In vitro methane output of perennial ryegrass produced under four grazing management regimes and sampled throughout the growing season

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Introduction Enteric methane (CH_4) production represents a loss of 0.02 to 0.12 of gross energy intake by ruminants. It is also one of the main greenhouse gases (GHG's) contributing to global warming being responsible for approximately 0.2 of the GHG effect. Understanding the impact of diet on enteric CH_4 production can help identify viable GHG reduction strategies on dairy farms. This study determined the effects of level of herbage mass (HM), level of sward allowance (SA) and stage of the growing season on the *in vitro* CH_4 output of perennial ryegrass grown under a well managed Irish dairy production system.

Material and methods Perennial ryegrass was produced throughout the 2008 growing season under four management regimes- two levels of HM (high ~ 2400 and low ~ 1600 kg DM / ha) and two levels of SA (high ~ 20 and low ~ 15 kg DM / cow per day) in a 2 x 2 factorial arrangement of treatments. Dairy cows were rotationally grazed throughout the grazing season with samples taken during five 4-week grazing periods (GP; 10 April to 8 May, 22 May to 19 June, 3 July to 31 July, 15 Aug to 12 Sept and 25 Sept to 23 Oct). Inocula for the *in vitro* total gas production (TGP) assay was obtained from the solid and liquid portions of the rumen contents of four rumen fistulated steers. After being filtered, the inoculum was used in the assay as described by Theodoru *et al.* (1994) and modified by Mauricio *et al.* (1999). Methane and volatile fatty acid (VFA) concentrations were measured using gas chromatography. The data were analysed using a model that accounted for the effects of HM, SA, HM x SA, and stage of season (repeated measures), and accounted for the correlations over time. As the data were not equally-spaced in time a spatial covariance structure was used.

Results and Discussion Grass fibre content and *in vitro* rumen fermentation characteristics are summarised in Table 1. Both TGP /g DM incubated and digested were lower for the high compared to the low SA treatment ($P<0.05$). No other variables were affected by the level of SA. The effect of high HM on CH_4 output corresponded with a reduction in DM disappearance. As fibre content was unaffected by HM, it is likely that the effect on CH_4 output were due to changes in fibre digestibility. Although there were no clear relationships between TGP or CH_4 output and the carbohydrate fraction of the herbage, CP was highest ($P < 0.01$) during GP 3 and 4, when CH_4 output was at its lowest.

Table 1 Grass NDF content and *in vitro* rumen fermentation characteristics

	NDF (g/kg DM)	ml TGP/g DM inc[1]	ml TGP/g DM dig[2]	ml CH_4/g DM inc[1]	ml CH_4/g DM dig[2]	ml CH_4/l TGP	Total VFA	A:P[3] ratio	aDMD[4]	pH
HM										
Low	397	180	225[a]	46[a]	57[a]	108[a]	50	1.63	807[a]	6.58[a]
High	404	184	232[b]	47[b]	60[b]	111[b]	50	1.62	794[b]	6.56[b]
SEM[5]	3.8	1.5	1.8	0.4	0.7	0.9	0.2	0.015	4.2	0.006
P value	0.175	0.099	0.010	0.013	<0.005	0.046	0.893	0.454	0.031	0.013
GP										
1	351[c]	197[a]	236[a]	50[a]	59[ab]	111[ab]	58[a]	1.46[d]	838[a]	6.54[b]
2	412[ab]	184[b]	241[a]	48[ab]	62[a]	113[a]	50[b]	1.63[bc]	786[c]	6.58[ab]
3	403[b]	182[b]	223[b]	44[c]	54[c]	105[c]	50[b]	1.62[c]	817[b]	6.60[a]
4	426[a]	171[c]	221[b]	44[c]	57[bc]	108[cb]	46[c]	1.68[ab]	777[c]	6.57[ab]
5	409[ab]	174[c]	221[b]	46[bc]	59[ab]	112[ab]	47[c]	1.73[a]	786[c]	6.57[ab]
SEM[5]	6.3	2.6	2.9	0.8	1.1	1.6	0.7	0.020	6.8	0.012
P value	<0.001	<0.001	<0.001	<0.001	0.001	0.008	<0.001	<0.001	<0.001	0.030

[a-d] Means within a factor within a column with different superscripts differ ($P < 0.05$); [1] incubated; [2] digested; [3] acetate : propionate; [4] apparent dry matter disappearance (g / kg DM); [5] standard error of the mean;

Conclusions An increase in HM increased TGP and CH_4 output and reduced apparent DM disappearance. Both TGP /g DM incubated and digested were lower for the high compared to the low SA treatment. Stage of season had an effect on all dependant gas and methane variables, most likely due to the observed changes in the chemical composition of the grass samples.

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