Influence of ryegrass alone or blended with clover and chicory on feed intake and growth performance of steers

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Abstract

The purpose of the experiment was to compare the influence of a sward of four species (FS) with that of a perennial ryegrass monoculture (RG) on feed intake and growth of fattening steers. The FS sward was sown with a mixture of 50% perennial ryegrass, and 50% chicory, white clover and red clover (in a ratio of one-third each); in the case of both the FS and the RG sward, half was used for cutting (C) and half as grazed pasture (P). Over 8 cycles, each lasting 2 weeks, two groups, each consisting of 3 Angus (AN) and 3 Limousin (LM) steers, ingested either the FS mixture or the RG, and then the opposite, in turn, with a change of system (C and P) every other cycle. The intake, weighed in the stable (C) and estimated at pasture using the n-alkane double-indicator technique, was significantly higher for the FS forage in the case of both C and P (P=0.022). In contrast, the daily growth was highest with the RG forage (P=0.036), pointing to better feed conversion efficiency, expressed in kg DM intake per kg average daily gain (ADG). A lower gut content and consequently a lower body weight at the end of the 14-day periods of FS intake is the likely explanation for these unexpected results because the lower NDF content of the FS forage probably increased its transit rate.

Keywords: multispecies, sward, pasture, cutting, beef steers, intake, growth

Introduction

Grassland systems can make a vital contribution to meeting the various challenges facing agriculture today, which include limiting the impact on the environment, preserving or increasing biodiversity, supporting sustainable development and preserving landscapes while continuing to produce high-quality food. Against this background, the use of forage areas in the form of grazed pasture responds to ethical needs (consumer wishes, closeness to nature), technical requirements (absence or restriction of the use of commercial nitrogen fertilizers) and economic needs (Peyraud and Baumont, 2002; Roinsard, 2011). Similarly, the plant species composition of swards may constitute an increasingly important lever in the future, particularly in terms of safeguarding forage systems against climate change. The importance of the complementarity of different species has been noted in many reports that have stressed, for example, the benefits of different root systems (Fustec *et al.*, 2010), the improvement in nutritional value (Rodriguez *et al.*, 2007; Niderkorn *et al.*, 2008) and the better ingestibility (Roinsard, 2011), as well as the more stable yield (Fustec *et al.*, 2008). Among the animals with the potential to optimize the use of these pastures, fattening cattle offer the greatest intake potential after dairy cows. Differences between breeds may be found, as illustrated by Dufey *et al.* (2002) in a comparison of 6 beef breeds. The objective of this experiment, carried out in the framework of the EU Multisward project (www.multisward.eu), was to compare two different swards (multi-species and monoculture), using two systems (pasture and stable) and steers of two different breeds (Angus and Limousin), in terms of growth performance.

Materials and methods

The experiment was performed on the experimental farm of Agroscope at Posieux (650 m altitude) from 27 April to 17 August 2012. A mixture of four species (treatment FS) comprising perennial ryegrass (*Lolium perenne*) cv. Alligator, white and red clovers (*Trifolium repens* and *pratense*) cv. Hebe and Dafila, and chicory (*Cichorium intybus*) cv. Puna II, was sown in August

2011 on a plot of 2 ha. The quantities sown were 17.5, 2.67, 2.74 and 1.09 kg/ha respectively, corresponding to ½, 1/6, 1/6 and 1/6 respectively of the usual quantity sown to grow a monoculture of the individual species. In parallel, a monoculture of perennial ryegrass (*Lolium perenne*) cv. Alligator (treatment RG) was sown on an adjacent plot of 2 ha at the rate of 35 kg/ha. Half of the 2 ha of each plot was intended for cutting and the other half as grazed pasture. To ensure that the sward established well, the first application of mineral fertilizer in the spring of the year of the experiment was doubled for the RG treatment to 54 kg N ha^{-1}, compared to 27 kg for the FS treatment. This had been preceded by an application of 40 kg N in the form of organic fertilizer. Subsequently, during the period of the experiment, a total of 81 kg N was applied in three applications of 27 kg each to both of the swards, giving a total for the year of 148 kg N for the FS treatment and 175 kg N for the RG treatment.

Six Angus (AN) and six Limousin (LM) steers produced from suckler cows, aged 14.2 months and weighing 447±33 kg, were divided into two groups each consisting of 3 AN and 3 LM cattle. During a total of eight consecutive two-week cycles, the two groups were kept either in a stable or at pasture, with a change of system every other cycle. One of the groups received the RG treatment and the other the FS treatment during the first cycle of a system; then the treatments were reversed for the second cycle. During the periods in the stable, forage was provided *ad libitum* and the daily forage intake was measured individually using feed containers mounted on electronic weighing machines (Insentec B.V., Marknesse, The Netherlands). The first 3 days of each cycle served as an adaptation period in both systems. The results of intake in the stable are based on the last 11 days of a cycle. In parallel, as well as during grazing periods, the intake of forage was estimated using the n-alkane double indicator technique. In each cycle, n-alkane HC32 was dosed orally in a gelatine capsule twice-daily during 11 days. Faeces were collected by rectal sampling twice-daily, from day 8 to day 11. During grazing, the same DM quantity of forage was offered each day to the two groups of animals. This quantity was calculated on the basis of biomass quantity measured each week on the test plots, taking account of the grass growth measured with an electronic rising plate meter (Jenquip, Feilding, New Zealand). During the first two and the last two cycles of grazing, the quantity offered was equal to 94% and 96%, respectively, of the average intake measured in the stable during the previous cycle. The animals were weighed before the start of each new cycle and at the end of the last cycle. The data were analysed using a General Linear Model (NCSS 2007, Dr. Jerry L. Hintze, Kaysville, Utah).

Results and discussion

Intake in the stable *(ad libitum)* was higher in the FS treatment than in the RG treatment (9.23±0.85 compared to 8.84±0.82 kg DM per animal per day) for an average of 4 cycles (P=0.002). The correlation with intake estimated by the HC31-HC32 n-alkane marker pair was more reliable than with the HC33-HC32 marker pair (R^2=0.71 compared to 0.59). The analysis of intake over the whole experimental period (4 cycles in the stable and 4 cycles at pasture) was therefore based on the estimate obtained with the HC31-HC32 marker pair. With a difference of 0.4 kg of DM in favour of FS compared to the RG treatment, the significant effect measured in the stable was confirmed (8.28±1.70 compared to 7.88±1.55; P=0.022). These results support the findings of Baumont *et al.* (2008), Ginane *et al.* (2008) and Roinsard (2011), who observed an associative effect between different species such as grasses and legumes, which was positive in terms of ingestibility. In the stable the trend was for the DM intake of the LM cattle to be 7% (0.64 kg) lower than in the case of the AN (P=0.095). This difference was less marked over all the cycles combined, with an average intake of 7.91±1.45 kg DM d^{-1} for the LM breed compared to 8.26±1.78 for the AN breed. This trend is in agreement with the results of Dufey *et al.* (2002), who observed an 8% lower intake for LM cattle compared to AN cattle (n.s.), and with results published by Faverdin *et al.* (1997), who concluded that the LM breed has a 10% lower intake

capacity than the other breeds. With a gap of nearly 320 g ADG in favour of RG, there was a statistically significant difference between sward treatments in the stable cycles (1535±526 g/d for FS compared to 1852±594 g/d for RG; P=0.003). This disadvantage of the FS sward type was confirmed when results were averaged over the eight experiment cycles (stable and pasture), with a reduction in ADG of 21% compared with the RG sward (746±1094 g/d for FS compared to 943±1164 g/d for RG; P=0.036). No significant effect of cattle breed was observed. This lower animal growth for the FS treatment in spite of a higher intake indicates a much less-efficient feed conversion efficiency (6.94 kg DM per kg ADG for the FS treatment, cf. 5.29 kg DM per kg ADG for the RG treatment; P=0.001). A lower gut content and consequently a lower body weight at the end of the 14-day periods of FS intake is the most likely explanation for these unexpected results because the lower NDF content of the FS forage probably increased its gut transit rate.

Conclusion

Supplying a mixture of four forage species to cattle both in the stable and at pasture resulted in increased intake compared with a monoculture of perennial ryegrass. The results of daily weight gain and feed efficiency showed an apparent negative effect of the four-species mixture which could not be explained conclusively. Feeding trials without changing the type of forage would elucidate this issue and help to optimize the composition of the mixture with a view to improving the efficiency of forage utilization in cattle.

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