Is Sulfur Fertilizer Needed for Alfalfa Production?

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The sulfur (S) needed to produce a ton of forage is approximately 6 lb, which is considerably less than nitrogen (N), potassium (K), and calcium (Ca); about the same as phosphorus (P) and magnesium (Mg); but much greater than the micronutrients boron (B), copper (Cu), zinc (Zn), and manganese (Mn) (Table 1). Phosphorus is generally the most limiting nutrient in North Dakota, South Dakota and northwestern Minnesota. Potassium is generally the most limiting nutrient in Wisconsin and southeastern Minnesota.

Sulfur deficiencies appear to be more common today than 15-20 years ago. Highly sandy, low organic matter soils are known to be deficient in sulfur for good crop production, including alfalfa. Therefore, sulfur fertilization has been a common practice on these soils. However, two sites have been found that have 2-3% organic matter and loam to sandy loam texture that are deficient in sulfur.

Table 1. *Nutrients removed per ton of forage produced.*

Nutrient	lb Removed/Ton
N	60-80
K	50-60
Ca	30-35
P	5-6
Mg	6-7
S	5-6
B	0.08
Zn	0.05
Cu	0.33
Mn	0.12

The sites found deficient in sulfur for alfalfa have fairly characteristic symptoms, especially during late summer and fall. During the spring, the alfalfa may not show deficiency symptoms due to organic matter breakdown over the winter releasing adequate sulfur for the first crop, but the breakdown is inadequate for later crops. Alfalfa plants with sulfur deficiency generally are stunted (half to two-thirds the normal height), yellowish-green to yellowish-brown, and have about half to two-thirds the stem density of normal alfalfa. In addition, lower lying areas of the field generally are dark-green, taller, and actively growing. The first impression of the first deficient site was the alfalfa may be inadequately nodulated causing a nitrogen deficiency. However, a test strip of nitrogen fertilizer had no effect.

A soil test (6-inch, similar to P and K) for sulfur deficiency is not as reliable as soil tests for P and K. However, any soil that tests less than 20 lb S/acre in the fall is a candidate for possible sulfur deficiency for alfalfa. The most reliable method to determine if this soil is truly sulfur deficient when indicated by a soil test is to apply a test strip with a sulfur-containing fertilizer like ammonium sulfate. If the site is deficient, the alfalfa color will turn dark green and the density of stems will increase considerably. Keep in mind that alfalfa is a deep tap-rooted crop that may have sulfur available at deeper depths than what is sampled in the soil test and therefore may not respond to sulfur fertilization.

Forage yields were increased by sulfur fertilization on the S-deficient site near Lake Park, MN (Table 2). Forage yield was increased 80-88% by sulfur fertilization in 2005 and 41-50% in 2006. Forage yields in 2005 would have been greater with sulfur fertilization if more had been applied. Twenty lb S/acre was applied, but this was used by the first two harvests and the third harvest was basically deficient. Forage yield in 2006 was not limited by sulfur since a second 20 lb/acre treatment was applied following the second harvest, but it was limited by rainfall. Forage yield of the elemental sulfur treatment in 2005 was higher than the check, but not as great as the other sulfur sources. However, in 2006 the yield with elemental sulfur was similar to other sulfur sources. The additional year to break down the elemental sulfur allowed adequate sulfur for the environmental conditions.

Table 2. *Forage yield of an orchardgrass-alfalfa mixture with sulfur fertilization.*

Treatment[1]	2005	2006
	Tons Dry Matter/Acre	
Unfertilized Check	2.7	3.2
Zinc Sulfate	4.9	4.7
Gypsum	5.1	4.8
S-15	5.1	4.5
Elemental Sulfur	4.2	4.3

[1]Fertilizer applied at 20 lb S/acre in 2005, 40 lb/acre in 2006.

Forage quality (crude protein, acid detergent fiber, neutral detergent fiber, hemicellulose, cellulose, and relative feed value) of the first harvest in 2005 was not significantly affected by sulfur fertilization.

Producers are advised to check their alfalfa fields in the fall for areas that are yellowish-green to yellowish-brown with other areas of the field dark green. These may be just small areas on a hillside or could be the majority of the field like the Lake Park, MN site. If such areas are found, try a test strip with some form of sulfur-containing fertilizer. The response may be surprising. For example, the test strip tried on alfalfa mentioned before resulted in the first documented case of sulfur deficiency in sugarbeets in the North Dakota/Minnesota sugarbeet growing area the next year.