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STRUCTURAL STABILITY OF SHORT LATENCY ALFALFA-BASED PASTURES IN THE HUMID PAMPA, ARGENTINA.

R.O. Refi and B. Martín

Facultad de Ciencias Agrarias, Universidad Nacional de Rosario, Argentina

Campo Experimental Villarino, CC 14, CP 2125, Zavalla.

Abstract

The aim of this study was to search the effects of grazing intensity and nitrogen fertilization on the structural stability of a mixed pasture composed by alfalfa (latency group 9), brome grass, tall fescue and white clover, sown in April 1997. Rotational grazing was carried out with dairy cattle with high intensity (HI: up to 3-4 cm) or moderate intensity (LI: up to 8-10 cm), whenever the alfalfa showed basal regrowth. According to a split-plot design, grazing intensities were subdivided to assign three levels of nitrogen fertilization: N0, without fertilization; N1 with 50 kg N/ha per year; and N2 with 100 kg N/ha per year, its supplied at the beginning of autumn and at the end of winter. The botanical composition (%), module density (number per m2) and basal cover (%) before grazing were measured from September 1997 through December 1999. After 20 grazing periods the use intensity affected significantly ($p<0.05$) all the variables, while N had minor effect. The average alfalfa content changed from 46.8% to 11.0% in HI, and 25.0% in LI in November 1999; fescue from 15.3% to 5.3% and 36% respectively; brome grass from 28.1% to 65% and 21.7% respectively; and perennial weeds from 4.3% to 8.3% and 6.3% respectively; the rest being dead material. The white clover practically disappeared during the

drought of the second summer. The pasture basal cover showed an evolution from 21% to 20.7% in HI and 95% in LI in December 1999; the weed Bermuda grass from 15% to 68.8% and 3.3%, respectively, and the bare soil from 63.9% to 8.2% and 0.5%, respectively. The total module density of alfalfa, tall fescue and brome grass was dramatically reduced from a global mean of 577 mod per m2 to 79 in HI and 152 in LI.

Keywords: grazing intensity, nitrogen fertilization, alfalfa, tall fescue, brome grass, structural stability.

Introduction

Pastures based in very short latency alfalfa (*Medicago sativa,* genetic groups 8 and 9) are the main link of the forage chain in the dairy companies of the Humid Pampa. These pastures frequently show a poor structural stability, with botanic changes toward grasses dominance in humid years or alfalfa dominance in regular and dry years. The loss of companion grasses is the main problem observed (Uztarroz and Brunetti, 1994; Romero *et al*, 1995). It has been hypothetized that the high frequency and intensity of defoliation which characterizes the very short latency alfalfa proper management would reduce the productivity and persistence of native brome grass (*Bromus catharticus),* orchard grass (*Dactylis glomerata)* and tall fescue (*Festuca arundinacea)* The loss of temperate grasses reduces the productivity and the life-span of the pastures below the optimum (three or four years), facilitates the occurrence of Bermuda grass *(Condon diction)* and other weeds, and increases bloat risk. At the same time, it might originate a poor organization of the upper horizon of the soil and lower companion sustainability.

A grazing experiment was carried out to search the effect of defoliation frequency and N fertilization on an alfalfa-grass mixture.

Material and Methods

The trial was carried out in Zavalla (33° Lat. S, 67° Long. W), Santa Fe province, on an Argiudol vertic soil. The annual rainfall of the experimental site is 980 mm, mainly occurring in autumn and spring. The mean air temperature range from 22.9°c (January) to 9.9°c (July). A mixture composed of 12 kg/ha of alfalfa seed cv 'Araucana' (latency group 9); 0.5 kg/ha of white clover cv. 'El Lucero'; 6.5 kg/ha of tall fescue cv. 'El Palenque'; and 6.5 kg/ha of brome grass cv. 'Bellegarde' was conventionally sown in April 1997. The pasture was defoliated by dairy cattle, every time the alfalfa showed a basal regrowth starting in September. From January 1998, grazing was accomplished to bring sward height to 3-4 cm (HI) to 8-9 cm (LI). At the same time, the pastures were fertilized with 50 kg (N1), or 100 kg (N2) N/ha per year. A control without fertilization (N0) was also considered. Urea was utilized as fertilizer employing half of the dose in autumn (April) and the other half at the end of winter (August). The treatments were arranged in a split plots design with three replications. The principal plots (grazing intensities) measured 300 m^2 and subplots (fertilization level) 100 m^2.

According to seasons the whole trial defoliation lasted from one to three days with a 65.000 kg live weight/ha. Prior to every grazing period the pasture botanical composition (proportion of each component in the total aerial biomass), the morphological characteristics (plant and module densities) and their basal cover, were measured. Destructive random sampling in the experimental units was performed utilizing a hand pair of scissors on 0.1 m^2 frames. The data obtained was analyzed by ANOVA test and mean comparison was by the Tukey test, with the MSTAT program.

From September 1997 through December 1999, 20 grazing periods were realized. In November 1997 the plots were fertilized for the first time, and in February 1998 differential grazing was performed.

Results and Discussion

The results are the output of twenty eight months of utilization, during which 125 kg (N1) or 250 kg (N2) of N/ha were applied to soil and 17 differential grazing were done.

Botanic composition. From November 1997 to August 1998, an exceptionally humid period due to the "Niño effect" decreased alfalfa percentage in the mixture except in HI-N0 (Figure 1). On the contrary, fescue, bromegrass and white clover contents were improved. After that, a moderate "Niña effect" (drought period) reverted the situation favoring the alfalfa, but at the same time a severe invasion of Bermuda grass occurred, which was remarkable under intensive grazing ($P<0.05$). Along with this change, the herbage mass at the beginning of each grazing, without weeds, dropped from 2000-4000 kg DM/ha (November 1998) to 300-1000 kg DM/ha (April 1999).

During the last phase of useful pasture life (2^{nd} half of 1999), forage components improved their participation in botanic composition in relation to Bermuda grass. Notwithstanding, grazing intensity modified the relative importance of the species ($P<0.05$). In LI, the perennial species alfalfa and tall fescue predominated over the annual brome grass and the Bermuda grass, while in HI the weed regained importance in N0 and N1, and brome grass was dominant (Figure 1). HI increased so the mixture instability.

Basal cover. The changes (Figure 2) were reflection of the botanic composition. En HI, the Bermuda grass morphology allowed that this species improved its relative importance against the others forage species ($P<0.05$).

Module density. During the initial development of pastures (September 1997), alfalfa showed 936 modules/m^2 (6 to 9 modules/plant), tall fescue 447 (4-6 tillers by plant) and brome grass 348 (7-8 tillers by plant). These densities were drastically reduced at last of the experimental period. Notwithstanding, the herbage mass at onset of each grazing, without weeds, was important, although variable ranging from 4000 kg DM/ha (October 1999) to 1000 kg DM/ha (December 1999).

The grazing intensity was more relevant than the nitrogen fertilization to modify the structural characteristics of these pastures. Harmful effects of height grazing intensity were found by García Spil *et al* (1998) on temperate grasses in mixtures with alfalfa. Arroquy and Arzadún (1998) observed higher yield of alfalfa with greater mowing intensity and indifferent behavior in orchard grass and redcanary grass. In their experiment, the grasses responded favorably to moderate nitrogen supply.

In this work, the meteorological changes observed during the experimental period could suppress the expected effect of small nitrogen additions. On the contrary, the defoliation effect seems to be powerful enough to act through the meteorological conditions (Figures 1 y 2). This point out the importance of the management developed regularly by dairy companies, characterized by intensive grazing or mechanical cutting to 3-5 cm post- grazing to produce an uniform quality alfalfa pasture. These results suggest that the traditional management of alfalfa should be reviewed regarding the association between genotypes of scanty latency and temperate

grasses. A lower grazing intensity might increase the sustainability of the resource reducing the Bermuda grass development and ameliorating the persistence of forage plants and their balance.

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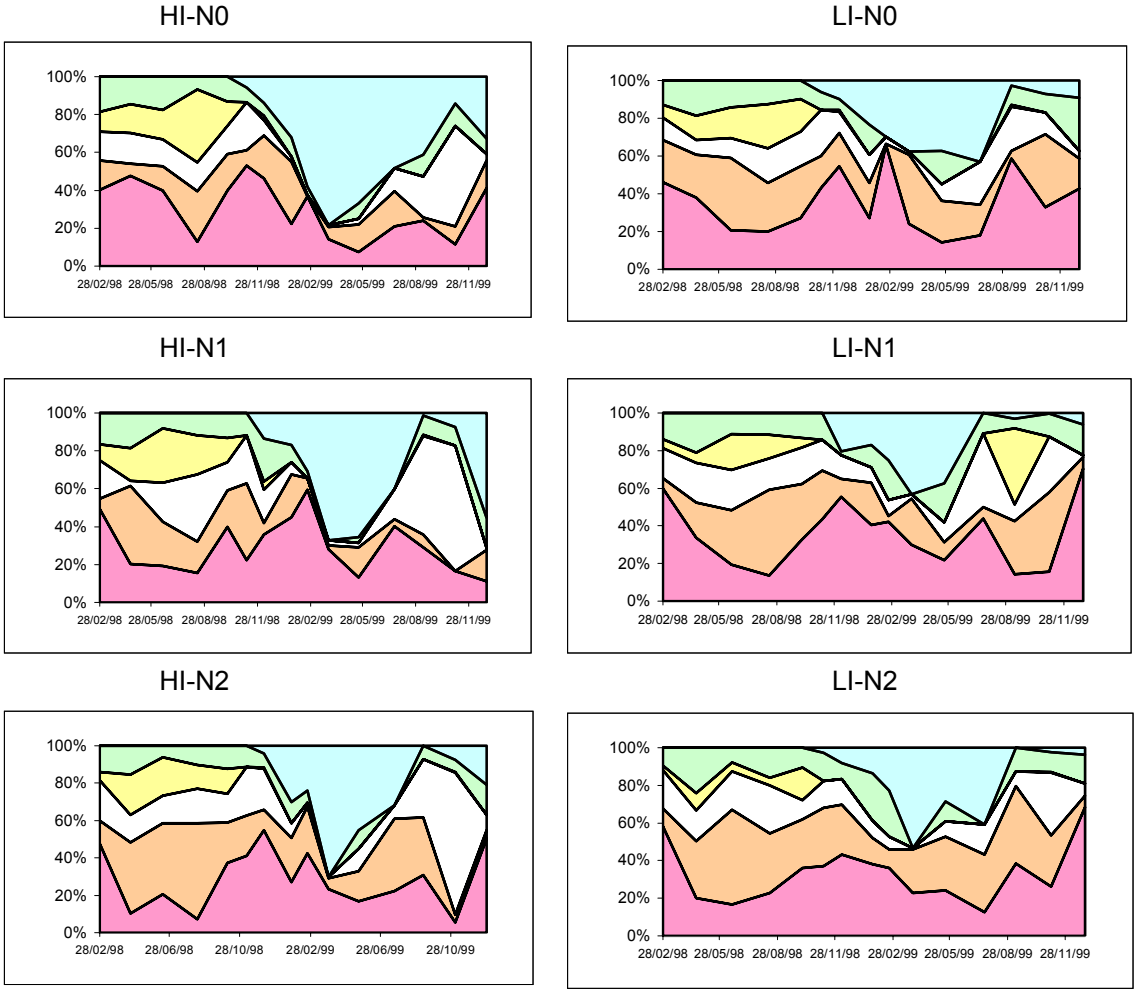

Figure 1- Sward botanic composition evolution during the trial (alfalfa), (tall fescue), (bromus), (white clover), (dead material), (weed).

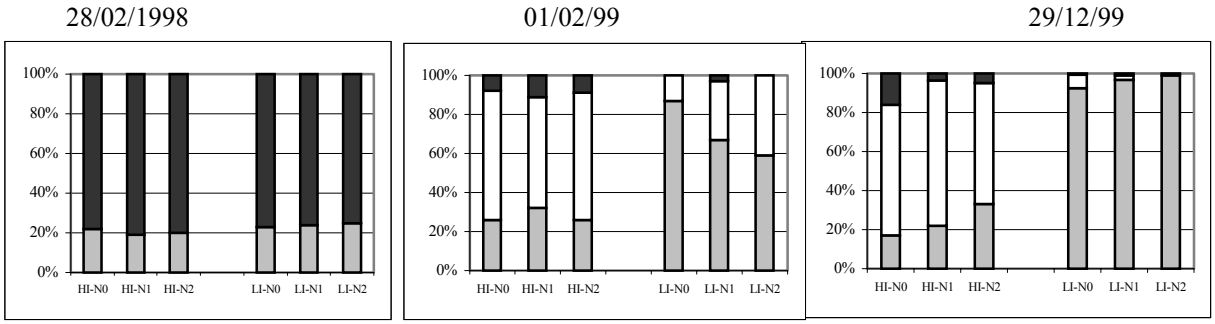

Figure 2 - Changes in basal cover during the life of past□re.
The basal cover are identified by: ■ (bare soil), ▭ (pasture), □ (weeds).