Sheep Updates 2005 - Part 4

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Is it worth increasing investment to increase lambing percentages?

Lucy Anderton, Economist, Department of Agriculture Western Australia

ABSTRACT

LambMax WA was a tightly integrated program based on collaboration between innovative farmers with an interest in sheep production, the Department of Agriculture Western Australia and the Animal Biology group at The University of Western Australia. The basic aim of the activity was to demonstrate the potential management strategies to increase weaning percentages in ewe flocks on farms in Western Australia (1).

On-farm studies were conducted to investigate the individual components contributing to the overall ewe lambing performances on five farms in 2003 and 2004 with issues learnt during the first year being used to improve the trials in 2004. This paper reports the results of an economic assessment of the strategies examined in the LambMax activity.

AIM

To conduct an economic assessment of the management strategies applied to ewe flocks in the LambMax trials.

METHOD

The data collected from the trials were incorporated into a gross margin (GM) model that represented and compared the different sheep enterprises, flock structures and treatments outlined in Table 1.

Gross margins are an economic tool to study enterprise specific issues. They are calculated by deducting variable costs from the gross income from sheep and wool sales. Variable costs are those that alter per head or per hectare according to the land use. The results are then reported as $/winter grazed hectare (WGHA) figures or $/Dry Sheep Equivalent (DSE). Winter grazed hectares are the number of hectares in pasture during the winter.

Table 1: Types of flock structures compared with different treatments

<table>
<thead>
<tr>
<th>Wool Merino</th>
<th>High Input March Lambing</th>
<th>High Input May Lambing</th>
<th>High Input July Lambing</th>
<th>High Input Merino July Lambing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shippers</td>
<td>38% ewes mated to terminal sires</td>
<td>38% ewes mated to terminal sires</td>
<td>38% ewes mated to terminal sires</td>
<td>Shippers ($48/hd)</td>
</tr>
<tr>
<td>No teasers</td>
<td>Prime lambs (350 cents/kg dwt)</td>
<td>Prime lambs (230 cents/kg dwt)</td>
<td>Prime lambs (280 cents/kg dwt)</td>
<td></td>
</tr>
<tr>
<td>Ovastim injection</td>
<td>Ovastim injection</td>
<td>Ovastim injection</td>
<td>Ovastim injection</td>
<td></td>
</tr>
<tr>
<td>Scanning once</td>
<td>Scanning once</td>
<td>Scanning once</td>
<td>Scanning once</td>
<td></td>
</tr>
<tr>
<td>Twins fed pellets (850 g/hd/d) for 5 weeks just before lambing</td>
<td>Twins fed pellets (850 g/hd/d) for 5 weeks just before lambing</td>
<td>Twins fed pellets (850 g/hd/d) for 5 weeks just before lambing</td>
<td>Twins fed pellets (850 g/hd/d) for 5 weeks just before lambing</td>
<td></td>
</tr>
</tbody>
</table>

All the analyses were based on a medium rainfall farming system (400-500 mm), such as found around Narrogin, assuming a stocking rate of 10 DSE/WGHA. The different lambing times were
included in the analyses because of the fluctuation in prices for lambs at different times of the year. The five-year average price for lambs between 18-20 kg dwt (dressed weight) at Katanning in July is 350 c/kg dwt, compared to October when the five-year average price is 230 c/kg dwt. Consequently the gross margins are slightly different.

The interaction between stocking rate (SR) and lambing percentage is quite complex. The increase in lambing percentage can influence stocking rate. Stocking rates have the greatest impact on profitability and any reduction in SR will reduce the GM/WGHA. To compensate for this in this analysis 38% of the ewes were considered a higher DSE rating because of their increased energy requirements from either twins or prime lambs.

RESULTS

The results of increasing inputs to lift lambing percentages (lambs born) are shown in Table 2. They demonstrate an increase in GM/WGHA only for the July lambing when compared to the results in Table 3 that show gross margins using the current standard practice.

Table 2: Gross margins with increased inputs as shown in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Wool Merino</th>
<th>High Input March</th>
<th>High Input May</th>
<th>High Input July</th>
<th>High Input Merino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambing %</td>
<td>75</td>
<td>108</td>
<td>108</td>
<td>112</td>
<td>108</td>
</tr>
<tr>
<td>GM /WGHA ($)</td>
<td>125</td>
<td>127</td>
<td>138</td>
<td>132</td>
<td>122</td>
</tr>
</tbody>
</table>

Table 3: Gross Margins with standard lambing percentages and no extra costs

<table>
<thead>
<tr>
<th></th>
<th>Wool Merino</th>
<th>March Lambing</th>
<th>May Lambing</th>
<th>July Lambing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambing %</td>
<td>75</td>
<td>81</td>
<td>81</td>
<td>85</td>
</tr>
<tr>
<td>GM /WGHA ($)</td>
<td>125</td>
<td>127</td>
<td>144</td>
<td>119</td>
</tr>
</tbody>
</table>

Sensitivity Analysis

Not all of the LambMax strategies achieved their objective, for example, improving nutrition of twin bearing ewes did not result in better lamb survival. There were however other benefits such as heavier weights of ewes and lambs at marking, which need further analysis. This could potentially decrease the number of days to finish lambs.

“What if” scenarios are shown in Table 4. As expected, the most profitable scenario is to increase the lambing percentage without increasing inputs.

Table 4: Gross Margins with increased or standard inputs.

<table>
<thead>
<tr>
<th></th>
<th>Wool Merino</th>
<th>March Lambing</th>
<th>May Lambing</th>
<th>July Lambing</th>
<th>Merino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Lambing %, High inputs</td>
<td>93%</td>
<td>94%</td>
<td>94%</td>
<td>98%</td>
<td>94%</td>
</tr>
<tr>
<td>GM /WGHA</td>
<td>147</td>
<td>116</td>
<td>141</td>
<td>103</td>
<td>99</td>
</tr>
<tr>
<td>High lambing %, High inputs</td>
<td>75%</td>
<td>121%</td>
<td>121%</td>
<td>125%</td>
<td>121%</td>
</tr>
<tr>
<td>GM /WGHA</td>
<td>125</td>
<td>152</td>
<td>146</td>
<td>149</td>
<td>140</td>
</tr>
<tr>
<td>High Lambing %, standard practice</td>
<td>75%</td>
<td>108%</td>
<td>108%</td>
<td>112%</td>
<td>108%</td>
</tr>
<tr>
<td>GM /WGHA</td>
<td>122</td>
<td>174</td>
<td>163</td>
<td>152</td>
<td>146</td>
</tr>
</tbody>
</table>

CONCLUSIONS

These results are preliminary and further analysis is required to clarify the benefits, if any, of increasing inputs to achieve higher lambing percentages. The results in Table 4 demonstrate that there is potential to increase GM/WGHA when increasing lambing percentages. However, if costs need to be increased then lambing percentages will have to be above 121% to justify the “Rolls Royce” version of inputs.

Further economic analysis is required on individual components of the LambMax strategies to determine which of these strategies will give the most benefit at least cost.
KEY WORDS
Lambing percentages, profit, LambMax

ACKNOWLEDGMENTS
Keith Croker and Rob Davidson
Paper reviewed by: Keith Croker

REFERENCE
What value is a Lamb?

John Young, Farming Systems Analysis Service, Kojonup, WA

ABSTRACT
In order to calculate the profitability of strategies aimed at increasing lambing percentage it is necessary to have an accurate estimate of the value of extra lambs. Calculations done using the MIDAS model show that the value of an extra lamb can vary between $12 and $49 depending on the flock type and prices received. Lambs are more valuable in a flock producing cross-bred prime lambs when meat price is high and least valuable in a wool producing flock when the meat price is low. Wool price and grain price have very little impact on the value of an extra lamb.

AIMS
There are a number of strategies aimed at increasing lambing percentage that farmers are implementing or considering implementing. In order to calculate the profitability of these strategies it is necessary to have an accurate estimate of the value of extra lambs (increased whole-farm $/extra lambs). This paper describes calculations done using the MIDAS model to examine the value of extra lambs for a range of prices and for a range of flock types.

METHOD
The calculations were done using the Great Southern version of the MIDAS model (1). The features of MIDAS that make it suited to this task are:

- The model includes the value of production of the whole flock and accounts for changes in flock structure that result from changes in lambing percentage.
- The model includes the impact of pregnancy and lactation on the value of the wool produced by ewes.
- The model uses a feed budget for the whole flock to calculate optimum stocking rate and level of supplementary feeding required. This feed budget includes the increase in energy requirement of the ewes for pregnancy and lactation when lambing percentage is increased.
- The feed budget also includes the energy required for backgrounding and finishing any lambs that are sold.

The model was setup with the 4 flock types outlined in table 1 and each flock was analysed over 7 price scenarios. A ‘standard’ price was selected for each of wool, meat and grain (Table 2), the price level selected represents a possible medium term outlook price. A ‘low’ and ‘high’ price scenario for each commodity was calculated that was 25% lower or higher than the standard for that commodity and using the standard prices for the other two commodities.

Table 1: Flock types examined in this analysis

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description of flock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialist Wool</td>
<td>Specialist wool producing flock, all ewes mated to merino rams wethers are sold as store lambs or as shippers at 18 months of age. Surplus ewes sold as hoggets.</td>
</tr>
<tr>
<td>Wool + MPL</td>
<td>As for Specialist Wool except a draft (33%) of the larger wether lambs are sold as merino prime lambs.</td>
</tr>
<tr>
<td>SRF with TS</td>
<td>A self replacing merino flock with surplus ewes mated to a terminal sire for first cross prime lamb production.</td>
</tr>
<tr>
<td>Specialist Meat</td>
<td>A specialist meat producing flock, with all ewes mated to a terminal sire for first cross prime lamb production. Replacement ewes are bought in at 18 mo.</td>
</tr>
</tbody>
</table>

Table 2: Prices used in this analysis (sensitivity analysis explored prices ± 25% of these values).

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wool</td>
<td>$5/kg greasy sweep the board for a 21u clip</td>
</tr>
<tr>
<td>Meat</td>
<td>Lambs $2.50/kg (Store $36/hd, MPL $48/hd, XB $59/hd), CFA Ewes $35/hd</td>
</tr>
</tbody>
</table>
For each of these flock types and price scenarios the profitability was calculated with each of a low and high fertility (number of ewes pregnant per ewe joined), low and high prolificacy (number of lambs born per ewe pregnant) and low and high lamb survival. The resulting increase in profit was divided by the number of extra lambs weaned and the 3 values were averaged. This means the value reported is an average for extra lambs being achieved from more ewes pregnant, more ewes having multiple births and fewer lamb deaths.

RESULTS

For each price scenario extra lambs are most valuable in flocks that produce first cross prime lambs (Table 3). Extra lambs are least valuable in specialist wool flocks, and are of intermediate value in a wool + merino prime lamb flock. The value of extra lambs is only slightly affected by wool and grain prices but is very sensitive to meat price. The cost of having an extra lamb, as calculated from the difference between the sale price of a lamb and the calculated value of an extra lamb is between $19 and $22 per head for the different flock types (standard prices). This value varies up or down by $5 for the high and low meat price scenarios because of differences in optimum stocking rate and feed utilisation between price scenarios.

Table 3: Value ($ whole-farm profit/extra lamb) of extra lambs for each flock type and price scenario (value was the same in the range 80-130% lambs weaned)

<table>
<thead>
<tr>
<th></th>
<th>Specialist Wool</th>
<th>Wool + MPL</th>
<th>SRF with TS</th>
<th>Specialist Meat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>17</td>
<td>25</td>
<td>38</td>
<td>37</td>
</tr>
<tr>
<td>Wool – Low</td>
<td>18</td>
<td>26</td>
<td>38</td>
<td>39</td>
</tr>
<tr>
<td>High</td>
<td>16</td>
<td>24</td>
<td>35</td>
<td>39</td>
</tr>
<tr>
<td>Meat – Low</td>
<td>12</td>
<td>14</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>High</td>
<td>23</td>
<td>37</td>
<td>47</td>
<td>49</td>
</tr>
<tr>
<td>Grain – Low</td>
<td>17</td>
<td>24</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>High</td>
<td>18</td>
<td>26</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

CONCLUSION

Meat prices are currently very high which increases the value of extra lambs and increase the incentive for farmers to improve reproductive rate in their flocks. But in order for farmers to decide whether it is profitable to implement any strategies to increase reproductive rate these results need to be combined with calculations of the cost of the strategies and the increase expected.

It is complicated to calculate the true value of extra lambs because of difficulties calculating the cost associated with the extra energy required by the ewes for pregnancy and lactation. These calculations with the MIDAS model indicate that the cost of raising a lamb to sale age is approximately $20/hd. This rule of thumb could be used by producers to calculate a value for extra lambs on their property based on the average net sale price of their lambs.

KEY WORDS

Lambing percentage, economics, MIDAS

ACKNOWLEDGMENTS

This work was funded by the Lifetime Wool project. The Lifetime Wool project was initiated as a cooperative project between the Department of Primary Industries, Victoria and the Department of Agriculture of Western Australia. Since, 2001 it has become a National project funded by Australian Wool Innovation Limited with on-farm experimental sites in all the main wool producing states.

Paper reviewed by: Chris Oldham (WA Department of Agriculture)
REFERENCES

Providing twin-bearing ewes with extra energy at lambing produces heavier lambs at marking

Rob Davidson, WAMMCO International, Burswood, formerly University of Western Australia; Keith Croker, Department of Agriculture, South Perth; Ken Hart, Department of Agriculture, Narrogin and Tim Wiese, “Chuckem”, Highbury.

ABSTRACT

Animal house studies have shown that providing twin-bearing ewes with a high energy supplement a week before lambing increases the production of colostrum. In this trial we compared the performances of two groups of twin-bearing ewes, and their lambs, offered a high energy supplement (850 g/h/d peri-partum pellets) or barley grain (1% of body weight) the week before and 3 weeks after lambing with twin-bearing ewes run under standard farm management (hay + 400 g/h/d oat grain). Two weeks post marking, the ewes on additional feed were heavier and in better condition than those offered standard nutrition. The survival rates of the twin born lambs were similar and lower than the survival rate of the single born lambs. At marking, the single born lambs and the supplemented twin born lambs were heavier than the twins on standard management. At weaning, the single lambs were heavier than the supplemented twins, which were heavier than the twins on standard management. The extra feed given to the twin-bearing ewes did not improve lamb survival. However, the supplemented ewes and their lambs benefited through improved live weights.

AIMS

Twin-bearing Merino ewes, and especially the maiden twin-bearing Merino ewes, have one of the highest lamb mortalities of any class of ewe. The inability of the Merino ewe to produce enough colostrum to satisfy the needs of twin lambs is thought to contribute to the high mortality rates. In studies done in animal houses it has been shown that the production of colostrum is increased in ewes given additional supplements of maize or barley one week before lambing (1, 2). In the trial reported here, we examined the response of lambs to feeding a high level of energy to twin-bearing ewes during late pregnancy and early lactation.

METHOD

Nine hundred and eighty five year old ewes were treated with two injections of Ovastim® (Virbac Australia). The ewes were synchronised by using progesterone sponges (Chronogest 30). Merino sires (14%) were introduced to the ewes on 12 January and removed on the 12 February 2004. The ewes were scanned by real time ultra sound to determine the numbers of lambs in utero. Single and twin-bearing ewes were allocated to one of the following four treatment groups (Table 1).

Table 1. Numbers of ewes and diets given to single and twin-bearing Merino ewes.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of ewes</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>120 single-bearing</td>
<td>Standard management (400 g/h/d oats)</td>
</tr>
<tr>
<td>2</td>
<td>120 twin-bearing</td>
<td>Standard management (400 g/h/d oats)</td>
</tr>
<tr>
<td>3</td>
<td>120 twin-bearing</td>
<td>Standard management + 850 g/h/d PP pellet (Macco Feeds) for 1 week pre- and 3 weeks post-lambing (twin - pellet)</td>
</tr>
<tr>
<td>4</td>
<td>120 twin-bearing</td>
<td>Standard management + 1% of ewe’s body weight of barley for 1 week pre- and 3 weeks post-lambing (twin - barley)</td>
</tr>
</tbody>
</table>

One week before the start of lambing, the ewes were allocated to their lambing paddocks. The single and twin-bearing ewes run under standard farm management lambed in the same paddock. All treatment paddocks were stocked at similar rates. The udders of the single and twin bearing ewes in the standard management treatment were covered with Oxide Cement Colour Additive (Diggers) and kept in the yards overnight to mother up with their lambs. The following morning, the lambs were
allocated to treatment groups, ear tagged and weighed. The ewes and lambs were re-grouped into one mob at marking at about six weeks of age. The ewes were weighed, condition scored and examined to determine those that were lactating or had lost their lambs two weeks post-marking and only the lambs were weighed at weaning as the ewes had been sold.

RESULTS

The use of the Ovastim to generate twin-bearing ewes worked well, with similar percentages of single and twin-bearing ewes (46.6 and 37.2% of the ewes scanned, respectively). There were no differences in the average live weights of the pregnant ewes when allocated to treatment groups. However, two weeks post-marking, the twin (barley) and twin (pellet) treatments were heavier than the single and twin standard treatment and the twin (pellet) treatment was heavier than the twin (barley) treatment. The twin (pellet and barley) treatments were in better condition than the treatments run under standard management.

Table 2. The numbers of lambs marked, percentages of lambs surviving to marking and average live weights of lambs at marking and weaning (kg).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Lambs at marking</th>
<th>Survival to marking$^\text{§}$</th>
<th>Wt at marking</th>
<th>Wt at weaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>109</td>
<td>91$^a$</td>
<td>15.1$^{ac}$</td>
<td>28.5$^a$</td>
</tr>
<tr>
<td>2</td>
<td>171</td>
<td>71$^b$</td>
<td>11.8$^b$</td>
<td>25.0$^b$</td>
</tr>
<tr>
<td>3</td>
<td>190</td>
<td>79$^b$</td>
<td>14.6$^a$</td>
<td>26.4$^c$</td>
</tr>
<tr>
<td>4</td>
<td>178</td>
<td>74$^b$</td>
<td>15.5$^c$</td>
<td>26.9$^c$</td>
</tr>
</tbody>
</table>

$^\text{§}$ Percentage survival of lambs at marking – number of lambs marked/number of potential lambs (singles 120, twins 240).

abc Means in the same column with different superscripts are different (P<0.05).

At marking, the live weights of the single, twin (pellet) and twin (barley) lambs were heavier than the twins (standard management, Table 2). The single-born progeny at weaning were heavier than the twin (pellet) and twin (barley) treatment progeny, which in turn were heavier than the twin standard.

CONCLUSIONS

The additional feed offered to the twin (pellet and barley) treatment groups failed to produce an increase in lamb survival. It did result in an increased live weight of the twins at marking, similar to that of single born progeny run under standard management. A greater response may have been possible because the producer estimated the twin (pellet and barley) ewes only consumed 50% of the supplement. It is possible that more of the supplement would have been consumed had it been protected from the weather (i.e. fed in a trough or self-feeder) and if there had been less winter green feed available.

KEY WORDS

Ewes, lambs, colostrum, lamb survival, energy supplement, growth

ACKNOWLEDGMENTS

Funds for the trial were provided by Meat and Livestock Australia, the Sheep Meat Research and Development Project, Department of Agriculture Western Australia, and the Animal Biology Group at The University of Western Australia.

Paper reviewed by: Dr Chris Oldham, Department of Agriculture Western Australia

REFERENCES
(2) Chadwick, M.E. 2004. Colostrum of twin-bearing maiden ewes is improved by supplementation with cereal grains in the last week of pregnancy. BSc (Agric.) (Hons) University of Western Australia.
Underlying biological causes of trade-off between meat and wool. Part 1. Wool and muscle glycogen

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¹University of WA, Crawley
²CSIRO Livestock Industries, Floreat Park WA
³Department of Agriculture Western Australia, Katanning WA
⁴CRC for the Australian Sheep Industry

ABSTRACT

A high level of wool production in Merino sheep has been shown to affect plasma glucose concentration, so we compared the effect of exercise on muscle glycogen concentration in Merino sheep with high and low fleece weight relative to bodyweight. We found that high fleece weight sheep used 10% more of their initial muscle glycogen than sheep with low fleece weight relative to body weight. Muscle glycogen concentration in both groups had returned to about 60% of their initial values 24 hours after exercise. This demonstrated that selection for fleece weight may alter muscle glycogen metabolism in merino sheep. Whilst the biochemical mechanism causing this finding was unclear, further investigation of this relationship may identify ways to improve the eating quality of meat from Merino sheep.

AIMS

Meat from Merino sheep tends to have a higher ultimate pHu than meat from crossbreds [1] and this is thought to be due to an increased susceptibility to stress induced muscle glycogen loss prior to slaughter [2]. Merino sheep that genotypically have a high fleece weight relative to body weight have relatively low plasma glucose and insulin concentrations, and so may also have altered muscle glycogen metabolism [3]. The aim of this experiment was to determine if fleece weight could influence the susceptibility of merino sheep to muscle glycogen loss due to stress, using the exercise depletion and repletion model [4].

METHOD

Twenty Merino rams, aged two years, were selected for high and low genetic potential for clean fleece weight (CFW) from the Great Southern Agricultural Research Institute ram flock using estimated breeding values for fleece weight and body weight. There was a 0.3kg difference in mean EBV for CFW at similar body weights between the high and low groups. The rams were in half wool at the time of the experiment.

The rams were grazed on poor-quality pasture in late autumn and were offered low quality fodder hay ad libitum for the duration of the experiment. On day seven they were also offered 200 g of lupins per head per day until the animals were removed from all feed late on the 24th day.

Muscle biopsies were taken on day 25 at 2 hrs before exercise, 2 hrs and 24 hrs after exercise. The exercise protocol aimed to deplete muscle glycogen by at least 50% [5]. On day 25 the animals were run for 8 km at 2km intervals at a fast trot, which was approximately 7km per hour and 60% VO2max. After each interval the animals were rested for 10 minutes, which was assumed to allow 90% recovery of basal respiratory rate [5].

Muscle biopsies were performed using a biopsy drill (D. Pethick, Murdoch University, Murdoch, Western Australia). Approximately 100 mg of tissue was excised from the semimembranosus (SM) muscle. The muscle sample was placed in liquid nitrogen immediately and stored at –80°C.

On day 25 the animals were offered 300 g of lupins and 750 g of oaten hay per head after the initial muscle biopsy, 300 g of lupins after exercise and 600g of lupins, 750 g of oaten hay and ad libitum fodder hay after the second biopsy. On day 26 the animals were offered 600g of lupins, 750 g of...
oaten hay and ad libitum fodder hay in the 10 hours before the final biopsy. The glycogen content of the samples was measured enzymatically [2,6].

RESULTS

The high CFW sheep had lower (P = 0.04) muscle glycogen content 2 hours after exercise (Table 1) when adjusted for variation in initial glycogen. The high CFW group depleted an average of 82.6 % of the initial muscle glycogen value compared to 73.0 % in the low CFW group.

| Table 1. Glycogen concentrations in M. semimembranosus before and after exercise |
|---------------------------------|-----------------|-----------------|
| Initial glycogen (g/100g)      | 2 hrs after exercise (g/100g) | 24 hrs after exercise (g/100g) |
| High CFW 1.16 ± 0.08           | 0.021* ± 0.04    | 0.68 ± 0.09     |
| Low CFW 1.12 ± 0.07            | 0.31* ± 0.08     | 0.66 ± 0.07     |

* indicates P<0.05

There was no difference between genotypes for muscle glycogen concentration 24 hrs after exercise, by which time both groups had recovered approximately 61 % of the glycogen concentration prior to exercise.

CONCLUSION

High wool producing Merino sheep used relatively more muscle glycogen during sustained exercise than low wool producing sheep. This finding was consistent with selection for wool production being related to the increased susceptibility to muscle glycogen loss in merino sheep. The mechanism of this effect was not clear, but it may be related to the chronically lower plasma concentrations of glucose and insulin reported in sheep with a high fleece weight [3]. The low availability of fat in high fleece weight sheep during autumn might also increase their dependence on glucose as a fuel, and so influence results. Further investigation into the mechanism for this link between fleece weight and glycogen metabolism would enhance the understanding of the meat wool trade-off, and may offer a way to develop practical means to improve meat quality in Merinos.

KEY WORDS

Meat quality, wool, glycogen, Merino.

ACKNOWLEDGMENTS

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Paper reviewed by: Robin Jacob

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Underlying biological causes of trade-off between meat and wool. Part 2. Wool and fatness

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ABSTRACT
When selecting for dual purpose Merinos, concerns arise that high fleece weight relative to body weight is associated with decreased lamb turnoff at weaning. Our research has shown that low levels of metabolic fuels in the body of high fleece weight sheep during autumn play a key role in this trade-off. Fatness of the sheep is a good indicator of metabolic fuel reserves. Therefore, if breeders are unable to select ewes directly for reproduction rate, it should still be possible to enhance both fleece weight and reproduction if sheep are selected to maintain a satisfactory level of fatness in autumn.

INTRODUCTION
Because stocking rate is a major profit driver of sheep enterprises, Merino sheep are often subjected to restricted feeding for at least part of the year. To combat this, Merino breeders have a strong awareness of 'fitness', defined in this case as the capacity to survive, grow and reproduce when feed is limited. However, up to now there has not been any simple ways to measure fitness.

It appears that fitness can conflict with productivity, because a genetic tradeoff between clean fleece weight and total weight of lambs weaned was observed in WA sheep by Cloete et al. (2002). The Sheep CRC has facilitated joint experiments between CSIRO and the WA Department of Agriculture to define the biological mechanisms that cause this tradeoff, with the aim of developing ways to measure the components of fitness that could be used to breed Merinos for wool plus meat in areas where feed quality or quantity are limiting.

REVIEW

Fleece weight affects the metabolic fuel supply of the sheep

Ewe hoggets were selected from the Katanning base flocks for high or low breeding value for clean fleece weight (phenotypic means 4.3 vs 3.0 kg), with the constraint that the two groups had similar mean liveweights and mean fibre diameters. The sheep were brought into the animal house in autumn when they were in relatively poor body condition (score approx 1.5), and fed hay and lupins at a rate calculated to supply 1.2 times maintenance energy requirement. The high fleece weight ewes had less fat, glucose and insulin (Table 1), even though average liveweights were similar.

Table 1. Mean values for high and low clean fleece weight (CFW) groups, with standard error of the mean (s.e.m.) and statistical significance of the difference.

<table>
<thead>
<tr>
<th></th>
<th>High CFW</th>
<th>Low CFW</th>
<th>s.e.m.</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total body wt (kg)</td>
<td>49.1</td>
<td>48.8</td>
<td>0.7</td>
<td>NS</td>
</tr>
<tr>
<td>Total body fat (kg)</td>
<td>8.9</td>
<td>11.1</td>
<td>0.5</td>
<td>0.003</td>
</tr>
<tr>
<td>Plasma glucose (mmol/L)</td>
<td>4.45</td>
<td>4.71</td>
<td>0.06</td>
<td>0.004</td>
</tr>
<tr>
<td>Plasma insulin (µg/L)</td>
<td>1.16</td>
<td>1.43</td>
<td>0.08</td>
<td>0.02</td>
</tr>
</tbody>
</table>
In short, even though the high and low fleece weight groups looked and weighed the same, the high fleece weight ewes had lower internal reserves of the metabolic fuels. This is probably associated with the greater depletion of muscle glycogen observed in high fleece weight rams after exercise stress, recorded in the accompanying paper by Thomson et al. (2005).

**Metabolic fuels and reproduction**

The difference between CFW groups in total body fat content was equivalent to the difference in fatness associated with half a body condition score (McNeill et al. 1999). Lower plasma glucose and insulin concentrations are also associated with reduced reproductive performance in sheep (Bucholtz et al. 2000). Our calculations indicate that the lower amounts of fat, glucose and insulin are sufficient to fully account for the effect of fleece weight on lamb turnover in comparisons of the different sheep strains in the Katanning Base flocks (Greeff, 2005) and also explain the preliminary results from ewe comparison trials. Thus, the effects of fleece weight on lamb turnover are mediated by associated changes in metabolic fuel supply.

Plasma concentrations of glucose and insulin respond to the increase in adrenalin that accompanies the stress of handling, and so are difficult to measure under field conditions. Therefore, it seems that measures of fatness will be the most useful means of minimising the effect of selection for high fleece weight on reproductive performance.

**Breeding goals for Merino ewes**

It is difficult to select ewes for the number of lambs weaned in flocks where the lamb is not identified at birth. This work suggests that it should be possible to maintain reproduction while continuing to select for fleece weight, if effects of fleece weight on fatness are taken into account.

Recent work in Scotland suggests that fat reserves are controlled by different genes at different times of the year (Lambe et al. 2004). In other words, it is likely that the sheep that have good metabolic reserves in spring are not the same as the sheep with adequate metabolic fuel reserves in autumn. Therefore, we need to determine the time of year at which fatness has the greatest effect on reproductive turnover so we can select for the sheep with genes that improve fatness at that time.

Prime lambs need to grow fast without too much fat accumulation, so some people select Merino dams for low fatness to improve the carcass quality of the offspring. However, the current work suggests that ewes with a greater genetic propensity for fatness may rear more lambs, and so be more profitable. A similar conflict occurs between the need for high growth rate (associated with large body size) and high stocking density, which is enhanced by small body size. We need to harmonise these conflicts to determine the most profitable breeding objective for Merino dams, taking into account profitability of the whole business system, flexibility of the enterprise, and the risks involved.

**CONCLUSION**

In seasonal climates like Western Australia, the capacity of the sheep to lay down and to draw upon body reserves plays a key role in matching the sheep with its environment. It is likely that the role of fatness in appropriate breeding objectives for Merino ewes will be a subject of increasing debate over the next few years.

**KEY WORDS**

Fat, Merino dam, lamb, reproduction

**Paper reviewed by:** R Kelly, T Schlink

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Genetic trade-offs between lamb and wool production in Merino breeding programs

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ABSTRACT
Merino breeding programs focus strongly on wool production traits. However, increased wool production can result in undesirable responses because of the negative relationships that exist between wool production and reproduction traits. An important future goal for Merino breeders should be to understand how to select for improved wool production as well as for reproduction rate and other traits affecting meat production and general fitness.

AIMS
The Merino has mainly been selected for wool production for a very long time. Today it is a specialised wool breed and is not generally considered as a meat animal, but it makes a substantial contribution to meat production in Western Australia. The recent increase in meat prices and the importation of alternative white wool breeds has highlighted the shortcomings of the Merino as a meat producer.

Recently, evidence came available that indicates genotypes with high wool production may have a low lamb production (Herselman et al. 1998; Cloete et al. 2002). The results show that live weight, clean fleece weight and fibre diameter are all positively correlated both genetically and phenotypically with total weight of lamb weaned over three lambing opportunities (TWW3). This implies that bigger animals and animals that cut more wool will tend to have a higher TWW3, whereas fine wool animals will have a lower TWW3. However, the results also show that the ratio clean fleece weight per unit of live weight has a negative phenotypic and genetic relationship with TWW3. This suggests that selecting continuously for increased fleece weight without increasing body weight will eventually result in a decrease in reproduction rate and ultimately in TWW3. This paper aims to verify whether this may have happened.

METHOD
The Katanning Base flocks, established in 1982, were used in this study. The data were recorded on ewes from six different strains. Their reproduction, survival and growth rates of the lambs were used to calculate the TWW3 over three lambing opportunities from 1993 to 1998. The six strains were Peppin, Collinsville, Bungaree, Performance group, a high wool producing medium wool line and a fine wool line. Each line can be viewed as the end product of a long term selection program for wool production. The groups were maintained in a single flock, except for mating during January-February and lambing during June-July, when they were maintained in single sire groups on small paddocks. These groups were pooled to form larger flocks as soon as possible after birth.

Premating ewe live weight (ALWT) and adult clean fleece weight (ACFW) were corrected for litter size and for sex of the lamb and used to calculate wool production potential (ACFW/ALWT) for each strain.

RESULTS
The results in Figure 1 show the TWW3 against wool production potential (ACFW/ALWT) for the six different Merino strains. Apart from the fine wool group, there was a remarkably consistent negative linear relationship between meat and wool production potential. This indicates that strains with high wool production potential will tend to produce fewer lambs than strains with a lower wool production potential. The fine wool strain is clearly an outlier and according to the trend line it should have a higher reproduction level. Closed examination of the data showed that it had a lower fertility, litter size, survival rate and growth rate up to weaning than the other groups. As fibre diameter is positively
correlated to reproduction rate, this implies that selecting also for reduced fibre diameter will have an added negative impact on reproduction rate.

Figure 1. Relationship between meat and wool production in six Merino strains.

These results support Herselman et al. (1998) who concluded that fitness may be compromised in animals with a high potential for fibre production. The trend demonstrated in this study also confirms the review from Safari and Fogarty (2003) that wool production is genetically negatively correlated (-0.49 to -0.10) with reproduction rate. These relationships are not very strong but ignoring them while selecting for increase fleece weight and reduced fibre diameter will eventually result in a deterioration of reproduction rate. As reproduction rate and its components are also heritable and usually have a high variation, they can be improved by selecting for number of lambs weaned in ewes and/or on scrotal circumference in rams.

CONCLUSION

Breeding programs should attempt to improve all aspects of sheep production and not only focus on specific production traits. Thus it is clear that the breeding goals of the Merino should be broadened to include meat production traits without affecting its superior wool production.

KEY WORDS

Breeding, wool, meat, Merino

ACKNOWLEDGMENTS

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Paper reviewed by: NR Adams

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Clean fleece weight is not phenotypically independent of other traits.

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ABSTRACT

The ‘Extreme ewes’ project is quantifying the phenotypic and genetic relationships between clean fleece weight (CFW), fibre diameter (FD) and bodyweight (BWT) and a range of other traits. Trangie QPLU$ ewes (medium strain) were identified as extreme (high or low) for CFW, FD and BWT (8 phenotypic groups). Analysis of the relative impact of CFW, FD and BWT on a range of hogget production traits has shown that both FD and BWT are largely independent of other traits. Phenotypic animal selection and management decisions based on FD will largely impact only wool quality traits and those made on the basis of BWT will largely impact only on carcase and growth traits. However CFW is not independent of other important traits and phenotypic selection on CFW will impact on wool quality, growth and feed intake. Therefore commercial wool producers must take into account the potentially large impact on other economically important traits of making animal selection and management decisions on the basis of phenotypic differences in CFW.

AIMS

‘Extreme ewes’ is a subproject of a Sheep CRC project aiming to identify and quantify the trade-offs between wool production, wool quality and bodyweight which may be limiting the profitability of Merino sheep. This will allow potential flock segmentation criteria to facilitate more precise and cost-effective nutritional management of Merino sheep. This paper presents some phenotypic relationships for a range of hogget traits in medium wool sheep. Commercial returns to producers are based on the sheep phenotype (e.g. kg clean wool) and their animal selection and management decisions based on phenotypic differences between sheep are of vital importance.

METHOD

Hogget ewes (n=104) from the 2001 drop medium wool strain of the Trangie QPLU$ project (Taylor and Atkins 1997) were identified as being ‘extreme’ (high or low) for CFW, FD and BWT with combinations from HHH to LLL. The hoggets were allocated to 1 of the 8 phenotypic groups on the basis of their CFW and FD at shearing in October 2002, and their subsequent unfasted off-shears BWT. A standardised deviation approach was used to identify the extreme ewes and a revolving pattern of allocation to each of the 8 groups ensured that the best available ewe was allocated to each group. The unique groups of sheep were used to empirically study the relationships between CFW, FD and BWT. Phenotypic differences between the 8 groups in CFW, FD and BWT were determined by fitting a model which included the main effect of group. The relative impact of CFW, FD and BWT on hogget wool production, quality, growth and carcase traits and feed intake was determined by coding each animal as either H or L for the 3 primary traits before fitting these codes in subsequent models.

RESULTS

Fibre diameter had no significant phenotypic impact on hogget wool production, body composition and growth nor on feed intake. Therefore commercial wool producers who make animal selection and management decisions based on phenotypic differences in fibre diameter between animals will be impacting only the wool quality of their flock, other important economic traits will be largely unaffected. Similarly bodyweight was also largely phenotypically independent of other traits and had no significant impact on wool production, wool quality or feed intake.
In addition to the highly significant impact on wool production traits (CFW, yield and staple length - P < 0.001) phenotypic selection on CFW had a significant impact on aspects of wool quality, growth and feed intake (Fig. 1). Dust penetrated 9.5 mm further into the fleeces of high CFW ewes (P < 0.001) which contained more wax and less suint than fleeces of low CFW ewes (P < 0.01). High CFW ewes were heavier at birth, weaning and at 10 months of age than low CFW ewes (P < 0.001). However contrary to expectations, there was no difference in either the birthweight or weaning weight of the progeny of high CFW ewes compared to the progeny of low CFW ewes. This lack of impact of CFW on the birth and weaning weights of their progeny was unexpected as previous research found that high CFW sheep have lower glucose production (Bermingham et al. 2004) and lower plasma concentrations of both glucose and insulin (Briegel et al. 2004) which lead us to hypothesise that high CFW sheep will have poorer reproductive outcomes due to the relatively greater amount of energy they use for growing wool. It is likely that the number of progeny born to the 2001 drop extreme ewes (n=112 in 2003 and 92 in 2004) was not large enough to pick up significant differences between the high and low CFW ewes and were not distributed evenly across the 8 phenotypic groups. The impact of high CFW on reproduction is currently being further investigated by both a desktop study of the reproductive performance of all medium wool ewes in the QPLUS project from 1993 to 2004 and is a component of a field experiment underway at Cowra Agricultural Research and Advisory Station.

Phenotypically high CFW sheep also consume about 400g/day more pasture than low CFW sheep (P<0.01) but they are not more efficient converters of feed to wool. This finding has significant implications for the dry sheep equivalent (DSE) rating of high versus low CFW sheep and hence on stocking rate decisions made by commercial producers, and clearly warrants further investigation.

Following on from the phenotypic analyses, genetic analyses are currently being undertaken using estimated breeding values (EBVs) for CFW, FD and BWT calculated for each of the extreme ewes. The EBVs will be used to develop regression equations to describe the genetic relationships between CFW, FD and BWT on the wide range of wool production, wool quality, growth, body composition, feed intake and reproductive traits currently being analysed phenotypically. In addition the field experiment at Cowra is looking at the interaction between CFW and nutritional status to determine whether high CFW ewes are more susceptible to poor nutrition under field conditions and the implications of this on the growth and meat characteristics of their progeny.

CONCLUSION

CFW is not independent of other important traits and phenotypic selection on CFW will impact on wool quality, growth and feed intake. Commercial wool producers must take into account the potentially large impact on other economically important traits of making animal selection and management decisions on the basis of phenotypic differences in CFW.

KEY WORDS

Phenotypic selection, clean fleece weight, fibre diameter, body weight

ACKNOWLEDGMENTS

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Paper reviewed by: DR N M FOGARTY
REFERENCES


WHEN YOU’RE ON A GOOD THING, DO IT BETTER: An economic analysis of sheep breed profitability.

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John Young, Farming Systems Analysis Service, Kojonup

ABSTRACT

Favourable prices for lamb and mutton since 2001 have sparked Australian farmers' interest in sheep breeds such as the Dohne Merino and South African Meat Merino that are better suited to meat production than the Merino. In this analysis, historical commodity price data and a whole-farm bio-economic model have been used to assess the likely profitability of these breeds in a southern coastal region of Western Australia. Results indicate that a Merino flock is likely to generate significantly greater profits than a Dohne or SAMM flock, however the variance of profit for the Merino is also likely to be greater. If micron premiums remain low, there is little economic merit in disinvesting in Merinos to fully switch to either of the two alternatives.

AIM

Identify profitability robustness of Australian Merino, Dohne Merino and South African Meat Merino.

METHOD

MIDAS is a whole-farm, profit-maximising model that calculates optimal farm management practices given a set of production relationships provided by the user. Optimal combinations of enterprises are found through using detailed biological, technical and financial information to compare the relative profitability of various enterprise combinations. For a full description of MIDAS see Kingwell and Pannell (1). The South Coast version (SC-MIDAS) was used in this analysis. It is based on a typical mixed crop and livestock farming system in the region north of Albany to east of Esperance (medium rainfall: 400-500 mm). Assumed farm size is 2500 ha.

Pure bred self-replacing Australian Merino (Merino), Dohne Merino (Dohne) and South African Meat Merino (SAMM) flocks were examined. Up to 33% of wether and surplus ewe lambs were allowed to be sold as prime lambs in the Merino flock and up to 90% in the Dohne and SAMM flocks.

The impact on farm profit of movements in prices of crops, wool and sheepmeat was examined. Real historical monthly commodity price data were collated and correlations between commodity prices were calculated. Probability distributions of prices for all commodities were simulated using the software package @RISK. Commodity price scenarios were inputs into MIDAS and probability distributions of profit were generated.

The risk of variation in the price differential between fine and broad wool was not built in to the simulation performed by @RISK. For this reason, fibre diameter premium risk was modelled separately. Two scenarios for micron premium were considered: a) most likely scenario - similar to the long term (10 year average), where there has been a significant premium for finer wool; and b) worst case scenario - similar to the short term (3 year average), where there has been little price differential between broader/finer wools.

RESULTS

Average fibre diameter premiums

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1 SAMM ewes (mutton) and wethers (shippers) were assumed to attract a 20% premium ($/head) over Merinos. Dohnes were assumed to attract a 10% premium ($/head) over Merinos (2.)

2 To overcome some period differences in the dataset, the correlation matrix was made consistent within @Risk (3). The sampling technique used to generate the data was Latin Hypercube. This sampling technique uses stratified sampling, and was chosen for increased sampling efficiency and faster runtime (3). To ensure convergence in sampling, 5000 iterations of commodity prices were run.
The mean and variance of farm profit based on Merinos is statistically significantly greater than that recorded for SAMMs and Dohnes (Table 1). Merinos are more likely to return higher profits than Dohnes and SAMMs, but the trade-off is that Merinos are likely to experience greater extremes in profit (lower in bad years and higher in exceptional years).

Table 1: Mean, minimum, maximum and range of profit for the Merino, Dohne and SAMM sheep breeds (NOTE: profits were calculated from real historical prices, ie have been adjusted for inflation).

<table>
<thead>
<tr>
<th>Farm Profit ($)</th>
<th>Merino</th>
<th>Dohne</th>
<th>SAMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>$320,500 ± 1455</td>
<td>$313,700b ± 1443</td>
<td>$312,000b ± 1442</td>
</tr>
<tr>
<td>Minimum</td>
<td>-$154,800</td>
<td>-$113,100</td>
<td>-$109,900</td>
</tr>
<tr>
<td>Maximum</td>
<td>$611,600</td>
<td>$589,900</td>
<td>$581,400</td>
</tr>
<tr>
<td>Range</td>
<td>$766,400</td>
<td>$703,000</td>
<td>$691,300</td>
</tr>
</tbody>
</table>

Different superscripts within rows indicate a significant difference (P≤0.01).

These results are in line with the risk-reward concept which states that the higher the investment risk, often the higher the possible return, and the higher the expected return needs to be to entice an investment from a risk-averse producer. Producers’ risk preference may influence the decision on which breed is most appropriate for them. A risk-averse producer (dislikes risk), may prefer to forego some expected profit to ensure less profit variability. In this case SAMMs or Dohnes may be the breed of choice. A producer who is comfortable taking on greater variability in profit, in the hope of achieving greater returns, would prefer the Merino as their breed of choice.

Low fibre diameter premiums

When micron premiums are very low, the mean and variation in profit are statistically similar for each breed. Despite different production characteristics between the breeds, these differences generate no clear economic comparative advantage for any one breed in the broadacre farming system of the region studied. As the high changeover costs associated with breed replacement have not been considered in this analysis, these results confirm that if premiums are to remain low, there is little economic merit in disinvesting in the Merino to fully switch to either of the two alternatives.

CONCLUSION

Based on long term average fibre diameter premiums, Merinos are more likely to return higher mean profit than Dohnes and SAMMs, but are more likely to experience a greater variance in profit (lower in bad years and higher in exceptional years). With low fibre diameter premiums, mean profit and variance of profit are the same for each breed, indicating there is little economic merit in for disinvesting in one breed to fully switch to another. Existing Merino producers contemplating a shift into alternative breeds are advised to consider alternative ways of improving the profitability of their Merino enterprise, such as increasing stocking rates or altering their flock structure to include more profitable enterprises such as first cross prime lambs (5).

KEY WORDS

Whole-farm modelling, South Coast, alternative sheep breeds, commodity price risk.

ACKNOWLEDGMENTS

Paper reviewed by: Allan Herbert

REFERENCES


Selection Demonstration Flocks: Demonstrating Improvements in the Productivity of Merinos

South Australian Research and Development Institute

ABSTRACT

The Selection Demonstration Flocks are showing that improvements in the productivity of the Merino are possible when following a defined breeding objective. The selection strategy, whether based on measurement or visual assessment, is less important than the gains in productivity achieved by focusing on a long-term breeding goal. Selection lines are highlighting the importance of monitoring overall progress towards a breeding goal to prevent undesirable changes in secondary traits.

AIMS

The Selection Demonstration Flocks are an exhibition of selection strategies for Merino sheep. The original three flocks aim to publicise the application of selection based on measurement and performance recording, professional classers and the ‘elite’ wool approach. These flocks have the goal to improve the productivity of the Merino, with a breeding objective to reduce mean fibre diameter and maintain or improve fleece and body weight. The fourth flock is a dual-purpose line aiming to simultaneously improve wool and meat quality attributes.

METHOD

Animals.

Three selection lines were established in 1996 based on measured performance and quantitative genetics (MPR), visual and tactile assessment by professional sheep classers (PCA) and the ‘elite’ wool approach (EWF). Industry participants determine mating decisions in each line. An unselected control line (CON) was established as a reference. Each flock consists of 200 breeding ewes, with replacement animals bred within each flock following two years of outside sires in 1997/1998. A dual purpose, fibre meat plus (FM+), line was created in 1999 from contributed ewes. The FM+ use a combination of outside and flock bred sires.

Data Collection and Analysis.

Data was collected from animals born into each selection line from 1997 to 2003 inclusive. Hogget (16mo) mean fibre diameter, clean fleece weight and body weight were measured. Estimated breeding values for each trait were calculated for each animal under Best Linear Unbiased Prediction conditions using ASREML (1). Adjustments were made for type of birth and rearing, age of dam, date of birth and sex. Genetic trends were formed by averaging selection line estimated breeding values within birth year and plotting over time. Publications on the establishment and management of the flocks can be found at the Selection Demonstration Flock website (2).

RESULTS

Genetic trends for each selection line are shown for hogget mean fibre diameter, clean fleece weight and body weight (Figures 1-2). The impact of the introduced sires is estimated by comparing initial values for the MPR, PCA and EWF with the CON for the 1997 and 1998 progeny. For the FM+, the initial difference from the CON in the 2000 progeny acts as a reference point to monitor progress toward their breeding goal.

The original three selection lines are moving towards their breeding objective, with the rate of attainment depending on the relative emphasis placed on traits by the selection committees. The MPR have steadily reduced mean fibre diameter, while the PCA has made a slight reduction and the EWF maintained fibre diameter at 1997 progeny levels. All selection lines have a steadily improved in
clean fleece weight. Body weight has been slightly improved by the PCA and EWF, while the MPR have seen a downward trend since the 2000 progeny.

The FM+ flock is largely attaining its breeding objective, showing small improvements in clean fleece weight and mean fibre diameter whilst maintaining a relatively high body weight.

**Figure 1:** Hogget (16mo) mean fibre diameter (mfd) genetic trend for the CON (◆), MPR (○), PCA (▲), EWF (■) and FM+ (□) selection lines

**Figure 2:** A. Hogget (16mo) clean fleece weight (cfw) and B. body weight (bwt) genetic trend for the CON (◆), MPR (○), PCA (▲), EWF (■) and FM+ (□) selection lines

**CONCLUSIONS**

The Selection Demonstration Flocks are a public display of the three most common selection methods for Merinos in Australia, how these selection systems are applied in practice and the type of response that could be expected. They are showing that improvements in productivity are possible following any of the methods and that it is most important to adhere to a long-term breeding objective.

Each of the selection lines are showing an unfavourable response in at least one trait, for example body weight in the MPR. This has resulted from unwanted correlated responses that have been magnified in the selection lines by the large influence of individual sires. Overall progress towards the breeding objective must be constantly monitored to avoid unfavourable changes in secondary traits when selection pressures are applied.

The selection lines are disproving the myth that fleece weight and mean fibre diameter cannot be improved simultaneously. The fibre meat plus line is demonstrating that a large framed animal with high body weight can produce a quality fleece with low mean fibre diameter.

**KEY WORDS**

Selection Demonstration Flocks, Merino

**ACKNOWLEDGMENTS**
You are compromising yield by using Dust Penetration and GFW in breeding programs

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A. (Tony) Schlink, CSIRO Livestock Industries, Wembley
Johan Greeff, Department of Agriculture WA, Katanning

ABSTRACT

Producers need to use yield and clean fleece weight in their breeding programs to increase yields. Selecting sheep based on reduced dust penetration and high greasy fleece weight, wax and suint contents will jeopardise progress towards high yield.

AIMS

WA is currently producing wool that yields 3% below the national average and is estimated to be costing the state $3 million per year. Dust is the likely source lowering WA yields due to our Mediterranean environment. When many producers class wool they use dust penetration in their assessment because they assume fleeces with high dust penetration also have high dust content and therefore lower yield. Producers have been recommended to select fleeces based on greasy fleece weight (GFW) as there is a positive relationship to clean fleece weight, without considering yield. However, experience in dusty environments using GFW to select breeding stock has leaded to poor yields. The aim of this study was to determine the breeding implications of selecting fleeces using dust penetration and GFW.

METHOD

This study was carried out on the fully pedigreed, Merino Resource flocks of the DAWA at Katanning. Sires of different Merino strains were used to produce 3987 progeny born in June/July of 2000, 2001, 2002, 2003. All progeny were reared under normal commercial conditions. The progeny were shorn as lambs and again at 15 months of age with 12 months wool growth. Mid-side wool samples were collected and analysed for total yield, wax, suint and dust content. Yield was expressed as the proportion of clean fleece weight relative to conditioned greasy fleece weight. Wax, suint and dust content were expressed as percentages of clean, dry wool. Dust penetration was objectively assessed by measuring the depth of dust on 10 wool staples per mid-side wool sample with a ruler. These measurements were averaged and expressed as a percentage of staple length. Weathering damage was determined using the Methylene Blue method. Phenotypic variances, heritability values, phenotypic and genetic correlations were determined.

RESULTS

Producers will make significant progress towards lowering dust content if they focus on breeding for high yielding wool. Yield has a high heritability ($h^2=0.64$) and a strong negative correlation with dust content ($r_g=-0.63$) (Table 1 and Table 2). It is not practical for breeders to directly select for reduced
dust content as greater genetic gain can be achieved from indirect selection on yield. In addition, yield is cheaper to measure (AWTA 2003).

If yield is improved, this will lead to increased dust penetration due to a positive correlation between the two traits ($r_g=0.37$). However, this will not negatively impact on dust content as there are low genetic and phenotypic correlations between dust penetration and dust content ($r_p=0.20$, $r_g=0.28$). Increasing yield will indirectly select against wax and suint as these traits are genetically highly correlated with yield and have high heritability values. Dust penetration should not be used as an indicator of yield due to the positive correlation ($r_g=0.37$) between the traits, thus selecting for low dust penetration will result in lower yields.

The relationship between yield and GFW is also negative ($r_g=-0.28$). In practise, selecting a fleece with high GFW will be selecting low yielding fleeces. However, if you select fleeces on a clean fleece weight basis you will be selecting high yielding fleeces ($r_g=0.35$). Hence, if producers keep using GFW to select breeding stock then yields will continue to be reduced.

If producers increase yield and clean fleece weight in there flock they will also see a reduction in weathering fibre damage. It appears that wax does not protect the fleece from fibre damage ($r_g=0.10$), whereas high levels of suint promote fibre damage ($r_g=0.88$).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Mean values, coefficient of variation (CV), phenotypic variances (Vp) and the heritability ($h^2$) for yield related wool traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait</td>
<td>Mean</td>
</tr>
<tr>
<td>Yield (%)</td>
<td>70</td>
</tr>
<tr>
<td>Dye Absorption (%)</td>
<td>42</td>
</tr>
<tr>
<td>Wax content (%)</td>
<td>21</td>
</tr>
<tr>
<td>Suint content (%)</td>
<td>10</td>
</tr>
<tr>
<td>CFW (Kg)</td>
<td>3</td>
</tr>
<tr>
<td>GFW (Kg)</td>
<td>4</td>
</tr>
<tr>
<td>Dust penetration (%)</td>
<td>32</td>
</tr>
<tr>
<td>Dust content (%)</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Phenotypic correlations (above diagonal) and genetic correlations (below diagonal) for yield related wool traits.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GFW</td>
</tr>
<tr>
<td>GFW</td>
<td>0.86</td>
</tr>
<tr>
<td>CFW</td>
<td>0.80</td>
</tr>
<tr>
<td>Yield</td>
<td>-0.28</td>
</tr>
<tr>
<td>Wax</td>
<td>0.30</td>
</tr>
<tr>
<td>Suint</td>
<td>0.13</td>
</tr>
<tr>
<td>Dust content</td>
<td>-0.03</td>
</tr>
<tr>
<td>Dust Penetration</td>
<td>-0.41</td>
</tr>
<tr>
<td>Dye Absorption</td>
<td>0.16</td>
</tr>
</tbody>
</table>

**CONCLUSION**

Dust penetration is a poor indicator of dust content in Merino wool and therefore should not be used in breeding programs to reduce dust content and improve yield. Selecting for greasy fleece weight will not improve yield. The main focus of breeding programs should be selection based on yield and clean fleece weight.
KEY WORDS
Dust penetration, dust content, yield, greasy fleece weight, clean fleece weight.

ACKNOWLEDGMENTS
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Paper reviewed by: Tara Crommelin

REFERENCES
Merino Sheep can be bred for resistance to breech strike

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John Karlsson, Department of Agriculture of Western Australia, Katanning WA 6317

ABSTRACT
The use of surgical mulesing to prevent breech strike in Merino Sheep has become a high profile issue with parts of the community wanting it banned. The industry would like it phased out by 2010. The traits that predispose sheep to fly strike are variable and heritable. Breeding sheep for resistance to breech strike is possible and over time could be used to phase out mulesing.

INTRODUCTION
Considerable efforts were directed in the 1940s and early 1950s at breeding sheep that are resistant to breech strike because it accounts for up to 90% of all strikes in unmulesed sheep (1). However, with the advent of effective insecticides and the acceptance of the ‘mules operation’, research efforts were mainly directed at non-genetic sheep husbandry practices. Today the mulesing operation has become an integral part of most sheep production systems to prevent breech strike. Recently, due to a buildup of adverse community reaction to the surgical mulesing operation, the Sheep Industry has indicated that it will be phased out by 2010. Given the high profile of this issue sheep farmers are now very concerned whether this can be done. As breeding offers the only permanent long term solution, this paper focuses on whether it is possible to breed Merino sheep to become more resistant to breech strike.

REVIEW
Breech strike is a major concern to all Merino sheep farmers. An enormous amount of time and effort is applied on preventative activities such as crutching, jetting, mulesing. Research shows that moisture and temperature are the key ingredients for the development of breech strike in Merino sheep. Moisture can come from rain, urine, diarrhoea (scouring) or blood and other exudates from wounds. Moisture and temperature create favourable conditions for bacterial to become prolific on the skin of sheep resulting in a potent olfactory attractant for the gravid female fly and a nutrient medium for the early stage larvae. In addition sheep with more wrinkles and sheep with high wool coverage are more susceptible than sheep with less wool on the points. Other traits such as wool length, suint and wax content, fibre diameter and coefficient of variation of fibre diameter may also contribute to making sheep more susceptible to flystrike.

To successfully breed sheep that are resistant to breech strike there are three things to consider. Firstly the trait must be measureable, secondly there must be variation in the trait and thirdly the trait must be heritable. The response to selection is highest if a trait is selected for directly. However, flystrike occurs sporadically and nearly all Merinos are mulesed, crutched or jetted and these treatments protect animals from becoming infected. Therefore to identify sheep that are genetically resistant to an organism the sheep must be exposed to the organism in a natural state to allow the organism to challenge the sheep. However, the undesirable symptoms that this trait causes that happens sporadically does not always make this possible. The alternative is to focus on the predisposing traits that can make sheep less susceptible to breech strike.

Table 1 shows that all the currently known predisposing traits show genetic variation. More importantly, it shows that there is also a large amount of variation between animals for these traits. The only area where there is a shortage of information is for the woolfree skin area around the anus that prevents the formation of dags. However, recent photos in the media have clearly shown that there is variation between sheep for this trait. James (pers. comm.) on a small number of lambs, also showed that there was genetic variation for wool free area at birth, marking and post mulesing in Merino lambs. The variation in this trait implies that it should be possible to increase the wool free area in animals through selection.
Wrinkles have a dramatic effect on the susceptibility of sheep to breech strike. Seddon as quoted by Belscher (1953) categorised 1000 unmulesed Merino ewes into plain (A-type), intermediate (B-type) and wrinkled (C-type) type sheep according to the amount of wrinkles. These ewes were managed as a single group and fly strikes were recorded over a four year period. Figure 1 shows how many times each type of sheep got fly strike. The plain-bodied ewes were much less susceptible to flystrike whereas the wrinkled type ewes were highly susceptible to flystrike. This shows that breeding plain-bodied animals will reduce flystrike.

Table 1. The variation and heritability of the predisposing traits to breech and flystrike.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Variation (%)</th>
<th>Heritability</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrinkles (neck, side, breech)</td>
<td>25 – 50</td>
<td>0.20 – 0.80</td>
<td>(2)</td>
</tr>
<tr>
<td>Faecal worm egg counts</td>
<td>120 – 250</td>
<td>0.08 – 0.55</td>
<td>(3)</td>
</tr>
<tr>
<td>Faecal consistency</td>
<td>20 – 40</td>
<td>0.08 – 0.28</td>
<td>(3)</td>
</tr>
<tr>
<td>Dags</td>
<td>100 – 150</td>
<td>0.04 – 0.38</td>
<td>(3)</td>
</tr>
<tr>
<td>Face cover</td>
<td>30</td>
<td>0.08 – 0.57</td>
<td>(2)</td>
</tr>
<tr>
<td>Wool on legs</td>
<td>40</td>
<td>0.04 – 0.53</td>
<td>(2)</td>
</tr>
<tr>
<td>Wool free skin area around anus</td>
<td>?</td>
<td>0.08 – 0.37</td>
<td>James (pers. comm.)</td>
</tr>
<tr>
<td>Yellowness of wool</td>
<td>10 – 30</td>
<td>0.10 – 0.40</td>
<td>(2)</td>
</tr>
<tr>
<td>Wool wax</td>
<td>43</td>
<td>0.63</td>
<td>(4)</td>
</tr>
<tr>
<td>Suint</td>
<td>50</td>
<td>0.58</td>
<td>(4)</td>
</tr>
</tbody>
</table>

Figure 1. Incidence of flystrike in different types of Merino ewes (Belscher 1953).

CONCLUSION

The traits that predispose sheep to breech strike and that can be changed genetically are, wrinkles, clean area around the anus and vagina, resistance to worms, susceptible to diarrhoea (dags) and amount of suint in the fleece. These traits are all heritable and are variable between animals which makes it possible to breed sheep that are resistant to flystrike.

KEY WORDS

Mulesing, breeding, breech strike

ACKNOWLEDGMENTS

Paper reviewed by: Gus Rose

REFERENCES
Parasite resistant sheep & hypersensitivity diarrhoea

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ABSTRACT

Diarrhoea or scouring is a major sheep health and management problem especially in the winter rainfall areas of Australia. Two sub-types of diarrhoea are recognized. One sub-type is prevalent in individuals with a low immune competence and high worm egg count (WEC). The other is due to an allergy related hyperimmune response and is associated with a low WEC.

The high WEC diarrhoea is reduced with selection for worm resistance. However, this study found that the prevalence of low WEC diarrhoea has increased with selection for low WEC i.e. increased worm resistance. This is an important finding and consultants and breeders should be made aware of this result. This paper will present the latest results and will make recommendations to consultants and ram breeders on what precautionary measures should be taken to prevent this from happening in normal sheep breeding programs.

AIMS

To determine whether selection for increased worm resistance using faecal worm egg counts, results in an increase in diarrhoea.

METHOD

The trial was conducted at the Mount Barker Research Station. Four hundred ewes were randomly allocated to four sire genotype mating groups. The four sire mating groups were; DAWA resistant (Rs), DAWA control (Ct), CSIRO resistant (Rs) and CSIRO control (Ct). Each sire mating group was represented by five sires.

Measurements

Pedigrees were recording at lambing. From weaning to 15 months of age eight separate measurements (Recording periods) comprising, body weight (BW), condition score (CS), dag score (DS), faecal consistency score (FS) and faecal worm egg count (WEC) were taken. This report is based on a sub-set of data covering the animals during their second winter, starting with recording period 6 being one month after the break of the season and recording periods 7 and 8 spaced out at 6 week intervals.

Animals were categorised as low, intermediate or high WEC sub-types using their WEC in each recording period as follows:

- Group 1 (Low WEC) = <250 eggs per gram (epg)
- Group 2 (Intermediate WEC) = 250-750epg
- Group 3 (High WEC) = >750epg

A chi-square test was carried out to determine if there were significant differences in the proportion of animals in each category for dag score.

RESULTS

Table 1 shows that there was a highly significant (P<0.001) increase in the proportion of animals with diarrhoea measured as all animals with dags from the 6th to the 8th recording period in the low WEC group and a corresponding reduction in proportion of dags in WEC groups 2 & 3. Significant differences were found between sire genotypes. A higher proportion of animals from the DAWA and CSIRO resistant genotypes scoured in the low WEC group (1) than their respective control groups (P<0.05) in all recording periods.
**Table 1.** Percentage distribution of progeny into diarrhoea sub-types

<table>
<thead>
<tr>
<th>Rec.per.</th>
<th>Tot. nos.</th>
<th>Rec. per. WEC grp.</th>
<th>DAWA Rs.</th>
<th>DAWA Ct.</th>
<th>CSIRO Rs.</th>
<th>CSIRO Ct.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>110</td>
<td>65.5%</td>
<td>57.3%</td>
<td>66.9%</td>
<td>47.1%</td>
<td>0.024</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>30.0%</td>
<td>31.8%</td>
<td>30.2%</td>
<td>41.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>110</td>
<td>4.5%</td>
<td>10.9%</td>
<td>2.9%</td>
<td>11.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>110</td>
<td>65.5%</td>
<td>57.3%</td>
<td>66.9%</td>
<td>47.1%</td>
<td>0.024</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>69.1%</td>
<td>110</td>
<td>134</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10.9%</td>
<td>26.4%</td>
<td>15.7%</td>
<td>28.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.9%</td>
<td>4.5%</td>
<td>5.2%</td>
<td>7.5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>108</td>
<td>92.6%</td>
<td>75.0%</td>
<td>84.8%</td>
<td>70.0%</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>70</td>
<td>0.0%</td>
<td>3.6%</td>
<td>7.1%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CONCLUSION**

These results indicate that selection for low WEC have resulted in an undesirable increase in scouring in a winter rainfall environment. Previous reports from the Rylington Merino flock (3) as well as others have generally found a non significant genetic correlation between selection for low WEC and overall dag scores. We believe that this is the first report of the genotypic relationship with hypersensitivity diarrhoea. In high prevalence diarrhoea environments selection for a reduction in both WEC and diarrhoea is advised.

**KEY WORDS**

Parasite resistance, hypersensitivity diarrhoea

**ACKNOWLEDGMENTS**

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**Paper reviewed by:** Dr. Dieter Palmer

**REFERENCES**


