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L. A. Daigger

G. W. Rehm

A. D. Flowerday

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Extension Service
University of Nebraska-Lincoln College of Agriculture
Cooperating with the U.S. Department of Agriculture
and the College of Home Economics
E. F. Frolik, Dean; J. L. Adams, Director

SULFUR for ALFALFA PRODUCTION in NEBRASKA

L. A. Daigger,[1] G. W. Rehm[2] and A. D. Flowerday[3]

Alfalfa, of all the crops growing in Nebraska, is most likely to be sulfur deficient. A five-ton yield of alfalfa removes 25 to 30 pounds of sulfur per acre each year. Fortunately most soils in Nebraska contain sufficient sulfur for top alfalfa yields. Some areas, however, do not have sufficient soil sulfur for alfalfa production, and insufficient quantities are added through atmospheric sulfur, pesticides or irrigation water.

The supply of sulfur in the soil varies throughout the state. Sandy soils, low in organic matter, often contain low levels of sulfur.

The sulfur content of Nebraska's irrigation water varies from many pounds per acre foot in the North Platte valley to almost zero in the Sandhills region.

Atmospheric sulfur is present in the air as sulfur dioxide. This gas can be returned to the soil through rain. However, atmospheric sulfur is found only in the immediate areas around Lincoln and Omaha where soil already contains adequate amounts of sulfur.

Most high analysis fertilizers are essentially free of sulfur so little sulfur is added with fertilization of crops. Higher yields of crops use more sulfur from the soil.

Determining The Need for Sulfur Fertilization

Several soil and plant characteristics can be used as guidelines in determining the sulfur status of soil and the likelihood of sulfur fertilizer response. Some important points to assess are:

Organic matter content—Organic matter in surface soil holds much of the readily available sulfur for plant use. Organic matter contents below 0.6% are considered low in organic matter.

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[1] L.A. Daigger is Dist. Extension Specialist (Soils), Scotts Bluff Station.

[2] G.W. Rehm is Dist. Extension Specialist (Soils), Northeast Station.

[3] A.D. Flowerday is Assoc. Professor of Agronomy.

Available soil sulfur—Chemical soil tests have been developed to determine the amount of sulfur in soil but these tests have not always correlated with field crop response to added sulfur. Samples collected in the surface 6 inches of soil are not as reliable as samples collected from the entire rooting depth because soils contain low sulfur levels in the upper 6-inch layer. Subsoils may or may not contain sulfur for plant use depending on soil texture and location.

Sulfur content of irrigation water—Irrigation waters can contain sufficient sulfur to supply the alfalfa plant. For example, irrigation water containing 6 parts per million sulfur supplies about 16 pounds of sulfur per acre foot of water applied—sufficient to supply sulfur for two to three tons of alfalfa.

Sulfur deficiency symptoms—Sulfur deficient alfalfa leaves are long and slender and uniformly light green to yellowish-green. The plants have fewer than normal stems from the crown, giving the appearance of a poor stand.

Plant analysis—The sulfur content of the growing plant can indicate when the soil sulfur level is inadequate for optimum growth. Whole plant samples should be collected when in 1/3 to 1/2 bloom stage. Samples with less than 0.22% sulfur are likely to respond to soil applications of sulfur.

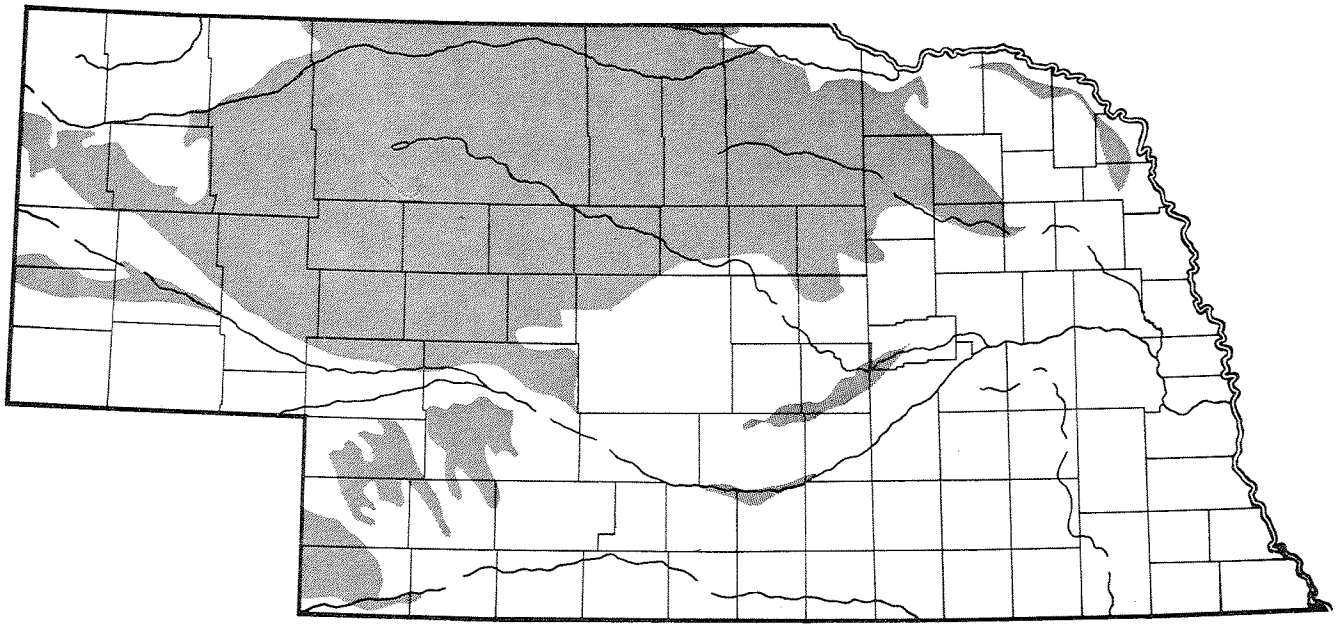
Soil texture, series and color—Sandy textured and light colored soils are generally lower in organic matter and may not contain adequate levels of plant available sulfur. Five soil associations, Moody-Thurman-Valentine, Thurman-O'Neill-Holt, Holt-Valentine, Anselmo-Keith-Bush and Valentine-Thedford have most often been sulfur deficient. (Fig. 1). Other soils may be sulfur deficient. Consult your County Extension Agent or the Soil Conservation Service for information about the soil in your locality.

Degree of erosion—Soils that have had the topsoil removed by erosion are generally lower in organic matter and can be sulfur deficient. However, subsoil often contains much more mineral sulfur than the surface soil.

Sulfur Has Increased Yields

Alfalfa grown on loamy sand soils low in organic matter and/or irrigated with water almost devoid of sulfur has responded well to sulfur fertilization. Table 1 records yields at two locations in western

FIG. 1 SOIL ASSOCIATION AREAS WHERE SULFUR DEFICIENCY MAY OCCUR



and northeastern Nebraska. Yield increases of one to one and one-half tons per acre are not uncommon under these conditions.

Sources of Sulfur

Sulfur fertilizers may be applied broadcast and incorporated at seeding time or topdressed on established stands. Application rates of 50-100 pounds sulfur per acre every three years are recommended, depending on location and need. This amount will carry over into the second or third year of alfalfa production, except where high yields of alfalfa are harvested.

Sulfur fertilizer materials which may be applied are agricultural sulfur, ammonium polysulfide solution, ammonium sulfate, ammonium thiosulfate, calcium sulfate (gypsum), magnesium sulfate (epsom salts), potassium-magnesium sulfate, super phosphate (0-20-0), urea sulfur and zinc sulfate.

Agricultural sulfur must be finely ground and mixed with the soil to produce yield responses equal to the soluble sulfate forms. Ammonium sulfur materials have been used on alfalfa in Nebraska but have not been evaluated in many field trials. The nitrogen contained in these materials is unnecessary since alfalfa fixes its own nitrogen from the air.

Calcium sulfate (gypsum) is an excellent source of sulfate-sulfur but is a low analysis material. Potassium magnesium sulfate is a readily available source of sulfate-sulfur but may be expensive since it also supplies potassium and magnesium—two plant nutrients not generally needed for top alfalfa yields in Nebraska. Magnesium sulfate is an expensive, low analysis sulfur material and is usually not used except in emergency situations.

Normal superphosphate (0-20-0) is commonly applied to alfalfa for the correction of sulfur deficiency. This material supplies both phosphorus and sulfur, two nutrients required by alfalfa in relatively large amounts. Urea sulfur and zinc sulfate are more commonly applied for corn but may supply residual sulfur to alfalfa in a crop rotation.

Several sulfur materials have been evaluated for their effectiveness in correcting sulfur deficiency in alfalfa. A comparison of finely divided agricultural sulfur and gypsum is shown in Table 2. A comparison of other sulfur sources is shown in Table 3. Table 4 lists the plant nutrient content of some sulfur-containing fertilizer material.

Table 1. Alfalfa response to sulfur fertilization on sandy soils of western and northeastern Nebraska.

	Yield—Tons/acre	
Fertilizer applied	*Western Nebraska irrigated*	*N.E. Nebraska non-irrigated*
No sulfur	3.8	2.2
Sulfur[a]	5.2	3.9

[a]60 lb./acre in western Nebraska, 50 lb./acre in northeast Nebraska.

Table 2. Effect of sulfur materials and rates on alfalfa yields, Antelope County, 1963. Thurman loamy fine sand.

Sulfur rate lb./A	*Fertilizer material*	
	Gypsum	*Elemental sulfur*
	yields T/A	*yields T/A*
10	2.4	—
25	3.1	3.6
50	3.8	3.7
100	3.7	—

Check, 1.7 tons/acre

Table 3. The effect of sulfur fertilizers on alfalfa yield in northeast Nebraska, 1968.

Fertilizer material	*Sulfur rate lb./acre*	*Yield tons/acre*
Check	—	2.1
Gypsum	100	2.9
Agricultural sulfur[a]	100	2.7
Prilled sulfur	100	2.0
Bentonite sulfur	100	2.6
Bentonite sulfur + sulfate sulfur	100	2.3
Prilled sulfur	300	2.4
Bentonite sulfur	300	2.6
Bentonite sulfur + sulfate sulfur	300	2.7

[a]Finely ground

Table 4. The plant nutrient content of some sulfur-containing fertilizer materials.

Material	Plant nutrient content (%)				
	N	P_2O_5	K_2O	S	Other
Agricultural sulfur	0	0	0	100	–
Ammonium polysulfide solution	20	0	0	40	–
Ammonium sulfate	21	0	0	24	–
Ammonium thiosulfate	19	0	0	43	–
Calcium sulfate (gypsum)	0	0	0	19	33 (CaO)
Potassium magnesium sulfate[a]	0	0	22	18	18 (MgO)
Magnesium sulfate	0	0	0	13	13 (MgO)
Superphosphate, normal	0	20	0	14	–
Urea sulfur	17	0	0	15	–
Zinc sulfate	0	0	0	18	36 (Zn)

[a]Trade names Sul-Po-Mg and K-Mag.

Alfalfa Quality Improved with Sulfur

An added benefit from the correction of sulfur deficiency is increased protein and carotene content. Hay protein has been increased from a check level (no fertilizer) of 15.5 to 20.5% from plots receiving phosphorus and sulfur. A combination of sulfur and phosphorus has increased carotene concentration 25% over the check.

Summary

Alfalfa needs 5 to 6 pounds of sulfur to produce one ton of quality hay. Under most Nebraska conditions, alfalfa uses naturally occurring soil sulfur, or sulfur supplied through irrigation water, or sulfur fertilizers.

Yield increases from sulfur fertilization is most common on sandy soils low in organic matter. Finely ground elemental sulfur and readily available sulfate materials have been used successfully to correct sulfur deficiency.

In areas of sulfur deficiency yield increases of one to one and one-half tons per acre from sulfur applications are common. In addition, protein and carotene content of the hay has been increased.