for sustainable levels of production. These data indicates, for Coastal Bermuda grass, a nutrient removal (kg ha^{-1}), due to productions of 6 and 12 t ha^{-1} of DM, respectively, N = 270-540, P = 30-60, K = 250-498, S = 30-60, Mg = 48-96. In the present experiment, results (Figure 1) also indicates that extraction of nutrients increases with N levels and that this nutrient removal is also considerable.

Figure 1 indicates that in treatments with 500 and 1,000 kg of N ha^{-1}, in which applied K rates were greater because forage yield was greater, the higher extraction of this nutrient in these treatments reflects this greater quantity of applied K. Since there was a decrease in the increments of forage yield, mainly at the highest N rate (Corrêa et al., 2001), this greater K extraction in treatments with 500 and 1,000 kg of N ha^{-1}, mainly as ammonium nitrate, is signalizing for a luxury use of this nutrient.

For high forage yields (treatment 500 kg ha^{-1}) and for both fertilizers, macronutrients extraction was greater for K and N, followed by Ca, S, P and Mg. Micronutrients extraction occurred in the following decreasing order: Fe, Mn, Zn and Cu. This fact agrees with the assertion (Silva, 1995) that N is one of the most absent elements in soil and that it has a fundamental role in modulation of response to plant fertilization.

It could be concluded that high coastcross forage yields need high replacements of nutrients, in order to avoid a decline in pasture productivity and to maintain its persistence.

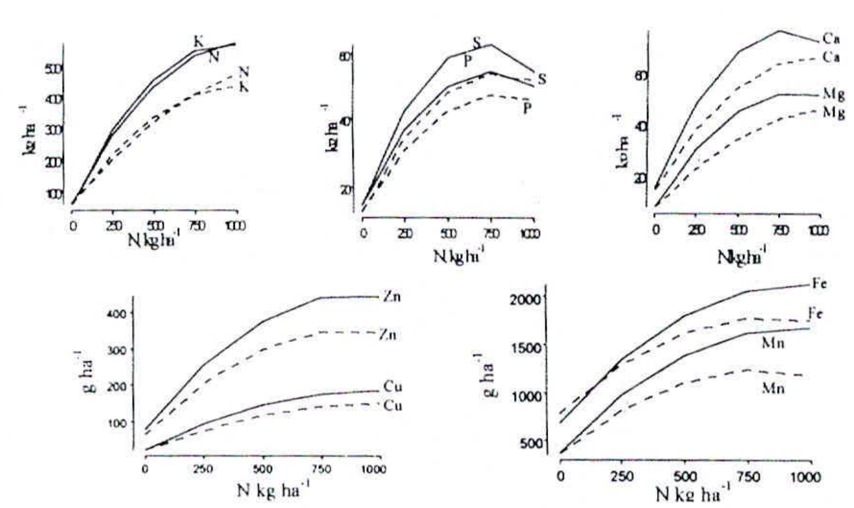

Figure 1 - Adjusted quadratic polynomial regression for extracted macronutrients (kg ha^{-1}) and micronutrients (g ha^{-1}) by coastcross forage fertilized with ammonium nitrate (bold lines) and urea (dashed lines).

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Dry matter production response of coastcross (*Cynodon dactylon* (L.) pears) to sources and rates of nitrogen[1]

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ABSTRACT

Dry matter production of a coastcross pasture grown on a dark red latosol (Hapludox), in São Carlos, São Paulo State, Brazil, under tropical altitude climate, was evaluated. The goal was to verify the efficiency of N rates as urea and ammonium nitrate: 0, 25, 50, 100 and 200 kg ha^{-1} per cutting, in five periods. Both sources were equally efficient. The mean N rates, which produced 80% of maximum forage yield, were 78 and 58 kg N ha^{-1}, respectively, for urea and ammonium nitrate, and were related to dry matter yields of 2,769 and 3,347 kg ha^{-1} per cutting.

KEYWORDS: Ammonium nitrate, forage production, nitrogen fertilizer, pasture, urea.

INTRODUCTION

Although tropical forage grasses do not achieve the quality of the temperate climate grasses, animal productivity on tropical grasses can be high, due to their high dry matter production potential. To express this potential, nitrogen fertilization is one of the most important factors. Response of tropical forages to high N levels has been cited by several authors (Vicente-Chandler et al., 1959; Werner et al., 1967; Corsi, 1986). Vicente-Chandler et al. (1959) found responses up to 1,800 kg of N ha^{-1} per year, but the greatest yield increases range from 300 to 400 kg of N ha^{-1} per year (Werner et al., 1967; Olsen, 1972; Gomes et al., 1987). In relation to coastcross, it can be concluded that responses to applied N depend on management (Monteiro, 1998), with responses occurring up to 500 kg of N ha^{-1} per year (Alvim et al., 1998).

Additional studies are needed in order to establish the most useful N source and the most adequate N rate for intensively managed pastures, mainly when urea is used on soil surface, due to NH_3 losses by volatilization, depending on the climatic conditions.

MATERIAL AND METHODS

The experiment was carried out from November 1998 to April 1999 on a coastcross (*Cynodon dactylon* cv. Coastcross) pasture grown on a dark red latosol (Hapludox) with 30% clay, in São Carlos, São Paulo State, Brazil (latitude 22°01´ S, longitude 47°54´ W and altitude of 836 m), under a tropical altitude climate. Lime was applied to raise soil base saturation to 70% of the cation exchange capacity, and fertilizer was added at a level of 100 kg of P_2O_5 ha^{-1} as single superphosphate, and 30 kg ha^{-1} of micronutrients as FTE BR-12. Potassium was applied as KCL, along with N treatments, in order to replace K removed by cuttings and to maintain K levels in the dry matter at a minimum of 20 g kg^{-1}.

Experimental design was a randomized block one, in a 2 x 5 factorial arrangement (two N sources: urea and ammonium nitrate and five rates: 0, 25, 50, 100 and 200 kg ha^{-1} per cutting), with four replications. Treatments were applied after each of five consecutive periods (cuttings), in the rainy season. Plot size was 4 x 5 m^2, in which an area of 6 m^2 was used to evaluate forage yield. Forage was cut in 24 to 37-day intervals, 10 cm above soil surface. Dry matter weight was determined in forage samples.

Coastcross dry matter production was estimated within N source and cutting periods by a polynomial regression using REG procedure (SAS, 1993). Eighty percent of the maximum yield was estimated using the fitted model.

Table 1 - Climatic conditions during the five periods of plant growth, 1998/1999.

Doses of N, kg ha^{-1}	1st Period (P1)	2nd Period (P2)	3rd Period (P3)	4th Period (P4)	5th Period (P5)
Period	11/9-12/10	12/11-1/4	1/8-2/3	2/4-3/2	3/3-4/9
Duration, days	32	24	26	26	37
Rainfall, mm	174.3	159.1	249.3	245.2	110.6
Qg, kcal cm^{-2}	16.9	8.7	12.1	12.6	17.4
Sunlight hours, h	216	74	137	138	236
Evaporation, mm	15	9	12	13	11
Maximum temperature, °C	24.4	28.7	29.2	31.5	30.0
Minimum temperature, °C	15.8	19.2	19.2	19.1	18.2
Average temperature, °C	20.1	24.0	24.2	25.4	24.1
Soil water storage, mm	54	100	93	85	91
Water deficit, mm	6	0	0	0	0

Qg = global energy.

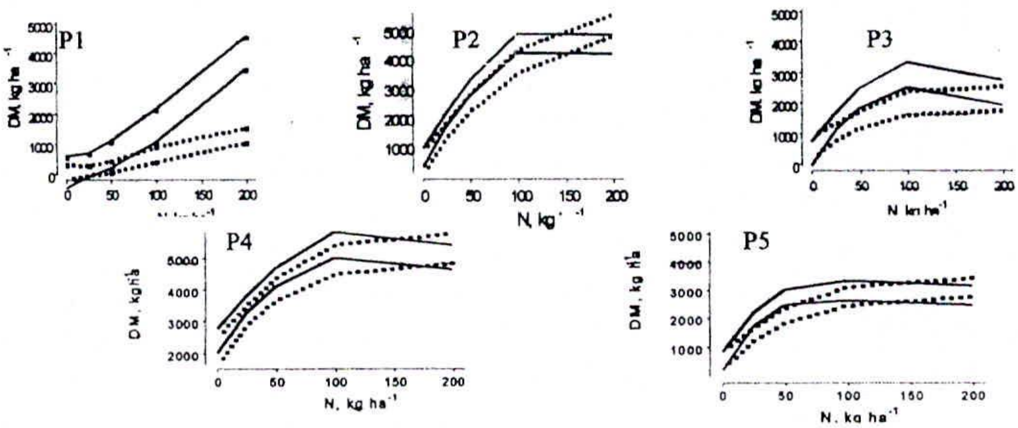

Figure 1 - Upper-and-lower 95% confidence interval for the mean expected value of dry matter (DM) production of coastcross pasture, in kg ha^{-1}, considering five rates for N: 0, 25, 50, 100 and 200 kg ha^{-1} from two sources: urea (dashed line) and ammonia (bold line) in five periods (P1 to P5).

RESULTS AND DISCUSSION

Forage yield was affected ($P < 0.01$) by main effects and interactions of N rates, N sources and periods (cuttings). Figure 1 shows the upper-and-lower 95% confidence limits for the mean expected value of dry matter production in each period by adjustment of the cubic polynomial regression, representing the source x period x rate interaction.

High response of coastcross to N sources and N rates occurred, compared to the low yield of the control plots, showing the importance of N application in order to intensify forage yield. An atypical period (P1) was observed due to water stress at the beginning of growth (Table 1), when ammonium nitrate was the most efficient source starting from the 50 kg ha^{-1} N rate.

Considering periods with the best growing conditions (P2 to P5), urea showed a behavior similar to that of ammonium nitrate. Although urea showed relatively high N losses (Cantarella at al., 2001), this fact did not result in a proportional yield decrease. For example, in P4, both sources were equal for all rates, although the N-NH_3 mean loss was 27% (Cantarella et al., 2001). A possible reason for this is that plants with ammonium nitrate already reached their maximum production potencial at the immediately lower rates. For the other situations of similar urea responses, the reasons could be the residual N, compensating N losses of urea, and the stimulation of the native soil N release (priming effect).

Nitrogen rates (kg ha^{-1}), responsible for 80% of maximum dry matter yield (kg ha^{-1}), were, respectively, 141 and 1,049; 111 and 4,141; 75 and 1,821; 56 and 4,278; 70 and 2,553, for urea in periods P1 to P5, respectively. For ammonium nitrate, they were: 170 and 3,248; 80 and 4,061; 60 and 2,423; 53 and 4,521; 38 and 2,484, in the same order.

Helminthosporium appeared in plots with 200 kg of N ha^{-1} per cutting, from de third cutting forward. It seems that the higher N rates increased plant susceptibility to this disease, with further decrease of plant population and yield.

It was concluded that there was significant response, in dry matter production of coastcross to nitrogen fertilization, with variations due to sources, rates and periods. Also, urea was an efficient source for dry matter production when compared to ammonium nitrate.

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