

Soil pH

The pH value of soil is a numerical expression of the intensity of acidity (or alkalinity) that in turn influences soil conditions and plant growth. The effects include changes in the solubility and activity of various biologically important elements and processes.

As with most measurements on soil, pH values vary with the procedure used. For example, pH is affected by the soil/solution ratio and by the composition and temperature of the equilibrating solution. In general, pH values increase as the ratio of soil/solution widens. Also, pH values of most soils are lower when determined in a salt solution rather than at the same soil/solution ratio in 1:5 soil/water (pH_w). Differences are commonly in the vicinity of 0.5 to 1.0 pH unit but inter-relationships vary with soil type and often are polynomial (Aitken and Moody 1991; Little 1992) rather than linear (Conyers and Davey 1988; Bruce *et al.* 1989). In highly weathered soils, the differences between pH values measured in salt solutions and in water extracts can be insignificant or even reversed. Ultimately, the laboratory measurement of soil pH, irrespective of the procedure, reflects the average of a range of effects at microscopic scale, including soil ionic strength, soil composition and biological activity.

For large numbers of Queensland surface soils, pH in a 1:5 soil/water extract of ≈ 5.0 – 5.4 is equivalent to pH in a 1:5 soil/0.01 M $CaCl_2$ extract of ≈ 4.6 . At pH 4.0 for a 1:5 soil/water extract, the corresponding pH of a 1:5 soil/0.01 M $CaCl_2$ extract is ≈ 3.5 (Ahern *et al.* 1995), although there are many exceptions, particularly in highly weathered and organic soils with variable surface charge characteristics.

The addition of soluble fertilisers to non-saline soils may result in an apparent lowering of soil pH when measured in water extracts but the presence of soluble fertilisers usually has little effect on the apparent pH, when measured in a salt solution such as 0.01 M $CaCl_2$. These effects are observed without any addition of H^+ to the system. Preferred pH_w levels in surface soils (0–10 cm) range from 6.0–8.0, although good growth of many plant species is possible over a wide range of pH values, in the absence of nutrient deficiencies or toxicities. Ratings for soil pH values are given in Table 4.1.

Table 4.1. Ratings for soil pH (adapted from Bruce and Rayment 1982 and USDA-NRCS 2004).

Rating	pH range	Rating	pH range
Ultra acid	1.8–3.4	Neutral	6.6–7.3
Extremely acid	3.5–4.4	Slightly or mildly alkaline	7.4–7.8
Very strongly acid	4.5–5.0	Moderately alkaline	7.9–8.4
Strongly acid	5.1–5.5	Strongly alkaline	8.5–9.0
Moderately acid	5.6–6.0	Very strongly alkaline	9.0–10
Slightly acid	6.1–6.5	Ultra alkaline	>10