NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Establishing pastures - Readers' Note

This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

http://www.dpi.nsw.gov.au/agriculture/livestock/dairy-cattle/feed/publications/establishing-pastures

Updated versions of this document can also be found at the above web address.

Soil testing

The key to productive, persistent perennial pastures is a good fertiliser program.

Soil tests are a useful and necessary tool for assessing soil fertility and for determining the need for fertiliser or lime. Soil tests do not give all the answers, but do indicate whether a deficiency or toxicity exists. They are less useful in determining rates of fertiliser to apply. Over several years, however, they indicate whether the fertiliser applied over that time has increased, maintained or decreased the nutrient status of a paddock.

Ensure that you follow the soil sampling procedures recommended by the laboratory. Avoid soil sampling within 6 months of fertiliser application to obtain meaningful results.

Although it is expensive, tissue analysis is the most reliable means of testing for trace elements.

Soil pH

This is a measure of the acidity or alkalinity of the soil. Many soils are naturally acidic, but others acidify through nitrogen fertiliser use and legume nitrogen fixation. Soil pH is a useful guide to species selection and the need for lime. It also determines the need for the trace element molybdenum (Mo), which is essential for nitrogen fixation by legumes.

There are two different pH tests: water and calcium chloride ($CaCl_2$). The $CaCl_2$ test is preferred as it fluctuates less with seasonal changes, but readings are 0.5–0.8 pH units lower than water tests. The pH scale ranges from zero (acid) to 14 (alkaline), where 7 is neutral.

Soils with a pH ($CaCl_2$) of 4.5 or less are rated as strongly acidic. The toxic element aluminium is soluble in these soils and is available to plants. Soils with a pH of 4.5–5.0 are moderately acidic; pasture growth is satisfactory. The ‘ideal’ pH range for pasture growth and nutrient availability is between 5.0 and 6.5.

Phosphorus (P)

The availability of soil phosphorus will vary with the acidity of the soil. The more acidic the soil, the more phosphate that is ‘fixed’ by the soil and made unavailable to plants. On acidic soils, the interpretation of phosphate requirement is more difficult as all tests overestimate the amount available.

There are three main phosphorus tests used in Australia. They have different minimum levels (or ‘critical’ values) for maximum yield.

- The **Bray test** appears least affected by low pH and has a similar critical value across all soils (15ppm for pastures). The test is not suitable for soils with a pH ($CaCl_2$) above 7.0.
- The **Olsen test** can be used on alkaline and acidic soilss. Critical values are similar to those for the Bray test.
- The **Colwell test** is used extensively in NSW. Its critical value changes with soil type. On soils with high levels of aluminium or reactive iron, it overestimates; interpretation must take this into account. Divide the P test result from slate or shale soils by 2.5 and from basalts by 2. Red-brown earths, most clays and non-acidic granites don’t require correction.

(This section has been derived from *Management of Profitable and Sustainable Pastures* and is reproduced here with the kind permission of the authors, Michael Keys, Bruce Clements, Mark Conyers and Michael Duncan of NSW Agriculture, and Rosalie Strachan of Analysis Systems, Port Kembla.)

Critical value is 35.

Adding 125kg/ha of single superphosphate will add about 5–6mg/kg of phosphorus to the soil (as measured by the Bray test), provided P levels are moderately high before application.

Sulphur (S)

The recent KCl-40 test for sulphur gives a reliable way of measuring the more available organic forms of S. The critical minimum value is 8mg/kg (previously ppm).

Exchangeable cations (CEC)

A full analysis includes the 'exchangeable cations', which give a measure of overall soil fertility. The cations—calcium (Ca), magnesium (Mg), potassium (K), sodium (Na) and aluminium (Al)—are added together to give the cation exchange capacity (CEC). The higher the total, the more fertile the soil. Soils with a CEC below 2.5meq/100g ('light' soils) have very low nutrient levels.

The relative percentages of each cation and the actual levels are both important. The desirable ranges for relative percentages are:

calcium	65%–80%
magnesium	10%–15% (20% max.)
potassium	1%–5% (10% max.)
sodium	0%–2% (max.)
aluminium	0% (ideal) to 5% (max.)

The ratio of **Ca** to **Mg** should be 3:1 or more, but not more than 8:1. Low magnesium levels cause grass tetany in animals. High levels (> 20%) can induce potassium deficiency.

A response to **potassium** is possible when the absolute level is below 0.2meq/100g. Highly productive pastures should have 3%–5% potassium. Dairy production transfers huge quantities of potassium from outlying areas of the farm to lanes and other dairy areas, where dung and urine accumulate. Hay or silage cutting also removes large quantities.

Soils with a sodium level of more than 5% are unstable: the soil aggregates begin to fall apart when they are wet, causing waterlogging, poor aeration, poor drainage and surface crusting. When dry, they are often hard-setting and compacted.

Aluminium is toxic to plants; it reduces root growth and phosphate metabolism. It becomes available only when soil pH is below 5. Sensitive species such as lucerne and phalaris perform poorly when aluminium levels exceed 5%. The only way to overcome aluminium problems is to use lime. Where soils are acidic to depth, also use tolerant species.

Electrical conductivity

The figure given for electrical conductivity on the soil test report has been adjusted for soil texture to give the salinity rating. Soils with a rating of more than 4.0 are considered saline, and tolerant species need to be used to achieve a reasonable yield.

Leaf analysis

Leaf analysis is used for testing all elements, although it is used especially for checking the trace element status of the pasture plants. It is considered to be a more accurate test for soil nutrients than a soil test.

For **trace element** deficiencies it is best to sample clover leaves. Take the fresh new growth. For **other nutrient deficiencies**, take the leaf sample while the clover is actively growing and before it starts to flower. To determine **herd nutritional requirements**, take a mixed sample of what the animals are eating.