Soil pH and the Home Landscape or Garden [1]

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This publication explains soil pH and provides strategies for Master Gardeners and homeowners to make the most of the pH in the home landscape or garden. Soil pH is a measure of the acidity or alkalinity of the soil. On the pH scale, a value of 7 is neutral, pH values less than 7 are acidic, and pH values greater than 7 are alkaline. (Soils may be referred to as sour [acidic] or sweet [alkaline]. However, this classification method is now obsolete, and we strongly advise against tasting the soil to determine soil pH.) Homeowners and gardeners alike are interested in soil pH because soil pH directly affects the growth and quality of many landscape plants by influencing (1) the chemical form of many elements in the soil and (2) soil microbial processes. For example, landscape plants may exhibit nutrient deficiency or toxicity symptoms as a result of highly acidic or alkaline soil pH. In acidic soils, the availability of plant nutrients such as potassium (K), calcium (Ca), and magnesium (Mg) is reduced, while availability of potentially toxic elements such as aluminum (Al), iron (Fe), and zinc (Zn) are increased. In alkaline soils, iron, manganese (Mn), zinc, and boron (B) are commonly deficient. Soil pH can also affect soil bacterial and fungal activity, enhancing or inhibiting the development of soil-borne plant diseases or how efficiently microbes function as decomposing organisms.

The median soil pH for Florida soils is 6.1, which is characterized as slightly acidic. However, Florida soils can vary widely in pH, depending on the "parent material" from which the soil formed or on the management of the soil. For example, soils formed under pine flatwoods can be quiet acidic. In contrast, soils formed from calcium carbonate-bearing materials like limestone, marl, or seashells are alkaline. Alkaline conditions are common in coastal soils and the mineral soils of south Florida. It is also common to encounter alkaline soils in the home landscape as a result of calcium carbonate-rich building materials (i.e., concrete, stucco, etc.) that may be left in the soil following construction.

Determining Soil pH

Soil pH can be determined by sending a soil sample to a reputable lab such as the UF/IFAS Extension Soil Testing Laboratory (http://soilslab.ifas.ufl.edu). Some UF/IFAS Extension offices also offer soil pH testing; locate your local UF/IFAS Extension office at http://solutionsforyourlife.ufl.edu/map/. (See EDIS SL281/SS494: *Soil Sampling and Testing for the Home Landscape* at http://edis.ifas.ufl.edu/ss494 for information about how to properly take a soil sample). Once you receive the results of a soil pH test, you can determine which plants are best suited for your soil. From a plant nutrition standpoint, strongly alkaline conditions are a greater problem than strongly acidic conditions in Florida landscapes.

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Most common landscape plants are well suited to a wide soil pH range. For example, popular woody shrubs and trees (e.g., pittosporum, viburnum, oak, and pine) grow well in acidic to moderately alkaline soils. In addition, several common home lawn grasses can tolerate wide ranges in soil pH. The best pH range for vegetable and flower gardens on sandy soil is 5.8 to 6.3. If your soil pH is between 5.5 and 7.0, there is no need to adjust pH. However, there are a few acid-loving plants like azalea, blueberry, and gardenia that do not grow well in soils with pH greater than 5.5. *The Florida-Friendly Landscaping™ Guide to Plant Selection & Design* provides information about the soil pH tolerance of many landscape plants well suited to Florida growing conditions. *The Florida-Friendly Landscaping™ Guide to Plant Selection & Design* is available at http://fyn.ifas.ufl.edu/pdf/FYN_Plant_Selection_Guide_v090110.pdf or from your local UF/IFAS Extension office.

Changing Soil pH

The best advice about dealing with soil pH is to choose landscape plants suited for the natural pH of your landscape soil. While some soil additives can raise or lower the pH of soils, the effects of these materials are often short-lived. In addition, if your soil pH is within 0.5 of a pH unit of the ideal range, adjusting the pH will probably not improve plant performance. However, if you want to try to change your soil's natural pH to grow a specific plant, you have the following options.

Raising the pH of Acidic Soils

To raise the pH of acidic soils, add a liming material like calcium carbonate or dolomite. Dolomite has the added benefit of supplying Mg, which is often deficient in Florida soils. Have your soil tested before applying any liming materials because many of Florida's natural and urban soils have an alkaline pH. If a soil pH test indicates that your soil is acidic, it is important to test for the lime requirement before applying any liming materials to the soil. The lime requirement test measures your soil's natural ability to resist (buffer) changes in pH. This test is part of the standard landscape and garden soil test offered by the UF/IFAS Extension Soil Testing Laboratory. Results of this test will indicate the amount of agricultural limestone you should apply to a specific area to reach a target pH.

For lime to be effective, it should be thoroughly mixed into the top 6 to 8 inches of soil. Mixing is easily accomplished prior to planting a garden or landscape. If applying lime to established landscapes or turf, incorporation can damage plant roots. In established landscapes, lime can be surface-applied and watered in, but take care not to overwater (e.g., no more than 0.5 inches of water over the treated area). Also, when applying lime to established areas (such as turf), choose non-caustic liming materials (e.g., ag lime vs. calcium oxide [CaO]). If the recommended lime rate exceeds 25 lb per 1000 square feet (0.5 tons per acre), splitting the application and applying the liming materials over a period of 3 to 4 weeks will reduce the chances for plant-related issues.

Lowering the pH of Alkaline Soils

Unlike liming, lowering the pH of strongly alkaline soils is much more difficult if not impossible. In fact, there is no way to permanently lower the pH of soils formed from high Ca materials, such as marl or limestone, or soils severely impacted by alkaline construction materials. In these circumstances, it is best to select plants that are tolerant of high pH conditions to avoid chronic plant nutrition problems.

Soil pH can be temporarily lowered by adding elemental sulfur. Bacteria in the soil change elemental sulfur into sulfuric acid, effectively neutralizing soil alkalinity. However, the effect of elemental sulfur is localized to the area that was amended, and the effect is temporary. Soil pH will begin to rise shortly after soil bacteria exhaust the added sulfur supply. This effect prompts repeated applications of sulfur to ensure that the soil remains at the desired pH. Using sulfur to amend a soil is complicated. Adding sulfur at high rates or applying it too frequently can damage your plants. If you decide to apply sulfur, be sure to look for signs of plant response after the application.

Depending on the measured and desired soil pH, elemental sulfur should be added to sandy soils at a rate of 4 to 19 lbs of sulfur per 1000 square feet (Table 1). Note that lowering soil pH below 5.0 is not recommended because of the potential for Al toxicity. Also, to avoid burning plants, add no more than 14 lbs of sulfur per 1000 square feet of soil in a single application to bare soils. Prior to plant installation, sulfur can be incorporated directly into the entire planting bed to the depth of the root zone of the plants to be established.

When applying sulfur to planted areas, no more than 7 lbs of sulfur should be applied per 1000 square feet to avoid burning plants. A partial root zone treatment can be used to apply powdered or granular sulfur to areas that are already planted. This practice allows the sulfur to lower the pH in the root zone quickly and be of more benefit to the existing plants. To use the partial root zone treatment, remove soil in the root zone of existing plant material and set it aside. Incorporate sulfur into the excavated soil at the appropriate rate to achieve the desired soil pH (Table 1). Refill the hole with amended soil.

Table 1. Reducing soil pH with sulfur in sandy soils (Adapted from Kissel and Sonon (2008)).

	Desired Soil pH		
	5.0	**5.5**	**6.0**
Initial Soil pH	**Sulfur* Required: lbs per 1000 square feet**		
5.0	0	--	--
5.5	4	0	--
6.0	8	4	0
6.5	12	8	4
7.0	15	12	8
7.5	19	15	12

* To convert to aluminum sulfate multiply the amount of element sulfur × 6.

Other soil amendments, such as ammonium sulfate, iron sulfate, and aluminum sulfate, can also be used to lower soil pH. These amendments are often included in so-called "acid-forming fertilizers" commonly applied to azalea. However, not all sulfate materials (e.g., calcium sulfate [gypsum], magnesium sulfate [Epsom salt], and potassium sulfate) will acidify soil. Alternatively, organic materials like peat or animal manure also counter the effects of alkaline soil pH on some landscape plants. Since these materials decompose with time, annual or semiannual applications are usually required.

Summary

Always consider the pH of your soil when selecting new plant material for your home landscape or garden. Take action to correct soil pH only when it is substantially higher or lower than the desired pH for the plants you are growing. To avoid damage to your landscape plants, always have your soil tested for pH and lime requirement (if soil pH is acidic) before adding lime or sulfur to the soil. Finally, if you are interested in growing specific plants that are not suited for your soil pH, consider growing them in pots, where you are able to amend small volumes of soil to reach the desired pH.

Reference

Kissel, D. E., and L. Sonon (eds.). (2008). *Soil Test Handbook for Georgia*. Athens: University of Georgia. http://aesl.ces.uga.edu/publications/soil/STHandbook.pdf (February 2014).