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Soil pH correction affecting n-use efficiency of urea by *Brachiaria brizantha* cv. Marandu pastures

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ABSTRACT

Nitrogen fertilization is one of the largest investment when recovering and intensifying pasture management. Urea nitrogen use efficiency was studied in *Brachiaria brizantha* pasture under tropical conditions where liming was applied to the soil in two dates ("early" and "late" - March and August, respectively). Lime was broadcasted and urea was either broadcasted or subsurface-band applied. "Early" applied lime caused 16,4% increase in forage dry matter yield in the rainy season. Urea-N recovered in the shoots was higher when subsurface band applied independently from time of lime application.

KEYWORDS: Pasture recover, liming time, ^{15}N, fertilization-N management

INTRODUCTION

Recovery of degraded pastures of *Brachiaria* spp by management and use of fertilizers is an important issue, since large areas of unproductive pastures are used for raising cattle. Studies on N use efficiency improvement are essential since one of the largest investment on pasture fertilization is represented by nitrogen. Urea is one of the most used nitrogen sources in Brazil due to its lower cost and high nutrient concentration. However urea applied to the soil surface may have significant ammonia loss by volatilization. Broadcasted lime is recommended to established pastures (Oliveira et al., 1999), however its application to the soil surface raise pH to levels that inherence N volatilization from urea broadcasted on established pastures. Subsurface banding urea application may reduce N losses by volatilization. Early lime application can improve N use efficiency since extended lime reaction period with the soil before urea fertilization may reduce the undesirable urea-lime interactions. This study evaluated urea-N use efficiency applied to established *Brachiaria brizantha* pastures when lime was applied to the surface soil in March or August and urea was used either broadcasted or subsurface band applied to the soil from November to March during the rainy season.

MATERIAL AND METHODS

The experiment was carried out on degraded *Brachiaria brizantha* cv. Marandú pasture established on a sandy soil. The experimental design was a randomized complete block replicated four times with treatments in incomplete factorial arrangement (2x2+1). The following factors were evaluated: time of lime application before N fertilization (eight and three months before N-fertilization, in March and August respectively) and urea placement (subsurface-banded or broadcasted). A control treatment was included to evaluate the ^{15}N natural abundance in different samples. Dolomite lime PRNT=90% (3 Mg/ha) was applied to the soil surface in March or August (1998) to 10 m^2 plots. One microplot represented by one open-ended stainless steel cylinder (40 cm inner diameter and 63 cm long) was inserted in each plot to a 60 cm depth in October (1998). Pasture was fertilized in November (1998) with 100 kg/ha P_2O_5 and 198 kg/ha K_2O as ordinary superphosphate and KCl, respectively. Four split applications of urea (60 kg/ha . application N, total 240 kg/ha. year N) was used after cut during the rainy season. Micronutrients as FTE BR 12 were applied at 40 kg/ha with the first nitrogen fertilization. Microplots were fertilized with urea labeled with 5.22 atom % ^{15}N. Forage dry matter yield, N content and N-use efficiency were evaluated in six cuts, performed every 35 and 60 days, respectively, in the rainy (November 1998 to March 1999) and dry season (March to December 1999), respectively. Samples from the microplot were analyzed for N content and ^{15}N abundance. At the end of the experimental period plants inside of the microplots were harvested to evaluate: plant residue, mulch from soil surface (plant residue detached from the plant and standing on soil surface), plant crown, roots and the soil at 0 to 5 cm, 5 to 10 cm, 10 to 20 cm, 20 to 40 cm and 40 to 60 cm depth. The following variables were evaluated:

1. Dry matter forage yield, root mass, residue, mulch, crown and total mass of dry soil;

2. N content (g/kg) and abundance of ^{15}N (atom %) in all plant parts, mulch and in the soil. N contents and ^{15}N abundance were determined using a mass spectrometer ANCA-SL (Europe Scientific Ltd.).

3. Nitrogen percentage in all plant parts, in mulch or in the soil derived from the fertilizer (%N*X*FF) was estimated, according to the equation:

$$\%NXFF = [(a-c)/(b-c)] .100$$

X = plant parts or mulch or soil; a = abundance of ^{15}N in X; b = 5,22 atom % ^{15}N; c = natural abundance of ^{15}N (determined in control plots samples).

4. Amount of nitrogen in all plant parts or in the mulch or in the soil derived from the fertilizer was estimated using the equation:

$$ANXFF\ (g/microplot) = [\%NXFF/100] . Np$$

N*X*= total nitrogen (g) in the plant parts or mulch or soil.

5. Recovery of nitrogen (percentage) applied as urea in plant parts or mulch or soil in different depths.

6. Amount of nitrogen derived from urea-N remained in soil and in the mulch.

The data were submitted by the overall analysis of variance. Tukey test was used to compare treatment means.

RESULTS AND DISCUSSION

There was no interaction between the factors studied. Otherwise, there was significant effect of lime application time before N fertilization on forage dry matter yield during the rainy season and for the annual forage dry matter yield (Table 1). "Early" liming caused a 16.4 to 10.7% increase compared with "late" lime application in the rainy and annual pasture dry matter yield, respectively. Forage dry matter yield and residue were not affected by the factors studied during the dry season. The amount of nitrogen in the plant shoot derived from urea-N (ANPFF) was higher for subsurface-banded than for broadcasted applied urea. A higher average recovery of

Table 1 – Forage dry matter yield (Mg/ha), amount of nitrogen in the plant derived from urea-N (kg/ha) and percentage of urea-N recovery by *Brachiaria brizantha* cv. Marandú. (November 1998 to December 1999).

Treatment	Forage dry matter		Residue		ANPFF[1]	ANRFF[2]	N Recovery	N Recovery	
Liming time	Subsurface-banding of urea	Rainy season	Dry season	Annual		Forage	Residue		
						(Mg/ha)		kg/ha %	
March	yes	7,2 a	1,9 a	9,1 a	3,9 a	62,1 a	11,9 a	27,26 a	5,25 a
March	no	7,7 a	1,9 a	9,6 a	4,5 a	44,8 b	9,9 a	19,85 b	4,38 a
August	yes	6,4 b	1,9 a	8,3 b	3,8 a	55,7 a	10,7 a	24,45 a	4,68 a
August	no	6,4 b	1,9 a	8,3 b	3,7 a	48,5 b	11,1 a	21,27 b	4,87 a
	Control	2,3	1,6	3,9	2,4	-	-	-	-
	CV (%)	23,4	32,2	20,0	23,4*	23,6	7,31*	23,2	19,0*
	Value prob.>F	1,3 %	-	1,7%	-	-	-	7,4 %	-

*Coefficient of Variation of a Variable transformed to Root Square of X+1.
Means followed by a same letter in column are not different by the Tukey test
[1] Amount of nitrogen in the shoot derived from urea – N
[2] Amount of nitrogen in the residue from urea-N

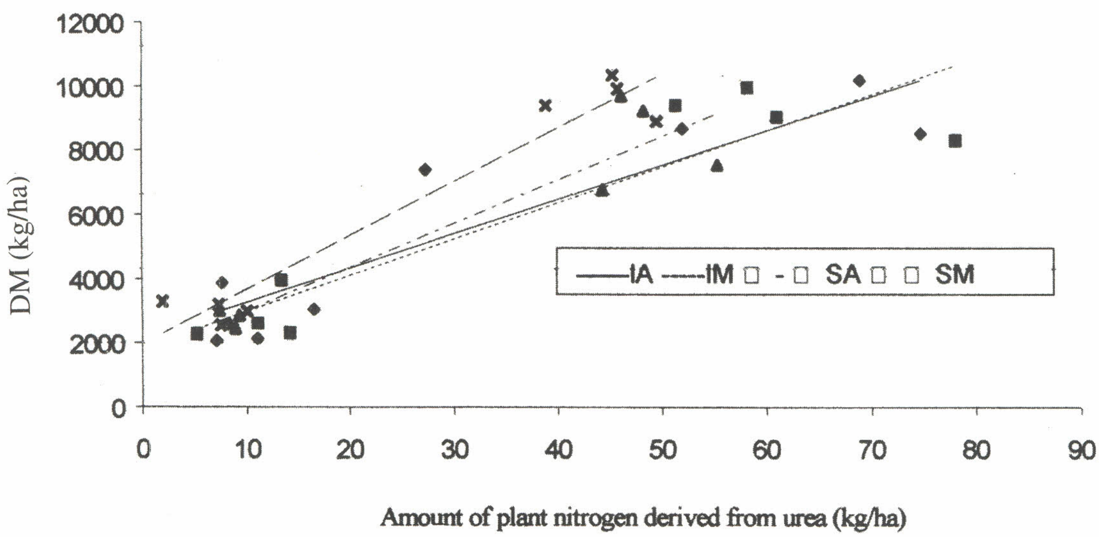

Figure 1 – Relationship between accumulated forage dry matter yield and amount of nitrogen derived from urea-N (ANPFF) in *Brachiaria brizantha* cv. Marandú as affected by experimental treatments. (November 1998 to December 1999)
SA (▲) = Subsurface-banded urea and liming in August; equation: Y=107.42X+2169.2 (R^2=0.83*)
SM (x) = Subsurface-banded urea and liming in March; equation: Y =112.98X+1838.4 (R^2=0.85*)
IA (♦) = Broadcast urea and liming in August; equation: Y =136.25X+1624.20 (R^2=0.88*)
IM (■) = Broadcast urea and liming in March; equation: Y = 168.17X +1977.8 (R^2=0.94*)

applied urea-N (25.8%) was observed for the subsurface-banded fertilizer when compared to the broadcasted urea (20.6%) (Table 1). Raczkowski & Kissel (1989) also obtained approximately 20% increase in the nitrogen recovery when a mixture of urea and ammonium nitrate subsurface-banded was compared to broadcasting. Urea-N recovery in the residue did not differ among treatments (Table 1). Best value for the urea-N recovery was 32.51% in the shoot and residues when lime was applied in March and urea used subsurface-banded. This value is low, compared to 50% N-recovery reported in the literature for temperate climate pastures (Ball & Ryden, 1984; Jones et al. 1977; Harper et al., 1996). Accumulated herbage drymatter was linearly related to the amount of herbage urea-N, a relationship that varied with the lime-urea treatment combination (Figure 1). Additional studies are needed to better understanding of the nitrogen cycle in tropical climate regions where soils are poor, fertilization practices are not adequate and the climate favors nitrogen loss from urea.

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