Dry matter yield of perennial ryegrass cultivars under mechanical cutting and animal grazing

Patrick A Cashman [AB], Trevor J Gilliland [AC], Michael O'Donovan [A], Marion Beecher [AD] and Mary McEvoy [A]

[A] Teagasc Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork, Ireland
[B] Queen's University Belfast, Belfast, UK
[C] Agri-food Biosciences Institute, plant testing station, Crossnacreevy, Belfast, BT5 7QJ, UK
[D] University College Dublin, Belfield, Dublin 4, Ireland
Contact email: patrick.cashman@teagasc.ie

Keywords: Perennial ryegrass, evaluation, grazing, yield.

Introduction

Perennial ryegrass evaluation trials are essential to identifying and promoting the most productive cultivars for use at farm level to maximise sward productivity (Grogan and Gilliland 2011). Cultivar testing is predominantly conducted under simulated grazing trials to predict dry matter yield (DMY) performance under animal grazing. Previous studies have shown a high correlation in DMY between these two defoliation methods (Camlin and Stewart 1975; Creighton *et al.* 2010). In contrast, Binnie and Chestnutt (1991) demonstrated that swards grazed by animals had higher DMY performance than those exposed to simulated grazing managements. Animal pressures such as pulling, treading and nutrient return are not present in a simulated grazing management. The objective of this study was to determine if a relationship exists between the DMY of perennial ryegrass cultivars exposed to mechanical cutting compared to animal grazing.

Materials and Methods

Two experiments were conducted over three years 2009 to 2011, inclusive, at the Animal and Grassland Research and Innovation centre, Teagasc Moorepark, Fermoy, Co. Cork (52º16'N; 8º26'W). The soil type was a free draining acid brown earth of sandy loam texture. The two experiments were located side-by-side. Ten cultivars of perennial ryegrass were selected, with an equal number of diploid (D) and tetraploids (T). The cultivars and their heading dates were: Spelga (D; 24 May), Magician (T; 24 May), Aberstar (D; 30 May), Astonenergy (T; 31 May), Abermagic (D; 28 May), Dunluce (T; 31 May), Tyrella (D; 1 June), Navan (T; 8 June), Millenium (D; 11 June) and Twystar (T; 16 June). Seed was broadcast onto a fine-firm seedbed at a rate determined by 1000 seed weight; with a target sowing density of 1181 seeds per m^2.

Experiment 1

The study used a randomised block design with three replicates. The experiment consisted of 30 plots, laid out in 3 blocks. Each plot was 9 m^2 (6 m ×1.5 m). The treatment imposed was simulated grazing (SG). The simulated grazing commenced with defoliation on 4 February with a second defoliation on 4 April. Subsequent defoliations took place at 3 week intervals until defoliation 9 and 10 at 4 and 5 week intervals, respectively. A total of 10 defoliations were conducted each year.

Experiment 2

The management imposed was animal grazing (AG). The study had a randomised block design with three replicates, consisting of 30 plots laid out in 3 blocks. Plot size was 27m^2 (9 m ×3 m). Plots were defoliated using lactating dairy cows on the same dates as cutting occurred in Experiment 1.

Sward measurements

In each year, across both experiments dry matter (DM) yield was determined at each defoliation. In Experiment 1 plots were completely defoliated using a mechanical mower to a height of 4 cm (Etesia UK Ltd., Warwick, UK). In Experiment 2, a 1.2 m × 4 m strip was harvested with the mechanical mower prior to grazing. The harvested strip was rotated throughout the plot to minimise the effect of mechanical cutting on the grazed plots. All mown herbage within each experiment was collected and weighted, of which a subsample of 0.1 kg sample was dried at 40^{o}C for 48 hrs for DM determination. In Experiment 2, pre and post-grazing sward height was determined at each grazing across all plots, using a rising plate meter with a steel plate (diameter 355 mm and 3.2kg/m^2; Jenquip, Fielding, New Zealand). In Experiment 1, dry matter offtake (DMO) was equal to the recorded yield as the plots were entirely defoliated. The DMO of the grazing cows was determined by calculating the sward density between the sample cutting height and the pre-grazing sward height. The change in height as a result of grazing was then used to calculate the DMO of the animals.

Fertilizer regime

Both Experiment 1 and 2 received similar fertiliser applications. Nitrogen (N) fertiliser, as granulated urea was applied before Cut 1 on 23 January on all plots at a rate of 38 kg N/ha. Following cut 1, 59 kg N/ha of Calcium Ammonium Nitrate (CAN) was applied, with 34.5 kg N/ha

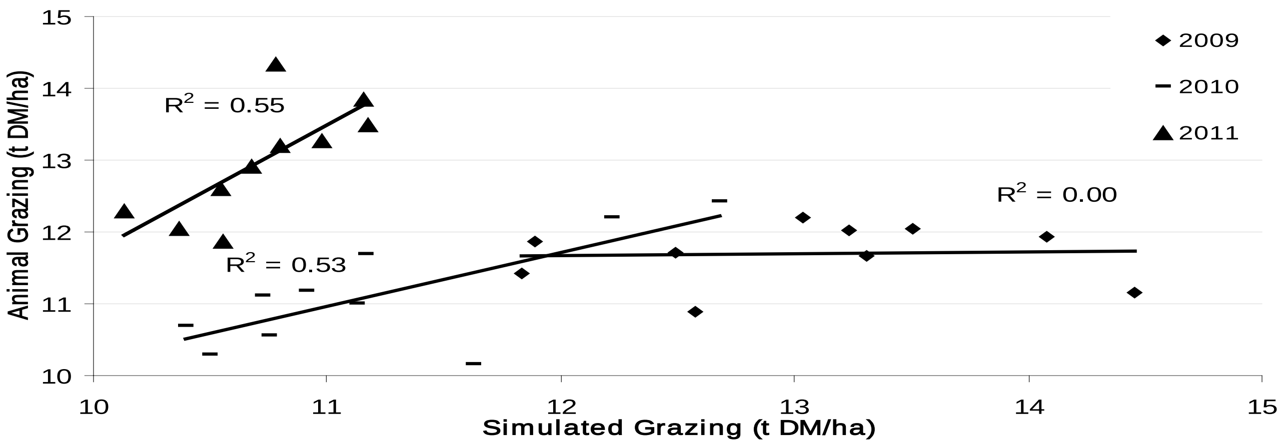

Figure 1. Relationship for dry matter offtake (kg DM/ha) between animal grazing and simulated grazing across three consecutive years.

applied after both cut 2 and 3. Each year 33 kg N/ha was applied after cut 4, 5 and 6; with 27 kg N/ha applied after cut 7 and 8, 35 kg N/ha applied after cut 9. A total of 354 kg N/ha was applied each year in total. Animal faeces were removed from plots in Experiment 2 after each grazing to reduce the effect of animal nutrient returns. Sward offtake data was analysed as two experiments. Analysis was carried out on all variables using Proc Mixed in SAS, with year, cultivar and year × cultivar included in the model for analysis.

Results

A year effect (P<0.001) was detected in both experiments across the 3 years. Dry matter yield was 11.7 and 10.6 t DM/ha per year for AG and SG, respectively. The DMO of the AG treatment was 11.9 t DM/ha, reducing the difference between the experiments to 0.3 t DM/ha. Dry matter offtake in experiment 1 declined by 18% from year 1 to year 3, however, DMO in experiment 2 increased by 11% in the same time period. Within year (Fig. 1) a good relationship was observed between AG and SG in year 2 and year 3 (R^2= 0.53 and 0.55, respectively). In contrast, a poor relationship was observed in year 1 of the experiments; with the mean performance of the cultivars in Experiment 1 out-yielding the DMO of the cultivars in Experiment 2 by 1.3 t DM/ha.

Discussion

Simulated grazing proved to be a good predictor of animal grazing for DMO in 2 of the 3 years. The large year effect confirms that it is essential to carry out cultivar evaluation across years. A poor relationship was evident between animal grazing and simulated grazing in year 1 due to the high DMO performance of the simulated grazing treatment. High growth rates after initial establishment of simulated grazing evaluation trials has been recognised and as a result DMY in the year of establishment is discounted from evaluation as luxury growth (Grogan and Gilliland 2011). However, these results suggest that the first full year of DMY under simulated grazing is also a poor predictor of performance under animal grazing.

Conclusion

Simulated grazing is a good predictor of DMY performance under intensive animal grazing in year 2 and year 3 of evaluation. This suggests the need to ensure perennial ryegrass evaluation trials are sufficiently long to ensure a good estimator of cultivar performance under animal grazing when testing is conducted under simulated grazing.

References

Binnie RC, Chestnutt DMB (1991) Effect of regrowth interval on the productivity of swards defoliated by cutting and grazing. *Grass and Forage Science* **46**, 343-350.

Camlin MS, Stewart RH (1975) Reaction of Italian ryegrass cultivars under grazing as compared with cutting. *Grass and Forage Science* **30**, 121-130.

Creighton P, Kennedy E, Gilliland TJ, Boland T, O'Donovan M (2010) The effect of sward perennial ryegrass content and defoliation method on seasonal and total dry matter production. *Advances in Animal Biosciences* **1**, 149-149.

Grogan D, Gilliland TJ (2011) A review of perennial ryegrass variety evaluation in Ireland. *Irish Journal of Agricultural and Food Research* **50**, 65-81.