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# Soil pH: What It Is, How It Is Measured, Why It Is Important

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Department of Agronomy

# Soil Science News & Views



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SOIL pH: WHAT IT IS, HOW IT IS MEASURED, WHY IT IS IMPORTANT.

J. H. Grove

## What is soil pH?

Soil pH is related to the hydrogen ion ( $H^+$ ) activity of the soil-water system. The chemical definition of pH is as follows:  $pH = -\log(H^+)$ . In other words, for a pH drop of 1 unit (e.g. from pH 6 to pH 5) there will be a ten-fold increase in  $H^+$  activity in the soil solution. If pH rises by 1 unit, only one-tenth as much acidity will be present in solution. As such, pH is only a measure of the active acidity in the soil water solution bathing plant roots. This fraction of total soil acidity is extremely small. It would take less than 1/2 pound of calcitic lime per acre to neutralize the active acidity contained in the soil solution of 8 inches of pH 5.0 silt loam topsoil at field moisture capacity.

The larger portion of total soil acidity, termed potential acidity, resides on the surface of soil clays and organic matter. The greater the soil clay or organic matter content, the greater the soil's ability to resist solution pH changes. This resistance is termed soil buffer capacity. It is possible for soils with very different quantities of potential acidity to have similar levels of active acidity. This observation has led soil testing laboratories to use two different, but complementary, measures of soil acidity.

## How is soil acidity measured?

The active acidity in soil solution is determined by placing a  $H^+$  sensitive electrode in a distilled water-soil suspension. The electrode is connected to a pH meter which then indicates the level of solution  $H^+$  activity detected by the electrode. This soil-water pH value is printed under the "pH" code on the UK Soil Test Report form.

A measurement of the soil's potential acidity is performed if the soil-water pH falls below 6.0 in order to determine the lime required to raise soil pH to higher values. This is done by suspending a portion of the soil sample in a solution that competes with the soil's buffering capacity and reacts with surface phase potential acidity. The buffer solution pH is preset at 7.0. The lower the pH of the buffer-soil suspension,

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the greater the soil's lime requirement. The buffer pH value is found under "BU" on the UK Soil Test Report form. Using Table 1, the lime requirement associated with a given buffer pH reading can be determined.

Why is a knowledge of soil pH important?

Soil pH can serve as a general indicator of soil nutrient availability, much like body temperature indicates general animal health. As soil acidity increases, soil pH falls and potentially toxic elements, especially manganese and aluminum, become more soluble and available for plant uptake. Acid soils are often low in other essential nutrients such as phosphorus and molybdenum. Acid surface soils can decrease the effectiveness of the triazine herbicides. Combined with a knowledge of past soil management and cropping history, an acid surface soil may indicate that soil acidity is being increased by large annual applications of ammoniacal nitrogen fertilizer.

Excessively high soil pH values also indicate potential nutrient stress problems. Deficiencies of iron, manganese, zinc, boron, copper and phosphorus may result in near neutral soils. Overliming, whether due to excessive application rates or improper spreader operation, should be avoided.

While these general rules of thumb are useful, they can not serve the producer unless regular soil samples (every 1 to 2 years) are taken.

Table 1. Limestone rates for soil buffer test readings.\*

Buffer pH	Ag. lime needed so raise soil pH to:	
	6.0	6.4
	-----tons/acre-----	
6.7	1.0	1.5
6.5	2.0	2.5
6.3	2.5	3.5
6.1	3.5	4.5
5.9	4.25	5.25
5.7	5.0	6.0
5.5	6.0	7.0

\* after: AGR-1. Lime and Fertilizer Recommendations.