Lime and Limestone in Agriculture

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Optimum pH

Considerable research has been done into the optimum pH range for various crops. Overall nutrient availability decreases, with a consequent adverse effect on quality and yield when pH levels are above or below the optimum range for a particular crop. It follows that effectiveness of fertilisers is maximised when the optimum pH is maintained. As pH of soil tends to decrease with time, usual recommendation is to maintain pH values above 6.0 for grass and above 6.5 for most arable crops (main exception being potatoes).

Soil Acidity

This tends to increase as a result of five factors.

- Rainwater naturally contains dissolved carbon dioxide and oxides of nitrogen which are acidic.
- Pollution of the atmosphere with oxides of sulfur and nitrogen causes acidity.
- Use of fertilisers contributes to soil acidity.
- Plant roots extrude hydrogen ions, resulting in increased acidity.
- When organic matter decomposes in soil, microbial oxidation of organic N and S produces strong acids such as nitric and sulfuric acids.

The acids from the above processes react with calcium and magnesium in the soil to form soluble salts, which are leached out and reduce both the pH and availability of calcium and magnesium.

Control of pH

Until the middle of the 20th century, most "liming" of agricultural land was done using quicklime and hydrated lime products. These produced fine particles of calcium hydroxide in the soil, which initially raised the pH and then reacted with atmospheric carbon dioxide to form finely divided calcium carbonate. The very fine carbonate particles were sufficiently soluble to maintain the pH at the required level for a prolonged period.

Effectiveness of Limestone and Quicklime

The effectiveness of agricultural limestone in raising pH of soil depends on several factors.

- Neutralising value, which is related to calcium and magnesium carbonate content of the limestone.
- Fineness affects reaction rate. Particles larger than 600 microns are usually considered to be ineffective due to slow reaction. This is due the extremely low solubility of limestone in water.
- Hardness of the limestone can affect neutralising performance. Soft and porous material will break down easily and provide more surface area for reaction.

The effectiveness of quicklime in raising soil pH is significantly different.

- Neutralising value is usually almost double that of limestone so application rates are correspondingly lower.
- Fineness is assured when the quicklime slakes by reacting with water to form very fine hydrated lime. Although hydrated lime displays very low solubility in water, it is far more soluble than limestone. The reaction of quicklime with water also liberates significant heat. Safety precautions should be taken when handling quicklime. Also, the alkaline nature of quicklime must be considered. Most quicklime producers can provide the relevant MSDS and typical analysis information required.
- Initial rate of reaction is rapid. The large surface area provided also assists the reaction and results in rapid pH increase. A significant portion of the hydrated lime will revert to fine particle carbonate by reaction with carbon dioxide. The carbonate or "limestone" will react slowly and keep the pH in

the required range for a prolonged period. The duration of that period will depend on the rate of application, nature of the soil and rate of lime loss.

Essentially, in either case, adequate application and spreading are important for success. Also, delivered cost per unit of neutralising value is an important issue. Chemical grade quicklime may be relatively expensive compared to finely milled limestone. This may not be a critical issue if significant and or immediate pH modification is required. Also, lower grade quicklime, commercial hydrator rejects or agricultural products containing hydrated lime can be very effective.

For further information, refer to "Lime and Limestone – Chemistry and Technology, Production and Uses" by J.A.H. Oates and "Chemistry and Technology of Lime and Limestone" by Robert S. Boynton.

For MSDS or typical analysis information regarding quicklime or hydrated lime please contact the Technical Marketing Department at Pacific Lime on 1800 674 781 or E-mail us at paclime@qcl.com.au