The effect of perennial rygrass cultivars and allowance on utilisation, grazing efficiency and milk production

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Abstract

The objective of this study was to investigate the effect of four cultivars (AstonEnergy, Delphin, Glenroyal and Tyrella) on sward utilisation, milk production and grazing efficiency of lactating dairy cows at two daily herbage allowances (DHA) during the vegetative growth phase. Four cultivars were compared by offering cows two levels of DHA 15 and 20 kg dry matter (DM) cow^{-1} day^{-1} (>4cm), resulting in 8 treatments. Increasing herbage allowance from 15 to 20 kg DM cow^{-1} day^{-1} increased milk yield and solids, but reduced sward utilisation with grazing efficiency being unaffected. AstonEnergy had a longer free leaf lamina (P<0.001; + 4.6 cm) but also higher leaf (P<0.001; + 0.14) and lower stem (P<0.01; -0.08) than Glenroyal. This resulted in a higher sward utilisation (P<0.001; +12%) milk yield (P<0.05; +1 kg) and milk solids (P<0.05; +0.1 kg) than Glenroyal. Delphin was most similar to AstonEnergy in sward structure and gave similar sward utilisation and milk production, whereas Tyrella was broadly equivalent to an average of the examined cultivars and also supported an intermediate milk output. Cultivars with longer free-leaf-lamina and higher leaf content were associated with reduced number of grazing bites (P<0.05) and ruminating time (P<0.001).

Keywords: ryegrass, grazing, milk production, sward utilization

Introduction

Improved efficiency of animal production from grass is the ultimate goal of forage grass breeding for most temperate regions (Wilkins and Humphreys, 2003). Perennial ryegrass cultivars form the basis of pasture production in many temperate regions. Sward structure can vary between cultivars and has been shown to affect milk production of grazing dairy cows (Wims *et al.*, 2013), though a significant effect on milk production does not always occur (Tas *et al.*, 2006). In addition to affecting milk production, sward structure is also an important determinant of grazing efficiency (O'Donovan *et al.*, 2004) even more, where cows are managed on intensive intervals of rotational grazing which require rapid removal of herbage. Confirmation and quantification of animal responses to sward structural differences is a critical step in comparing perennial ryegrass cultivars for on farm performance. The objective of this study was to compare the milk production performance of dairy cows when grazing four perennial ryegrass cultivars varying in sward structure at two herbage allowances.

Materials and methods

Four perennial ryegrass cultivars comprising two diploids (D) and two tetraploids (T) were sown as monocultures. Cultivars included AstonEnergy (T), Delphin (T), Glenroyal (D) and Tyrella (D). Seven cows (two primiparous and five multiparous) were assigned to each cultivar during the vegetative growth phase (1 July to 28 July) at two herbage allowances: 15 and 20 kg dry matter (DM) cow^{-1} day^{-1}. This resulted in 8 treatments (4 cultivars × 2 allowances). Cows were blocked based on lactation number (3.0), milk yield (18.5 kg d^{-1}), milk solids (1.4 kg d^{-1}), protein (33.7 g kg^{-1}), fat (40.5 g kg^{-1}) and lactose (47.6 g kg^{-1}), and body weight (549 kg) and body condition score (3.0; based on a scale of 1 to 5, 1 = emaciated,

5 = extremely fat). Fresh grass was allocated to cows daily. Pre- and post-grazing sward heights were measured daily (50 heights per treatment) directly before and after grazing using a rising plate meter with a steel plate (diameter 355 mm, 3.5 kg m^{-2}; Jenquip, Fielding, New Zealand). Pre-grazing free-leaf-lamina (FLL) was measured from the highest ligula (longest leaf sheath) to the top of the leaf using a hand-ruler on 100 random tillers across each offered treatment twice weekly. Approx. 40 g of representative herbage was sampled from each treatment twice weekly to ground level; samples were then cut to the weekly post-grazing height per respective treatment and separated manually into leaf and stem fractions. Fractions were then dried for 16 h at 90 °C for DM determination. Grazing behaviour was estimated by fitting all cows simultaneously with an Institute of Grassland and Environmental Research (IGER) headset behaviour recorder after morning milking and removed prior to the morning milking 24 hours later. Individual milk yields were recorded at individual AM and PM milking. Milk solids (protein, fat and lactose) were measured twice weekly. Animal variables were analysed using PROC MIXED in SAS (2011), with grass allowance, cultivar, their interactions and pre-experiment covariate included in the model as fixed effects and animal included as a random effect.

Results and discussion

There was no cultivar × allowance interaction for any of the sward, animal or grazing efficiency variables in this study. Cows allocated 15 kg DM had a higher pseudostem proportion (P<0.05; +0.2) in the grazed sward compared to the 20 kg DM daily herbage allowances (DHA) grazed swards. Herbage allowance of 20 kg DM resulted in a lower utilisation (P<0.001; -23%), higher post-grazing height, longer post-grazing FLL and SH (P<0.001; +1.1 cm, +1.5 cm, +0.9 cm, +0.7 cm) of the grazed swards in comparison to the 15 kg DM DHA swards (Table 1). As a result, cows on the higher DHA produced significantly more milk yield and milk solids (P<0.001; +1.6, +1.1 kg day^{-1}). Although the four varieties had a similar herbage mass (kg DM above 4 cm from 12 m^2, not shown), AstonEnergy and Delphin were grazed to a lower residual height (4.1, 4.2 cm) compared to the highest, Glenroyal (+0.6 cm; P<0.001). AstonEnergy also had higher FLL (P<0.001), higher leaf (P<0.001) and lower stem (P<0.05) contents than Glenroyal. Importantly, AstonEnergy supported a higher milk yield (+1 kg cow^{-1} d^{-1}; P<0.05) and milk solids (+0.1 kg cow^{-1} d^{-1}; P<0.05) than Glenroyal. Delphin was most similar to AstonEnergy in sward structure and gave the same milk production, whereas Tyrella was broadly equivalent to an average of the examined cultivars and also supported an intermediate milk output. This is in agreement with O'Donovan and Delaby (2005) stating that cultivars producing a higher green leaf allowance impact positively on milk production. Cows grazing AstonEnergy with a longer FLL and higher leaf:stem ratio had significantly less grazing bites (P<0.001; -7083) than cows grazing Glenroyal which had increased ruminating mastications (P<0.001; +6717) compared to the other three cultivars averaging 32,329 (Figure 1). Higher stem content resulted in failure to break the barrier of standing stem despite elevated

Table 1. The effect of perennial ryegrass cultivars and herbage allowance on milk production and solids, post-grazing sward height, pre-grazing free-leaf-lamina, leaf and stem proportion and sward utilisation.

Herbage DM allowance	15 kg	20 kg	Aston[1]	Delphin	Glenroyal	Tyrella	SED	Allowance	Cultivar
Milk yield (kg cow^{-1} d^{-1})	15.1^{a}	16.7^{b}	16.3^{a}	16.3^{a}	15.3^{b}	15.7^{ab}	0.26	***	*
Milk solids (kg cow^{-1} d^{-1})	1.24^{a}	1.35^{b}	1.31^{a}	1.35^{a}	1.23^{b}	1.28^{ab}	0.03	***	*
Post-grazing SH (cm)	3.8^{a}	4.9^{b}	4.1^{a}	4.2^{a}	4.7^{c}	4.4^{b}	0.19	***	***
Pre-grazing FLL (cm)	17.5	17.5	18.7^{ab}	19.9^{a}	14.1^{c}	17.4^{b}	0.37	NS	***
Leaf (%)	74.0	77.0	82.0^{a}	78.5^{ab}	68.0^{c}	74.0^{b}	0.01	NS	***
Stem (%)	17.0	15.0	12.0^{a}	15.5^{ab}	19.5^{b}	16.0^{b}	0.01	NS	*
Utilisation (%)	105^{a}	82^{b}	99^{a}	96^{a}	87^{c}	92^{b}	0.01	***	***

[1] Aston = AstonEnergy.

$^{a-c}$ Means within a row with different superscripts differ (P<0.05).

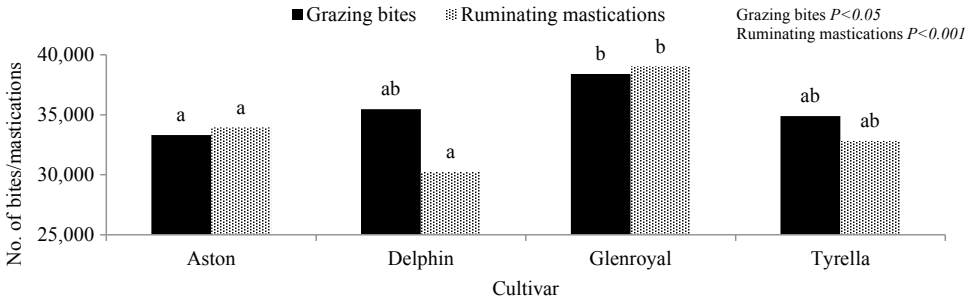

Figure1. The effect of cultivar on grazing bites and ruminating mastications of grazing dairy cows.

grazing pressure (Parga *et al.*, 2000) and impacted negatively on rumination process (Van Soest *et al.*, 1991) in turn reducing milk production.

Conclusions

To conclude, increased herbage allowance increases milk production but reduces sward utilisation significantly. Variations in sward structure in particular free leaf lamina between grass cultivars influence sward utilisation. When sward structural characteristics such as leaf : stem ratio and free leaf lamina length coupled with digestibility are differing by the magnitudes observed in this study between the four cultivars, milk production and grazing efficiency of grazing dairy cows are influenced. Improving cultivar sward characteristics such as leaf:stem ratio and free leaf lamina have the potential to improve overall efficiency of the conversion of grass to milk and improve grazing efficiency.

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