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

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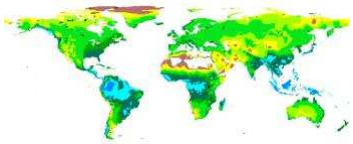
## Grass and enteric methane production



- 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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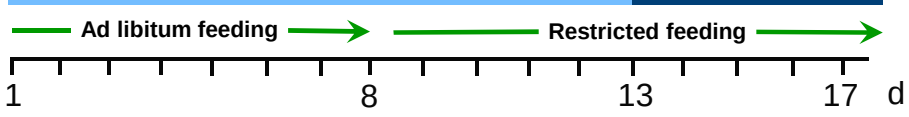
## Experimental set-up

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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 $CO_2$e/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 $CO_2$e) | 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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## Acknowledgements

André Bannink, Geronda Klop, Bayissa Hatew,
Sabrina Podesta, Daniel Warner
Wageningen University – NL

Product Board Animal Feed (NL)
Dutch Dairy Board (NL)
Ministry Economic Affairs (NL)

**THANK YOU**

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