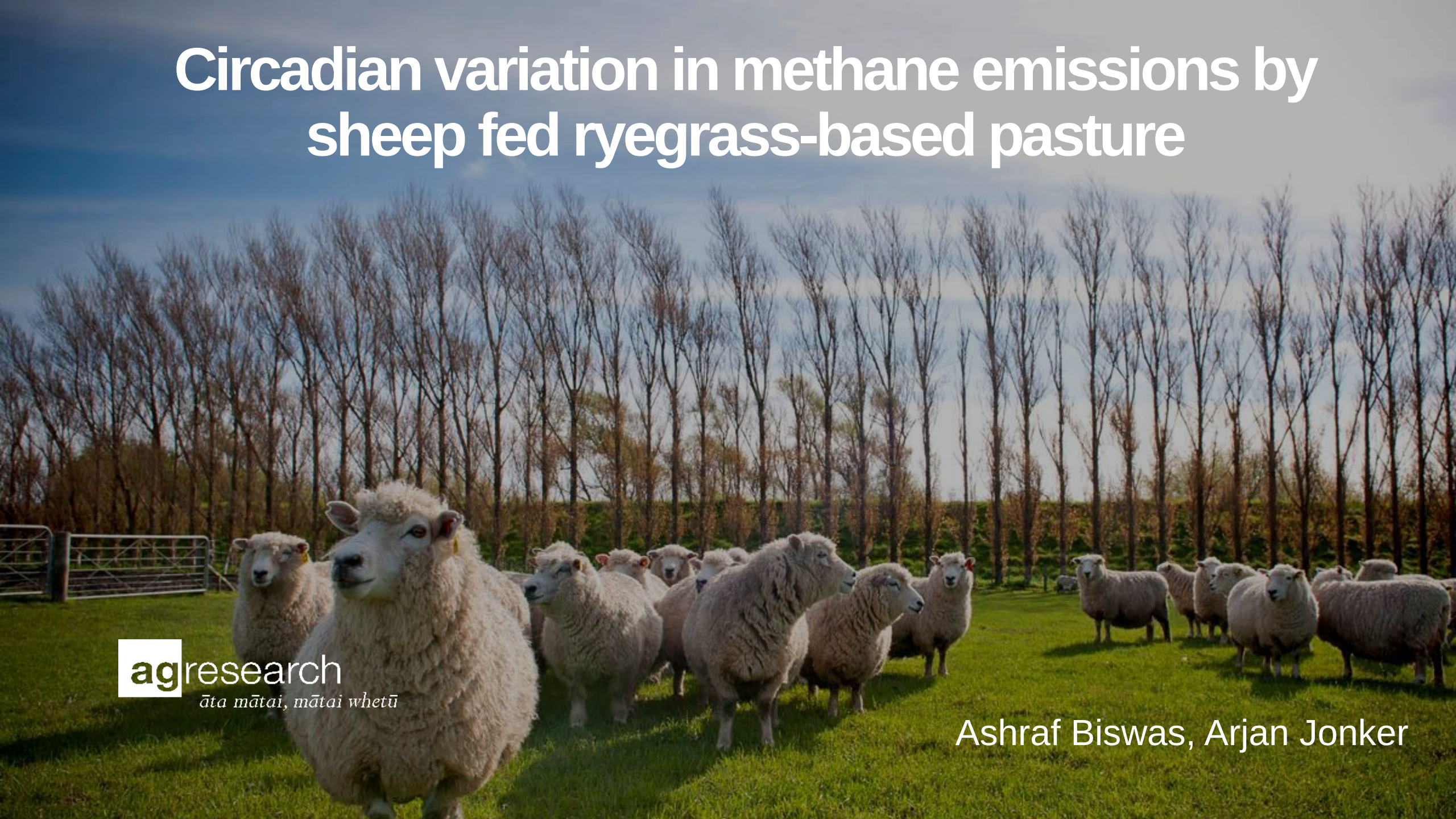
Circadian variation in methane emissions by sheep fed ryegrass-based pasture



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Background

- Green house gas (GHG) emissions are a great concern for global warming.

Methane emitted by ruminants constitutes:

- Approximately 15% of global CH_4 emissions (Gerber et al. 2013)
- Approximately 33% of total greenhouse emissions in New Zealand (MfE 2017)

- Therefore, a lot research in progress to find ways to precisely measure CH_4 from ruminants

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Background

In sheep, new methods used for estimating CH_4 by averaging CH_4 emissions from multiple spot samples

GreeFeed for small ruminant

Hand-held laser

Portable accumulation chamber

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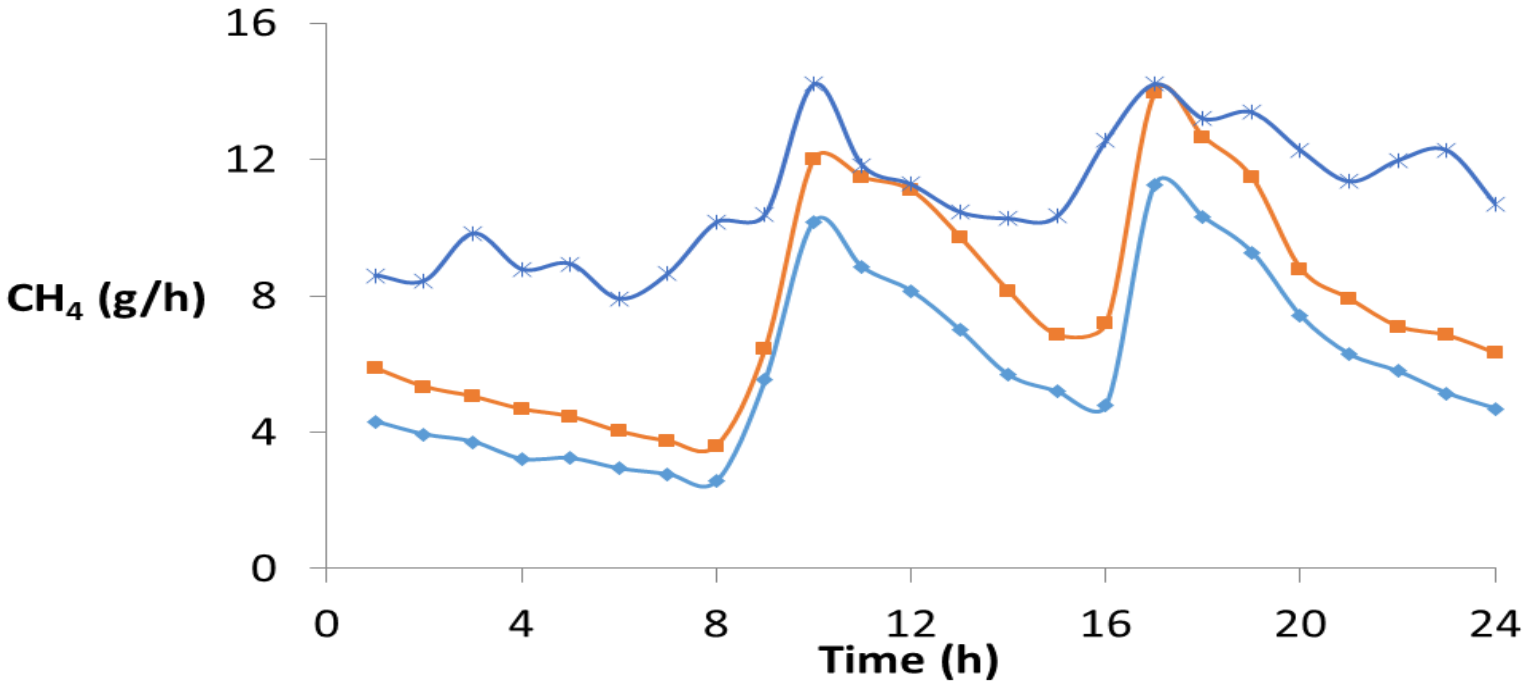
Background

- Rate of CH_4 emissions is not constant and can vary significantly within 24 h



(Jonker et al. 2014)

- Not much information available on circadian variation and factors that affect it

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Objective

- To determine:
  - the circadian variation in CH_4 emission by sheep
  - Identify parameters that affect this circadian variation

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Methods

- Meta-data of 9 trials with sheep:
  - 3 trials with 3 ryegrass cultivars and 2 feeding levels
  - 6 trials with 2 qualities of ryegrass-based pasture and 2 feeding level
  - In all trials, fed cut pasture twice daily at 8.00 and 16.00 h
  - CH_4 emissions measured approximately every 6 minutes over two consecutive days using respiration chamber

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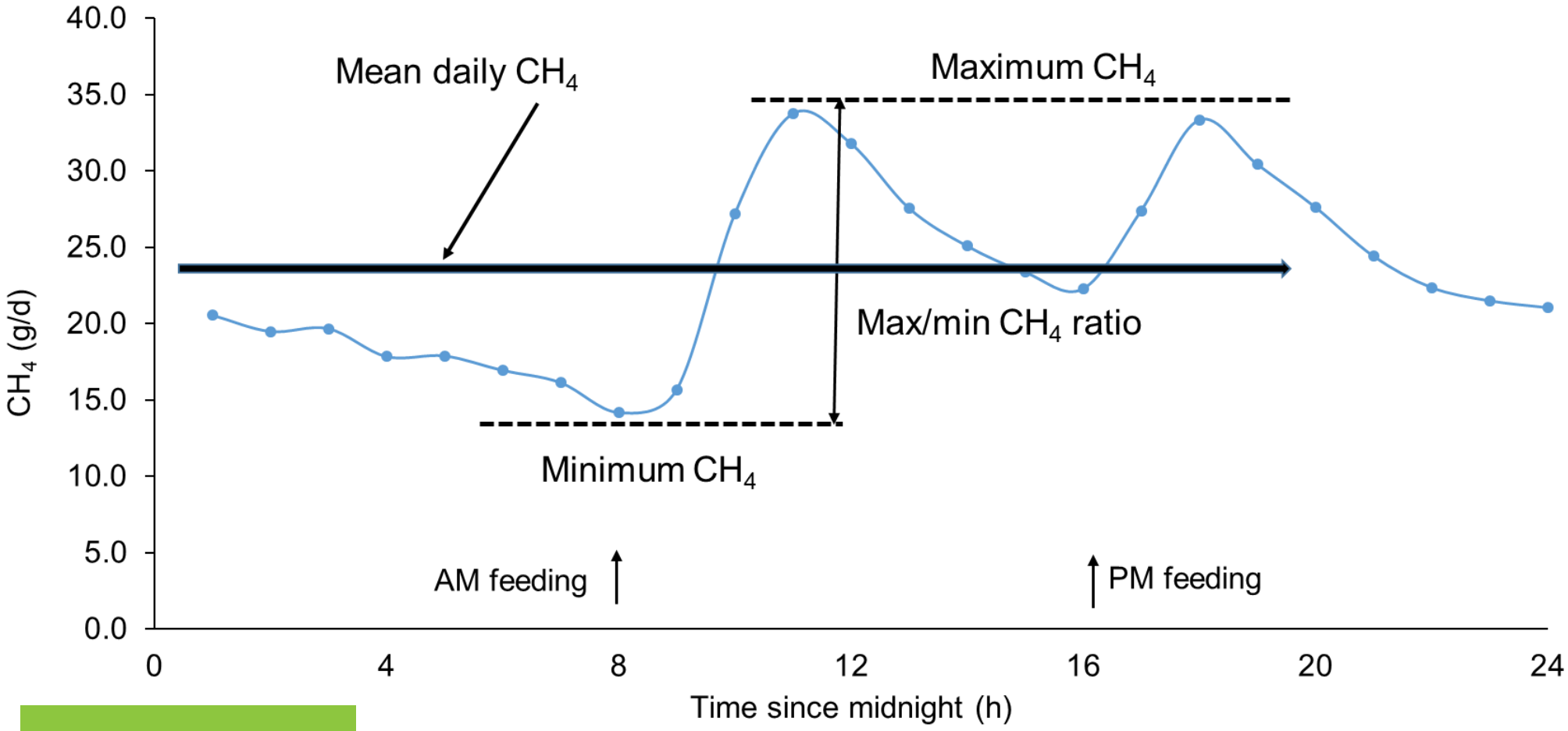
Methods: CH_4 parameters defined

- Every 6 min CH_4 measurement expressed as grams per day



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Statistical Analysis:

- Summary statistics of min and max CH_4 using R version 3.4.2.

- All subset regression and multiple regression using GenStat version 19.

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Results:

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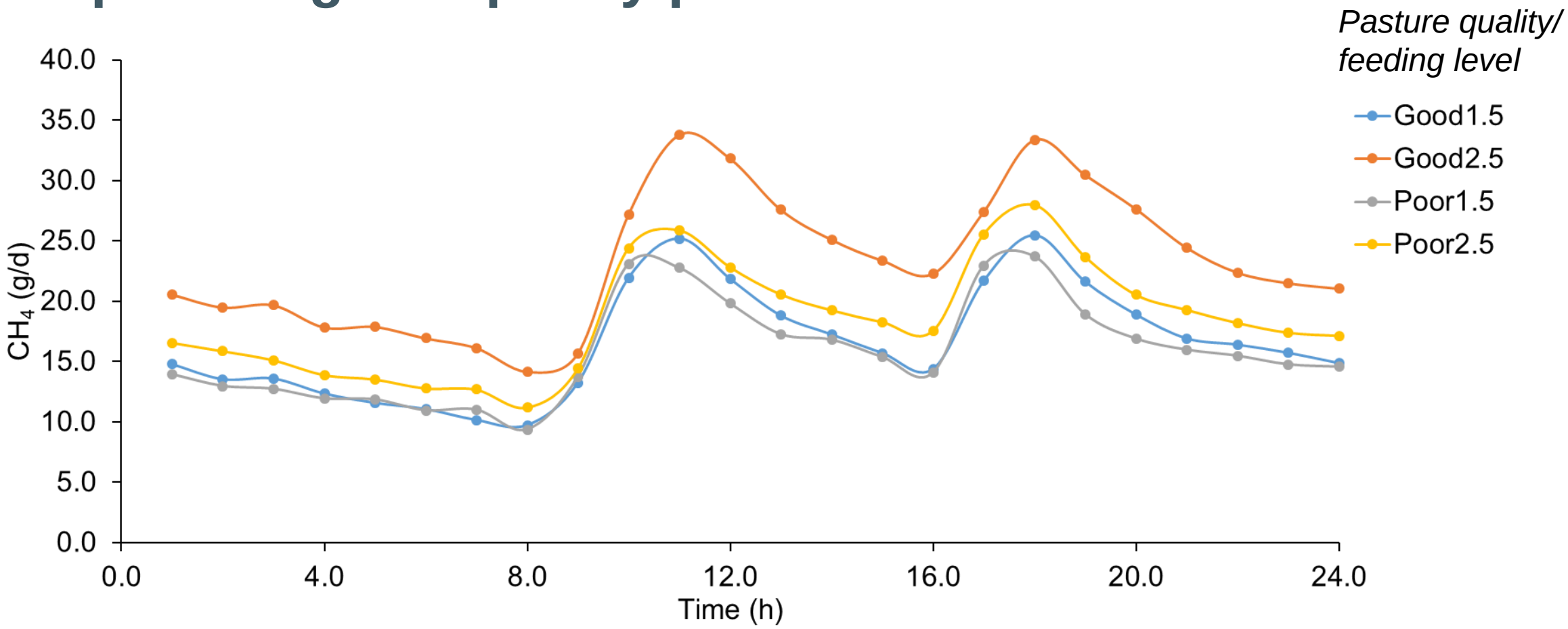
Results: Emission profiles of sheep offered two levels of poor or good quality pasture



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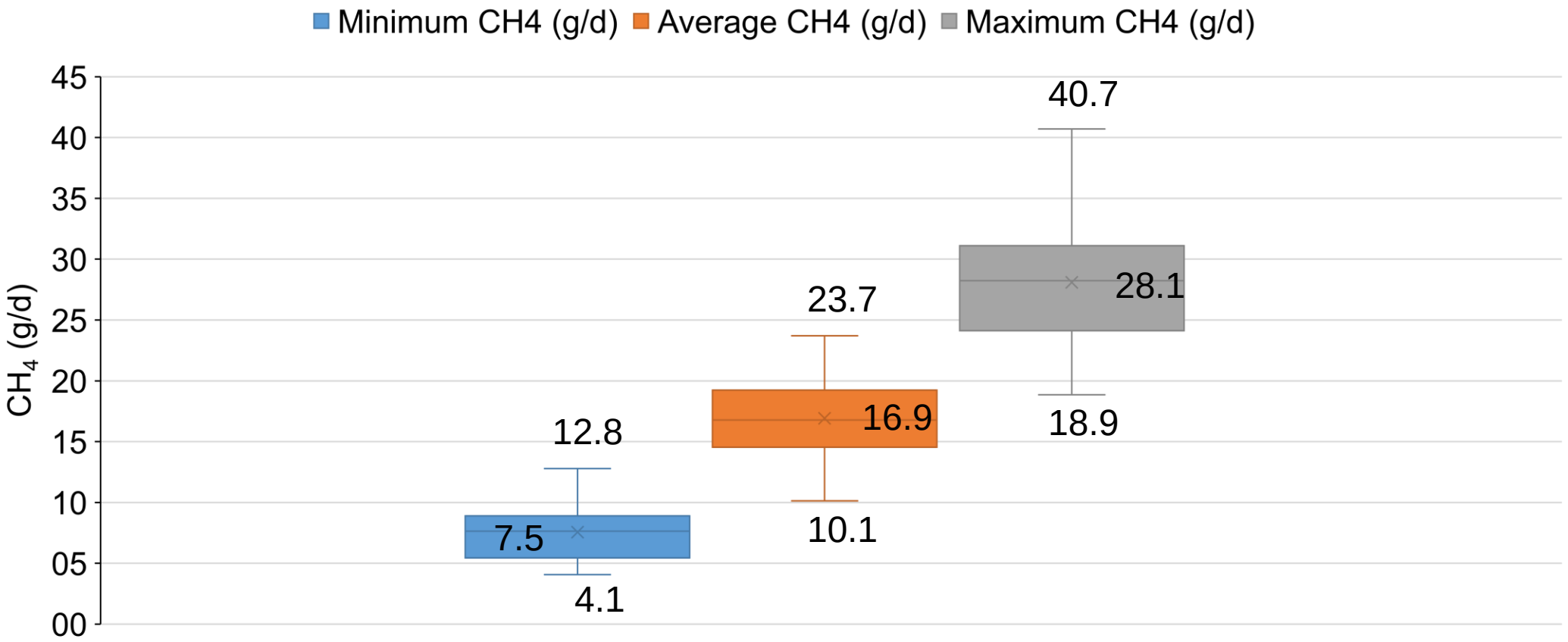
Results: Min, max and mean CH_4 among treatments



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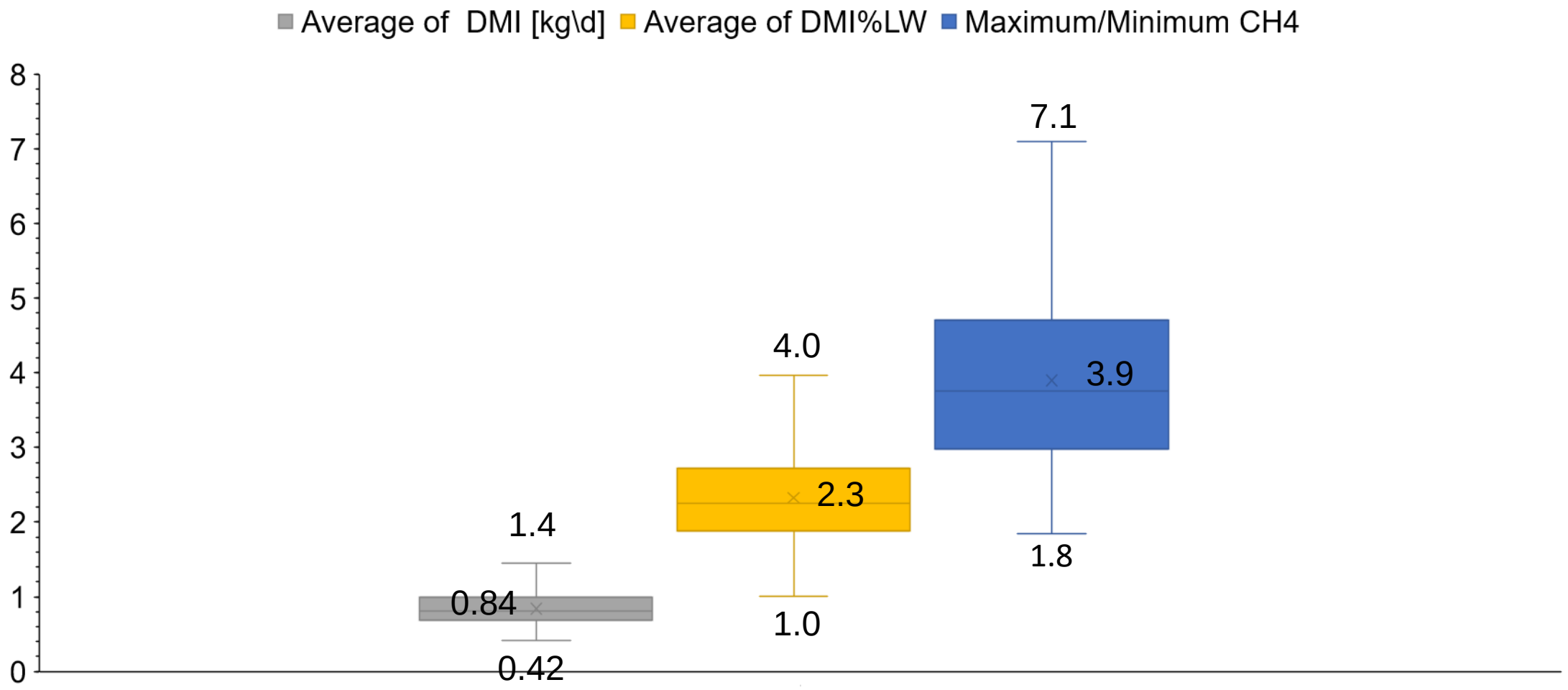
Results: DMI, DMI%LW and Maximum/Minimum CH_4



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Results: Multiple regression to explain max/min CH_4

Significant intake and pasture composition parameters (P<0.05) explaining variation in max/min CH_4

	R^2	DMI % of live-weight	Crude Fat	Crude protein	Neutral detergent fibre	Organic matter	Non-fibre carbohydrates
1 parameter							
	0.283	-1.42					
2 parameters							
	0.346	-1.52		0.010			
3 parameters							
	0.420	-1.59	-0.078		-0.004		
	0.398	-1.38		0.021			0.007
4 parameters							
	0.561	-1.75	-0.172			-0.083	-0.018
	0.546	-1.72	-0.129		-0.015	-0.030	
	0.508	-1.68	-0.098		-0.021		-0.008
	0.488	-1.66	-0.075	0.010	-0.012		
	0.457	-1.66	-0.044	0.023			0.009

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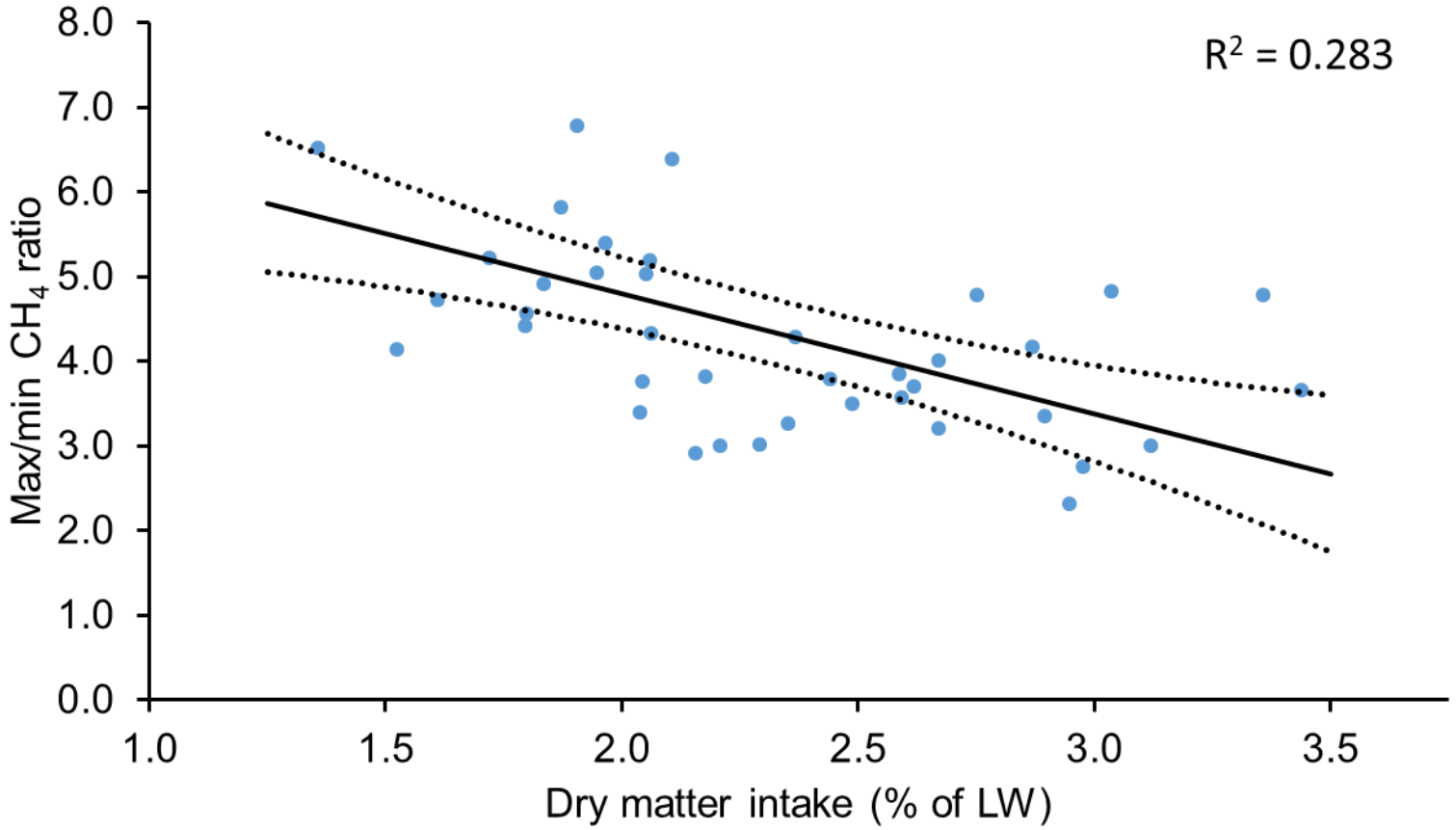
Results: Regression of feeding level with Max/min CH_4



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Conclusions:

- Maximum CH_4 emission rate was reached after each morning and afternoon feeding and minimum CH_4 emission rate in the day occurred before morning feeding.

- The magnitude of circadian variation in CH_4 emissions in sheep fed ryegrass-based pasture decreased with increasing feeding level

- To a lesser extent variation also decreased with increasing pasture crude fat and fibre (i.e. NDF) and with decreasing pasture crude protein

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Acknowledgements

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