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Amazing Grazing: science in support of future grass based dairy systems

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Abstract

The Amazing Grazing project addresses the challenges that Dutch farmers face in grazing systems with high feed supplementation and high stocking rates on the available grazing area. The project consists of six interlinked components (soil, grass growth, grass supply, grass intake, supplementation and behaviour), that are arranged around two grazing and three cutting experiments, as well as three farmer consultation groups. The grazing experiment showed that fresh grass intakes of approximately 6 kg DM cow^{-1} d^{-1} are feasible in intensive grazing systems with high feed supplementation levels. Tools for grass monitoring and planning, as well as cow behaviour monitoring, are being developed to support farmer decisions.

Keywords: Amazing Grazing, cow behaviour, planning, growth prediction, intake

Introduction

In the Netherlands, the proportion of dairy cows that had access to pasture declined steadily from 90% in 2001 to 65% in 2016 (CBS, 2017). The main driver of reduced grazing was increasing herd size combined with a lack of increase in the available grazing area (Van den Pol-Van Dasselaar *et al.*, 2013). Grazing is under debate amongst dairy farmers, the dairy chain and society. Several measures have been introduced to increase the proportion of cows having access to grazing. A crucial parameter that determines the ability to graze is the stocking rate on the available grazing area. Above a threshold of approximately 6 cows ha^{-1} it becomes increasingly difficult to maintain six hours of grazing per day. Consequently more farmers will be challenged to implement an efficient grazing system at these high stocking rates. The Amazing Grazing project addresses the issues that farmers face in managing grazing systems with high levels of feed supplementation.

Material and methods

The project framework (Figure 1) consists of six interlinked components (soil, grass growth, grass supply, grass intake, feed supplementation and cow behaviour) that are combined into three activities. (1) Two grazing experiments with contrasting grazing systems. On a clay soil, a Holstein herd grazed during day-time at a stocking rate of 7.5 cows ha^{-1}, either under Strip Grazing (SG) or Compartmented Continuous Grazing (CCG). On peat soil, a mixed Holstein and Jersey herd grazed at the same stocking rate, either under SG or Kurzrasen (KR). In SG, cows were offered a fresh strip of grass each day. Compartmented Continuous Grazing is an adapted set-stocking system in which the cows rotate on a daily basis between six compartments in one paddock. Kurzrasen is a set-stocking system with a target sward height of 3 to 5 cm. The non-exhaustive list of measurements comprised soil compaction measurements, sward height and density, *n*-alkane grass DM intake and cow behaviour using electronic sensors (Holshof *et al.*, 2018; Zom, 2018). (2) Cutting trials on clay, sand and peat soil with a combination of nitrogen (N) levels and growth intervals. Grass growth was measured with several nearby and remote sensing techniques based on spectral images. Short term growth predictions based on modelling and meteorological forecasts were compared to observed growth (Hoving *et al.*, 2018). (3) Three working groups of farmers, consultants and

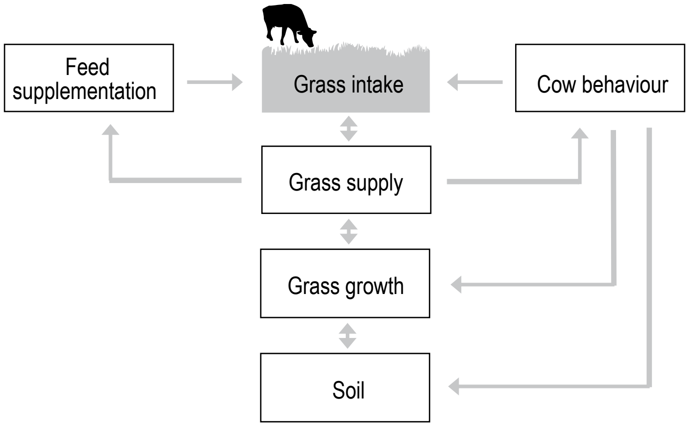

Figure 1. Framework of Amazing Grazing.

researchers, each focused on developing planning rules and tools for a different grassland management system (Stienezen *et al.*, 2018).

Results and discussion

The grazing trials were carried out on perennial ryegrass (*Lolium perenne* L.) dominant (> 50%) swards. On peat soil, the sward density and carrying capacity was higher on KR than on SG. In the first year, fat and protein corrected milk production levels were 27 and 22 kg cow^{-1} d^{-1} on clay and peat soil, respectively (Table 1), with no treatment effect (Holshof *et al.*, 2018). The daily supplementation levels per cow were 7.7 kg DM maize silage and 5.1 kg concentrates on clay soil, and 4.0 kg DM grass silage and 6.7 kg concentrates on peat soil. Based on the required energy intake, the proportion of Net Energy Lactation (NEL) from grass intake was around 30%. This equates to average daily grass intakes of 5 to 6 kg DM cow^{-1}. The daily time at pasture was 7.5 hours on clay soil (day-time grazing) and 12 hours on peat soil (night-time grazing). The average proportion of time spent grazing was 54 and 38% of pasture time on clay and peat soil, respectively, resulting in equal amounts of actual grazing time at both sites. On clay soil, the *n*-alkane grass intake during three weekly periods was 6.2 and 4.5 kg DM cow^{-1} d^{-1} on CCG and SG, respectively (Zom, 2018). Attempts to stimulate fresh grass intake by lowering rumen-degradable protein balance (OEB) in concentrates were unsuccessful, but reduced maize intake instead. The low OEB group produced less milk than the high OEB group, but the N utilisation increased from 35% to 40% (Klootwijk *et al.*, 2018).

In the cutting trials, the biomass index WDVI (Weighed Difference Vegetation Index) showed a good exponential relationship with ground truth DM yield for individual cuts (Hoving *et al.*, 2018). Short term predictions of grass growth were relatively successful for mineral soils, but rather poor for the peat soil because of the complex hydrology and soil N turnover.

Planning tools were developed for rotational grazing systems with high feed supplementation levels and implemented in a web application (Stienezen *et al.*, 2018).

Table 1. System performance (2016) for day-time grazing (clay) and night-time grazing (peat). SG = Strip Grazing; CCG = Compartmented Continuous Grazing; KR = Kurzrasen.

	Clay soil		Peat soil	
	SG	CCG	SG	KR
Nitrogen input (kg ha^{-1})	358	356	175	175
Grazing season (h d^{-1})	192	185	163	181
Pasture time (h d^{-1})	7.5	7.6	11.6	12.9
Grazing (%)	52	55	37	38
Grazing time (h d^{-1})	3.9	4.2	4.3	4.9
Grass on offer (cm)	9.0	7.2	11.0	3.7
Residual sward height (cm)	5.4	6.1	6.4	-
NEL from grass intake (%)	26	33	29	33
Grass intake (kg DM cow^{-1} d^{-1})	5.1	5.4	6.1	-
Grass silage intake (kg DM cow^{-1} d^{-1})	-	0.2	4.3	3.6
Maize silage intake (kg DM cow^{-1} d^{-1})	7.5	7.8	-	-
Concentrates intake (kg DM cow^{-1} d^{-1})	5.0	5.1	6.7	6.7
Milk production (kg FPCM cow^{-1} d^{-1})	26.6	27.7	22.3	22.0
Animal weight (kg)	618	612	487	489
Silage yield (kg DM ha^{-1})	3,629	1,595	1,602	838

Conclusion

The grazing experiment showed that daily grass intakes of approximately 6 kg DM cow^{-1} are possible in intensive grazing systems with high supplementation levels. At least two thirds of the total grass DM yield was fresh herbage intake. Tools for grass monitoring and planning, as well as cow behaviour monitoring, are being developed to support farmer decisions.

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