Mitigating enteric methane emissions: impact of nutritional quality of grass herbage and grass silage

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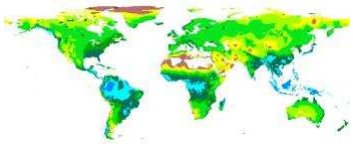
Grass and enteric methane production



- Grass is main feed base to produce milk
- Conflicting evidence on relationship grass quality and enteric CH_4 production
  - significant effects grass quality on in vitro CH_4 production (Navarro-Villa et al., 2012)
  - minor effect grass quality on CH_4 per unit feed in sheep and cattle (SF_6 / respiration chamber; Clark, 2013)
  - mechanistic models indicate significant effects grass quality on CH_4 production (Ellis et al., 2012)

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Grass and enteric methane production

Objective: evaluate effects of fertilisation rate, grass maturity and feed intake level on enteric CH_4 production of dairy cattle

- 3 experiments with 18 dietary treatments
  - 4 grass herbage treatments
  - 14 grass silage treatments
  - 132 individual cow observations in respiration chamber
- CH_4 yield (% gross energy) and intensity (g/kg milk)

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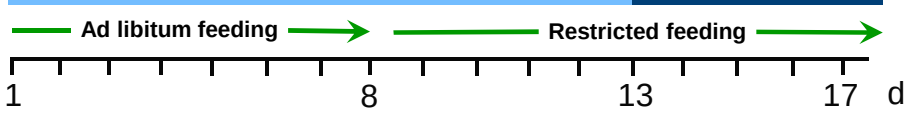
Experimental set-up



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Exp 1: grass herbage (85% diet DM) - effect of N fertilization & maturity

	Treatment				*P*-value	
	low fertil.		high fertil.		fertil.	maturity
	early	late	early	late		
OM dig. (%)	77.0	74.0	83.6	79.6	<0.01	<0.01
FPCM (kg/d)	21.1	16.8	22.6	21.2	<0.01	<0.01
CH_4 (% GE)*	6.5	6.4	6.7	7.1	0.07	NS
CH_4 (g/kg FPCM)	14.9	17.4	14.6	16.2	NS	0.02

* IPCC default 6.5%

Warner et al. (2015) J Dairy Sci

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Exp 2: grass silage (80% diet DM) - effect of N fertilization & maturity

	Treatment						*P*-value	
	low fertil.			high fertil.			fertil.	mat.
	early	mid	late	early	mid	late		
OM dig. (%)	80.6	79.5	73.9	80.3	80.0	72.1	NS	<0.01
FPCM (kg/d)	28.8	22.4	21.4	26.7	25.3	19.7	NS	<0.01
CH_4 (% GE)*	6.7	7.2	7.2	6.4	7.2	7.3	NS	<0.01
CH_4 (g/kg FPCM)	12.8	16.0	16.8	13.2	14.0	17.4	NS	<0.01

* IPCC default 6.5%

Warner et al. (preliminary results)

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Trade-offs other GHG and cost-effectiveness?

- CH_4, N_2O and CO_2 in LCA and farm level LP approach
- Grazing / ensiling grass of lower maturity (±15% lower DM yield/ha) to reduce enteric CH_4
- Strategy compared with adding linseed (1.5 kg/d) or nitrate supplementation (1% diet DM), relative to base

Source (kg CO_2e/t FPCM)	Grass maturity	Nitrate	Linseed
CH_4	-10	-33	-42
Other on-farm GHG	0	+1	-2
Production farm inputs	-1	-1	35
Total emissions	-11	-32	-9
Cost effectiveness (€/t CO_2e)	57	241	2,594

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Van Middelaar et al. (2014)

Conclusions

Significant impact of grass quality on enteric CH_4

- CH_4 yield (% GE and per kg DM intake) not constant
- large variation in CH_4 intensity (per kg FPCM)

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THANK YOU

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