EFFECTS OF DEFOLIATION FREQUENCY ON THE PERSISTENCY OF OVERSOWN TEMPERATE LEGUMES INTO A NATURAL PASTURE

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ABSTRACT
The objective of this study was to study the establishment dynamics and persistence of a legume mixture oversown into natural grasslands under five different grazing management systems. Topographic position had the most significant effect on establishment and persistence. The lowlands were the best sites for legume establishment and persistence. Two years of previous management changed the ground cover components affecting the germination pattern of introduced seeds. The more frequent grazing treatments increased the total number of established legumes and their persistence throughout five years of grazing in the lowlands. Legume persistence on the slopes was generally shorter and was optimized under intermediate defoliation frequencies (rest periods of 40 and 60 days). The performance of each legume was optimized at a different grazing frequency. Site selection and grazing management were the main factors conditioning their establishment, contribution and persistence.

KEYWORDS
Grazing frequency, ground cover, natural grasslands, oversowing, persistence, temperate legumes

INTRODUCTION
Resident species of natural pastures in the Uruguayan Region, usually dominate the introduced temperate legumes under uncontrolled grazing management. The short persistence of these improvements makes them not profitable for farm development purposes (Millot., 1994). Since 1989, the Faculty Pasture Department initiated a Regional Project (supported by INIA, Uruguay) to study the effects of grazing management on forage production and the contribution of oversown legumes on seven representative locations of the extensive animal production area. The present paper summarizes the more relevant findings regarding the effects of grazing frequency on oversown legume population establishment and persistence in one location and two topographic sites.

MATERIALS AND METHODS
The experiment was conducted on a representative 25 ha paddock at EEMAC, Paysandú (1989) in the Uruguayan Central-Western Region. A large area (23 has) was used under continuous grazing (treatment 1, traditional management). The remaining area was subdivided into four 0.5 ha plots to perform the other four grazing frequency treatments: 2) Very Frequent defoliation, with 20 days of rest period; 3) Frequent, grazed every 40 days; 4) Moderate, grazed every 60 days and, 5) Low frequency, with a 80-day rest period. Animals were used as defoliators on a mixed grazing system (42 sheep + 15 cows). The animals that used to continually graze the large paddock, also grazed the other treatments during a short time (1-2 days). All treatments were closely grazed (< 3 cm post-grazing stubble height) before oversowing in June 1992. Thereafter animals grazed each treatment according to the previously-defined grazing interval treatments. The plots comprised two pasture sites (lowlands and slopes), on which a legume mixture was oversown. The legume mixture was: white clover (*Trifolium repens* L.); red clover (*Trifolium pratense* L.) and birdsfoot trefoil (*Lotus corniculatus* L.). *Lotus tenuis* Waldst & Kit. was sown only in the lowland and Lotus subbiflorus L.at the slopes. Basic phosphorous establishment fertilization (60 u P_20_5 /ha) and maintenance refertilization (30 u P205 /ha) was used to avoid nutrient deficiencies. The number of seedlings.m^{-2} in all treatments were measured on four permanent transects according to topographical position: 2 in the lowland soil (Gleysol) and 2 in the slopes (Lito-brunosol). The sampling units were five fixed areas (0.2m x 0.5m) located on each transect (20 per treatment). The counting was performed at 40, 80, 120 and 270 days after sowing during the first year in each grazing treatment; subsequent countings were made on a seasonal basis. The location of plants on different ground cover components (bare soil, plant litter, vegetation) was determined in each quadrat; and their relative frequency was determined 40 days after-sowing. During the first year percentual summer survival was determined as the ratio of the number of plants observed in autumn (270 days after sowing) on the basis of established plants detected in spring (120 days after sowing). A systematic split-plot design was used, to analyze sites (topographic position), grazing frequencies and time effects.

RESULTS AND DISCUSSION
Topographic position and grazing management had significant effects on legume establishment (P-0.05). At the first evaluation (40 days after sowing), seedling density in the lowlands was significantly higher than in the slope (1110 vs 391 seedlings m^{-2} respectively). The previous grazing treatments (2.5 years before sowing), affected sward conditions at sowing date and had particular effects on the stand of oversown plants observed in each site. Seedling density on each ground cover component followed a similar pattern on both sites. The density of legume seedlings emerging on litter was higher than the observed on bare soil or vegetation. This suggests a different germination pattern on each ground cover component, given an original random seed distribution. The maximum seedling density in both sites and treatments, was observed between 40 and 80 days after sowing; when the germination rate matched seedling disappearance rate. Low winter temperatures and competition increased seedling disappearance rate until spring (120 days after sowing). Thereafter, summer stress (high temperature and drought) caused the highest rate of legume disappearance during the first year, especially in the slope site (270 days after sowing). Summer survival in the lowlands was highest on the frequent defoliation treatment (40-day rest period), because of avoidance of light competition from the resident summer (C_4) erect grasses. Conversely in the slope sites survival was associated with the duration of the rest period, being the longest rest period (80-day treatment) the best for summer survival (Fig.1). These results suggest that plant density at 40 days after sowing may not be directly related to the population at 120 days or with post-summer survival. Each pasture (resident pasture and introduced legume species) reacts differently to defoliation frequency and environmental conditions. The lowland habitat was appropriate for legume oversowing under controlled grazing management. Persistence and productivity of introduced species would make this technology profitable for soils with low agricultural aptitude. The total number of established plants throughout the experimental period showed a downwards trend in all grazing managements (Fig.2). The frequent and very frequent grazing treatments in the lowlands gave satisfactory densities to ensure high productive persistence. The best grazing interval treatment on the slopes were the moderate and frequent until the fourth year. In the lowlands white clover and *Lotus tenuis* were adapted to frequent and very frequent grazing throughout the experimental period. *Lotus subbiflorus* failed to establish probably

because of high Ca content in the slope soil and competition from resident grasses. In both sites the performance of birdsfoot trefoil was good, but it was optimized under different defoliation frequencies: 40- and 60-day rest period in the lowlands, and 60- and 80-day rest period in the slopes. Red clover was a short-lived perennial species adapted to unfrequent grazing management on both sites (80-day rest period). Site selection, legume species and grazing management should be adjusted to achieve success in the establishment, production and persistence of oversown legumes.

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Figure 1
Effect of grazing frequency on the legume summer survival in both sites.

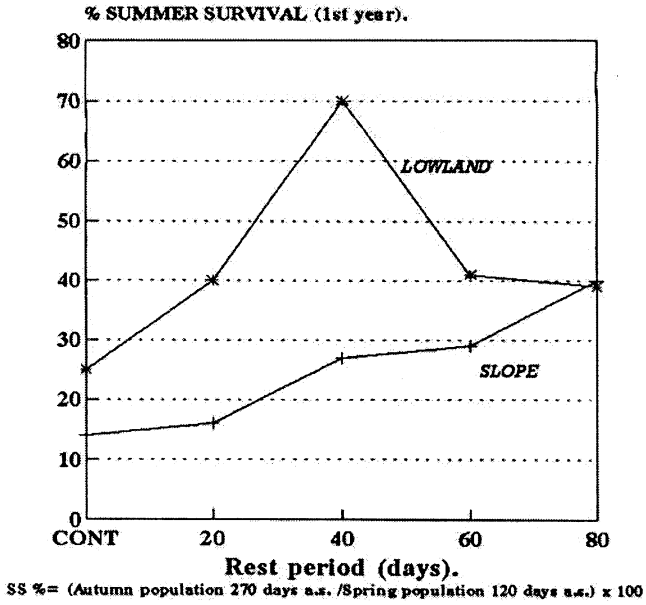

Figure 2
Grazing frequency on the evolution of oversown legumes in two sites: a) Slope, b) Lowland.