

Effect of Nitrogen Source on Forage Grass Yield and Mineral Content

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Introduction

High potassium levels in dry cow diets interfere with magnesium and calcium absorption, and can result in milk fever or hypomagnesia. While much of the discussion has focused on these minerals, sulfur is also important in dietary cation-anion differences (DCAD). One way to achieve a DCAD of zero or less for close-up dry cows is to minimize potassium fertilization. However, two years of research at Miner Institute, funded by the Zen-Noh National Federation of Agricultural Cooperative Associations, suggests that even with low soil K levels and minimal fertilization, tissue K levels may still be unacceptably high. Another way to achieve a proper DCAD is to increase sulfur levels. Since nitrogen must be applied to forage grasses for acceptable yield and crude protein levels, use of a nitrogen source which contains sulfur may be economical. While ammonium nitrate (34-0-0) is the most commonly used N source for topdressing grasses, ammonium sulfate (21-0-0-24S) is also an economical and readily available fertilizer.

Objectives

1. Compare two sources of nitrogen fertilizer, ammonium nitrate and ammonium sulfate, for yield response and mineral content of three cool-season forage grasses.
2. Determine the dietary cation-anion difference (DCAD) for each species, and evaluate whether any differences are of practical significance in balancing rations for dry cows.

Procedures

“Toro” timothy, “Palaton” reed canarygrass, and “Shawnee” orchardgrass were seeded in 9 meter wide replicated strips on July 20, 1994, in a Malone sandy loam soil. Since establishment, two crops of grass had been harvested with no fertilizer amendments. Soil pH was 6.0 which is adequate for grass production. Available soil phosphorus and potassium levels were low, and the soil magnesium level was high. Soil fertility was quite uniform throughout the plot area. Two sources of nitrogen fertilizer were applied on May 2, 1996, at a rate of 56 kg/Ha of actual N. One source, ammonium sulfate, in addition to nitrogen supplied 62 kg/Ha of sulfur. The other source, ammonium nitrate, is a commonly used nitrogen fertilizer which contains no sulfur.

Plots were harvested on June 3, 1996. A 0.9 meter by 3.0 meter area was harvested from each plot, with four replications of each treatment. Samples were collected for each plot, dried, ground, and submitted to Northeast DHI for forage analysis including mineral content, ADF, NDF, and protein fractions, and to Cumberland Valley Analytical Service for chloride analysis.

Results and discussion

Yield

Ammonium sulfate significantly increased yields ($P < .10$) compared to ammonium nitrate. While yields were lower than normal because of a cold, wet spring, ammonium sulfate plot yields were 17% higher than ammonium nitrate plots. All three species of grasses responded to ammonium sulfate with higher yields (Table 1).

Table 1. Forage yield, Kg/Ha

Fertilizer	Orchardgrass	Timothy	R.Canarygrass	Mean
Ammonium sulfate	1969	3085	3252	2769*
Ammonium Nitrate	1577	2661	2847	2362

*P<.10

Forage quality

Crude protein and fiber levels were lower in forage from plots which were fertilized with ammonium sulfate. However, the magnitude of the differences, while statistically significant, would have little impact on dry cow ration formulation. For both fertilizer sources, crude protein and NDF levels were more than adequate for dry cow rations (Table 2).

Table 2. Forage quality, % of DM

Fertilizer	Crude protein	ADF	NDF
Ammonium sulfate	14.2	29.8	56.7
Ammonium nitrate	15.1**	31.7*	58.6**

* P<.10

**P<.05

Mineral levels

Sulfur levels were significantly higher (P<.05) in forage from plots fertilized with ammonium sulfate. There was a trend toward higher sulfur levels in each of the species, but orchardgrass was the only species for which this difference was statistically significant (P<.10). Sodium concentration in orchardgrass was significantly higher than in timothy or reed canarygrass, but fertilizer N source had no effect on Na (Table 3). Sodium will be discussed more fully in the next section.

Table 3. Mineral levels,% of dry matter

Treatment	Na	K	S	Cl
Ammonium sulfate Orchardgrass	.025	2.42	.25	.55
Ammonium nitrate Orchardgrass	.026	2.24	.20	.43
Ammonium sulfate Timothy	.002	2.20	.17	.52
Ammonium nitrate Timothy	.002	2.16	.16	.40
Ammonium sulfate Reed canarygrass	.003	2.55	.24	.60
Ammonium nitrate Reed canarygrass	.002	2.46	.21	.57

Dietary Cation-Anion Difference

Ruminant nutritionists use the Dietary Cation-Anion Difference (DCAD) to balance dry cow rations. Sodium (Na) and potassium (K) are cations, and chloride (Cl) and sulfur (S) are anions. Prefresh dry cows need an anionic diet, so for these purposes Cl and S concentrations should be relatively high, and Na and

K relatively low. To prevent milk fever, DCAD should be between -100 and --200 mEq/Kg of feed. Because of the high potassium levels in the forage, the DCAD for both fertilizer materials and for all three species were quite high. However, the use of ammonium sulfate resulted in improved DCAD balances for all species (Table 4).

Table 4. DCAD, mEq/Kg

Species	Ammonium nitrate	Ammonium sulfate
Orchardgrass	+338	+320
Timothy	+342	+311
Reed canarygrass	+339	+335

In all of the grass research trials at Miner Institute to date, Na concentrations for orchardgrass have been 4 to 12 times higher than for the other two species. Sodium content is higher in first cutting orchardgrass than in second, but quite low in both cuttings for timothy and reed canarygrass. Sodium is not as important as K in DCAD, but high Na combined with the consistently higher K concentrations of orchardgrass *makes this species a particularly bad choice for dry cow rations*. In our research we have found no relationship between potassium fertilizer rate and Na concentration, but other research has found that high potassium fertilizer rates depress sodium uptake.

Summary

Ammonium sulfate is not an expensive fertilizer compared to other nitrogen sources, and substituting it for ammonium nitrate when fertilizing grasses which will be fed to dry cows represents only a small investment. Even though the Miner Institute research (one cutting, one year) showed a modest yield increase in the ammonium sulfate plots, previous sulfur research in New York with alfalfa and wheat has not shown consistent yield improvement. Our research is not conclusive enough to say that applying sulfur to forage grasses will increase yield. However, while ammonium sulfate won't "correct" very high potassium concentrations, the potential improvement in DCAD *may* justify the small added investment when the forage will be fed to dry cows. More research on this subject is needed.

References

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