Why test my lime?

The old saying of "oils aint oils" definitely applies to lime. Lime varies from pit to pit and from within pits. Lime from each pit has different neutralising values (expressed as a percentage relative to pure Calcium Carbonate) and particle size distributions and is often geographically isolated from your farm. Lime isn't cheap so these factors need to be considered when purchasing your recommended amount.

When testing your lime, you need to know the neutralising value of the lime (the purity of the lime affects its capacity to change the pH) and the particle size (which affects the speed of pH change).

NUTS & BOLTS

- Soil pH is a measure of the concentration of hydrogen ions in the soil solution. The lower the pH of soil, the greater the acidity.
- Soil acidity reduces pasture and crop production and some legume species may fail to persist.
- Acidic soils can affect grain production, pasture health, decrease biodiversity and ecological function; and exacerbate other soil issues.
- pH should be maintained at above 5.5 in the topsoil and above 4.8 in the subsurface.
- A well maintained soil pH will maintain the value of the soil resource, maximize crop and pasture choice and avoid production losses due to low pH.
- Not all lime is the same with differences in particle size and neutralising value from pit to pit.
- Understanding the effectiveness of lime will allow farmers to make more timely and cost saving management decisions.

SOIL ACIDIFICATION

Soil acidification is a major soil degradation problem in the south coast region (DAFWA 2013). Acidification is a natural process but it increases with agriculture and accelerates with higher productivity. The rate of acidification also varies with management, land use and soil type. Although many soils in WA are naturally acidic their acidity has increased, and increased deeper into the soil profile over time since clearance (Dolling and Porter 1994). A low pH in the top soil decreases nitrogen fixation

"SOIL acidification is an insidious process that develops slowly and, if not corrected, can continue until the soil is irreparably damaged (Moody et al. 2002)'

by legume-rhizobia symbiosis and restricts availability of nutrients to the plant. In subsoils, low soil pH causes an increase in soluble aluminium (which is toxic to plants) resulting in a decline in root growth and reduced access to moisture and nutrients (DAFWA, 2013).

A high proportion of soils on the south coast are either below optimum pH or at high risk of acidity. While topsoil acidity is easy to ameliorate with surface application of lime, sub-soil acidity is a growing problem and it takes much longer for surface applied lime to reach deeper soil layers. Acidic soils reduce crop yields by 10-12% and by

Denmark Shire pit. C Gazey - Department of Primary Industries and Regional Development.

even more for sensitive crops such as canola and barley. Bulk lime in the form of limesand, crushed limestone or dolomite, is currently the cheapest way to ameliorate acidic soils.

Acidic soils can also negatively impact soil biodiversity such as bacteria and fungi (DAFWA, 2014). Acidic soils have been seen to reduce important processes such as nitrogen fixation and organic matter decomposition. Acidic soils and associated toxicity can also create a decline in the health of plant populations; creating decreased plant cover that can lead to other soil issues such as erosion or weed invasion. Acidic soils can cause a decline in macro fauna such as earth worms that provide essential services such as creating ideal top soil structure for plant growth, organic material cycling, unlocking nutrients like nitrogen and phosphorous; and provision of a food source for predator species.

QUALITY = EFFECTIVENESS

The capacity of lime to improve soil pH is referred to as its neutralising value (often abbreviated as NV). It is the carbonate in calcium, magnesium carbonate and the oxide in calcium oxide that neutralises the acid. The finer the particles, the quicker the response with an average particle size of 0.25 mm considered as optimal. Lime with an average particle size over 1 mm has nearly no effect on the soil pH (Cregan et al, 1989; Whitten, 2002; South Coast NRM, 2015). Finer lime particles are more effective because of their larger surface area by weight increasing their ability to react with the acidic soils.

The NV effectiveness is often expressed as a percentage and can help farmers decide on where they should purchase their lime. The percentage of lime is calculated by comparing the NV of the source lime relative to pure calcium carbonate, which has a value of 100%.

For an explanation on how percentages are calculated or on how limestone, limesand or dolomite works, visit the Department of Primary Industries and Regional Development web site www.agric.wa.gov.au/climate-land-water/soils/soil-constraints/soil-acidity.

Lime piles from different sources. G McDonald - Department of Primary Industries and Regional Development.

ECONOMIC

The economic viability of applying lime to paddocks varies from farm to farm. It depends on the NV, soil type, soil constraints, current soil pH profile, rainfall, land management practices, transport costs, application costs and market prices. Not all lime pits release lime quality information for farmers to calculate the cost and efficiency of the lime and with those that do, quality within the pits can significantly vary. Lime testing is therefore an important management tool.

South coast lime of a higher quality than 50% NV efficiency may be more economical than transporting lime from the west coast. For south coast lime of very poor quality (< 30% efficiency) it would likely be more economical to transport high quality lime from the west coast. For west coast lime of lower quality than 80% efficiency, it may not be economical to transport lime from the west coast if south coast lime was 40-50% efficiency.

There are online calculators that can assist with these decisions (such as the Lime Comparison Calculator and Lime Benefit Calculator) however they do have limitations. Another thing to be aware of is that the industry data sheets generally do not calculate the NV efficiency and this needs to be calculated using the online calculators (DAFWA, 2014).

In terms of carbon emissions, it may be better to use more of lesser quality south coast lime than to transport lime from the west coast and freight costs are also more likely to increase more rapidly than the cost of the lime itself.

Knowing the exact cost of applying the lime required to address soil acidity is critical with managing the long term sustainability of farming enterprise as well as potentially reducing costs.

Loading lime. C Gazey - Department of Primary Industries and Regional Development.

PURCHASING LIME

I haven't purchased lime before, what should I do?

- Test your soil pH at 0–10 cm, 10–20 cm and 20–30 cm to determine where, and at what rate, you need to lime.
- Download product information sheets from the suppliers at www.limewa.com.au for participating members who are independently audit sampled by officers from the Department of Primary Industries and Regional Development and click on the supply source. These give a good indication of the variability of the source.
- Calculate costs being sure to include the cost of the lime, transport and spreading.

"THE best lime is the one which can be landed and spread for the cheapest price WHEN quality has been taken into account"
Chris Gazey (Senior Research Officer, Department of Primary Industries and Regional Development).

- Use the lime comparison calculator on the Soil Quality website to compare the total cost of effective neutralising value delivered and spread on farm.
- Test your lime once it arrives on site to ensure that you are getting what you have paid for.
- If your lime supplier is not a member of Lime WA Inc. ask them why and encourage them to do so.
- Consider spreading the full required lime to 25% of your farm each year over 4 years to spread the cost. Failing to apply enough lime will not ameliorate the problem, wastes the resource and wastes your return.

Recommended minimum targets:

Topsoil 0-10cm pHca 5.5 or above - this will allow some lime to move down the profile and will make nutrients more available and suitable pH for nodulation of legumes.

Subsurface 10-20 and 20-30cm pHCa 4.8 this will ensure that aluminium toxicity is not a problem for root growth and therefore water and nutrient uptake.

Refer to Online Calculator to get rates
www.soilquality.org.au/calculators/lime_comparison

www.aglime.com.au/liming-onlinelimecalculator.htm

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- Chris Gazey (Senior Research Officer, Department of Primary Industries and Regional Development).

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Produced by David Broadhurst (South Coast NRM)

A series of marginal land farming short films can be viewed on the South Coast NRM YouTube channel.

"Foraging for the Future"
www.youtube.com/watch?v=O5FTxmNSsLc

"Resilience through Perennials"
www.youtube.com/watch?v=moEUCBG3Z0Q

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Design and Photography

Nicola Edwards - Synergy Graphics (Design)
Chris Gazey and Glen McDonald - Department of Primary Industries & Regional Development (Photography)

Contact South Coast NRM
39 Mercer Road, Albany, WA 6330
Phone: 08 9845 8537 Fax: 08 9845 8538
Email: info@southcoastnrm.com.au
Web: www.southcoastnrm.com.au