# PUBLICATIONS

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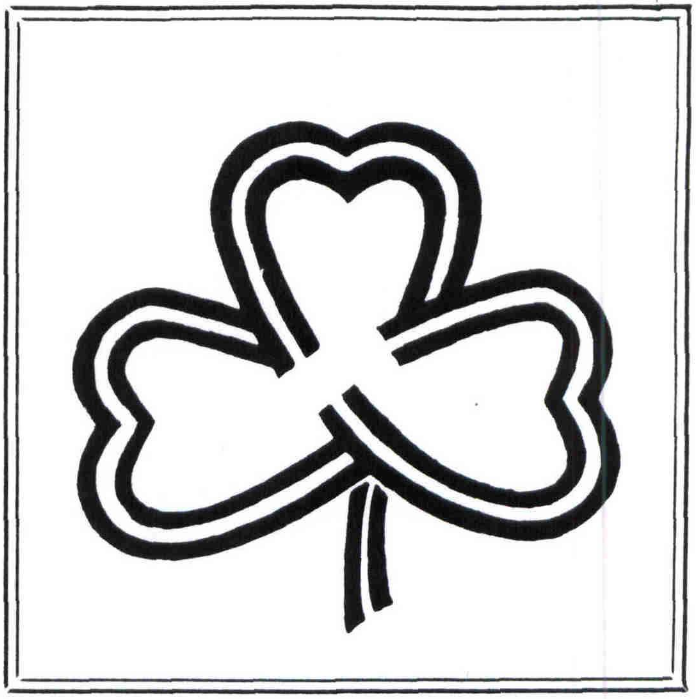

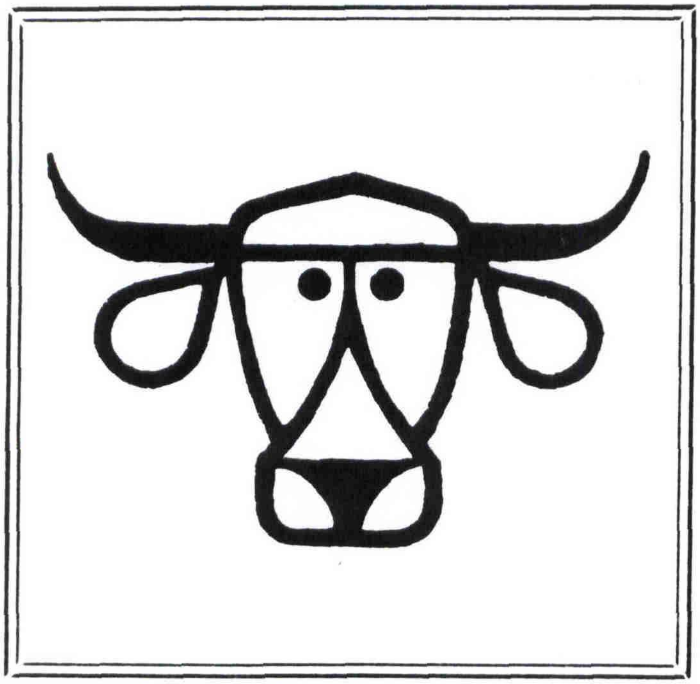

# Forage Research in Texas

# 1984

The Texas Agricultural Experiment Station   Neville P. Clarke, Director   The Texas A&M University System   College Station, Texas

# Field Efficiency of Nitrogen Fertilizers Surface Applied on Bermudagrass

T.E. Kunkel and W.B. Anderson

## SUMMARY

Four nitrogen fertilizers [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 $CaCl_2$ increased plant response to urea fertilization. Individual experiments were initiated successively throughout two growing seasons on two diverse soils to encompass the differing environmental conditions which might influence $NH_3$ volatilization.

Data indicates the relative efficiency of the N sources on Ships C (a calcareous clay) to be UREA = AN = UAN > AS. On Lufkin fsl (an acid sandy loam) relative efficiency was UREA = AN = AS = UAN. Although $CaCl_2$ additive with urea reduced N losses from surface applied urea in the laboratory, it failed to significantly increase bermudagrass yield in 30 field tests conducted in the College Station, Texas area over two growing seasons. Nitrogen uptake data indicated no increased plant response to urea when supplemented with $CaCl_2$. It is hypothesized that significant N loss from surface applied urea due to $NH_3$ volatilization did not occur because soil surface (0-0.5 cm) moisture at the time of fertilizer application was insufficient to allow rapid urea hydrolysis and subsequent large $NH_3$ losses.

## INTRODUCTION

In recent years, urea has gained importance among N fertilizers because of its low cost per unit of nitrogen. However, because of numerous studies citing decreased plant response (yield, N uptake) to urea as a nitrogen fertilizer, especially when surface applied, producers are hesitant to use this source in situations where fertilizer cannot be incorporated. Nitrogen losses as high as 70 percent have been recorded 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.

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Graduate Student and Associate Professor, Soil & Crop Sciences Department, College Station, TX.

## PROCEDURES

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 1982 and 1983 growing seasons. A total of 15 experiments per year were staggered throughout the two seasons 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 2. Each fertilizer treatment and the control were replicated 4 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 (>10 mm). 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

Statistical analysis of bermudagrass dry matter yield for the two soil types is included in figure 1. The values of bermudagrass yield produced on Ships C are means of 22 experiments each with 4 treatment replications over both growing seasons. Yield values for Lufkin fsl include 8 experiments conducted over the same two growing seasons.

No significant difference is indicated among the AN, UAN, urea and urea + $CaCl_2$ treatments of Ships C. The AS treatment is comparable to AN, urea, and UAN. However, urea + $CaCl_2$ performed significantly better than AS (Duncan's multiple range test, $\alpha = 0.05$). In individual experiments of Ships C conducted during the two seasons, bermudagrass fertilized with AS produced lower yields than one or more of the other N sources in 15 of the 22 experiments. In 5 of 22 experiments, AS gave significantly lower yields than all other N sources. The lower yields are attributed to $NH_3$ volatilization losses when AS is applied to a calcareous soil.

The three urea products (urea, UAN, and urea + $CaCl_2$) gave consistantly comparable bermudagrass yields to those of AN throughout the two growing seasons. Contrary to most field comparisons between urea and AN, urea performed as well as or better than AN in all of the 22 individual experiments. Only minimal $NH_3$ volatilization losses are expected from AN. This suggests that $NH_3$ volatilization losses from urea were insignificant during the two growing seasons. Although urea supplemented with $CaCl_2$ effectively decreased $NH_3$ volatilization losses in laboratory and greenhouse experiments, no evidence is indicated for the necessity of $CaCl_2$ supplemented urea under environmental and soil conditions similar to those existing in the College Station, Texas area.

The comparison of bermudagrass yields on Lufkin fsl with different N sources indicates no significnt differences among sources (Duncan's multiple range test, $\alpha = 0.05$).

Plant tissue nitrogen concentration with varied N sources is depicted in Figure 2. Nitrogen content values are means of all 30 experiments conducted, each consisting of 4 treatment replications. Plant tissue nitrogen concentration is elevated from approximately 1.0% to 1.3% by N fertilization. However, no significant differences are indicated among N sources.

Nitrogen uptake by bermudagrass for the various N sources is depicted in Figure 3 for both soils. On Ships C, N uptake by bermudagrass was significantly lower from AS than from the other N sources. All other N sources (UAN, urea, AN, and urea + $CaCl_2$) were comparable. No significant difference among N sources was indicated on Lufkin fsl.

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 | 28.5 |
| 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 | Rate (kg N $ha^{-1}$) | 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 | liquid | surface band |
| Control | 0 | | |

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

Fig. 1 BERMUDAGRASS YIELD

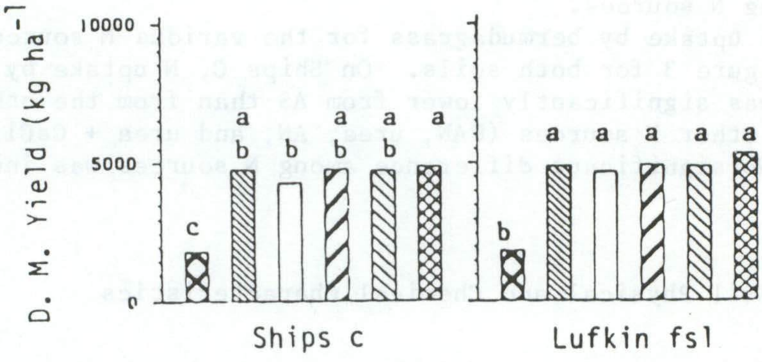


Fig. 2 PLANT TISSUE NITROGEN

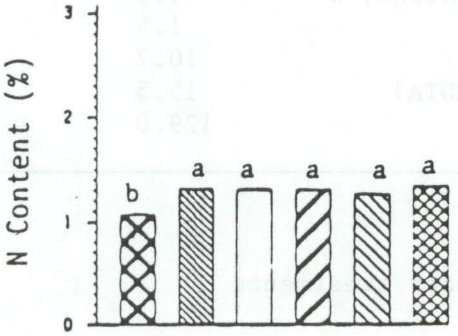
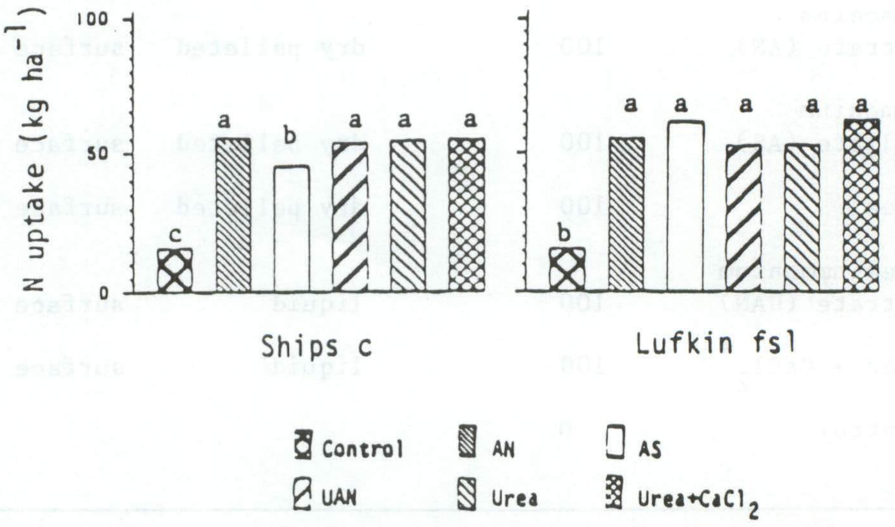


Fig. 3 NITROGEN UPTAKE BY BERMUDAGRASS



N rate = kg ha$^{-1}$