Soil constraints (pH and aluminium) for legume performance in hill country of Uruguay

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Keywords: lotus spp., white clover, pH, aluminium tolerance

Introduction Pastoral areas in eastern Uruguay have soils with pH 5.5 or lower (Mas, 1978), which is frequently associated with the acid soil syndrome (Cregan, 1980). As pH drops below 5.5, aluminium (Al) concentration can increase to toxic levels. These conditions may adversely affect growth of introduced legumes. A way to overcome these constraints is by the use of tolerant species. The objective of this study was to evaluate the adaptation and productivity of different legumes under environments with restrictions in pH and Al concentrations.

Materials and methods Four legumes (*Lotus subbiflorus* "El Rincón" (LR), *Lotus corniculatus* "INIA Draco" (LD), *Lotus pedunculatus* "Grasslands Maku" (LM) and *Trifolium repens* "Zapicán"(WC)) were oversown in March 2002 in a hill country acid soil (pH 5.3) of eastern Uruguay (32º 20´ S, 54º 10´ W). Chemical soil properties were P4.5 µg P/g, K0.29 and Al0.41 me/100 g soil, respectively. Plots were top dressed annually with natural phosphate rock at 26 kg P/ha. During two years, two cutting heights were applied at monthly intervals (4 or 10 cm height) in the periods October-February, November-February and December-February. A split plot design with three replicates was used. Measurements included herbage dry matter (DM) production and species contribution (native grasses, sown legume) during year 1 and 2 and soil seed reserves at the end of year 1.

Results The two-year average of total herbage DM production showed differences between legumes, with the total yield of the annual lotus (LR) being 23% higher than the average of the perennial legumes (Table 1). Perennial legumes did not differ between themselves. Differences were explained by the higher native grasses' contribution during summer for the LR pasture. There was a significant interaction between species and cutting height (Table 1), with the legume yield of LM defoliated at 4 cm being 23% higher than at 10 cm. The other legumes (LR, LD and WC) did not show differences in yield as a consequence of cutting height. The relative herbage production of oversown legumes was LM 100, LR 59, LD 35 and WC 18(%). For soil seed reserves, a significant interaction of species x closing period was detected (Table 2). The annual legume (LR) produced significantly more seeds than the perennial legumes (LD, LM and WC) in October and November. There were no significant differences between perennial legumes in soil seed reserves.

Table 1 Total dry matter and legume dry matter (kg/ha) of 4 oversown legumes (2- year averages)

	Total DM	Legume DM	
Species		4 cm	10 cm
LR	8072	2198	2567
LD	6474	1311	1436
LM	6869	4315	3520
WC	6333	609	758
Significant factors			
Species (S)	*	**	
Cutting height (I)	ns	ns	
Closing dates (R)	**	ns	
SxI	ns	*	
SEM (n)	325 (36)	225 (18)	

ns= not significant; *= p<0.05; **=p<0.01; SEM= standard error of the mean; n=observations for each mean

Table 2 Soil seed reserves (seeds/m^2) in March 2003 of 4 legumes for different rest dates in spring

Closing dates	LR	LD	LM	WC
October	50300	4050	3583	3883
November	12683	4216	2250	1383
December	7233	3367	833	2450
Significance (species x dates)			**	
Standard error (n)			2823(12)	

**=p<0.01; SEM=standard error of the mean; n=observations for each mean

Conclusions A high degree of adaptation and tolerance to soil constraints (pH and Al) in the hill country was observed in Grasslands Maku, in comparison with other lotus species and white clover. The annual lotus (El Rincón) invested more resources in reproductive processes than perennial legumes.

References

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