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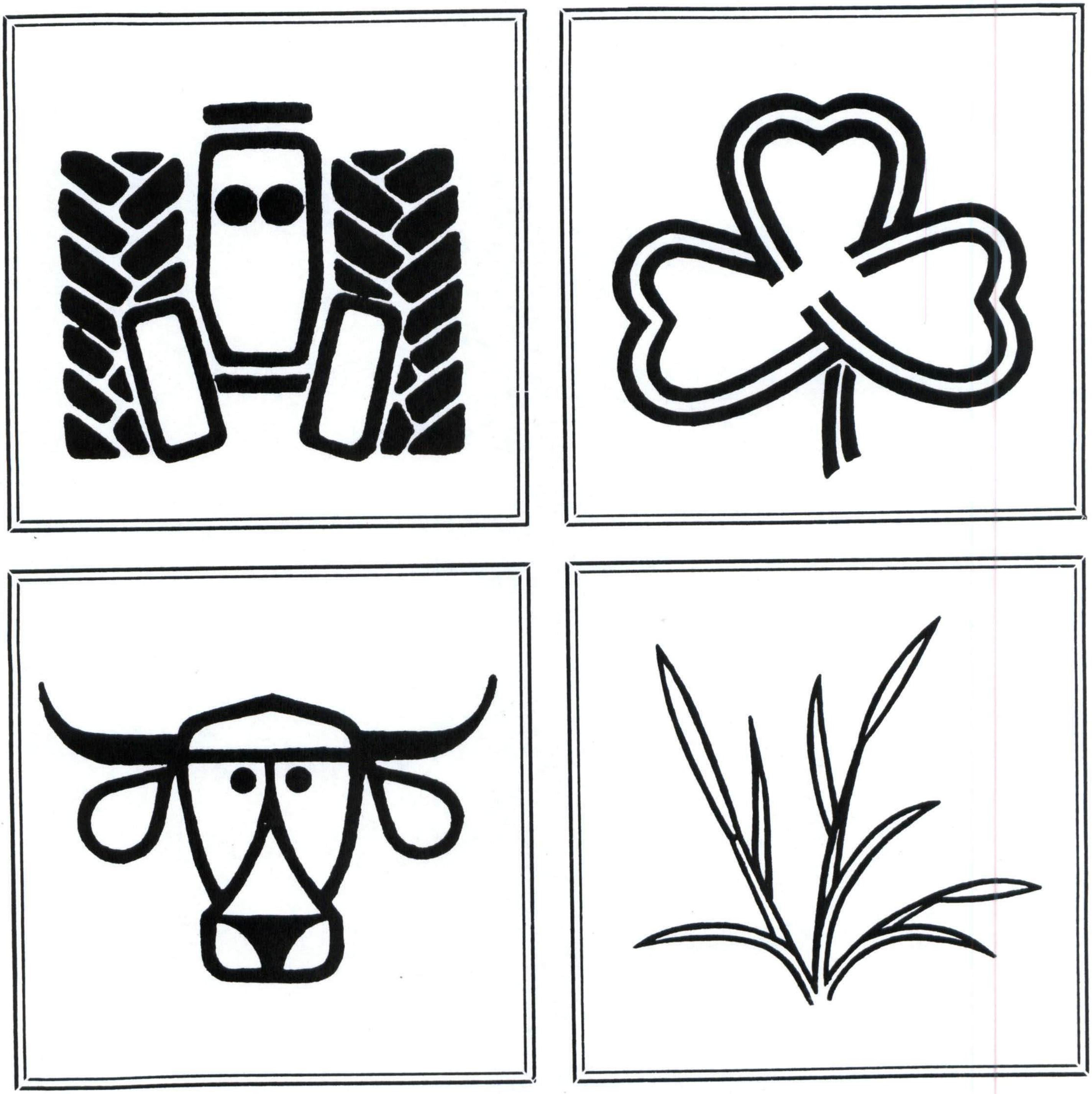

Forage Research in Texas

1983

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

The Effects of Various Nitrogen Fertilizers on Yield and N Uptake of Bermudagrass

W.B. Anderson and T.E. Kunkel*

Summary

Nitrogen was applied to bermudagrass grown on a fine, calcareous soil (Ships clay) and a coarse, acid soil (Lufkin fsl) at a rate of 100 kg/ha thoughout the 1982 growing season. Nitrogen sources included urea, urea plus $CaCl_2$, ammonium nitrate, ammonium sulfate and a urea-ammonium nitrate solution. Yields ranged from 2,150 to 8,900 kg/ha for treated plots depending on bermudagrass variety, soil type, N source applied, estimated days of ammonia volatilizations, date of fertilizer application and length of growing period. Yields and N uptake obtained from bermudagrass fertilized with various sources were compared within each test. Generally on Ships clay, bermudgrass fertilized with urea resulted in yield as high as, and in some cases higher than that from ammonium nitrate and urea-ammonium nitrate solution. No significant differences were found when comparing yields of grass from urea plus $CaCl_2$ vs. urea alone. Bermudagrass yields from ammonium sulfate fertilization were consistently low on the calcareous clay, while on the Lufkin fsl soil they were consistently high. Very few significant yield differences were found among the other N fertilizers.

Introduction

The use of urea as a nitrogen fertilizer is becoming more widely accepted. However, it is generally thought that severe nutrient loss due to ammonia volatilization could occur if the surface applied urea is not mechanically incorporated or moved into the soil by water. Losses as high as 70% have been recorded in laboratory experiments. Numerous chemical compounds applied with urea have been effective in reducing ammonia volatilization from surface applied urea under laboratory and greenhouse conditions. Soluble $CaCl_2$ appeared to be the most effective in the widest range of soil conditions. 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 over a wide range of soil and environmental conditons, and (2) to field test urea surface applied with $CaCl_2$ to determine its effectiveness in decreasing N losses due to ammonia volatilizations.

Procedures

Field plot studies were established at two locations with contrasting soil types. Table 1 describes some of the physical and chemical characteristics of the two soils.

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*Assoc. Professor and graduate student respectively, Soil & Crop Sciences Department, College Station, Texas 77843.

Table 1. Soil Physical and Chemical Characteristics

Soil Series	Lufkin	Ships
Texture	fine sandy loam	clay
percent clay	3.	69
percent silt	13.	30
percent sand	84	1
pH	4.9	7.8
CEC	1.5 meq/100 g	38 meq/100 g
Percent Organic Matter	1.3	1.8
Soil Nitrate	24 kg/ha	59 kg/ha
Available P_2O_5	63 kg/ha	118 kg/ha
Available K_2O	232 kg/ha	270 kg/ha
Percent $CaCO_3$ equivalent	-	13

Three bermudagrass varieties, Coastal, Callie and S-54 were utilized on the Ships clay soil and Coastal bermudagrass on the Lufkin fsl soil. Trials were conducted in successive periods throughout the 1982 growing season as shown in Table 2. The first plots were established on April 6 and the last plots were harvested October 26. A total of 21 trials were staggered throughout this time period to incompass the differing environmental conditions which influence ammonia volatilization losses from urea as compared to other nitrogen fertilizers. The following nitrogen fertilizer treatments were used in each trial:

	N rate kg/ha
Control	0
Urea	100
Urea and Calcium Chloride	100
Ammonium Nitrate	100
Ammonium Sulfate	100
Uran (32-0-0 solution)	100

Urea and calcium chloride were dissolved together and applied as a solution to determine if a soluble calcium salt additive would be a practical method to prevent NH_3 loss subsequent to occurrence of urea hydrolysis.

All fertilizer sources were topdressed at a rate of 100 kg/ha nitrogen. Each fertilizer treatment and the control were replicated 4 times within each trial. Repeated trials were established in an attempt to vary the potential volatilization time period between fertilizer application and first rainfall. This criteria was used to estimate days of volatilization for each trial. Plots were fertilized to initiate trials and, later, harvested when the grass reached maturity. After harvesting, samples were dried, ground and chemically analyzed for nitrogen content using a common micro Kjeldahl method.

Results and Discussion

Initial statistical analysis of yield data for 1982 indicated the significant differences among fertilizer treatment. When all data from the completed trials were compiled and analyzed, no significant difference between repetitions was found, however in several individual cases, there was significant difference in repetitions. Significant differences in yield were present between the 2 soil series and among the 3 varieties of Bermudagrass tested. Significant differences were also discovered among the trials. As indicated before, each of these trials was initiated at different times during the growing season and growth occurred under different climatic and environmental conditions. Each trial was harvested when grass matured as affected by available soil moisture, temperatures, etc., so trials were conducted for different lengths of time, varying between 33 and 68 days. Days of volatilization ranged from 0 to 23 days with short periods most frequent due to termination by rainfall. Because of the different environmental variables affecting the efficiency of nitrogen fertilizers during each different trial time period, it is necessary to consider each trial as an individual experiment. They will be discussed in terms of trends of significant differences in yield and N-uptake among the fertilizer treatments within individual trials. Bar graphs depicting yield and nitrogen uptake for each trial are included. Nitrogen analysis for the 2 S-54 trials has not been completed, (and thus is not included). The N-uptake is the product of the individual plot yield and percent N detected in analysis. Both yield and N-uptake are expressed in kg/ha. Fertilizer treatments are indicated at the base of their respective bars. Bars having the same letter are not significantly different at the .05 probability level (Duncan's multiple range test). Yield and N-uptake data from each fertilizer treatment is the mean of 4 replications. Figure numbers are used to direct attention to the appropriate bar graphs.

Yield

Ships Clay Soil (Figures 1 to 13)

Of the 15 trials initiated on the Ships clay soil as shown in the Table 2 schedule, 13 trials were completed.

Yields from nitrogen fertilizer sources were not significantly different in 4 of the 13 trials completed on Ships clay (a calcareous soil). However, in the other 9 trials, yield produced by the ammonium sulfate treatment was significantly less than one or more of the other N-fertilizer sources. This may be due to ammonium volatilization loss from $(NH_4)_2SO_4$ when applied to a high pH, calcareous soil.

The three urea products tested (urea, urea with $CaCl_2$ and Uran) appeared to perform as well as, and in some cases, significantly better than ammonium nitrate in terms of yield production of the three varities of bermudagrass studied. The performance of urea with the $CaCl_2$ additive was never significantly better than that of urea without the additive.

Lufkin fsl Soil (Figures 14-15)

Of the six trials implemented on the Lufkin fsl acid soil two were harvested. When compared with the trials on Ships clay calcareous soil, the ammonium sulfate produced yields comparable to those produced by the other nitrogen sources in the more acid environment of the Lufkin fsl. Yield data collected from both trials on Lufkin fsl indicate no significant difference between nitrogen sources. The yields produced by the urea fertilizers were comparable to those from ammonium sulfate and ammonium nitrate.

Yield data collected from the first year trials conducted on Ships clay indicate no significant degradation of efficiency of the three urea products as compared with nitrate and sulfate over a range of 0 to 23 estimated days of volatilization. An insufficient range of days of volatilization was collected on Lufkin fsl to determine trends of significant difference in yield among the fertilizer treatments within trials (Figure 14, 15).

Nitrogen Uptake

Ships Clay (Figures 16 to 26)

N-uptake among treatments receiving a nitrogen source was not significantly different in 4 of the 11 trials for which data is now available. Of the 7 trials in which there was significant difference, the urea plus $CaCl_2$ treatment consistently outperformed the other nitrogen treatments. These differences were not attributed to yield. Percent nitrogen in the plant tissue of grasses receiving the urea plus $CaCl_2$ treatment was consistently higher. This factor contributed to the increased N-uptake results.

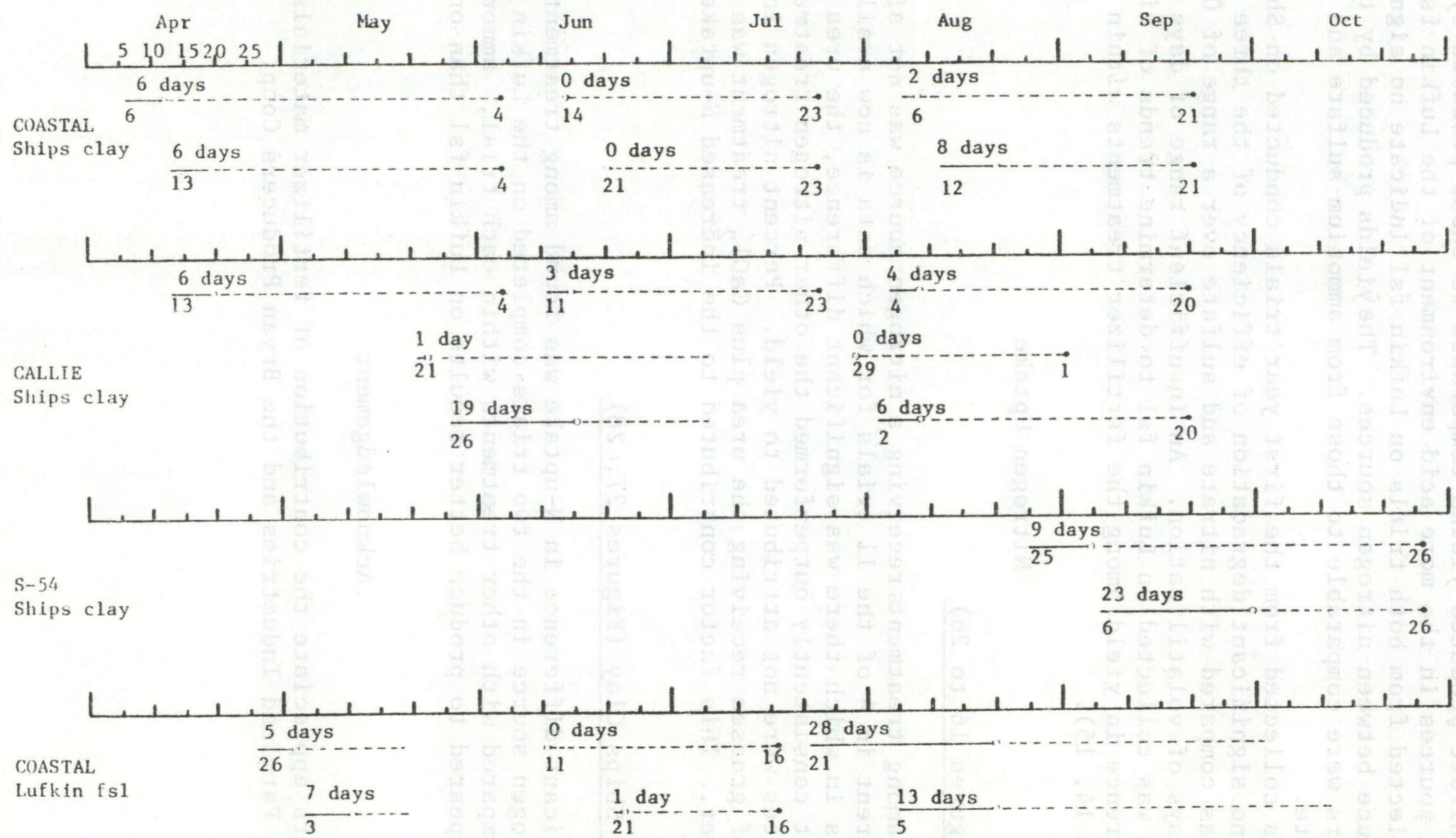
Lufkin fsl vs. Ships Clay (Figures 27, 28)

No significant difference in N-uptake was found among treatments receiving a nitrogen source in the two trials completed on the Lufkin fsl soil. When compared with other treatments within each trial, ammonium sulfate appeared to produce better results on Lufkin fsl than on Ships clay.

Acknowledgement

The authors appreciate the contribution of fertilizer materials and cooperation of Farmland Industries and the Bryan Producers Coop.

TABLE 2. NITROGEN SOURCE STUDY - SCHEDULE OF APPLICATION AND HARVEST DATES



——— Days of volatilization (from topdress to first rainfall)

——— --- Length of trial (from topdress to harvest date)

o Date of first rain

· Harvest date (no symbol present indicates trial was aborted)

1982 COASTAL YIELD
Votalization: 6 days
Soil Series: Ships Clay
Application Date: April 6
Harvest Date: June 4

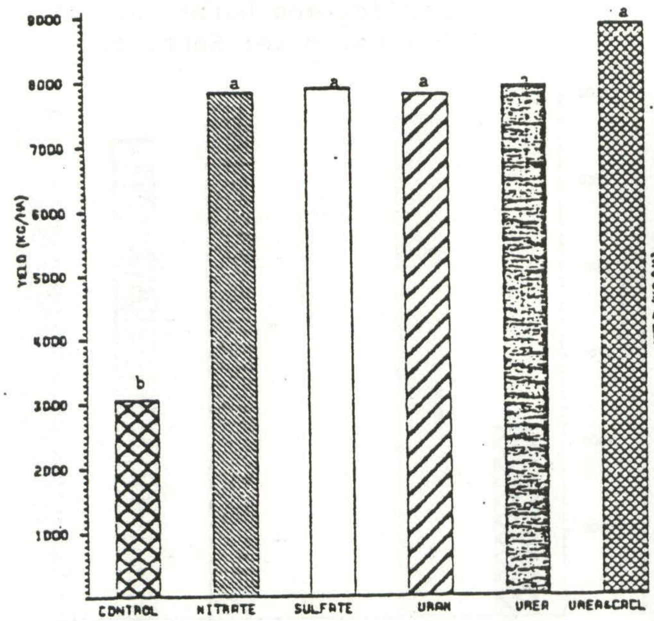


Figure 1

1982 COASTAL YIELD
Volatilization: 6 days
Soil Series: Ships Clay
Application Date: April 13
Harvest Date: June 4

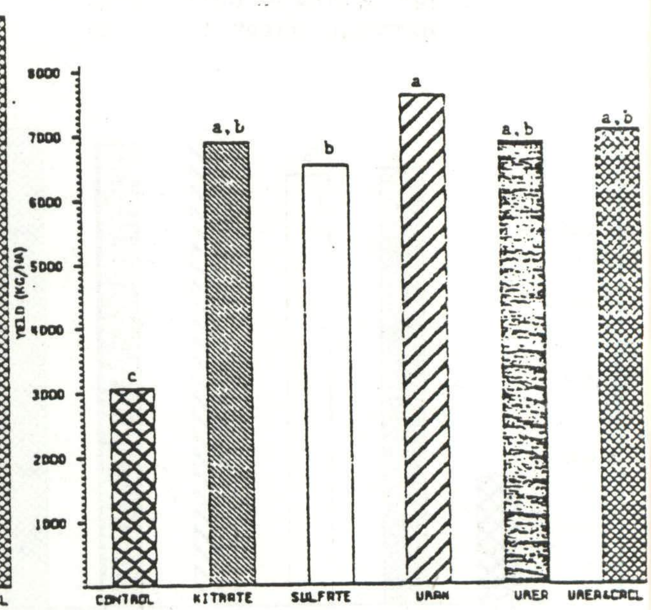


Figure 2

1982 COASTAL YIELD
Volatilization: 0 Days
Soil Series: Ships Clay
Application Date: June 14
Harvest Date: July 23

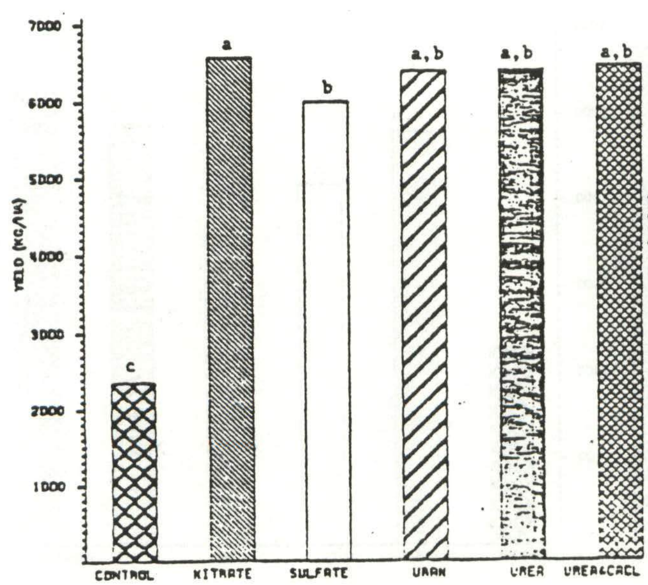


Figure 3

1982 COASTAL YIELD
Volatilization: 0 Days
Soil Series: Ships Clay
Application Date: June 21
Harvest Date: July 23

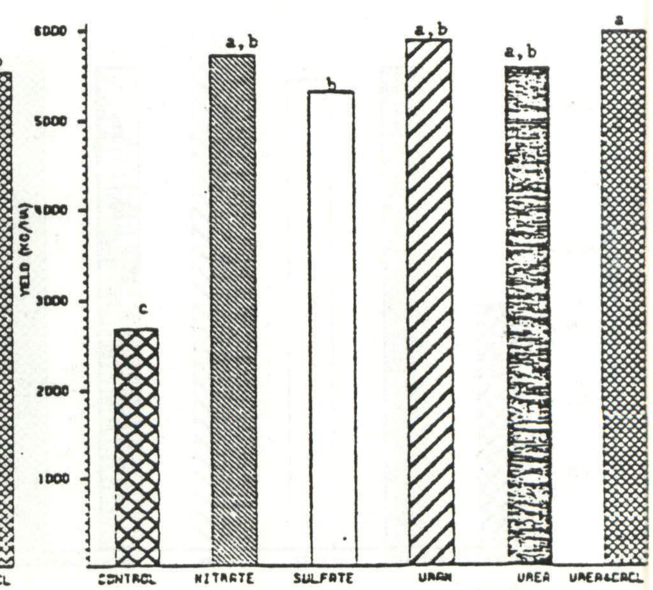


Figure 4

1982 COASTAL YIELD
Volatilization: 2 days
Soil Series: Ships Clay
Application Date: Aug. 6
Harvest Date: Sept. 21

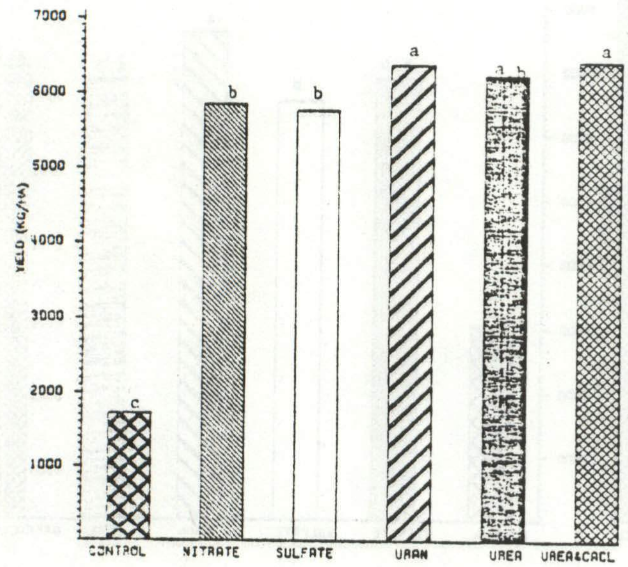


Figure 5

1982 COASTAL YIELD
Volatilization: 8 days
Soil Series: Ships Clay
Application Date: Aug. 12
Harvest Date: Sept. 21

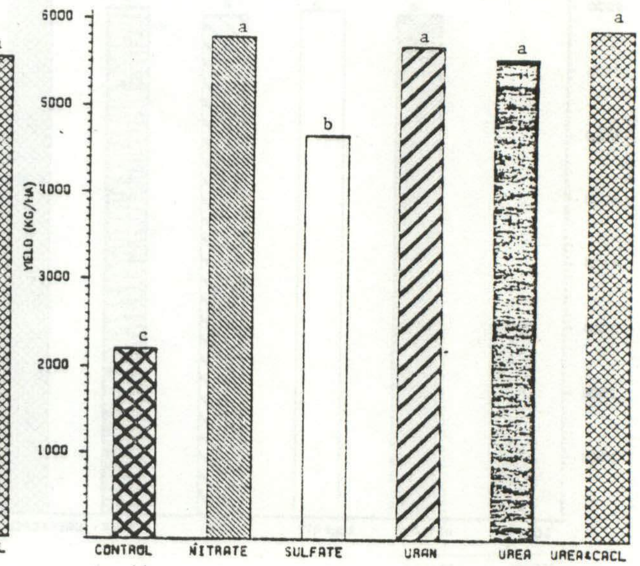


Figure 6

1982 CALLIE YIELD
Volatilization: 3 days
Soil Series: Ships Clay
Application Date: June 11
Harvest Date: July 23

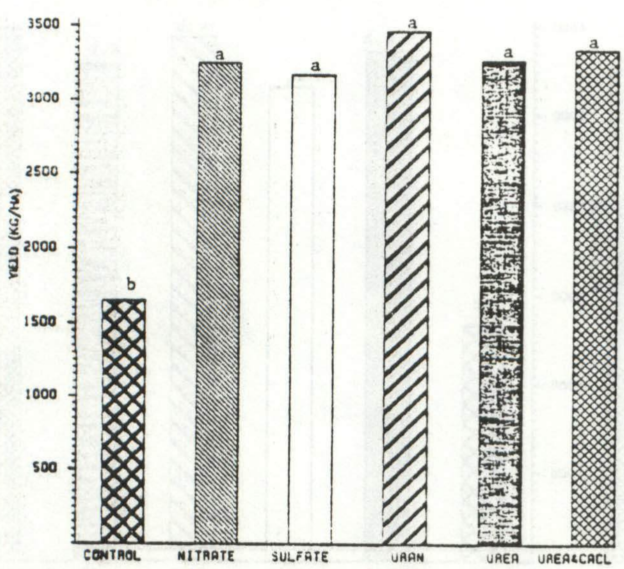


Figure 8

1982 CALLIE YIELD
Volatilization: 6 days
Soil Series: Ships Clay
Application Date: April 13
Harvest Date: June 4

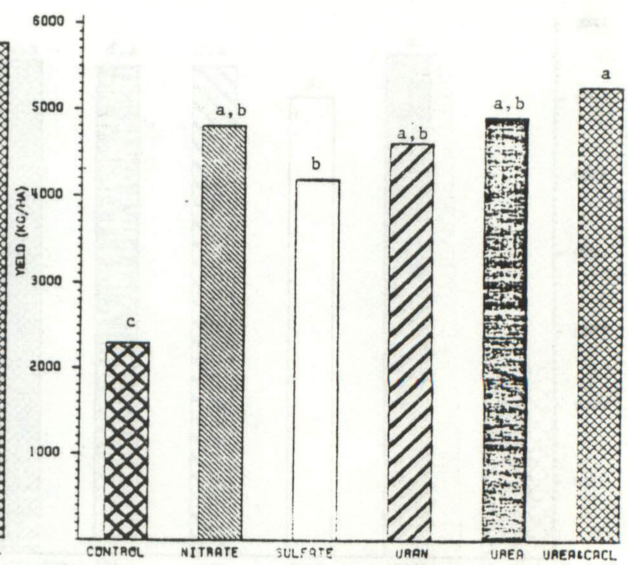


Figure 7

1982 CALLIE YIELD
Volatilization: 0 days
Soil Series: Ships Clay
Application Date: July 28
Harvest Date: Sept. 1

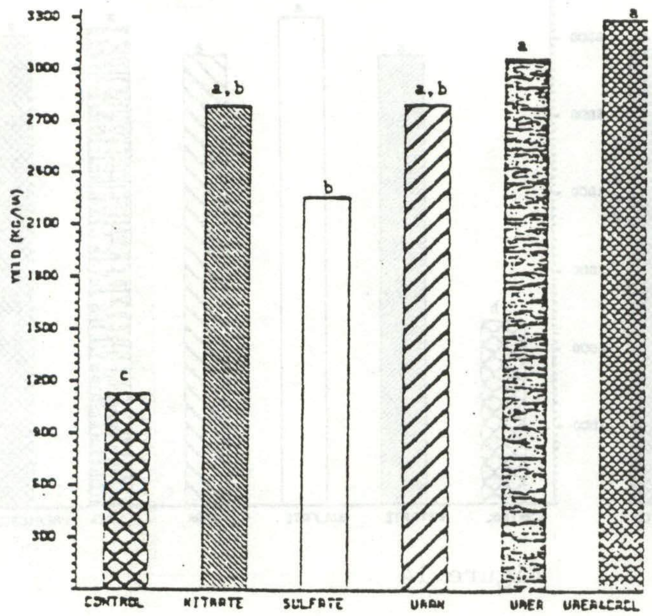


Figure 9

1982 CALLIE YIELD
Volatilization: 6 days
Soil Series: Ships Clay
Application Date: Aug. 2
Harvest Date: Sept. 23

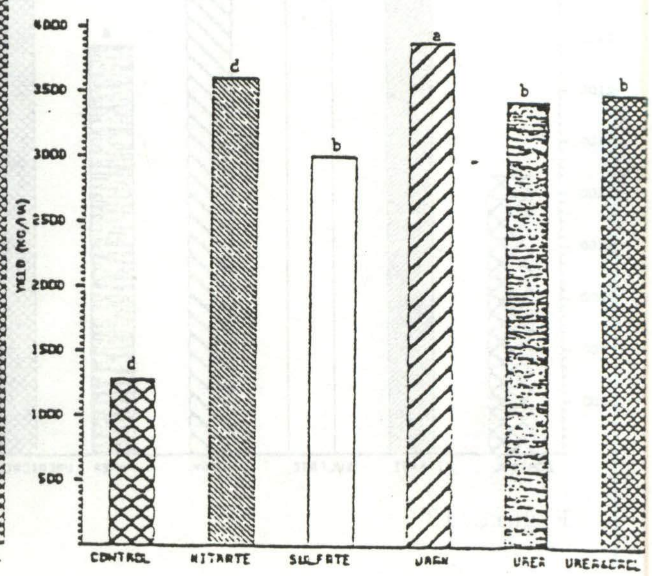


Figure 10

1982 CALLIE YIELD
Volatilization: 4 days
Soil Series: Ships Clay
Application Date: Aug. 4
Harvest Date: Sept. 20

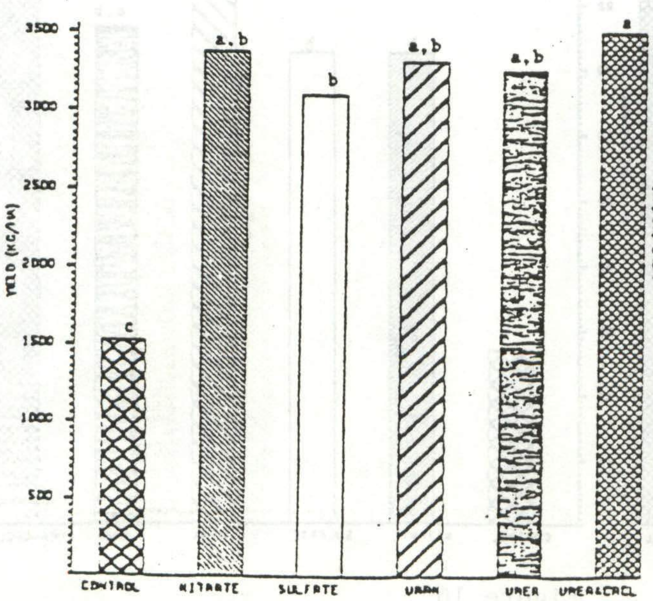


Figure 11

1982 S-54 BERMUDA YIELD
Volatilization: 5 days
Soil Series: Ships Clay
Application Date: Aug. 25
Harvest Date: Oct. 26

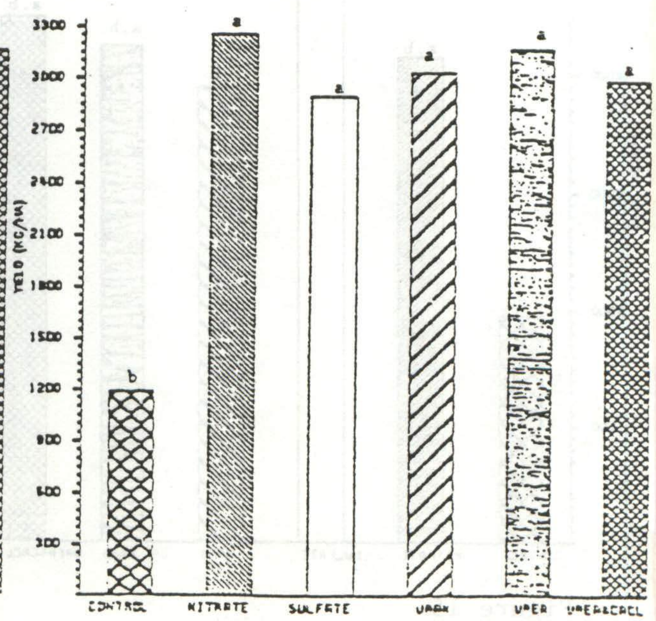


Figure 12

1982 S-54 BERMUDA YIELD
Volatilization: 23 days
Soil Series: Ships Clay
Application Date: Sept. 5
Harvest Date: Oct. 26

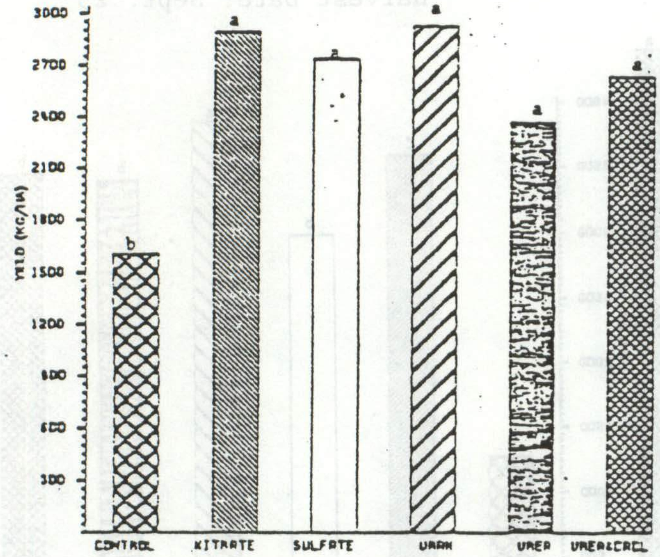


Figure 13

1982 COASTAL YIELD
Volatilization: 0 days
Soil Series: Lufkin FSL
Application Date: June 11
Harvest Date: July 16

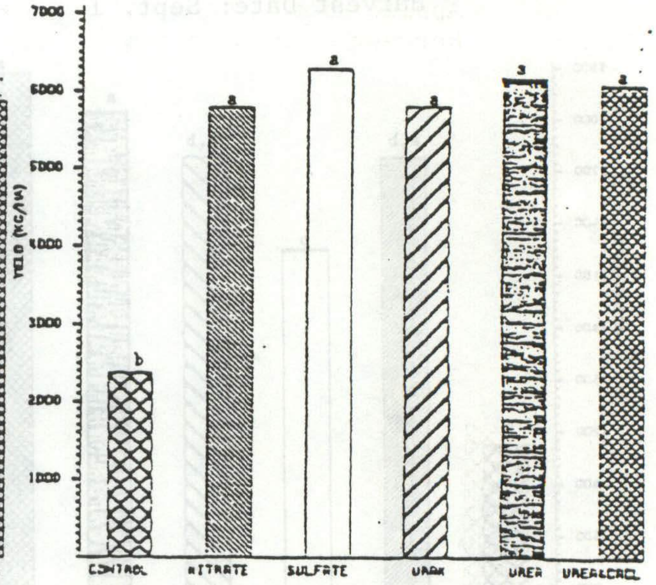


Figure 14

1982 COASTAL YIELD
Volatilization: 1 day
Soil Series: Lufkin FSL
Application Date: June 21
Harvest Date: July 16

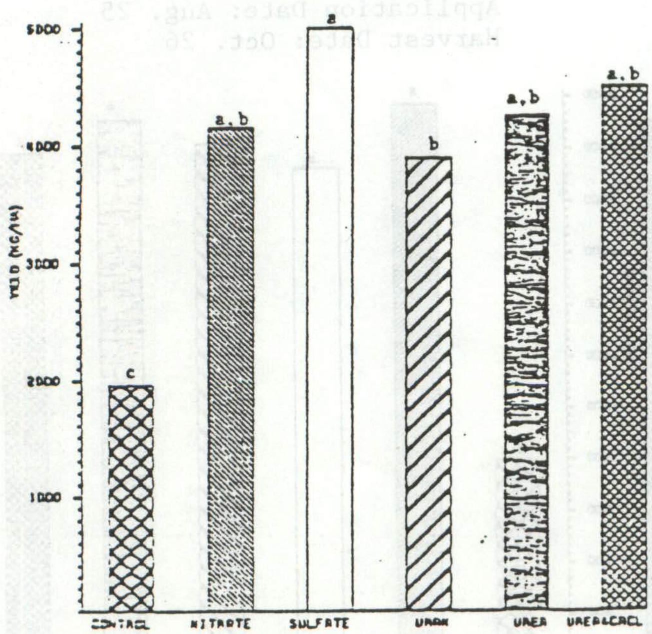


Figure 15

1982 COASTAL N-UPTAKE
Volatilization: 6 days
Soil Series: Ships Clay
Application Date: April 6
Harvest Date: June 4

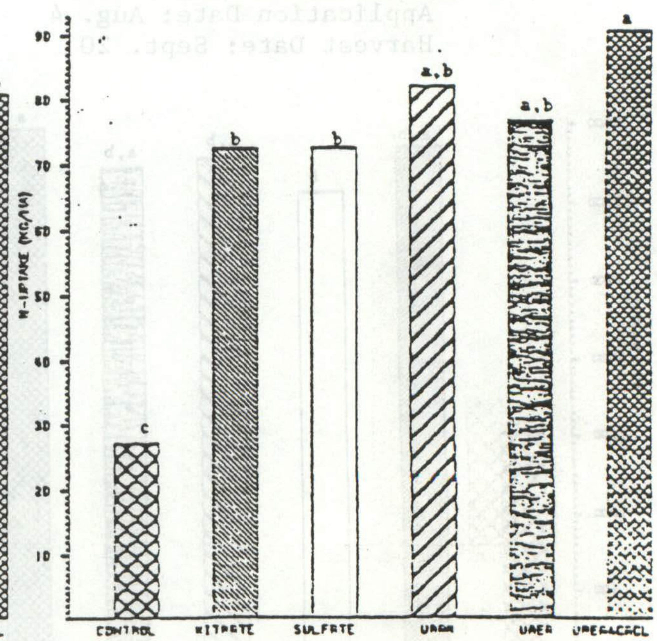


Figure 16

1982 COASTAL N-UPTAKE
Volatilization: 6 days
Soil Series: Ships Clay
Application Date: April 13
Harvest Date: June 4

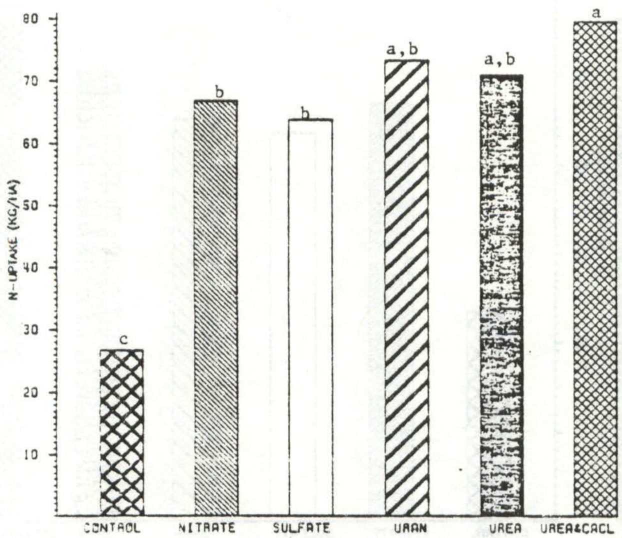


Figure 17

1982 COASTAL N-UPTAKE
Volatilization: 0 days
Soil Series: Ships Clay
Application Date: June 14
Harvest Date: July 23

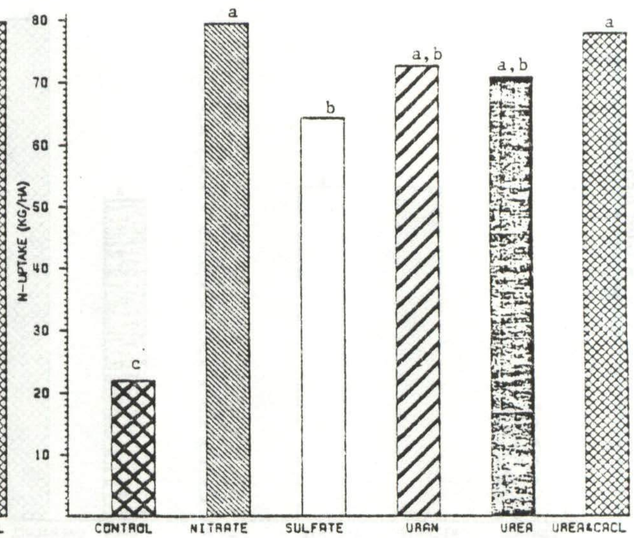


Figure 18

1982 COASTAL N-Uptake
Volatilization: 0 days
Soil Series: Ships Clay
Application Date: June 21
Harvest Date: July 23

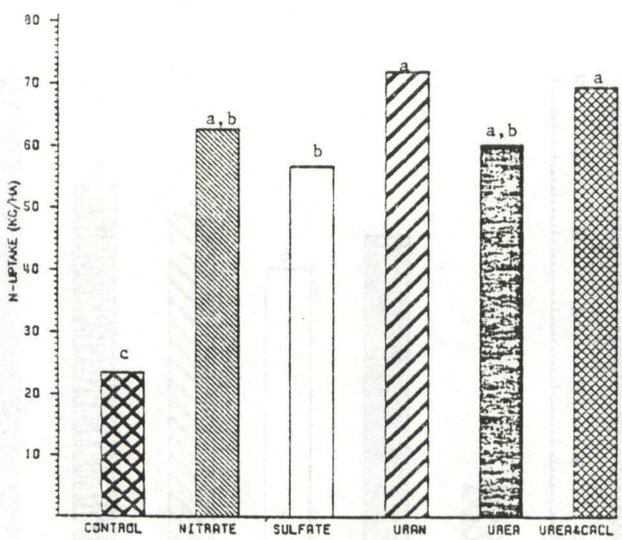


Figure 19

1982 COASTAL N-UPTAKE
Volatilization: 2 days
Soil Series: Ships Clay
Application Date: Aug. 6
Harvest Date: Sept. 21

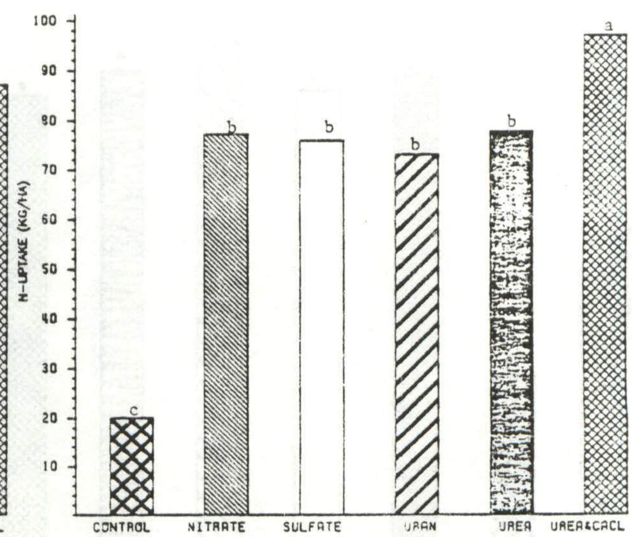


Figure 20

1982 COASTAL N-UPTAKE
Volatilization: 8 days
Soil Series: Ships Clay
Application Date: Aug. 12
Harvest Date: Sept. 21

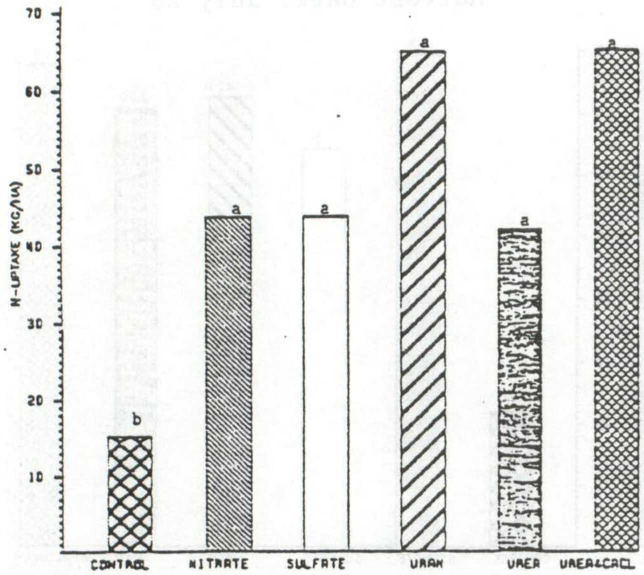


Figure 21

1982 CALLIE N-UPTAKE
Volatilization: 6 days
Soil Series: Ships Clay
Application Date: April 13
Harvest Date: June 4

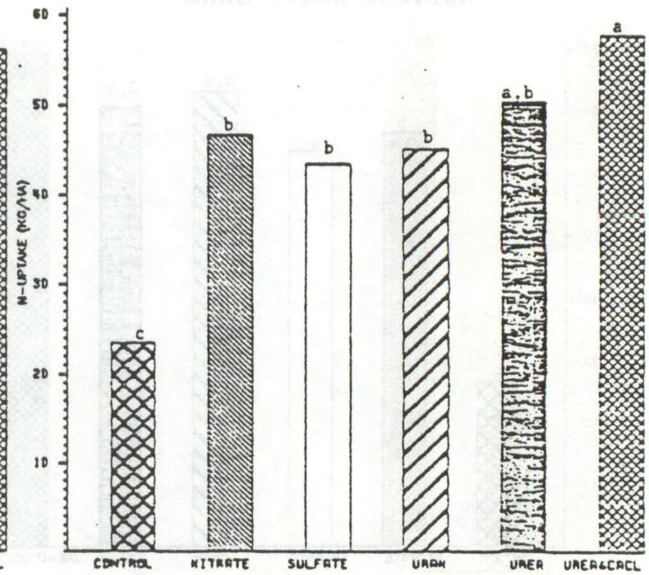


Figure 22

1982 CALLIE N-UPTAKE
Volatilization: 3 days
Soil Series: Ships Clay
Application Date: June 11
Harvest Date: July 23

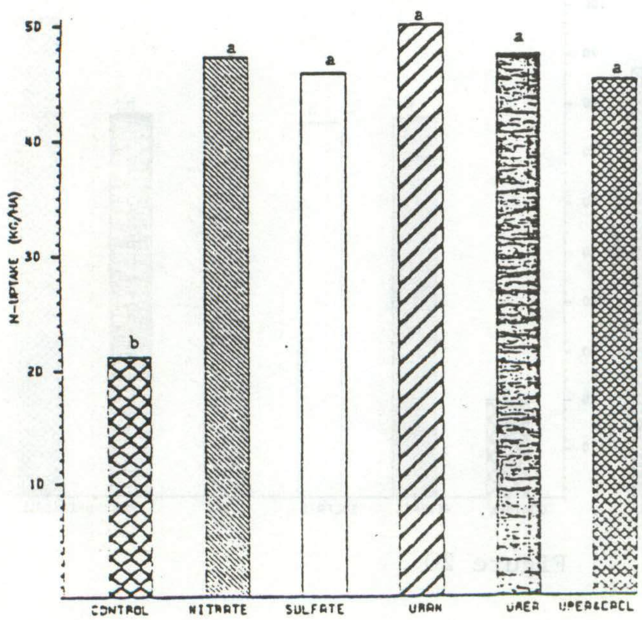


Figure 23

1982 CALLIE N-UPTAKE
Volatilization: 0 days
Soil Series: Ships Clay
Application Date: July 28
Harvest Date: Sept. 1

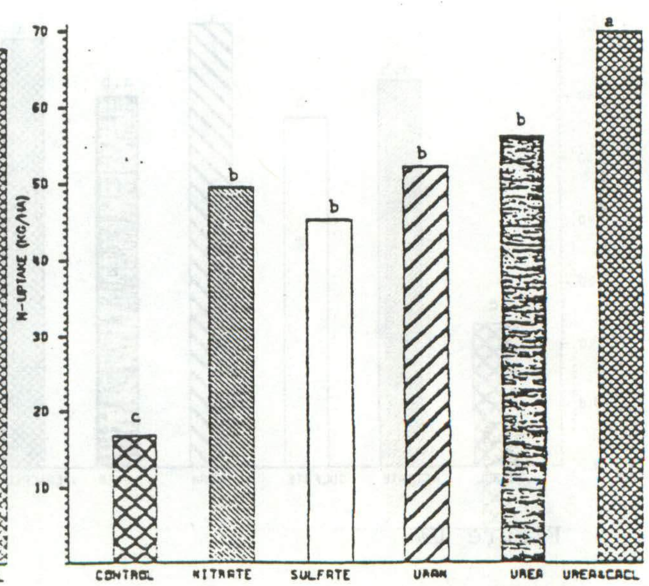


Figure 24

1982 CALLIE N-UPTAKE
Volatilization: 6 days
Soil Series: Ships Clay
Application Date: Aug. 2
Harvest Date: Sept. 20

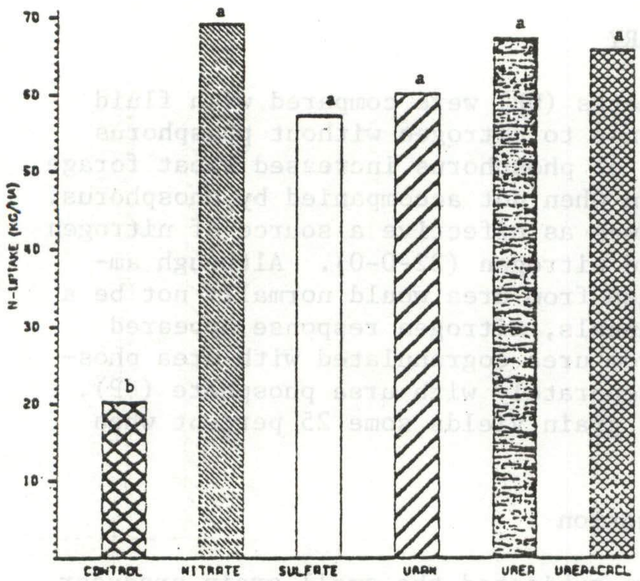


Figure 25

1982 CALLIE N-UPTAKE
Volatilization: 4 days
Soil Series: Ships Clay
Application Date: Aug. 4
Harvest Date: Sept. 20

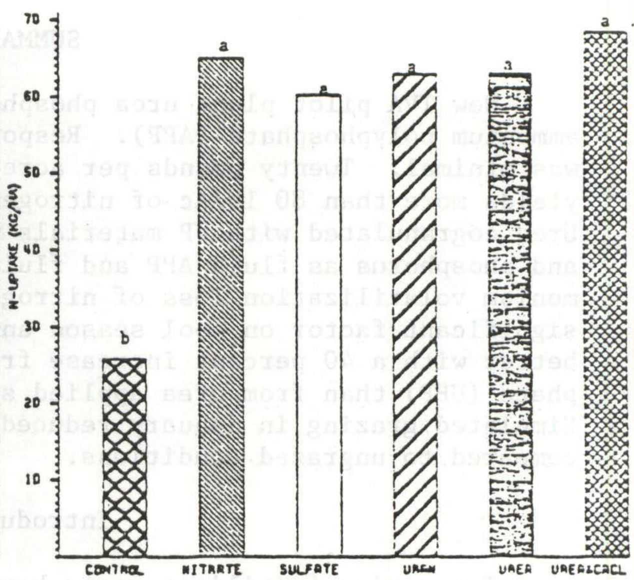


Figure 26

1982 COASTAL N-UPTAKE
Volatilization: 0 Days
Soil Series: Lufkin FSL
Application Date: June 11
Harvest Date: July 16

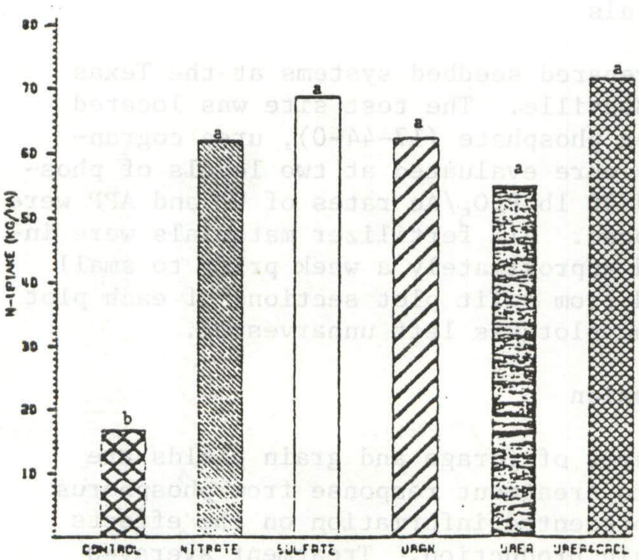


Figure 27

1982 COASTAL N-UPTAKE
Volatilization: 1 Day
Soil Series: Lufkin FSL
Application Date: June 21
Harvest Date: July 16

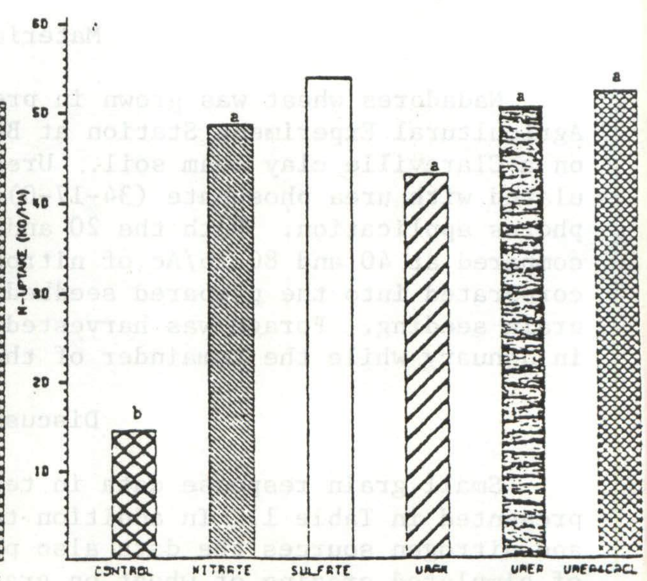


Figure 28