6-1983

N:S Ratio of Forages in Kentucky

Kenneth L. Wells
University of Kentucky

UNIVERSITY OF KENTUCKY
COLLEGE OF AGRICULTURE
Lexington, Kentucky 40546

COOPERATIVE EXTENSION SERVICE

AGRONOMY NOTES

Vol. 16, No. 4 June, 1983

N:S RATIO OF FORAGES IN KENTUCKY[1/]

K. L. Wells[2/]

Background

Concern has been expressed during recent years that sulfur may have become more limiting for plant growth and subsequently ruminant animal nutrition than was expected. This likelihood is based largely on the fact that (a) the inherent sulfur content of fertilizer phosphates has greatly diminished with declining use of normal superphosphate in manufacture of mixed fertilizers, (b) increased regulatory effect on burning of high sulfur fuels, and (c) increased use of nitrogen fertilizers for production of animal feeds. Assumedly, any or all these factors could result in alteration of nitrogen and sulfur content of forages to the point that either growth of the crops or utilization of forages by ruminant animals could be affected. This situation is very important to Kentucky agriculture with its heavy dependence on forage crop production for support of its 2.5-3.0 million head of cattle and calves.

Nutritional requirements for sulfur are not necessarily the same for plants as for animals, i.e., even though a plant may contain enough sulfur for optimum growth, it may or may not provide the animal dietary requirements for optimum animal production. For this reason, sulfur requirements for optimum crop production should not be confused with sulfur requirements for optimum animal production. In all cases, forage testing is recommended as a diagnostic aid for determining sulfur content of feeds used in formulating animal diets.

As indicated by Murdock (1), measurements of atmospheric fallout of sulfur in Kentucky and surrounding states during the 1970's was substantial and it, together with the residual content of soil sulfur is considered to be sufficient for good crop production. In general, sulfur should occur in plant tissue at nearly the same concentration as phosphorus, generally within the range of 0.25-0.40 percent, and should occur somewhere around a ratio of 15:1, nitrogen to sulfur, for good plant growth. In contrast, as indicated in a review by Reid and Jung (2), the N:S ratio of forage should be in the range 10:1 to 15:1 for best ruminant animal utilization. If the forage N:S ratio exceeds 16:1, and particularly if the forage in question is the sole source of the animal diet, optimum ruminant animal performance would be questionable.

[1/] Appreciation is expressed to the Sulfur Institute for partial financial support of this project.

[2/] Extension Soils Specialist

Survey of N:S Ratios in Kentucky - grown Forages

In order to get an indication of N:S ratios in Kentucky forages, tissue samples from several forage field experiments which were conducted in Kentucky at several locations during 1973 were analyzed for total content of N and S. None of these experiments received any fertilizer sulfur. Results are shown in tables 1-7 for corn silage, barley silage, wheat silage, alfalfa, fescue, orchardgrass, and grass-clover mixtures. The nature of some of the studies enabled measuring the effect of different fertilizer nitrogen rates on N:S ratios of the herbage. Sites and soil types for the various herbage analyzed were: Corn and small grain silages, Breathitt Co., Ky., (Pope silt loam); alfalfa, Warren Co., Ky., (Pembroke silt loam); fescue and fescue-legume mixtures, Franklin Co., Ky., (Elk silt loam), Graves Co., Ky., (Grenada silt loam), and Breathitt Co., Ky., (Allegheny loam); orchardgrass and orchardgrass-legume mixtures, Franklin Co., Ky., (Elk silt loam).

Results

The silage data show quite clearly that increased fertilizer N rates resulted in higher nitrogen content with little effect on sulfur content, thereby increasing the N:S ratio. Although silage is rarely if ever the sole component of a ruminant animal's diet, N:S ratios never approached that of concern even with 260 and 90 lbs N/A respectively on corn and barley.

The alfalfa data came from a study on intensive production at sustained high yield levels (5-6 T/A/Yr) and never approached N:S levels of concern for the 4 harvests tested during 1973.

Herbage analyzed from the N-rate studies on fescue and orchardgrass show a major effect of fertilizer N on herbage content of N, but little effect on S content. The effect was more pronounced on the first harvest following application of N, but still did not result in N:S ratios of concern even at 120 lbs N/A/Yr. Second harvest N:S ratios were even lower, reflecting reduced carryover N effect from the March 15 top-dressing. Even with the normally expected lower growth rate of fall stockpiled fescue, N:S ratios still did not approach those of concern.

Results from the grass-legume interseeding where no fertilizer N was used showed both high levels of dry matter production and nitrogen content, but N:S ratios which should not affect animal utilization of the herbage.

Assuming these data for a variety of forages produced during 1973 at several locations in Kentucky are representative of situations where N:S ratios of herbage may be of concern, there would appear to be little likelihood that high (greater than 16:1) N:S ratios would occur.

Seasonal Carryover Effect of Fertilizer N on N:S Ratio of Tall Fescue

Another UK study conducted during 1981 was designed to measure the effect of a March topdressing of N (50 lbs/A) on N:S ratios of fescue herbage sampled on monthly intervals through the growing season. Data for the study are shown in table 8. As indicated, resultant N:S ratios were well below the level of concern. As indicated by the progressive decline in N content of the season-long stockpiled herbage, quality was low. The N:S ratios of the herbage regrowth are more like that which would be

expected under good grazing management, with N content (and subsequently crude protein content) maintaining a much higher level. As shown, N:S ratios of the regrowth herbage were also well below the critical value.

Table 1. Effect of Fertilizer N on Yield and N:S Ratios of Double-Cropped Silage

Silage Crop	lbs N/A	Yield lbs dry matter/A	% Content Nitrogen	% Content Sulfur	N:S Ratio
Corn	260	18,723	1.20	0.11	10.9
	190	15,892	1.05	0.12	8.8
	100	14,380	0.83	0.11	7.5
Wheat	60	7,316	1.05	0.13	8.1
Barley	90	6,435	1.71	0.18	9.6
	60	5,539	1.14	0.16	7.1
	50	4,664	0.96	0.15	6.4

Table 2. N:S Ratio of Alfalfa

Cutting Date	Yield (lbs dry matter/A)	% Content Nitrogen	% Content Sulfur	N:S Ratio
5-14	3087	3.12	0.28	11.1
6-18	3320	3.05	.26	11.7
7-30	3060	2.60	.28	9.3
9-10	2390	3.06	.28	10.9

1/ Topdressed annually with 90, 200, and 2 lbs/A respectively of P_2O_5, K_2O, and B.

Table 3. Effect of Fertilizer N Rates on Yield and N:S Ratio of Ky 31 Tall Fescue

lbs N/A[1/]	First Harvest (May 15) Yield lbs dry matter/A	% Content N	% Content S	N:S	Second Harvest (August 15) Yield lbs dry matter/A	% Content N	% Content S	N:S
			Franklin Co.					
0	1680	1.47	0.24	6.1	2708	2.07	0.25	8.3
40	4393	1.95	.22	8.9	2908	1.53	.27	5.7
80	4516	2.53	.23	11.0	3893	1.68	.25	6.7
120	5027	2.89	.22	13.1	4517	1.72	.23	7.5
			Graves Co.					
0	670	1.58	0.18	8.8	608	1.51	0.29	5.2
40	2952	1.78	.18	9.9	1125	1.28	.30	4.3
80	3813	2.14	.20	10.7	1445	1.35	.26	5.2
120	3551	2.81	.20	14.1	2736	1.36	.21	6.5
160	3712	3.14	.23	13.7	2874	1.61	.24	6.7
			Breathitt Co.					
0	1542	1.43	0.18	7.9	2963	1.40	0.23	6.1
40	4001	1.77	.19	9.3	3532	1.42	.24	5.9
80	4901	2.27	.19	12.0	4435	1.42	.22	6.5
120	4700	2.61	.19	13.7	4707	1.59	.22	7.2

[1/] Topdressed March 15

Table 4. Effect of Fertilizer N Rates on Yield and N:S Ratio of Boone Orchardgrass

lbs N/A[1/]	First Harvest (May 15) Yield lbs dry matter/A	% Content N	% Content S	N:S	Second Harvest (August 15) Yield lbs dry matter/A	% Content N	% Content S	N:S
0	1660	1.76	0.22	8.0	2245	1.73	0.23	7.5
40	4910	1.94	.21	9.2	2716	1.75	.26	6.7
80	4350	2.31	.20	11.6	2930	1.63	.24	6.8
120	3718	2.86	.21	13.6	4277	1.77	.21	8.4

[1/] Topdressed March 15

Table 5. Effect of Fertilizer N Rates on Yield and N:S Ratios of Fall-Stockpiled Ky. 31 Tall Fescue[1/]

Franklin Co., Ky.

lbs N/A[2/]	Yield lbs dry matter/A	% Content N	% Content S	N:S
0	793	2.09	0.29	7.2
40	1912	1.70	.28	6.1
80	2382	1.93	.22	8.8
120	2566	2.44	.21	11.6

[1/] Growth accumulated from August 15 to November 15

[2/] Topdressed August 15

Table 6. Effect of Interseeded Legumes on Yield and N:S Content of Ky 31 Tall Fescue[1/]

	First Harvest (May 15)				Second Harvest (August 15)			
legume	lbs dry matter/A	% Content N	% Content S	N:S	lbs dry matter/A	% Content N	% Content S	N:S
				Franklin Co.				
Alfalfa	3271	2.66	0.23	11.6	3647	1.77	0.27	6.6
red clover	3557	2.28	.20	11.4	3228	1.81	.25	7.2
ladino clover	3228	2.16	.23	9.4	3593	2.10	.28	7.5
				Graves Co.				
red clover	2632	2.60	0.25	10.4	2731	1.52	0.24	6.3
ladino clover	2584	2.56	.22	11.6	2216	1.76	.26	6.8

[1/] Third year following legume establishment with 50% or more legume in herbage; no fertilizer N applied.

Table 7. Effect of Interseeded Legumes on Yield and N:S Content of Boone Orchardgrass[1/]

	First Harvest (May 15)				Second Harvest (August 15)			
	Yield lbs dry	% Content			Yield lbs dry	% Content		
Legume	matter/A	N	S	N:S	matter/A	N	S	N:S
alfalfa	2933	2.72	0.23	11.8	3719	1.91	0.23	8.3
red clover	3044	2.14	.19	11.3	4031	2.11	.21	10.1
ladino clover	3685	2.01	.20	10.1	3435	1.98	.23	8.6

[1/] Third year following legume establishment with 50% or more legume in herbage; no fertilizer N applied.

Table 8. N and S Content and N:S ratios of Stockpiled Fall Fescue Herbage Accumulated From March and in Regrowth Sampled One Month After the First Harvest Following a 50 lb/A Topdressing of N in March.[1/]

	Stockpiled Herbage			Regrowth Herbage		
Date	N(%)	S(%)	N:S	N(%)	S(%)	N:S
1 June 1981	1.43	0.26	5.5			
29 June 1981	1.07	0.27	4.0	1.88	0.41	4.6
29 July 1981	1.17	0.31	3.8	2.44	0.50	4.9
27 August 1981	1.16	0.30	3.9	1.90	0.36	5.3
24 Sept 1981	1.22	0.31	3.9	1.99	0.35	5.7
22 Oct 1981	1.04	0.24	4.3	1.47	0.27	5.4
19 Nov 1981				1.75	0.32	5.5

[1/] K. P. Coffey, M. S. Thesis. Univ. of Ky., 1983.

References

1- Murdock, Lloyd. The status of sulfur fertilization of crops in Kentucky. Soil Sci. News & Views. 2:7. July 1981.

2- Reid, R. L. and G. A. Jung. Effects of elements other than nitrogen on the nutritive value of forage. In, Forage Fertilization. ASA, CSSA, SSSA. Madison, Wisc. 1974.