Nitrogen Fertilizer Source Study on Coastal Bermudagrass

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Summary

Nitrogen fertilizer sources, (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 Brazos River Bottom Ships clay series (calcareous). The sand soil was a Lufkin fsl series (an acid fine sandy loam).

Urea fertilization consistently resulted in higher yields of Coastal bermudagrass than the other nitrogen sources tested. The relative ranking of nitrogen sources was:

For yield (urea > urea + $CaCl_2$ > AN = AS > UAN).

For nitrogen uptake (urea + $CaCl_2$ > urea > AS > UAN).

It appears that $CaCl_2$ tended to enhance nitrogen uptake somewhat. The higher yields resulting from surface applications of urea fertilizer over the other nitrogen sources throughout the growing season indicate no serious risk of nitrogen loss from urea.

KEYWORDS: Nitrogen volatilization/bermudagrass yield/urea/nitrogen uptake.

Introduction

Urea has gained importance among nitrogen fertilizers in recent years because of its low cost per unit. However, because of numerous studies citing decreased plant response (yield and nitrogen uptake) to urea as a nitrogen fertilizer, especially when surface applied, producers are hesistant to use this source in situations where fertilizers 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 nitrogen 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 nitrogen 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.

Procedure

Field plots were established at two locations with contrasting soil types. Table 1 describes some of the physical and chemical characteristics of the two soils. Experiments were conducted in successive periods throughout the 1984 growing season. A total of eight experiments were staggered throughout the season to encompass the varying environmental conditions which influence NH_3 volatilization losses from urea as compared with other nitrogen fertilizers. Fertilizer treatments, rates, and application methods are listed in Table 2. 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 (>0.1 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 nitrogen content using a common micro Kjeldahl method.

TABLE 1. SOIL PHYSICAL AND CHEMICAL CHARACTERISTICS

Soil Series	Lufkin	Ships
Texture	fine sandy loam	clay
pH (1:1 H_2O)	4.9	7.8
Organic matter content, %	1.3	2.5
CEC, cmol/kg	1.5	38.5
N, ppm	10.7	15.2
P, ppm (NH_4OAc, EDTA)	15.5	103.3
K, ppm (NH_4OAc)	129.0	504.4

TABLE 2. FERTILIZER TREATMENTS

Treatment	N Rate (lb/A)	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 + $CaCl_2$[a]	100	liquid	surface band
Control	0		

[a]$CaCl_2$ applied at 0.25 Ca^{+2} : 1 N ratio.

Results and Discussion

Each trial (by date) in Table 3 must be considered as a separate individual experiment because of environmental conditions differ with date and time period which would affect growth and nitrogen fertilizer efficiency. Thus, yield comparisons between nitrogen sources in a column are valid because of the same growing conditions during that growing period. However, other growing periods had considerably different environmental conditions. The Brazos River Bottom location had supplemental irrigation available whereas the Wellborn location was dependent on rainfall (dryland). The Wellborn site yields were considerably reduced by drought conditions.

Statistical analysis of bermudagrass dry matter yield for the two soil types is included in Table 3. The values of bermudagrass yield are the means of four treatment replications.

The urea treatments gave the highest yields in all trials compared to the other nitrogen sources. Although the yields were always highest, this superiority was statistically significant only in a few of the trials. Apparently, nitrogen losses do not differ much among the nitrogen

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

		Experimental Locations							
		Brazos River Bottom Clay Soil						Wellborn Sand Soil Dryland	
N Sources	Fertilized Volatile days[1]	Apr. 6 1	Apr. 16 24	June 29 1	July 5 22	Aug. 22 2	Aug. 24 1	Apr. 13 35	Apr. 23 25
	N rate (lb/A)	Dry matter (Pounds per Acre)							
Control	0	1,589d[2]	2,078d	1,690d	1,807c	1,033c	1,027c	662b	721d
Ammonium Nitrate	100	3,102c	3,982bc	5,314ab	3,274b	2,796ab	2,919b	2,571a	2,892b
Urea	100	4,309a	4,600ab	5,794a	3,480ab	3,400a	3,794a	2,466a	2,399c
Urea + $CaCl_2$	100	3,981ab	5,116a	5,304ab	3,910a	3,101ab	3,526a	2,792a	3,469a
Urea Ammonium Nitrate	100	2,908c	3,434c	4,828b	3,429b	2,438b	2,807b	2,444a	2,658bc
Ammonium Sulfate	100	3,465bc	4,337b	4,152c	3,688ab	2,507b	2,948b	3,176a	2,608bc

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

[2]Values are the means of four replications. Values within a column with the same letter are not significantly different by Duncan's Multiple Range Test (p = 0.05).

TABLE 4. THE NITROGEN UPTAKE BY COASTAL BERMUDAGRASS FROM DIFFERENT NITROGEN FERTILIZER SOURCES

		Experimental Locations							
		Brazos River Bottom Clay Soil						Wellborn Sand Soil Dryland	
N Sources	Fertilized Volatile days[1]	Apr. 6 1	Apr. 16 24	June 29 1	July 5 22	Aug. 22 2	Aug. 24 1	Apr. 13 35	Apr. 23 25
	N rate (lb/A)	Nitrogen uptake (Pounds per Acre)							
Control	0	16c[2]	20d	14e	14c	12c	12c	7b	8c
Ammonium Nitrate	100	29b	37bc	45bc	28b	38ab	37b	40a	42b
Urea	100	39a	41bc	47ab	32b	45a	51a	37a	36b
Urea + $CaCl_2$	100	42a	51a	51a	43a	47a	54a	42a	56a
Urea Ammonium Nitrate	100	28b	34c	41cd	30b	34b	36b	37a	38b
Ammonium Sulfate	100	33b	42b	36d	38a	34b	40b	44a	37b

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

[2]Values are the means of four replications. Values within a column with the same letter are not significantly different by Duncan's Multiple Range Test (p = 0.05).

sources. An overall consideration of yields from the several trials shows little statistically significant differences between the nitrogen sources.

The nitrogen uptake by Coastal bermudagrass as influenced by nitrogen sources is shown in Table 4. The nitrogen uptake values were highest in almost every trial from the urea treatments. The addition of $CaCl_2$ with urea seemed to enhance nitrogen uptake even further. These results corroborate the yield data as evidence that nitrogen losses are not occurring from urea more than from the other nitrogen sources.