Discussion Paper LNV-01

BACK PADDOCK SoilMate

Liming – is finer always better?

In a single word NO!

Acid (low pH) soils are increasingly identified and discussed as a significant problem facing agricultural productivity in many parts of Australia, and it is common for me to get enquiries from advisers asking the question," Can I reduce the rate of lime use if it is of high quality?" A other more concerning statement that is quotes is " I've been told that if I apply Product X, because it is a lot finer you can reduce you application rate by X%".

As a generalisation this answer is yes, higher quality means lower rates, but this is a qualified yes. The definition of "quality" requires a little more scrutiny as does how far we can reduce the lime rate while achieving your desired outcome. While applying finer lime increases the ***rate*** at which the soil pH is increased, lowering the rate too far because of finer particle size can reduce the total depth of soil amended, or the size of the final pH increase.

When talking about liming materials, quality in terms of effectiveness is defined by two parameters, the first being purity referred to as Neutralising Value (NV) and the second being proportion of the product in defined particle size ranges. The greater the proportion of product in the fine particle ranges the faster the product works. The combination of these two parameters is generally referred as the effective neutralising value (ENV).

The combination of purity and application rate provides the potential amount of power in the applied product to reduce soil acidity in total.

The particle size distribution (fineness) regulates the speed at which the acidity is reduced.

To some degree the two parameters are interchangeable, but there are limits!

Don't be fooled by a sales pitch that claims a 5 x reduction in rate of liming amendment required because the product is twice or three times as fine. The product might increase the soil pH of a proportion of the application zone quickly, but the depth and duration of the pH increase may be limited by the reduction application rate.

Liming soil reduces acidity by "deactivation" of hydrogen ions (H^+) (and their activation of aluminium (Al^{3+})) via a simple chemical reaction that can be represented as

$$1Ca^{2+} + 1CO_3^{2-} + 2H^+ \longrightarrow 1CO_2 + 1H_2O + 1Ca^{2+}$$

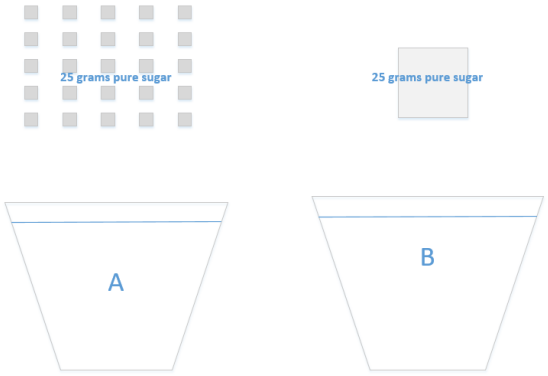
Calcium carbonate + soil acidity → carbon dioxide + water + calcium

The relevant component of this reaction is the proportional relationship between the number of H^+ ions deactivated by a single unit of CO_3 in the neutralisation reaction above. As you can see, two hydrogen ions are deactivated for each CO_3 unit. Therefore a product with the same purity and particle size distribution claiming to be more effective than another that is the same defies this basic law of chemistry and requires closer scrutiny of the product characteristics.

The carbonate in this reaction can be replaced with bicarbonate (HCO_3^-), oxide (O^{2-}) and hydroxide (OH^-) with varying degrees of efficacy.

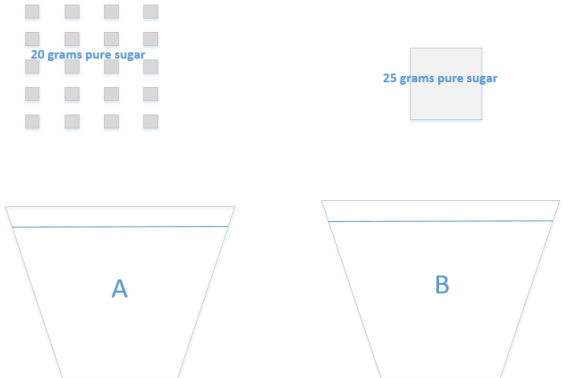
A good analogy to understand the relationship between lime purity and particle size is to think of lime to soil in terms of adding sugar to a cup of tea to increase the it sweetness. Consider the cups of tea below:

1. Which cup will contain the sweetest tea?



Answer – "A" will be sweeter more quickly because the finer particle size will dissolve more quickly. Given there is 25 grams of sugar in each the sweetness will be the same by the time all of "B" dissolves.

2. Which cup will contain the sweetest tea?



Answer – "A" will be sweeter more quickly because the finer particle size will dissolve more quickly. Given there is 20 grams of sugar in "A" and 25 g in "B", "B" will be sweeter once all sugar dissolves. i.e. cutting lime rates on the basis of particle size can be a false economy.

Lime performs similarly to the above examples but the effect of particle size is more pronounced because of the relatively low solubility of lime compared to sugar. Particles of lime greater than about 0.25mm have been found to contribute to pH reduction in the short term and those with a primary particle size greater than 1mm having little value as an agricultural liming material at all.

Essential guidelines for selecting liming products

- Access most recent details of lime quality lab test particular ENV from the product supplier or obtain sample and submit to a qualified laboratory for testing (ensuring sampling pit or pile process is appropriate and request details of screen sizes used in assessing lime be provided with results)
- Determine the ENV assumed in the liming product rate recommendation. Be aware that differences in the number of screen size factions and sizing of screens may be defence between laboratories. The ENV of a single product may differ based on the differences in calculation better those using WA, VIC or NSW based equations for ENV.
- Adjust the liming rate for any difference in assumed and actual ENV
- When comparing costing do so on a $ per tonne spread on the ground as products with a higher ENV will generally reduce the per hectare cost of freight and spreading.
- Consider the finer the lime the more wind will affect spread patterns and potential loss to non- target areas.

Opterra LimeMate is a simple web based calculator that contains a liming product ENV calculator, liming product cost comparator and liming rate calculator that requires only a couple of simple soil and amendment product measurements to run scenarios.

For further information contact BPC Customer Support

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