

Lowering Soil pH with Elemental Sulfur

By Dr. James Camberato, Clemson University

Editor's Note: A good portion of Wisconsin soils are alkaline in nature, and research in several diseases has shown part of their control can be accomplished with the cultural measure of lowering the soil pH. Therefore, this article by Dr. Jim Camberato, which appeared in the Volume 35, Number 35, May-June 1999 issue of Carolinas Green, clearly could be helpful to Wisconsin golf course superintendents like it undoubtedly was to those in North and South Carolina. It also nicely complements what Dr. Wayne Kussow has written on the issue in this journal.

Chuck Borman, editor of Carolinas Green, and Jim Camberato have both granted permission to reprint it in this issue of The Grass Roots. Thanks to both of them.

In the Carolinas excessively high soil pH occurs in Coastal areas when high bicarbonate water is used for irrigation. With alkaline water, soil pH will increase over time and stabilize around pH 8.2, if calcium is the predominant cation in the soil. Calcium carbonate

(lime) is formed in the soil at this pH. Soil pH can exceed pH 8.2 when sodium, rather than calcium, is the dominant cation. In these soils lowering pH is necessary to increase the availability of calcium and micronutrients, particularly iron and manganese. Elemental sulfur (S) is often chosen to lower soil pH, but it must be used carefully. Elemental S has a high potential to burn plant tissue and can lower soil pH too much (pH less than 4.0 is possible) if used improperly or at too high an application rate.

Mode of Action

Sulfur is oxidized by soil bacteria, thereby forming sulfuric acid which is the substance that lowers soil pH. Each 10 pounds of elemental S generates enough acidity to neutralize 30 pounds of lime. Warm temperatures and good moisture and aeration are required for S oxidizing bacteria to function. Sulfur oxidation is minimal at soil temperatures less than 50 degrees F. Consequently S oxidation in the winter can be limited even in our mild climate. Sulfur lies 'dormant' in the winter, however, will be oxidized when hot tem-

peratures occur. Even at 75 degrees F the oxidation rate of S is about 15% of that at 85 degrees F, so peak rates of S oxidation don't occur until late spring. Applications are best made when



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temperatures are warm enough for the bacteria to oxidize the S (70 - 80 degrees F), but not hot enough to accentuate tissue burn.

Advantages of Incorporation Over Surface Application

Sulfuric acid produced on leaf and crown tissue can burn these tissues. Incorporation of S into the soil by application just after core aerification is a good method for reducing burn. In addition, incorporated S is preferred over surface application because acidification is accelerated and a greater volume of soil is treated.

1) Less chance for leaf and crown damage with incorporated applications. *Sulfuric acid generated on leaves and in thatch can damage foliage and destroy crown. Contact with the soil buffers the decrease in soil pH around the S particle so this damage is limited.*

2) Faster reaction of incorporated S in comparison to surface applied S occurs because of higher soil moisture levels. *Sulfur oxidation requires good moisture which is more prevalent in the soil than in the thatch or on the leaf surface. Plenty of irrigation water should be applied to wash the S from the turfgrass leaves after any method of application.*

3) Incorporated applications acidify a larger portion of the root zone than surface applications. *Elemental S is immobile in the soil so surface applications remain on the soil surface. Even after the S is oxidized the acidity produced is slow to move into the root zone. Consequently severe decreases in pH may occur in the thatch layer and immediate soil surface with little impact on the remainder of the root zone.*

Sulfur Application Rates

Sulfur application may be warranted on soils with pH in the high 7's or greater. Using S on soils of lower pH is usually not necessary and can be dangerous due to over-acidification. Calcium should be added to soils dominated by sodium at the same time soil pH is lowered with S.

Sulfur rates should be low to avoid damage to the crowns of the turfgrass plant. Each application to bermudagrass at fairway or rough height should be less than 5 pounds per 1000 square feet, with lower rates being safer. Applications to greens should not exceed 0.5 pounds per 1000 square feet per application. *It is wise to check the soil pH before reapplication of S to avoid over-*

acidification, especially on sand-based greens that have little capacity to buffer changes in soil pH. Before taking a soil sample and considering reapplication of S, ensure that temperatures and time were sufficient for the S to have been oxidized, greater than 75 degrees F and 4 to 6 weeks. Commercial S sources range in purity from 50 to 99%, so remember to adjust the application rate based on the S content of the material. ♣

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