Management of forb species mixtures for high biomass production

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Implications

Including forb species in grassland mixtures may secure a more biodiversity-friendly production of biomass. This experiment showed interesting future perspectives in terms of production of low-cost biomass for e.g. biogas production, which can be obtained by reducing the number of cuttings without compromising yield levels. No significant differences in dry matter (DM) yields of chicory, birdsfoot trefoil, yarrow and a 13 species mixture were observed between the situations with four compared to one autumn cut per year. Especially the 13 species mixture showed great potential in terms of yield and suppression of unsown species, for which reasons it should be developed further through knowledge on the species in pure stands.

Background and objectives

Production of biomass from species-rich grasslands is interesting in many aspects. The cultivation of multispecies grassland mixtures may increase yield levels (Sanderson et al. 2004), and a nine species herb mixture showed potential to improve yield stability (Mortensen et al. 2012). The objective of this experiment was to investigate yield levels of eleven different forb species, a 13 species- and a standard mixture, when exposed to two different cutting frequencies: four versus one autumn cut per growing season.

Key results and discussion

Annual DM yields of red clover, salad burnet, field scabious, sainfoin, caraway, dandelion, chive, ribwort plantain and the standard mixture were higher with four than one cut per year (Fig. 1). Compared to the situation where cutting took place four times per year, regrowth was not stimulated by defoliation, when cutting was performed in autumn only. Moreover, for some forbs, the degree of senescence exceeded the production of new growth, resulting in lower DM yields in the single autumn cut than totally with four cuts. Contrary, there were no significant yield differences between the two cutting situations in case of chicory, birdsfoot trefoil, yarrow and the 13 species mixture (Fig. 1). In fact, with one autumn cut, birdsfoot trefoil, chicory and many of the species in the 13 species mixture were able to continue growth throughout the entire growing season.

Dry matter yields of forb species and mixtures were differently influenced by the two cutting frequencies. Compared to the traditional high-yielding standard mixture, annual DM yields of red clover, field scabious, ribwort plantain and the 13 species mixture were not significantly different with four cuts per year (Fig. 1). The remaining forb species had DM yield levels, which were almost always significantly lower than those of the high-yielding species. With only an autumn cut, more species were equally productive, but DM yields in plots of salad burnet, sainfoin, caraway, dandelion and chive were relatively low.

The individual forb species and mixtures differed in their ability to suppress unsown species (Fig. 1). Consistent with Søegaard et al. (2008), the standard mixture, but also the 13 species mixture, was very suppressive against unsown species, perhaps due to their structural and functional complexity. Moreover, chicory, caraway, red clover and ribwort plantain showed relatively high competitiveness against unsown species. In contrast, species such as sainfoin and chive had very low competitiveness, for which reason they only made up small proportions of the total DM yield in their plots.

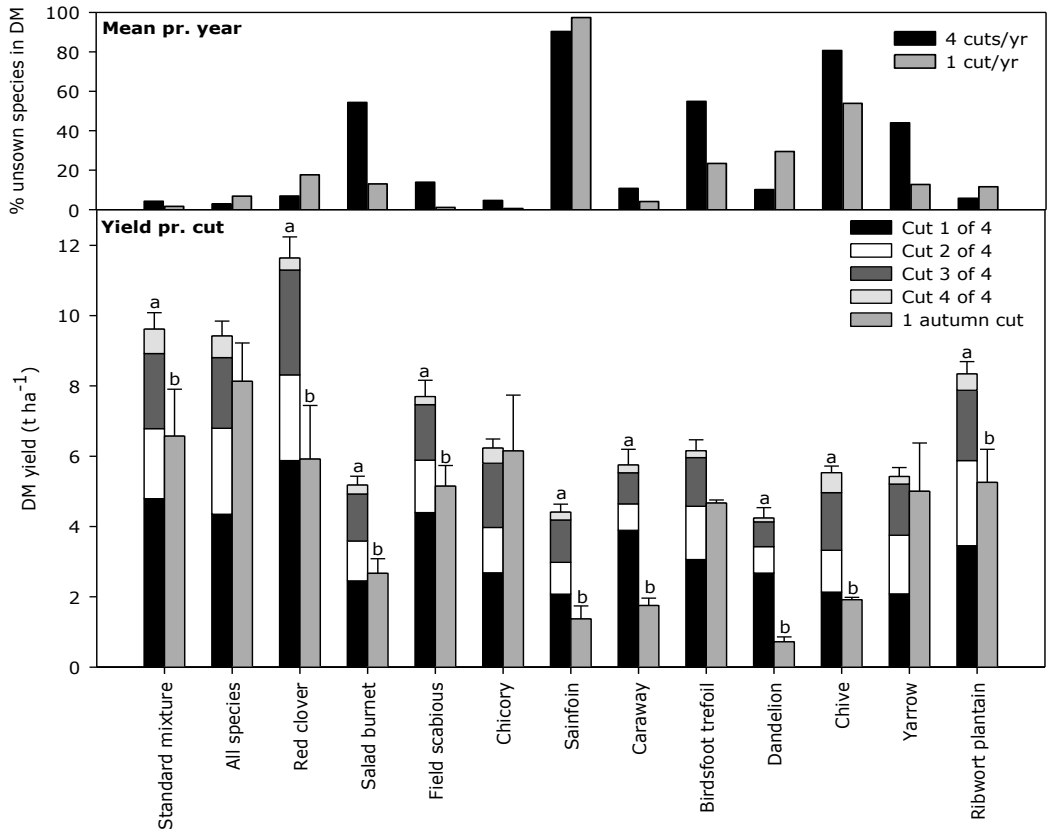

Figure 1. Annual dry matter (DM) yield and percentage (%) of unsown species in the DM of pure stands of forbs, a mixture of 13 species (the 11 pure stand forbs, white clover and perennial ryegrass) and a standard mixture of perennial ryegrass, white- and red clover. Letters *a* and *b* indicate when DM yields of each species or mixture were significantly different between the two cutting frequencies at the P<0.05-level. Error bars: SE.

How work was carried out?

A plot experiment was established in an organic dairy crop rotation at Aarhus University, Denmark in 2011 in spring barley. The barley cover crop was harvested at maturity in August, after which there were no defoliations. Pure stands of forbs and mixtures (Fig. 1) were sown at 25 kg ha^{-1} in plots of 1.5*10 m, with three replicates each. Plots were managed without application of fertiliser, and cut one- (on 4th October 2012) or four times (29th May, 10th July, 21th August, and 9th October 2012) per year with a Haldrup plot harvester. DM yields were determined per plot by oven-drying of a 150 g herbage subsample at 80°C for 24 hours. The botanical composition at each cut was determined by hand-separating a 100-500 g (depending on the size of the individual plant species) subsample of herbage from each plot. The statistical analysis was carried out using a mixed procedure in the SAS package. In the model, species (or mixture), cutting frequency and their interaction were fixed effects and replicates a random effect.

References

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