IPNI Plant Nutrition TODAY
Better Crops, Better Environment...through Science

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SULFUR—THE 4TH MAJOR NUTRIENT

Sulfur is an essential nutrient in crop production. It is classified as a secondary element, along with Mg and Ca, but it is sometimes called "the 4th major nutrient". Some crops can take up as much S as P. Sulfur has become more important as a limiting nutrient in crop production in recent years for several reasons. These include higher crop yields that require more S, less S impurities in modern fertilizers, less use of S-containing pesticides, reduced industrial S emissions to the atmosphere, and a greater awareness of S needs.

Sulfur serves many functions in plants. It is used in the formation of amino acids, proteins, and oils. It is necessary for chlorophyll formation, promotes nodulation in legumes, helps develop and activate certain enzymes and vitamins, and is a structural component of two of the 21 amino acids that form protein.

The crop's need for S is closely associated with N. The relationship between S and N is not surprising since both are components of protein and are involved in chlorophyll formation. They are also linked by the role of S in the conversion of nitrate to amino acids. Crops having high N need will usually also have high S needs.

The majority of S in most soils is contained in organic matter. Organic S must be mineralized to the inorganic sulfate anion before it can be taken up by crops. Organic matter decomposition and the resulting S release is affected by temperature and moisture, and generally conditions that favor crop growth also favor mineralization and release of S, although this may be less likely with cool season crops. Sulfate, like most anions, is somewhat mobile in soils and therefore subject to leaching. Soil conditions where S is most likely to be deficient are low organic matter levels, coarse (sandy) texture with good drainage, and high rainfall conditions. But, these are generalizations and S can be deficient under other conditions as well.

Several factors should be taken into account when making S fertilization decisions. Among these are crop and yield goal, soil and plant analysis, organic matter content, soil texture, and contribution from other sources such as irrigation water and manure. High yielding forage crops such as alfalfa and hybrid bermudagrass remove more S than most grain crops and tend to be relatively responsive. Soil test S is usually a measure of sulfate-S, and as with nitrate-N samples should be taken deeper than normal (0 to 2 ft.) because of sulfate mobility in the soil. Soils containing less than 2% organic matter are most commonly S deficient; however, deficiencies do occur in soils with higher organic matter. Coarse textured soils are more apt to need S, but finer textured soils can also be deficient. Sulfur content of irrigation water should be determined since in some cases it can deliver significant amounts of S.

There are several S fertilizer sources available. Most soluble S fertilizer contains sulfate, but others such as bisulfites, thiosulfates, and polysulfides are also available. The most common insoluble S fertilizer is elemental S, which must be oxidized to sulfate before plants can use it. This is a biological process and is affected by temperature, moisture, aeration and particle size. This process also produces acidity, and elemental S can be used in some instances specifically to acidify soils.

Sulfur is an important component of complete and balanced crop nutrition, and has justifiably gained more attention in recent years. Several factors should be considered to make the best decision regarding S need and fertilization.

—WMS—

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Abbreviations: Mg = magnesium; Ca = calcium; P = phosphorus; N = nitrogen; S = sulfur.

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