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Response of COASTAL BERMUDAGRASS to Nitrogen in Sulphur-Coated Urea, Urea and Ammonium Nitrate

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■ WHEN FORAGE GRASSES are fertilized with ammonium nitrate, urea, or other soluble nitrogen sources the response is characterized by rapid growth and excessive N uptake soon after fertilization, followed by N deficiency in a few weeks. Organic materials such as sewage sludge, oil seed meals and urea formaldehyde which release N over an extended period of time are too expensive for use on forages.

In recent years several research workers have coated soluble fertilizers with a number of materials including plastic (3, 4), asphalt, and waxes in an effort to develop slow release N fertilizers at reasonable cost. The Applied Research Branch of the Tennessee Valley Authority has developed a coated urea product (2, 6) using elemental sulphur and wax which combines satisfactory slow release characteristics with reasonable cost.

The research reported here was conducted to measure the growth responses of Coastal bermudagrass (*Cynodon dactylon*) following fertilization with TVA sulphur-coated urea (SCU), uncoated urea (UCU), and ammonium nitrate (AN).

An experiment was conducted from 1966 to 1969 at Muscle Shoals, Alabama, on a well established Coastal bermudagrass sod. The experiment included three replications of all combinations of the treatments shown in Table 1 plus a check receiving no N.

Table 1
SUMMARY OF EXPERIMENTAL TREATMENTS

N Source and Analysis		N applied, kg/ha	Application times
AN	33.5-0-0	224	all in early April
UCU	45.9-0-0	448	½ in April and ½ after second cut
SCU	26.1-0-0-40S	—	¼ in April and ½ after each of first 3 cuts

This work was done with SCU manufactured several years ago when heavy (40 to 45%) coatings were thought necessary for adequate reduction of dissolution rates. Newer coating techniques plus the addition of a microbicide have made it possible to reduce coatings to the 20 to 25% level, thus reducing costs and raising the analysis of the finished product to 35 to 38% N.

The soil was Sango silty clay loam which had initial P and K levels of 330 and 450 kg/ha respectively. Maintenance levels of P and K were applied annually in the fall. The entire experimental area was surface limed with 6.7 ton/ha of dolomitic limestone the fall before starting the experiment, when the soil pH was 4.9 to 5.0. Each year the experimental area was burned over about March 1 to destroy winter weeds and disease organisms, then sprayed with Dacthal or Simazine to control crabgrass.

The 1.5 x 7.0 m plots were harvested four times annually in 1966-'67 and '68. The approximate harvest dates were June 5, July 10, August 20 and September 20. In 1969 no fertilizer was applied and a harvest to measure residual N effects was taken on June 9.

After the cut green forage was weighed, subsamples were taken for dry matter determination and later analyzed for N content. All yield and N uptake data were statistically analyzed by multiple regression techniques (5).

Response of Coastal bermudagrass to these N sources varied with the application schedule and year of application. In 1966 (Figure 1) all three N sources produced comparable yields of forage when applied once or twice annually. With four applications SCU produced significantly less forage than the soluble sources, probably because the delay in dissolution

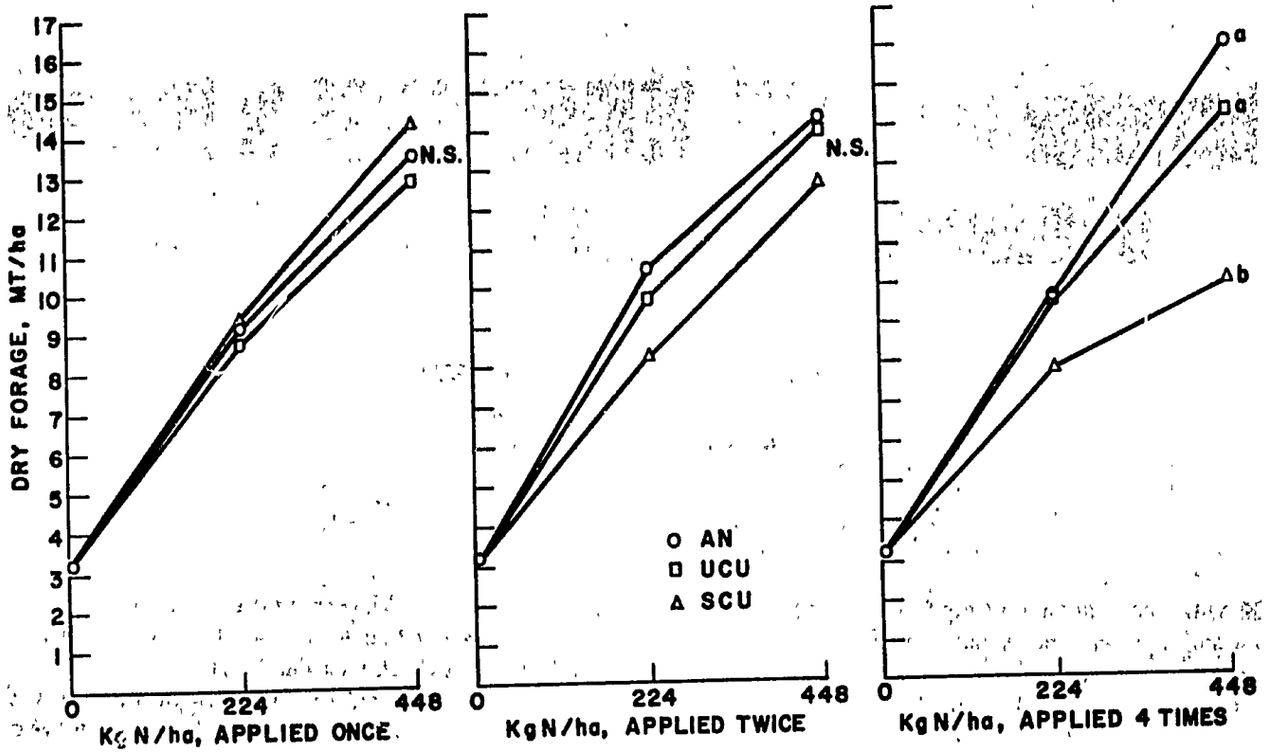


Fig. 1 Yield of Coastal bermudagrass forage in 1966.

resulted in a net reduction in the amount of N available to the plants during the most favorable part of the growing season. A comparison of application schedules for individual N sources shows that yields from AN and UCU tended to increase slightly with more applications, while yields from SCU were markedly less with four applications.

Figure 2 shows that yield responses were quite different in 1967 than in 1966. The highest yields following all application schedules were obtained from SCU-fertilized plots, the difference being greatest with four applications. This indicates a significant recovery of the N that remained in the soil after the 1966 season. This appeared to be carried over winter as soil N or crop residues and not as undissolved SCU granules, since no intact granules were found.

The lowest yields were obtained from UCU-fertilized plots, with the difference between AN and UCU being greatest following the single application. As in 1966, yields from AN and UCU tended to increase slightly with a greater number of applications.

The 1968 yield results were similar to those shown for 1967 and again pointed to a significant carry over of N in plots fertilized four times annually with SCU.

Although the three year average yield data are not shown, there were no significant differences among any of the materials applied two or four times annually. However, UCU produced significantly less forage than AN or SCU when all were applied as single spring applications.

One of the primary advantages of a slow release N source is in producing fairly uniform growth over a long period of time from a single application of fertilizer. Figure 3 shows cumulative forage yields in 1966 following single and split applications of AN and SCU at annual N rates of 224 kg/ha. Note that a single spring application of AN resulted in more than half the total forage being removed at the first harvest. A single spring application of SCU resulted in the same type of uniform seasonal distribution as four applications of AN. Split applications of SCU released N too slowly for maximum growth in 1966. However, in later years when some residual N was present split SCU also resulted in uniform yield distribution curves.

Apparent N recovery (Table 2) showed the same general relationship as total yields. However, regres-

Table 2

APPARENT NITROGEN RECOVERY, 3 YEAR AVERAGE

N applied kg/ha	No. of Applications	N recovery, % AN	UCU	SCU
224	1	61	52	70
—	2	64	56	59
—	4	55	53	55
448	1	67	48	66
—	2	64	52	56
—	4	65	48	57

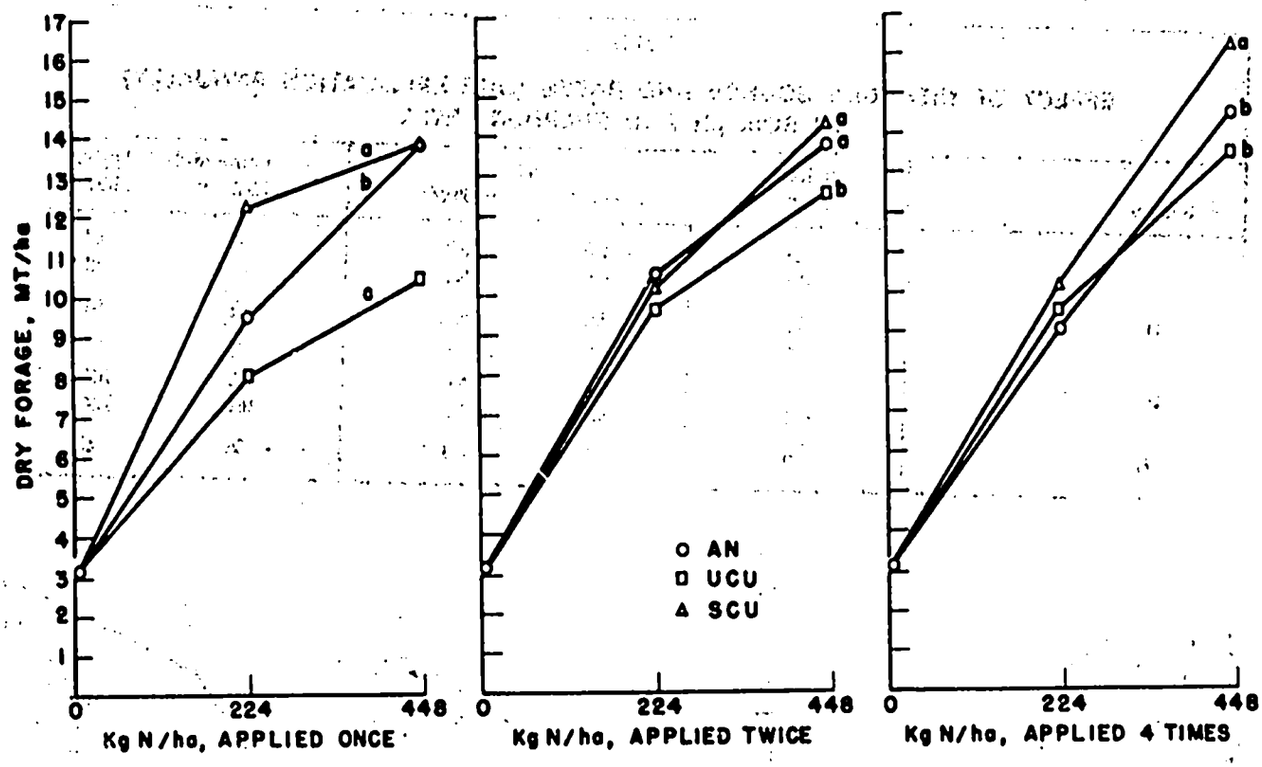
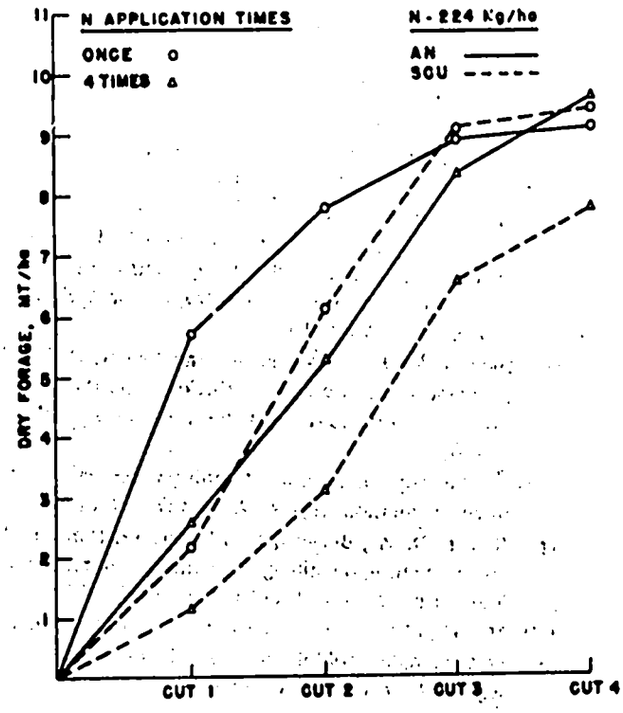


Fig. 2 Yield of Coastal bermudagrass forage in 1967.

sion analysis showed more significant differences among N sources than were shown by the yield data in Figures 1 and 2. Note that N recovery from SCU was much higher from single than from multiple applications. This same trend was true to a lesser extent with AN but not with UCU. The lower N recovery from UCU reflects the generally lower yields from this source and also slightly lower N contents in the forage.

Fig. 3 Effect of N source on cumulative forage yield in 1966.



Soil pH and sodium bicarbonate extractable S were measured in the fall of 1968. Table 3 shows that there was little difference in soil pH following any of the treatments, even though more than 700 kg/ha of S was added annually at the high rate of SCU. However, SCU increased the soil S level over the three year period. The soil sulphur states are considered adequate on this site, as approximately 22 kg/ha annually is added to the soil from atmospheric industrial sources.

Figure 4 shows the influence of residual soil N on yields of bermudagrass harvested in June 1969. Highest yields were obtained from SCU following all application schedules. The differences between SCU and AN were significant at the 10% but not at the 5% level following two and four applications, while UCU resulted in significantly less yield than SCU in all instances. These data tend to confirm that plots fertilized with SCU yielded more in 1967 and 1968 than in 1966 relative to AN and UCU, because of greater carry over of residual N in the soil.

The foregoing data clearly show that SCU has satisfactory agronomic properties for use on Coastal bermudagrass, a warm-season species. Earlier papers (1, 6) have shown its usefulness for tall fescue, a cool-season species.

SCU has the following advantages for use on Coastal bermudagrass:

Table 3

EFFECT OF NITROGEN SOURCE AND RATES (ONE APPLICATION ANNUALLY) ON SOIL pH AND SULPHUR LEVEL

N Source	N Rate kg/ha	pH 2.5-15 cm	pH 15-30 cm	Extractable S, kg/ha 2.15-15 cm	Extractable S, kg/ha 15-30 cm
AN	224	5.0	5.0	34	47
	448	4.8	5.1	40	60
UCU	224	4.9	5.1	34	50
	448	4.8	5.0	41	52
SCU	224	5.0	5.0	140	185
	448	4.8	4.8	161	224
No N	0	5.1	4.9	36	59

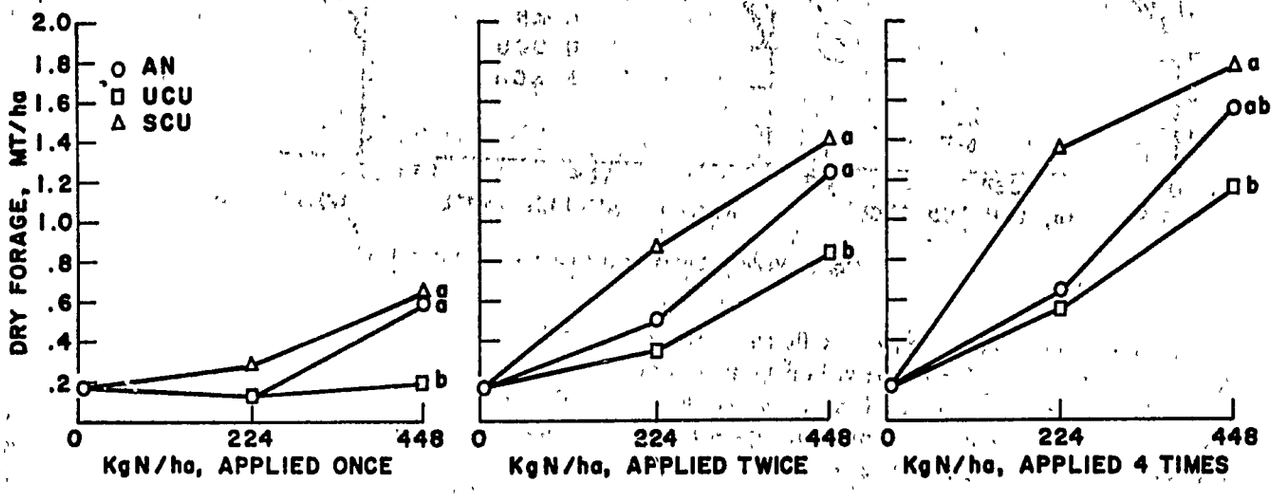


Fig. 4 Residual yield of Coastal bermudagrass forage in 1969.

1. Single spring applications give total forage yields and seasonal distribution as good as more resulting from the same amount of total N in four applications of AN.
2. Excess early production of lush forage with unnecessarily high N content is avoided.
3. The S added by SCU is effective in increasing soil sulphur levels.
4. Sulphur-coating appears to make it possible to use urea for surface application on sod crops without foliage burning or appreciable N losses to the atmosphere.
5. The slow release characteristic should reduce leaching losses caused by excessive rain soon after application.

The primary disadvantages appear to be increased materials and processing cost over uncoated soluble N fertilizers, and the necessity for handling more weight because of reduced analysis. However, the value the added sulphur in S-deficient situations may compensate for this higher cost per unit of N.

References

(1) Allen, S. E., Mays, D. A., and Terman, G. L. Sulfur-coated urea: an effective slow-release nitrogen fertilizer. *Crops Soils 21* (3) 13-15 (1968).

(2) Anonymous. TVA shows sulphur-coated urea. *Sulphur Inst. J. 4* (3) 2-6 (1968).

(3) Beaton, J. D., Hubbard, W. A., and Speer, R. C. Coated urea, thiourea, urea formaldehyde, hexamine, oxamide and oxadized nitrogen-enriched coals as slowly available sources of nitrogen for orchardgrass. *Agron. J. 59*:127-133 (1967).

(4) Brown, M. J., Luebs, R. E., and Pratt, P. F. Effect of temperature and coating thickness on the release of urea from resin-coated granules. *Agron. J. 58*:175-178 (1966).

(5) Engelstad, O. P. Use of multiple regression in fertilizer evaluation. *Agron. J. 60*:327-329 (1968).

(6) Rindt, D. W., Blouin, G. M., and Getsinger, J. G. Sulfur coating on nitrogen fertilizers to reduce dissolution rate. *J. Agr. Food Chem. 16*:773-778 (1968).

(7) Mays, D. A., and Terman, G. L. Sulfur-coated urea and uncoated soluble nitrogen fertilizers for fescue. *Agron. J. 61*:489-493 (1969).