

# **Effect of seed mixture composition and management on competitiveness of herbs in temporary grasslands**

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## **Abstract**

In multispecies grasslands the proportion of different herb species may vary considerably due to low competitiveness of some herbs. To examine the possibility for increasing the competitiveness, an experiment with three factors was set up: 1) amount of herb seed (5, 50 or 100%) in a mixture of perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*), 2) cutting frequency, and 3) slurry application. The experiment was carried out over three years. The herb mixture contained salad burnet (*Sanguisorba minor*), fenugreek (*Trigonella foenum-graecum*), chicory (*Cichorium intybus*), caraway (*Carum carvi*), birdsfoot trefoil (*Lotus corniculatus*), chervil (*Anthriscus cerefolium*), plantain (*Plantago lanceolata*), lucerne (*Medicago sativa*), and melilot (*Melilotus officinalis*). All herb species, except lucerne and caraway, were most competitive in the first harvest year. The proportion of all herbs, except lucerne, was higher at a 6-cut than at a 4-cut strategy, and application of cattle slurry also affected the competitiveness of the herbs. In general, lucerne, chicory, caraway and plantain were the strongest competitors; salad burnet and birdsfoot trefoil were intermediate; and melilot, fenugreek, and chervil were very weak competitors.

Keywords: herbs, competitiveness, temporary grassland, cutting, slurry

## **Introduction**

The utilisation of herbs in temporary grassland seed mixtures is related to their expected beneficial side-effects such as increased concentrations of essential macro- and microminerals in the herbage (Pirhofer-Walzl *et al.*, 2011). However, successful establishment and growth of forage herbs are important for farmers to implement their use; and central to this is the competitive ability of the herb species. As the traditional sown grassland species, perennial ryegrass and white clover, are highly competitive, herbs need to find their own niche in the struggle for survival (Søegaard, 2009). Thus, in multispecies grasslands the proportion of different herb species may vary considerably due to low competitiveness of some herbs (Søegaard *et al.*, 2008). Consequently, to examine the possibility for increasing the competitiveness of herbs in temporary grasslands, an experiment investigating the effects of seed mixture composition, cutting frequency and slurry application on the competitiveness was set up.

## **Materials and methods**

Different seed mixtures were established in spring 2008 on a sandy loam at the Research Farm Foulumgaard. These were undersown in spring barley (*Hordeum vulgare*). The 100% herb mixture (seed in percentage of total shown in brackets) comprised salad burnet (19.1), fenugreek (19.1), chicory (9.6), caraway (9.6), birdsfoot trefoil (9.6), chervil (9.6), plantain (4.8), lucerne (9.6), and melilot (9.6). The 5% and 50% herb mixtures included the same herb mixture, but it was sown in combination with a mixture of perennial ryegrass and white clover making up the remaining 95% and 50%, respectively. The total seeding rate was 25 kg ha<sup>-1</sup>. The experiment comprised plots of 3×8 m, and it was set up with

three variables: 1) the proportion of herb seeds in the total seed lot was 5, 50 or 100%, 2) the cutting frequency was either 4 or 6 times per year, and 3) cattle slurry was applied at two levels equivalent to 0 or 200 kg total N ha<sup>-1</sup> (120 N in spring, and 80 kg N after cut 2 or cut 3 for the 4- and 6-cut strategies, respectively). Two replicates of each treatment were established. Slurry application was main plots, seed mixture was split plots, and cutting frequency was split-split plots. Plots were harvested by a Haldrup plot-harvester and the botanical composition was determined by hand separation of subsamples in spring and summer cuts (cut 3 in the 4-cut strategy and cut 4 or 5 in 6-cut strategy).

## Results and discussion

The total dry matter yields increased in all three years by inclusion of herbs in the seed mixture when cut 4 times (Table 1). The opposite occurred under the 6-cut strategy. Further, the yield stayed high for the 100% herb mixtures cut 4 times per year during all three years, whilst it was significantly reduced over years in the case of the 6-cut strategy.

Table 1. Dry matter yield (t DM ha<sup>-1</sup>) of the three grassland seed mixtures in the years 2009, 2010, and 2011. Values with different letters are significantly different ( $P < 0.05$ ) within each column

Cuts per year	4						6					
	Slurry application (kg total N ha <sup>-1</sup> )			0	200			0			200	
Year	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
5% herbs	12.5 <sup>b</sup>	9.6 <sup>b</sup>	8.9 <sup>b</sup>	13.5	10.8	9.5 <sup>b</sup>	11.8 <sup>a</sup>	10.0 <sup>a</sup>	8.9 <sup>a</sup>	12.6 <sup>a</sup>	10.7 <sup>a</sup>	8.8 <sup>a</sup>
50% herbs	14.1 <sup>a</sup>	10.9 <sup>ab</sup>	10.8 <sup>ab</sup>	14.7	11.5	11.0 <sup>ab</sup>	11.6 <sup>a</sup>	10.0 <sup>a</sup>	8.3 <sup>a</sup>	12.6 <sup>a</sup>	10.7 <sup>a</sup>	8.9 <sup>a</sup>
100% herbs	13.8 <sup>a</sup>	11.9 <sup>a</sup>	13.0 <sup>a</sup>	14.1	11.5	12.6 <sup>a</sup>	9.1 <sup>b</sup>	6.8 <sup>b</sup>	5.6 <sup>b</sup>	9.7 <sup>b</sup>	7.2 <sup>b</sup>	6.7 <sup>b</sup>

All herbs established well. However, chervil and fenugreek were quickly outcompeted and they are therefore not included in Table 2. In general, the herb species, except lucerne and caraway, were most competitive in the first harvest year. Throughout the year, i.e. spring vs. summer cuts, variations in the amount of herb species existed. Species such as salad burnet, chicory and melilot made up a significantly higher proportion of the total dry matter in spring compared to summer ( $P < 0.05$ ). On the other hand, lucerne and birdsfoot trefoil were present in larger proportions in summer compared to spring. The proportion of most herbs, except for lucerne were higher in a 6- than in a 4-cut strategy. Further, the results

Table 2. Species composition in the herbage (percentage of total dry matter). Values with different letters are significantly different ( $P < 0.05$ ) when comparing across mixture, slurry application, year, cutting strategy and time of year for the individual species

Species	% of herbs in the seed mixture			Slurry application (kg N ha <sup>-1</sup> )			Year	Cuts per year	Time of year			
	5	50	100	0	200	2009			4	6	Spring	Summer
S. burnet	0.1 <sup>b</sup>	0.5 <sup>b</sup>	3 <sup>a</sup>	1.0	1.1	1.4	0.8	1.0	0.7	1.4	1.6 <sup>a</sup>	0.5 <sup>b</sup>
Chicory	2 <sup>b</sup>	10 <sup>b</sup>	19 <sup>a</sup>	11	10	21 <sup>a</sup>	4 <sup>b</sup>	1.2 <sup>b</sup>	10	11	12 <sup>a</sup>	9 <sup>b</sup>
Caraway	0.7 <sup>b</sup>	3 <sup>b</sup>	13 <sup>a</sup>	3	8	0.7	7	12	5	7	6	5
B. trefoil	0.1 <sup>b</sup>	0.9 <sup>b</sup>	7 <sup>a</sup>	3	2	3	2	2	1.6 <sup>b</sup>	4 <sup>a</sup>	2 <sup>b</sup>	3 <sup>a</sup>
Lucerne	1.0 <sup>b</sup>	20 <sup>b</sup>	42 <sup>a</sup>	25	17	17	25	22	33 <sup>a</sup>	8 <sup>b</sup>	19	23
Melilot	0.0	0.2	0.7	0.3	0.3	0.7	0.0	0.0	0.3	0.3	0.5 <sup>a</sup>	0.1 <sup>b</sup>
Plantain	1.1 <sup>b</sup>	5 <sup>b</sup>	8 <sup>a</sup>	4	5	8 <sup>a</sup>	3 <sup>b</sup>	1.8 <sup>b</sup>	3 <sup>b</sup>	6 <sup>a</sup>	4 <sup>b</sup>	5 <sup>a</sup>
W. clover	53 <sup>a</sup>	31 <sup>b</sup>	0 <sup>c</sup>	31	25	30	29	24	24 <sup>b</sup>	32 <sup>a</sup>	23 <sup>b</sup>	33 <sup>a</sup>
P. ryegrass	42 <sup>a</sup>	29 <sup>b</sup>	0 <sup>c</sup>	18 <sup>b</sup>	28 <sup>a</sup>	17	27	29	21 <sup>b</sup>	26 <sup>a</sup>	29 <sup>a</sup>	18 <sup>b</sup>
Unsown	0.3 <sup>b</sup>	1.4 <sup>b</sup>	8 <sup>a</sup>	3	3	1.6	4	6	1.4 <sup>b</sup>	5 <sup>a</sup>	3	4

indicated that application of cattle slurry affected the competitiveness of the herbs although differences were not significant.

Figure 1 highlights the interaction between the three dominating herb species (lucerne, caraway and chicory) in the 100% herb mixture without application of nitrogen. It is evident that the amount of chicory is reduced throughout the years in both the 4- and 6-cut strategy. The opposite is true for caraway, whilst the performance of lucerne peaks in the second year.

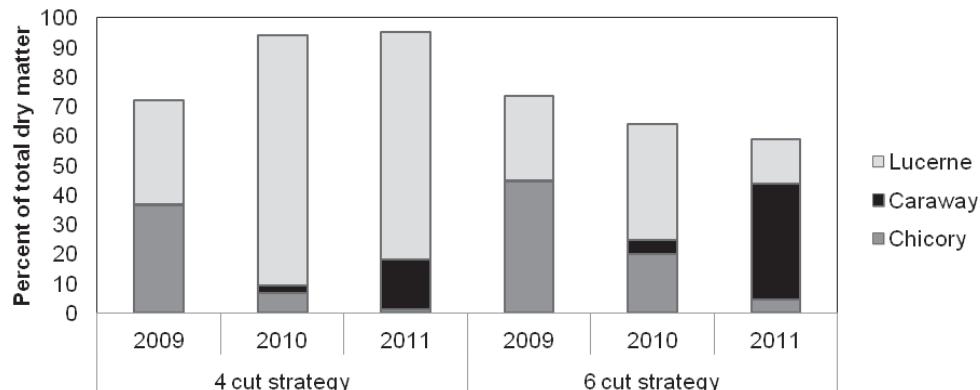


Figure 1. The percentage of lucerne, caraway and chicory in spring cuts over three harvest years in the treatment with 100% herbs in the seed mixture for the two cutting strategies. No slurry has been applied

## Conclusions

The botanical composition was highly affected by management, i.e. amount of herbs in the seed mixture, cutting frequency and slurry application. This presents the farmer with an opportunity to manipulate the botanical composition in temporary multispecies grasslands in order to achieve desired beneficial effects.

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