Reducing sheep methane emissions through improved forage quality on mixed farms

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Searching for answers

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.

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.
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 to 100 g daily weight gain over the grazing period.

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

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

*Dry matter, **Metabolisable energy

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

<table>
<thead>
<tr>
<th>Forage intake (kg DM/head/day)</th>
<th>Winter 2015 (Feedlot)</th>
<th>Spring 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slow growth</td>
<td>Fast growth</td>
</tr>
<tr>
<td>Hay</td>
<td>0.75</td>
<td>0.81</td>
</tr>
<tr>
<td>Grain</td>
<td>0.99</td>
<td>1.03</td>
</tr>
<tr>
<td>Lucerne</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total forage intake</td>
<td>1.74</td>
<td>1.84</td>
</tr>
</tbody>
</table>
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 \((g \text{ CH}_4/\text{head/hr})\) 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 \((g \text{ CH}_4/\text{hr}/100\text{g ADWG})\) was recorded in the feedlot trial (phase 4) from the ‘fast growth’ treatment (0.64 g).

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).

Acknowledgements
Thanks to Mark Klante, Brett McEvoy and John Kelsh for managing the livestock and setting up trial infrastructure; Jessica Crettenden for livestock handling and sheep data management, and Roy Latta for his technical expertise. This project is supported by funding from the Australian Government Department of Agriculture – Action on the Ground program (Project Code: AOTGR2-0039 Reducing sheep methane emissions through improved forage quality on mixed farms).

References
Livestock grazing behaviour in large Mallee paddocks

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Key messages

• For the first time sheep grazing behaviour in a Mallee paddock was monitored and mapped using GPS tracking collars.

• Sheep grazed the stubble paddock evenly as they sought out spilt grain during the summer fallow, but they preferred to graze on sandy soil types first.

• While grazing a vetch pasture in the same paddock, livestock spent 50% of the time grazing only 25% of the paddock and 25% of the paddock was not utilised.

• At least $4000 profit was foregone from the paddock through the under-utilisation of the vetch pasture.

• Within-paddock fencing technology in large Mallee paddocks has the potential to capture this potential profit by improving feed utilisation.

Why do the trial?

Livestock are an integral component of Mallee farming systems. However, the integration of cropping and grazing remains a major management challenge, as paddock sizes tend to be large to benefit efficient cropping practices. Furthermore, Mallee paddocks are also characterised by extreme soil variability and these variable soil types support different levels of feed availability and have different susceptibilities to soil erosion. As a result, farmers report that they are not able to utilise all of the feed on offer within a paddock without reducing groundcover below critical levels. In situations in which farmers are forced to extract maximum productivity, soil erosion often results on the most vulnerable soil types such as sand dunes.

Advances in technology such as portable fencing systems and virtual fencing potentially offer a solution to the issue of grazing large Mallee paddocks with high soil variability. However, to effectively design and deploy these innovative grazing techniques, the grazing behaviour of livestock in these paddocks needs to be understood and quantified. This project has begun to address this knowledge gap by quantifying sheep grazing habits in a large Mallee paddock with variable soil types.

How was it done?

A flock of two-year-old merino ewes (approximately 200) was monitored over a summer and winter grazing period during 2015 using Global Positioning System (GPS) tracking collars. Prior to the commencement of grazing, 25 animals within the flock were fitted with UNE Tracker II GPS collars. Livestock monitoring data was supported with on-ground assessment of vegetative soil cover and feed quantity over both grazing periods.

The project was undertaken in a 107 ha paddock near Nandaly in the Victorian Mallee which had a range of soils (deep sands to clay loams) commonly associated with Mallee paddocks. The summer grazing period commenced on 14 January 2015 and concluded on 24 February 2015. The paddock was sown to barley in 2014, and livestock grazed the stubble and grain from lodged heads and grain spilt during harvest. No green plants (volunteer barley or summer weeds) were present when the livestock were introduced into the paddock. The paddock was sown to a vetch pasture in autumn and the flock was re-introduced into the paddock on 28 July 2015. The sheep grazed the paddock until 17 September 2015.

At the conclusion of each grazing period, the collars were removed and the data downloaded from the GPS devices. Data was then analysed for the purpose of quantifying variable grazing pressure. Speed thresholds from behavioural modelling techniques were developed to identify when the sheep were grazing, travelling or camping.
What happened?

Summer grazing

Utilisation of paddock zones (light, moderate and heavy soil types) was compared at 5-day intervals over the summer grazing period (Figure 1). Initially the sheep spent most time grazing the lighter soil types in the paddock before moving on to the other zones. This may suggest preferences for certain zones or soil types before feed became limiting and utilisation of other areas became necessary. By the end of the summer period, paddock utilisation was relatively even.

During summer, grazing speeds and distance travelled were very high as the sheep constantly searched for spilt grain. The amount of spilt grain declined from around 80 kg/ha when the sheep were introduced to approximately 20 kg/ha when they were removed 40 days later. Very little green pick was available during the grazing period and as a result they lost condition over this time. There also appeared to be a change in animal behaviour, with an approximately 5% decrease in daily time spent grazing when spilt grain levels dropped to around 40 kg/ha. There may be some value in using this type of data (assuming it could be delivered in real-time) for managing livestock in stubbles where the feed value of spilt grain is difficult to determine.

There was a very slight decline in groundcover over the summer grazing period, but on average, groundcover levels remained well above critical levels of 50%. There were already some parts of the paddock at 50% when the sheep were introduced and in an ideal system, grazing would have been avoided in these zones to reduce the risk of erosion.

Winter grazing

Grazing intensity was much more spatially variable on the sown vetch pasture in winter than on the cereal stubble in summer. Figure 2 shows that the sheep concentrated grazing on the western end of the paddock during the first 10 days after which paddock utilisation by the livestock slowly increased over time. However, during any 10-day period, livestock spent 50% of the time grazing only 25% of the paddock and a further 25% was not utilised.

Spatially variable grazing led to under-utilisation of pasture on the eastern end of the paddock. Figure 3 shows vetch dry matter accumulation at two of the 29 monitoring locations. On the western edge (site 12), dry matter did not accumulate between the first four monitoring dates, probably because grazing intensity matched pasture growth rate. However, on the eastern end of the paddock (site 16) dry matter accumulated at a consistent rate and when the sheep were removed, approximately 2.5 t/ha vetch still remained. This represents a significant under-utilisation of the feed base with a subsequent loss of potential income from either increased stocking rates or harvest of the excess feed for fodder.

![Figure 1 Cumulative utilisation of the three soil type zones (light, moderate, heavy) over the summer grazing period.](image1)

![Figure 3 Dry matter accumulation of vetch over the grazing period at monitoring site 12 and 16 which are located on the respective western and eastern ends of the paddock.](image2)
Figure 2 Grazing residency index (hours spent grazing) in 30 x 30 m cells for 10 day intervals over the winter grazing period.
What does this mean?
Farmers already recognise that livestock graze large Mallee paddocks unevenly, but this project began to put some hard numbers on the extent of the variability in spatial paddock utilisation. During summer, when feed was limiting, the paddock was fully utilised, but sheep spent about 40% of their time grazing just 25% of the paddock. This means that large areas were very lightly grazed, with animals travelling long distances across the field.

This contrasted with the winter grazing period in which sheep concentrated 50% of grazing on 25% of the paddock. A further 25% of the paddock was left unutilised which represents a significant economic opportunity foregone that could be addressed using cost-effective within-paddock fencing or virtual fencing. Two hundred ewes with lambs at foot grazed the paddock, or 5.6 dry sheep equivalent (DSE) per hectare. However, as grazing occurred on only 75% of the area, the stocking pressure on the utilised part of the paddock was 7.3 DSE/ha. It is logical that, with improved grazing management an additional 65 ewes with lambs could have been fed. Alternatively, a quarter of the paddock could have been cut for hay. If 1.5 t/ha of vetch hay were cut from 25% of the paddock, an additional $150/ha of profit would have been made on a quarter of the paddock or the equivalent of approximately $4000 additional profit.

Currently there is no easy solution to overcoming the problem of uneven grazing by livestock in large paddocks. Management actions such as moving water points, increasing mob sizes and rotating sheep in and out of paddocks regularly are likely to improve paddock utilisation but will not fully resolve the issue. Rapid fencing systems such as portable electric fencing have been used effectively by some Mallee farmers, but require resources to erect and dismantle. The development of such new technologies as virtual fencing could drastically improve the utilisation of large Mallee paddocks and the data from this project can start making an economic case for investing in more flexible fencing technologies.

Acknowledgements
This project is supported by Mallee Catchment Management Authority, Mallee Sustainable Farming, University of New England and BCG through funding from the Australian Government’s National Landcare Programme. GRDC funded Grain & Graze 3 (SFS00028) provided additional support.
Eyre Peninsula Farming Systems 2015 Summary

Key messages

- There were no feed value differences between grazing-hay varieties. Feed value was low, but still useful feed for ewes with young lambs at that time of year.
- There was no difference between varieties in biomass production at anthesis (hay). Biomass was reduced by 15 per cent when grazed.
- Yallara and new variety WA02Q302-9 had the greatest dual purpose value. They had higher grain yields and little yield penalty after grazing, providing a degree of flexibility to be able to respond to the season, and manage for livestock and hay or grain markets.

Why do the trial?

Oats are very versatile and have long been used in Mallee paddock rotations for grazing, hay production and grain for feeding animals, but of late they have not usually been grown for grain value. Oats became more popular in 2015 when attractive contracts for milling oats were offered prior to sowing, largely driven by demand from China.

In 2015 the GRDC Grain & Graze 3 program set out to evaluate a selection of grazing/hay oat varieties. There were no current evaluation trials for oats in the southern Mallee, nor had there been any local evaluation of oat variety response to grazing since 2012 at Corack.

The aim of this trial was to evaluate the grazing value, hay and grain yield of grazing/hay oat varieties in the southern Mallee.

How was it done?

A randomised grazing/hay oat trial was sown by direct-drilling at Berriwillock on 24 April 2015, following 13.4 mm of rain. Varieties included Wintaroo, Mulgara, Brusher, Tungoo, Yallara and WA02Q302-9 (a new variety), and were sown with a target plant density of 200 plants/m². Fertiliser applied was Granulock Supreme Z + Impact @ 50 kg/ha at sowing, and later top-dressed with urea at @ 45 kg/ha at GS20 on 9 July.

Varieties used in the grazing/hay trial are normally recommended for May sowing and grain production (rather than early sowing in March-April and grazing potential), but were chosen for their suitability for a low-medium rainfall environment with quick early dry matter production and early-mid growing season length.

What happened?

Dry seasonal conditions meant that emergence was patchy and early growth was slower than normal. Overall, grain yields for (ungrazed) grazing/hay varieties averaged 0.52 t/ha, compared with 0.76 t/ha for an adjacent milling oat variety trial.

Crop growth was slow so grazing didn’t occur until 12 weeks after sowing, just prior to the canopy closing. They were grazed high enough to ensure some green stem and leaf remained to assist with plant recovery, which is important when there is lower rainfall and shorter season length. This meant the amount of feed available was light and variable. There were no differences between varieties (P=ns, CV%=28.2), although feed ranged from 103-175 kg/ha (or 155-263 grazing days) (Figure 1). Despite the lower growth, the grazing value of the oats would still be very useful for ewes with young lambs at that time of year.
Figure 1 Grazing biomass and DSE grazing days of oat varieties, Berriwillock 2015.

Table 1 Hay and grain value of oat varieties, Berriwillock 2015.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Grazing treatment</th>
<th>Hay biomass at anthesis (kg/ha)</th>
<th>Grain yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brusher</td>
<td>Grazed</td>
<td>1786</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Ungrazed</td>
<td>2180</td>
<td>0.51</td>
</tr>
<tr>
<td>Mulgara</td>
<td>Grazed</td>
<td>1985</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Ungrazed</td>
<td>2032</td>
<td>0.68</td>
</tr>
<tr>
<td>Tungoo</td>
<td>Grazed</td>
<td>1527</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Ungrazed</td>
<td>2000</td>
<td>0.10</td>
</tr>
<tr>
<td>WA02Q302-9</td>
<td>Grazed</td>
<td>1525</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>Ungrazed</td>
<td>2067</td>
<td>0.63</td>
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<tr>
<td>Wintaroo</td>
<td>Grazed</td>
<td>1895</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Ungrazed</td>
<td>2036</td>
<td>0.49</td>
</tr>
<tr>
<td>Yallara</td>
<td>Grazed</td>
<td>1836</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>Ungrazed</td>
<td>2120</td>
<td>0.69</td>
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Significant difference

<table>
<thead>
<tr>
<th>Variety</th>
<th>Grazing x variety</th>
<th>ns</th>
<th>P&lt;0.001</th>
<th>P=0.003</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSD (P=0.05)</td>
<td>Variety</td>
<td>235.7</td>
<td>0.053</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grazing</td>
<td>136.1</td>
<td>0.031</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Variety x grazing</td>
<td>333.3</td>
<td>0.075</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CV%</td>
<td>12.1</td>
<td>11.1</td>
<td></td>
</tr>
</tbody>
</table>
Dry seasonal conditions meant that emergence was patchy and early growth was slower than normal. Overall, grain yields for (ungrazed) grazing/hay varieties averaged 0.52 t/ha, compared with 0.76 t/ha for an adjacent milling oat variety trial.

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There was no difference between varieties in biomass production at anthesis, averaging 2073 kg/ha across ungrazed varieties. Hay biomass was reduced by 15% in grazed oats, averaging 1759 kg/ha of hay - a reduction of 314 kg/ha (Table 1).

Grain yield was highest for Yallara and the new variety WA02Q302-9, followed closely by Mulgara - all early-mid maturing varieties. Tungoo, a mid-late maturing type, suffered with the season and produced the lowest yield.

Grain yield was reduced by grazing, but only by 100 kg/ha. It is common to have smaller grain yield penalties in poorer seasons.

New variety WA02Q302-9 was able to maintain grain yield after grazing, while Brusher, Mulgara and Wintaroo incurred grain yield penalties. Yallara, while losing 90 kg/ha in grain production, was still one of the best grazed varieties.

What does this mean?
Attractive milling oat contracts offered in 2015 meant oats became a favourable option for growers in locations that are higher risk for pulse and oilseed production. Oats generally have lower input costs; with fewer pest threats they do not incur the cost of high pesticide use needed for management of other break crops.

Having two oat varieties (Yallara and new variety WA02Q302-9) express potential for dual purpose use - early winter grazing, and hay and grain production - provides a degree of flexibility to respond to the season at hand and manage for livestock and hay or grain markets.

These varieties are CCN resistant, but CCN intolerant: they will ensure that CCN does not multiply in the paddock, but will be affected if CCN is present. Yallara has leaf rust resistance, but depending on the pathotype could be MR to S for stem rust. However, rust is species specific, so oat rust will not affect wheat or barley.

The National Oat Breeding Program is focusing on releasing oats with added health benefits, including higher fibre beta-glucan levels for lower cholesterol re-absorption such as Mitika. In the future they aim to release varieties with low avenin (gluten protein in oats) which will elevate oat products as an alternative for gluten-free (wheat) diets. This will increase the markets for oats around the world.

Acknowledgements
This research was funded by the GRDC as part of the Grain & Graze 3 project (SFS00028). Grain was provided by the National Oat Breeding Program at SARDI.
The response of lactating and non-lactating ewes to human presence and lamb handling

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Previous studies have shown that isolation and restraint stress does not evoke a stress response (indicated by increased plasma cortisol) in lactating ewes but it does in non-lactating ewes (Ralph and Tilbrook, 2016). Therefore, the response of a ewe to a stressor is likely determined by stage of reproduction and the nature of the stressor. This project will develop information that will enhance this understanding in Merino ewes and will enable producers and researchers to make better decisions about ewe management and welfare.

How was it done?
Three groups of six ewes were selected from a mob of 400 merino ewes to use in the trial. Ewes were selected according to their mothering temperament and their pregnancy and birth status in 2015. The three groups included;

• Group 1 (good mothers): Ewes who were perceived to be ‘good’ mothers were categorised at lambing time when the lamb was caught for measurement at 0-48 hours of age by observing the dam’s temperament. Good mothers were also determined by the health and survival of the lamb. Ewes selected had good records of maternal temperament and rearing lambs within the previous 4 years. All ewes had single lambs.

• Group 2 (poor mothers): Ewes who were perceived to be ‘poor’ mothers were categorised at lambing time when the lamb was caught for measurement at 0-48 hours of age. Generally these lambs were weak and undernourished. Ewes also had a history of being a poor mother and abandoning lambs within the previous 4 years. All ewes had single lambs.

• Group 3 (dry ewes): Dry ewes selected for this group were scanned dry and had not had a lamb in 2015, but had reared a lamb within the previous 4 years.

Maiden ewes were avoided in this trial as they can tend to have a flighty nature with their first lamb and their temperament therefore may not be reflective of usual behaviour, which would have made good or poor mothers difficult to select. The average age of the ewes was 4.3 years at the time of measurement.

Week 1
Ewes were segregated from the main mob when lambs were approximately 8 weeks of age, and fed a specialised ration of sheep nuts, medic hay and lupins that could be supplemented during the trial situation.

Week 2
After a week, the ewes and lambs were put into yards in the shearing shed where they became accustomed to the supplementary feed and new surroundings. They were provided with clean water and ad lib hay every day. The lambs were present in the pens (separated for each treatment group) with their mothers and were able to move about freely and suck without restriction.
**Week 3 and 4**

To collect sterile blood samples from the ewes, a catheter was inserted into the sheep’s jugular vein. Catheter lines were checked daily and flushed out with heparinized sterile saline (50 units/ml). Testing began the day after catheters were inserted.

The experiment was carried out over two days, separated by a week. Different stressors were imposed on all animals on each of the experimental days. One stressor was the presence of a novel human for 2 minutes in the pen, which was repeated every hour on the hour for 4 hours. The other stressor was the removal of the lamb from the pen for 2 minutes, every hour for 4 hours. On each experimental day blood samples (5 ml) were collected every 15 minutes for 6 hours. After 2 hours of sampling, the stressor treatment was imposed for the remaining 4 hours. Once the sample was collected, it was placed into collection tubes. Plasma was harvested from the blood by centrifugation at 4°C for 10 min at 3000 rpm and stored at -20°C until assay. Plasma concentrations of cortisol were determined by radioimmunoassay.

At the conclusion of the experiment all ewes and lambs were returned to their normal flock.

**What happened?**

Differences between cortisol and oxytocin levels from the blood sampling are in the process of being analysed, however initial results indicate that there are differences in the stress response between treatment groups.

**What does this mean?**

Results from this study will be utilised to understand the association between behavioural and physiological stress responses in lactating and non-lactating ewes. It will provide some insight into the instinctive biological role of the dam to maintain homeostasis and promote survival by protecting her offspring, and will assist producers to recognize the drivers of good maternal temperament. This research will be important for future breeding decisions of sheep flocks and could provide valuable information as to why some ewes are better mothers and can rear more lambs than others.

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**References**
