WEST VIRGINIA UNIVERSITY EXTENSION SERVICE

ANR-SOWA-15-001

Preparing Soil for Acid-loving Plants

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Learn how to modify soil pH in preparation for acid-loving plants.

About soil pH

Soil pH is a measure of the acidity of the soil. When pH is below 7.0, the soil is said to be acidic. Soils become acidic when calcium and magnesium are leached from the soil. Leaching generally occurs in regions that receive in excess of 24 inches of precipitation per year. As calcium and magnesium are leached and replaced by exchangeable hydrogen and hydrated forms of iron and aluminum, the soil acidifies. Typically, most West Virginia soils are acidic, with a pH between 5.3 and 5.8. If you intend to grow acid-loving plants like azaleas, rhododendrons, gardenias, blueberries, heath, and heather you may need to acidify your soil.

Start with a soil test

Before acid-loving trees and shrubs are planted, the pH of the soil should be determined with a soil test. Test results will detail how to adjust your soil pH to the desired level. When possible, naturally acidic soil material, preferably rich in organic matter, should be used for backfill (the soil material placed around new plantings to fill the hole back in). When pH is too high, acidic or sulfur-containing materials should be mixed with the backfill material. If at all possible, modify pH before planting, since modifying pH post-planting requires more caution and is less successful. Also, avoid situations where you need to make large changes in pH.

Figure 1. *Soil ball and soil ribbon. (from Michigan State University)*

Consider soil texture

Soil texture impacts the effort required to modify soil pH. Sandy soils respond more quickly to soil acidification attempts than loamy soils. In general, as the soil's clay content increases, the amount of sulfur needed to reach a desired pH increases. To determine the amount of sulfur needed for a specific pH change in the two soil texture categories, see Table 1. Note that compared to sandy soils, loamy soils require dramatically higher sulfur rates to change the soil's pH.

Determining soil texture

To determine whether your soil is sandy or loamy, examine the soil texture by feel. Place about one tablespoon of soil in your palm, remove any plant roots, and add a few drops of water. Knead the soil until it is a uniform consistency, free from particles larger than 2mm. Squeeze the soil into a ball. If it will not form a ball,

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Table 1. Pounds of sulfur per 100 ft^2 to change pH

		Ending pH															
		4.0		4.5		5.0		5.5		6.0		6.5		7.0		7.5	
		Sand	Loam	Sand	Loam	Sand	Loam	Sand	Loam	Sand	Loam	Sand	Loam	Sand	Loam	Sand	Loam
Starting pH	**4.0**	0.0	0.0														
	4.5	0.4	1.2	0.0	0.0												
	5.0	0.8	2.4	0.4	1.2	0.0	0.0										
	5.5	1.2	3.5	0.8	2.4	0.4	1.2	0.0	0.0								
	6.0	1.5	4.6	1.2	3.5	0.8	2.4	0.4	1.2	0.0	0.0						
	6.5	1.9	5.8	1.5	4.6	1.2	3.5	0.8	2.4	0.4	1.2	0.0	0.0				
	7.0	2.3	6.9	1.9	5.8	1.5	4.6	1.2	3.5	0.8	2.4	0.4	1.2	0.0	0.0		
	7.5	2.7	8.0	2.3	6.9	1.9	5.8	1.5	4.6	1.2	3.5	0.8	2.4	0.4	1.2	0.0	0.0

it is very sandy. If the soil forms a ball, place the ball of soil between your thumb and forefinger and gently push it with your thumb, working it outward into a ribbon (see Figure 1). If you can make a ribbon, your soil is loamy. Based on this general characterization of your soil's texture, you can determine the proper amount of sulfur or other acidifying materials to add (see Table 2).

Table 2. Soil Acidifying Agents with Conversion Factors

Simply multiply the "sulfur needed" number from your soil test report by the conversion factor for your material to determine the amount you need.

Material	Chemical Formula	Conversion Factor
Iron Sulfate	FeSO4	9
Aluminum Sulfate	Al2(SO4)3	7
Ammonium Sulfate	(NH4)2SO4	4

Spectrum Analytic Inc. Fertilizing Blueberries *www.spectrumanalytic.com*

Soil modification

Soil test recommendations for adjusting pH levels are based on the amount of sulfur needed to achieve the desired change in pH. Conversion factors for other acidifying materials can be seen in Table 2. For a small change in pH, any fertilizer containing ammonium (NH4) has the potential to lower pH. Microbes in the soil transform this nitrogen source into nitrate (NO3-). During this process, acid is generated and pH is lowered. This technique is best suited for long-term pH management and for making changes in the range of 0.2 – 0.3 units.

Larger differences between the current and target pH levels require more chemicals, more time, and are more prone to unwanted rapid drops in pH. For example, changing from a pH of 7.8 to 4.8 can be very difficult and time consuming. Small quantities of aluminum sulfate can be used to make moderate changes in pH, but they are ineffective for making large changes. Additionally, large applications of aluminum sulfate can produce a toxic salt effect. A preferred choice when making large changes in pH is to add enough elemental sulfur to the soil when planting to partially change the pH. By incorporating most of the needed sulfur into the soil, and allowing time for the pH to change, you can get the pH close to the optimal level. Then retest and add a second, smaller surface application the following year to reach the target pH.

Modification for established plants

If you have established plants, you must be very careful when modifying pH. To lower pH after planting, you can use the same materials as you would use prior to planting. However, for the sulfur additives to have the desired effect, there must be soil-to-sulfur contact, adequate moisture, proper temperature and sufficient microbes. This requires the additives be mixed into the soil. Be careful; total incorporation of acid-generating materials risks root damage to shallow-rooted plants (see Figure 2).

Figure 2. *Potential root damage can occur when incorporating acid-producing materials around established plants.*

One approach to more safely adjust soil pH post-planting is to create a feeding bar. Feeding bars act as a localized source from which the plant can supplement its needed nutrients, without the grower having to disrupt the majority of the plant's roots. To make a feeding bar dig a 6 to 12 inch deep hole (or multiple holes for large plants) in the soil at about the drip line's distance from the plant's stem (Figure 3). Place sulfur mixed with soil into the hole and backfill with organic matter or top soil. In the remaining rooting area, add acidifying materials, incorporate them with great caution, and cover them with organic matter. Be very careful not to damage the roots of your acid-loving plants when incorporating the acid-generating materials into the soil surface. Most acid-loving plants will also benefit from an annual mulching with acidic organic materials.

Figure 3. *Create a feeding bar by digging a small hole 6 to 12 inches deep near the drip line of an established plant. Fill feeding bar with sulfur and soil, and cover with organic matter; apply remaining acidic material to the soil's surface around the plant and cover with organic matter.*

Example of soil pH modification

Assume you have an existing stand of blueberries in loamy soil with a pH of 5.5. Since blueberries prefer a soil pH around 4.2, our needed change is 1.3 pH units. With a 100 ft^2 bed, we will need to add between 2.4 and 3.5 pounds of sulfur to change the pH (from Table 1). In this scenario, add 2 pounds of sulfur to a freshly raked soil surface, carefully incorporate the materials into the soil, and cover the surface with pine bark mulch. Next dig a small post hole 6 to 12 inches deep at or near the drip line of the plant. Fill the hole with $^1/_2$ pound of sulfur mixed with native soil, and top it with pine bark mulch. The following year, take a soil sample from inside the drip line, away from the feeding bar, and measure the pH. Fertilize the blueberries with ammonium-containing fertilizer, and add other soil-acidifying materials to the soil's surface below the pine bark mulch, inside the drip line,

as needed to reach the target pH. If the pH is very high, a second feeding bar may be needed.

References

Ball, J. 1988. Rodale's Garden problem solver: vegetables, fruits, and herbs. Rodale press, Emmaus, PA.

Colier, C.W. 1981. Preparing soils for acid loving plants. West Virginia University Cooperative Extension Service. *www.caf.wvu.edu/plsc/side%20menu/wvu%20soil%20lab/Soil%20Test%20Web%20Page/Soil%20for%20Acid%20Loving%20Plants%20P1.pdf*

Hart, J., D. Horneck, R. Stevens, N.Bell, C. Cogger. 2003. Acidifying soil for blueberries and ornamental plants in the yard and garden. Oregon State University Cooperative Extension Service. *extension.oregonstate.edu/catalog/pdf/ec/ec1560-e.pdf*

Havlin, J.L., J.D. Beaton, S.L. Tisdale, and W.L. Nelson. 2005. Soil fertility and fertilizers – An introduction to nutrient management. 7th ed. Prentice Hall, Upper Saddle River, NJ.

Mullen, R.E. Lentz, M. Watson. 2007. Soil acidification: how to lower soil pH. Ohio State University Extension fact Sheet AGF-507-07. *ohioline.osu.edu/agf-fact/pdf/0507.pdf*

Skousen, J., and L. McDonald. 2005. Liming Principles and Lime Products. West Virginia University Cooperative Extension Service. *anr.ext.wvu.edu/r/download/44896*

Spectrum Analytic. Guide to fertilizing blueberries. *www.spectrumanalytic.com/support/library/pdf/Fertilizing%20Blueberries.pdf*

Thien, S.J. 1979. A flow diagram for teaching texture by feel analysis. *Journal of Agronomic Education*. 8:54-55.

For more information

Last updated May 2015

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