



## SHORT COMMUNICATION

# Botanical composition of a natural rangeland overseeded with annual ryegrass under N fertilization

 Ávila, M.R.<sup>1,\*</sup>; Nabinger, C.<sup>2</sup>; Schneider-Canny, R.<sup>3</sup>; Fedrigo, J.K.<sup>4</sup> 
<sup>1</sup> Universidade Federal do Pampa, Dom Pedrito, RS, Brazil.

<sup>2</sup> Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.

<sup>3</sup> Noble Research Institute, Oklahoma, EUA.

<sup>4</sup> Universidad de la República Oriental del Uruguay, Melo, Carro Largo, Uruguay.

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### Abstract

The fertilization in rangelands has a positive effect in the forage production. The increased nitrogen (N) availability improves plant growth and forage quality of native pastures. However, in the Pampa biome conditions of Rio Grande do Sul State, Brazil, these responses occur surprisingly fast and consistently. Therefore, the objective of this work was to quantify the N effect in the botanical composition of a natural pasture overseeded with annual ryegrass in Southern Brazil. The effects of three rates of N fertilization (zero, 100 and 200 kg N ha<sup>-1</sup>) were evaluated. Forage biomass was estimated on a monthly basis using the double sampling approach. The different botanical components of each forage sample were manually sorted in the laboratory. In order to calculate the Rényi diversity profile, two floristic composition evaluations were performed in the experimental area in December of 2010 and September of 2011. The ryegrass biomass production is highly affected by the N fertilization. The botanical composition of natural pastures modifies most probably by increasing ryegrass competition at early spring.

**Keywords:** Rangeland fertilization; nitrogen; annual ryegrass; biomass.

### 1. Introduction

In Rio Grande do Sul, the most Southern Brazilian State, the meat production occurs mostly in the natural rangelands of the Pampa biome (Allen *et al.*, 2011). The Pampa biome is one of the six biomes found in Brazil and extends to Argentina and Uruguay (Pereira *et al.*, 2018). Nitrogen (N) fertilization has a positive effect on the natural rangelands productivity (Sanderson *et al.*, 1997) since higher N availability improves biomass production as well as the crude protein levels of the pasture.

Despite the increased interest in understanding the impacts of the management practices used in the natural rangelands (Storkey *et al.*, 2015; Jaurena *et al.*, 2016), there is a lack of information about the effects of long term fertilization and the practice of overseeding the rangelands with exotic species.

A few years are necessary to clearly notice

the effects of fertilization on rangelands specially on the modification of the botanical composition (Hughes and Metcalfe, 1972). However, in the environmental conditions of the Pampa biome in Rio Grande do Sul the effects of fertilization have been occurring surprisingly fast and consistently (Boggiano *et al.*, 2000). Therefore, the objective of this work is to quantify the effect of N fertilization in the botanical composition in a the natural rangeland pasture overseeded with annual ryegrass located in the Depressao Central region in the state of de Rio Grande do Sul, Brazil.

### 2. Materials and methods

The work was conducted in an area of natural rangeland (30°05'52" S, 51°39'08" W) with deep and well drained soil. During the period of study, annual ryegrass was overseeded on 05/27/2010 and 04/13/2011 at the rate of 46 kg seeds ha<sup>-1</sup>.

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\* Corresponding author  
E-mail: [marianaravila@gmail.com](mailto:marianaravila@gmail.com) (M. Ávila).

The treatments consisted of two rates of N, as urea, one with 100 kg N ha<sup>-1</sup> (N100) and one with 200 kg N ha<sup>-1</sup> (N200) and, the control area with no fertilization. The biomass offer was maintained at 12% (12 Kg of dry biomass 100 kg<sup>-1</sup> livestock ha<sup>-1</sup>) using young heifers cross breed of Angus-Hereford-Nelore. To estimate the biomass production, as dry matter (DM), we utilized the double-sample method (Wilm et al., 1944). The biomass samples collected at the field were taken to the lab for manual classification of the botanical components: ryegrass, other grasses, legumes, other species, and dead material. Following, the samples were weighed and placed to dry in forced air oven at 60 °C t determine the dry matter.

To calculate the diversity profiles of Rényi two botanical evaluations (number of different species) were carried out on December/2010 and September/2011. The data for DM and botanical components were submitted to statistical analysis using PROC MIXED (mix models) of SAS 9.0. The diversity profiles of Rényi were calculated to compare the effects of the N rates on the richness of the botanical diversity using the statistical software R.

### 3. Results and discussion

On September, the control treatment (no N added) generated higher diversity of species, obtaining 1,9874 in the diversity profile of Rényi. While the treatment N100 had 1.4302 and 1 N200 obtained 1.4806. The treatments N100 and N200 clearly demonstrate a reduced diversity, mainly on N200 (Figure 1). During this period, the annual ryegrass was the predominant species on the fertilized treatments (Table 1). The ryegrass dominance was determinant for the reduction of species diversity. In both treatments with N fertilization there is the tendency to de-crease diversity, which results in a strong effect on the ecosystem (Chapin et al., 1997).

The diversity of species according to the Rényi index shows that on December

(Figure 1a) the treatment with no N added obtained higher diversity and uniformity of species (Control = 1.8433, N100 = 1.3941, N200 = 1.3160). As the amount of each species present in the rangeland changes, so that there is less equality, the curve will tend to be more inclined with more variability in the values (Hill, 1973).

There was a significant difference between the evaluation months for the biomass of the legumes, other grasses, other species, annual ryegrass and dead material (Table 1), however, the N fertilization had a significant effect only on the ryegrass. For the ryegrass a significant difference was observed for the period of evaluation ( $p \leq 0.0001$ ) and treatment ( $p = 0.0016$ ) (Ávila et al., 2013).

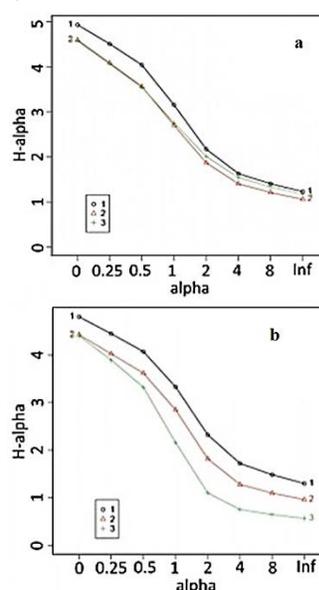


Figure 1. Diversity profile of Rényi on December/2010 (a) and September/2011 (b) under different N rates (1 = no N added, 2 = N100, 3 = N200). Alpha with variation from zero to infinite.

There was a significant reduction on the biomass production of the legumes and other grasses, from the first evaluation (December, 2010) compared to the last evaluation (February, 2011).

Table 1

Dry matter production (kg ha<sup>-1</sup>) from July/2010 to February/2011 of a natural rangeland overseeded with annual ryegrass under different N rates (mean of treatments). The grasses and legumes correspond to native species only. Values followed by different letters, in the lines, are significant different at  $p < 0.05$ . [0] – Botanical component not present

Botanical component* (kg/ha)	Month							
	Jul	Ago	Sep	Oct	Nov	Dec <sup>1</sup>	Jan	Feb
	2010							
Total DM	2390a	2300a	2571a	1938ab	1361b	2077ab	2708a	2542a
Legumes	[0]	[0]	[0]	96ab	22.6b	41.2b	[0]	52.1a
Other grasses	335c	162c	439c	474c	353c	881b	1113ab	1429a
Other species	161ab	88ab	15b	99ab	51b	154ab	169ab	259a
Dead material	1091bcd	1583ab	1687a	1104bcd	867d	1001cd	1426abc	802d
Ryegrass	803a	467ab	430b	165bc	67c	[0]	[0]	[0]
	2011							

\*No interaction for the variables evaluated. <sup>1</sup>First botanical evaluation.

However, the N effect was significant only for the biomass production of the annual ryegrass, that had a higher production on July (2010).

#### 4. Conclusions

The biomass production of ryegrass is highly dependent on the N rate. The botanical composition of the natural rangeland overseeded with ryegrass was modified by the increased increments of N fertilization.

According to the diversity profiles of Rényi the highest diversity and uniformity of species occurred in the control treatment where no N was added.

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#### ORCID

J.K. Fedrigo  <https://orcid.org/0000-0003-4472-453X>

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