

Species competition in multispecies grass swards



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There is growing interest in establishing highly biodiverse grasslands that are also capable of maintaining high yields. In order to design successful multispecies mixtures it is necessary to know the competitiveness of individual species and how different management regimes affect this. Some species can survive in highly productive pastures, while others need nursing in special mixtures if they are to make a significant contribution to the forage.

This is investigated in the ECOSERVE project and has also been studied in the earlier ORGGRASS project.

When several plant species share the same area there is fierce competition for resources. Above ground the competition is for light and in the soil the battle is over water and nutrients. Grass is a monocot with a fibrous root system that gives better soil infiltration than the tap root of, for example, clover. Grass also has longer and more abundant root hairs. Herbs are dicots like clover and are also tap-rooted. Some species are plentiful in the sward – they are called dominant species – while others do less well. All our traditional grassland species are dominant species, although their dominance

depends on growth conditions. The herbs chicory, ribwort plantain and caraway are also dominant. The reason that we do not usually find them to be so is because they are seeded in only small amounts and are not able to spread. We can influence the competitive relationship between species through our management systems. This we know from, for example, red clover, which can dominate strongly in fields cut for silage, but has problems surviving in grazed fields.

The dominant herbs

Ribwort plantain has a leaf rosette and should therefore

find it more difficult to compete for light. Although the leaves become more upright in a system with silage cuts, they tend to stay close to the ground. This is probably also the reason why the proportion of plantain decreased from 17% in the first year of use to 5% in the fourth year in the ORGGRASS experiment. Plantain flowers stick their heads up above the grass canopy but have little photosynthetic activity. Chicory also has a leaf rosette, but its taller stem with leaves means it is better able to catch the sunlight. This was reflected in the proportion of chicory in the experiments, which

remained constant at approx. 10% of dry matter in the four years of the experiment.

In experiments on competition between plants, one of the findings is usually that if a species initially spends its resources on establishing a large root system, it does not compete so well later on against the dominant species. This is a lesson that caraway obviously did not learn. Caraway starts off with small leaves but they grow larger with time so that in the third and fourth year it has made up as much as 25% of the dry matter in the spring cut. We also found



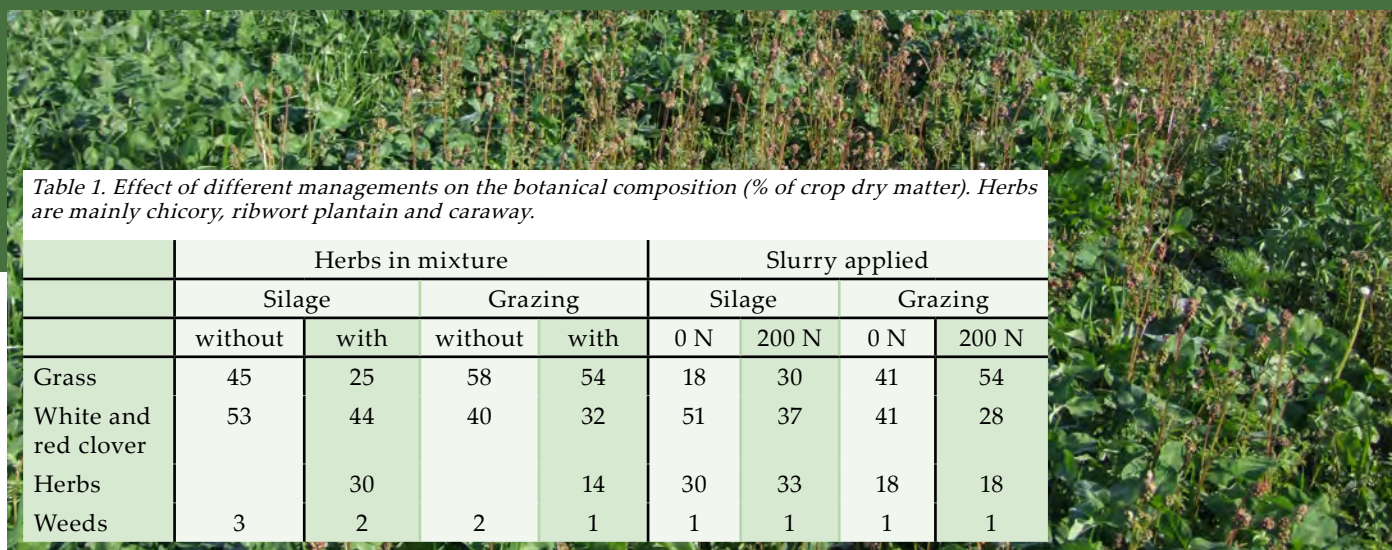


Table 1. Effect of different managements on the botanical composition (% of crop dry matter). Herbs are mainly chicory, ribwort plantain and caraway.

	Herbs in mixture				Slurry applied			
	Silage		Grazing		Silage		Grazing	
	without	with	without	with	0 N	200 N	0 N	200 N
Grass	45	25	58	54	18	30	41	54
White and red clover	53	44	40	32	51	37	41	28
Herbs		30		14	30	33	18	18
Weeds	3	2	2	1	1	1	1	1

caraway to have a very large root mass, which suggests that it uses the first year to consolidate itself before growing really strong. Caraway is described as a facultative biennial. It adapts to the conditions – perhaps because it is harvested regularly – and therefore continues to grow. How well it would do beyond four years we do not know.

Who are the competitors to herbs?

This depends entirely on whether the field is used for silage cuts or for grazing! When used for silage cuts, the crop may grow quite tall and competition for light will be strong. Here grass is often outcompeted by the herbs. A large percentage of herbs in the experiment of 30% of dry matter reduced the grass content from 45 to 25% of DM, whereas white and red clover only fell from 53 to 44% (Table 1). Grazing with heifers in a large paddock gave a different result. Here the grass content only decreased by 4

percentage points (Table 1). As the competition for light is less intense with grazing, this would indicate that the herbs compete particularly with grass for light. The herbs do not cope quite so well with frequent browsing by cattle, and with grazing the herb content was only half as large as with cutting (Table 1).

Slurry injection

In an ordinary grass-clover field, the clover content will decrease when fertilised with nitrogen. This is mainly due to the different rooting systems. It is simply easier for the grass to absorb the nitrogen. When we fertilised with 200 kg N in cattle manure this resulted, as expected, in significantly more grass and less clover. But the herbs were actually unaffected (Table 1), and the effect was the same for the cutting and grazing regimes. The proportion of grass increased by 12-13 and clover fell by 13-14 percentage points. This would suggest that slurry affected particularly the

competition below ground, and that herbs cannot be compared with clover. They fall somewhere in between grass and clover, although their rooting system mostly resembles that of clover.

The weak competitors

Salad burnet, dandelion, yarrow and birdsfoot trefoil are weak species that can handle being cut several times a year, but find it difficult to compete with the dominant grassland species. There may be different reasons for wanting a larger share of these species: they increase appetite, contain various beneficial components, or there may be other reasons such as dandelion being good for pollinators in the spring when there are few other food sources around. A method of promoting such species is to establish them in small areas in the field where the competitive pressure from the dominant species can be restricted. As model plants, we use, respectively, burnet and dandelion together with a nitrogen-supplying

legume. Red clover and lucern are seeded in very small amounts of 0.5 and 1.5 kg/ha in order to depress competition. The yield in the first year of use was highest in mixtures with red clover where it dominated plots (Table 2) – despite the low seed rate. In combination with lucern the herbs did better, but they also let in more weeds than with red clover. In combination with birdsfoot trefoil there was heavy weed pressure, especially late in the season.

Our experiments have given us better insight into the growth and competitiveness of the species which will ultimately be used to purpose-design multispecies swards.

Table 2. Mixtures with a less competitive herb plus a legume. Seed rate of red clover was 0.5 kg/ha, 1.5 kg for lucern and 12.5 kg for birdsfoot trefoil. Total seed rate was 25 kg/ha. DM: dry matter.

Herb	Burnet			Dandelion		
	Birdsfoot	Lucern	Red	Birdsfoot	Lucern	Red
Annual yield (hkg DM/ha)	83	94	105	79	85	114
Herb (% of DM)	22	25	21	29	23	13
Legume (% of DM)	55	53	70	54	65	83
Weeds (% of DM)	23	12	9	17	12	3

More information

Read more about the Organic RDD project EcoServe at: http://www.icrofs.org/Pages/Research/organic-rdd_ecoserve.html



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