10. Efficient Liming: Increase production & reduce costs

Agricultural production in Western Australia has resulted in a steady increase in soil acidification, reducing plant growth and pasture production. Liming is an efficient, low-cost solution to soil acidification, correcting past damage and enabling plants to again flourish. It prevents nutrients being leached from the soil and washed into waterways, while the subsequent improved plant root depth strengthens pastures, preventing soil erosion.

Top Tips to Improve Soil pH

- Annually test soil pH to check soil pH trends and variability
- Apply lime to raise soil pH to 5.5 – 6.0 0 ($CaCl_2$)
- Regularly undertake pasture analysis post lime application
- Discuss the farm liming program regularly with your consultant/advisor.

Acidification of Soils

Most soils used for dairy production in Western Australia are sand to sandy loam. These soils have become increasingly acidic due to:

- Inability of soil to fix nitrogen as a result of the loss of soil organic matter caused by removal of plant and animal product;
- Lower take-up of nitrogen by plants;
- Acidifying fertilisers such as ammonium nitrogen, being added to the soil; and
- Weathering, to a much lesser extent

Soil acidification causes the concentration of hydrogen ions in the soil to increase, with the level of concentration measured on a pH scale. The pH scale ranges from 0 (most acid) to 14 (most alkaline) with pH 7 being neutral. Most pasture species require a soil pH of 5.5 – 7.0 ($CaCl_2$) for growth, with pH 6.0-6.5 ($CaCl_2$) optimal for pasture growth. Soil pH can be measured in water or calcium chloride.

As soils acidify, plants can access fewer nutrients. When a soil's pH is in the 6.0-6.5 ($CaCl_2$) band, the plant has close to 100 percent access to macro and trace element nutrients in the soil. However, if the pH of the soil falls below 5.5 ($CaCl_2$), two factors begin to affect the availability of nutrients:

1. Aluminium toxicity increases, reducing plant root growth and function; and
2. The capacity of soil to sorb (absorb, fix, retain, bind and chemically react with the nutrients) is reduced.

(See Diagram over)

Other factors of concern are low availability of calcium, phosphorus and magnesium in plants which can affect livestock health and production. The reduction of earthworms, fungi, bacteria, insects, protozoa and algae in acidic soils further increases the need for fertiliser.

Success Story

Oscar Negus Jnr and parents Oscar Snr and Wendy run up to 3000 cattle on a farm at Tutunup in the South West. They have been liming the dairy platform in February/March each year with the objective of maintaining a pH of 5.5 0 (CaCl2) and above.

"We tissue test on average every three months and carry out annual soil testing, with up to 80 soil samples, before applying lime at 1 to 2.5 tonne/ hectare depending on soil pH. With irrigation it is even more important because we are expecting the soil to perform year round. We try to always buy lime that has the highest neutralising value per dollar spent, including cost of freight and also considering particle size.

Correcting pH is one of the first and most important factors to get right. If the pH is too low, the production response and economics of fertiliser inputs can be minimal!"

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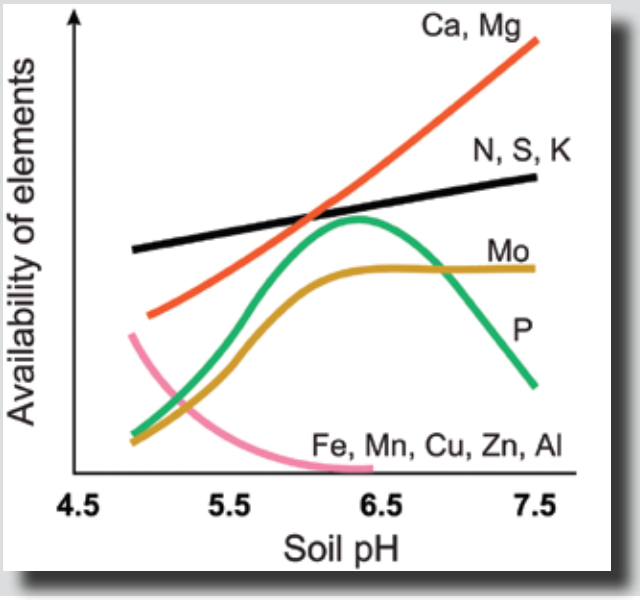
[cont'd from P1]

DIAGRAM: Relationship between soil pH and nutrient availability.

In acidic soils, some nutrients may be insufficiently available for optimal plant growth and aluminium may become toxic. Source: DAFWA Bulletin 4784.



Testing Soil Acidity

Off-the-shelf soil pH test kits are available from rural merchandise stores, however these kits usually measure pH in water and add 0.6-1.0 units to roughly convert to pH measured in calcium chloride. Most soil analysis services provide soil pH in both calcium chloride and water. While some labs will provide an estimate of lime required to raise pH via titration tests, ensure the lime quality is taken into account.

Liming

Lime sand or limestone deposits occur naturally. Lime acts as a soil ameliorant, raising the pH level while adding calcium to the soil.

The quality of the lime is determined by the particle size and Neutralising Value (NV), as this determines how quickly and effectively the lime raises the soil pH. Fine quality lime with particle size of less than 0.5mm is the most efficient, while the higher the NV, the greater the effectiveness of the lime. Analysis of lime from various Western Australian pits is available at: www.limewa.com.au.

Lime is traditionally applied in autumn to allow it to be washed into the soil by winter rains. It can also be applied prior to cultivation, speeding up its absorption. Degraded paddocks require reseeding to take advantage of the lime. There is no withholding period for livestock.

Sandy soils are generally more responsive to lime than heavy clays or soils with high organic matter. On-farm observations

observations in WA's south-west suggest the rate required to lift pH from, say 4.5 to 5.5-6.0, are 5-10t/ha for sandy loams and 10-20t/ha for clay soils, although all soils respond differently. Farmers are advised to trial applications and monitor results.

Once the topsoil pH is above 5.5 ($CaCl_2$), alkali dissolved from the lime moves rapidly into the subsoil, raising the subsoil pH. This supports increased root depth and can lengthen the growing season.

If trace elements were marginal before liming, excessive liming can induce trace element deficiencies. Either tissue test pasture herbage before and after liming to determine when trace element fertilisers should be applied, or always apply trace elements when liming. Care must be taken with fertilisers containing molybdenum as excessive amounts of this metal can cause copper deficiency in cattle.

Post-liming follow-up

As soil acidification is ongoing, so is the need to apply lime. Dairy farmers need to:

- Monitor test strips for differing responses after the initial liming and use the test strips as a guide to further annual application rates;
- Analyse pasture samples to ensure trace element availability is adequate as the soil pH rises;
- Resample the topsoil and subsoil to monitor lime movement through the soil profile;
- Aim for a topsoil pH of above 5.5 ($CaCl_2$), and a subsoil pH of above 5.0 ($CaCl_2$);
- Be aware that as pasture production potential increases, other limiting factors may come into play such as copper, manganese or zinc deficiencies;
- Review fertiliser applications.

Further information:

Contact Western Australian Department of Agriculture or your local consultant.

DAFWA Bulletin 4784 "Soil Acidity – A Guide for WA farmers & consultants", and the WA Soil Quality website www.soilquality.org.au/factsheets.

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