EFFECT OF NITROGEN FERTILIZATION UPON WINTER GROWTH IN NATURAL PASTURES OF THE SOUTH EAST OF BUENOS AIRES PROVINCE, ARGENTINA

Fernández Grecco, R.C[1]; A.E. Mazzanti[2] and H.A. Echeverría[2]

[1]INTA Balcarce and [2] INTA Balcarce - Facultad de Ciencias Agrarias, Universidad Nacional de Mar del Plata (FCA-UNMdP). CC, 276, CP 7620 Balcarce, Argentina.=

ABSTRACT

The effect of winter nitrogen fertilization upon herbage accumulation during the winter-spring period on a natural pasture of the Flooding Pampa dominated by cool season annual (*Lolium multiflorum*) and perennial (*Stipa neesiana*) grasses was evaluated. The experiment was carried out from August to November in 1994 and 1995. Fertilization treatments were: 0, 50, 100, 150, 200 and 250 kgN ha^{-1} (N0, N50, N100, N150, N200 and N250, respectively). The experimental plots were set out in three randomized blocks. In 1994, maximum forage accumulation was reached at N150, and no significant differences were found among N150, N200 and N250. In 1995, N250 showed the highest yield. No differences were found between N200 and N150, both being significantly higher than the rest of the treatments. In both years N0 showed the lowest forage yield. Though a 50% rainfall deficit during 1995 delayed forage growth initiation as compared to 1994, no significant differences in the total herbage accumulated in both years were registered.

KEYWORDS

Natural grassland, nitrogen fertilization, herbage growth

INTRODUCTION

The Flooding Pampa is a cattle raising region of 6,000,000 ha at the south east of the Buenos Aires province. Forage resources are mainly constituted by natural pastures (70-80%). Management systems are typically extensive, nitrogen fertilization being a scarcely used practice by typical farmers. In spite of native and naturalized cool season grasses being common constituents of the natural pastures, herbage production during that period is extremely low. Under natural field conditions, available nitrogen in the soil during winter (Vazquez and Barberis, 1982) would limit the herbage growth potential of cool season grasses. In this sense, as long as no other nutrient or water deficit exists, a strong effect of nitrogen fertilization upon winter and early spring herbage production of natural pastures could be expected.

MATERIALS AND METHODS

The experiment was carried out in a natural pasture dominated by cebadilla (*Bromus auleticus*), annual ryegrass (*Lolium multiflorum*) and stipa (*Stipa neesiana*). Average 1994-1995 pH, assimilable P and NO_3 concentration in the first 40 cm were 6.4, 5.7 mg kg^{-1}, and 5.8 mg kg^{-1}, respectively. In Aug-28 of 1994-1995 six fertilization treatments were applied: 0, 50, 100, 150, 200 and 250 kg ha^{-1} of nitrogen (N0, N50, N100, N150, N200 and N250), in the form of calcareous NO_3+NH_4. The experimental plots were set out in three randomized blocks. To prevent P deficiency, 20 kg ha^{-1} of P were added at the begining of Aug. after an initial cut of the pasture (T0). The pasture was harvested by mechanical cuttings on Sep-8 (T1), Sep-16 (T2), Sep-26 (T3), Oct-5 (T4) and Oct-14 (T5), 1994 and on Oct-24 (T1), Nov-3 (T2), Nov-13 (T3) and Nov-23 (T4), 1995. Analysis of variance and linear regressions were used for the statistical comparisons (GLM and REG, SAS, 1989). Level of significance for mean differences was set at P≤0.05 (Duncan's test).

RESULTS AND DISCUSSION

Nitrogen fertilization signficantly increased the herbage accumulation of the natural pasture, maximum differences between treatments being achieved at the end of the experimental period. Table 1 shows the levels of herbage accumulation for the six fertilization treatments in both experimental periods. During the first year, which had average winter rainfalls for the area, maximum herbage accumulation was reached at N150, and no significant differences were found among N150, N200 and N250. This maximum yield was sixfold higher than that obtained with N0. In 1995, N250 showed the highest yield. No differences were found between N200 and N150, both being significantly higher than the rest of the treatments. In both years N0 showed the lowest forage yield. Herbage growth rates are additionally shown in Table 1. The rates were calculated from linear regressions performed upon herbage accumulation through time (Thomas, 1980).

A linear-plateau model (Newton's algorithm (SAS, 1989)), was used for describing herbage accumulation response to nitrogen fertilization during 1994:

$$FA = a + b * Ni, \text{ if } Ni < Ó$$

where FA is herbage acumulation (kg ha^{-1} DM), a is the intercept, b is the herbage accumulation rate, Ni is the nitrogen dose applied, and is the threshold nitrogen level above which no dry matter increases are achieved.

$$\text{If } Ni < 170 \text{ kg ha}^{-1} \; FA = 686.1 + 22.76*Ni$$
$$\text{If } Ni > 170 \text{ kg ha}^{-1} \; FA = 4559 \text{ kg}$$

According to the model, an increase in FA of around 23 kg ha^{-1} DM would be obtained for each unit of applied nitrogen until a 170 kg ha^{-1} dose. No further increases would be obtained with higher levels of nitrogen fertilization.

For 1995, the FA was described by means of the following exponential model:

$$FA = K + Ó * (1 - EXP (- ß * Ni)$$

where FA is herbage accumulation (kg ha^{-1}), K is the FA for the N0 treatment, Ó and ß are coefficients calculated by adjusting the non-linear regression model, and Ni is the applied nitrogen dose.

$$FA = 1912 + 3313.24*(1- EXP(-0,0029*Ni)$$

The apparent herbage accumulation response to nitrogen fertilization was calculated from the model. Herbage accumulation showed decreasing increments as applied nitrogen increased. The highest response (17.2 kg of DM per kg of applied nitrogen) was achieved with N50, while N250 showed a 100% decrease in the response (9.2 kg of DM per kg of applied nitrogen). In 1995, the rainfalls recorded during the experimental period were around 50% lower than the historical average. This could explain the marked delay in the start of the growing period of the pasture as compared to 1994. However, no significant differences in the total herbage accumulated among both years were registered.

The general responses observed in herbage accumulation and herbage growth rate during winter and early spring in a natural grassland of the Flooding Pampa to nitrogen fertilization were similar to those reported elsewhere for temperate sown pastures (Marino et al., 1995).

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Table 1

Effect of Nitrogen fertilization on herbage accumulation and herbage growth rate in a natural pasture at the end of the experimental periods.

N Dose	Herbage acumulation (kg ha^{-1} DM)		Growth rate (kg $ha^{-1}day^{-1}$ DM)	
	1994	1995	1994	1995
N0	70 [d]	1912 [d]	9±4.1	58±12.3
N50	1749 [c]	2771 [c]	26±8.3	77±20.1
N100	2861 [b]	2827 [c]	45±13.1	103±22.8
N150	4193 [a]	3378 [cb]	75±16.2	103±22.1
N200	4477 [a]	3796 [b]	76±16.8	106±28.9
N250	4641 [a]	4218 [a]	84±27.6	137±27.9

Figures followed vertically by the same letter are not significantly different. Duncan's test ($p \geq 0,05$)