Queensland Government

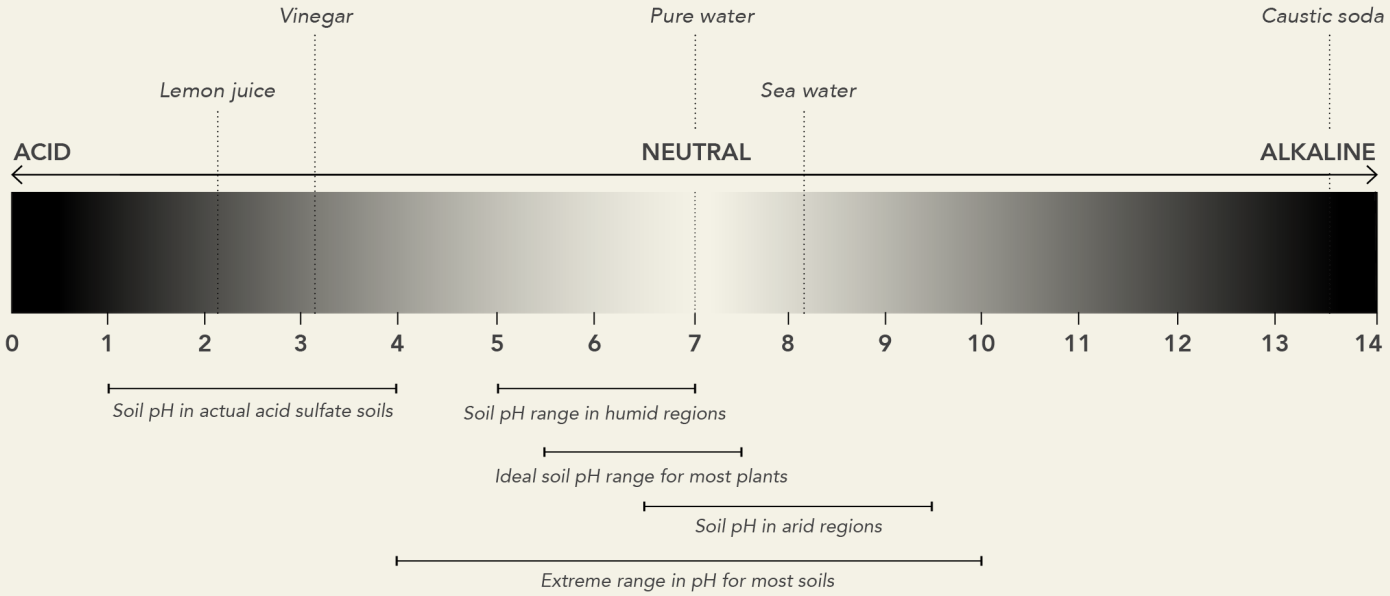
Know your soils

Understanding Soil pH

Soil pH is a measure of the acidity or alkalinity of the soil. pH ranges from 0 (most acid) to 14 (most alkaline). pH values of 6.5 to 7.5 are referred to as neutral. Soils can be naturally acid, neutral or alkaline. Soil pH determines the availability of different nutrients to plants, making it very important for plant growth.

Under acid conditions, calcium, magnesium and phosphorus become deficient, while aluminium and manganese become too available, causing toxicity. Under alkaline conditions, zinc, copper, boron and manganese become deficient. However, most nutrients are readily available to plants when soil pH is near neutral.

The acid limit for plant roots is about pH 4, and the alkaline limit is about pH 10. In high rainfall areas the natural pH of soils typically ranges from 5 to 7, whereas in drier areas the range is 6.5 to 9.5. The ideal pH range for most plants is 5.5 to 7.5. The pH of actual acid sulfate soils (found in low-lying coastal areas) is extremely acidic (less than pH 4).



Natural soil pH depends on the rock from which the soil was formed (parent material) and the processes that acted on it i.e. climate, vegetation, topography and time. These weathering processes tend to cause a lowering of pH (increase in acidity) over time. Some agricultural activities will accelerate the soil acidification process e.g. prolonged use of nitrogen fertilisers.

For more information, contact
Soil.Enquiry@resources.qld.gov.au

How to measure soil pH

Soil pH can be measured by a laboratory (using a pH 1:5 soil:water suspension test). Soil pH is however quick and easy to measure yourself using commercially available field pH kits (available at gardening stores, usually for $15–20). Make sure the soil you test is representative of your paddock. Do multiple tests of the surface soil and always make sure to test the deeper subsoil too. As explained in the Understanding Soil Texture fact sheet, soil properties can change substantially as you move from the soil surface to the deep subsoil.

To use a pH test kit, place half a teaspoon of soil on a plate, add enough liquid dye to just saturate the sample, and mix the dye and soil together. Sprinkle on the white powder (barium sulfate) and let the colour develop. The colour is compared with the test card to estimate pH. Record the pH for each sample of soil tested.

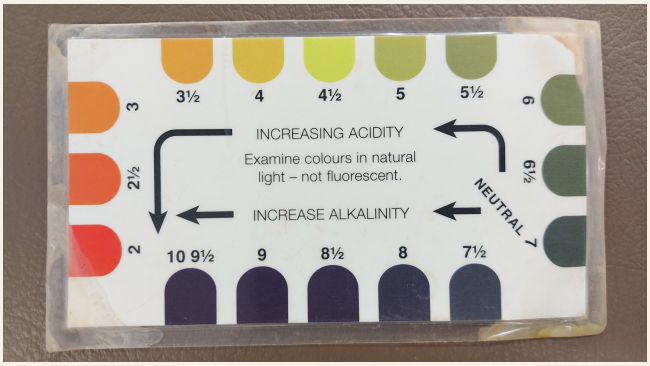
Early identification of soil pH problems is important as it can be both costly and difficult to correct long-term nutrient deficiencies.

Changing soil pH

Fertilisers such as crushed sulfur and some ammonium-based nitrogen fertilisers lower pH and make soil more acid. They are useful for soils with problems caused by high pH.

When soils are too acidic for a particular crop, lime (calcium carbonate) or dolomite (calcium and magnesium carbonate) can be used to increase the pH to the desired level. The amount of lime or dolomite required to correct an acidic pH will vary depending on soil texture, organic matter content, and how much you want to change the pH. Soils with high organic matter and clay content will be more resistant to changes in pH and will require larger application rates. Changing soil pH won't work immediately—allow a couple of months for changes to occur. Measure pH regularly to check your soil's progress. Soil pH, while indicating the need for lime, is not a reliable guide as to how much lime is required. Soil laboratory testing can determine liming rates.

Field trials, in which good quality lime was cultivated into the soil surface to a depth of 10 cm, have been undertaken on a number of acidic soils in Queensland. Across all soils, for every tonne of lime added per hectare, the soil pH increase ranged from 0.1 to 0.8 pH units. The most common change was an increase of 0.2 to 0.3 pH units. The larger pH increases were obtained on sandy soils with low organic matter content. Typical commercial application rates of around two tonnes of lime per hectare are therefore likely to increase the pH by only about 0.5 of a pH unit. However, these small pH increases are often enough to result in an increased yield.



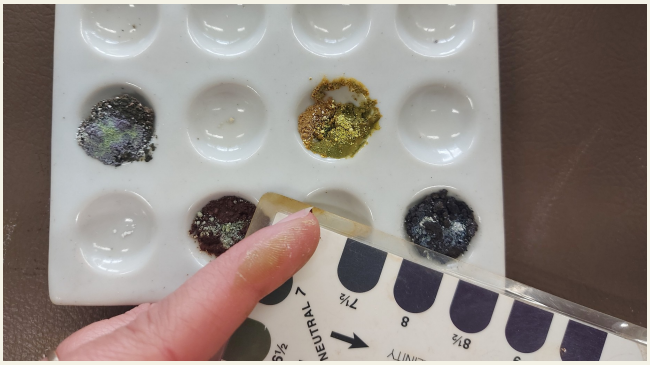


Figure 1: Carrying out a soil pH test. Compare the colour to the test card to estimate the soil pH.

What is pH?

A pH value is actually a measure of hydrogen ion concentration. Because hydrogen ion concentration varies over a wide range, a logarithmic scale is used (this means that for a pH decrease of one, the acidity increases by a factor of 10). The pH scale is a 'reverse' scale in that a very acid soil has a low pH and high hydrogen ion concentration. A very alkaline soil has a high pH and low hydrogen ion concentration.

Other fact sheets in this series:

- Understanding Soil Texture
- Understanding Soil Colour
- Understanding Soil Structure
- Understanding Soil Sodicity
- Understanding Dispersive Soils
- Understanding Soils from an Erosion Rehabilitation Perspective

For further information on soils, refer to the Queensland Government website at https://www.qld.gov.au/environment/land/soil/

resources.qld.gov.au

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