Impact of Increasing Nitrogen Fertilizer Rates upon an Irrigated Tanzania Grass Pasture. 1. Dry Matter Yield

F. Queiroz-Neto
Universidade de São Paulo, Brazil

G. B. Martha Jr.
Universidade de São Paulo, Brazil

M. A. Penati
Universidade de São Paulo, Brazil

M. Corsi
Universidade de São Paulo, Brazil

M. J. T. Menezes
Universidade de São Paulo, Brazil

The XIX International Grassland Congress took place in São Pedro, São Paulo, Brazil from February 11 through February 21, 2001.

Proceedings published by Fundacao de Estudos Agrarios Luiz de Queiroz

ID # 04-40

IMPACT OF INCREASING NITROGEN FERTILIZER RATES UPON AN IRRIGATED TANZANIA GRASS PASTURE. 1. DRY MATTER YIELD

F. Queiroz, Neto[1]; G.B. Martha, Jr.[1,2]; M.A. Penati[1]; M. Corsi[1]; M.J.T. Menezes[1]

[1]Departamento de Produção Animal – Escola Superior de Agricultura "Luiz de Queiroz" - USP, Piracicaba, São Paulo, Brasil, CP 09, 13418-900.

[2]Sponsored by FAPESP

Abstract

An experiment was carried out with irrigated Tanzania grass (*Panicum maximum*, Jacq.) pasture receiving five nitrogen (N) rates of (0, 30, 60, 90 and 120 kg N ha^{-1} cut^{-1}) during the growing season. N application increased dry matter yield and Tanzania growth rate linearly ($P < 0,05$). Responses to nitrogen applications were higher in the first two cuts of the growing season than in the last two cuts. The N fertilizer conversion into herbage dry matter was also higher in the beginning of the growing season.

Keywords: tropical pasture, N fertilization, irrigation

Introduction

Irrigated high-yielding tropical pastures for milk and meat production have been adopted by Brazilian farmers as an alternative to make cattle enterprises competitive in regard to other agricultural enterprises. High herbage dry matter yield (DMY) demand large mineral nutrient supply, and nitrogen (N) has been claimed as the most important mineral nutrient to grassland productivity. In this context, intensively managed pasture systems should use considerable levels of N fertilizers in the absence of legumes in order to sustain high herbage DMY (Martha et al., 1999). *Panicum maximum* species presented a linear apparent growth response of about 29-74 kg dry matter (DM) per kg of N at fertilizer rates up to 448 kg N ha^{-1} during the growing season as shown by Vicente-Chandler et al. (1974) and Monteiro (1995). Response to N additions has been associated with positive economic results within this range of linearity (Tosi, 1999).

Several studies have reported tropical herbage response to increasing rates of N fertilizers, but information regarding new genetic material under irrigated conditions are still lacking. The present experiment aimed to evaluate the impact of increasing rates of N fertilizer upon the DMY and herbage growth rate (HGR) of an irrigated Tanzania grass pasture.

Material and Methods

The experiment was carried out at Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ/USP), Piracicaba, São Paulo State, Brazil, and consisted of an irrigated (central pivot) Tanzania grass pasture that received five rates of N in the form of ammonium sulfate (0, 30, 60, 90 and 120 kg N ha^{-1}) after each of the four cuts representing the summer growth, i.e., from November 6/1999 to March 29/2000. Individual cuts were performed on December 12/1999, January 17/2000, February 22/2000, and March 29/2000. Treatments were assigned to 3.5 x 2.5 m plots in a randomized complete block design replicated four times. All plots were cut at the ground level and received 120 kg N ha^{-1} on October 9/1999. By this time lime, phosphorus, potassium and trace elements were corrected according to soil analysis. Subsequent forage cut was performed to a 30 cm-cutting height. The DMY was determined by weighing samples collected in the field (two sampling areas of 0.25 m^2 each per plot) before and after an oven drying (55^o C) of a 72 h period. The interval between two successive cuts was 36 days.

The first two cuts represented the beginning of the growing season whereas the last two cuts represented the end of the growing season. Pooled data of the four cuts represented the accumulated DMY (aDMY). For each of the two-cuts groups of evaluations herbage growth rate (HGR) was determined by dividing the DMY by 72 days and for the four-pooled cuts accumulated HGR (aHGR) was calculated by dividing aDMY by 144 days. In the former case N rates considered were 0, 60, 120, 180 and 240 kg N ha^{-1} while in the latter case N rates considered were 0, 120, 240, 360 and 480 kg N ha^{-1}. Data was first tested for homogeneity of variance and normality and the statistical package SAS System (1989) was used to perform the overall analysis of variance.

Results and Discussion

DMY and HGR increased linearly with increasing N rates ($P<0,05$). Irrigated Tanzania grass pasture presented better responses to N application in the first two cuts (beginning of the growing season) in comparison to the last two cuts (end of the growing season) (Fig. 1 and Fig. 2). Figure 1 shows that in cuts 1 and 2 the DMY in control plots, as indicated by intercept value, was 92,4 % higher than in cuts 3 and 4 and that N efficiency (kg DM/kg N), given by the angular coefficient of the line, was 29,9 % higher in the former case. This fact could be a consequence of: 1) a greater response to N additions in the beginning of the growing season as plant growth factors (light, temperature, etc.) are increasingly more favorable to tropical herbage production; 2) a residual N fertilizer effect arising from the 120 kg N ha^{-1} fertilization practiced on October 6/1999; 3) the mineralization of soil organic N. Similar trends were verified for PGR (Fig. 1).

The lower DMY and HGR in cuts 3 and 4 relative to cuts 1 and 2 seems to be a consequence of the apical meristem removal on cut 2. Conversely higher figures for DMY and HGR on cuts 1 and 2 are probably related to stem elongation. It is interesting to note that equations for the last two cuts of the growing season better explained DMY and HGR than equations for the beginning of the growing season (see the corresponding R^2 values shown in Fig. 1). This fact might reflect a greater dependence on N additions once apical meristem is removed.

N fertilization improved DMY and HGR greatest benefits being observed in the beginning of the growing season (cuts 1 and 2). Further studies should focus, among other issues, on the residual value of nitrogen fertilizers and on the dynamics of soil organic matter mineralization within the soil-pasture system. These information may indicate that N rates could be reduced with appreciable gains in the economics of pasture production and environmental conditions.

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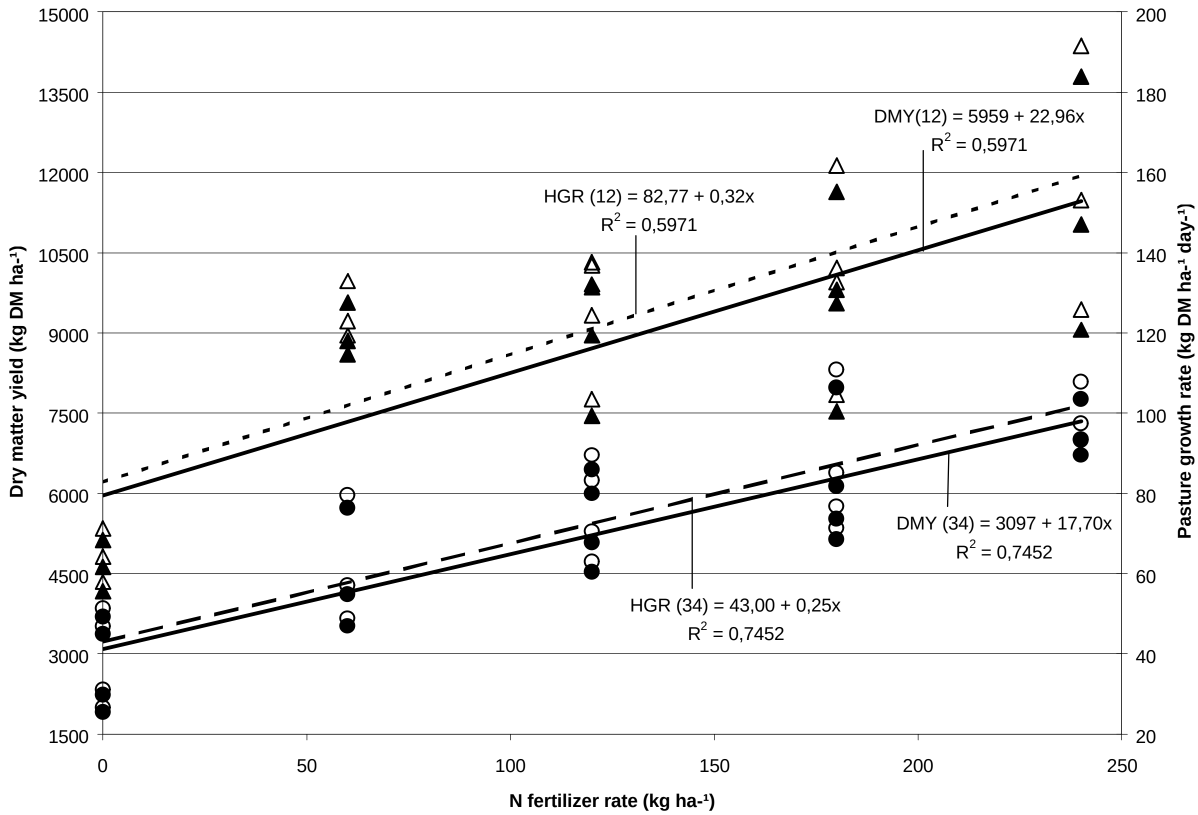

Figure 1 - Dry matter yield (solid line, solid symbols) and pasture growth rate (dashed line, open symbols) as affected by increasing N fertilizer rates in the beginning of the growing season (cuts 1 and 2, DMY(12) and HGR(12)) and in the last part of the growing season (cuts 3 and 4, DMY(34) and HGR(34)).

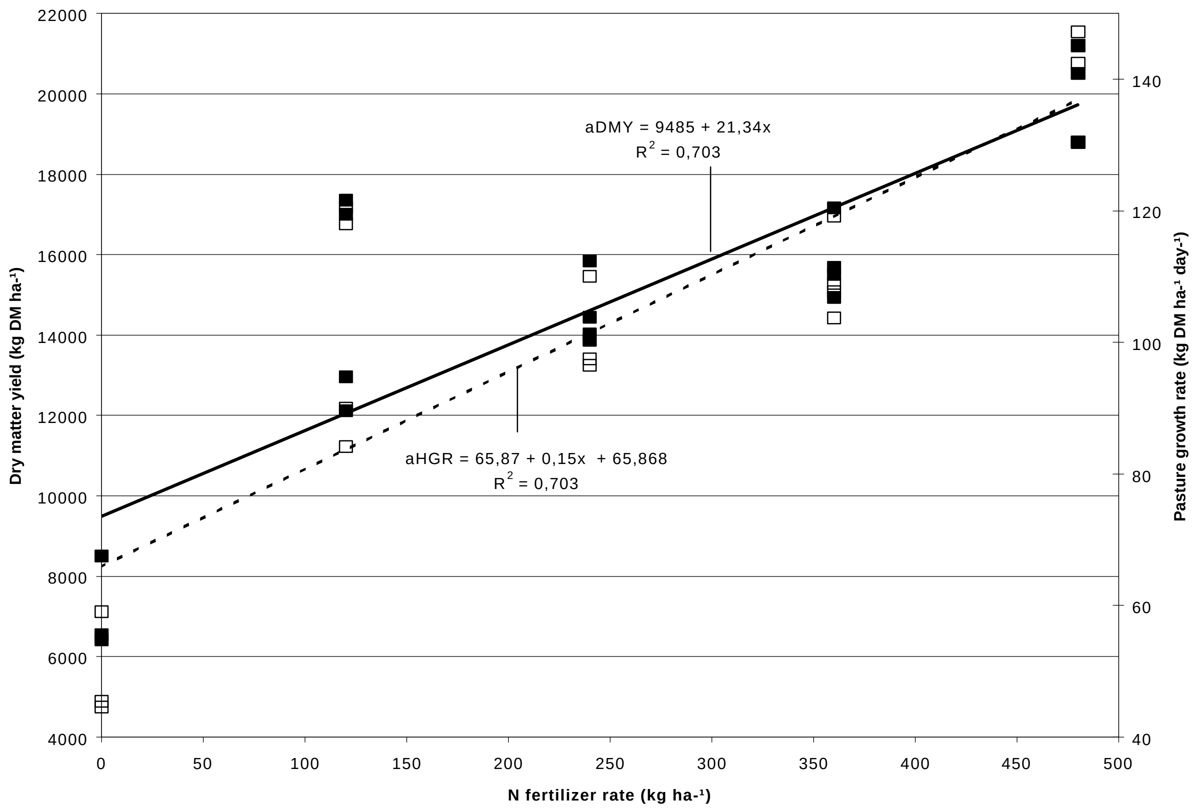

Figure 2 - Dry matter yield (solid line, solid symbols) and pasture growth rate (dashed line, open symbols) as affected by increasing N fertilizer rates during the growing season (cuts 1 to 4, aDMY and aHGR).