SOIL pH

Soil pH indicates the acidity or alkalinity of soil based on a scale of 0 to 14. On the pH scale, 7.0 is neutral, values below 7.0 constitute the acid range, values above 7.0 make up the alkaline range.

Most Colorado soils are alkaline, having a pH between 7.0 and 8.0. A pH value above 8.5 indicates that the soil contains excess sodium. **While roses are tolerant to a wide variation, a slightly acid soil of 6.0 to 6.5 is generally considered ideal.**

A soil pH that is too high or too low interferes with or prevents the chemical reactions that make nutrients available to plants, in spite of regular fertilization. It is recommended that a soil pH test be carried out prior to amending your soil and periodically thereafter. Soil pH may be tested using inexpensive testing tapes or monitors available at local garden centers.

For a more extensive soil pH test, with recommendations, contact your local Colorado State University Extension Office[1] for procedure and cost. It is important to stress, to newcomers in particular, that additives such as lime and gypsum which may have been used in previous locations, should not be used automatically in Colorado.[2]

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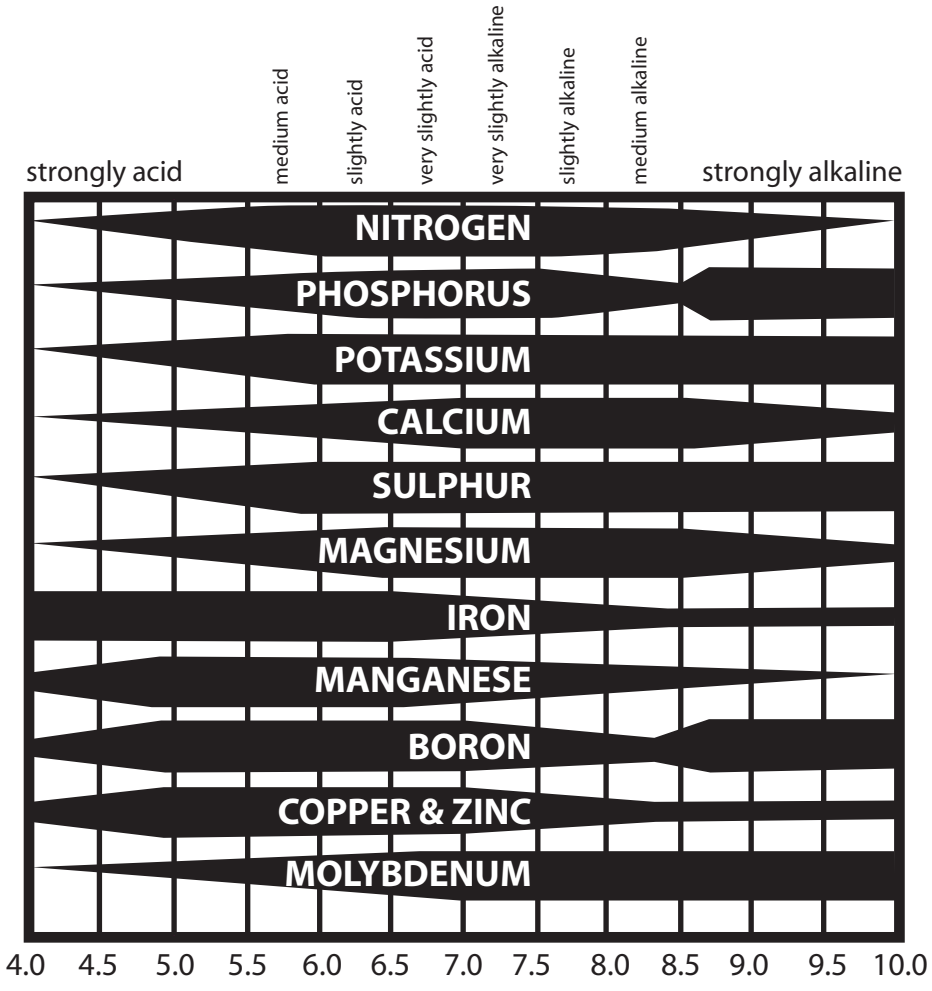
1 Graph courtesy of Colorado State University Extension

2 DRS Education Committee, April 2007



NUTRIENT AVAILABILITY VS. SOIL pH

Colorado Master Gardener[sm] Program
Colorado Gardener Certificate Training
Colorado State University Extension

GardenNotes #222

Soil pH

Fact sheet outline:

pH

Soil pH is a measurement of the acidity or alkalinity of a soil. On the pH scale, 7.0 is neutral, below seven is acid, and above seven is basic or alkaline. A pH range of 6.8 to 7.2 is termed ***near neutral***. Areas of the world with limited rainfall typically have alkaline soils while areas with higher rainfall typically have acid soils.

In Colorado, the majority of our soils are on the alkaline side, having a pH of 7.0 to 7.8 and above. Soils with a pH above 7.5 generally have a high calcium carbonate content, known as ***free lime***. In some mountain soils and older gardens that have been highly irrigated and cultivated for many years the pH may be in the neutral range or slightly acid.

Table 1. Soil pH and Plant Growth

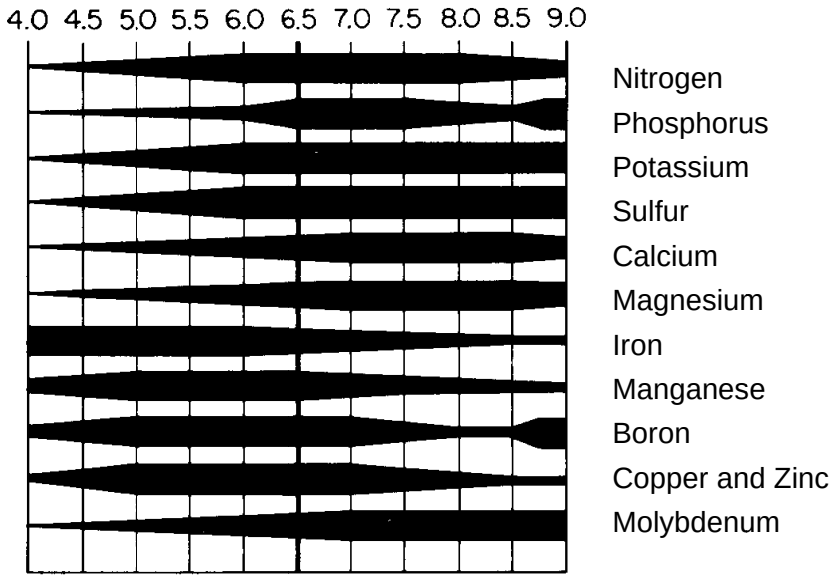
Soil Reaction	pH	Plant Growth
	>8.3	Too alkaline for most plants
	7.5	Iron availability becomes a problem on alkaline soils
Alkaline soil	**7.2**	6.8 to 7.2 – "near neutral" 6.0 to 7.5 – acceptable for most plants
Neutral soil	**7.0**	
Acid soil	**6.8**	
	6.0	
	5.5	Reduced soil microbial activity
	<4.6	Too acid for most plants

Many gardening books list the preferred pH for common plants (generally 6.0 to 7.2). For most plants, however, what is preferred and what is tolerated are not related. **Most garden and landscape plants tolerate a pH up to 7.5 to 7.8 with little problem.** The exception is acid-loving plants, like blueberries, azaleas, and rhododendrons that need acid soil. Blue hydrangeas also require a pH lower than 5.0 to induce the blue flower color. [Table 1]

pH and Nutrient Availability

Soil pH is an important chemical property because it affects the availability of nutrients to plants and the activity of soil microorganisms. The influence of pH on nutrient availability is illustrated in the Figure 1. Iron chlorosis is common in Colorado due to alkaline soil pH. Phosphorus will become less available in highly alkaline soils. Zinc deficiencies are occasionally observed in sensitive field crops, like corn and beans.

Figure 1. Availability of nutrients based on soil pH



Managing Alkaline Soils

In Colorado soils with moderate to high alkalinity (pH above 7.5), manage the soil by giving extra attention to increasing the organic matter, using organic mulches, and light frequent irrigation. Plants are less tolerant of dry soil conditions when the pH is high.

In Colorado, the major problem with high pH is iron chlorosis. For details, refer to CMG GardenNotes #223, *Iron Chlorosis.*

Soils with a pH above 7.3 and/or with *free lime* cannot be adequately amended for acid-loving plants like blueberries, azaleas, and rhododendrons.

In near-neutral pH soils rich with organic matter and without free-lime, gardeners may find a slight decrease in soil pH over many decades. This occurs as irrigation leaches out some naturally occurring elements (calcium and magnesium) contributing to the higher pH. The growth of plants that secrete weak acids into the soil may also contribute to a gradual pH change.

Lowering the pH

Textbooks talk of sulfur applications to lower a soil's pH. This is effective in many part of the country**. However it is not effective in many Colorado soils due to high levels of "*free lime*" (calcium carbonate) found in the soils.**

> To test for ***free lime***, place a heaping tablespoon of crumbled dry soil in a cup. Moisten it with vinegar. If the soil-vinegar mix bubbles, the soil has free lime. **On soils with *free lime*, a gardener will not effectively lower the pH.**

On soils without free lime, the following products may help lower the pH.

Elemental sulfur is one chemical that can be used to lower soil pH. The soil type, existing pH, and the desired pH are used to determine the amount of elemental sulfur needed, (see Table 2). Incorporate sulfur to a depth of six inches. It may take several months to over a year to react with the soil, lowering the pH. Test soil pH again 3 to 4 months after initial application. If the soil pH is not in the desired range, reapply.

Table 2. Pounds of Sulfur Needed to Lower Soil pH[1]

Material	pH change	Pounds per 100 square feet[2]
Sulfur	7.5 to 6.5	1.5
	8.0 to 6.5	3.5
	8.5 to 6.5	4.0
Iron sulfate	7.5 to 6.5	12.5
	8.0 to 6.5	29.0
	8.5 to 6.5	33.2

1 Effective only on soils without free lime, do the vinegar test.
2 Higher rates will be required on fine-textured, clayey soils and soils with a pH 7.3 and above.

Iron sulfate can also be used to acidify soils. This material reacts much faster than elemental sulfur, usually within three to four weeks following application. Do not apply more than nine pounds per 100 square feet in a single application. If higher rates are required, split applications to avoid excessive levels of soluble salts. (See Table 2)

Aluminum sulfate will also lower pH, but it is not recommended as a soil acidifying amendment because of the potential for aluminum toxicity to plant roots.

Acid sphagnum peat incorporated into the soil prior to planting will help provide a favorable rooting environment for the establishment of acid-loving plants in near neutral soils. Incorporate peat at the rate of one to two cubic feet per plant. The positive effects of acid peat will last a few years, but unless other measures are used, the pH of the soil will eventually increase. The pH will be driven up with the high calcium in our irrigation water. Soil high in a pH above 7.3 and/or with *free lime* cannot be adequately amended for acid-loving plants.

Fertilizers – Use of **ammonium sulfate** or **urea** as nitrogen fertilizer sources will also have a small effect on lowering soil pH in soils without free lime. However, do not use these fertilizers at rates greater than those required to meet the nitrogen needs of the plants. For example, ammonium sulfate fertilizer, 21-0-0, at ten pounds per 1000 square feet (maximum rate for crop application) may lower the pH from 7.3 to 7.2.

Fertilizers that contain nitrogen in the nitrate form will have a slight effect to increase the pH.

Raising the pH on Acid Soil

On acid soils, the pH can be raised by adding lime (calcium carbonate). The amount to add is determined by the ***Buffer Index*** test, which measures the responsiveness of the soil to lime applications. The soil test will give recommendations on application rates.

Home pH Test Kits

In alkaline soils, home pH kits have questionable value. Inexpensive kits do not calibrate closely enough on alkaline soils to be meaningful; and small changes in techniques, such as how much water and the pH of the water used in the sample, can change results. Most home soil test kits are designed for acid soils.

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