Lowering soil pH

Most horticulture and agronomic crops grow best when soil pH is about 6.0 to 6.5. Many crops can also adapt to higher or lower pH, with no adverse effect on crop quality or yield. However, crops like blueberries and rhododendrons require acid soil conditions (soil pH of 5.5 or less) in order to grow and perform as expected.

Many soils in Wisconsin especially in south-eastern Wisconsin are alkaline (high pH), and may contain free calcium carbonates. These carbonates are a source for alkalinity. Soils in Milwaukee, Waukesha, Kenosha and other eastern Wisconsin counties are a special case because they are marl-based. Marl is a finely divided calcareous material deposited when the area was an old lake bed. Having this marl-based soil means very finely sized highly reactive free calcium carbonate is present and soil pH can reach very high levels, (7.5 or greater). These alkaline soils having free calcium carbonate will require high levels of management to grow acid requiring crops successfully. Adding a sulfur amendment to these soils that contain free calcium carbonate will probably not result in a significant pH decrease because all carbonate must dissolve before soil pH will change. The amount of carbonate, its particle size and origin all affect the ability of a sulfur amendment to change pH. Some soils having high carbonate content, especially if marl-based, will show little pH change even after large sulfur additions. If you have soil pH of 7.5 or greater, consider growing crops that do not require low pH. You will probably not be able to achieve or maintain and acid soil pH in these areas with reasonable applications of a sulfur amendment.

For most soils in the rest of Wisconsin that have a pH less than 7.5, you should be able to add elemental sulfur or aluminum sulfate in sufficient quantities to lower soil pH to the desired level. The change in pH will take 2 to 3 months, so if you should decide to plant crops requiring low pH it might be best to add sulfur this year and do your planting in the following year.

Roots of these acid sensitive plants will not extend far beyond the acidified soil zone, so make sure the hole you prepare is adequate for expected root growth. The amount of elemental sulfur needed depends on the initial soil pH and the organic matter content of the soil.

Have your soil tested by the UW Soil and Plant Analysis Lab, Madison or the UW Soil and Forage Analysis Lab, Marshfield to know the soil pH, organic matter content and other fertility levels are in your soil. Contact the Lab (608-262-4364 Madison or 715-387-2523 Marshfield) or your local county extension agent for sampling instructions.

Sulfur is a soil amendment which can be used to lower soil pH. It takes about 32 lbs of finely ground elemental sulfur to reverse the soil pH change

obtained with 100 lbs of lime. It is not desirable to use over 20 lbs of sulfur per 1000 sq. ft. at any one time. If more is required, use split applications of 20 lbs and apply in succeeding years. Check the soil pH before making a second application in order to see how much change has taken place.

In order to lower the pH of the soil, sulfur must be oxidized by bacteria to sulfate. Sometimes the soil will contain very small numbers of this special kind of bacteria. Under these conditions, it will take longer for the bacteria to oxidize the sulfur, perhaps 6 months or more. The oxidizing reaction brought about by the organisms is as follows:

$$S + 3/2\ O_2 + H_2O \longrightarrow 2\ H^+ + SO_4\ =$$

Approximate pounds of finely ground elemental sulfur needed to increase soil acidity.

	Soil organic matter content, %					
Change in pH desired	0.5 to 2	2 to 4	4 to 6	6 to 8	8 to 10	>10
	pounds of sulfur per 1000 sq. ft.					
0.25	6	18	28*	40*	53*	62*
0.50	12	35*	56*	80*	106*	125*
1.00	24*	70*	112*	120*	212*	250*

* Do not apply more than 20 lbs of sulfur per 1000 sq. ft. per year. Retest soil between applications.

Most urban soils will require between 35 and 56 lbs sulfur/1000 sq. ft. to lower soil pH 0.5 units. In general, it is not recommended to apply more than 20 lbs of sulfur per 1000 sq. ft. at any one time. If more is required, split applications and apply in succeeding years. If you are planting a single rhododendron, assume the hole should be equivalent to the surface area of about 9-16 sq. ft. (3 ft. or 4 ft. square). If soil pH needs to be reduced by 0.5 unit, about 0.5 to 1 lb of elemental sulfur should be applied and incorporated to a depth of at least 6-8 inches. Please remember that at the recommended maximum annual rate of 20 lbs / 1000 sq. ft. only about 0.20 lbs can be safely applied to a 10 sq. ft. area at one time. Caution must be exercised if this rate is exceeded and planting should probably be delayed. One pound of elemental sulfur is equal to about 2 cups. Topdressing sulfur is not as effective as incorporation. Plan to add sulfur to the soil well before planting. Take a soil sample to depth of 6 inches about 3 months after your initial application to check pH. If soil pH has not been reduced to desired levels, top-dress additional elemental sulfur equivalent to no more than 6

lbs/1000 sq ft. Some incorporation is needed because elemental sulfur is converted to the acidifying sulfate from only by soil microbes.

Aluminum sulfate can also be used to lower soil pH. Its effect is nearly immediate. It is also more readily available at lawn and garden centers, but generally more expensive. The amount of aluminum sulfate needed to achieve the same decrease in pH is 6 times the amount of elemental sulfur required. If 1 lb of elemental sulfur incorporated in a 9-16 sq. ft. area 6-8 inches deep is needed for each rhododendron, about 6 lbs of aluminum sulfate should be added. One pound of aluminum sulfate is equal to about 2 cups. Because too much aluminum and iron can be toxic to plants, aluminum sulfate should not be applied at rates exceeding 50 lbs per 1000 sq. ft. or 0.5 lbs per 10 sq. ft. at any one application. Please keep in mind that fertilizer products containing sulfate-sulfur are not effective in lowering soil pH. This includes products such as potassium sulfate (K_2SO_4) and gypsum ($CaSO_4$). Remember to amend the soil well in advance of planting. Poor plant growth and potential temporary acid toxicity can result if sulfur has not fully reacted by planting time.