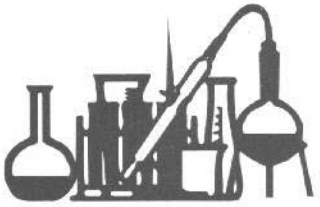

Soil Acidification

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Soil acidification, the process whereby soil pH is reduced, has taken on renewed interest in Wisconsin. The reason has nothing to do with matters such as nutrient availability or *Poa annua* control. Rather, the concern is with the growing incidence of take- all patch. The single most effective means for controlling the disease is to reduce soil pH.

The incidence of take-all patch increases substantially when the pH of soil immediately surrounding turfgrass roots increases above 5.5. When the predominant form of nitrogen being taken up by the grass is in the form of ammonium ions, the pH of soil surrounding the roots is typically about one-half pH unit lower than the bulk of the soil. Thus, what we're really concerned with are soil pH values above 6.0. This is the ideal goal when using soil pH modification as a control measure for take-all patch. In reality, any significant reduction in soil pH values above about 6.5 will aid in control of the disease.

Soil acidification requires two things. First, we have to introduce hydrogen ions or substances from which the ions can be produced through microbial action. Secondly, we need to reduce the levels of the dominant exchangeable cations, calcium and magnesium, by way of leaching. The presence of divalent anions such as sulfate hastens the leaching process.

Although one could actually use acid to reduce soil pH, from the standpoint of safety and cost, the most practical soil acidifiers are elemental sulfur, ammonium sulfate fertilizer and materials such as ammonium thiosulfate. Among these, elemental sulfur has been most widely used.

The acidifying action of elemental sulfur is totally dependent on microbial oxidation of the sulfur to sulfate ions and, in the process, release of hydrogen ions. Herein lies some of the limitations in the use of sulfur as an acidifying agent. For one, the soil needs to be well populated with a rather select group of microorganisms. This is not always the case. Even under ideal environmental conditions for microbial activity, the rate at which sulfur is oxidized varies greatly from one soil to another, presumably because of variation in the populations of sulfur oxidizing organisms that are present. The other issue is that of the conditions required for rapid microbial oxidation of sulfur. To function well, soil microorganisms require a continuously moist environment and temperatures in the range of 75˚F to 90˚F. When elemental sulfur is applied to established turf, these conditions are often not met, at least not on a continuous basis. Even when incorporated into soil, complete oxidation of sulfur may require six months or more. On turf, this period of time is often even greater. The bottom line here is that the rate of soil acidification by elemental sulfur applied on turf often varies considerably from one location to another and can be painfully slow. Another factor one has to deal with when acidifying soil with surface applications of sulfur is the time required to achieve acidification to some depth in the soil. It may take years to significantly alter soil pH to a depth of even two inches. In the meantime, the soil within a fraction of an inch of the surface may be at a pH of 4.0 or less for a long period of time. This why monitoring the change in soil

pH change with sulfur requires sampling the soil in one-half inch increments or less.

On a pound-for-pound basis, elemental sulfur has considerably more acidifying capacity than does ammonium sulfate fertilizer. But the advantages of using ammonium sulfate are numerous. The reaction time is much shorter, there is much less soil-to-soil variabilty in terms of the microbial action required, and the acidifying action extends more rapidly into the soil.

This brings us to the question of how much sulfur or ammonium sulfate is required to bring about a desired reduction in soil pH. There are ways of estimating the quantities that may be required, but they are rather crude. I much prefer a monitor as you go approach. There are limits as to how much of either of these materials you can or want to apply at any one time and the rates are far less that the total amounts required. In the case of sulfur, the recommendation is 0.5 lb sulfur/M in a single application on putting greens and tees at intervals of at least two weeks and no more than 10 lb total/season. The rate per application on fairways can be as high as 5 lb/M, providing the applications are made in the cooler parts of the season. Sulfur applications should be followed by sufficient irrigation to remove all sulfur from the turfgrass leaf surfaces. At least once a year soil samples need be taken at one-half inch soil depth increments and pH measured to show the progress of the acidification process.

In order to have a reasonable rate of microbial oxidation, sulfur must be in the form of very fine particles. You can find on the market sulfur that is so finely divided that its possible to form a suspension with the material and apply it with a sprayer. This is perhaps the most convenient method of application.

Ammonium sulfate application rates and frequency of application are governed by your N fertilization program. The acidifying action of ammonium sulfate is determined by the amount applied and not the frequency of application. Merely substituting ammonium sulfate once or twice a season into your normal fertilization program is not a very effective way of acidifying soil. In using ammonium sulfate, you have to keep in mind that this fertilizer has moderate to high burn potential. Application should only be to dry turf and irrigation shortly after application is essential.

For all of you that live in the "hard water" region of the state, soil acidification is virtually an unending process. Even after you've achieved the soil pH you want, you're going to find it necessary to either apply an acidifying agent one or twice annually or repeat the process every few years.

There are some of you for which soil acidification is impractical. If your soil pH is at or above 8.3, your soil likely contains calcium carbonate. To reduce the pH of such soils, the carbonate must first be destroyed by reaction with hydrogen ions. To illustrate what this means, let me use the example of a green constructed with sand containing 2% calcium carbonate. In order to acidify this green to 2-inch depth, you would first have to apply a minimum of 93 lb sulfur/M **before** the pH would begin to decline throughout this 2-inch depth. At 0.5 lb sulfur per application, that's 186 applications!