ANIMAL PRODUCTIVITY AND DYNAMICS OF NATIVE PASTURES IMPROVED WITH OVERSOWN LEGUMES IN URUGUAY

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ABSTRACT

Natural pastures in large areas of Uruguay can be improved by fertilization with phosphorus (P) and surface sowing of adapted legumes, promoting an increased forage production and quality, with the consequent higher carrying capacity and better animal performance. A study was conducted to evaluate two improved grasslands with two stocking rates under rotational grazing. Such improvements resulted from the oversowing of: 1) white clover (*Trifolium repens*) plus birdsfoot trefoil (*Lotus corniculatus)*; and 2) annual lotus (*Lotus subbiflorus*). In these pastures, with important presence of legumes, a higher frequency of C_3 and winter species, high levels of animal production were registered during the first two years of evaluation, showing the potential of this technology.

KEYWORDS

Natural grassland, improved pastures, dynamics, legumes, animal production

INTRODUCTION

Cattle and sheep husbandry in the country is mainly based on natural pastures, dominated by C_4 grasses, some forbs and brushes, while native legumes are less than 1%. Among others, production and quality of forage and its utilization are important factors determining grazing animal performance (Hodgson, 1990). Such pastures present severe winter deficits, with medium to low forage annual production and quality, resulting in a moderate carrying capacity, 0.8 Animal Units (AU) ha^{-1} and an average meat production of approximately 70 kg ha^{-1} $year^{-1}$. However, they can be sustainably improved with relatively low costs, without soil cultivation, by legume interseeding and P fertilization (Risso and Morón, 1993). The purpose of this study is to quantify animal production of two improved pastures under two stocking rates, as well as to characterize the dynamics of their vegetations, considering that animal production at an economic stocking rate is the most relevant evaluation of pasture productivity (Hart and Hoveland, 1989).

MATERIALS AND METHODS

On a typical medium granitic soil type (Brunosol subeutrico, MGAP, 1976) an experiment was started in the fall of 1993, involving two improved pastures that resulted from the oversowing of: 1) a mixture of white clover (cv. Zapican) and birdsfoot trefoil (cv. San Gabriel); and 2) annual lotus (cv. El Rincón) both fertilized whit 45 kg P_2O_5 ha^{-1} $year^{-1}$. Seeding rates were: 4 + 12 and 5 kg ha^{-1}, for pastures 1 and 2 respectively. Before sowing, canopy was conditioned by severe grazings with cattle and sheep along the previous five months. Treatments, arranged in two replications (from now on called 1H; 1L; 2H and 2L), were imposed in late spring 1993 and consisted in two basic stocking rates with use of spare animals for seasonal adjustments, resulting in an average of 2,14 and 1.67 AU ha^{-1} for each of those pastures, along the evaluation periods. Every year, 32 steers (two years old and initial liveweight of 233 (21 kg) were randomly divided into four balanced groups and assigned to each sward treatment. Unfasted weight was recorded every 28 days. During the grazing period (about 320 days, for both periods 93-94 and 94-95) rotational grazing on five paddocks was used, with a grazing spell of 35 days (7 + 28). Even though average rainfall is about 1100 mm, frequent summer rainfall deficits associated with high temperatures and C4 species competition affect the persistence of introduced legumes, so a period of rest of about 40 days in late spring - early summer was practiced, to allow for flowering and seed setting of the introduced and other C3 species. In the establishment year, gravimetric estimations of soil cover by the introduced legumes were performed in each pasture. Vegetation evolution was estimated in three seasons during the experimental period, by the modified double-meter method (Daget and Poissonet, 1971) registering 12 m transects, with a total of 100 points per treatment. As a basis to evaluate changes in vegetation composition, estimates were also performed on a natural pasture in adjacent paddocks grazed at the average stocking rate of the region. Statistical treatment of data was performed using the SAS package (SAS, 1990).

RESULTS AND DISCUSSION

Establishment of introduced species was reasonably good along fall and winter, even though the small seeded annual lotus was slower. In both pastures, there was an important spring development, so resulting in a high proportion of soil covered by the legumes at the beginning of the grazing period. The mixture of white clover and birdsfoot trefoil (1), constituted 66% of soil coverage, while annual lotus (2) was 54%. Relative frequencies of most relevant species in the natural pasture are shown in Table 1. When comparing the frequencies of winter species against the summer growing for each of the three pastures, no significant differences were detected for winter estimates. The high frequency of winter species in the natural grassland is mainly associated to forbs (*Chevreulia sarmentosa*), graminoids (*Carex spp.*) and unproductive annual grasses (*Vulpia australis*). In the improved pastures, winter species are mainly the introduced legumes, acclimatized (*Lolium multiflorum*) and native productive grasses (*Stipa neesiana* and *Piptochaetium stipoides*). For the following two sampling dates, the difference in the frequency between winter and summer species was highly significative ($P<0.01$) in both stocking rates. This results agree with others, for basaltic soils (Berretta and Risso, 1995). Legume overseeding, P fertilization and grazing management, promoted the vegetation through a threshold to a new equilibrium, in which the induced succession tends to a greater productivity (Laycock, 1994). In late spring, the frequency of some summer prostrate grasses increases (*Axonopus affinis* and *Paspalum notatum*) as well as some forbs like *Richardia stellaris;* frequency of the summer tall grass, *Bothriochloa laguroides* increased while winter annuals decreased. The tall and dense canopy of the overseeded pastures prevents the development of prostrate grasses and forbs. *Stipa charruana*, a winter coarse grass, increased its frequency during late spring associated to unpalatability of its foliage (dead and tough leaves) resulting in avoidance by the steers. Animal performance was high in all cases; for the average of the two years, daily gains based on the regression coefficients, were: 0.614, 0.612, 0.476 and 0.509 kg, for treatments 1H, 1L, 2H and 2L respectively. Pastures improved with the legume mixture (1), resulted in a significantly ($P<0.1$) higher liveweight increase ha^{-1} $year^{-1}$ for the average of the first two years. In relation to the levels of productivity usually obtained in the range, annual lotus improvements were, anyway, highly productive. In spite of the trend in favor of the high stocking rate in each pasture, no significant differences were detected (Figure 1). Possibly, a further longer period of evaluation might be required . With the introduction of legumes, occurs a positive modification in the environment, involving changes in the relative frequency of the species, that allows for a manyfold increase in their potential productivity. The sustainability of such modification implies the maintenance of management factors.

REFERENCES

Berretta, E. J. and D. F. Risso. 1996. Native grassland improvement on basaltic and granirtic soils in Uruguay. Proc. 5th. Int. Rangeland

Cong., Salt Lake City, Utah, USA, pp 52-53.

Hart, R. H. and C. S. Hoveland. 1989. Objectives of grazing trials. Pages 1-6 *in* G.C. Marten, ed. Grazing research: Design, methodology and analysis. CSSA Special Publication 16, Madison, Wisconsin, USA.

Hodgson, J. 1990. Grazing management: Science into practice. Longman handbooks in agriculture, England, 203p.

Laycock, W.A. 1994. Implications of grazing vs. no grazing on today's rangelands. Pages 250-280 *in* M. Vavra, W.A. Laycock and R.D. Pieper, eds. Ecological implications of livestock herbivory in the West. Society Range Management, Denver, Co., USA.

Risso, D. F. and D.A. Morón. 1993. Rangeland improvement on granitic soils in Uruguay. Proc. 17th. Int. Grass. Cong., New Zealand and Australia, pp 1728-1730.

SAS. 1990. SAS User's Guide: Statistics, 5 and 6 ed. SAS Inc., Cary, North Carolina, USA.

Uruguay. Ministerio de Ganadería Agricultura y Pesca. 1976. Carta de reconocimiento de suelos del Uruguay a escala 1:1.000.000. Tomo I. Montevideo, Uruguay. 93p.

Table 1
Frequency of the most important species in three dates of evaluation of both improvements under two stocking rates and a reference range.

	Natural Pasture			White clover + Birdsfoot trefoil						Annual lotus					
				High stocking rate			Low stocking rate			High stocking rate			Low stocking rate		
Species	Winter'94	Fall'95	Spring'95	Winter'94	Fall'95	Spring'95	Winter'94	Fall'95	Spring'95	Winter'94	Fall'95	Spring'95	Winter'94	Fall'95	Spring'95
Trifolium repens L.	0.0	0.0	0.0	22.4	17.5	14.6	21.0	27.6	17.9	0.0	0.0	0.0	0.0	0.0	0.0
Lotus corniculatus L.	0.0	0.0	0.0	11.5	12.4	5.5	11.5	7.3	10.9	0.0	0.0	0.0	0.0	0.0	0.0
Lotus subbiflorus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.3	21.1	22.2	31.5	23.3	23.1
Lolium multiflorum Lam.	0.0	0.0	0.0	1.1	1.6	0.0	7.8	4.6	1.6	4.1	7.5	5.3	7.5	5.5	0.7
Vulpia australis (Nees) Blom.	9.4	6.5	0.0	16.9	8.0	0.0	7.7	10.8	0.0	12.8	15.4	0.0	11.8	15.9	0.0
Stipa neesiana Trin et Rupr.	0.0	0.0	0.0	3.3	1.7	5.5	2.2	6.2	8.0	1.3	2.9	5.2	0.7	3.7	0.7
Stipa charruana Arech.	1.6	1.3	2.9	1.1	1.6	5.5	4.4	1.2	7.2	1.7	4.6	7.5	0.7	2.5	4.3
Piptochaetium stipoides (Trin et Rupr) Hac. ex Arech.	3.1	11.7	2.9	1.1	16.7	15.2	1.1	12.8	12.7	2.5	6.9	4.4	4.2	3.7	5.7
Carex spp.	17.2	9.1	2.9	8.7	4.6	1.8	7.7	6.6	0.0	15.4	4.6	0.7	9.0	6.8	0.0
Chevreulia sarmentosa (Pers.) Blake	9.4	10.4	0.0	1.1	0.5	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Axonopus affinis Chase	4.7	3.9	5.8	0.0	2.4	0.6	0.0	0.0	1.6	0.0	8.0	4.4	3.5	3.7	1.4
Bothriochloa laguroides (DC.) Pilger	1.6	7.8	13.0	2.2	2.4	15.2	1.6	0.6	9.4	1.6	4.6	18.0	1.4	3.7	14.4
Paspalum notatum Fluge	4.7	13.0	10.1	1.1	1.2	3.6.	1.1	2.6	0.8	1.4	2.8	3.1	2.2	1.8	0.0
Richardia stellaris (Cham. et Schlecht) Steud.	0.0	5.2	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0

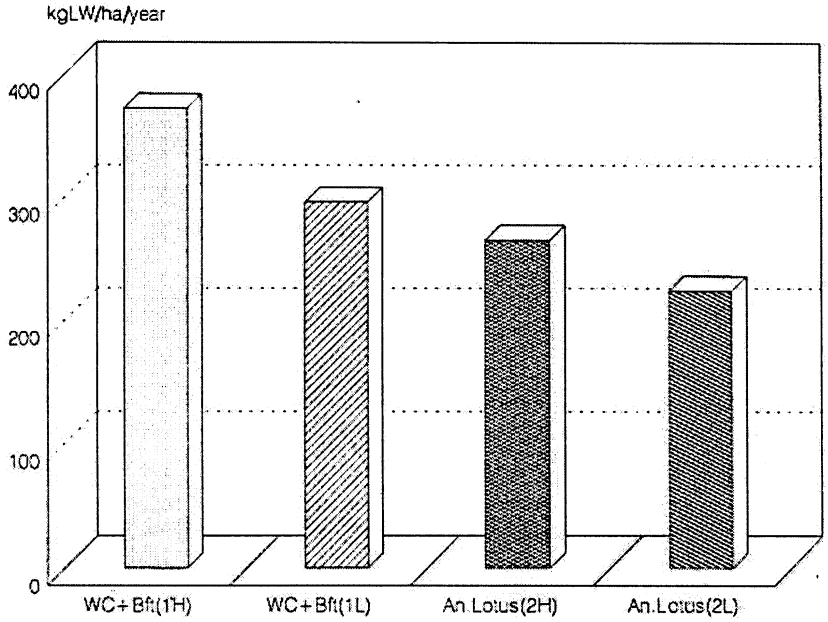

Figure 1
Animal production of two improved pastures under two stocking rates (average of 2 years).