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Extension FactSheet

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Soil Acidification:
How to Lower Soil pH

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Many plant species require acid soil conditions to thrive. Throughout Ohio and many other parts of the Midwest surface soils are neutral to slightly alkaline. Elemental sulfur can be applied as a soil amendment to decrease the pH or acidify such soils. Due to the cost, the application of sulfur to acidify soils is more practical for horticultural crops than agronomic crops. The objective of this fact sheet is to provide interested individuals (agronomic and horticultural) with rates necessary to adjust soil pH.

Sulfur reaction in the soil is slow, and quick changes in soil pH should not be expected. It may take a few months or longer to change soil pH to the desired level because the process of sulfur oxidation (conversion of elemental sulfur to sulfate) is the result of microbial activity. Elemental sulfur should be incorporated to increase the speed of oxidation. Since the oxidation of sulfur is the result of microbial activity, fall and winter applications are not advisable (it can be done but changes in soil pH will not occur). Equation 1 shows the chemical process by which sulfur (S) application results in release of hydrogen ions (H^+) to change soil pH:

Equation 1:

$$CO_2 + \mathbf{S^0} + \tfrac{1}{2}O_2 + 2H_2O \rightarrow CH_2O + SO_4^{2-} + 2\mathbf{H^+}$$

Addition of elemental sulfur to soil produces two hydrogen ions, which can be seen from Equation 1 (Havlin et al., 1999). The hydrogen ions released cause soil pH to decrease. Soil pH is, after all, simply a measure of the hydrogen ion concentration in soil solution, and the higher the concentration, the lower the soil pH.

If the soil is calcareous (contains free calcium carbonate), additional sulfur will be required to neutralize the free calcium carbonate. To neutralize a soil that contains 2% calcium carbonate, for example, requires 6 tons of sulfur per acre (this only neutralizes the calcium carbonate; additional sulfur will be needed to affect a change in soil pH). Obviously, it would be impractical to apply enough elemental sulfur to alter soil pH of calcareous soils on a field scale. Soils of Eastern Ohio typically do not contain free calcium carbonate, but there are soils in Western Ohio that do. Assuming there is no free calcium carbonate, the amount of elemental sulfur needed to lower soil pH is given in Table 1. Note that the amount of sulfur required to lower soil pH varies depending upon soil texture.

To convert the recommended rates from pounds per acre to pounds per 1000 ft^2 divide the values in Table 1 by 43.56. To adjust the pH of a soil with a measurable volume, use Equation 2 to determine the rate of sulfur needed:

Equation 2:

$$\text{Calculated rate (lb/volume)} = \text{sulfur recommendation (lb/A)} \div 37{,}635{,}722 \times \text{soil volume (in}^3\text{)}$$

When using Equation 2, the sulfur recommendation is determined from Table 1, and soil volume is the vol-

Table 1. Rates of elemental sulfur required to decrease soil pH to a depth of 6 inches.

	Application rate based on soil texture[1]		
Desired change in pH	**Sand**	**Silt loam**	**Clay**
	---------- lb S/A ----------		
8.5 to 6.5	370	730	1460
8.0 to 6.5	340	670	1340
7.5 to 6.5	300	600	1200
7.0 to 6.5	180	360	720
8.5 to 5.5	830	1660	3310
8.0 to 5.5	800	1600	3190
7.5 to 5.5	760	1530	3050
7.0 to 5.5	640	1290	2580

[1]Assumptions—cation exchange capacity of the sandy loam, silt loam, and clay soil are 5, 10, and 20 meq/100 g, respectively; soils are not calcareous.

ume (in cubic inches) of soil in the container. If acidifying the entire volume of soil (which may be possible if the container is small enough), mix the sulfur with the soil thoroughly. If the sulfur cannot be adequately mixed with the entire volume of soil, then determine the area of the container (in square inches – width * length) and determine to what depth the sulfur can be incorporated (measurement in inches). Calculate the volume of soil (in^3) and use Equation 2 to determine the new sulfur rate. For example, if attempting to acidify soil in a container that is 36 inches in diameter to a depth of 8 inches and the recommended rate of sulfur (based on initial soil pH) is 360 lb sulfur per acre, it would require 0.08 lb of sulfur be mixed with the top 8 inches of soil (360 ÷ 37,635,722 x 8143). For a deep rooted crop this may not acidify the entire volume of soil, so multiple applications over time will probably be necessary. Remember, soil pH adjustment will not happen quickly, so give the material time to react.

Soil pH adjustments with elemental sulfur should be monitored over time with routine soil sampling and analysis. This will ensure that the sulfur applied is having the desired effect on soil pH. Soils that are overacidified due to sulfur application (soil pH is lower than desired) should be limed to neutralize soil pH to the desired soil pH level. Soils that are underacidified (soil pH is higher than desired) should receive additional sulfur. Once the soil pH has been acidified to the desired level, the soil pH should remain low for a fairly long period (greater than 5 years). It may not be definite, so monitoring of soil pH with soil sampling is important.

References

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