

Herbs in grasslands - effect of slurry and grazing/cutting on species composition and nutritive value

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Abstract

Herbs are established in many organic grasslands due to their expected beneficial properties for nutritive value and biodiversity. However, knowledge about grassland herbs is limited. Three mixtures were therefore established at different grazing/cutting management and slurry applications. The competitiveness of the species varied greatly. Plantain (*Plantago lanceolata*) and lucerne (*Medicago sativa*) competed best under cutting; in contrast, chicory (*Cichorium intybus*) competed best under grazing. Caraway (*Carum carvi*), burnet (*Poterium sanguisorba*) and lotus (*Lotus corniculatus*) had a relative low competitiveness. Slurry application did not affect the proportion of non-leguminous herbs. The nutritive value differed: caraway had the highest and plantain the lowest values, as judged by *in-vitro* organic matter digestibility (IVOMD) and content of NDF, ADF and ADL. Under cutting, the annual dry matter yields of the three mixtures were similar.

Keywords: herbs, competitiveness, nutritive value, grazing, cutting, slurry

Introduction

On Danish organic dairy farms, herbs are often sown together with grass/clover – broadcast or strip sown. There is a considerable anecdotal support for the beneficial properties of herbs, but the amount of herbs in the sward is often limited (Smidt and Brimer, 2005). The expectations are that herbs contribute to greater biodiversity, better drought tolerance, higher N utilization in the cow, higher mineral content, reduced parasitism, and a positive effect on milk quality. However, available knowledge about herbs is very limited concerning their establishment, growth, nutritive value and different side effects. An experiment was therefore established to examine the effect of management on the competitiveness and the nutritive value of different species.

Materials and methods

The study was carried out in an organic dairy cattle crop-rotation system running since 1987 at Research Centre Foulum. Three seed mixtures were established in 2006, and were composed of: 1) perennial ryegrass (*Lolium perenne*), white clover (*Trifolium repens*) and red clover (*Trifolium pratense*); 2) mix 1 together with the herbs chicory (*Cichorium intybus*), plantain (*Plantago lanceolata*), caraway (*Carum carvi*), lotus/birds foot trefoil (*Lotus corniculatus*), salad burnet (*Poterium sanguisorba*), sainfoin (*Onobrychis viciifolia*) and chervil (*Anthriscus cerefolium*); and 3) mix 2 together with festulolium (*XFestulolium*) and lucerne (*Medicago sativa*). The seeds were sown at 0-1 cm depth and the total rate was 26 kg ha⁻¹. The seed rate of the single species is shown in Table 1. In 2007 the sward was either grazed continuously by heifers or cut four times. In addition, there were two application levels of cattle slurry: 0 and 200 kg total N ha⁻¹ (half in spring and half after the first cut). There were two replicates. During the second regrowth, parts of the grazing plots were fenced off and harvested at the same time as the cutting plots. Degree of coverage was estimated in 0.5 m² randomly positioned plots in early growth in April. The botanical composition at

harvest was determined by hand separation of sub samples. Herbage quality at cut 1 and 3 was determined for the single species; IVOMD (Tilley and Terry) and fibres (NDF, ADF and ADL; van Soest). Results from the first year, 2007, are reported in this paper.

Results and discussion

Mix 1 represents a common mixture for pasture, with a small amount of red clover added (Table 1). In mix 2 herbs replace a part of mix 1 (5 out of 26 kg). Mix 3 has the highest species number and it is supplemented with lucerne and festulolium as longer lasting species (Table 1). The establishment of chervil and sainfoin did not succeed at all. The other herbs constituted 3 to 20% of the area in spring (Table 1). White clover was not established satisfactorily and constituted only 20% of the area in mix 1, which probably is a main reason for the fact that nearly half of the area was covered by herbs in mix 2 and 3. In the multi-species mixtures 2 and 3, the grass only constituted approximately 20% of the area.

Table 1. Seed rate of the different species, degree of coverage in April and botanical composition in mixture 3 in unfertilized cut plots during the season.

Mixture	Seed rate			Degree of coverage			Cut 1	Cut 2	Cut 3	Cut 4
	1	2	3	1	2	3	3	3	3	3
	% of total weight			% of area			% of herbage DM			
Festulolium			31			5.4				
Per. Ryegrass	82	66	28	61.0	21.8	16.8	23.3*	13.6*	4.0*	7.9*
White clover	14	12	5	19.9	10.1	8.4	2.6	7.9	14.3	16.0
Red clover	4	3	1	15.0	11.5	5.1	6.5	13.1	21.8	10.6
Chicory		3	3		16.1	15.0	10.9	9.0	5.8	3.7
Plantain		3	3		19.7	18.5	40.9	32.5	21.7	22.7
Caraway		3	3		5.3	6.7	2.1	0.5	2.1	1.5
Burnet		3	3		3.0	4.0	0.7	1.0	0.4	0.3
Lotus		2	2		3.3	3.1	0.8	2.9	4.9	2.9
Chervil		2	2		0	0	0	0	0	0
Sainfoin		3	3		0	0	0	0	0	0
Lucerne			15			8.9	10.7	19.1	25.1	33.7
Unsown sp.				2.4	1.8	1.8	1.5	0.5	0.5	0.1
Bare soil				1.7	7.4	6.7				

*) include both festulolium and perennial ryegrass

The mean proportion of herbs was about 40% of the dry matter (DM) and was thus considerably higher than in multi-species pastures reported by Goh and Bruce (2005). Slurry application decreased the proportion of the legume species (white clover, red clover, lotus and lucerne), increased the grass proportion, but hardly affected the non-leguminous herbs (data not shown). During the season the proportion of legumes increased from 21 to 66% of DM ($P=0.002$) in unfertilized cut plots (Table 1). In the fertilized plots the legume proportion also increased considerably, from 14 to 54% ($P=0.03$). This was mainly at the expense of grass and plantain (Table 1). Grazing/cutting affected the botanical composition considerably (Table 2). In the grazed plots compared with the cut plots, the proportions of grass and white clover were higher and the proportions of red clover and lucerne were lower. This effect is normally found in traditional pastures, and was thus the same for multi-species mixtures. In contrast to chicory, the plantain proportion was reduced by grazing (Table 2). Thus, these two dominating herbs seem adapted to different growing conditions. Inclusion of lucerne and festulolium in the sward (mix 3 compared with mix 2) mainly depressed the content of red clover, whereas the herbs were nearly unaffected (Table 2). Even though the species

composition was very different between the mixtures, the annual yield under cutting was not affected by the mixtures (Table 3). Slurry application increased the yield from 12.2 to 14.1 t DM ha⁻¹ ($P<0.001$).

Table 2. Botanical composition in the second regrowth in cut and grazed plots, and herbage quality expressed as mean of first and third cuts across slurry and defoliation systems.

	Grazing			Cutting			Herbage quality*			
	Mix 1	Mix 2	Mix 3	Mix 1	Mix 2	Mix 3	IVOMD	NDF	ADF	ADL
Grass	23.1	15.4	19.1	19.8	6.2	8.8	77.8 ^b	47.9 ^a	28.7 ^b	2.4 ^c
White clover	34.6	18.6	14.2	27.6	13.6	11.8	77.7 ^b	26.6 ^e	23.3 ^d	4.0 ^b
Red clover	41.4	31.9	25.7	52.2	49.0	21.0	74.7 ^{bc}	30.6 ^d	23.2 ^d	3.2 ^{cd}
Chicory		18.1	15.8		6.4	7.5	73.2 ^c	32.6 ^d	27.6 ^{bc}	3.6 ^{bc}
Plantain		12.0	13.8		20.5	21.2	63.0 ^e	42.6 ^b	33.6 ^a	6.1 ^a
Caraway		2.0	1.1		1.7	1.7	82.4 ^a	25.8 ^e	23.5 ^d	2.8 ^{de}
Burnet		0.3	0.3		0.3	0.4				
Lotus		1.5	2.5		2.4	3.3	68.1 ^d	30.8 ^d	26.2 ^c	5.8 ^a
Lucerne			7.5			23.9	67.8 ^d	36.0 ^c	28.7 ^b	5.6 ^a
Unsown spp.	0.9	0.2	0.2	0.8	0.1	0.5				

* different letters indicate significant differences ($P<0.05$) between species

There was a great difference in nutritive value between the species (Table 2). Plantain differed from the others by having the lowest value: very low IVOMD and very high content of NDF, ADF and ADL. The opposite was shown for caraway, which differed by having the highest nutritive value. Chicory had roughly the same nutritive value as red clover according to the measured parameters. Lotus and lucerne were characterized by having the same low IVOMD and high ADL, whereas lotus had a lower NDF and ADF than lucerne. Sanderson *et al.* (2003) reported nearly the same nutritive value of plantain and chicory in monoculture, and this was not confirmed by the results shown here. In this multi-species experiment, however, the herbage quality is probably affected by the growing conditions for the individual species.

Table 3. Annual yield under cutting (t DM ha⁻¹).

Mixture	1	2	3	1	2	3
Slurry app	0 N	0 N	0 N	200 N	200 N	200 N
t DM ha ⁻¹	12.7	11.9	12.1	13.8	14.3	14.2

Conclusions

The competitiveness of the individual species in multi-species grassland was affected by species composition and management. The nutritive value differed very much. Plantain had the lowest and caraway the highest nutritive value.

References

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