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Livestock

Reducing sheep methane emissions through improved forage quality on mixed farms

RESEARCH

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Location: Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 241 mm
2015 Total: 333 mm
2015 GSR: 258 mm
Livestock
Enterprise type: Mixed cropping and livestock
Type of stock/breed: Merino sheep

Key messages

- **For the 3 phases of methane measurement reported, methane emission intensity (L CH4/hr/100g ADWG) was significantly lower for lambs on a better quality forage with high metabolisable energy, digestibility and crude protein.**
- **Feedlotting is an option that gives producers the flexibility to finish lambs when pasture availability is limited or light soils are at risk of erosion.**
- **Spray-topping cereal crops is a good management strategy for weed control and feed management for livestock, however, livestock productivity gains can be compromised when spray-topped cereals are grazed without offering lambs better quality fodder supplements.**

How was it done?

Trial details, forage intake and liveweight data from the 2014 winter and spring (Phases 2 and 3) are presented in the EPFS Summary 2014, p175-178.

The 2015 winter trial involved evaluating the performance of animals in a feedlot as opposed to a grazing system. The feedlot option was chosen as 'normal farm practice' for nutritional management of animals and protection soils at risk of wind erosion through overgrazing during key times of the year. The trial commenced on 12 May 2015 with a 100 merino lambs (July 2014 drop) placed in feedlots on two treatments (slow growth diet and a fast growth diet, Table 1). Hay was offered to the lambs ad lib, in hay rings and grain was fed through lick feeders. The lambs, with an average liveweight (LW) of 44 kg, were split into two groups of 50 animals, with each group further split into two replicates of 25 lambs per feedlot, of which 20 were randomly selected for methane measurements in the polytunnel.

The 2015 spring trial involved evaluating the performance of lambs on green forage (lucerne, supplemented by medic hay), a mature forage oats crop and a spray-topped forage oats crop. The grazing trial commenced on 27 October 2015 with 180 merino lambs (July 2015 drop) with an average LW of 30 kg, split into groups of 60 lambs per treatment, with each group further split into two replicates of 30 lambs, of which 25 were randomly selected for methane measurements in the polytunnel.

After a total of 30 days on the treatments, methane measurements were conducted in conjunction with CSIRO (WA) staff and their mobile polytunnel, starting on 10 June 2015 and 25 November 2015 for the winter and spring trials respectively. During the measurement days, lambs from each replicate were moved into the polytunnel for three hours of gas sampling. After exiting the polytunnel, the lambs were put in the yards for an overnight fast and weighed the following morning to get their final LW measurement.

What happened?

Dry matter intake and liveweight gains

The lambs on the 'fast growth' 2015 winter feedlot treatment consumed 1.84 kg versus 1.74 kg DM/head/day on the 'slow growth' treatment (Table 2). There was about 25% wastage of the grass pasture hay mainly because the lambs were being selective on the poor quality hay offered, but it did not affect total intake at the end of the 30 day trial.

Table 1 Treatment details, fodder/pasture quality and availability at the start of the grazing period.

	Treatment	Diet		Food on offer (kg DM/ha)	Dry matter (%)	Crude protein (% DM)	DM* Digestibility (%)	ME** (MJ/kg DM)
Winter 2015 (feedlot)	Slow growth diet	Grass pasture hay, + grain mix of 50% barley and 50% oats	Grass pasture hay	675	90.4	8.5	47.4	6.5
			Barley	360	91.7	14.5	87.5	13.3
			Oats	360	94.3	14.0	76.6	13.8
	Fast growth diet	Medic hay + grain mix of 70% barley and 30% lupins	Medic hay	580	88.0	22.5	66.1	9.8
			Barley	573	91.7	14.5	87.5	13.3
			Lupins	245	92.8	29.2	87.9	14.6
Spring 2015	Lucerne	Lucerne + medic hay	Lucerne	1100	32.6	23.5	67.1	10.1
			Medic hay	250	88.0	22.5	66.1	9.8
	Oats 1	Spraytopped oats	Hay	4600	66.2	4.3	63.3	9.3
			Grain	700	95.4	13.8	81.1	14.2
	Oats 2	Mature unharvested oats	Hay	4420	62.7	4.6	56.8	8.1
			Grain	2100	95.7	10.7	78.6	14.0

**Dry matter, **Metabolisable energy*

Feedlot data (winter 2015) indicated a significant response ($P<0.001$) in total LW gain and average daily liveweight gain (ADWG) between the two treatments. ADWG for lambs on the 'fast growth' diet was higher (209 g/head/day) than the lambs on the 'slow growth' diet (140 g/head/day) (Figure 1). This was largely attributed to the fact that the 'fast growth' diet (medic hay, lupins and barley) had higher crude protein (CP), digestibility and metabolisable energy (ME).

For the spring 2015 grazing trial, the lambs on the lucerne pasture were also offered medic hay as there was not enough lucerne biomass (approximately 1000 kg DM/ha) to support the lambs for 30 days and it contributed 20% of the total DM intake. Their total DM intake (1.70 kg DM/head/day) was higher than the lambs on the oats treatments (Table 2). The lambs foraging on the spray-topped oats had the lowest DM intake and this was largely attributed to the fact that there wasn't enough grain in the heads and also less bulk than the mature oats crop. Harvest cuts were done from the pasture exclusion cages and the spray-topped oats and the mature oats crop had grain yields of 0.7 t/ha and 2.1 t/ha respectively.

A statistical analysis of LW gain and ADWG for the 2015 spring grazing trial also indicated a significant response ($P<0.001$) among the three treatments. ADWG for the lambs on lucerne was higher (114 g/head/day) than lambs on the forage oats (Figure 1). Lambs on the forage spray-topped oats lost weight, losing an average of 37 g/head/day, and this was correlated to the low DM intake (1.16 kg DM/head/day) and less grain in the forage offered.

Methane production (Phase 2, 3 & 4)

Phases 2 and 3 (winter and spring 2014) grazing trial data, pasture intake and liveweight gains are summarised in EPFS Summary 2014, p 175-178).

Methane production was calculated over the three-hour period that the sheep were placed in the polytunnel, and the figures provided a comparative estimate of hourly methane emissions between the respective forage treatments. Methane emission intensity, (defined as the amount of methane produced per unit of livestock product), was assessed based on the LW performance of the sheep in their respective treatments and was standardized relative to100 g daily weight gain over the grazing period.

Table 2 Forage intake (kg DM/head/day) for winter (feedlot) and spring (grazing) in 2015.

	Winter 2015 (Feedlot)		Spring 2015		
Forage intake (kg DM/head/day)	Slow growth	Fast growth	Lucerne	Spray-topped oats	Mature unharvested oats
Hay	0.75	0.81	0.35	0.81	0.95
Grain	0.99	1.03	0	0.35	0.41
Lucerne	0	0	1.35	0	0
Total forage intake	**1.74**	**1.84**	**1.70**	**1.16**	**1.36**

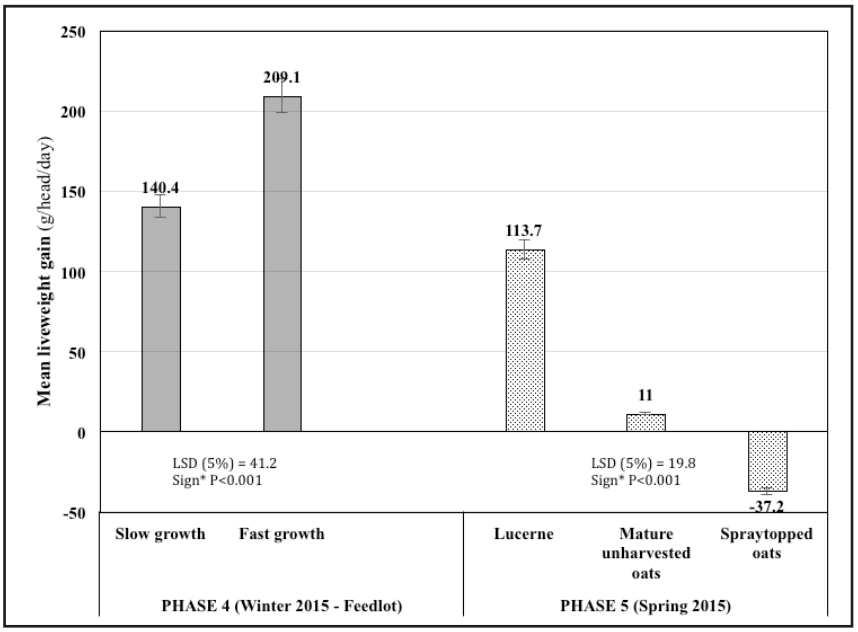

Figure 1 Mean liveweight gains (g/head/day) for winter (feedlot) and spring 2015.

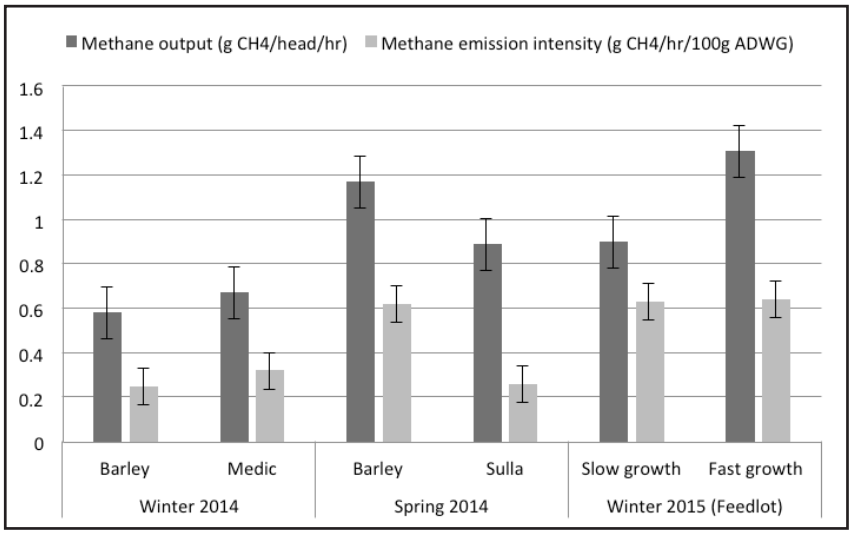

Figure 2 Methane output (g CH4/head/hr) and emission intensity (g CH4/hr/100g ADWG) for Phases 2, 3 and 4.

There was a significant response (P<0.001) of methane production (output and intensity) to the forage treatments in all of the phases. In terms of methane output (g CH4/head/hr) the lambs on the medic pasture produced 13% more methane than the ones grazing a young barley crop (Phase 2); lambs on a mature standing unharvested barley crop produced 24% more methane than the ones on sulla (Phase 3); and the lambs in the feedlot on the 'fast growth' diet produced 31% more methane than their counterparts on a 'slow growth' diet (Figure 2). The highest emission intensity (g CH4/hr/100g ADWG) was recorded in the feedlot trial (phase 4) from the 'fast growth' treatment (0.64 g).

Lambs grazing on the young barley crop during winter 2013 had the lowest methane emission intensity (0.25 g) as shown in Figure 2.

What does this mean?

A 30 kg lamb growing at 200 g/day requires 1.3 kg DM/day of forage with 14-16% CP and 10.5-11 ME (MJ/kg DM). As a general rule, the pasture or forage that is optimal for finishing weaned lambs should have a DM digestibility of about 70% and have more than 50% green matter (Jolly, 2006). These requirements are hard to achieve particularly during the late spring, and late autumn feed gaps. For the 2015 spring grazing trial, only the lucerne treatment provided enough CP and ME and therefore proved to be a better option to maximise animal productivity. The lucerne was a poor crop and did not get enough moisture during early spring when it was starting to grow vigorously, therefore opportunities exist to target even higher LW gains when a more productive crop is established. Both oats treatments (mature and spray-topped) had very low CP and ME and therefore can be considered as maintenance forages, unless the lambs are supplemented with higher quality hay (medic, sulla, lucerne) and/or grains (lupins, peas).

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