Understanding soil pH

Soils can be naturally acid or alkaline, and this can be measured by testing the pH value of the soil. Having the correct pH is very important for healthy plant growth, so it is important to understand more about soil pH, and to be aware of the long-term effects of different soil management practices on soil pH. Research has demonstrated that some agricultural practices significantly alter soil pH values.

What is pH?

Soil pH is a measure of the acidity or alkalinity of the soil. This is measured using a logarithmic scale, which means that for a pH decrease of one, the acidity increases by a factor of 10.

A pH value is actually a measure of hydrogen ion concentration. Because hydrogen ion concentration varies over a wide range, a logarithmic scale (pH) is used. It is a 'reverse' scale in that a very acid medium has a low pH and a high hydrogen ion concentration. At high (alkaline) pH values, the hydrogen ion concentration is low.

Most soils have pH values between 3.5 and 10 (Figure 1). In higher rainfall areas the natural pH of soils typically ranges from 5-7, whereas in drier areas the range is 6.5-9. Soils with pH values of 6.5 to 7.5 are referred to as 'neutral'. Those with pH less than 6.5 are acidic, and soils with pH less than 5.5 are considered strongly acidic. Acid sulphate soils, which occur in low-lying coastal areas, can have extremely acidic pH values (pH less than 4).

Origins

Natural soil pH depends on the rock from which the soil was formed (parent material) and the processes that acted on it. These processes are 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 acidification process.

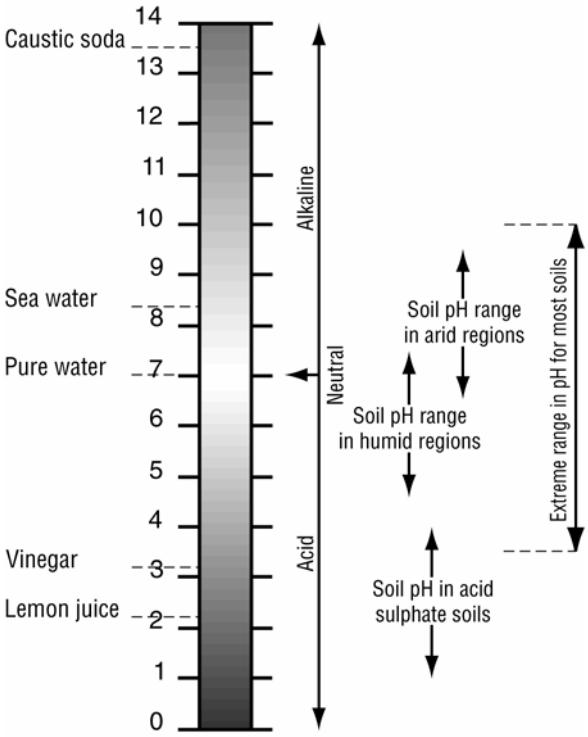

Figure 1. The range of pH values found in soils

Effects

Soil pH affects the amount of nutrients that are soluble in soil water and, therefore, the amount of nutrient available to plants. Some nutrients are more available under acid conditions while others are more available under alkaline conditions. However, most mineral nutrients are readily available to plants when soil pH is near neutral.

The development of strongly acidic soils (pH less than 5.5) can result in poor plant growth as a result of one or more of the following factors: low pH, aluminium toxicity, manganese toxicity, calcium deficiency, magnesium deficiency, and low levels of essential plant nutrients such as phosphorus and molybdenum.

Alkaline soils may have problems with deficiencies of nutrients such as zinc, copper, boron and manganese. Soils with an extremely alkaline pH (greater than 9) are likely to have high levels of sodium.

The correct balance of trace elements is obtained where the soil pH is between 5.5. and 7.5, so every effort should be taken to check soil pH levels regularly. 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

Some fertilisers can change soil pH and thus cause other nutrients to be more available to plants or, perhaps, reduce their availability.

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

When soils are too acidic for a particular crop, lime or dolomite 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 from soil to soil. Soils with high organic matter and clay content will be more resistant to changes in pH and will require larger application rates. Therefore soil pH, while indicating the need for lime, is not a reliable guide as to how much lime is required.

Field trials, in which good quality lime was cultivated into the soil surface to a depth of 10cm, have been undertaken on a number of acidic soils in Queensland. Across all soils, for every tonne of lime added per hectare, soil pH increases 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.

Liming tropical and subtropical acidic soils usually results in an increase in their capacity to hold nutrients. This effect of lime on the nutrient holding capacity of a soil is a benefit that is not often realised by landholders.

Measurement

Inexpensive and easy to use field kits are available to measure soil pH. These provide only an approximate soil pH value and laboratory testing is required to obtain an accurate pH value.

Most Queensland laboratories use a 1:5 soil:water suspension method to determine pH. However, some laboratories use different testing methods. For this reason it is advisable to seek professional advice when interpreting the significance of test results and in planning management strategies.

Further information

Another *NRW Facts* related to pH in soils are:

- L45 *Soil acidification*
- L60 *Acid sulfate soils in Queensland*.

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Fact sheets are available from NRW service centres and the NRW Information Centre phone (07 3237 1435). Check our web site <www.nrw.qld.gov.au> to ensure you have the latest version of this fact sheet. While every care is taken to ensure the accuracy of this information, the Department of Natural Resources and Water does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.
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