randomly within each strip.

## Results

### Soil acidity (pH $\text{CaCl}_2$ )

In 2020, soil test results indicated soil acidity was a constraint to pasture production. The pH ( $\text{CaCl}_2$ ) tested across the paddock ranged from 4.4 to 4.9 (averaged results in Table 1).

In 2021, all treatments areas were significantly different from one another, with soil pH highest from the 3 t/ha application of Aglime (Site A) at 5.1 compared to the control at 4.6. The pH increased further in 2022 to 6.0. The pelletised lime treatment increased pH to 4.7 in 2021 and 5.0 in 2022, which is only 40% of the increase that occurred from Aglime.

The Aglime, at 3 t/ha, is likely to have near 100% coverage but the lower rate of pelletised lime and its larger size means there would be less areas in contact with lime. This therefore affects the soil test results. The untreated area increased slightly and this could be either due to inherent site variability or windblown lime dust movement that occurred during spreading.

At pH of 4.6, production is predicted to achieve about 90% of potential pasture production (Figure 1) assuming there are no other constraints limiting pasture production.

| Site                | 2020 | 2021 | 2022 |
|---------------------|------|------|------|
| A - Aglime          | 4.68 | 5.1  | 6.03 |
| B - Untreated       | 4.55 | 4.6  | 4.72 |
| C - Pelletised lime | 4.5  | 4.7  | 5.02 |

Table 1. Soil pH of site areas in 2020 before lime and in 2021 and 2022 following lime applications to sites A and B.

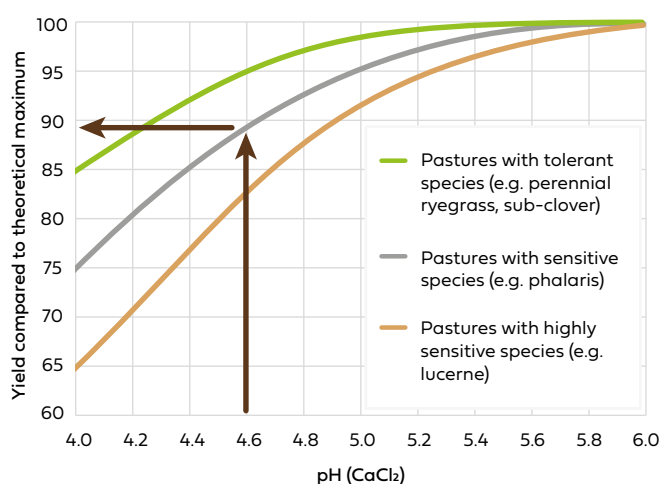


Figure 1. Relative yield at different pH levels for plant species with different sensitivities (Nicholson, 2020)



| Analyte   | Site A | Site B | Site C | Ideal |
|---|--------|--------|--------|-------|
| pH (1:5 CaCl <sub>2</sub> )                     | 5.1    | 4.6    | 4.7    | 5.5   |
| Aluminium (KCl)<br>% of Cations                 | <1     | 4      | 3      | <5    |
| Phosphorus -<br>Olsen (mg/kg)                   | 7      | 9      | 10     | 15    |
| Phosphorus -<br>Colwell (mg/kg)                 | 15     | 16     | 17     | 32    |
| Phosphorus<br>Buffer Index -<br>Colwell (mg/kg) | 47     | 51     | 63     |       |
| Potassium -<br>Colwell                          | 190    | 230    | 330    | 155   |
| Sulphur (KCl40)<br>(mg/kg)                      | 9      | 8      | 12     | 8     |
| Organic<br>Carbon (%)                           | 2.1    | 2.3    | 2.2    | > 3   |

Table 2. Soil test results for clay loam soils of three treatment sites taken in 2021, compared against ideal levels. Analysed by Nutrient Advantage, 2021.

## Pasture quality

The pasture exhibited varying levels of phalaris, ranging from approximately 30% to 70%, with 10% consisting of native grasses. However, the sub-clover content was lacking, likely due to insufficient Olsen P content. Sub-clover persistence becomes problematic when Olsen P levels drop below 8 mg/kg. Although sub-clover can tolerate acidity, the rhizobia responsible for nitrogen fixation become less efficient when the pH falls below 5.0.

The pasture's response to lime application did not yield clear improvements in terms of quality, as evidenced by measurements of pasture composition (Figure 2) and nutritive values (Figure 3). Phalaris consistently dominated the composition in each year's measurements. The high quantity of pasture and its substantial dry matter content, observed in the May 2023 measurements, suggest that excessive debris may have hindered the breakdown of sub-clover hard seeds and subsequent germination.

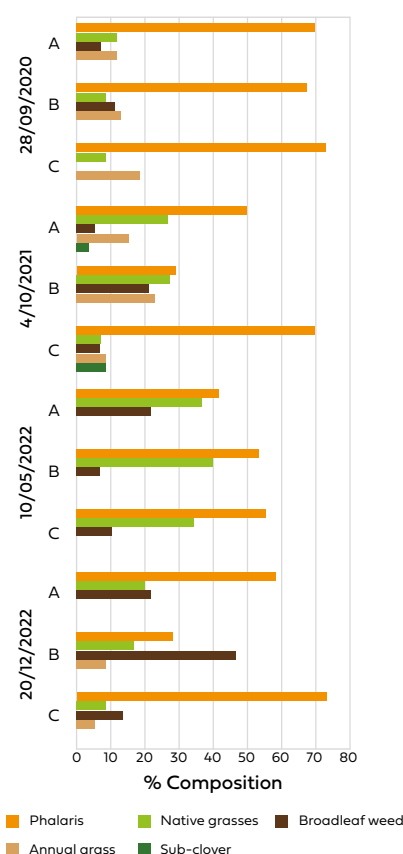


Figure 2. Pasture composition % of different categories of plants at Site A (Ag lime), B (Untreated) and C (Pelletised lime) at four assessment times.

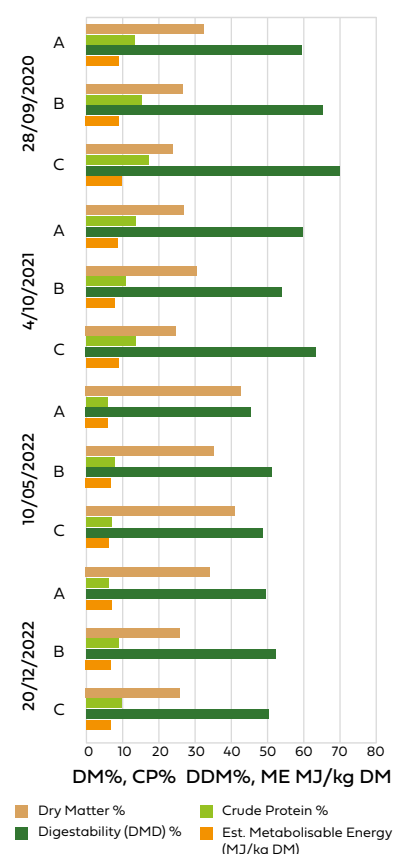


Figure 3. Feed quality results and Estimated Metabolisable energy of pasture composition at Site A (Ag lime), B (Untreated) and C (Pelletised lime) at four assessment times.

In liming trials conducted in south-west Victoria, it was typically observed that phalaris and sub-clover experienced growth while annual weeds decreased. Instances of significant increases in sub-clover content and growth were later attributed to lime's ability to enhance the availability of molybdenum, a critical element for clover and nitrogen fixation.

The initial whole-paddock soil test conducted in 2020 revealed phosphorus levels (Olsen P 5.6 mg/kg) to be significantly below the ideal range. The demonstration aimed to move the Olsen P from 5.6 to 8 to sustain productive pasture. To achieve this, both maintenance and capital rates of phosphorus were applied (as Single Super) in 2020 and 2021.

In 2020, the goal was to move phosphorus from Olsen P 5.6 to 6.6, by applying 160 kg/ha (14 units of P/ha). Soil tests conducted 9 months after the fertiliser application showed only a slight improvement in capital P levels (Table 2).

Site A (crushed Aglime) had the lowest fertility with an Olsen P of 7. Whereas Site C displayed higher levels of potassium and phosphorus (pelletised lime) indicating that it may be a sheep camp (potassium comes from urine and phosphorus from dung). In 2021, the aim was to continue to raise Olsen P levels by applying 160 kg/ha (14 unit of P/ha).

## Pasture quantity

In 2020, a significant difference in quantity of growth was observed, with Site C displaying higher growth compared to Site A. However, neither site showed a significant difference when compared to Site B - Untreated (Figure 4). This could be due to higher fertility levels in Site C as no other statistical differences were recorded.

Visually, Site C (pelletised lime) had a better-looking pasture compared to Site A or B. This observation is supported by higher quantities of pasture recorded in Site C. Despite similar Olsen P levels between sites B and C, the results for Site C suggest that this effect may be attributed to lime application. It is possible that the constraint of soil acidity was alleviated by lime, enabling the pasture to respond positively (Figure 4).

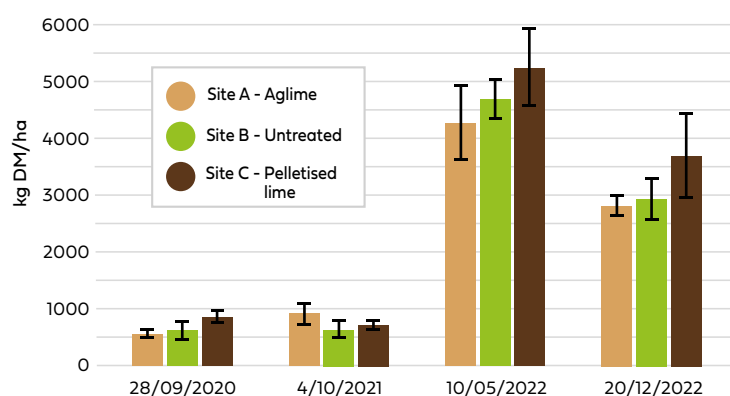


Figure 4. The amount of pasture quantity (kg DM/ha) recorded in 2020 to 2022 (Standard Error of means shown).

*"We've just had the wettest two years (2021 and 2022) that we've seen on the property, so we probably need a couple of tough years to really notice the difference in the quality of the pasture."*



## Summary

In this trial, the Aglime was better at increasing soil pH and removing the acidity constraint than pelletised lime and the liming effect will impact pasture growth for longer. However, it's worth considering the role of phosphorus rather than lime, and building levels to an Olsen P of 12 to 15 mg/ha.

The most limiting factor to pasture growth was most likely phosphorus content and unless this is addressed, pasture growth remains limited despite liming or applying other nutrients. Response curves generated from hundreds of trials indicate an Olsen P content of 7 is likely to achieve 75% of potential production in

an improved pasture. Where the Olsen P was 10 mg/kg in site C, this constraint effect was reduced allowing the pasture to respond to the pelletised lime. In contrast, the acidity at pH 4.6 was only limiting pasture production by about 10%.

Pasture responses to soil constraints follows Liebergs Law of Minimum. Put simply, the most limiting factor will hold the pasture back from reaching its potential yield. You can remove that limiting factor but then the next most limited factor will hold pasture back from achieving potential production.

We commonly aim to fertilise or lime to reach potential

production levels of 95%. Limiting factors are commonly lack of water, soil temperature, nutrient deficiencies, soil acidity or physical soil properties.

### So why is liming important?

We lime to maintain good soil pH, so we avoid the steep downward drop in production as pH falls. It's like servicing the car, when maintaining a neutral pH the soil system runs more efficiently and major nutrients become more available to plants, rather than not servicing and waiting for the soil to become broken when yield constraints occur.