Sheep Updates 2006 - part 2

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Novel selection traits – what are the possible side effects?

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ABSTRACT
Temperament, breech bareness and skin wrinkle are traits of interest to breeders of ‘easy care’ or low input sheep. Phenotypic relationships between these novel traits and time taken to shear were investigated in 960 mixed age ewes. Breech bareness and breech wrinkle, but not temperament; was shown to reduce shearing time.

AIMS
Considerable Industry funds are being invested to evaluate the potential of temperament, breech bareness and freedom from wrinkle as traits to improve lamb survival and eliminate mulesing. These novel traits could be associated with reduced time to shear but may be negatively associated with production characters such as fleece weight. This study aims to investigate the effect of breech bareness, wrinkle and temperament on the time taken to shear.

METHOD
Time taken to shear was recorded in 960 mixed age (1997-2003 drop) ewes shorn in January 2006. Time was recorded as the interval between the shearer pulling in and out of gear. Ewe production related to wool quality, wool quantity, and number of lambs reared in the previous lactation was recorded. Breech bareness score, ranging from 1 (fully wooled) to 5 (bare between hind legs and in perineal area), as described by Hebart et al (2006), was recorded at shearing. Body, neck and breech wrinkle score, where 1 is plain and 5 wrinkled, plus body weight were recorded off-shears. Temperament was measured on 260 2003-drop ewes prior to shearing, using the isolation box test (Murphy 1999).

Data were analysed using a general linear model using SAS (SAS 2003). Shearer, horn status and run of day were treated as factors with fixed levels, while number of lambs reared, breech bareness score, neck, body and breech wrinkle score, yield, fibre diameter, fibre length, staple strength, fleece weight, belly weight, off-shears body weight, isolation box score and shearing order (nested within run) were all continuous variables. The maximum model tested contained all main effects and all first order interactions between the factors and the factors and covariates with the exception of the shearing order (within run) interaction. Non-significant (P<0.05) interactions and main effects were removed sequentially until only significant effects remained. No quadratic terms of covariates were tested.

The average, standard deviation, maximum and minimum values for the production and novel traits under investigation are given with time taken to shear in Table 1. The breech bareness scores 1, 2, 3, 4 and 5 were 2%, 24%, 35%, 26% and 12% of flock respectively.

Table 1: Distribution for production and novel traits under investigation.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Av.</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Trait</th>
<th>Av.</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear time (mins)</td>
<td>3.3</td>
<td>0.9</td>
<td>1.2</td>
<td>6.7</td>
<td>Staple Length (mm)</td>
<td>99.8</td>
<td>9.6</td>
<td>68.0</td>
<td>133.2</td>
</tr>
<tr>
<td>No. of lambs reared</td>
<td>0.8</td>
<td>0.7</td>
<td>0.0</td>
<td>2.0</td>
<td>Staple strength (N/k)</td>
<td>36.6</td>
<td>14.2</td>
<td>3.7</td>
<td>81.2</td>
</tr>
<tr>
<td>Breech bareness score</td>
<td>3.2</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>Neck wrinkle score</td>
<td>3.1</td>
<td>0.9</td>
<td>1.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Weight of fleece (kg)</td>
<td>7.2</td>
<td>1.0</td>
<td>4.0</td>
<td>10.8</td>
<td>Body wrinkle score</td>
<td>2.1</td>
<td>0.7</td>
<td>1.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Weight of belly (kg)</td>
<td>0.5</td>
<td>0.2</td>
<td>0.0</td>
<td>1.0</td>
<td>Breech wrinkle score</td>
<td>1.8</td>
<td>0.7</td>
<td>1.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Wool Yield (%)</td>
<td>73.0</td>
<td>5.0</td>
<td>56.7</td>
<td>84.0</td>
<td>Bodyweight (kg)</td>
<td>62.7</td>
<td>8.4</td>
<td>38.5</td>
<td>89.5</td>
</tr>
<tr>
<td>Fibre Diameter (μ)</td>
<td>21.4</td>
<td>1.9</td>
<td>16.4</td>
<td>29.7</td>
<td>Isolation box score</td>
<td>27.0</td>
<td>18.6</td>
<td>0.0</td>
<td>103.0</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION
The fitted model explained 73% of the variation in time taken to shear. Shearing time was significantly increased by a wrinkly and woolly breech, heavier belly and fleece weight, broader fibre diameter and...
longer staple length. Wool yield, staple strength, body weight, number of lambs reared, isolation box score, neck wrinkle did not affect shearing time.

The rate of reduction in time as fleece weight fell depended on the shearer but for each shearer lighter fleeces could be shorn in less time. Body wrinkle score had a net zero affect on shearing time, for one shearer shearing time increased as the score increased, for another shearer shearing time reduced, while shearing time for the other two shearers was not affected by body wrinkle score. We did not record quality of shearing. Shearing speed in wrinkly sheep may have been maintained by reducing quality. Temperament, as measured by the isolation box test, was not a significant factor affecting shearing time.

Raw data suggests that ewes with a breech bareness score 5 were shorn 26% faster than score 1 ewes. They also cut 20% less fleece wool and had 54% lighter bellies. The bareness score was associated with the number of lambs weaned during the previous lactation with score 1, 2, 3, 4, and 5 ewes rearing on average 0.4, 0.5, 0.8, 1.0, and 1.2 lambs respectively. The reduction in fleece and belly weight associated with increased bareness exhibited in this flock could be a reflection of their previous lactation status and may partly explain producer perception that increased bareness will result in reduced wool cuts. The reduced wool production obtained in our flock does not necessarily reflect the production that may be obtained in flocks where breech bareness is the result of properly designed breeding programs. This needs further formal study.

Economic pressures and labour availability have changed since McGuirk et al. (1981) concluded that reduced time taken to shear was not an important breeding objective for the Australian Merino. At present 100 million sheep are shorn by approx 10,000 full and part time shearers, averaging 120 sheep per day, working on average 90 days per year (Pollock, pers. comm.). The Sheep CRC re-bid business plan states “the Australian Wool Industry has the capacity to double wool production from current levels”. If 20% of this increase comes from improvement in per head production, 80% is to be achieved by increased sheep numbers. If the population increases to 180 million, the historical peak, the available shearers would each need to shear 18,000 sheep or for 150 days a year.

Plain bodied, bare breech, bare pointed sheep, that are easy to shear, are needed to attract new entrants to shearing and to compete with other industries which utilise unskilled labour eg mining. In addition easier to shear sheep are needed to reduce upward pressure on the cost of shearing, and to fully capture the benefits of upright posture shearing platforms currently being developed by AWI.

CONCLUSION

Shearing time was reduced in plain bare breeched sheep with lighter fleece and belly weights, shorter staple length and finer diameter wool. Temperament (isolation box test) didn’t influence shearing time.

The future challenge for sheep breeders is to breed plain bodied, bare breech, bare pointed sheep without reducing fleece weight by identifying potentially desirable sires and placing emphasis on improving production through increased bodyweight, staple length and follicle density.

KEY WORDS: Breech bareness, temperament, shearing time

Paper reviewed by: Dr Forbes Brien, South Australian Research and Development Institute.

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Genetic Changes in the Australian Merino since 1990

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ABSTRACT

Genetic changes since 1990 in a subset of 105 Merino ram breeding flocks from the Sheep Genetics Australia database are reported. Across these flocks, average hogget fibre diameter has declined at the rate of 0.93 microns per decade, hogget greasy fleece weight has essentially remained unchanged, hogget body weight has increased by 0.2 kg per decade and coefficient of variation of fibre diameter has declined by 0.29% per decade. The rate of genetic change in fibre diameter has been relatively constant since 1990, declining least in mid-micron categories. Most of the genetic changes in body weight and coefficient of variation of fibre diameter have occurred in the last decade.

AIMS

The average fibre diameter of the national Merino clip has declined by about one micron in the decade beginning 1992-93 (ABARE 2006), suggesting that producers have responded to price signals prevailing in the 1990s that saw high premiums for reductions in fibre diameter. Changes at a national level can result from individual producers changing their ram source, buying a different type of ram from existing sources, choosing different attributes in the replacement ewes and wethers that they bred or purchased, changing their management or flock structure or by entering or leaving the industry. Collectively, these factors mask any trends that are occurring in the ram breeding sector, which drives most of the genetic changes. Sheep Genetics Australia (SGA) was recently established to provide a single genetic evaluation system for Australian sheep breeders, and it therefore allows changes in the ram breeding sector to be monitored. The aim of this paper is to report genetic changes that have occurred in a sample of Merino ram breeders’ flocks since 1990.

METHOD

The key features of SGA analyses were outlined by Brown et al. (2006). Merino data were obtained from the SGA database in April 2006, averaged by their genetic group solutions. In almost all instances, genetic groups coincided with individual ram breeding flocks. All industry flocks with suitable genetic linkage were used. After data from research flocks, small flocks and central progeny tests were excluded, 105 genetic groups remained. Average breeding values were calculated by birth year for four traits at hogget age – average fibre diameter (HFD), coefficient of variation of fibre diameter (HFDCV), body weight (HBW) and greasy fleece weight (HGFW%). These overall averages were obtained by weighting the averages of each of the genetic groups by the respective number of animals born in each year.

In order to examine trends across the micron spectrum, genetic groups were subdivided into three HFD categories on the basis of their solutions for HFD in 2000. Group averages ranged from -2.75 microns to +0.98 microns. Each group was subsequently allocated into one of three micron categories: Fine, -2.75 to -1.75 microns (F, 19 groups); medium, -1.5 to -0.5 microns (M, 68 groups); and strong, above -0.5 microns (S, 18 flocks). Deviations for fibre diameter and all other traits are expressed relative to the base year, which is 1990. The summary reported here includes estimated breeding values from a total of 783,016 animals born during the period 1990 to 2004 inclusive.

RESULTS

Figure 1 shows a reduction of about 1.2 microns in HFD between animals born in 1990 and 2004 – an average reduction of 0.93 microns every ten years (range between groups -0.21 to +0.08 microns per annum). When averaged across all genetic groups, there has been little overall trend in HGFW% despite an unfavourable genetic correlation of +0.30 with HFD (the value assumed in SGA analyses).

* AGBU is a joint venture of NSW Department of Primary Industries and The University of New England.
However, variation between groups was appreciable, ranging from -1.5% to +2.6% per annum. Most of the genetic changes in HBW (upwards) and HFDCV (downwards) seem to have occurred since about 1994-95. Annual average trends for individual groups over the entire reporting period ranged from -0.5 kg to +0.8 kg for BWT and from -0.23% to +0.16% for HFDCV.

Trends for HFD in each of the three micron categories are shown in Figure 2. It is clear that Merino breeders in all micron categories have been reducing the average fibre diameter of their flocks. The greatest decline has been in the finer micron genetic groups, where the average breeding value for HFD has been reduced by 1.9 microns between 1990 and 2004. Genetic groups on the broad end of the distribution declined in HFD by 1.4 microns during this period and those in the mid-micron categories declined by 1.0 microns. The reduction has been approximately linear in all three categories over this time period.

**Figure 1.** Genetic trends in hogget fibre diameter, hogget greasy fleece weight, hogget body weight and hogget coefficient of variation of fibre diameter in a sample of Merino flocks since 1990. Each Y-axis is scaled to represent a range of approximately 0.7 phenotypic standard deviations.

**Figure 2.** Average solutions for 105 genetic groups classified by year of birth and hogget fibre diameter category in 2000.
CONCLUSION

SGA provides a very powerful mechanism for tracking genetic changes at the flock level and nationally. Although the SGA database contains some large and influential ram breeding flocks, the genetic groups involved in this analysis do not represent all available ram sources. Nevertheless, the results show that most of the changes in average fibre diameter of the Australian Merino clip observed since the early 1990s (ABARE 2006) could be explained by genetic selection. There is also good evidence that breeders have selected for increased body weight and lower coefficient of variation of fibre diameter over the past decade. Changes in all four traits are in line with market signals to reduce FD and maintain FW and more recently to increase staple strength (effectively selected for by reducing FDCV) and increasing BW.

These four traits are a sub-set of many objectively-measured traits in the SGA database with adequate data for a long term study of industry trends. However ram breeders also place significant emphasis on other traits, some measured and some visually assessed. Studies for individual breeders show that it is common for 60% to 80% of selection emphasis to be applied to traits in their selection index, with the remaining emphasis applied to visually-assessed wool quality traits, conformation and traits associated with resistance to fleece rot. In many cases, ram breeders are also placing significant emphasis on additional measured traits, such as worm resistance, staple strength, comfort factor and reproduction rate. In total the traits reported in this paper could be expected to describe no more than 70% of the breeders' selection emphasis.

KEY WORDS
Genetic trends, Merino, breeding

ACKNOWLEDGMENTS

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Paper reviewed by: Dr Andrew Swan.

REFERENCES


Influence of Sire Growth Estimated Breeding Value (EBV) on Progeny Growth

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ABSTRACT

Paying a higher price for sires with high EBV's for growth would not be justified in terms of weight advantage if slaughtering un-weaned/young lambs. Progeny need to be kept to at least 3 months of age to realise a benefit and this applies to a range of sire types. Irrespective of the breed type selecting sires with high EBV’s for growth will result in heavier progeny than those from sires with low EBV’s for growth. Sires selected for muscling will produce slower growing progeny.

AIMS

As part of the meat program of the Australian Sheep Industry CRC a resource flock was established at the NSW Department of Primary Industries, Centre for Sheep Meat Development, Cowra. The flock generated progeny in 2003 (n = 595) and 2004 (n = 627) for use in two strategic experiments on fat and muscle development. The design of the experiments has allowed further investigation of the impact on progeny of selecting sires based on estimated breeding values (EBV’s).

METHOD

Experiment 1

Sires were selected using LAMBPLAN EBV’s for growth and muscle development and were linked to previous genetic studies. Poll Dorset sires selected for growth (PDg) were used over both Border Leicester×Merino (BLM) and Merino (M) ewes, with the other sires (Poll Dorset selected for muscling (PDM), Merino and Border Leicester (BL)) used only across M ewes. The lamb types were generated by artificially inseminating ewes using 4 sires per sire group (PDg, PDM, BL and M, a total of 16 sires) which differed in EBV’s for growth and muscling. An experiment was conducted where the animals were slaughtered at 1 of 4 ages, from weaning (4 months) to 22 months.

Ewes were separated into the 20 sire/dam breed groups for lambing (July 2003). Lambs were tagged within 15 h of birth and their birth weight, dam identification, sex, type of birth (number of lambs in the litter), and birth date were recorded. After weaning the lambs grazed a combination of lucerne and pasture grasses and were fed supplements. The first group of progeny were slaughtered in November 2003 as suckers (un-weaned), with the other groups in March 2004 (weaned lambs at 8 months of age), September 2004 (lamb/hogget at 14 months of age) and May 2005 (hoggets at 22 months of age). Final weight for each slaughter group was analysed using a mixed linear model in ASReml. The fixed effects in the model were genotype (PDg×BLM, PDM×M, PDg×M, M×M, BL×M), sex (wether, ewe), birth type (1-4), rearing type (1-3) and the covariates YWT (sire yearling EBV for weight) and animal age and the interaction between these covariates. Other interactions were also tested, but they will not be reported here for the sake of brevity. In modelling, the genotype contrasts based on sire breed and dam breed were examined. Sire and dam identification were included as random terms, as was the sire by dam breed interaction.

Experiment 2

Poll Dorset sires selected for growth (PDg), for muscling (PDM), for growth and muscling (PDgm) and control sires were used across Merino ewes. The lamb types were generated by artificially inseminating ewes using 5 sires per sire group (i.e. 5 x 4 = a total of 20 sires). Progeny were weaned at either 20 or 30 kg and within each weaning group half the lambs were maintained at their weaning weight for 8 weeks or grown on full feed. After the maintenance period lambs were reallimented. Lambs were slaughtered when each weaning/growth path group (n = 4) reached 45 kg on average.
Ewes were separated into the 20 sire groups for lambing (July 2004). Lambs were tagged within 15 h of birth and their birth weight, dam identification, sex, type of birth (number of lambs in the litter), and birth date were recorded. From birth to weaning lambs were run with their mothers at pasture. The lambs were weighed at marking (20 days after birth), the early weaners at 62 days after birth and the late weaners at 95 days after birth. Liveweight at each age was analysed using a linear mixed model in ASReml. The fixed effects in the model were sex (wether, ewe), birth type (1-4), rearing type (1-3) and the covariates sire post weaning weight (PWWT) EBV, sire post weaning eye muscle depth (PEMD) EBV, birth weight and animal age. Sire and dam identification were included as random terms.

RESULTS

Experiment 1

There was a significant interaction \( (P < 0.05) \) between the YWT EBV and age at slaughter. Given the different sire types used in the experiment and their differing range of YWT EBV's the interaction of this covariate with age at slaughter on final live weight is shown within genotypes at the various ages (Figures 1 & 2). The YWT EBV range for each genotype shown in Figures 1 & 2 represents the range for the sires used to generate the respective genotype.

The overall coefficients for YWT were -0.01, 0.14, 0.34 and 0.65 for slaughter ages 108, 234, 398 and 657 days respectively indicating that while in young animals there was no effect of sire EBV on liveweight, as the animals aged there was an increasing effect such that progeny of sires with high sire
YWT EBVs were heavier. As shown in the Figures 1 & 2 this effect is evident within all genotypes. This data is unique because previous studies have focussed on weaned lambs and none to our knowledge have included 14 or 22 month old animals.

**Experiment 2**

The results suggest that the growth advantage in progeny from sires selected for high PWWT EBV’s will not be evident within 2 months of birth, but by 3 months will be evident (Table 1).

Table 1. Impact of fixed effects and covariates on lamb weight at different ages

<table>
<thead>
<tr>
<th>Terms</th>
<th>Birth weight</th>
<th>20 day weight</th>
<th>62 day weight – early weaned</th>
<th>95 day weight – late weaned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight</td>
<td>Not applicable</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Birth type</td>
<td>**</td>
<td>**</td>
<td>n.s.</td>
<td>*</td>
</tr>
<tr>
<td>Rearing type</td>
<td>Not applicable</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Gender</td>
<td>**</td>
<td>n.s.</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Age</td>
<td>Not applicable</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>PWWT</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>*</td>
</tr>
<tr>
<td>PEMD</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>*</td>
</tr>
</tbody>
</table>

n.s.; not significant; *P<0.05; **P<0.001

The advantage of using sires with high EBV’s for PWWT will not be evidenced in young lambs and as shown elsewhere becomes more apparent as progeny increase in weight/age. Hall et al. (2002) suggested that this reflects a decreasing influence of maternal effects such as milk production. It is of interest that the PEMD EBV has a significant effect on weight in the older lambs and because the coefficient was negative indicates that sires with high EBV’s for this trait will produce slower growing progeny consistent with the results of Hegarty et al. (2006). It is of importance that the sire PWWT EBV does not impact on birth weight confirming previous work (e.g. Hall et al. 2002) as this implies that lambing difficulty due to larger lambs should not occur if sires with high PWWT EBV’s are used, whereas other factors such as gender and birth type will impact significantly on birth weight.

**CONCLUSIONS**

- Irrespective of the breed type selecting sires with high EBV’s for growth will produce heavier progeny than those from sires with low EBV’s for growth.
- This benefit will increase as the animals become older.
- For un-weaned/young lambs at slaughter the advantage in weight would not justify a higher price for sires with high EBV’s for growth.
- Selecting sires with high EBV’s for growth does not impact on birth weight suggesting that lambing difficulty due to larger lambs should not occur, whereas other factors such as gender and birth type will impact significantly on birth weight.
- Sires selected for muscling will produce slower growing progeny with a lighter mature weight.

**KEY WORDS**

Sires, growth, lambs

**ACKNOWLEDGMENTS**

Technical support for these studies was provided by Tony Markham, Jayce Morgan and Andrew Roberts, (NSW Department of Primary Industries). Thanks to Dr. A. Ball (LAMBPLAN) for providing the sire recommendations and to the breeders who allowed the purchase of semen. The study was funded by NSW Department of Primary Industries, Meat and Livestock Australia and the Australian Sheep Industry Cooperative Centre.

Paper reviewed by: Dr. Alex Safari

**REFERENCES**

Predicting Input Sensitivity on Lamb Feedlot Profitability by Using a Feedlot Calculator

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ABSTRACT
Producers can use the Feedlot Calculator to predict lamb feedlot profitability for their production system. Inputs can be varied to determine the changes in profitability. Factors independent of the time lambs remain in the feedlot (eg. lamb price) give predictable responses to profit. Factors relating to liveweight gain and feeding have a variable affect on profit. This paper reports on the sensitivity of profit for a number of input criteria using data from seven published feedlot production studies.

AIMS
As part of the nutrition program of the Australian Sheep Industry CRC a Feedlot Calculator was developed to enable producers to predict lamb feedlot profitability. This paper summarises the results obtained by using this software on a number of data sets from feedlot studies and shows how variation in costs and returns will affect profitability.

METHOD
Production, intake and ration data were sourced from seven studies across Australia. The main input information is summarised in Table 1. Other inputs such as lamb purchase price, skin value at sale, ration wastage, variable, fixed and ration components costs are not shown, but are used to calculate lamb profit. Individual inputs were varied for each data set to establish their affect on profit.

Table 1. Production, intake and ration data for lamb feedlot calculations.

<table>
<thead>
<tr>
<th>Study</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td>TxMer</td>
<td>2nd cross</td>
<td>2nd cross</td>
<td>2nd cross</td>
<td>TxMer</td>
<td>Mer</td>
<td>TxMer</td>
</tr>
<tr>
<td>Starting Weight (kg)</td>
<td>35</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>36</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Final weight (kg)</td>
<td>49</td>
<td>43</td>
<td>43</td>
<td>52</td>
<td>50</td>
<td>54</td>
<td>55</td>
</tr>
<tr>
<td>HCWT ($/kg)</td>
<td>3.50</td>
<td>3.50</td>
<td>3.50</td>
<td>4.50</td>
<td>3.50</td>
<td>3.50</td>
<td>3.50</td>
</tr>
<tr>
<td>Dressing%</td>
<td>46</td>
<td>43</td>
<td>43</td>
<td>45</td>
<td>44</td>
<td>42</td>
<td>45</td>
</tr>
<tr>
<td>LWT gain (g/h/d)</td>
<td>165</td>
<td>240</td>
<td>265</td>
<td>235</td>
<td>190</td>
<td>138</td>
<td>180</td>
</tr>
<tr>
<td>Intake(DM) (%LWT)</td>
<td>2.6</td>
<td>3.5</td>
<td>4.7</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Intake(DM) (kg/h/d)</td>
<td>1.09</td>
<td>1.38</td>
<td>1.85</td>
<td>1.23</td>
<td>1.20</td>
<td>1.39</td>
<td>1.52</td>
</tr>
<tr>
<td>Feed convDM (DM/LWT)</td>
<td>6.6</td>
<td>5.8</td>
<td>7.0</td>
<td>5.2</td>
<td>6.3</td>
<td>10.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Ration Feeding</td>
<td>Grain/hay</td>
<td>Grain/silage</td>
<td>Grain/silage</td>
<td>Grain/hay</td>
<td>Grain/hay</td>
<td>Pellets</td>
<td>Pellets</td>
</tr>
<tr>
<td>Ration Feeding</td>
<td>Separate</td>
<td>Separate</td>
<td>TMR</td>
<td>TMR</td>
<td>Separate</td>
<td>TMR</td>
<td>TMR</td>
</tr>
<tr>
<td>Ration Cost ($/t fed)</td>
<td>191</td>
<td>123</td>
<td>123</td>
<td>264</td>
<td>171</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Ration Cost ($/t DM)</td>
<td>214</td>
<td>215</td>
<td>215</td>
<td>296</td>
<td>193</td>
<td>333</td>
<td>333</td>
</tr>
</tbody>
</table>

Breed: TxMer = Terminal sire x Merino ewe; 2nd cross = Terminal sire x BLM; Mer = pure Merino
Feeding: Separate = grain and roughage separate feeders; TMR = Total Mixed Ration
HCWT price is a wholesale price producer also pays slaughter costs

RESULTS
Lamb Profit
Profit from five of the seven systems was moderate ranging from $5.87 to $10.33 per lamb. Two sets of results (6 and 7) had negative returns (-$21.60 and -$11.79 respectively).

Input Sensitivity
Provided deaths are low and all lambs except shy feeders are sold for the same hot carcass weight (HCWT) and skin price then factors such as skin value, purchase price/lamb, variable costs/head (eg. drenching, shearing) can easily be equated to a direct dollar value change/head. These have not
been varied for this paper. Other price orientated inputs that are not related to time in the feedlot have a fairly uniform affect on profit. The average input changes from these seven studies were:

1. Purchase price/lamb on liveweight (LWT) basis. A $0.10 change in $/kg LWT = $3.80 profit change.
2. Hot carcase price. A $0.20 change in $/kg HCWT = $2.13 profit change.
3. Dressing % (changes carcase weight). A 1% change = $1.66 profit change.
4. Second draft (tail 20 to 30% of lambs). A 10% drop in value = $1.44 profit change for all lambs.

Time in the feedlot is dependant on the amount of LWT gain required and the daily growth rate. By changing starting and/or finishing weights, growth rate, feed efficiency, labour, machinery and ration costs sensitivity for these individual factors has been calculated from these seven studies as follows:

1. Increasing starting or decreasing finishing LWT (at constant prices) will save on average $1.10 and $1.41/kg LWT respectively, but with considerable variability. The finishing LWT is more important (range $0.25 to $4.54/kg LWT) especially if you are losing money (see study 6 and 7).
2. Labour with self feeders has been estimated to be $0.05/lamb/day and open troughs with feeding daily $0.10/lamb/day. The doubling of the labour cost will decrease profit by $1.22 to $4.08/lamb.
3. Doubling machinery feedout costs on average decreases profit by $0.90/lamb.
4. Increasing growth rate by increasing intake by 0.3%LWT and maintaining the same feed conversion can increase profit by up to $1.00/hd whereas a modest increase in growth rate of 10 g/h/d for the same intake (improved feed conversion) has a dramatic effect on profit as illustrated in Figure 1.
4. Changes of 10% in ration costs per tonne as fed either through lower ingredient costs or lower losses will change lamb profit by $1.04 to $4.53.

Figure 1. Gain in lamb profit by increasing daily growth rate by 10 g/h/d when intake is maintained.

CONCLUSION

- The Feedlot Calculator allows producers to consider single or multiple factors when predicting lamb feedlot profit and highlights the need to examine different systems before commencing a feeding program, otherwise significant income could be foregone.
- Profit is driven by many interrelated factors, with considerable variation between feedlot systems. Lamb growth rate is critical.
- Feed efficiency and ration costs (ingredients and wastage) are major contributors to profit. Breed, low growth, poor feed conversion and high ration costs are the main contributing factors to an estimated loss of $21.60 per lamb for study 6.
- Other important factors that are related to time in the feedlot are starting/finishing weights and labour costs.

The Feedlot Calculator can be downloaded from the Sheep CRC website: www.sheepcrc.org.au/feedlootcalc

KEY WORDS
Feedlot, lambs, profit

Paper reviewed by: Mr. Ashley White

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Annual ryegrass toxicity (ARGT) in WA – 2006
David Kessell, Meat & Livestock Australia ARGT Project, Northam, WA

ABSTRACT
Annual ryegrass toxicity (ARGT) is a disease of grazing livestock resulting from the ingestion of annual ryegrass seed-heads infected by the toxin-forming bacterium Rathayibacter toxicus. The causal organisms are now widespread in the areas of WA that support annual ryegrass. Alongside chemical control of ryegrass (reducing in effectiveness due to herbicide resistance) three biological control options are discussed (Safeguard ryegrass, Twist fungus and non-toxigenic Rathayibacter).

REVIEW

The Disease: Annual ryegrass toxicity (ARGT) is a disease of grazing livestock resulting from the ingestion of annual ryegrass seed-heads that have been infected by the toxin-forming bacterium Rathayibacter toxicus. During winter the bacteria adhere to seed-gall nematodes (Anguina funesta) as they move across the soil surface to find young ryegrass plants. The nematodes, some with bacteria attached, invade the ryegrass seedling and wait until the plant starts to produce a seed-head. The nematodes then invade a developing seed to produce a gall, inside which they attempt to complete their life cycle. If bacteria are attached to the nematode they colonise the galls, suppressing the nematodes, and toxicity develops as the plants hay-off. The toxin production is possibly promoted by the presence of a specific bacteriophage.

Distribution: First recorded at Black Springs, SA in 1956, ARGT has become a far greater problem in WA since the first outbreak near Gnowangerup in 1968. The ARGT causative organisms have continued to spread throughout WA, and recent surveys have shown that they are now widely spread in the wheatbelt and mixed farming areas. Deaths have also occurred on the Swan coastal plain in animals fed locally made hay.

Impacts: The Department of Agriculture and Food in WA estimates that ARGT costs WA producers around $40M/yr. The major visual impact is livestock deaths, but this only accounts for approximately 5% of the overall costs of the disease. There are subclinical effects on wool and reproduction and suspected on meat production and feed conversion efficiency. Daily monitoring of stock is costly (15%) and psychologically draining on producers.

There is also a large cost to export hay producers through rejection of contaminated hay (currently from 1 bacterial gall/kg of hay). A mandatory testing program ensures that the exported hay is risk free. At present there is no similar testing regime for local hay.

Detection: A field assessment can often detect deformed heads, bacterial galls and maybe slime, but laboratory tests are required to quantify the levels present.

The Department of Agriculture and Food’s Animal Health Laboratories currently run tests (ELISA test for R. toxicus) on mature ryegrass seed-heads, and hay. At present samples require soaking for 17 hours, but work has been completed to reduce this to 9 hours to shorten turnaround times.

Control Options:
Plant intervention: In winter, a number of herbicide options are available to reduce the ryegrass populations in crops and pastures. The sowing of Safeguard ryegrass is also a very useful option for graziers and is covered in more detail later.

In spring, the use of slashing or heavy grazing to remove infected seed-heads before toxicity develops can vastly increase the safety of affected paddocks. Spray-topping with gramoxone or glyphosate at the correct times will also prevent further development of toxicity and make paddocks safer to graze, but both these treatments are very damaging to legume seed set. Glyphosate (450g/L) @ 350mL/ha when ryegrass seed-heads first begin to emerge or gramoxone (250g/L) @ 400mL/ha about 10 days after head emergence can be very effective treatments (Note that these timings are much earlier than those for seed-set control).
After haying-off has occurred, toxin levels increase, and in crop, removal of seeds/galls using chaff carts can increase the grazing safety of stubble. In pasture, burning affected patches is also an option when permitted. By January, galls have begun to shed naturally and can be assisted by dragging heavy chain or railway iron over affected patches in pastures.

**Biological control:** A number of biological control possibilities have been tried and those considered to have the greatest potential are Safeguard ryegrass, twist fungus and non-toxigenic *Rathayibacter*. An integration of several of these is likely to have the most success.

**Safeguard** is a cultivar of ryegrass that has resistance to gall production from the nematode *Anguina funesta*. It is suited to WA conditions, has resistance to root diseases and enhanced herbage production. The resistance to nematode gall formation is dominant, and will be carried over to progeny resulting from cross fertilisation between the local ryegrass and Safeguard, providing flowering times are similar. For Safeguard to have the greatest impact, it must be established in at least a 3:1 proportion with the local ryegrass. This option is popular with livestock producers and costs $40/ha (8kg/ha @ $5/kg) for the seed which is readily available.

**Twist fungus** (*Dilophospora alopecuri*) competes with the bacteria for the nematode vector and plant host. Inside the ryegrass, twist grows more rapidly inhibiting nematode and bacterial gall production. Once established, twist will persist and spread, has been shown to dramatically reduce numbers of toxic bacterial galls, and is not adversely affected by commonly used fungicides. Twist prefers wetter seasons and areas, so establishment along waterways and contour banks provides long-term reservoirs of inoculum. Testing to confirm the presence of nematode or bacterial galls should be done before attempting to establish twist fungus. Applications, in the absence of nematodes, or after nematodes have entered ryegrass or in dry seasons could result in twist fungus failing to establish. Inoculum is readily available by ordering early in the year. Order forms are available through the ARGT.com.au website. It costs around $3.80/ha (200g/ha) and comes in boxes of 20kg (8 x 2.5kg bags)

The combined effectiveness of the two approaches was demonstrated at a number of sites around WA in 2005. In a particularly impressive case, on a farm near Beverley WA, the treatment reduced toxic gall numbers from potentially deadly to relatively safe, within one season.

<table>
<thead>
<tr>
<th>Bacterial galls per kg of pasture</th>
<th>Season before treatment (Oct 2004)</th>
<th>One season later (Oct 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated area</td>
<td>&gt;1000</td>
<td>&gt;1000</td>
</tr>
<tr>
<td>Area treated with Safeguard + Twist</td>
<td>8 (range 1-21)</td>
<td></td>
</tr>
</tbody>
</table>

**Non-toxigenic *Rathayibacter*** may prove to be highly effective in the control of ARGT. These are other species of the bacteria that do not produce toxin, grow more rapidly and in quarantine facilities have been shown to displace the toxic bacteria. Quarantine studies have confirmed that there are no threats from introducing these bacteria. A decision from AQIS to allow field trials is hoped for by the end of 2006. Potentially these bacteria would be easier to mass-produce and apply than twist fungus. If AQIS approval is given and provided they establish, spread and persist as expected they may provide the best control of ARGT. The likely timeline for first release, after field evaluation, would be towards the end of this decade.

**KEY WORDS**

Annual ryegrass toxicity, ARGT, *Anguina funesta*, *Rathayibacter toxicus*, *Dilophospora alopecuri*.

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Paper reviewed by: Jeremy Allen and Ian Riley
Poor ewe nutrition during pregnancy increases fatness of their progeny

Andrew Thompson, Department of Primary Industries, Victoria

ABSTRACT

Poor ewe nutrition during pregnancy can reduce lamb birth weight and survival and have permanent adverse impacts on their production. The ‘Lifetime Wool’ project has shown that progeny from ewes that lost a condition score during pregnancy produce up to 1 kg less wool during their entire lifetime and that their wool is 0.2 to 0.3 microns broader than those from ewes which maintained condition during pregnancy. Progeny from poorly fed ewes are also much fatter when they reach mature size, which may predispose them to various metabolic, cardiovascular and other diseases as occurs in humans. In this study, more than 80% of the variance in the proportion of fat (and lean) was explained by differences in mature size of the progeny and the liveweight profile of their dam during pregnancy.

AIMS

In the context of optimising whole farm stocking rate it is inevitable that the Merino ewe will be managed to achieve less than maximum rates of production for both herself and her progeny. Merino ewes typically lose significant weight at some stage during pregnancy or lactation. There has been a perception that nutrition during pregnancy has negligible effects on the offspring, largely due to the resilience of lamb birth weights to all but the most severe nutritional challenges, but this view is rapidly changing as evidence emerges that even subtle changes in nutrition during development in utero can have permanent impacts on the production potential and health of the progeny. Quantifying the impacts of foetal programming and its importance in the context of developing practical feeding systems for Merino ewes is the basis of the ‘Lifetime Wool’ project (Thompson and Oldham 2004). Low birth weight lambs are fatter up to 20 kg liveweight when compared with lambs with normal birth weights (Greenwood et al. 1998), but evidence is limited on whether this persists through to heavier weights. We hypothesised that such effects would be evident at mature size, given that small human babies tend to have significantly reduced muscle mass and higher overall body fat content in adult life (reviewed by McMillen et al. 2005).

METHOD

The experiment used progeny from the ‘Lifetime Wool’ project in Victoria (Thompson and Oldham 2004). Twenty four single born adult wethers were selected from ewes that experienced extreme differences in nutrition during pregnancy and lactation; the average condition score of the ‘Low’ and ‘High’ ewes was 2.7 vs. 2.6 at joining, 2.3 vs. 2.8 at Day 90 of pregnancy, 2.4 vs. 3.4 at lambing and 2.1 vs. 3.1 at weaning. Lambs from the ‘Low’ group were significantly lighter (P<0.001) at birth (4.6 vs. 5.9 kg) and at weaning (14.7 vs. 22.2 kg) than those from the ‘High’ group. All wethers were grazed together from weaning and differences in liveweight between groups persisted until 2 years of age.

At about 3.5 years of age, the wethers were allocated to individual pens in an animal house. They were initially offered a maintenance ration of oaten hay that was replaced over one week with step-wise increases in the amount of a roughage-based pellet (10.9 MJ/kg; 16.5% CP). The amount of pellets offered was increased gradually to ad libitum during the second week and then maintained at this level for 8 weeks. Feed intake was measured daily and liveweights weekly. Back fat and eye muscle depth was measured using ultrasound in weeks 1, 4 and 7, and whole body composition was measured at the end of the experiment using dual energy x-ray absorptiometry (DEXA).

RESULTS

- The ‘Low’ group grew slower than the ‘High’ group during the first 4 weeks of ad libitum feeding (172 vs. 238 g/d; P <0.01) and this trend continued over the 8-week period (131 vs. 173 g/day; P = 0.06).
- There were no significant differences in average daily feed intake between the ‘Low’ and ‘High’ groups (1.51 vs. 1.65 kg DM/day) or feed conversion efficiency (11.4 vs. 10.0 kg gain/kg intake). However, the ‘High’ group tended to eat more and be more efficient at converting feed into liveweight gain.
There were massive differences in whole body lean and fat tissue mass measured by DEXA; on average, after correction for liveweight, the proportion of fat was greater (33.8 vs. 24.0%; P<0.001) and lean was less (63.1 vs. 72.0%; P<0.001) for the 'Low' than 'High' groups. These differences in whole body fat and lean were not reflected in difference in average depth of back fat (4.2 vs. 3.9 mm) and eye muscle (30.3 vs. 28.8 mm) after correction for liveweight.

Body composition of adult wethers was most closely related to their liveweight. After correcting for differences in liveweight, lambs that were smaller and grew more slowly to weaning had less lean tissue and were fatter at mature size. More than 80% of the variance in the proportions of fat and lean was explained by differences in liveweight of progeny (PLW; kg), ewe liveweight at joining (ELW_0; kg) and changes in ewe liveweight between joining and day 90 of pregnancy (LWC_0-90; kg) and day 90 and lambing (LWC_90-L; kg).

\[
\text{Fat} (\%) = -5.0 + 1.12 \text{PLW} – 0.60 \text{ELW}_0 – 0.67 \text{LWC}_0-90 – 0.58 \text{LWC}_{90-L} (r^2 = 0.83; P<0.001)
\]

\[
\text{Lean} (\%) = 102.2 – 1.00 \text{PLW} + 0.50 \text{ELW}_0 + 0.54 \text{LWC}_0-90 + 0.50 \text{LWC}_{90-L} (r^2 = 0.84; P<0.001)
\]

**CONCLUSION**

These results indicate that nutrition *in utero* and pre-weaning has very significant effects on the physiology and body composition of mature Merino wethers. A 10 kg change in ewe liveweight during early/mid pregnancy or late pregnancy increased the proportion of fat by about 6% units, or in whole body terms from 24 to 30%. Increases in fatness were associated with decreases in lean of similar magnitude, as there were no effects of early lifetime nutrition on ash content. The effects on total body fat and lean were not evident from measurements of back fat and eye muscle depth measured by ultrasound, suggesting that the extra fat that resulted from nutritional stresses early in life was probably located in the abdominal region. This would be consistent with the human literature, and is significant because central obesity has been linked to increased incidence of metabolic, cardiovascular and other diseases. There is some evidence that animals that experienced poor nutrition during early life may have lower feed conversion efficiency, which is weakly linked to differences in body composition. More efficient steers have been shown to have less whole body fat and more whole body lean than less efficient steers, but differences in composition explained less than 5% of the variation in efficiency (Richardson and Herd 2004), indicating that other factors are clearly involved.

The importance of these nutritionally mediated effects on early-life programming of body composition and possibly feed conversion efficiency during adulthood in the context of developing practical ewe feeding systems and marketing systems requires further investigation. It is clear however that if we do not account for these and other impacts from manipulating ewe nutrition, both on the ewe and her progeny, then our ability to predict farm system level outcomes from changes in ewe management policies or environmental conditions will be limited.

**KEY WORDS**

Foetal programming, body composition, feed conversion efficiency, Lifetime Wool

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