Does early spring grazing stimulate spring grass production?

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Abstract

Early spring grazing may stimulate grass growth in spring by increasing grass root exudation, which enhances mineralization. The objective of this study was to investigate the net effect of early spring grazing on spring grass production. Therefore, we conducted two field experiments on production grasslands. Simulated early spring grazing negatively affected the yield of the first cut: compared to ungrazed plots on sandy soil and a tendency on clay soil, dry matter yield of early-grazed plots was reduced by 20% (sand, P=0.009) and 12% (clay, P=0.062), respectively. These differences were partly compensated in later cuts. Despite the negative effect on grass yield of the first cut, early grazing positively affected the crude protein (CP) content of the grass in the first cut on sandy soil, but only in the plots that had not been fertilized with CAN. The stimulating effect of early spring grazing on soil nutrient mineralization appears to be too small to compensate for the negative effects of early grazing on grass leaf area and photosynthesis capacity.

Keywords: Grazing, root exudates, mineralization, spring production

Introduction

For dairy farmers the key question in spring is how to get the grass growing as soon as possible. The easiest method is to add nitrogen fertilizer, but due to stricter fertilizer regulations farmers have to depend more and more on soil nutrient mineralization. This process starts when the soil warms up in spring, and can be stimulated by mechanical soil aeration and lime additions. Furthermore, according to the experience of various dairy farmers, grass growth may also be stimulated by 'early spring grazing', a method in which grasslands are grazed in early spring for a short period of time. A possible explanation for this effect is that grazing leads to increased root exudation, which in turn triggers mineralization (Hamilton *et al.*, 2008). However, it is not known whether this mechanism also works in spring when soil temperatures are still low. Furthermore, it is unclear whether the positive effects of grazing on mineralization could outweigh the negative effect of (early) grazing on photosynthetic leaf area and thus growth rate. Therefore, the objective of this study was to investigate the net effect of early spring grazing on spring grass production.

Materials and methods

In 2013 we conducted two field experiments on production grasslands: one on a shallow sandy soil in the south of the Netherlands, and one on a clay soil in the north. All plots in both experiments were fertilized with cattle slurry at 25 m^3 ha^{-1} in mid-March. The experiment on sandy soil consisted of four treatments with six replicate plots: early spring grazing with, and without, the addition of artificial fertilizer; artificial fertilizer only; and a control. To this end, on 19 April half of the plots were mowed to ±4cm with a lawn mower to simulate early spring grazing. On the same day, half of the mowed and unmowed plots received 50 kg N ha^{-1} of calcium ammonium nitrate (CAN). The experiment on clay soil consisted of three treatments with five replicate plots: early spring grazing on 19 April (lawn mower treatment, see above); artificial fertilizer (50 kg N ha^{-1} of CAN); and a control. The effect of early spring grazing was measured in the first two cuts. The plots on sandy soil were cut on 19 May and 8 July; and on clay soil on 24 May and 2 July. Grass production of each plot was determined by mowing a strip of 0.84 m × 5 m (sandy soil) or 1.50 m × 10 m (clay soil). Half of the yield from mowing the plots at t=0 to simulate early grazing was added to the yield of the first cut. After weighing the fresh biomass, a sub-sample was analysed for dry matter and crude protein (CP) content. Results were analysed for significance by ANOVA and Tukey's test.

Results

Simulated early spring grazing negatively affected the yield of the first cut compared to ungrazed plots on sandy soil, and there was a tendency on clay soil: dry matter yield of early-grazed plots was reduced by 20% (sand, P=0.009) and 12% (clay, P=0.062), respectively (Figure 1). These losses were partly compensated by the yields of later cuts: on sandy soil, total grass yield of the first and second cut of early-grazed plots was only 8% lower than of ungrazed plots; on clay soil it was only 5% lower. This 'catch-up' effect is likely to be due to higher re-growth rates after the first cut in the early-grazed plots, compared with the ungrazed plots where the first cut was heavier because no simulated grazing had taken place.

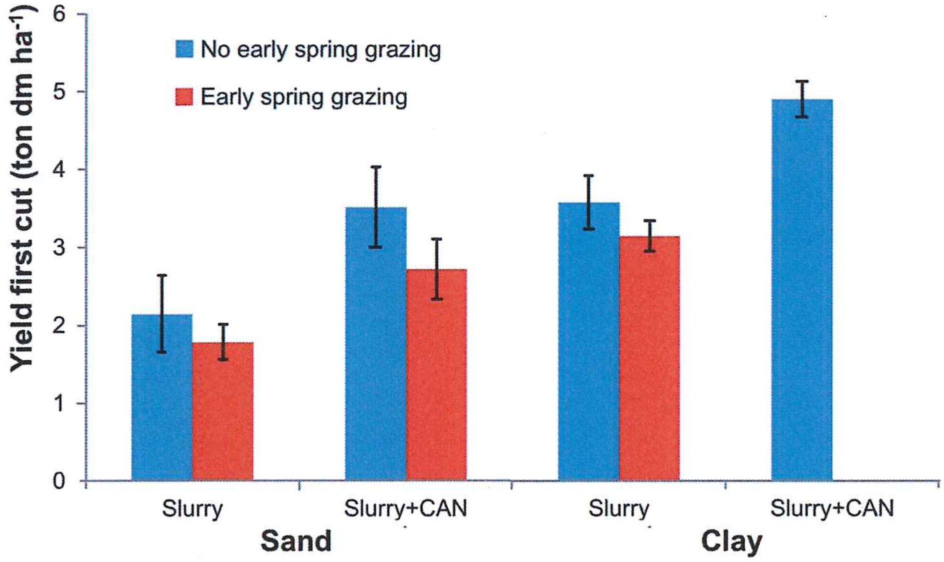

Figure 1. The effect of early spring grazing on dry matter yield of the first cut (sandy soil: 19 May; clay soil: 24 May) in plots with and without artificial fertilizer addition. Note that the yield from early-grazed plots includes 50% of the yield from mowing these plots at t=0 to simulate early grazing. Slurry=cattle slurry (25 m^3 ha^{-1}, applied to all plots including the control), CAN (50 kg N ha^{-1}). Error bars represent 2×standard deviation.

Despite the negative effect on grass yield of the first cut, early grazing positively affected the CP content of the grass in the first cut on sandy soil, but only in the plots that had not been fertilized with CAN. On sandy soil, early grazing increased the CP content of the first cut by 12%, to 151 g kg dm^{-1} compared to 135 g kg dm^{-1} in ungrazed plots (Figure 2, P=0.001). On clay soil the difference of 6% was not significant: 144 g kg dm^{-1} in the early grazing plots compared to 136 g kg dm^{-1} in ungrazed plots. The results on sandy soil suggest that early spring grazing promotes feed quality. This can be considered a positive effect of early spring grazing, particularly if feed quality is an issue (for example, in the case of delayed cuts, and in organic dairy pastures with low clover density). Due to the higher relative CP content of early-grazed grassland, the total nitrogen yield of early-grazed versus ungrazed plots was not significant different, in both sandy and clay soil experiments.

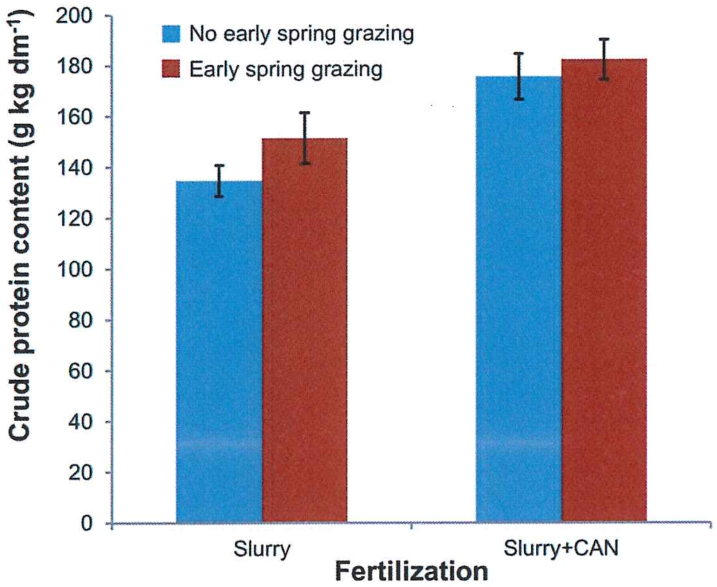

Figure 2. The effect of early spring grazing on CP content of the first cut (19 May) in plots with and without artificial fertilizer, in the sandy soil experiment. Slurry=cattle slurry (25 m^3 ha^{-1}, applied to all plots including the control), CAN (50 kg N ha^{-1}). Error bars represent 2×standard deviation.

Discussion

Contrary to expectations, early spring grazing was not found to 'kick-start' grass production. It is possible that the timing of the first cut was too early to detect a positive effect but, even if that were the case, our results show that the effect of artificial fertilizer on dry matter yield and CP content is likely to be much greater than any effect of early grazing (Figures 1, 2). Thus, it appears that early spring grazing provides no real alternative to artificial fertilizer for encouraging early grass growth in spring. Other methods still worth exploring are mechanical soil aeration and liming, both of which should stimulate soil biotic activity, nutrient mineralization, and hence grass growth.

Conclusions

Early spring grazing leads to a higher crude protein content in grass on sandy soil.
The stimulating effect of early spring grazing on soil nutrient mineralization appears to be too small to compensate the negative effects of early grazing on photosynthesis capacity.
The negative effect of early grazing on dry matter yield of the first cut is compensated in later cuts.

References

Hamilton E.W., Frank D.A., Hinchey P.M. and Murray T.R. (2008) Defoliation induces root exudation and triggers positive rhizospheric feedbacks in a temperate grassland. *Soil Biology & Biochemistry* 40, 2865–2873.

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