Nutri-Facts

Agronomic information on nutrients for crops

Nutri-Facts #4

It's the Missing Link — Sulfur Is Required by Plants

EVERYONE knows that a chain is only as good as its weakest link. The weak link in many fertility programs is often overlooked—sulfur (S).

Why Has Sulfur Become the Weak Link?

Today, S is becoming more of a limiting nutrient in crop production than in the past. The reasons for this increasing need include:

- higher crop yields which require more S
- increased use of high analysis fertilizers containing little or no S
- reduced amounts of atmospheric S fallout in rainfall
- reduced soil S reserves from organic matter losses due to mineralization and erosion

Table 1 shows uptake by major crops.

Table 1. Uptake of S by major crops.[1]

Crop	Yield level	S taken up in total crop, lb
Corn	160 bu	26
Soybeans	60 bu	20
Wheat	100 bu	25
Alfalfa	6 tons	30
Grain sorghum	7,500 lb	35
Canola	30 bu	18

[1] Total amount taken up by the crop in both the harvested and above-ground unharvested portions.

Sulfur deficiency may be related to several conditions:

- Sandy soils
- Low organic matter soils
- Areas of high rainfall
- High yield management
- Low S irrigation water

Sulfur's Link in the Soil

Sulfur is supplied to the plant from the soil by organic matter and minerals, but it is often present in insufficient quantities and available at inopportune times for the needs of high yielding crops. Most S in the soil is tied up in organic matter and cannot be used by the plant until it is converted to the sulfate (SO_4) form by soil bacteria. That process is known as mineralization.

Sulfate is mobile in the soil and can be leached out of the root zone in some soils under heavy rainfall conditions. As a soil begins to dry out, sulfate may move toward the soil surface as water is evaporated. Because of mobility of S, a soil test may not give dependable information as to the soil's S supplying ability. Plant tissue analysis helps give a better view of S needs.

Sulfur's Link in the Plant

Sulfur is recognized along with nitrogen (N), phosphorus (P) and potassium (K) as a key nutrient necessary for crop growth.
In the plant, S is required for amino acids, proteins, photosynthesis and winter hardiness.

Sulfur deficiencies are often confused with N deficiencies. Symptoms of S deficiency appear as:

- stunted plant growth
- general yellowing of leaves.

In less severe S deficiency situations, visual symptoms may not be apparent, but both yield and quality of crops will be affected. Sulfur concentrations in crop plants should range between 0.2 and 0.5 percent. The S status of crops is best diagnosed by plant analysis.

Potatoes and many other vegetables require large amounts of S and have produced best with S included in the fertility program. The Irish potato is a good example: quality is often improved by including S in the fertilizer. Peas and beans are legumes needing S for protein formation and nodulation.

Sulfur's Link To Crop Production and Profits

North American crop responses to S

have been well documented. Yield increases from S additions are often dramatic and very profitable. Numerous experiments on a wide range of crops in the U.S. and Canada have shown responses to S fertilization.

Using adequate S increases crop yield and lowers production costs per unit. Lowering production costs per unit leads directly to higher crop profitability (**Table 2**).

Table 2. Sulfur fertilization lowers production cost per bushel of corn and raises net returns.

S, lb/A	Yield, bu/A	Gross return, $/A	Produotion cost, $/A	Net return, $/A	Cost of crop, $/bu
0	143	358	300	58	2.10
10	163	408	306	102	1.88
20	170	425	309	116	1.82
30	167	418	311	107	1.86

Prices used: Corn = $2.50/bu, Harvest = 20 cents/bu, Sulfur = 20 cents/lb. Pierce County, Nebraska.

Crop quality is also important. A 5-year experiment in Louisiana showed that S fertilization can significantly affect yield and digestible dry matter of Coastal bermudagrass (**Table 3**). Other forage crops, including alfalfa, show similar quality effects.

Table 3. Sulfur increases forage and digestible dry matter (DDM) yields of Coastal bermudagrass.

Sulfur, lb/A	Forage Yield, lb/A	DDM, lb/A
0	12,590	7,095
24	13,091	7,330
48	13,504	7,580
72	13,862	7,728
96	14,580	8,123

Nitrogen rate= 400 lb/A

Sulfur's Link to Animal Nutrition

Sulfur is an essential nutrient for crops, and for animals that consume those crops. Researchers report that forage growth can be near maximum rates, but S content might be inadequate for ruminant animal nutrition. In the southeastern U.S., high rates of N fertilization have caused depression of the S concentration in Coastal bermudagrass and increased the N to S ratio. This appears to contribute to low animal performance on Coastal bermudagrass.

Many researchers recommend a N:S ratio of 10:1 to 15:1 for optimum animal nutrition. It should be noted, however, that in a deficiency situation (with both low N and S), an "adequate" ratio can be misleading. Both nutrients could be limiting animal performance, even though an "adequate" ratio has been maintained.

Strengthening the Weak Link

Sulfur can be applied as broadcast or banded fertilizer materials or applied through irrigation systems (furrow and sprinkler). Typical S recommendations range from 10 to 20 lb S/A, but sometimes exceed 50 lb/A, depending on the crop and other management considerations.

Sulfur fertilizers may contain S as either sulfate, other soluble forms, or as elemental S. Sulfur in the sulfate form has the advantage of being immediately available to the plant; however, it is also often readily leached from the root zone. Elemental S is not available to the plant until it has been converted in the soil to sulfate, a process which can take weeks or months.

Selection of a particular fertilizer material will depend on the cropping situation, time of application, customer preference, cost, suitability of application equipment and availability of materials.

Remember, S may be the missing link in your fertilizer program. ■

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