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Yield and Nitrogen Uptake Efficiency by Coastal Bermudagrass Show Urea as a Safe Nitrogen Source

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Summary

Several sources of nitrogen fertilizer [ammonium nitrate (AN), ammonium sulfate (AS), urea, and urea-ammonium nitrate solution (UAN)] were field tested on bermudagrass (*Cynodon dactylon* L.) to determine nitrogen efficiency. Additionally, urea was supplemented with $CaCl_2$ to determine if $CaCl_2$ would protect urea from ammonia volatilization loss. Individual experiments were initiated successively throughout the growing season on two diverse soils to encompass the differing environmental conditions which might influence NH_3 volatilization. The clay soil was a Brazos River Bottom Ships clay series (calcareous). The sand soil was a Lufkin fsl series (an acid fine sandy loam).

Coastal bermudagrass yields from urea fertilization were consistently as good and sometimes higher than from the other N sources tested.

The addition of $CaCl_2$ did not enhance N uptake as it did in the previous year. The comparative high yields resulting from surface applications of urea fertilizer throughout the growing season indicate no serious risk of N loss from urea under the prevailing environmental conditions.

Introduction

In recent years, urea has gained importance among N fertilizers because of its low cost per unit of nitrogen. However, since some studies have cited decreased plant response to urea as a nitrogen fertilizer, especially when surface applied, producers are hesitant to use this source in situations where fertilizer cannot be incorporated into the soil. Considerable nitrogen losses have been reported in laboratory work under conditions favoring rapid urea hydrolysis and build up of NH_3 in the soil. Recent laboratory and greenhouse work has shown that $CaCl_2$ and other soluble salts are effective in reducing N loss from surface applied urea. The objectives of this study were: (1) to determine the effectiveness of urea in the field as a nitrogen fertilizer compared with other N sources commonly used for bermudagrass production in the local area, and (2), to field test $CaCl_2$, applied with urea as a means of reducing volatile NH_3 loss over a range of soil and environmental conditions existing in the College Station, Texas area.

Procedures

Experimental field plots were established at two locations with contrasting soil types. The physical and chemical characteristics of the two soils were reported in the preceding annual report. Experiments were conducted in successive periods throughout the 1985 growing season. A total of 30 experiments were staggered throughout the season to encompass the varying environmental conditions which might influence NH_3 volatilization losses from urea as compared with other nitrogen fertilizers. Fertilizer treatments, rates, and application methods are listed in Table 1. Each fertilizer treatment and the control were replicated four times in a randomized block design within each experiment. Repeated experiments were established to vary the potential volatilization time period between fertilizer application and first significant rainfall (>0.2 inch). This criteria was used to estimate days of potential volatilization for each experiment. Plots were fertilized to initiate individual experiments and harvested when bermudagrass reached maturity. After harvesting, samples were dried, ground, and chemically analyzed for N content using a common micro Kjeldahl method.

Results and Discussion

Each trial (by date) in the Tables must be considered as a separate individual experiment because environmental conditions differ with date and time period which would affect growth and N fertilizer efficiency. Thus, yield comparisons between N sources in a column are valid

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because of the same growing conditions during that growing period. However, other growing periods had considerably different environmental conditions. The Brazos River Bottom location (Table 2) had supplemental irrigation available whereas the Wellborn location (Table 3) was dependent on rainfall (dryland). The Wellborn site yields were considerably reduced by drought conditions.

TABLE 1. NITROGEN FERTILIZER TREATMENT APPLIED TO BERMUDAGRASS

Treatment	N Rate (lb/Acre)	Form	Application Method
Ammonium Nitrate (AN)	100	dry pelleted	surface broadcast
Ammonium Sulfate (AS)	100	dry pelleted	surface broadcast
Urea	100	dry pelleted	surface broadcast
Urea-ammonium Nitrate (UAN)	100	liquid	surface band
Urea + $CaCl_2$*	100 100	liquid	surface band
Control	0		

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

Statistical analysis of bermudagrass dry matter yield for the two soil types is included in the Tables. The values of bermudagrass yield are the means of four treatment replications.

The urea treatments gave comparatively high yields in all trials compared to the other N sources. Yields from urea were not significantly better than from AN; however sometimes they were better than from AS. Apparently, N losses do not differ much among the N sources. An overall consideration of yields from the several trials shows little statistically significant difference between the N sources.

The N uptake by bermudagrass as influenced by N source is shown in Tables 4 and 5. The N uptake values showed no consistent pattern of one N source being better than another. The addition of $CaCl_2$ with urea did not enhance N uptake as it did in the previous year. These results corroborate the yield data as evidence that N losses are not occurring from urea more than from the other N sources.

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

Variety		Coastal						Callie					
Fertilized		Mar. 28	Apr. 3	May 24	May 30	July 23	Aug. 1	May 4	May 15	May 2	July 16	Aug. 9	Aug. 16
Days Until Rain		2	5	25	19	6	15	4	2	1	3	7	1
N-Source	N-rate (lb/A)	Dry matter yield in cwt/acre											
Control	0	7c*	8c	16b	16b	17c	13c	11b	11b	17b	13b	27b	23b
NH_4NO_3	100	43a	41a	50a	49a	56ab	57a	28a	23a	33a	32a	35a	40a
Urea	100	40ab	44a	51a	48a	57a	55a	28a	23a	33a	34a	33ab	37a
Urea + Ca	100	37b	40a	47a	46a	52b	53ab	31a	23a	37a	32a	42a	36a
UAN	100	41ab	34b	47a	49a	54ab	53ab	24a	21a	32a	29a	35b	36a
$(NH_4)_2SO_4$	100	36b	34b	47a	44a	55ab	49b	28a	22a	33a	28a	28b	34a

Variety		S-16						S-54			
Fertilizer		Apr. 12	Apr. 15	June 17	June 25	July 31	Aug. 8	May 1	June 7	Aug. 7	Aug. 16
Days Until Rain		1	5	1	8	16	8	7	11	9	1
N-Source	N-rate (lb/A)	Dry matter yield in cwt/acre									
Control	0	6c	6c	7b	9b	9b	10c	13b	22c	17c	22d
NH_4NO_3	100	32a	27a	36a	29a	46a	48a	32a	57a	45a	36bc
Urea	100	30a	24ab	38a	26a	48a	46a	35a	47b	43a	41ab
Urea + Ca	100	32a	23ab	33a	25a	47a	42ab	40ab	53ab	44a	44a
UAN	100	29a	26a	29a	30a	48a	47a	42a	51ab	46ab	42a
$(NH_4)_2SO_4$	100	23b	21b	34a	27a	43a	37b	34a	50ab	39b	35c

*Numbers within a column followed by the same letter are not significantly different at the 5 percent probability level using Duncan's Multiple Range Test.

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

	Fertilized Days until rain	Apr. 1 7	Apr. 15 5	May 14 6	May 23 26	Aug. 30 6	Sept. 9 1	Sept. 13 15	Sept. 16 12
N-Source	N rate (lb/A)	Coastal yield (cwt/acre)							
Control	0	10b*	13c	8c	7b	8b	8b	8b	8b
NH_4NO_3	100	40a	43ab	49a	42a	48a	42a	39a	35a
Urea	100	36a	43ab	45ab	46a	53a	39a	36a	28a
Urea + Ca	100	38a	48a	48a	49a	50a	37a	39a	28a
UAN	100	38a	42ab	44b	44a	48a	38a	39a	33a
$(NH_4)_2SO_4$	100	37a	39b	47ab	46a	47a	41a	36a	33a

*Numbers within a column followed by the same letters are not significantly different at the 5 percent probability level using Duncan's Multiple Range Test.

TABLE 4. THE N UPTAKE BY BERMUDAGRASS FROM DIFFERENT N FERTILIZER SOURCES ON CLAY SOIL

Variety		Coastal						S-16						S-54			
Fertilized		Mar. 28	Apr. 3	May 24	May 30	July 23	Aug. 1	Apr. 12	Apr. 15	June 17	June 25	July 31	Aug. 8	May 1	June 7	Aug. 7	Aug. 16
Days Until Rain		2	5	25	19	6	15	1	5	1	8	16	8	7	11	9	1
N-Source & N-Rate (lb/A)		N uptake (Pounds per Acre)															
Control	0	9c*	10d	20b	17b	14b	11b	8c	10c	10d	12c	11c	13d	15c	24c	20d	24d
NH_4NO_3	100	63a	75a	75a	74a	54a	73a	41a	37a	67ab	55ab	61ab	66ab	42b	71a	53b	43c
Urea	100	59ab	73ab	66a	74a	57a	67a	37a	30ab	72a	52ab	74a	59b	48b	64ab	56ab	51bc
Urea + $CaCl_2$	100	57ab	63bc	67a	73a	55a	65a	40a	30ab	56bc	47b	73a	71a	59a	72a	57a	62a
UAN	100	58ab	59c	71a	77a	56a	63a	41a	36a	52c	59a	69a	69ab	64a	74a	59a	53ab
$(NH_4)_2SO_4$	100	51b	58c	68a	70a	57a	68a	29b	28b	62abc	47b	55b	49c	44b	60b	45c	45bc

*Numbers within a column followed by the same letter are not significantly different at the 5 percent probability level using Duncan's Multiple Range Test.

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

	Fertilized Days until rain	Apr. 1 7	Apr. 15 5	May 14 6	May 23 26	Aug. 30 6	Sept. 9 1	Sept. 13 15	Sept. 16 12
N-Source	N rate (lb/A)								
Control	0	13d	18c	8c	7b	24b	7c	7d	9c
NH_4NO_3	100	94a	94a	74a	60a	58a	56a	60a	57a
Urea	100	65c	74b	52b	56a	60a	42b	38c	37b
Urea + Ca	100	76b	91a	59b	65a	60a	44b	47bc	45ab
UAN	100	76b	96a	59b	65a	55a	54a	57ab	54ab
$(NH_4)_2SO_4$	100	82b	86ab	60b	61a	62a	62a	62a	52ab

*Numbers within a column followed by the same letter are not significantly different at the 5 percent probability level using Duncan's Multiple Range Test.