Productivity of Winter and Spring Native Improved Vegetation under Different Grazing Stocking Rates on Basaltic Soil

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PRODUCTIVITY OF WINTER AND SPRING NATIVE IMPROVED VEGETATION UNDER DIFFERENT GRAZING STOCKING RATES ON BASALTIC SOIL

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Abstract

Improved grassland with *Lotus corniculatus*, *Trifolium repens* and annual phosphorus fertilization, was evaluated during winter and spring for five consecutive years under grazing at three different stocking rates on medium basaltic soil. Specific contribution of *Lotus* and *Trifolium* reached 67% of grassland community in the first year. *Stipa setigera* and *Poa lanigera* increased their contribution from 0.8 to 17% in the fourth year of grazing experiment. Highest average value of crude protein was 19% during the second year and was related to legumes contribution. Forage availability was always up to 1.5 ton MS/ha at the three stocking treatments. Average daily gain was 770, 720 and 675 g/steer/day for 1.4, 1.9 and 2.3 steers/ha during the evaluated period.

Keywords: *Stipa setigera*, *Poa lanigera*, *Lotus corniculatus*, *Trifolium repens*, grassland improvement, legume persistence, stocking rates

Introduction

Grassland community of mid basaltic soils in the north of Uruguay are characterized mainly by a mixture, of warm-season and cool-season grasses and sedges, that present low growth rates and low quality of forage production specially during winter (Castro, 1980; Berretta y Bemhaja, 1998). Sod seedling native pastures with *Lotus corniculatus, Trifolium repens,* and annual phosphorus fertilization, have proved to be very productive during winter and spring. Improvement with these legumes let increase forage production, its quality and distribution (Bemhaja, 1998). Once legumes have been established, changes in native vegetation appear because of the increase of nutrients in soil and management.

Winter and spring growth rate (fourteen year average) of native grassland, were determined by 7 and 15 kg DM/ha/day, representing 15 and 30% of total forage production (Berretta y Bemhaja, 1998). This primary production can maintain 0.82 AU/ha. Establishment of productive legumes promotes an increase of forage production and consequently on stocking (Risso et al., 1998) and system incomes. The improved winter native species are *Stipa setigera* and *Poa lanigera,* both respond to changes in nitrogen due to legumes fixation and mineral recycling in plant community. The goal of this study is to characterize winter and spring improved grassland, looking at forage dynamics and productivity, under three different stocking rates utilizing steers during five consecutive years.

Material and Methods

A 16 hectares (ha) of an improved grassland area, with *Lotus corniculatus* cv. San Gabriel, *Trifolium repens* cv. Zapican and phosphate fertilizer (60 kg of P2O5/ha), was divided into 6 paddocks in medium Basaltic soil. It was imposed three treatments of stocking: Low with 1.4 steers/ha (L), medium stocking with 1.9 (M) and high stocking with 2.3 (H) with two

repetitions. The area was grazed for two years old steers, that were replaced each autumn annually, from 1995 to 1999. Number of steers was 24 and they entered into the experiment with all the recommended sanitary pack.

Each paddock was subdivided into five rotation grazing system and steers moved weakly. Measures of forage allowance was done before each animals entrance by rectangle of 0.5*0.20 m and samples were send to nutrition laboratory to determine protein content for each treatment. Dynamic of native grasses (*Stipa setigera* and *Poa lanigera*) and seeded legumes (Lotus and white clover) was monitored monthly along a 10 m fixed transept by ten forage rectangles in all treatments. Biomass of each specie was separated and weighted. Animals were weighted each 21 days with 12 hours fasting. Statistic analysis was done by SAS program with GLM procedure.

Results and Discussion

Annual average rainfall registered, was 1166 mm for the evaluated period and this value varied between 916 mm (1997) and 1882 mm (1998). Winter and spring rainfall average registered were 42% of this total and was higher in winter (265 mm, sd=141.4) when compared with spring value (229 mm, sd=79.8).

Forage contribution by legumes was between 56 (H) and 67% (L) of total forage amount for the first year of grazing, declining in consecutive years. Legumes reached 4% in L treatment in 1997 due to animal selection and native species competition. Legumes maintain their presence in M and H treatment for the evaluated period. Stipa and Poa (WNG) increased their contribution in all treatments along the five years period and reached the maximum value (17%) in 1998 in L. Contribution of legumes and specially WNG to forage allowance was more important during spring (table 1) because of the increase of air temperatures and day length.

Forage availability was always maintained up to 1600 kg DM/ha in all treatments, but there were significant differences between stocking treatments, evaluated years and seasons. Three stocking treatments were significant different, and L presented 2275 kg DM/ha, the highest mean value for the period. Forage allowance during first and last year of grazing produced the maximum values for the period with no significant differences. Loose in legumes production at the end, were substituted by native grasses. Spring forage biomass (2021) was higher than winter (1872) and showed significant differences (table 2).

Forage quality, determined by crude protein (CP), was higher than 14 % for all variables and there were significant differences between stocking treatments, seasons and years. It is important to pointed that CP maximum value was 19.3, the year of less forage allowance after legumes decayed. This fact is probably explain by changes in native grasses that were expressed in WNG in the next grazing period (1997) (table 2). An important constrain of native grassland is its low quality where %CP presents values around 9% (Bemhaja et al., 1998). Improvement with adapted legumes demonstrated that it is possible to change and maintain this parameter for years, even with relative low persistence of legume species.

Steers daily gain (SDG) presented significant differences between season of grazing. Average weight gain obtained was 1.087 kg/steer/day during spring versus 0.358 during winter. Average daily gain presented differences between years, the maximum value was obtained the first year (0.913 kg/day), when forage availability and quality presented the maximum values. SDG did not present mean differences for stocking variables during the five years (table 2).

Adapted legumes with annual phosphorus fertilization can improve basaltic native community promoting important changes on biomass for a five consecutive year period. WNG increased their relative contribution (0.8 – 17.0%) during and after the third year of grazing period and consecutively improving forage allowance and quality specially during winter and

spring. Winter forage production duplicated (>1500 kg DM/ha) when compared with average of native grassland (700 kg DM/ha). Improvement of native community promotes productivity, due to forage production, quality and animal utilization and stocking.

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Table 1 - Effects of low (L), medium (M) and high (H) stocking rate (SR) and grazing season, on dynamics of legumes and winter native grasses, *Stipa setigera and Poa lanigera* (WNG) in five consecutive years (1995-99).

	Species Specific Contribution (%)									
	SR						Season			
	L		M		H		Winter		Spring	
	Leg	WNG	Leg	WNG	Leg	WNG	Leg	WNG	Leg	WNG
1995	67	0.8	69	0.8	56	0.8	40	0.6	68	1.0
1996	27	1.7	30	1.2	19	0.8	26	0.8	24	1.6
1997	4	9.1	44	8.5	10	8.3	16	7.5	22	9.7
1998	0	17.0	55	15.0	32	14.0	25	11.0	33	18.0
1999	0	13.0	36	12.0	32	10.0	34	14.0	34	10.0

Table 2 - Effects of low (L), medium (M) and high (H) stocking rate (SR), consecutive years and grazing season, on forage availability (FA), percent of crude protein (CP) and steers daily gain (SDG).

	SR			Years					Season	
	L	M	H	1995	96	97	98	99	Winter	Spring
FA (kg DM/ha)	2275 a	1913 b	1651 c	2260 a	1520 c	1752 b	1928 b	2271 a	1872 b	2021 a
CP (%)	14.4 b	17.2 a	16.7 a	15.7 bc	19.3 a	17.8 ab	14.8 cd	12.8 d	14.7 b	17.5 a
SDG (kg/d)	0.770	0.722	0.675	0.913 a	0.658 b	0.639 bc	0.899 a	0.503 c	0.358 b	1.087 a

*Means on the same row, for stocking, consecutive years and two seasons, followed by the same letter are not different (P>0.05).