Sulphur Can Increase Yields, Quality, and Profits from Cool Season Grasses

By R.E. Lamond and D.A. Whitney

Yields and quality of cool season forage grasses may be limited by unrecognized sulphur (S) deficiencies. Kansas researchers report that S responses, recognized for almost 20 years, are becoming more consistent.

THE ROLE OF S in plant nutrition is well recognized, but the need for supplemental S in forage fertilization has not received as much attention in eastern Kansas and western Missouri. Data from earlier investigations have demonstrated that providing adequate S can improve nitrogen (N) use efficiency, increase plant crude protein concentrations, and enhance forage quality of grasses such as brome and fescue.

Early Investigations

Studies conducted by Kansas State University agronomists in the early 1970s indicated the probable need for supplemental S on cool season forage grasses in the eastern part of the state. Comparisons of performances among various N sources included urea and urea-ammonium sulphate (40 percent N, 4 percent S). Urea-ammonium sulphate (UAS) frequently was superior to urea in these studies, both in terms of forage yield (**Table 1**) and forage crude protein content (**Table 2**). Effects were consistent for both fall and spring applications. Since UAS was frequently superior to ammonium nitrate as well, the effect was arguably due to the addition of sulphate-S, not a change in performance of urea in the more acid environment of the UAS prill. All soils in these studies were acid, with pHs of 5.3 to 6.6, silt loam to silty clay loam in texture. The soils had organic matter contents ranging from about 1.8 to 2.3 percent.

Responses to S in UAS varied with year in these early investigations, possibly related to soil temperature and release of S from organic matter.

The effects of S on crude protein content of the forage (**Table 2**) were much more pronounced early in the growing season when cattle would have been on pasture. Even when S applications had less effect on total yield (1974), protein was higher when S was applied. The higher crude protein levels reflect this improved N use efficiency. Nitrogen recovery increased about 23 lb/A because of S application, improving efficiency of applied N recovered from 61 to 80 percent.

Table 1. Sulphur effects on cool season grasses are not new. (Kansas, 1973).

N	S	Source	Riley Co. Brome	Jackson Co. Brome	Franklin Co. Brome	Labette Co. Fescue
lb/A			Yield, lb/A			
120	0	Urea	7,118	4,476	6,846	5,632
120	12	UAS	8,511	7,062	7,979	5,760

N spring applied. Yield at 12.5% moisture. Lamond, Kansas State Univ.
UAS = Urea-ammonium sulphate, 40% N, 4% S.

Dr. Lamond is state Extension soil fertility specialist and Dr. Whitney is state Extension agronomy leader, Department of Agronomy, Kansas State University.

Table 2. Sulphur application can affect bromegrass protein. (Kansas, 1973).

N lb/A	S	Source	April 24	May 8	May 21	June 1
			% crude protein			
120	0	Urea	18.6	13.6	9.7	7.4
120	12	UAS	21.2	14.5	10.4	8.1

Data average of three N rates. Riley County.
Lamond, Kansas State Univ.

Response Continues

Little use was made of the early information indicating S responses in cool season grasses. However, increasing incidence of S responses in wheat in Kansas and low S concentrations in tissue analyses of both grain sorghum and grasses prompted the resumption of studies of S application effects on cool season grass yields and quality.

These studies included evaluation of the effectiveness of ammonium sulphate and ammonium thiosulphate at rates of 15 and 30 lb S/A. Sulphur rates in the earlier studies had ranged from 6 to 18 lb S/A. Nitrogen was held constant at 120 lb N/A. Both N and S were spring-applied, broadcast. Soils were silt loam to silty clay loam in texture, mildly acidic.

Data in **Table 3** indicate S responses from 1987 through 1991. Magnitude of response varied with year, temperature and moisture stress, but the effects were consistently positive. An additional site-year in 1991 at a third location in Brown county produced a net increase in yield from S of 822 lb/A. Both ammonium sulphate and ammonium thiosulphate were effective sources of S with no significant differences between the performance of the two materials.

Crude protein in forage taken at harvest, usually mid- to late-May . . . early bloom, did not show large effects of S application. However, N recovery did increase about 10 to 15 percent. Late April plant sampling in Riley county in 1990 showed the same positive effects of S on crude protein noted in the 1970s. Sulphur application increased crude protein to an average value of 22.5 percent compared to 19.9 percent in the controls. Sulphur concentration in the immature grass was also increased significantly by S application . . . from a low 0.08 percent in the controls to 0.21 percent for areas receiving S. Sulphur levels at the hay-stage were not affected as much by S application . . . often the result of dilution of nutrient content by greater dry matter production.

Higher Yields and Higher Quality Mean More Profits

Sulphur in the nutrition of cool season grasses means higher yields . . . higher quality . . . and higher profits for the hay producer and cattleman. **Here's an example of how that works, based on the Kansas data.**

Hay value = $50 per ton
Protein value = $0.25 per lb
Sulphur cost = $0.16 per lb S

Average yield increase from S, 9 site-years (1987-91) = 572 lb hay/A

Value of extra hay produced = 572 lb/A × $50/ton = $14.30/A

Cost of S, average rate of 22.5 lb/A × $0.16/lb = $3.60/A

Net from application of S = $10.70/A or about $4 for each dollar invested in S.

But data indicate that yield alone is not the only increased value from better forage nutrient management. Sulphur

Table 3. Current studies continue to show the need for S in bromegrass production.

S	Greenwood Co.			Riley Co.				
	1988	1989	1990	1987	1988	1989	1990	1991
lb/A	Yield, lb/A							
0	5,411	3,910	5,930	6,231	4,089	2,990	8,280	5,200
15	5,907	4,070	7,155	6,641	4,317	3,525	8,905	5,745
30	5,691	4,260	6,930	7,065	4,090	3,245	9,260	5,935
Avg S. response	+388	+255	+1,112	+622	+114	+395	+802	+640

Yield at 12.5% moisture.
Averaged for ammonium sulphate and ammonium thiosulphate.

application produced a slight increase in protein in hay . . . about 0.2 percent. That increase was as much as 0.7 percent in some cases. Extra protein in the hay can add profit by replacing protein supplement in animals' rations.

Average yield with S = 6,037 lb hay/A

Crude protein increase from S = 0.2 percent

6,037 lb hay/A × 0.2 percent more protein with S × $0.25/lb protein = $3.02/A

Increased value of hay/A = $14.30

Value of extra protein/A = $3.02

Increased net from S = $17.32/A or a return of about $4.80 per dollar invested in S.

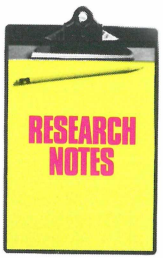
An increase of 0.7 percent protein for 6,037 lb of hay would have added over $10 per acre in additional protein value.

Summary

Research has shown that S fertilization is an important part of improved management of cool season grasses. Kansas data have shown S responses in bromegrass and tall fescue hay can range from zero to over a ton per acre. Over the past 5 years, S responses have been recorded each year. Nitrogen use efficiency has been improved by eliminating S deficiencies and forage quality has been improved. In the final analysis, forage profitability has been substantially improved by the use of S. Sulphur soil tests may be of some value in determining areas needing S, but forage producers and cattlemen should also consider using plant analysis in April to help in the diagnostic process. ■

SULPHUR fertilization increases bromegrass yield and protein content. Note the effects of S (right) on growth and leaf color.

North Carolina



Cotton Response to Starter Fertilizer Placement and Planting Dates

FIELD STUDIES were conducted in four North Carolina environments to determine the effect of planting date on cotton response to side-banded starter fertilizer on soil testing high in phosphorus (P). Three planting dates, early-, mid- and late May, and two methods of starter fertilizer placement, broadcast and side-banded, were evaluated. Ammonium polyphosphate starter was applied at a rate of 15 lb N and 51 lb P_2O_5 per acre.

Fertilizer placement had only minor effect on population. Mid- and late May planting decreased average lint yields across the four environments by 31 and 50 percent, respectively. Lint yield was increased by 9 percent by side-banded fertilizer placement, even though 24 lb N and 45 lb P_2O_5 had been broadcast prior to seeding at 3 of 4 locations. No significant planting date by fertilizer placement interactions were observed for plant population, flower production or lint yield.

The researcher concluded that applying side-banded starter fertilizer can benefit cotton producers, irrespective of planting date. ■

Source: D.S. Guthrie, Department of Crop Science, North Carolina State University, Raleigh, NC 27695. Published in Agron. J. 83:836-839 (1991).