SULFUR DEFICIENCY: A POTENTIAL PROBLEM

Distribution of total and available sulfur in selected soils and soil profiles. *M.A. Tabatabai and J.M. Bremner. 1972. Agronomy Journal. 64:40-44. (from the Department of Agronomy, Iowa State University, Ames, Iowa 50010).*

The sulfur status of Iowa soils was evaluated during the course of this study. Sixty-four surface soils, representing the major soil series occurring in Iowa, were analyzed for sulfate-sulfur and mineralizable sulfur.

The results indicate that most of the agriculturally important soils in Iowa have low reserves of plant-available sulfur. Thus, these soils may require sulfur fertilization for satisfactory plant growth, particularly for those species having a high sulfur requirement. The total sulfur content of the soils analyzed ranged from 57 to 618 parts per million; the average was 294 parts per million. The sulfate-sulfur content ranged from one to 26 parts per million and averaged nine parts per million. The total sulfur content was highly correlated with the organic carbon content of the soils. In addition, the sulfate-sulfur content was significantly correlated with the total sulfur content. The majority of the sulfur occurring in these soils was in the organic sulfur form rather than mineralizable sulfur. Analyses of sulfur distribution vertically through the soil profile revealed that the total sulfur content decreased markedly with an increase in the soil depth. The authors concluded that Iowa soils have low reserves of plant-available sulfur.

Comments: Sulfur (S) is an essential macro-nutrient for turfgrass growth and development. A sulfur deficiency results in the disruption of protein synthesis and a subsequent impairment of growth. Some sulfur also occurs in plant tissues in the form of sulfates and certain volatile compounds. The quantity of sulfur removed in turfgrass clippings is similar to the quantity of phosphorus removed.

A sulfur deficiency usually involves an initial paling of the older, lower turfgrass leaves. The leaf blades develop a pale yellow-green appearance as the deficiency progresses. A faint scorching of the leaf tip is also associated with discoloration. The scorching advances toward the base of the blade in a thin line along each leaf blade margin. Eventually the scorching enlarges until the entire leaf blade is affected and withers.

The visual foliage symptoms of a sulfur deficiency are quite similar to those of a nitrogen deficiency. An iron deficiency also appears as a yellowing and chlorosis of the leaf tissue; it first appears on the young, actively growing leaves. In contrast, the sulfur and nitrogen deficiencies appear first on the older, lower leaves. In this way, one is able to distinguish between an iron deficiency and the nitrogen or sulfur deficiencies. However, it is difficult to distinguish between the latter two other than to make an application of readily available, water soluble nitrogen to the foliage to determine if there is a greening and growth response. If not, it would suggest the possibility of a sulfur deficiency, assuming that the levels of available iron in the soil are adequate.

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considerable portion of sulfur in the soils is contained in organic matter and, therefore, is concentrated in the surface horizons of the soil profile. Soils having a lower sulfur content are usually associated with conditions that accentuate the decomposition rate of organic matter and where leaching is more severe. Sulfur that occurs in the soil in the sulfate form is highly water soluble and readily leached.

Sulfur is taken up by the roots as the SO_4 — ion. Sulfur can also be absorbed to a limited extent through the foliage as gaseous sulfur dioxide (SO_2).

A significant amount of sulfur can be added to the soil through the absorption and removal of sulfur gases from the atmosphere by rain water. Generally, the quantity of soil sulfur originating from the atmosphere is highest in urban or industrial areas.

In the past, turfgrass fertilization practices have not been concerned with a sulfur deficiency under most conditions. A visual sulfur deficiency was rarely reported. This situation may now be changing to one where sulfur may have to be added comparable to the fertilization practices for nitrogen, phosphorus, potassium and iron.

The reason for this change in the sulfur status of turfgrass soils is that most of the turfgrass fertilizers used in the past have contained significant quantities of sulfur. For example, the nitrogen carrier ammonium sulfate, which was once widely used for turfgrass fertilization, contains 24 per cent sulfur. Similarly, the phosphate carrier, ordinary superphosphate, contains 11.6 per cent sulfur.

Many of the specialty fertilizers now being manufactured for turfgrass use are of higher analyses and contain smaller quantities of sulfur. In addition, the use of ammonium sulfate as a nitrogen carrier source is declining. Consequently, the potential for the development of a sulfur deficiency in certain soils having an inherently low sulfur level has increased. This potential for a deficiency is greatest in those areas

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most distant from urban or industrial locations.

The sulfur content of some common turfgrass fertilizers are summarized in the table. Where the level of available sulfur in the soil is only slightly lowered, the deficiency can frequently be corrected by the regular use of such fertilizer carriers as ammonium sulfate, potassium sulfate, ordinary superphosphate or potassium magnesium sulfate.

Situations may also occur where the sulfur deficiency is more severe. In these cases, materials such as elemental sulfur or gypsum may be used. The elemental form of sulfur normally contains from 85 to 99 per cent sulfur. The rate of sulfur release for plant absorption is dependent on soil microorganisms to oxidize and transform the sulfur into sulfuric acid. This usually requires 10 to 15 days. This process is most rapid if the elemental sulfur is incorporated into the soil prior to turfgrass establishment. Because elemental sulfur has a high foliar burn potential, it is necessary to water it in immediately after application if applied to an established turf.

Gypsum ($CaSO_4 \times 2H_2O$) is also a source of sulfur that decomposes relatively slowly in the soil. The water solubility is low and thus it is most effective, in terms of a sulfur response, if it is incorporated into the soil. Where a visual foliar sulfur deficiency exists, which must be corrected immediately, it would be preferable to use one of the more readily available, water soluble sulfur sources in the table.

APPROXIMATE SULFUR CONTENT OF EIGHT FERTILIZER CARRIERS

Sulfur carrier	Approximate sulfur content, %
Sulfur, elemental	99
Ammonium sulfate	24
Ferrous sulfate	18.8
Gypsum	18.6
Potassium magnesium sulfate	18
Potassium sulfate	17.6
Ferrous ammonium sulfate	16
Superphosphate, ordinary	11.6

The obvious question to the reader is "do I have a sulfur deficiency?" Just because there have been scattered reports of sulfur deficiencies on turfgrasses around the country does not mean that it is a widespread occurrence at this time, which necessitates an immediate application of sulfur. However, the golf course superintendent should recognize that the potential for the development of a sulfur deficiency is greater under the current turfgrass cultural practices than in the past. He should be able to recognize the sulfur deficiency symptoms. If adequate levels of both iron and nitrogen have been applied, but the turfgrass response has been inadequate, assuming the soil temperature and moisture levels for growth are adequate, then the possibility of a sulfur deficiency does exist. If this situation occurs, one should first apply sulfur to a small area leaving an adjacent, untreated plot to see if there is any visual response in terms of greener color and an improved shoot growth rate and density. If a positive response occurs and similar responses could be anticipated on the remainder of the turfgrass area, then one may conclude that a sulfur deficiency does exist and steps should be taken to correct the problem. □