Sulfur: The Missing Link for Warm Season Grasses

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Sulfur (S) deficiency can limit effectiveness of other nutrients and yields of warm season grasses. This article points out some guidelines for nutrient management.

EVERY FARMER who has ever pulled his truck out of a mudhole with another vehicle knows his chain is only as good as its weakest link. Sulfur, a sometimes overlooked nutrient, may be the weak link in many fertility programs for warm season grasses.

Why Has Sulfur Become the Weak Link?

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

- increased crop yields which require more S
- increased use of high analysis fertilizers containing little or no S
- the Clean Air Act which has reduced the amount of atmospheric S fallout in rainfall
- reduced S reserves from organic matter losses due to mineralization and erosion.

Sulfur's Link in the Plant

Sulfur deficiencies are now reported across the United States and Canada in areas where they were unheard of before. Although S is a secondary plant nutrient, it is often referred to as the fourth major nutrient, along with nitrogen (N), phosphorus (P) and potassium (K).

In the plant, S is required for:

- amino acids
- proteins
- photosynthesis
- winter hardiness.

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

- stunted plant growth
- general yellowing of leaves.

SULFUR POINTER: Remember, in less severe S deficiencies, visual symptoms may not be apparent, but both yield and quality of forages will be affected.

Sulfur concentrations in grasses should range between 0.2 and 0.5 percent. The S status of forages is best diagnosed by plant analysis.

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 grasses. 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.

SULFUR POINTER: 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 gives a better view of S needs.

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Sulfur's Link with Warm Season Grasses

Coastal Bermudagrass

Coastal bermudagrass is widely grown for pasture and hay throughout the southern U.S. **Table 1** shows that as yields increase, requirements for nutrients, including S, also increase dramatically.

Table 1. Total nutrient uptake of Coastal bermudagrass.

Hay yield, tons/A	N	P_2O_5	K_2O	Mg	S
	lb/A				
6	258	60	288	18	30
8	368	96	400	26	44
10	460	120	500	32	55

SULFUR POINTER: Remember, these are the amounts of each nutrient taken up by the plant. Since the plant operates at only about 20 to 70 percent overall uptake efficiency (depending on nutrient), more nutrients than listed here must be available from the soil and fertilizer.

A 5-year experiment in Louisiana showed that S fertilization can significantly affect forage and digestible dry matter yield of Coastal bermudagrass (**Table 2**).

Table 2. Sulfur increased forage and digestible dry matter yields of Coastal bermudagrass.

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

Nitrogen rate = 400 lb/A

An important question is whether to split S applications. Data from a 3-year trial in Louisiana (**Table 3**) show that a single application of ammonium sulfate in the early spring was equal to or better than other methods of application. Weather conditions, plant growth and intensive grass management in some years may point to a need for split applications.

Table 3. Effects of ammonium sulfate application frequency on Coastal bermudagrass yields (3-year average).

S application frequency	Total S applied	Avg. yield	Avg. response to S
	lb/A		
0	0	13,173	0
April 1	120	15,013	1,840
April 1 and after 2nd harvest	120	14,913	1,740
April 1, after 1st, 2nd and 3rd harvest	120	13,750	577

Bahiagrass

Florida research has indicated that bahiagrass should respond to S fertilization when plant tissue is below 0.2 percent S. A 3-year study showed that S fertilization had a significant influence on both bahiagrass yield and quality. Ammonium sulfate produced significantly higher yields and protein contents than ammonium nitrate at the same N rates (**Figures 1 and 2**). It was noted that S not only increased bahiagrass yields but also increased plant numbers.

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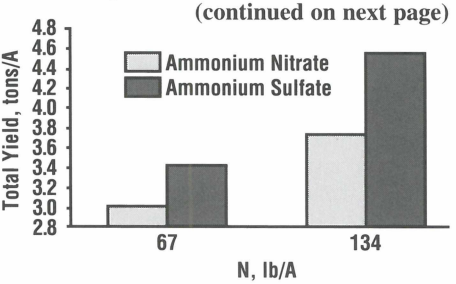

Figure 1. Effect of ammonium nitrate and ammonium sulfate rates on bahiagrass yields.

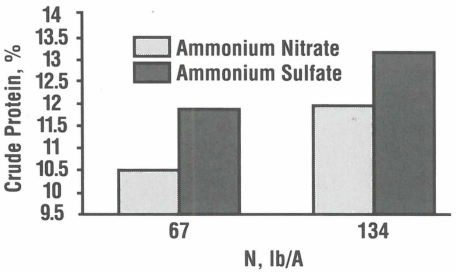

Figure 2. Effect of ammonium nitrate and ammonium sulfate on percent crude protein content of bahiagrass.

Ammonium sulfate also had a significant effect on digestibility and S concentration in bahiagrass (data not shown). Bahiagrass fertilized with N alone (ammonium nitrate) was deficient in S at both N levels.

Sulfur's Link to Animal Nutrition

Sulfur is an essential nutrient not only for forages, but also for the animals that consume those forages. Researchers report that forage growth may be near maximum rates, but S content may 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.

SULFUR POINTER: 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 production, even though an "adequate" ratio has been maintained.

Nitrate poisoning in animals is a result of the accumulation of abnormally high nitrate content in forages consumed by ruminant animals. Plants with severe S deficiency may accumulate higher concentrations of nitrate than S-fertilized plants, resulting in greater likelihood of nitrate poisoning.

Copper (Cu) is an essential nutrient for animals. Researchers in Arkansas and Louisiana have studied the effects of increased S rates on Cu concentrations in Coastal bermudagrass. As S fertilization was increased up to 96 lb S/A, forage yields increased. However, there was no significant effect on Cu concentrations in the plant tissue (**Table 4**) . . . no depression of Cu concentrations occurred.

Table 4. Effects of S on yields, S and Cu concentrations of Coastal bermudagrass.

S Rate, lb/A	S Concen., %	Cu Concen., ppm[1]	Yield, lb/A
0	0.13	5	12,590
24	0.16	4	13,091
48	0.20	4	13,505
72	0.24	4	13,862
96	0.28	4	14,582

[1]parts per million

Sulfur's Weakest Links

Be on the lookout for conditions that can influence S needs, affect S concentrations in forages, forage production, forage quality . . . **and forage profits.**

- sandy soils
- low organic matter soils
- areas of high rainfall
- high yield management
- high quality/high protein crops
- areas with low atmospheric fallout of S (located away from urban areas)
- low S irrigation water.

Sulfur may be the missing link in your forage production program. ■

RESPONSE of Coastal bermudagrass to N and S was recorded in these Arkansas research plots.

BAHIAGRASS in plots at left and right both received 134 lb/A rate of N as ammonium nitrate. Note response in plot at right which also received S at a rate of 77 lb/A.