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Management targets for maximising the short-term herbage intake rate of cattle grazing in *Sorghum bicolor*

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ABSTRACT

One of the variables in the structure of the sward with the most influence on the short-term herbage intake rate by grazing ruminants is the canopy height. The objective of this study was therefore to characterise the effect of the canopy height on short-term herbage intake rate using *Sorghum bicolor* cv BR 501. as a reference. Two experiments were conducted at Research Station of the Federal University of Rio Grande do Sul, Brazil, between December 2009 and April 2010. The treatments in experiment 1 were used to determine the influence of the pre-grazing canopy height on the short-term herbage intake and consisted of six canopy heights (30, 40, 50, 60, 70 and 80 cm). The treatments in experiment 2 used the pre-grazing canopy height from experiment 1 that maximised the short-term herbage intake rate to evaluate the influence of the severity of grazing down (16, 33, 50, 67 and 84%) on the herbage intake. Both experiments used a completely randomised block design, with two replicates in experiment 1 and three replicates in experiment 2. Four heifers (24 ± 2 months and 306 ± 56.7 kg) were used in experiment 1. Three of these animals were used in experiment 2, which were then 26 ± 2 months and 339 ± 45.5 kg. The short-term herbage intake rate was measured by weighing the heifers pre- and post-grazing, corrected for insensible weight losses. The number of grazing jaw movements (biting and non-biting) was counted automatically using an IGER Behaviour Recorder. In both experiments, the sward measurements included the pre- and post-grazing canopy height, the pre-grazing herbage mass and the vertical distribution of morphological components. In experiment 2, the post-grazing herbage mass was also measured. The results showed that the grazing canopy height that maximised the short-term herbage intake rate was approximately 50 cm. The grazing down protocol showed that the short-term herbage intake rate was constant until the depletion of 40% of the optimal pre-grazing canopy height. After this level of depletion, there was a marked reduction in the short-term herbage intake rate. The results show that the best target management height in a *Sorghum* cv. BR 501 pasture, allowing for high levels of the short-term herbage intake rate, is 50 cm. With intermittent stocking, this level should be considered as the pre-grazing canopy height, and the level of herbage depletion should not exceed 40%.

1. Introduction

In addition to grazing, the daily activities of an animal include a host of other essential activities that are essential to their survival (e.g., rumination, vigilance and idling). Therefore, management actions that provide an increase in the herbage intake rate, with the consequent reduction of the time necessary to achieve their daily nutrient requirement, is

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essential for successful animal production (Carvalho et al., 2001).

Maintaining high rates of herbage intake requires the provisioning of appropriate sward structures. In the case of tropical swards, bulk density is one of the structural characteristics that determines the herbage intake rate by grazing animals (e.g., Brereton and McGilloway, 1998; Hodgson, 1985; Laca et al., 1992; Stobbs, 1975). Thus, the sward structure should be seen as a management target as it directly influences the herbage intake rate and, consequently, animal production (Gordon and Benvenutti, 2006; Hodgson, 1990). The canopy height is one of the structural sward variables that affect the short-term herbage intake rate (Carvalho et al., 2001; Forbes, 1988). For both continuous and intermittent stocking, the canopy height is an important management variable. With continuous stocking, the animals rarely take consecutive bites on the vertical stratum, while with intermittent stocking, the animals graze down the sward during grazing periods, changing the sward structure (Charnov, 1976). Severe grazing reduces the mass of green leaves and stems but increases the proportion of leaves to stems (Barret et al., 2001; Gregorini et al., 2011). As a consequence of herbage depletion, the foraging dynamics are altered and the short-term herbage intake is reduced (Barret et al., 2001; Baumont et al., 2004).

In this study, two experiments were performed based upon the hypothesis that different sward structures, formed by distinct canopy heights and levels of grazing down, influence the short-term herbage intake rate of cattle. The first experiment defined the ideal canopy height for grazing with short-term herbage intake maximisation to define the management target. The second experiment investigated the ideal level of herbage depletion using the same criterion. The experimental model is used to propose management targets with applications for intermittent and continuous stocking methods.

2. Material and methods

2.1. Experimental area

Two experiments were carried out at the Research Station of the Federal University of Rio Grande do Sul, Brazil (30º05′27″S, 51º40′18″W). An area of 5500 m^2 of *Sorghum bicolor* cv. BR 501 sown in December 2009 was used for experiment 1, and another area of 4820 m^2 of the same cultivar sown in February 2010 was used for experiment 2. Both pastures were no-tillage sod with a sown density of 33 kg ha^{-1}. The distance between rows was 0.17 m. Nitrogen, phosphorus and potassium were applied uniformly in the area twice: at sowing (20 kg N ha^{-1}, 100 kg P_2O_5 ha^{-1} and K_2O ha^{-1}) and after 20 days (200 kg N ha^{-1}).

2.2. Treatments

Experiment 1 consisted of six pre-grazing canopy height treatments (30, 40, 50, 60, 70 and 80 cm) with two replicates in a randomised block design ($n=12$). Based upon the best pre-grazing canopy height set in experiment 1, the percentages of grazing down in experiment 2 were set at 16, 33, 50, 67 and 84%, equidistant among treatments. Experiment 2 had a randomised block design with three replicates ($n=15$). In both experiments, the blocking criterion was the time of day for the evaluation (morning and afternoon). The area for experiment 1 was scaled so that the canopy height remained relatively constant over the grazing period, such that the same sward structure was available for the animal both at the beginning and at the end of the grazing test. That is, the aim was for the sward structure, at the bite level, to remain constant over the entire grazing period. Twelve grazing tests of 45 min each were conducted between January and March 2010. The grazing period was defined as the minimum period of time necessary to detect weight fluctuations accurately with an electronic balance during the evaluation of the short-term herbage intake rate (adapted from Penning and Hooper, 1985).

For experiment 2, the paddocks were scaled so that the percentage of grazing down was achieved within approximately 45 min. To determine the area necessary for each treatment, a grazing test of 45 min was performed in an adjacent paddock with an area of 100 m^2. The canopy height was measured every 10 min during the grazing period, and calculations were based upon the percentage of grazing down in that defined 100 m^2 area to define the ideal area for each treatment. Fifteen grazing tests of 45 ± 5 min in April 2010 were performed. In both experiments, all tests were performed in the early morning and late afternoon.

2.3. Sward measurements

In both experiments, strata were cut every 10 cm using a 0.153 m^2 quadrat to determine the pre-grazing herbage mass. Five cuts were made in experiment 1 per experimental unit, whereas there were three such cuts for experiment 2 at ground level. In experiment 2, the post-grazing herbage mass was also sampled in 0.25 m^2 quadrats. The samples were separated into damaged herbage mass (e.g., pieces of broken or trampled plants) and intact herbage. All samples were separated into leaf lamina, stem and dead material and were then weighed. Next, they were dried at 55 °C for at least 72 h to determine the dry matter (DM) content. The total herbage mass was determined as the sum of the mass of each component (damaged or intact). To determine the canopy height, a *sward stick* was used to measure 200 points per experimental unit both pre- and post-grazing (Barthram, 1985).

2.4. Animal measurements

Four heifers were used in experiment 1 (24 ± 2 months and 306 ± 56.7 kg of live weight (LW)). Three of these animals were used in experiment 2 (26 ± 2 months old and 339 ± 45.5 kg LW). Approximately 30 days before each experiment, the animals were adapted to the experimental procedure and remained in an adjacent paddock with a *Sorghum* sward. In experiment 1, the animals were non-fasted before the grazing tests because such a method may increase the herbage intake rate (Gregorini et al., 2009b) and reduce diet selection (Newman et al., 1994). In experiment 2, the animals were fasted from solids for 5 h before each grazing test. Although it is known that hunger may change the bite dimensions and herbage intake rate (Gregorini et al., 2009b), the animals were fasted to ensure that they grazed down the total percentage intended. The fasting period was similar in all treatments, permitting valid comparisons.