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EVALUATING THE IMPACTS OF SULFUR ON MIXED, COOL-SEASON FORAGES IN EASTERN OHIO

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Background and Significance

Sulfur in the Environment

Historically, eastern Ohio has had some of the highest sulfur content soil in the state due to the impact of coal energy production. After the impacts of acid rain were discovered and mitigated, less sulfur was found on the soils of eastern Ohio. Currently we have seen a shift on the amount of sulfur in the area as soil tests are coming back deficient (less than 15 ppm) in sulfur. When amending the soil, elemental sulfur and sulfate are the two easiest forms to add sulfur to the ground. We discuss the results of three sites in eastern Ohio, two sulfur deficient and one that was found to be sufficient (over 15 ppm) and compare the results of the impact of nitrogen with and without sulfur. We examine both the quality and quantity of the forage in each site and measure the impacts of the sulfur.

Sulfur Plot in Muskingum County Ohio, August 2023

Sulfur as a Nutrient

Sulfur is an element found in two out of the twenty protein forming amino acids in plants. It is considered a secondary macronutrient because of its essential requirements at lower levels than the other macro-nutrients: nitrogen, phosphorous, and potassium. Elemental sulfur takes many months to react and will cause acidification. Sulfate is found in many fertilizers and gypsum (Calcium Sulfate) and is readily available for plant uptake.

Elemental Sulfur H_2SO_3

Ammonium Sulfate $(NH_4)_2SO_4$

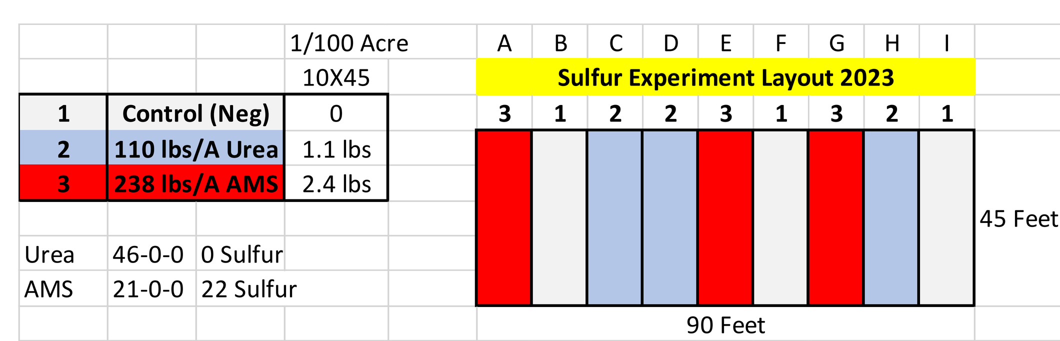
Experimental Layout

Site Selection and Soils

Three counties in Eastern Ohio were chosen for the study, Jefferson, Licking, and Muskingum Counties, all were mixed, cool-season grass fields. Soil tests confirmed Jefferson at 7.7 ppm, Licking at 8.6 ppm, and Muskingum at 18 ppm of sulfur. We grouped Jefferson and Licking together because they were sulfur deficient (below 15 ppm). Muskingum was analyzed separate and categorized as sulfur sufficient, above 15 ppm.

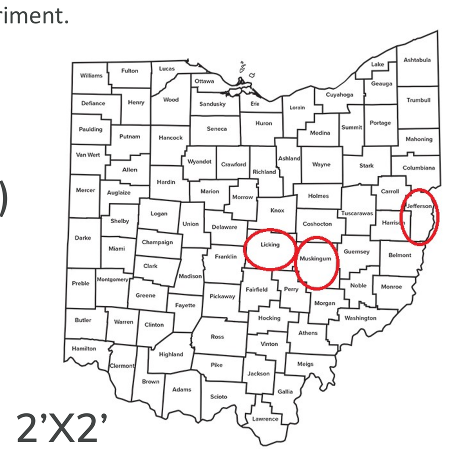
10'X45' plots were laid out. All treatments were triplicated in each site. Urea applications were applied at the rate of 110 lbs./A; Ammonium Sulfate (AMS) at 238 lbs./A; and a control with no inputs. The treatments were such that 50 lbs./A of nitrogen was received with or without ~50 lbs./A of sulfate. Fertilizer/treatment applications were done on July 26, 2023, at a grass height of approximately 3". The plots were harvested on September 16, 2023, and analyzed for dry matter using microwave drying and fresh weights, the protocol from Bucholtz, 2007. Forage quality was measured by subsampling from each replicate and aggregating the subsamples for one analysis. The plots were set up in a complete block randomization.

Sulfur Plots Design



Plot Layout and map locations of the counties used for the experiment.

1. Soil Test (JUL)
2. Apply Fertilizer (Late JUL)
3. Dry Matter for each plot (Mid SEP)
4. Average forage analysis for each treatment (Same as 3.)



Dry Matter and Forage Analysis

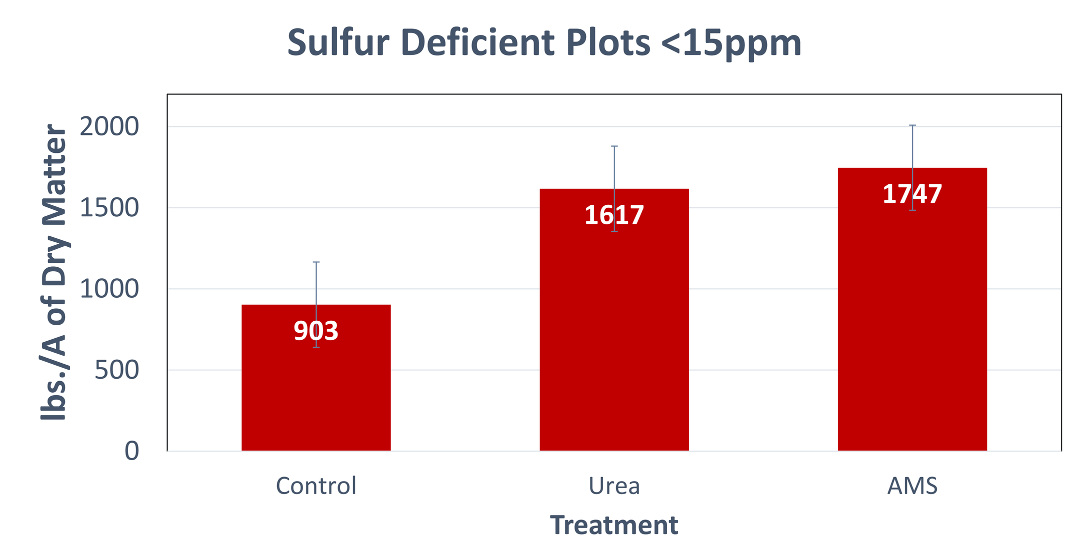
Dry matter was analyzed using a 2'X2' square and weighed for fresh matter. Dry matter was calculated by drying 100 grams in a microwave and obtain the moisture level for each sample. For each site, dry matter readings were averaged per treatment.

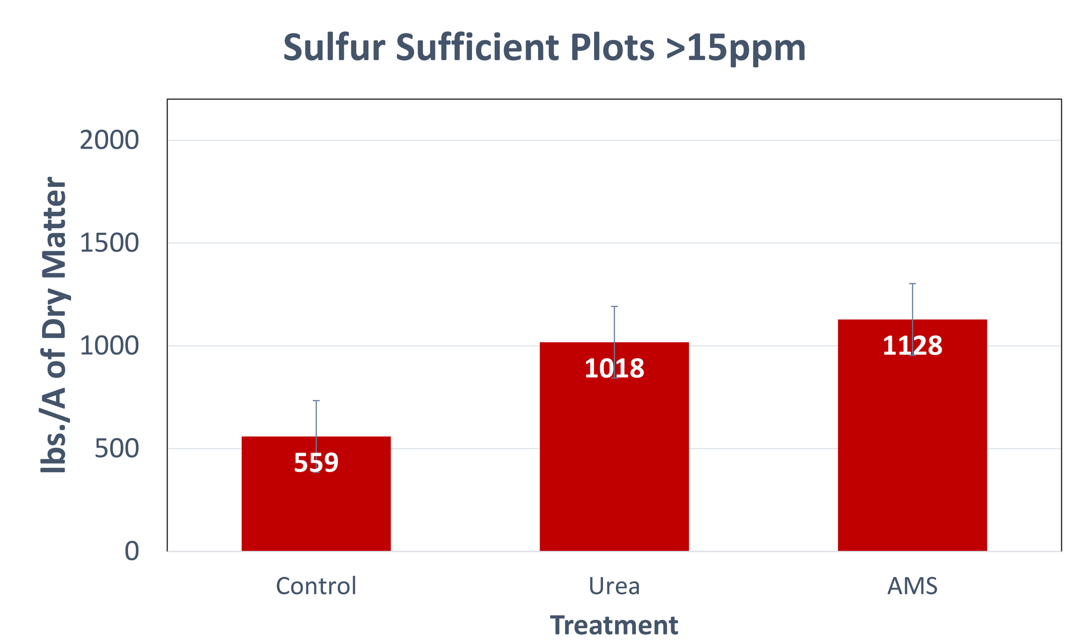
Quality analysis was determined by sub sampling from each plot by treatment and sent to a forage analysis lab. Quality was tested with Near-Infrared Spectroscopy.

2'X2' used for harvesting forage in September .

Results

Pounds of Dry Matter in Sulfur Plots





Average Forage Dry Matter Results of Sulfur Sufficient and Deficient Plots .

Quality Analysis of Forages in Each County Location

County	Treatment	CP%	ADF%	TDN%	Sulfur%
Jefferson	Control	16.5	33.9	59	0.29
	Urea	23.1	31.2	62	0.34
	Ammonium Sulfate	22.9	27.1	64	0.42
Licking	Control	16.2	31.9	65.1	NA
	Urea	17.9	31.1	65.5	NA
	Ammonium Sulfate	17.1	31.3	63.3	NA
Muskingum	Control	15.5	29.3	62	0.26
	Urea	21	28.2	63	0.32
	Ammonium Sulfate	19.7	28.7	64	0.36

Quantity and Quality of Forage

- No significant difference was observed between Urea and AMS treatments in both sulfur sufficient and deficient sites.
  - Error bars indicate standard error
- Quality analysis point toward an increase in quality with the use of urea or AMS
  - Quality analysis between the urea and AMS behaved similarly in all sites.

Conclusions and Discussion

Under the conditions in this experiment, addition of sulfur did not improve pounds of dry matter, CP%, ADF%, or TDN% over addition of nitrogen alone. This study does support the application of nitrogen for increasing production. Addition of nitrogen in the form of either urea or AMS led to similar increases in dry matter production over control plots regardless of deficiency or sufficiency of S in the soil.

Jefferson County Site.

This project was intended to evaluate two easily accessible retail products that could be selected for summer forage fertilization as an example of one choice out of many that a producer may make in product selection. A basic price analysis with Urea priced at ~$500 per ton and granular AMS priced at ~$425 per ton would cost $0.54 and $1.01 per unit N, respectively (local price, Dec 2023). In the three fields selected for this project, a simple agronomic recommendation to improve forage quality continues to be a timely application of a nitrogen source like granular urea. This is strongly supported by price and our measured observation of a lack of difference in the final forage product.

Urea

Ammonium Sulfate (AMS)

Urea: $0.54 per unit of N
AMS: $1.01 per unit N

The Sulfur threshold for this study was 15 ppm. Two fields at levels 7.7 and 8.6, Jefferson and Licking respectively, did not show a response to sulfur. Further experiments are necessary for more definitive conclusions.

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