The effect of kurzrasen and strip-grazing on grassland performance and load bearing capacity of a peat meadow

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Abstract

Herd size per farm is increasing in the Netherlands. Therefore, there is need for assessing the performance of different grazing systems at high stocking densities. The objective of the current experiment was to assess the effect of two contrasting grazing systems, kurzrasen (KR, continuous grazing at 3-5 cm sward height) and strip-grazing (SG) at a high stocking rate, on load bearing capacity, sward density, grass production and morphology on peat soil. To this end, a two-year grazing trial with four herds of 15 cows on 2 ha each was conducted. Sward density was higher for KR compared with SG, which had a positive impact on load bearing capacity. This is an important feature on peat soils, where load-bearing capacity is often limited. KR showed on average 18% lower herbage dry matter production than SG. The yield penalty of using a shorter regrowth period under KR was limited due to the strong response in grass morphology, resulting in a dense and lamina-rich sward.

Keywords: grazing systems, swards, load bearing capacity, root density, nutritional value

Introduction

Due to the increased herd size in the Netherlands, there is need for assessing the performance of different grazing systems at high stocking densities. Strip-grazing (SG) is a system in which cows are allowed a fresh strip of pasture herbage (with back-fence) each day, followed by a regrowth period. This system generally results in the highest grass and milk production. Recently, there is increasing interest in kurzrasen (KR), a continuous grazing system, in which sward height is always kept between 3 and 5 cm. Herbage production is generally lower; however, the high quality of the ingested herbage results in a good conversion into milk. A major potential benefit of this system for the Dutch peat meadow region is its positive effect on sward density, which may increase the load bearing capacity.

The objectives of the current experiment were to assess the effect of these two contrasting grazing systems, SG and KR at a high stocking rate, on load-bearing capacity, sward density, grass production and morphology on peat meadows.

Materials and methods

The experiment was conducted on permanent grassland at KTC Zegveld on drained peat soil in the western peat region in the Netherlands (see Hoekstra *et al.*, 2019 for more details). The experimental treatments consisted of two grazing systems, SG and KR, in two replications. In 2016 and 2017, four independent farmlets were formed, each consisting of 15 cows (9 Holstein Friesian, 6 Jersey) on 2 ha, representing a stocking rate of 7.5 LU ha^{-1} on the grazing platform. For KR, each farmlet consisted of one single grazing block, with the aim to maintain a constant sward height between 3 and 5 cm. These fields had already been subjected to a KR grazing regime in 2015, in order to allow the sward to adapt. For SG, cows had access to a new strip each day, with strip-size depending on the herbage supply. Herbage in excess of animal requirements was harvested for silage production. Yearly N application rate was approximately 140 kg N ha^{-1}.

Soil parameters were measured 2-5 times per year on 5×5 m observation plots (two per farmlet) and included load-bearing capacity (analogue penetrometer), soil moisture content (SMC; gravimetric) and sward density (point quadrat method). Herbage measurements included weekly sward height measurements (rising plate meter) and weekly herbage growth rate (for KR under growth cages) based on sward height difference, using a calibration method for conversion into DM yield. Additionally, herbage morphology (tiller length, free-leaf lamina length, number of leaves tiller^{-1}) was measured for 25 tillers per observation plot, 3 times per year.

The effect of grazing system on the measured parameters were analysed with GLM, taking into account the random structure of repeated measures over time and sub-plots within each farmlet, using the LMER package in R 3.4.4.

Results and discussion

Load-bearing capacity was on average 10% higher for KR than for SG (Figure 1A), but the difference was only statistically significant during July 2016, November 2016 and March 2017. Load-bearing capacity is an important parameter that has a large impact on grassland utilisation, as it affects the number of available grazing days. Load-bearing capacity showed a strong negative correlation with SMC, both within and between measurement periods (data not shown). Also, load-bearing capacity was positively correlated with sward density (Figure 1B). The sward density was 39% higher for KR compared with SG (Table 1).

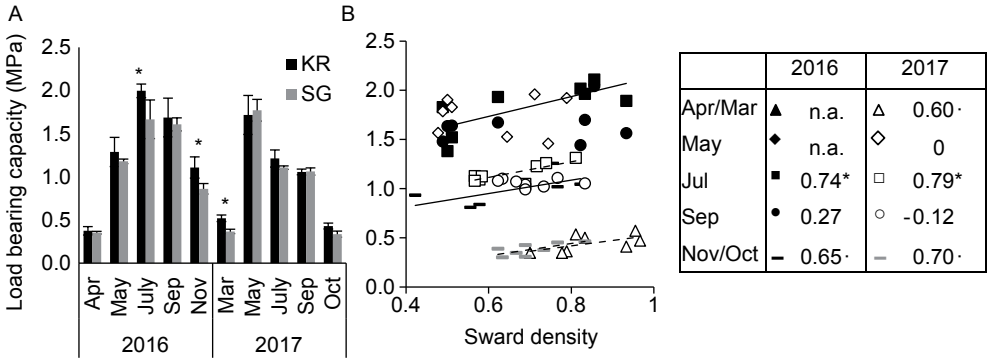

Figure 1. (A) The load-bearing capacity (LBC) for the KR and SG systems during 2016 and 2017. Error bar = 2SE, n=4. (B) Correlations between LBC and sward density (prop. cover) during 2016 and 2017. Regression lines indicate significant correlations or trends as represented in the Table (• = P<0.1; * = P<0.05).

Table 1. Mean sward density, sward height and herbage morphology for KR and pre and post-grazing SG swards.

Parameter[1]	KR		SG-pre		SG-post		P-value[2]
Sward density (prop)	0.80	b	0.60	a			**
Sward height (cm)	4.5	a	11.3	c	6.0	b	*
No. of ungrazed leaves per tiller	1.2	b	2.0	c	0.1	a	**
Total FLL length (cm tiller^{-1})	9.4	a	30.2	b	5.9	a	***
Proportion FLL	0.76	b	0.75	b	0.47	a	***

[1] FLL = free leaf lamina.

[2] * P<0.05; ** P<0.01; *** P<0.001; means followed by different letters in same row are significantly different at P<0.05.

In 2016, the cumulative herbage DM production on the grazed area was 7.4 and 8.8 Mg DM ha^{-1} for kurzrasen and strip-grazing, respectively. In 2017, the cumulative herbage dry matter production was 23% higher for strip-grazing than kurzrasen (12.8 and 10.4 Mg DM ha^{-1}, respectively). Generally, highest herbage yields are achieved by grazing at the two to three leaf stage, to a residual grazing height of approximately 5 cm. Just after grazing, there is relatively little photosynthetically active plant material (i.e. laminae), and growth is mainly dependent on carbohydrate reserves in the stubble and roots. As soon as sufficient lamina material has developed, further growth is based on photosynthesis, and at this stage the sugar reserves can be replenished. If swards are grazed too often (before the sugar reserves have been restored), this can result in decreased growth capacity. In the current experiment, on average, the leaf stage at time of grazing was lower for KR than for SG, and the residual grazing height was also lower for KR (Table 1).

However, the yield penalty for KR was smaller than expected, as a result of the morphological changes in the perennial ryegrass plants in response to these different systems.

For KR, the amount of lamina material (expressed as free-leaf lamina length per tiller) was smaller than the pre-grazing free-leaf lamina length of SG. However, just after grazing, the free-leaf lamina length was greater for KR than for SG. Additionally, free leaf lamina, as a proportion of total tiller length, was always greater for KR (Table 1). This might imply that the amount of photosynthetically active material just after defoliation is less limiting for the regrowth of the KR sward (but is even higher for KR compared with SG) and therefore the depletion of sugar reserves just after defoliation is smaller. Additionally, the KR system resulted in a much higher sward density, and the lower productivity per tiller was partly compensated by an increase in the number of tillers.

Conclusions

Sward density was higher for KR than for SG, and this had a positive effect on load-bearing capacity. Therefore, KR may be employed as a strategy to increase the load-bearing capacity and therefore to increase the number of days available for grazing and to reduce sward damage caused by treading. KR showed a lower amount of herbage dry matter production compared with SG. The yield penalty of using a shorter regrowth period under KR was limited due to the strong response in grass morphology, resulting in a dense and lamina-rich sward, even at very low stubble heights.

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References

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