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EC65-164 Sulfur Deficiency of Field Crops in....Nebraska

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Sulfur Deficiency

of Field Crops in...



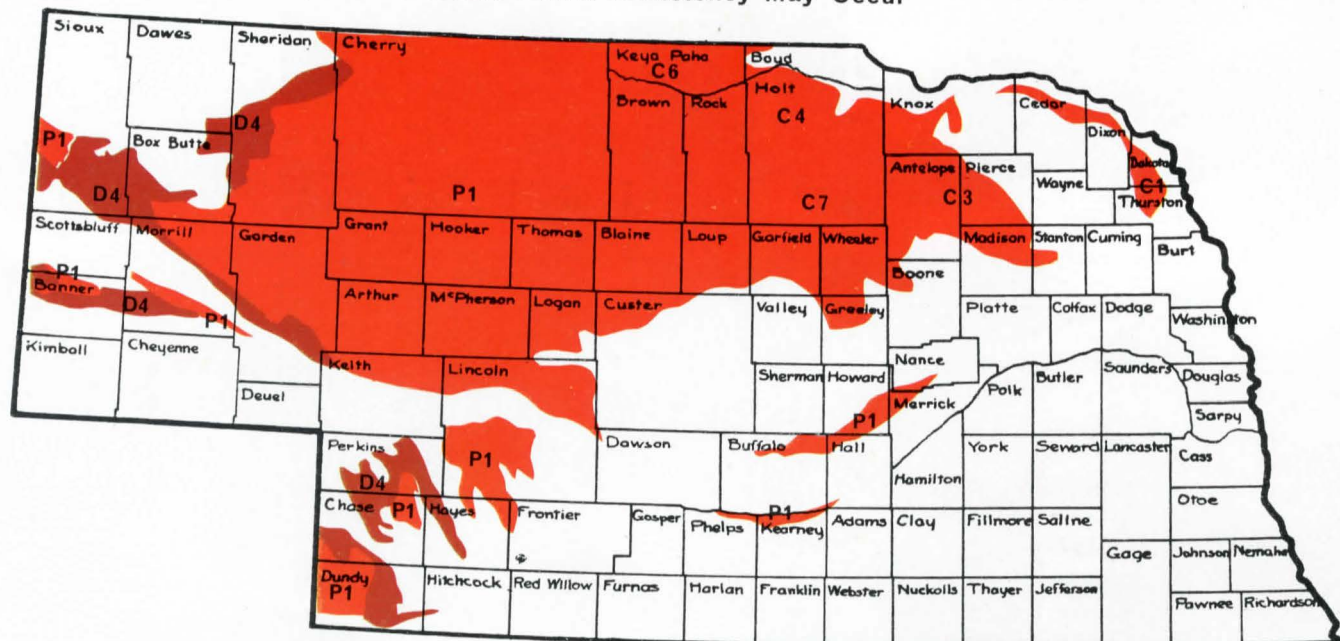
Extension Service

University of Nebraska College of Agriculture and Home Economics
and U. S. Department of Agriculture Cooperating

E. F. Frolik, Dean

E. W. Janike, Director

Fig.1 Soil Association Areas Where Sulfur Deficiency May Occur



SULFUR DEFICIENCY:

- Expected on **MANY** soils
- Expected on **SOME** soils
- NOT generally expected

SOIL ASSOCIATION AREAS:

- C1 Crofton - Moody
- C3 Moody-Thurman-Valentine
- C4 Thurman-O'Neill-Holt
- C6 Holt-Valentine
- D4 Anselmo-Keith-Bush
- P1 Valentine-Thedford

SUMMARY AND CONCLUSIONS

1. Nebraska soils that are sandy or low in organic matter may be sulfur deficient.

2. Alfalfa is the common crop most likely to be sulfur deficient in Nebraska. Corn has also responded to sulfur application on some soils. Although other crops may respond, more research is needed to identify deficiency symptoms and response conditions.

3. Organic matter content may be used to evaluate a soils sulfur status. A phosphate extraction of sulfate sulfur also shows promise.

4. On irrigated crops in Nebraska the effectiveness of soil tests for sulfur may be limited. If the source of water is high in sulfur, yield response may not occur even on soils low in organic matter or low in sulfate content.

5. The Platte, Republican and Missouri Rivers contain considerable amounts of sulfate sulfur. Crops irrigated with water from these sources probably will not respond to sulfur fertilization. A sulfur test on the irrigation water may be needed for an adequate recommendation.

6. Common sulfur sources include gypsum, ammonium sulfate, elemental sulfur, normal superphosphate and magnesium sulfate. Other fertilizers may contain varying amounts of sulfur.

7. An application of fifty pounds of actual sulfur per acre is adequate for two years alfalfa production on most sulfur deficient soils. Application of ten pounds of sulfur is recommended for corn on sulfur deficient soils.

8. Either topdress or preplant application of sulfur is effective for alfalfa. Starter applications are recommended for corn.

Sulfur Deficiency of Field Crops in Nebraska

By Ulverdr U. Alexander, Area Extension Agent (Soils)
And Delno Knudsen, Extension Agronomist

All plants require sulfur for normal growth and maturity. Sulfur is part of most proteins and several other plant compounds and has a definite effect on quality and nutritive value of many plants.

The amount of sulfur required varies with the species of plant. In general, crops require about the same amount of sulfur as phosphorus. Alfalfa and corn are the common crops grown in Nebraska that exhibit sulfur deficiency.

The first definite sulfur response on alfalfa was identified in Pierce County in 1952. Sulfur deficiency has been observed since then in other areas of the state on both legumes and corn. Recent research indicates sulfur may be deficient in soils low in organic matter, especially sandy soils, in all areas of the state, with the exception of irrigated areas along the Platte, Republican, and Missouri Rivers. Figure 1 shows areas of the state where sulfur deficiency is most likely to occur.

Sensitive Crops

Alfalfa and sweet clover are heavy users of sulfur and are sensitive to low levels of sulfur in the soil. Grass and small grains appear to have a lower sulfur requirement than alfalfa and sweet clover. Corn has been observed to be sensitive to Nebraska soils low in sulfur, particularly under conditions favorable for high yields.

Deficient Soils

Much of the readily available sulfur is held in the organic fraction of the soil. So sandy soils or those low in organic matter as a result of erosion are most likely to be sulfur deficient. Alfalfa grown on such Nebraska soils usually responds to sulfur application if other nutrient deficiencies are also corrected. Deficiencies have been found on both acid and alkaline soils and on soils of all textural classes. The problem may occur throughout the field or in isolated spots within a field.

Most surface waters and many underground waters used for irrigation contain high amounts of sulfur. For example, water from the Platte River contains over 100 pounds of sulfate sulfur per acre foot. Crops irrigated from such sources are well supplied with sulfur. The sulfate sulfur content of the Missouri and Republican Rivers is

also high. Water of the sandhills and adjacent areas is low in sulfate sulfur. Some irrigated crops of the sandhills area may need sulfur fertilization for efficient production.

Ground water between the Platte and Republican Rivers varies in sulfur content. Irrigation water must be analyzed for sulfur in evaluating sulfur needs. Figure 2 shows the sulfur content of the water from about 5% of the irrigation wells in the state.

How To Identify Sulfur Deficient Soils

There are several ways to determine sulfur deficiency in soils. Some involve measurements of total sulfur content and others measure readily available sulfur. Still others measure sulfur supplying ability of the soil indirectly. Soil organic matter measurement is an example of the latter.

Nebraska experiments indicate that either a measurement of soil organic matter or sulfate sulfur may be correlated with field and greenhouse response to sulfur. Organic matter measurement (by the wet combustion method) is a good indicator of a soils sulfur supplying power.

Much soil sulfur is held in reserve as partially decomposed plant residues. Thus, soils low in organic matter are usually low in sulfur reserve. As the organic matter oxidizes or decomposes further, sulfate sulfur is released. Sulfates can be taken up readily by plant roots.

A phosphate extraction of sulfate sulfur also shows considerable promise as an indicator of a soil's sulfur supplying capacity. This method extracts sulfate sulfur and possibly a portion of readily available organic forms of sulfur.

There are limitations to these evaluation methods. Irrigation water may supply sufficient sulfur for plant needs. Some fertilizers may contain sulfur as a result of manufacturing methods. Rainfall, especially near industrial areas, supplies some sulfur. All these factors must be considered before making a good recommendation for sulfur application.

If profile samples are taken, the phosphate extraction method may overcome some of these limitations. Samples taken in increments of six inches or one foot to a depth of five to six feet will give the sulfate sulfur content of the soil for much of the root zone.

Several other analytical procedures have been evaluated under Nebraska conditions. Most measure the total sulfur content of the soil. This type of sulfur evaluation has not been closely related to sulfur response in field and greenhouse studies.

More field data are needed before making a final selection of a soil sulfur test.

Sulfur Deficiency Symptoms

Sulfur deficient plants appear yellow or chlorotic. Deficiency symptoms appear first on the upper or younger leaves. As the problem becomes more severe, symptoms may occur on the entire plant. Plants are also stunted. Maturity also may be affected by sulfur availability in the soil. In general, if sulfur is deficient, maturity is delayed.

Sulfur deficient alfalfa leaves are long and slender. Affected plants do not branch normally, resulting in a thin stand. Alfalfa is more likely to show sulfur deficiency symptoms than any other common Nebraska crop. If lime and high analysis phosphates or other sulfur free fertilizers are applied, the symptoms are more likely to occur. Symptoms may not appear on alfalfa until the stand is two to three years old.

Corn and grasses may exhibit a striping of upper leaves. Deficiency symptoms are seen most frequently on young plants. As the growing season advances, symptoms may disappear completely.

Correcting the Deficiency

Sulfur deficiency may be corrected by applying agricultural sulfur, ammonium sulfate, magnesium sulfate (epsom salts), calcium sulfate (gypsum) or by using low analysis phosphate fertilizers. Low analysis phosphate carriers such as 0-20-0 contain as much as 12% sulfur as a result of the manufacturing process. Many of the high analysis phosphate fertilizers contain very little sulfur.

Broadcast applications of sulfur may be made for legumes at seeding time. Topdress applications on established stands are also effective. Sulfur should be applied for legumes at the rate of 50 pounds of actual sulfur per acre. This amount may carry over into the second or even the third year of alfalfa production. The period of effectiveness largely depends upon production. A four-ton yield of alfalfa may require 20 to 25 pounds of sulfur per acre. A small amount of this may come from the atmosphere. The remainder must come from the soil, applied fertilizers, or irrigation water.

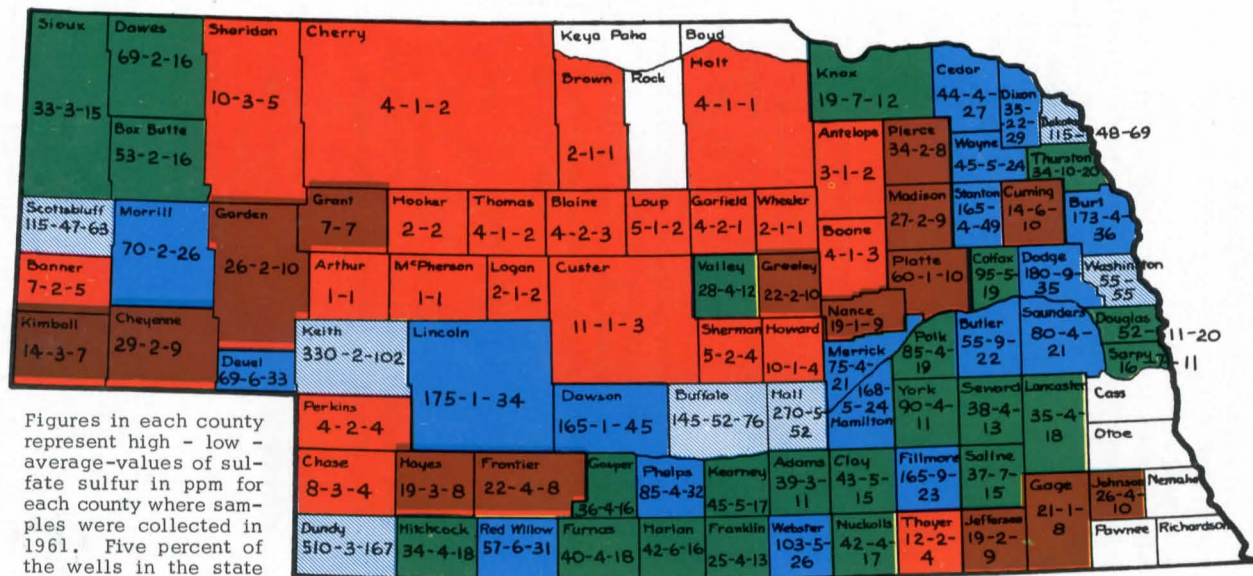
The most logical time to apply sulfur to corn is with starter fertilizer at planting time. Ten to twenty pounds of sulfur applied at seeding time has been found adequate for corn production on sulfur deficient soils. Starter application for corn should be in sulfate form. This allows immediate availability of the applied sulfur. Ammonium sulfate, normal superphosphate, magnesium sulfate and gypsum are satisfactory starter sources of sulfur.

Rainfall in Nebraska supplies from 4 to 12 pounds of sulfur per acre to the soil each year. This source is sufficient to supply the needs of corn or alfalfa only near industrial areas, but it supplements other sources.

Preventing the Deficiency

Because the topsoil usually contains most of the sulfate sulfur in the soil, any practice that prevents erosion or loss of topsoil is a means of preventing sulfur deficiency. Since much of the sulfur is held in the organic fraction of the soil, any practice that maintains the organic matter level is effective in preventing sulfur deficiency problems.

Fig. 2 Sulfur Content of Irrigation Well Water (County Range and Average)



COLORLED AREAS BASED ON AVERAGE SULFATE SULFUR VALUES
BY COUNTIES in ppm as follows:

