Sulfur for crop production

Donald R. Christenson, Department of Crop and Soil Sciences, Michigan State University

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Sulfur (S) is an essential element for all plants and animals. Plants contain smaller amounts of S than the major elements, N and K, but it may be present in similar quantities as P in some plants. However, it is required in much larger quantities than the micronutrients. Sulfur uptake by most crops is less than 20 pounds, although a 6-ton alfalfa crop may contain up to 30 pounds per acre.

An understanding of atmospheric deposition of S seems in order. Assessing the amount of S added to soil through precipitation can be approached through global considerations and through a site (area) specific measurements. On a global basis, sulfur is added to the atmosphere from oceans (24 percent of total added), soils (35 percent), volcanic activity (6 percent) and man's activities (35 percent).

Sulfate salts present in sea water and dimethyl sulfide [$(CH_3)_2S$] from algae activity can be released as particles when spray bubbles burst above the ocean surface. The fine particles of these aerosols remain suspended for some time and contribute to the global S budget.

Soils represent another major source of natural S. Emission of S gases occurs in both aerobic and anaerobic (water logged) soils. However, the rate of emission varies greatly between various soil types and among different sites within a soil type. For example in one study, S emissions from Mollisols ranged from 1 ounce to 1.6 lb/A/year, Histosols from 2 ounces to 3 lb/A/year while saline marshes ranged from 3 ounces to 6,000 lb/A/year.

Volcanic activity contributes S to the atmosphere. The large amount released during volcanic eruptions can cause extensive variations in the global budget. It is thought that S released during non eruptive periods plays a major role in the global S budget.

Industrial contributions come mainly from combustion of S containing fossil fuels. The focal point of recent efforts to reduce S emission has been in electrical generating plants. As of this writing, the best estimate shows that there has been a 20 percent reduction in S emissions from this source. If this represents the reduction of all of human activity, there would be a 7 percent (0.20 x 35) reduction in the man-made S contribution.

It is known from previous studies that sulfur deposition is not uniform across the state of Michigan. Measurements to determine the amount contributed from precipitation are needed. No current results of S deposition from a systematic study were found. Consequently, we don't know how much S is deposited in Michigan.

Deficiencies of S may occur in Michigan, although to date no well-defined situations have been identified. Deficiency symptoms on most crops are similar to those of nitrogen. A light green color over most of the plant is the first noticeable symptom. As the severity increases, younger leaves will show the most yellowing. This will start at the base and

extend to the tip of the leaf.

The most likely conditions for S deficiency are for crops grown on sandy, low organic matter soils. Legumes, especially alfalfa, and canola will normally be the first crops to respond to S fertilization.

In over 50-location-year experiments in Michigan there have been three cases where there was a significant response to applied sulfur. One was on kidney beans grown on an acid sandy soil. However, there was a similar response to applied lime without sulfur. The second was on a loam soil where alfalfa responded in one out of three years to applied sulfur. The third was on canola on a sandy loam soil in the Upper Peninsula in 1997. Ear leaf samples from 176 corn fields showed only one sample which tested below the critical concentration of 0.16 percent. There have been no further problems on that field. One of the reasons that response to applied S is not seen is that the concentration in soils increases with depth.

Sulfur is not recommended for application to field crops in Michigan because yield responses have been rare and inconsistent. Soil tests measuring sulfate-sulfur do not predict when S should be applied. This may be related to the increase in S with depth seen in a number of situations. There is no evidence to suggest that protein can be increased by applying S under Michigan conditions. Often an increase in protein is associated with an increase in yields.

Several materials contain S. Among the most commonly available are ammonium sulfate (24 percent), gypsum (19 percent), potassium sulfate (18 percent) and potassium-magnesium sulfate (18 percent). A number of other fertilizers contain S, but are usually used in small quantities so don't contribute much S. These include copper sulfate (12 percent, ferrous sulfate (19 percent), magnesium sulfate (13 percent), manganese sulfate (21 percent) and zinc sulfate (18 percent).

Where S deficiency is suspected, apply 20 to 40 pounds of S per acre. Use test strips to determine if there is a response.

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