MINERAL CONTENTS OF WHITE CLOVER GRASS AND NITROGEN-FERTILIZED GRASS PASTURES FOR LAMBS

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ABSTRACT

The mineral contents (Ca, P, Mg, K, Na, Fe, Cu, Zn, and Mn) of white clover grass without nitrogen and grass-only pastures with annual nitrogen rates of 0, 120 and 250 kg ha^{-1} were studied in 1994 and 1995. The pastures were grazed twice per season by growing lambs. The white clover contents averaged 25% and 42%, respectively. The Ca and Mg contents and the Ca/P ratio were higher, and the K/(Ca+Mg) equivalent ratio lower in white clover grass than in grass-only swards. The P content of white clover grass was similar to that of grass, and the K content increased with increasing N fertilization. The Cu content did not differ between pastures, and it was higher than recommended (5.1 mg kg^{-1} DM) in all pastures. Nevertheless, no health problems (copper toxicosis, grass tetany) were observed in grazing lambs.

KEYWORDS

Grass, grazing, legume, mineral content, lamb, nitrogen, trace elements, *Trifolium repens*

INTRODUCTION

White clover is widely known to improve animal performance due to its good digestibility and high protein content (Thomson, 1984; Bax and Schils, 1993). However, information on mineral content of white clover grass is very sparse. Grazing can change the morphology of the sward radically, which has a direct bearing on the mineral content of the sward with return of urine and manure. The first results of white clover lamb pasture production under extreme Finnish conditions were encouraging (Sormunen-Cristian et al., 1996), and they were complemented with a study on the mineral content. Macro and trace elements of white clover grass without nitrogen and grass-only pastures with three nitrogen rates were compared under lamb grazing over a two-year period.

MATERIALS AND METHODS

Four pasture treatments, i.e. grass (G) (*Phleum pratense* L. cv Iki + *Lolium perenne* L. cv Riikka + *Festuca pratensis* Huds. cv Kalevi) with annual nitrogen (N) rates of 0 (G0), 120 (G120) and 250 kg ha^{-1} (G250) and a white clover (*Trifolium repens* L. mixture of cvs Sonja and Jögeva 4) grass without nitrogen fertilization (CG0) containing 25% clover in the seed mixture, were established on 1 July 1993 with four replications in a randomized complete block design on organic soil. The soil characteristics in the autumn of 1994 were as follows: pH 5.7, Ca 3991, Mg 471, P 13.3 and K 186 mg l^{-1} soil. The plots were fertilized with 36 kg ha^{-1} P and 42 kg ha^{-1} K in May. The pastures were grazed at a stocking rate of 62.5 lambs ha^{-1} twice per season: 24 May - 20 June and 12 July - 8 August in 1994 and 30 May - 3 July and 18 July - 7 August in 1995. The mean temperatures of the growing season (May - September) were 12.8°C and 13.2°C, and precipitations 260 mm and 371 mm in 1994 and 1995, respectively. The 1961-1990 averages were 12.6°C and 310 mm. The botanical and chemical compositions were determined every two weeks during the grazing periods. Calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na), iron (Fe), copper (Cu), zinc (Zn) and manganese (Mn) contents were analysed by gas chromatography. The data was analysed statistically by the GLM Procedure of the SAS Institute.

RESULTS AND DISCUSSION

CG0 swards contained white clover 14% and 36% in May and 36% and 52% in July in 1994 and 1995, respectively. In May 1995, perennial ryegrass accounted for 33% of CG0, with increasing amount of secondary species (*Alopecurus pratensis* L.). Timothy dominated the G120 and G250 swards, and perennial ryegrass the G0 swards, whereas only few meadow fescues were found in the swards in 1995.

The Ca contents of CG0 averaged 6.8 and 8.6 g kg^{-1} dry matter (DM) in 1994 and 1995, respectively, whereas that of all G averaged 4.6 g kg^{-1} DM (Table). The Mg content of all plots in 1994 and G in 1995 averaged 1.7 g kg^{-1} DM, but that of CG0 in 1995 2.2 g kg^{-1} DM. The P content of all plots averaged 4.1 g kg^{-1} DM. The desirable Ca/P ratio of 1.8 for growing lambs (ARC, 1980) was not reached in G plots, but the Ca/P ratio of CG0 pastures (1.9) was ideal for them.

The K content of CG0 (35.1 g kg^{-1} DM) was not lower than that of G0 (32.4 g kg^{-1} DM), but it increased with increasing soil status (fertilization, fixation, grazing): 36.5 and 38.4 g kg^{-1} DM K in G120 and G250, respectively, and 30.0 g kg^{-1} DM at the beginning of the first grazing period in all plots *vs* mean of the following season 38.0 g kg^{-1} DM. The K/(Ca+Mg) equivalent ratio averaged 1.8 in CG0 plots and 2.8 in G. Kemp and Hart (1957) showed grass tetany to occur in dairy cows more frequently when the equivalent ratio was higher than 2.2. In lambs there were no problems either of grass tetany or copper toxicosis, although the Cu content of all pastures (11.3 mg kg^{-1} DM) exceeded the recommended 5.1 mg kg^{-1} DM (ARC, 1980). Contrary to the results of Davies (1984), white clover did not contain more Cu than G pastures. The other trace element contents did not differ between the pastures.

The Ca, Mg and Na contents were higher in pure white clover than in CG0 or G pastures, and they increased with increasing white clover proportion. In 1995, Ca, P, Mg, K, Na, Fe, Cu, Zn and Mn averaged in pure white clover 14.5 g, 4.6 g, 2.9 g,
39.2 g, 552.4 mg, 133.3 mg, 12.0 mg, 28.0 mg and 53.2 mg kg^{-1} DM, respectively.

The mineral composition of the pasture was more balanced for growing lambs, and their health was good when white clover was added to grass pasture with no N fertilization.

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Table 1
Mineral contents of white clover grass and grass at the beginning of the first (May) and second (July) grazing periods in 1994 and 1995

	Grazing period I				Grazing period II			
	CG0	G0	G120	G250	CG0	G0	G120	G250
1994								
g kg DM^{-1}								
Ca	5.4a	4.1b	4.3b	4.9a,b	9.1	5.2	4.8	5.2
P	3.7b	3.7b	4.2a	4.3a	4.2	4.2	4.0	3.7
Mg	1.5a,b	1.3b	1.7a	1.7a	2.3	1.6	2.0	2.1
K	26.4b	27.5b	32.5a	33.4a	41.2	37.7	39.3	40.1
mg kg DM^{-1}								
Na	315.5a	238.4a	237.7a	256.0a	422.0	327.8	360.3	433.0
Fe	200.3a	223.9a	191.0a	203.5a	275.4	267.7	168.7	201.0
Cu	7.6a,b	7.2b	9.6a	8.9a,b	10.4	8.7	9.2	9.2
Zn	26.4b	29.2a,b	32.0a,b	34.2a	32.9	32.8	36.8	37.9
Mn	51.0a	53.2a	51.4a	55.0a	106.9	132.5	106.6	91.7
1995								
g kg DM^{-1}								
Ca	8.0a	4.3b	3.8b	4.4b	10.0	6.3	3.8	5.6
P	5.0a	4.6b	5.1a	5.4a	4.2	3.9	4.2	4.0
Mg	2.2a	1.6c	1.8b	1.9b	2.3	1.8	2.0	2.1
K	42.3c	40.9c	45.6b	48.2a	38.0	29.8	37.2	39.9
mg kg DM^{-1}								
Na	286.7a	356.5a	274.5a	256.5a	344.9	306.9	328.6	250.8
Fe	146.3a	177.5a	141.5a	149.2a	127.3	114.6	120.9	111.2
Cu	12.3a	11.9a	12.8a	12.7a	11.5	9.7	11.1	11.3
Zn	36.9a,b	38.6b	40.2a,b	42.7a	31.6	28.9	34.2	37.3
Mn	54.6a	53.9a	550.1a	49.7a	97.2	120.0	114.1	99.0

Only the first grazing period was tested. Numbers with different letters differ significantly ($P<0.05$).