

Efficiency of Sulfur-Coated Urea and Potassium Chloride Compounds Applied to Stargrass Growing on an Ultisol under Humid Tropical Conditions^{1, 2}

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ABSTRACT

The efficiency of various S-coated urea and KCl compounds applied to stargrass growing on an Ultisol under humid tropical conditions was determined. Applying N as urea in six applications yearly or in one application of S-coated urea compounds TV 1415 and 1255 resulted in higher recovery of fertilizer N compared to urea in one application. Applying K as KCl in six applications yearly resulted in higher recovery of fertilizer K in the forage than when applied in one application. The various S-coated KCl compounds did not result in higher recovery of fertilizer K than did KCl in one application.

INTRODUCTION

Tropical grasses growing on Ultisols under humid tropical conditions in Puerto Rico responded strongly to N fertilization up to 448 kg/ha (400 lb/acre) yearly as shown by Vicente-Chandler et al. (3, 4, 5, 6, 7, 8) and Caro-Costas et al. (1, 2). An average of 52.4% of the N applied as ammonium sulphate at rates of 224 to 448 kg/ha (200 to 400 lb/acre) yearly in six equal applications was recovered by the grasses. Vicente-Chandler et al. (9) found that ammonium sulphate, sodium nitrate, ammonium nitrate, urea, and ammonium hydroxide produced similar forage yields, but the latter two were less efficient providers of N as shown by a lower recovery of fertilizer N in the forage.

Tropical grasses growing on Ultisols under humid tropical conditions in Puerto Rico also responded strongly to fertilization with K. Vicente-Chandler et al. (10) found that yields increased sharply with K rates from 224 to 448 kg/ha (200 to 400 lb/acre) yearly. An average of 74.5% of the K applied at the rate of 448 kg/ha (400 lb/acre) yearly was recovered in the

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forage. Vicente-Chandler et al. (9) found that pangolagrass responded to K applications at nine different sites representing seven soil types in Puerto Rico.

This paper presents the results of two adjacent, concurrently run experiments to determine the efficiency of various S-coated urea and KCl compounds compared to the uncoated materials when applied to stargrass growing on an Ultisol under humid tropical conditions in Puerto Rico.

MATERIALS AND METHODS

The experiments were conducted at Orocovis at an elevation of about 600 m (2,000 ft) with a mean annual temperature of about 24° C (75° F) and seasonal variations of less than 4° C (10° F). Monthly rainfall for the

TABLE 1.—*Monthly rainfall during the 2-year experimentation with S-coated urea and KCl at Orocovis*

Month	First year		Second year	
	<i>Cm</i>	<i>In</i>	<i>Cm</i>	<i>In</i>
January	20.8	8.2	10.7	4.2
February	4.6	1.8	4.1	1.6
March	8.9	3.5	31.0	12.2
April	8.1	3.2	26.4	10.4
May	53.3	21.0	9.9	3.9
June	17.8	7.0	2.3	.9
July	23.4	9.2	1.5	.6
August	16.5	6.5	14.0	5.5
September	27.9	11.0	7.4	2.9
October	46.7	18.4	22.6	8.9
November	32.5	12.8	19.3	7.6
December	33.0	13.0	12.2	4.8
Total	293.5	115.6	161.4	63.5

duration of the experiments is shown in table 1. Annual rainfall was 293.5 and 161.4 cm (115.6 and 63.5 in) during the first and second years, respectively.

The soil was Humatas clay (Ultisol) with 3.2% organic matter and 13.4 meq of exchange capacity per 100 g of soil. The soil contained 204 kg/ha (182 lb/acre) of exchangeable K and 74 kg/ha (66 lb/acre) of K extractable with hot nitric acid in the upper 6 in of soil.

A randomized block design was used in both experiments with all treatments replicated five times. The treatments, shown in table 2 and 3, compared urea and KCl applied in one and six applications yearly to various S-coated urea and KCl products provided by TVA applied once yearly. All these materials contained .25% coal tar as a microbicide.

Plots were 3.5 × 3.5 m surrounded by ditches to prevent fertilizer from washing from one plot to another. Stargrass (*Cynodon nlemfuensis*)⁴ was grown in all plots and harvested by cutting every 60 days. Dry matter yields were determined and samples from each cutting analyzed for N and K.

The soil in all plots was limed to pH 6 at the start of the experiment. All plots received 224 kg/ha (200 lb/acre) of P yearly in one application. In the experiment on N sources, N from the various compounds was applied at a rate of 336 kg/ha (300 lb/acre) yearly and K at a rate of 672 kg/ha (600 lb/acre) yearly. In the experiment on K, K from the various

TABLE 2.—Efficiency of various forms of urea applied to stargrass growing on an Ultisol in the humid mountain region of Puerto Rico

Treatment ¹	Yield of dry forage				Fertilizer N recovered in forage		
	First year		Second year		First year	Second year	Total
	Kg/ha	Lb/acre	Kg/ha	Lb/acre	%	%	%
No N applied	22,619	20,187	9,251	8,260	—	—	—
Urea in one application yearly	25,442	22,116	9,442	8,430	24.9	1.2	26.1
Urea in six applications yearly	29,949	26,740	11,435	10,210	39.1	11.3	50.4
S-coated Urea 1415 (28.6% coating) once a year	27,955	24,960	11,738	10,480	37.0	11.7	48.7
S-coated Urea 1005 (20.7% coating) once a year	28,414	25,370	10,338	9,230	41.1	5.3	46.4
S-coated Urea 1255 (21.4% coating) once a year	28,157	25,140	10,808	9,650	49.2	10.0	59.2
LSD ⁰⁵	3,427	3,060	1,176	1,050	17.9	6.3	21.9

¹ 336 kg/ha (300 lb/acre) of N were applied during the first year and none during the second year.

compounds was applied at the rate of 493 kg/ha (440 lb/acre) yearly, and N at the rate of 672 kg/ha (600 lb/acre) yearly.

During the second year, N and K fertilization was discontinued in the respective experiments with these nutrients, but the other fertilizer elements continued to be applied as during the first year. During the second year the grass continued to be harvested every 60 days and forage samples analyzed for N and K.

⁴ Possibly a Puerto Rico bermudagrass cultivar.

RESULTS AND DISCUSSION

The soil contained considerable quantities of available N and K as evidence by the lack of a strong response to applications of these nutrients during the first year (tables 2 and 3). Yields were much lower during the second year when rainfall was less abundant.

First year yields were not increased by urea in one application but were increased by urea applied in six applications and by the various S-coated urea compounds in one application (table 2). Applying urea in six applications increased yields over those obtained with one application. However, the S-coated urea compounds applied once yearly did not

TABLE 3.—*Efficiency of various forms of KCl applied to stargrass growing on an Ultisol in the humid mountain region of Puerto Rico*

Treatment ¹	Yield of dry forage				Fertilizer N recovered in forage		
	First year		Second year		First year	Second year	Total
	<i>Kg/ha</i>	<i>Lb/acre</i>	<i>Kg/ha</i>	<i>Lb/acre</i>	%	%	%
No K applied	21,493	19,190	10,864	9,700	—	—	—
KCl in one application yearly	23,654	21,120	16,576	14,800	42.5	18.0	60.5
KCl in six applications yearly	26,656	23,800	19,566	17,470	52.7	46.6	99.3
S-coated KCl 1015 (22.5% coating) once a year	24,405	21,790	17,640	15,750	48.4	36.6	85.0
S-coated KCl 1215 (31.6% coating) once a year	25,928	23,150	20,429	18,240	53.0	38.9	91.9
S-coated KCl 1000 (31.4% coating) once a year	24,685	22,040	16,867	15,060	44.3	26.6	70.9
LSD ⁰⁵	3,427	3,060	2,408	2,150	18.6	19.0	32.3

¹ 493 kg/ha (440 lb/acre) of K were applied during the first year and none during the second year.

increase yields above those obtained with urea in one application. Similar yields were obtained with the various S-coated compounds and with urea applied six times yearly.

Urea in one application during the first year did not increase second year yields. Higher yields were obtained during the second year when urea had been put on in six applications during the previous year or as S-coated compounds 1415 and 1255 in one application during the previous year than with no N fertilization or urea in one application during the year.

Recovery of fertilizer N in the forage during the first year was similar for all treatments except for compound 1255 which resulted in a higher recovery than one application of uncoated urea.

Urea in six applications and compounds 1415 and 1255 in one application during the first year resulted in higher recovery of fertilizer N during the second year.

Total recovery of fertilizer N during the 2 years was higher when urea was applied in six applications during the first year or when compounds 1415 and 1255 were applied in one application than when uncoated urea was applied once. There was no difference in recovery of fertilizer N between the various S-coated urea compounds in one application and urea in six applications.

In the K experiment, first year yields were increased by KCl in six applications and by S-coated compound 1215 in one application, but not by KCl in one application yearly (table 3). There was no difference in yields obtained with KCl in one or six applications and the various S-coated compounds applied once a year.

During the second year, much higher yields were obtained when K in the various forms had been applied during the previous year. Higher yields were produced with KCl in six applications and with compound 1215 in one application than with one application of KCl. Compound 1000 resulted in lower second year yields than did compound 1215 or KCl in six applications yearly.

During the first year the various K compounds resulted in similar recoveries of fertilizer K in the forage. Recovery of fertilizer K during the second year was higher with KCl in six applications or compound 1215 in one application during the previous year than with KCl in one application. KCl in six applications during the previous year and compounds 1015 and 1215 in one application resulted in similar recovery rates of fertilizer K during the second year. Compound 1000 in one application during the previous year resulted in lower recovery of fertilizer K during the second year than did KCl in six applications.

Total recovery of fertilizer K over both years exceeded 60% in all cases. KCl in six applications resulted in higher recovery of fertilizer K than with one application. There was no difference in recovery of K with KCl in six applications and the various S-coated compounds applied once, nor did these compounds result in higher recoveries than did KCl in one application.

RESUMEN

Se determinó la eficacia de varios compuestos de urea y de cloruro de potasio recubiertos con azufre cuando se aplicaron a la yerba Estrella

sembrada en un suelo Ultisol bajo condiciones típicas de los trópicos húmedos. La aplicación de nitrógeno en forma de urea en seis aplicaciones al año o una aplicación anual de los compuestos de urea recubiertos con azufre (T.V. 1415 y 1255) lograron una recuperación mayor de nitrógeno del forraje en contraste con la urea en una sola aplicación al año.

La aplicación de potasio en forma de cloruro de potasio en seis aplicaciones al año arrojó un porcentaje mayor de potasio recuperable en el forraje, que cuando se aplicó todo de una sola vez. Los varios compuestos recubiertos con azufre en una aplicación no arrojaron porcentajes de recuperación de potasio en el forraje más elevados que el obtenido con cloruro de potasio en una aplicación.

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