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EFFECTS OF MANAGEMENT STRATEGIES ON SEED PRODUCTION AND SEEDLING RECRUITMENT IN BIRDSFOOT TREFOIL-WHITE CLOVER MIXTURES

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ABSTRACT

The effects of grazing management on seed production, seed bank size and seedling emergence patterns of *Trifolium repens* cv. Zapicán (WC) and *Lotus corniculatus* cv. San Gabriel (BFT) oversown swards were evaluated. A complete randomized block design with 4 replicate blocks was used, in which 4 grazing strategies (grazing all year (SI), summer spelling for seed production (S2), winter rest plus summer spelling (S3) and autumn rest plus summer spelling (S4)), were combined with two defoliation severalties (4 and 10 cm height post-grazing residuals). Plots of 110 m^2 were grazed monthly by sheep. Seed production, soil seed bank and seedling emergence were monitored from April 1998 to August 1999. In both species, summer spelling for seed production improved seed yield, especially in BFT. Severe defoliation (4 cm) reduced seed inputs drastically (46% in BFT and 64% in WC). 1000 seed weight was only affected by defoliation severity in WC (0.544

and 0.562 g for 4 and 10 em height respectively). Potential seedling emergence, between June and December from soil seed bank, was 44 and 35% in BFT and WC, respectively. Seedling emergence of *Lotus corniculatus* increased under high seed production levels (S3), and also it was improved under intensive grazing during autumn and winter. There were no effects on *Trifolium repens* seedling emergence. Soil seed bank can preserve seedling recruitment rates in the short term, but maintenance of species balance will depend on seeding spelling management.

Keywords: Birdsfoot trefoil, white clover, management, seed production, seed bank, seedling recruitment

Introduction

White clover-birdsfoot trefoil oversown mixtures are commonly used in semi-extensive pastoral systems of Uruguay. Long term pasture persistence is based mainly on the maintenance of population by replacement rather than the survival of original plants. Grating management determines seed production levels and consequent recruitment (Bologna, 1996). The objective of the experiment described in this paper was to define the effects of grazing management on seed production and seedling recruitment and the consequences to species balance in the sward.

Materials and Methods

A field experiment was conducted at INIA Treinta y Tres, Uruguay (33° 54' S) on a two years old oversown pasture of *Trifolium repens* cv. Zapicán (WC) and *Lotus*

corniculatus cv. San Gabriel (BFT). In April 1998, four defoliation strategies and two defoliation intensities were combined in a complete randomized block design with four replicates in plots of 110 m^2. Defoliation strategies included grazing all year (S1), summer spelling for seed production (S2), winter rest plus summer spelling (S3) and autumn rest plus summer spelling (S4). During grazing cycles, plots were graced monthly by sheep for short periods to achieve post-grazing sward heights of 4 cm or 10 cm.

Seed production was monitored from December 1998 to February 1999 in two fixed quadrats per plot of 0.1 m^2 each. Weekly, BFT mature pods and WC mature heads were collected, dried and hand threshed. Measurements included seed yield, seed number and 1000 seed weight. In April 1998 and March 1999, six soil cores per plot (22.9 cm^2 x 5 cm depth) were taken randomly, and legume seeds recovered by a process that included hand crumbled, sieving, air flow and addition of ethylene-chloride (C_2Cl_4) (Prestes, 1995). Seeds were then hand sorted, weighed, counted and germination tests performed (ISTA, 1985). Potential seedling recruitment was checked weekly from June to December 1998 from four soil cores collected per plot (22.9 cm^2 x 5 cm depth) and placed in a complete randomized design in an adjacent area maintained free of ground cover. Germinated seedlings were removed weekly. From March to August 1999, seedling emergence was examined weekly in one fixed quadrat (0.1 m^2 each) per plot.

PROC GLM of Statistical System program (SAS, 1990) was used for statistical analysis.

Results and Discussion

Results are considered here in terms of numbers of seeds produced and seedlings emerged per unit of ground area (n^o. m^{-2}) (see Table 1). In April 1998, initial soil seed reserves were 4340 and 2570 seeds m^{-2} for BFT and WC respectively. Thousand seed weight was 1.17 g for BFT and 0.58 g for WC, with 64% of hard seeds in BFT and 78% in WC.

BFT seed production was significantly affected ($P<0.01$) by grazing strategies, that for the unspelled treatment (S1) being only· 5% of summer spell treatment (S2). Winter rest improved BFT seed production, possibly associated with a better condition of the BFT stand. Management effects on WC were not significant, though again seed production was lower in Sl then in the other treatments. Intense defoliation (4 cm) reduced seed production drastically by 46 and 64% in BFT and WC respectively. Thousand seed weight was not affected by treatment in either BFT (1.21 g) or WC (0.55 g).

BFT soil seed reserves in March 1999 were significantly affected by both grazing strategies ($P<0.05$) and grazing severity ($P<0.01$) (Table 1), being 10% less than in April 1998 in S1 and 59, 78 and 66% greater in treatments S2, S3 and S4. Treatment contrasts for WC were similar. though in all treatments reserves were substantially higher in 1999 than 1998. Seed reserves were greater following lax (10 cm) than severe (4 cm) defoliation in both BFT and WC. In BFT, 1000 seed weight was not affected by either grazing strategy or severity, and in WC was affected only by grazing severity.

The two species followed similar seedling emergence patterns in controlled conditions without any sward competition between June and December 1998, achieving 44 and 35% of potential emergence from 1998 seed banks. From March to August 1999, seedling emergence under sward competition was substantially lower, varying from 6-13%

in BFT and 4-7% in WC of 1999 seed reserves. BFT seedling emergence showed significant effects of defoliation strategy (Table 1), with particularly high emergence in S3, mainly associated with a high seed input during spelling. A reduction of sward competition by intense defoliation (4 cm) promoted an increase of 71% in BFT seedling emergence compared with more lax defoliation (10 cm). In contrast, WC did not show any treatment effect on seedling emergence.

The results described showed the importance of the seed bank as a buffer maintaining seedling recruitment rate. Since seed production is much more sensitive to grazing management in BFT than in WC, the use of a grazing spell during seeding is critical to long term maintenance of species balance in BFT/WC swards.

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Table 1 - Viable seed production, soil seed reserves, 1000 seed weight and seedling emergence parameters in mixed birdsfoot trefoil (BFT) and white clover (WC) swards

	Viable seed production December 1998-Mach 1999 (no. m^{-2})		Soil seed reserves Mach 1999 (no. $m^{-2)}$		Seed weight of seed bank Mach 1999 (g per 1000 seeds)		Seedling emergence Mach 1999-August 1999 (no. m^{-2})	
	BFT	WC	BFT	WC	BFT	WC	BFT	WC
Defoliation strategies								
S1	410	4850	3890	7670	1.22	0.55	320	320
S2	9000	7580	6890	8780	123	0.56	420	420
S3	11110	7130	7720	8980	1.23	0.55	830	650
S4	7020	1.1360	7220	14070	1.26	0.56	460	640
SEM	1594	1432	968	1682	0.029	0.007	126	120
Significance	**	NS	*	*	NS	NS	*	NS
Defoliation intensities								
4 cm	4850	4100	5050	6170	1.26	0.54	640	450
10 cm	8920	I1370	7820	13580	I.22	0.56	370	570
SFM	1127	1013	684	1190	0.021	0.005	89	85
Significance	*	**	**	**	NS	*	*	NS

*,** indicate significant et the 5 and 1% level of probability respectively