

Effect of sward maturity on the dry matter intake, enteric methane emission and milk solids production of pasture grazed dairy cows

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Introduction Methane (CH₄) from ruminant digestion is the largest source of greenhouse gases (GHG) from Irish milk production systems and is estimated to represent 46% of the total GHG cost of milk production (Deighton *et al.*, 2009). Pasture management decisions, such as grazing rotation length, can enable farmers to improve the quality of pasture available to the grazing dairy herd. Any reduction in the CH₄ emission from grazed pasture arising from an improvement in quality could be exploited immediately to improve the GHG efficiency of pasture based milk production. This study provides a direct comparison of the pasture intake, CH₄ emission and milk production of Holstein Friesian (HF) dairy cows grazing permanent perennial ryegrass (*Lolium perenne*) pastures of contrasting maturity and pre-grazing herbage mass.

Material and methods The study was conducted in Co. Cork, Ireland during the 2009 grazing season. Spring calving HF cows (n = 46) were allocated to treatment via a completely randomised design. Dietary treatments applied were low maturity pasture (LMP) or high maturity pasture (HMP) with pre-grazing growth periods of 14 and 24d respectively. Treatments were imposed from mid-April while measurements of pasture intake, enteric CH₄ emission and milk production were replicated during June and July. Pre-grazing pasture height was measured via plate meter and samples were collected to determine sward mass and composition above 4cm. Individual pasture intake was determined via the *n*-alkane technique (Dillon and Stakelum, 1989). Simultaneously the CH₄ emission of each cow was measured via the sulphur hexafluoride (SF₆) tracer technique as described by Johnson *et al.*, (2007), with equipment modifications for free ranging dairy cattle. SF₆ permeation tubes were calibrated over an 8 week period, blocked by emission rate (mean 7.22 mg/d, SD 0.50) and randomly allocated. Samples were collected continuously for 120h in each period and concentrations of CH₄ and SF₆ were determined via gas chromatography. Milk yield was recorded twice daily (07.00 and 16.00h), composition was calculated from two successive AM and PM samples during each period. Data were analysed using the MIXED procedure of SAS (SAS Inst., Cary, NC). The linear model included diet, month and diet x month as fixed effects with cow as a random repeated effect.

Results The extended re-growth period significantly increased herbage mass of HMP in both months (P < 0.001). Mean herbage accumulated was 1076 vs. 2045 and 1074 vs. 1941 kgDM/ha for LMP vs. HMP during June and July respectively. Swards comprised similar proportions of leaf:stem:dead matter during June (LMP 73:19:8 vs. HMP 65:21:14), however, in July HMP displayed greater reproductive composition with a 13% higher proportion of stem than LMP (LMP 79:12:9 vs. HMP 62:25:13). Cows fed LMP emitted 9.4% less CH₄/d and 11.5% less CH₄/kg intake than those fed HMP. CH₄ emission per kg intake increased by 20% between June and July across both treatments (Table 1). A significant diet x month interaction resulted in a greater effect of pasture maturity upon CH₄/kg milk solids yield during July than during June due to a larger increase in daily CH₄ emission and decrease in MS yield of HMP cows compared to their LMP counterparts.

Table 1 Effect of sward maturity on enteric CH₄ emission, intake and milk solids yield of pasture grazed cows.

	Diet				Month				Diet x Month
	LMP [†]	HMP [†]	SED [‡]	Sig.	June [†]	July [†]	SED [‡]	Sig.	Sig.
CH ₄ emission (g/cow/d)	276	304	13.4	*	282	298	10.4	*	NS
Dry matter intake (kg/cow/d)	15.8	15.5	0.85	NS	16.6	14.7	0.63	***	NS
Milk solids yield (kg/cow/d)	1.43	1.38	0.08	NS	1.54	1.26	0.07	***	NS
CH ₄ /kg dry matter intake (g/kg)	18.0	20.3	0.86	*	17.4	20.9	0.75	***	NS
CH ₄ /kg milk solids yield (g/kg)	199	231	11.3	**	186	244	8.97	***	**

[†]Least squares means; [‡]Standard error of the difference between means; Significance: *** = P<0.001; ** = P<0.01; * = P<0.05; NS = not significant.

Conclusions Significant relationships exist between pasture maturity and CH₄ emissions per cow and per unit intake. CH₄ emission per unit milk solids yield was also significantly effected by pasture maturity. This effect was greatest during July (mid summer), coinciding with increased reproductive composition of the HMP relative to LMP. Managing swards to maintain low herbage mass and high leaf:stem ratio represents a simple yet potentially important tool in optimising the GHG efficiency of milk production from pasture, particularly during periods of the grazing season when grass plants exhibit reproductive growth.

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References

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