Chapter B5. Does my soil need lime?

PURPOSE OF THIS CHAPTER

To describe how to work out whether your soil needs lime

CHAPTER CONTENTS

- acidity
- pH testing
- liming materials
- lime quality

ASSOCIATED CHAPTERS

- A3 ‘Features of soil’
- B1 ‘Common problems’
- D3 ‘Chemical tests’

WHAT DOES LIME DO?

Lime has two effects on soil. First, it neutralises acidity. Second, it may be a slow-acting alternative or a complement to gypsum in the treatment of sodic, dispersive clay soil.

OCCURRENCE OF ACIDITY

Acidity occurs naturally in many coastal, tablelands and slopes vegetable districts, as well as in parts of the Riverina. Localised acidity also occurs in micro-irrigation systems using ammonium-based nitrogen fertilisers.

The major problems in acid soils are aluminium and manganese toxicity. Some elements—particularly phosphorus, calcium and molybdenum—become less available to plants.

PLANT SYMPTOMS

Soil acidity results in poor establishment, yield, and persistence of plants, including barrel medic and lucerne, which are often used in vegetable rotations. Figure B5–1 shows the effect of pH on nutrient availability.

Plants affected by acidity also become more prone to disease.

Plants affected by aluminium toxicity have smaller, dark green, sometimes purplish leaves. Plant growth is slow and lateral root growth is stunted.

Acid soil also limits nodulation and nitrogen fixation by legumes.

Potatoes, sweet potatoes and watermelons tolerate some acidity.

PH TESTING

You can do a soil pH test yourself to determine whether acidity is a problem. Soil pH kits are available from some garden shops and plant nurseries, but these kits are only accurate to half a pH unit. They

measure pH in water, whereas laboratories measure pH in calcium chloride ($CaCl_2$). The pH in calcium chloride gives values about 0.5 to 0.8 lower than pH in water.

More expensive kits, costing about $500, measure pH in calcium chloride to an accuracy of about 0.2 pH units. These kits are available from the Centre for Conservation Farming, Charles Sturt University, Wagga Wagga.

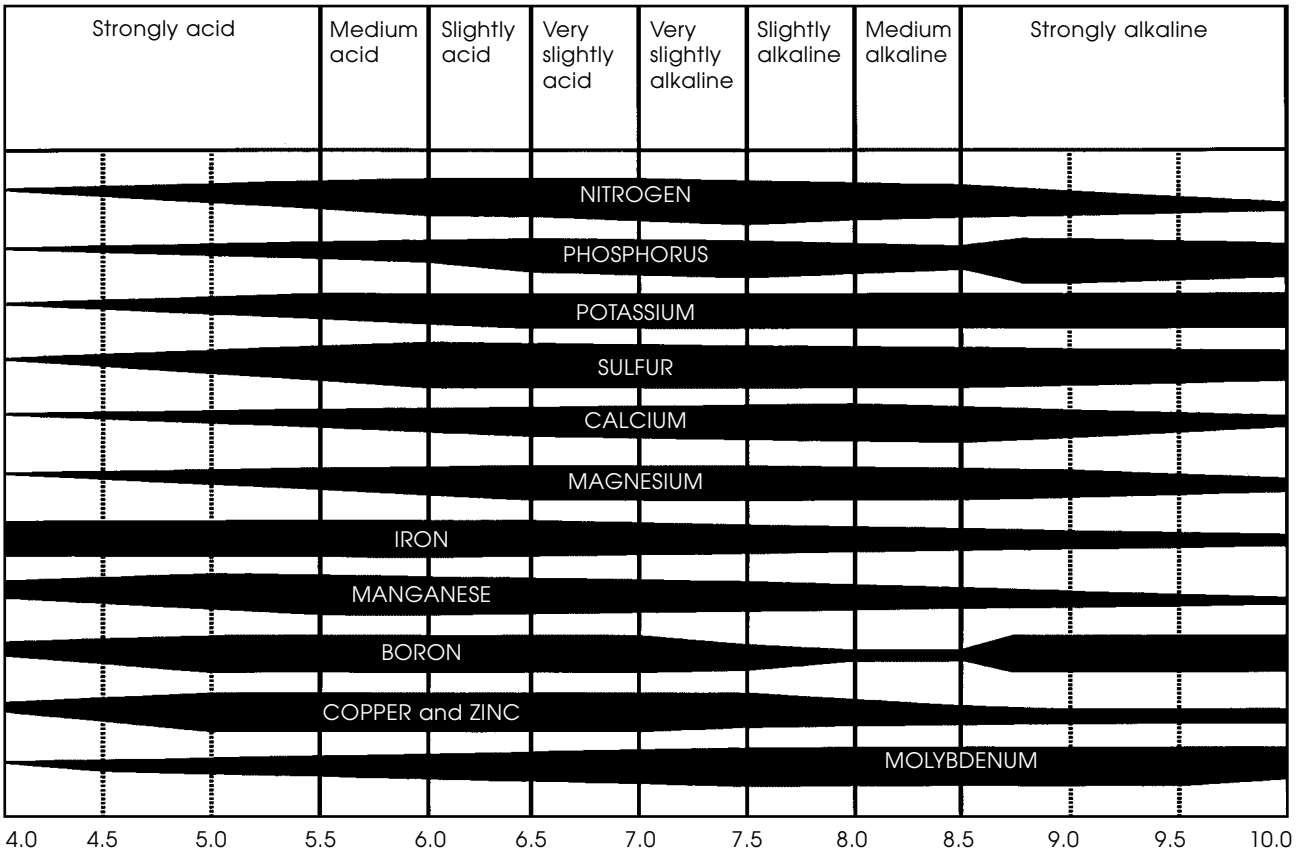
Test the subsoil as well as the topsoil to determine the extent of any problem. If the pH as shown by the pH kit is well above 6.0, then acidity is not a problem. If the pH is below 6, get laboratory tests done for soil pH and exchangeable cations, and seek advice on what to do.

Soil test results for topsoil pH

Interpret the pH of topsoil as follows (these pH values are for pH in calcium chloride):

- pH above 5.6: soil acidity is not a problem yet.
- pH between 5.1 and 5.5: there is a risk of soil acidity problems. Think about a maintenance liming program and methods that will reduce the rate of acidification.
- pH between 4.6 and 5.0: you need to check the exchangeable aluminium percentage as a percentage of the total cation exchange complex. If aluminium is present, even at low levels (1%–5%), then sensitive species will be affected. Subsoil pH should not be a problem, but test to make sure.

Figure B5–1. Influence of pH on nutrient availability



- pH below 4.5: you need to check the exchangeable aluminium percentage and the subsoil pH. With this level of acidity, the subsoil is probably acid, and a liming program needs to be implemented.

LIMING

The aim is to apply sufficient lime to reduce the soil's exchangeable aluminium percentage to zero. Ask your soil testing laboratory or your horticultural adviser for advice on how much lime to apply. Thereafter, make maintenance applications of lime at regular intervals, depending on the rate of acidification. Don't wait until the problem is seriously effecting yields. When a soil becomes strongly acid, you are already losing production.

Acidity is a potential problem on any farm, and its prevention should be part of your soil management plan.

Caution: Strongly acid soils (pH in calcium chloride less than 5.0, or pH in water less than 5.5) require special care. Adding large amounts of lime can result in potassium and magnesium deficiencies.

In sandy soils, over-liming can cause deficiencies in trace elements such as zinc, manganese and iron. Over-liming causes problems! Get laboratory testing for pH and exchangeable cations before applying large amounts of lime.

If finely ground agricultural lime (100% passing a 0.25-mm sieve) is incorporated into the soil, it reacts with the soil that it contacts as soon as moisture is available. However, the lime moves very slowly through soil and may take many years to reach an acid subsoil. On pastures used in rotation where the lime is not incorporated, it may take a year or two to have an effect on the topsoil. Coarse lime is slow to act, and its use is inadvisable.

MINIMISING SOIL ACIDIFICATION

As well as liming, better management of nitrogen and soil water will reduce the rate of soil acidification.

A major cause of soil acidification is the leaching of nitrate from the soil. Use cropping rotations that include deep-rooted plants to use up nitrogen before it is leached. Also, use less-acidifying nitrogen fertilisers, such as urea, rather than ammonium sulfate. Apply nitrogen in small amounts more frequently to minimise nitrate leaching.

LIME QUALITY

Agricultural lime comes from naturally occurring limestone that is mined and crushed. The quality, and therefore the effectiveness, of different lime products varies. The sale of lime in New South Wales is covered by the *Fertilisers Act 1985*. All liming material must be labelled before it is recognised under the Act.

Neutralising value

The capacity of a liming material to neutralise soil acidity is called its neutralising value (NV). The higher the NV, the greater the ability of the product to correct the acidity. Pure lime—that is pure calcium carbonate—is taken as the standard; it has an NV of 100.

Hydrated (slaked) lime and burnt (quick) lime have NVs of 120 and 160 respectively. They can neutralise acidity rapidly, but must be used with caution. When mixed with water, the pH rises to over 11 and can damage plants.

Calcium and magnesium content

Pure calcium carbonate contains 40% calcium and no magnesium.

Good commercial agricultural lime contains 35%–38% calcium and very little magnesium.

Dolomite contains 8%–11% magnesium and 12%–20% calcium.

Magnesite (pure magnesium carbonate) contains 25% magnesium.

If a soil test shows that your soil is deficient in magnesium, use dolomite or magnesite as your liming material. However, beware of overdoing magnesium applications: too much magnesium can interfere with the potassium uptake and can aggravate clay dispersion problems. Have the soil tested for exchangeable cations. Keep the magnesium and calcium in balance by the sparing use of liming materials containing magnesium.

Fineness

The finer the lime, the more quickly it will react with the soil. A lime with fine particles has more surface area exposed to acid soil and more particles distributed through the soil than an equal weight of coarse material. The percentage of particles passing through a 0.25 mm sieve is the measure of fineness.

TYPES OF LIMING MATERIALS

Agricultural lime (calcium carbonate) is the most commonly used liming material. It consists of limestone crushed to a fine powder, and is usually the most cost-effective material for correcting soil acidity.

Dolomite (also known as maglime) is a naturally occurring rock containing calcium carbonate and magnesium carbonate. It is useful for acid soils where supplies of magnesium are low. On most occasions use agricultural lime.

Magnesite (magnesium carbonate). Made from crushed magnesium carbonate rock, magnesite has an NV of 95 to 105. It may be used where there is a magnesium deficiency.

Wet lime. Wet liming materials are sometimes available at low prices. Their usefulness is determined by their NV and water content. If the water content is 10%, then the lime will only be 90% as effective as dry lime. You need to consider the extra costs of handling, freight and spreading.

Crushed shells of oysters and other shellfish are mainly calcium carbonate, but the shells tend to be contaminated with sand and organic material and are usually too coarse to be effective quickly in soil.

Gypsum (calcium sulfate) is classified by the Fertilisers Act as a liming material, but is not considered one in agriculture because is does not reduce soil acidity. Although it is used mainly to improve the structure of sodic clay soils, it also reduces aluminium levels when applied to some acid soils.