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Bermudagrass Yield and Nitrogen Uptake as Influenced by Source of Nitrogen Fertilizer

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Summary

Nitrogen source comparisons were conducted on bermudagrasses grown on Ships clay and Lufkin fine sandy loam soils in 1986. Nitrogen rate was 100 lbs/A topdressed prior to each new growth of grass. Nitrogen sources were ammonium nitrate, ammonium sulfate, urea with and without $CaCl_2$ added, and urea ammonium nitrate (UAN) with and without ammonium thiosulfate. These urea additives had been postulated to inhibit urea hydrolysis and subsequent nitrogen volatilization loss. However, since apparent nitrogen loss was negligible, their inhibition abilities were not thoroughly tested.

A total of 29 trials were conducted throughout the season both on clay and sandy soils and under widely differing environmental conditions at varied times during the season. All trials were top-dressed on bermudagrass and allowed to remain on the surface for varied periods of time before being moved into the soil root zone either by rainfall or irrigation. Seldom was there a significant difference in yield between nitrogen sources, even when fertilizer laid on the surface for several weeks before rainfall occurrence. These tests showed that bermudagrass top-dressed with urea resulted in yields as high as, and in some cases higher than from ammonium nitrate, ammonium sulfate, and liquid UAN. Based on these results we conclude that urea is not inferior to the other nitrogen sources for surface application on bermudagrass.

Introduction

Urea has been rapidly becoming a major source of nitrogen fertilizer over that of previously predominate nitrogen sources because it is more economical to manufacture. However, due to some reports of poor response from surface applied urea, forage producers have been hesitant about its use in topdressing forage crops. Laboratory studies have suggested that certain additives such as $CaCl_2$ and ammonium thiosulfate may inhibit urea hydrolysis and subsequently prevent volatilization loss of nitrogen from surface applications. These additives were tested in this study under actual field conditions. Also, topdressed nitrogen fertilizers were allowed to remain on the surface for varied periods until rainfall occurrence to determine potential for nitrogen loss.

Results of this study should help producers to assess the magnitude of risk for nitrogen loss and aid in the decision of which nitrogen source might work best for their system of bermudagrass production.

Procedure

Fertilizer N sources, rates, and application methods are listed in Table 1. Each treatment was replicated four times in a randomized block design. Phosphorus and potassium fertilizers were applied in the spring as required according to soil test levels. Field plots were established at two locations with contrasting soil types. The Brazos River bottom clay soil was a Ships clay soil series with a pH of 7.8, while the sandy soil was a Lufkin fine sandy loam soil series with a pH of 4.9. A total of 29 trials were staggered throughout the 1986 growing season to encompass the varying environmental conditions which might influence NH_3 volatilization losses from urea as compared with other nitrogen fertilizers. Plot size was 5 × 20 ft of which a 3- × 17-ft swath was harvested for yield measurement. A small sample was collected from each plot for moisture and chemical analyses. Samples were ovendried, finely ground, and analyzed for N on a "NIR" (near infrared) spectrophotometer. Data were analyzed statistically by SAS for analysis of variance and Duncan's Multiple Range Test for mean comparisons.

TABLE 1. NITROGEN FERTILIZER TREATMENTS APPLIED TO BERMUDAGRASS

Treatment	N Rate (lbs/Acre)	Form	Application Method
Control	0		
Ammonium Nitrate (AN)	100	dry	surface broadcast
Ammonium Sulfate (AS)	100	dry	surface broadcast
Urea	100	dry	surface broadcast
Urea + $CaCl_2$*	100	liquid	surface band
Urea-ammonium Nitrate (UAN)	100	liquid	surface band
UAN + 2% ATS	100	liquid	surface band
UAN + 5% ATS	100	liquid	surface band
UAN + 19% ATS	100	liquid	surface band

* $CaCl_2$ applied at 0.25 Ca^{+2} : 1 N equivalent ratio.

† ATS=Ammonium thio sulfate (12-0-0-26S).

TABLE 2. YIELD OF BERMUDAGRASSES AS INFLUENCED BY N FERTILIZER SOURCE ON BRAZOS RIVER BOTTOM CLAY SOIL

Date Fertilized Days Until Rain*		Mar. 24 17	Mar. 24 17	May 29 1	June 13 4	July 18 16	July 22 12	Sept. 16 4	Apr. 7 3	Apr. 15 4	June 23 14	June 30 7	Aug. 14 4	Aug. 27 1
N-Source	N rate (lbs/Acre)	S-16 Bermudagrass							Coastal Bermudagrass					
		yield (cwt/Acre)												
Control	0	19b[†]	23b	21b	20c	29b	30b	18c	17b	20c	24b	25c	23b	23b
NH_4NO_3	100	39a	44a	48a	46a	52a	53a	44a	53a	52a	50a	51a	53a	50a
Urea	100	39a	44a	51a	43ab	51a	50a	44a	52a	46ab	53a	42ab	55a	46a
Urea + Ca	100	39a	39a	50a	42ab	51a	47a	44a	50a	45ab	48a	45ab	49a	46a
UAN	100	36a	42a	51a	31bc	47a	50a	37b	44a	47ab	47a	46ab	53a	50a
UAN + 2% ATS	100	41a	41a	51a	43ab	49a	48a	41ab	49a	43b	45a	43ab	55a	46a
UAN + 5% ATS	100	39a	39a	49a	45a	52a	49a	43a	47a	45ab	49a	49ab	50a	50a
UAN + 19% ATS	100	37a	36a	54a	44a	51a	49a	42a	50a	49ab	49a	47ab	49a	49a

*Days that ammonia volatilization loss might occur between fertilizer application and first significant rainfall occurrence.
[†]Means within a column followed by the same letter are not significantly different ($P<0.05$).

Date Fertilized Days Until Rain*		Apr. 22 5	June 16 1	July 29 5	May 7 2	May 20 4	July 3 4	July 7 10	July 16 18
N-Source	N rate (lbs/Acre)	S-54 Bermudagrass			Callie Bermudagrass				
		yield (cwt/Acre)							
Control	0	26c[†]	16c	17c	22c	19c	18b	16c	18ab
NH_4NO_3	100	50ab	43ab	40ab	51a	48ab	33a	38a	26a
Urea	100	53a	44a	36ab	44ab	49a	34a	34a	25a
Urea + Ca	100	52a	43ab	39ab	44ab	47ab	31a	34a	24a
UAN	100	50ab	42ab	42a	46ab	46ab	34a	35a	21a
UAN + 2% ATS	100	49ab	40ab	34b	43ab	46ab	32a	32a	26a
UAN + 5% ATS	100	49ab	42ab	39ab	41b	46ab	30a	33a	25a
UAN + 19% ATS	100	52a	39ab	37ab	44ab	41b	34a	24b	25a
$(NH_4)_2SO_4$	100	44b	38b	37ab	38b	45ab	34a	34a	23a

*Days that ammonia volatilization loss might occur between fertilizer application and first significant rainfall occurrence.
[†]Means within a column followed by the same letter are not significantly different ($P<0.05$).

Results and Discussion

Yield of bermudagrasses on the Brazos River bottom clay soil as influenced by N fertilizer source is given in Table 2. The use of several bermudagrass varieties was incidental only to acquire additional plot space to accommodate a greater number of trials. The objective was to evaluate N sources without regard to the variety. The main purpose was to compare N source performance in each given trial which had environmental conditions differing from any other trial date. The days until rain is the time period which the fertilizer laid on the surface until moved into the soil by the first significant rainfall (>0.2 inch) or by irrigation. Compared with NH_4NO_3 as a standard, urea performed as well even in trials where urea remained on the surface subject to potential volatilization for several weeks. Since there was no significant loss of N from urea, the effectiveness of Ca or ATS amendments as N loss inhibitors was rendered undeterminable.

Yield of Coastal bermudagrass as influenced by N fertilizer source on sandy soil is shown in Table 3. Again urea performed as well as NH_4NO_3 when left for as much as several weeks without rain on the soil surface, in this case an acid sandy soil. Significant yield differences between other N sources were too few to indicate any trend.

The efficiency of N uptake by bermudagrass is shown in Tables 4 and 5. The N efficiency percentage is determined by subtracting the control N uptake then calculating the percent of applied N recovered in the crop. In 28 of the 29 trials, urea performed as well as NH_4NO_3 in N efficiency percentage. None of the inhibitor amended treatments were superior to urea alone. Apparently the daily rapid drying of the surface sod and soil by summer environmental conditions following a light rain shower or nighttime dew reduces the urease emzyme activity sufficiently to prevent hydrolysis and serious volatilization N loss. This is in contrast to high N loss in laboratory tests where the surface is kept moist. Under actual field conditions, urea N was not lost more than from other N sources as evidenced by the yield data.

TABLE 3. YIELD OF COASTAL BERMUDAGRASS AS INFLUENCED BY N FERTILIZER SOURCE ON SANDY SOIL

Date Fertilized		Apr. 4	Apr. 22	May 29	June 20	June 30	July 3	July 17	July 21
Days Until Rain*		6	5	1	24	15	12	17	13
N-Source	N rate (lbs/Acre)	Coastal Bermudagrass							
		yield (cwt/Acre)							
Control	0	33b[†]	39b	32b	29c	23c	18b	34b	29c
NH_4NO_3	100	45a	58a	42a	47ab	38a	42a	42ab	48ab
Urea	100	51a	54ab	51a	50a	33ab	33a	46a	49ab
Urea + Ca	100	44ab	55a	48a	43b	30b	36a	48a	43b
UAN	100	40ab	51ab	45a	44ab	33ab	36a	45a	46ab
UAN + 2% ATS	100	47a	57a	48a	46ab	30b	35a	47a	49ab
UAN + 5% ATS	100	46a	62a	44a	48ab	32ab	38a	47a	51a
UAN + 19% ATS	100	40ab	58a	46a	42b	33ab	39a	43ab	48ab

*Days that ammonia volatilization loss might occur between fertilizer application and first significant rainfall occurrence.

†Means within a column followed by the same letter are not significantly different ($P<0.05$).

TABLE 4. NITROGEN UPTAKE BY BERMUDAGRASSES FROM DIFFERENT N FERTILIZER SOURCES ON CLAY SOIL

Date Fertilized		Mar. 24	Mar. 24	May 29	June 13	July 18	July 22	Sept. 16	Apr. 7	Apr. 15	June 23	June 30	Aug. 14	Aug. 27
Days Until Rain*		17	17	1	4	16	12	4	3	4	44	7	4	1
N-Source	N rate (lbs/Acre)	S-16 Bermudagrass							Coastal Bermudagrass					
		N Efficiency Percentage												
NH_4NO_3	100	45a[†]	43ab	29ab	35a	30a	38a	36a	38a	39a	38ab	46a	41a	36a
Urea	100	46a	53a	25ab	33a	37a	40a	36a	38a	33a	49a	36ab	37ab	28a
Urea + Ca	100	40a	28bc	29ab	36a	36a	34a	34a	39a	33a	34ab	44a	27b	30a
UAN	100	40a	39abc	34a	14b	39a	35a	23a	31a	34a	38ab	40ab	35ab	31a
UAN + 2% ATS	100	41a	34bc	20ab	32a	40a	29a	28a	35a	32a	29b	39ab	33ab	28a
UAN + 5% ATS	100	43a	33bc	28ab	38a	42a	33a	29a	32a	33a	38ab	41ab	32ab	32a
UAN + 19% ATS	100	37a	24c	34a	41a	39a	30a	30a	39a	36a	35ab	41ab	28b	29a

*Days that ammonia volatilization loss might occur between fertilizer application and first significant rainfall occurrence.
[†]Means within a column followed by the same letter are not significantly different ($P<0.05$).

Date Fertilized		Apr. 22	June 16	July 29	May 7	May 20	July 3	July 7	July 16
Days Until Rain*		5	1	5	2	4	4	10	18
N-Source	N rate (lbs/Acre)	S-54 Bermudagrass			Callie Bermudagrass				
		N Efficiency Percentage							
NH_4NO_3	100	27ab[†]	34a	36a	32a	32a	37a	37a	26a
Urea	100	32ab	35a	37a	22ab	40a	38a	32ab	26a
Urea + Ca	100	37a	36a	38a	30ab	35a	32a	31ab	18ab
UAN	100	27ab	30a	39a	24ab	27a	33a	31ab	14ab
UAN + 2% ATS	100	31ab	35a	32a	20ab	33a	35a	26ab	23a
UAN + 5% ATS	100	27ab	35a	38a	21ab	38a	27a	37a	22a
UAN + 19% ATS	100	28ab	35a	38a	23ab	34a	30a	24b	22a
$(NH_4)_2SO_4$	100	19b	28a	36a	17b	31a	36a	36a	17ab

*Days that ammonia volatilization loss might occur between fertilizer application and first significant rainfall occurrence.
[†]Means within a column followed by the same letter are not significantly different ($P<0.05$).

TABLE 5. NITROGEN UPTAKE BY COASTAL BERMUDAGRASS AS INFLUENCED BY N FERTILIZER SOURCE ON SANDY SOIL

Date Fertilized Days Until Rain*		Apr. 4 6	Apr. 22 5	May 29 1	June 20 24	June 30 15	July 3 12	July 17 17	July 21 13
N-Source	N rate (lbs/Acre)	Coastal Bermudagrass							
		N Efficiency Percentage							
NH_4NO_3	100	29ab[†]	28a	10a	35a	21a	36a	15a	29ab
Urea	100	36a	26a	14a	29a	10a	20b	16a	29ab
Urea + Ca	100	25ab	15ab	16a	26a	12a	24b	17a	23b
UAN	100	25ab	20ab	14a	27a	16a	21b	20a	23b
UAN + 2% ATS	100	32a	24a	17a	27a	11a	21b	20a	25b
UAN + 5% ATS	100	25ab	20ab	10a	27a	13a	26b	16a	37a
UAN + 19% ATS	100	18a	20ab	17a	24a	14a	25b	18a	27ab

*Days that ammonia volatilization loss might occur between fertilizer application and first significant rainfall occurrence.

[†]Means within a column followed by the same letter are not significantly different ($P<0.05$).