

Will Alfalfa Respond to Sulfur in Wisconsin?

by John Peters and Keith Kelling

Introduction

Going back over 30 years, agronomists, soil scientists, consultants and farmers have recognized the potential for significant responses to applied sulfur fertilizer in northern and western Wisconsin. This is particularly true of lighter textured, low organic matter soils that had not recently received manure applications. In more recent years, crop consultants and others have reported seeing sulfur responses on soils or in locations where they typically were not expected. Part of the reason sulfur responses may be occurring more frequently is that precipitation S levels have been decreasing. From 1969 to 1987, precipitation S decreased an average of 42% across Wisconsin (Andraski and Bundy, 1989). Furthermore, a Wisconsin Department of Natural Resources estimate showed Wisconsin sulfur emissions have declined another 40% from the mid-1980s to the mid-1990s.

Wisconsin started testing soils for SO₄-S in the early 1970s, however, this approach only measures the amount of sulfate-S in the plow layer and does not account for several other sources of plant-available sulfur. The result is that this approach is useful in identifying situations where the amount of plant-available sulfur is adequate, but does not adequately determine if sulfur should be added if the test is low, since adequate S may be coming from other sources. With the revision of the Wisconsin soil test recommendations in 1991, a new approach called the sulfur availability index was introduced. This was an attempt to account for S from other sources such as precipitation, manure, soil organic matter, subsoil, as well as sulfate-S measured by soil test. Research has continued over the years and the SAI was modified in 2005 to reflect changes that have occurred over the years in S contributions from precipitation and the subsoil.

What is the best way to determine if sulfur should be applied to my alfalfa crop?

A soil test including a test for sulfate-S that leads to a determination of the sulfur availability index (SAI) for a field is the first step to help make a management decision on whether or not to apply S. The ideal diagnostic approach is to take a tissue sample of the top six inches, or top one-half

of the alfalfa plants if they are less than eight inches tall. Samples of 35 plants should be collected when the alfalfa plants are between six inches of growth and early bloom. More detailed information on tissue sampling can be found at http://uwlab.soils.wisc.edu/pubs/pa_sampling.pdf. The advantage of a tissue sample, and an accompanying soil sample, is that this technique measures that impact of all sources of plant-available S by measuring what is actually getting taken up by the plant.

Is sulfur fertilizer needed in eastern and southern Wisconsin?

Yes. On-farm trials were conducted in recent years and yield responses to S were seen in many cases. When yield responses were seen, the increases were mostly found in the first cutting, occasionally second cut, but much less frequently in third and fourth cuttings. Tissue analyses for these studies show that where yield responses were seen, control S concentrations were generally below 0.21-0.23% S, whereas at one non-responsive site, tissue S values were above 0.25%.

Crop consultants, county faculty and industry agronomists were asked to submit alfalfa tissue and soil samples from fields that had not received sulfur fertilizer or manure for the past 2-3 years. Results of this survey as shown in Figure 1 indicate that over one-third of all samples from the survey indicated that alfalfa S levels were <0.25%.

Sulfur Deficiency More Common

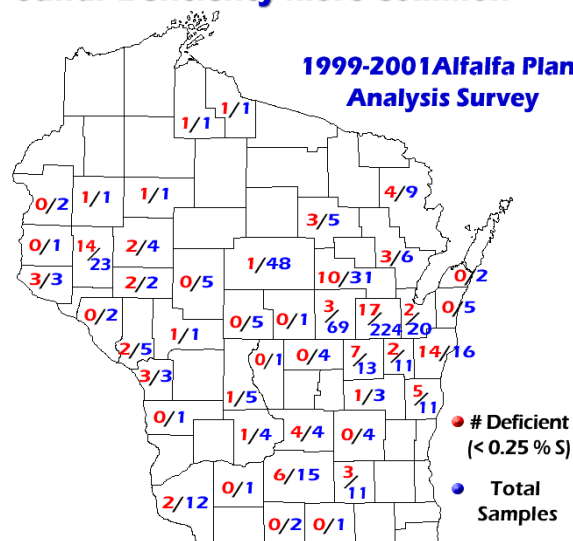


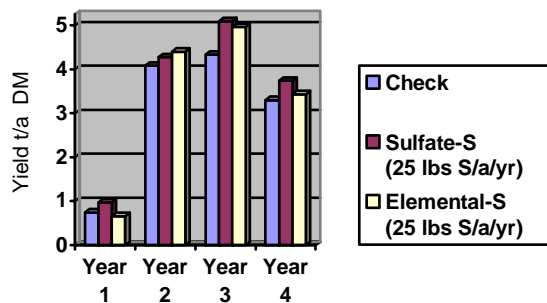
Figure 1. Alfalfa tissue samples testing <0.25% S in 1999-2001

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Is a high rate of sulfur needed to improve alfalfa yield and quality?

In a four year study conducted at Spooner (a sulfur responsive site) elemental S did not become available quickly enough to benefit the crop in the first year it was applied (Figure 2). However, by the second season, enough of the elemental S had oxidized so that it performed as well as sulfate-S forms. The research data showed little benefit to rates of S higher than 25 lb S/acre, except when elemental S was used the first year (Kelling, Speth and van Wychen, 2002).

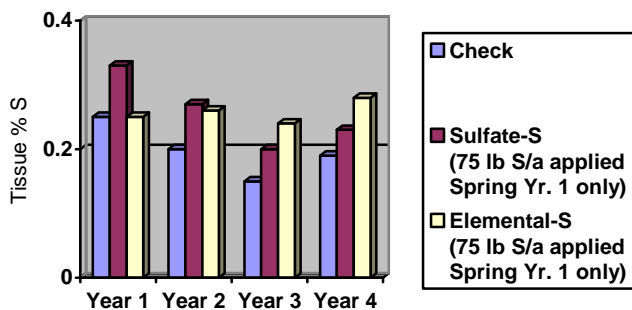
Figure 2



How long will an alfalfa stand benefit from a sulfur application?

Based on research done at Spooner, it appears that a moderately high rate of S applied preplant is adequate to carry the crop for three to four seasons on a sandy loam soil where deficiencies are likely (Figure 3). On heavier textured soils, the lasting power of preplant S treatments would be even better.

Figure 3



Summary

There continues to be the potential for significant alfalfa yield responses from sulfur additions in northern and western Wisconsin. Recent data suggests that the potential for a S response is now higher in southern and eastern Wisconsin than it was a few years ago. A yield response to S additions on alfalfa fields is most likely where the following conditions exist.

1. Manure or S-fertilizer have not been applied for 2-3 years
2. Soils are sandy textured with an organic matter of less than 3%

References

- Andraski, T. W. and L. G. Bundy. 1989. Sulfur, nitrogen and pH levels in Wisconsin precipitation. *J. Environ. Qual.* 19:60-64.
- Kelling, K. A., P. E. Speth, and S. van Wychen. 2002. Sulfur responses and the Wisconsin alfalfa sulfur survey. *New Horizons in Soil Science*, #13-2002. Department of Soil Science, University of Wisconsin-Madison.

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