Sheep Updates 2008 - part 3

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Controlling Fly Strike

Breeding for Blowfly Resistance – Indicator Traits
LJE Karlsson, JC Greeff & L Slocombe, Department of Agriculture & Food WA

ABSTRACT
Breeding for natural blowfly resistance offers a clean and green solution.

INTRODUCTION
Sheep Blowfly Strikes were first identified as a major sheep industry problem in the early 1920s, following some good rainfall seasons in the Riverina area. Early observations by sheep farmers and research workers at the time began to associate the individual sheep strike incidence with certain sheep types; that is, sheep with a high skin wrinkle were identified as high risk. By the late 1920s and early 1930s a classical trial showed that by categorising a mob of sheep into ‘plain’, ‘intermediate’ and ‘wrinkly’ big differences in flystrike incidence were achieved between the three types. However, these early genetic research findings were not generally adopted by the sheep breeding industry. Thus the question arises as to why this was the case? It has been proposed that it was due to two other developments in the 1930s:
1. The introduction of the ‘mules operation’ in 1932 by Mr G. Mules from SA following an offer of financial rewards for solutions to the blowfly problem.
2. By the 1930s easier to apply chemicals for blowfly control started to become available

The sheep industry also had a strong following of the concept that high fleece weights required more ‘skin’ which was associated with more surface area which was dependent on skin wrinkles. Changing community standards and an increase in general public debate about wider environmental and associated topics have resulted in both the surgical mulesing operation and the over reliance on chemicals for blowfly strike becoming under close scrutiny. As a result the sheep industry leaders have given an undertaking to cease surgical mulesing by the end of 2010.

In the 1980/90s research examined the phenotypic and genetic aspects of body strike resistance using artificial wetting. However, research specifically on breech strike resistance has not been done because of the general effectiveness of the surgical mulesing operation. From an industry point of view direct selection for blowfly resistance presents two problems:

1. Blowfly strike is very dependent on local climatic conditions resulting in potentially big seasonal variability.

2. A challenge based selection method can potentially become very labour intensive to manage if it was to avoid serious animal welfare issues.

For the above two reasons it is highly desirable to develop an indirect selection methodology for blowfly resistance that is not reliant on a challenge and blowfly strike incidence.

The Department of Agriculture & Food WA submitted a research proposal to Australian Wool Innovation in 2003 to examine the optimum genetic procedure for selection for blowfly resistance especially with respect to breech strike. CSIRO Armidale NSW, were invited to join to cover the summer rainfall areas. The winter rainfall areas will be covered by our work at Mt Barker Research Station in WA. This proposal was accepted by AWI and started in July 2005.

METHOD
On each of the two sites we have a flock of 600 ewes; they are divided into three lines of 200 ewes each with the following designation and selection regime:
1. Selected A; both rams and ewes are selected on the Indicator Traits

2. Selected B; only rams are selected on the Indicator Traits (Commercial Flock)

3. Control Line; no selection on the Indicator Traits.

Based on the collective practical and scientific experience in this area the known potential Indicator Traits include:

<table>
<thead>
<tr>
<th>Potential Indicator Traits</th>
<th>Poll</th>
<th>Body</th>
<th>Breech</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horn and/or deep fold at horn site</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Wrinkles</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fleece Rot, Dermo, high suint, wool colour, fleece moisture</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Excessive wool coverage breech and points</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Dags and urine stain</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Others; crimp or staple structure? 'Water Proofing'; smell / odour</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Part of our research is to determine the optimum time to measure the different Indicator Traits as their maximum expression will vary between birth or lamb marking and up to the hogget selection time. Furthermore, this is likely to vary over different climatic regions. Some of the key times for the winter rainfall regions are;

1. Wrinkle and Bare Area Scoring; soon after shearing

2. Dags and Urine Stain; on sheep with long wool at the end of the winter worm challenge period

3. Fleece Faults; on long wool sheep after the main rain season.

In the research flock where we need to establish the predictability of the Indicator Traits for flystrike we deliberately try not to mask susceptibility of individuals to flystrike. This means that we try not to use ‘blanket’ preventative measures such as jetting and crutching or shearing before the main fly challenge period which for Mt Barker typically starts in October. As part of this strategy we have to commit extra resources for monitoring and early detection and treatment of individually struck animals.

**CONCLUSION**

Selection base on Indicator Traits will provide the Sheep Industry with a ‘Clean and Green’ permanent solution to blowfly strike prevention. There will also be additional benefits such as easier shearing and more robust animals.

**ACKNOWLEDGMENTS**

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**REFERENCES**


A practical method to select for breech strike resistance in non-pedigreed Merino flocks

J C Greeff, L J E Karlsson, L Slocombe, K Jones and N Underwood
Department of Agriculture and Food, Western Australia

ABSTRACT

The method of independent culling level using known indicator traits, offers a simple and flexible method to select for breech strike resistance in Merino sheep.

INTRODUCTION

Breech strike resistance is an all-or-none trait in that an animal is either struck or is not struck. However, it is a complex trait which is strongly dependent on environmental factors such as the presence of blowflies and whether the wool in the breech is moist. Selecting directly for breech strike resistance is not efficient because of the sporadic nature of the disease and the associated production losses. This approach requires huge labour inputs to identify and treat animals in a timely fashion to prevent any potential complications.

An alternative method would be to select animals on indicator traits that are correlated with breech strike resistance. It has been shown that breech wrinkles, dags, urine stain, wool cover in the breech, and wool colour are all important indicator traits for breech strike resistance. It has also been found that these characteristics are heritable and can be used effectively to select for resistance to breech strike (Scobie et al, 2007; Greeff and Karlsson 2006; Karlsson et al 2008).

An indirect selection approach is to obtain breeding values for all the listed indicator traits and to weigh their importance in a selection index in such a way to maximise the correlation between the index value and breech strike resistance. Unfortunately, the genetic correlations between breech strike resistance and the indicator traits are not currently known. Hence, an alternative method should be followed to change the indicator traits without dramatically affecting the traditional production traits.

This paper discusses the use of indicator traits to select for breech strike resistance in commercial and non-pedigreed Merino flocks using the independent culling level method (Turner and Young 1969).

PROCESS

The principle advantage of the independent culling level is that this method can follow the biological development of the animal. Culling can occur in stages corresponding to the level of maturity as the data is collected over time. All the information does not need to be available everytime. With this method a certain fraction of the available animals are culled for an individual trait. Thus for trait 1 a fraction of x, for trait 2 a fraction of y, for trait 3 a fraction of z, etc. are culled from the available population. This implies that selection is carried out independently of the other traits the total fraction selected is the product of one minus the different fractions of the different trait (ie. total proportion selected = [(1-x) * (1-y) * (1-z)]. It is suggested that a fraction of the young sheep are nominated for culling at specific times when the lambs are scored for the indicator traits at marking, weaning, yearling and hogget age. As the correlations between indicator-traits are not generally known at this stage it is suggested that these traits should be treated as being uncorrelated and normally distributed until additional information becomes available.

The number of animals selected is determined by the flock fertility and the total number of replacement ewes that are required to maintain the flock size. It also depends on the proportion of mature ewes culled for age, breech strike or that are seen to be highly susceptible animals based on their performance for the indicator traits. However, this method allows for flexibility to cull different proportions of animals at different times depending on the proportion of animals in the different indicator trait scoring categories. The following example provides a guide on how to go about using this technique.
EXAMPLE

Assume a breeding ewe flock of 1000 ewes. Class the flock for any abnormalities and cull ewes on age that are unsuitable for another production year. Score the flock on a one to five scale for all the known indicator traits (wrinkles, dags, bare breech area, urine stain, wool colour) using the Visual Sheep Scores guidelines booklet (AWI; MLA 2008). Cull ewes with very high scores (i.e. ≥4) for each of the indicator traits. Let’s assume that 250 ewes are culled on this basis and need to be replaced.

To get started in the first year let’s assume that 400 hogget ewes are available as replacements. Score all these ewes for the same indicator traits. If 250 ewes are needed and 400 hogget ewes are available, then 62.5% or approximately two thirds of the hogget ewes are required for replacements. If four indicator traits are scored, then approximately 10% of animals should be culled for each indicator trait at each time. Thus we need to select (1-fraction =) 90% animals on each trait independently. For the four traits this will result in (((1-0.1) * (1-0.1) * (1-0.1)) * (1-0.1) =) 65% of the available ewe hoggets kept as replacements. The proportions culled will depend on the expression of the indicator traits and it can be varied depending on the expression and distribution of the trait. If 20% of animals are culled (i.e. 80% selected) on a particular trait then a higher proportion of animals should be selected for the other trait(s). However, as long as the product of the proportion of animals selected for the different indicator traits is approximately 62.5%, then the right number of replacements will be found. The remaining animals can then be selected on live weight and wool characteristics.

The next generation of ewe lambs can be selected starting at marking. Using the available number of lambs at marking, calculate the total proportion that should be selected to maintain the flock as per normal. Make allowance for a death rate of up to 5% from marking to hogget age as well as culling a certain proportion on the production traits. As wrinkle is a very repeatable trait, most of the extremely wrinkled lambs would have been marked for culling at marking. However, as the development of dags is dependent on the environment it is suggested that 10% of the animals are allowed to develop dags if it was decided to cull 10% of the animals on dags. If the prevalence of dags is high, cul from the highest scores down to the allocated threshold level. If 10% are culled on wrinkle at marking, 10% on dags at yearling age, 10% on urine stain pre-hogget shearing and 10% on bare breech after hogget shearing, then this will result in (((1-0.1)*(1-0.1)*(1-0.1)*(1-0.1))=) 65% selected sequentially over 18 months. These values can vary depending on the proportions that can be culled.

CONCLUSION

The method of independent culling level offers flexibility to select a specific number of animals sequentially on the known indicator traits for breech strike resistance in a Merino flock.

KEY WORDS

Breech strike resistance, selection, independent culling level

ACKNOWLEDGMENTS

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Twice a year shearing – no mulesing
Fred Wilkinson, Producer, Brookton.

ABSTRACT
Shearing unmulesed plain bodied Merino ewes twice a year (2x) virtually eliminated the incidence of flystrike and the need for treatment with insecticides. There were indications that a higher percentage of fleece wool with a higher staple strength resulted from 2x shearing. The fibre produced from selected fleeces proved to be easier to process and had characteristics suitable for producing high value woollen material and worsted cloth.

INTRODUCTION
The sheep used in this study (2005-2007) were in a flock of plain bodied non-mulesed Merino ewes that had an infusion of Finn genes and were run in the Great Southern region (450 mm rainfall). The flock formed in 2004 was a closed self replacing flock with selection of the ewe replacements and rams based on fibre diameter, staple length and comfort factor. A decision was made in November 2004 to shear the flock at 6 monthly intervals (in May and November) to reduce the need for mulesing. The aim was to produce a wool clip with a 21 micron diameter, 120 mm length staple and a 98% comfort factor on an unmulesed sheep.

METHOD
The ewes were mated to start lambing in late June, with weaning of the lambs at 7-12 weeks of age. The progeny were not mulesed and the only blowfly strike preventative treatment applied was to the breech of female lambs at marking in 2005 and 2006. At shearing there was minimal skirting of the fleeces, with nearly all fleeces being placed in one line (AAAM). The fleece wool was commercially tested prior to sale (AWTA) and the percentages of fleece wools, bellies, pieces and locks were recorded.

Following the November 2006 shearing 60 kg of wool from ewes with 21 µ fibre diameter, 98% comfort factor and 67mm staple length was forwarded to Canesis in New Zealand for processing into worsted knitting yarn, and a knitted fabric. The processing of the greasy wool involved an initial scouring (yield of 64%). The scoured fibre was opened/oiled and worsted carded allowing vegetable matter to be removed without carbonising. The fibre was then processed into single combed tops and 5 kg were returned for testing at DAFWA. A worsted spun yarn was then manufactured and knitted into a single jersey fabric. After the fabric was scoured and dried, half the fabric was decatised with settings of 3 minutes pre vacuum, 3 minutes steam at 116°C and a final 3 minutes vacuum. Both decatised and undecatised fabrics were produced to test the quality of the fibre in this product. A Canesis fibre processing report was returned with 5 kg tops, 4.5 kg yarn and 50 m of 172 mm width knitted fabric. The end products were measured in the DAFWA wool laboratory.

RESULTS
The results of the tests by AWTA on the fleece wools are shown in Table 1.
Table 1 – AWTA Test Results of fleeces collected at each shearing

<table>
<thead>
<tr>
<th>Date</th>
<th>Length (mm)</th>
<th>Diameter (micron)</th>
<th>VM (%)</th>
<th>Yield (Schulm dry)</th>
<th>Strength (N/ktex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 05</td>
<td>62</td>
<td>22</td>
<td>1</td>
<td>71</td>
<td>45</td>
</tr>
<tr>
<td>Nov 05</td>
<td>66</td>
<td>24</td>
<td>1.4</td>
<td>72</td>
<td>49</td>
</tr>
<tr>
<td>May 06</td>
<td>55</td>
<td>21</td>
<td>3.1</td>
<td>68</td>
<td>54</td>
</tr>
<tr>
<td>Nov 06</td>
<td>72</td>
<td>23</td>
<td>1.6</td>
<td>68</td>
<td>36</td>
</tr>
</tbody>
</table>
The average length of the staples was 63 mm, but November shorn wools were 6 mm longer than May shorn wools. The average staple strength was 45 N/ktex, well above the long-term state average strength, and well in excess of the needs for the knitting processors. There were variations in diameter and vegetable matter that related to the time of shearing, and to differences between years. Wool shorn in November had an average diameter that was 2.4 micron broader, and May shorn sheep had 50% more vegetable matter.

At shearing the percentages of wool marketed were fleeces 89%, pieces 4%, bellies 4.5% and locks 2.5%. The proportions of bellies and locks were approximately industry averages for flocks shorn once a year, but fleeces were above the industry average of 82.5%, while pieces were below the 2007 industry average of 9.5%. There were virtually no skin pieces and shearers enjoyed shearing these plain bodied sheep with very few dags. The need for minimal skirting and bulk classing resulted in shed hands being under-utilised during shearing.

The weight of the 50 m of fabric was 276 g/m². The decatised fabric was about half the thickness of the untreated fabric and it was more lustrous. The combed top was tested on an OFDA4000 by DAFWA. The average diameter for the wool sample was 23 micron with a coefficient of variation of 19, and a comfort factor of 96%. The huter of 64 mm was only 3 mm less than the average staple length of the mid-side samples collected from the ewes.

**CONCLUSION**

The results of processing and end product examination indicate that wool from shearing twice a year can be processed into yarn without difficulty with the product having characteristics suitable for producing highly valued woollen material and worsted cloth. The fabrics showed no effects from the use of the shorter fibre, and the results of decatising showed the fabric was versatile and had an attractive handle in both forms. The fabric is currently being used by Fashion Design students at Curtin University in their projects.

The incidence of flystrike recorded over years 2006 and 2007 was 1.3% in ewes and 1.7% in lambs. All strikes were in Spring. When lambs were not preventatively treated in year 2007 3% were affected with equal numbers of male and female being struck. Scouring appeared to be the predisposing factor in both years in lambs and ewes.

Within a changing wool industry and different consumer demands shearing twice a year appears to be a viable alternative for owners of plain bodied flocks that produce long wool from annual shearing. The results from this study indicate that shearing twice a year could lead to a reliable supply of wool of desired characteristics for the wool processing industry for a high value niche market. At the same time the problems associated with blowfly strikes will be minimised without the need to mules.

**KEY WORDS**

Shearing frequency, mulesing, flystrike.

**ACKNOWLEDGMENTS**

John Stanton’s advice assisted in the decision to shear the flock twice a year. John and Melanie Dowling advised on the processing of the wool and undertook the end product appraisal.

**Paper reviewed by:** K Croker
Commercial testing of a new tool for prediction of fatness in beef cattle

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ABSTRACT

An evaluation of a new tool for the prediction of P8 fatness (mm) in beef cattle compared with 2 commercial data sets. The results indicate that the fat calculator predicts the group means with a reasonable degree of accuracy.

BACKGROUND

A simple computerised fat calculator has been developed within the current Beef CRC and is described by McKiernan et al. 2008. It was developed to help beef producers make better management decisions for achieving market specification. Beef producers are continually making management decisions that influence how well their cattle meet market specifications. Achieving high compliance rates in high value markets is an important profit driver for beef businesses. The number of animals failing to meet market specifications in Australia can be high which results in lower dollar returns. A study of 40,000 feedlot cattle (Andrew Slack-Smith, unpublished; 2008) reports that cattle not meeting market specifications impacts on the final quality, cost and delivery of the product. The study reports that in short fed feeding situations (20,000 head) – 28% missed weight specifications with an estimated cost of $31,000 ($5.50/head) and 16% missed P8 fat specifications costing $54,000 ($17.50/head). In the long fed situation (20,000 head studied) 29% missed weight specifications costing $62,000 ($11/head) and 70% missed the marbling specification of 3 marble score or better costing an estimated $1.5 million ($105/head).

Beef producers make decisions such as selecting cattle with the optimum liveweight, P8 fat thickness, frame size, expected daily liveweight gain, feeding program (grain or pasture), length of time in the finishing program and the use of hormonal growth implants (HGP) as part of managing cattle to meet market specifications. This paper evaluates the prediction of P8 fat (mm) on 2 commercial data sets: data set 1: predominately AngusxSanta Gertrudis steers and grain finished, and data set 2: Brangus steers and grass finished.

METHOD

Two commercial data sets were used to evaluate the fat calculator. They were steers grown out and finished for a high quality domestic market. As steers entered these finishing programs they were assessed for liveweight, P8 fat depth, frame size (frame score – height at the hips relative to age – McKiernan 2005) and HGP status. Following slaughter Hot Standard Carcase Weight (HSCW) and P8 fat depth was recorded. A final liveweight was calculated by assuming that HSCW represented 53% of the liveweight prior to slaughter. Average daily gain (ADG) was determined by simply dividing total kilograms gained by the number of days in the finishing program.

Inputs to the fat calculator have been described by McKiernan et al. 2008 and the input summary statistics from the 2 commercial data sets are shown in Table 1. The inputs to the fat calculator were the mean values as shown in bold (Table1).

Table 1. Summary of inputs to the fat calculator.

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Initial BW, kg</th>
<th>Initial P8, mm</th>
<th>Days on Feed</th>
<th>ADG, kg/day</th>
<th>Frame Size</th>
<th>Initial BW, kg</th>
<th>Initial P8, mm</th>
<th>Days on Feed</th>
<th>ADG, kg/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Set 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RESULTS
The observed P8 fat on the carcass and the predicted P8 fat are reported in Table 2.

Table 2. Observed versus predicted P8 fat (mm)

<table>
<thead>
<tr>
<th></th>
<th>Set 1</th>
<th>Set 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed</td>
<td>Predicted</td>
</tr>
<tr>
<td>n</td>
<td>34</td>
<td>-</td>
</tr>
<tr>
<td>Min</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Max</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>Mean, mm</td>
<td>10.7</td>
<td>11.0(^1)</td>
</tr>
<tr>
<td>S.D.</td>
<td>3.1</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Predicted P8 fat (mm) from Fat Calculator, it is not the mean of individual animals

The results shown in Table 2 indicate that the fat calculator predicts P8 fat with a reasonable degree of accuracy when the group means are used as inputs to the calculator.

CONCLUSION
The relationship between the predicted and the observed P8 fat depth (mm) on the carcass for 2 commercial data sets suggest that the fat calculator could be a useful tool for beef producers. It has a potential to assist beef producers improve management decisions that influence market specification compliance. As illustrated the group means can be used as inputs into the fat calculator. The group means should be relatively easy to collect. A range of ‘what if’ scenarios e.g. manipulating growth rate or using a HGP may be evaluated to assist producers meet market specifications. Further testing on a broader sample of cattle types is recommended to test the accuracy and robustness of the model.

KEY WORDS
P8 fat, fat calculator, liveweight, growth rate, HGP

ACKNOWLEDGEMENTS
The authors gratefully acknowledge the support of Yulgilbar Partnership, Baryulgil and Trevor and Colleen Jorgensen “Magnet” Delungra.
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A new tool for the prediction of fatness in beef cattle

W.A. McKiernan\textsuperscript{A}, V.H. Oddy\textsuperscript{B} and M.J. McPhee\textsuperscript{C}; Cooperative Research Centre for Beef Genetic Technologies, \textsuperscript{A} N.S.W. Dept of Primary Industries, \textsuperscript{B} University of New England, \textsuperscript{C} N.S.W. Dept of Primary Industries Beef Industry Centre of Excellence.

\textbf{ABSTRACT}

A simple computerised fat calculator is described here. It was designed to assist beef producers make critical management decisions for achieving market specifications. The calculator reports final liveweight and predicts P8 fat thickness using inputs of initial liveweight, frame size, current P8 fat depth, expected average daily gain, feed type (grain or pasture), length of time on feed (days) and growth promotant implant status (Yes/No) as well as an assessment of activity (feed yard, small paddocks or large paddock).

\textbf{INTRODUCTION}

A series of cattle growth path studies conducted over the last 2 Beef CRC’s have increased our knowledge of animal growth and carcase characteristics. Within the current Beef CRC, we have extended the cattle growth path research to combine it with a biological growth model called the Davis Growth Model (DGM). The DGM is built on the dynamic steer growth model of Oltjen \textit{et al.} (1986) that includes 4 fat deposition sub-models (Sainz and Hastings 2000; McPhee 2006). The new, simple to use tool, has been developed for the specific prediction of P8 fat depth when given various growth scenarios. The biology underlying the tool accounts for the effects of nutrition (quality and amount of feed eaten) on cattle growth and body composition as affected by variation in frame size, condition score, sex, amount of activity and implant status. The current prototype model works for \textit{Bos Taurus} steers.

The aim of the tool is to assist beef producers in managing cattle to meet market specifications.

\textbf{METHOD}

Frame size (frame score – height at the hips relative to age – McKiernan 2005), initial fatness and liveweight (as an assessment of current phenotypic status), expected rate of weight gain (the realised outcome of amount, type and quality of feed eaten) along with implant status all interact in changing body composition as an animal grows. Knowledge of the above parameters and their interactions in the mechanisms of growth and its impact on eventual carcase traits, allows us to predict fatness of cattle at any time. Models of cattle growth (Oltjen \textit{et al.} 1986; Williams 2005) typically are designed to integrate biological principles into a rational framework that can predict specified outcomes. For example, knowledge of the energetics of nutrient metabolism allows the prediction of total body protein and total body fat from such models. Total body fat in the DGM is partitioned into 4 fat pools: intermuscular, intramuscular, subcutaneous, and visceral. Subcutaneous fat is then converted into rib fat (McPhee \textit{et al.} 2008) and subsequently converted into P8 fat (Walmsley \textit{et al.} unpublished).

Data were generated by simulations from the DGM over a range of initial liveweights, frame sizes, starting fat depths, implant status and predicted growth rate, the later determined by assessed metabolisable energy content of feed. These data were then used to create a multiple linear regression equation which best fits the matrix of inputs and outputs. The resulting regression coefficients are used within a simple computerised calculator which predicts P8 fatness from practical inputs by the user.

This simple computerised calculator is intended to be a tool that beef producers can use to assist them make critical management decisions in meeting market specifications. The calculator (Figures 1 and 2) reports final liveweight and predicts P8 fat thickness using inputs of initial liveweight, frame size, current P8 fat depth, expected average daily gain, feed type (grain or pasture), length of time on feed (days) and implant status (Yes/No) as well as an assessment of activity (feed yard, small paddocks or large paddock). All inputs are derived from practical information that producers use every day.
OUTCOME

Figures 1 and 2 demonstrate the close to final version of the simple Fat Calculator. It will be freely available to the public via the MLA website and located in the More Beef from Pastures Tools area on that website in the near future.

The tool requires inputs as described above and will then report final liveweight and predict P8 fatness. Final liveweight and P8 fatness will assist producers to determine and implement on farm strategies to achieve a desired market specifications. This can be used with the cattle types they currently have on hand or investigate the impacts and/or requirements if long term changes in animal type are considered.

CONCLUSION

Prediction of carcase composition, as described by liveweight and fatness, at any time in an animal’s life is possible using biological growth models. This requires relatively few inputs of animal details that are practically feasible for the producer to collect.

This tool provides greater predictability of cattle’s future carcase performance and therefore increases confidence in producers to manipulate growth, genotype and current animal status to achieve market endpoints.

Figure 1. Inputs for setting up the fat calculator.
Figure 2. Inputs for predicting P8 fat thickness (mm) in the fat calculator.

KEY WORDS
Prediction tool, fat calculator, decision support, liveweight, growth rate

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Paper reviewed by: Dr John Wilkins NSW DPI Wagga Wagga

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Effect of gene markers for tenderness on eating quality of beef

B.L. McIntyre, CRC for Beef Genetic Technologies, Department of Agriculture and Food WA

SUMMARY

The quality of beef from Brahman cattle with all combinations of alleles for two gene markers (calpastatin and calpain 3) and Angus cattle with the most favourable combination was measured. The animals received hormonal growth promotant treatments, and their carcases hanging and ageing treatments. In AT hung carcases after 7 days aging, cattle with two favourable markers for both calpastatin and calpain 3 had striploin shear force values approaching 1kg less than those with no favourable markers. In Brahmans the HGP treatment increased shear force by approximately 0.6 kg while the effects of carcase hanging and ageing were approximately 0.1 and 0.4 kg respectively.

INTRODUCTION

There are currently four gene markers that are known to be associated with tenderness in beef cattle. These genes control the activity of the ‘calpain’ enzyme system which is responsible for the degradation of muscle proteins and affects meat quality. The markers are known as calpastatin, Calpain 1-316, Calpain 1-4751 and Calpain 3. Van Eenennaam et al. (2007) found that the first three of these markers accounted for approximately 1 kg difference in shear force, a mechanical measurement of tenderness. Typically, a shear force of 3.5 kg equates to very tender meat while a measurement over 5.5 kg would be regarded as tough.

The aims of this experiment were to quantify the effect of the gene markers for tenderness on shear force, to determine the interactions between the gene markers and other factors such as hormonal growth promotants, ageing and hanging method, and to determine the biochemical and physiological mechanisms underpinning the effects of the gene markers for tenderness.

METHOD

The experiment was designed to test all possible combinations of alleles for two of the tenderness markers, calpastatin (0, 1 or 2 favourable alleles) and calpain 3 (0, 1 or 2 favourable alleles) in Bos indicus (Brahman) cattle and one treatment containing the most favourable combination in Angus (2 favourable alleles for both markers). This resulted in 10 genotype groups each consisting of approximately 20 animals.

From May to November 2006 the animals were fed on a range of backgrounding feeding regimes at Vasse Research Station. From the end of November all animals were grazed in common until they entered the feedlot in early January 2007. Half of the animals in each treatment group were implanted with an HGP (Revalor H®) two weeks after entering the feedlot. The animals were slaughtered in early April 2007 after a further 70 days on feed. Following slaughter one side of each carcase was hung by the achilles tendon (AT) while the other was tenderstretched (TS). Sections of longissimus (striploin) muscles were aged for either 1 or 7 days post-slaughter.

RESULTS

Over the 210 day backgrounding period from June 2006 to the start of lot feeding in January 2007, the Brahmans grew at 0.64 kg/d while the Angus grew at 0.52 kg/d. During the 83 day feedlot period, Brahmans gained on average 1.28 kg/d compared with 1.42 kg/d for Angus. Following HGP treatment, implanted Brahmans and Angus gained 1.70 and 1.75 kg/d while those that were not implanted grew at 1.14 and 1.34 kg/d respectively.

Quality of meat from Brahman steers with different combinations of gene markers for calpastatin and calpain 3 and subjected to different hanging treatments and ageing times are shown in Figure 1. In
AT hung carcases there were no effects of tenderness markers on shear force after 1 day ageing. After 7 days ageing there was a clear trend for shear force to decrease with the presence of 2 copies of the favourable calpastatin markers, with a difference between 0-0 and 2-2 combinations of 0.95 kg. In tenderstretched carcases the presence of 2 copies of the favourable calpastatin marker was accompanied by decreasing shear force after both 1 and 7 days ageing. The difference between the 0-0 and 2-2 combinations was 0.61 and 0.58 kg after 1 and 7 days ageing respectively.

Figure 1. Shear force of the longissimus muscle (striploin) of Brahman steers with different combinations of calpastatin and calpain 3 markers (Cast-Cap3), hung by the achilles tendon (AT) or tenderstretched (TS) and aged for 1 or 7 days.

Tenderstretching resulted in no improvement in shear force at 1 day ageing, while there was an overall improvement of 0.36 kg at 7 days ageing. In Brahmans implanted with HGP, shear force was increased by approximately 0.6 kg. The shear force of cattle with 2-2 combination of markers was 0.22 - 0.91 kg lower for Angus than Brahmans depending on the hanging and ageing treatment.

CONCLUSION
Calpain system gene markers have commercially relevant effects on tenderness in Brahman cattle. Cattle with four favourable markers for calpastatin and calpain 3 had striploin shear force values approaching 1 kg less than those with four unfavourable markers after 7 days aging from AT hung carcases. The use of gene markers for tenderness has potential to greatly improve the quality and consumer acceptability of meat from Brahman cattle particularly since the favourable alleles are lower in frequency in Brahmans than in Bos taurus cattle. The improvements in quality resulting from the two gene markers studied in this experiment did not account for all of the difference in shear force between Brahmans and Angus of comparable age and nutritional background.

KEY WORDS
Beef cattle, tenderness, gene markers

Paper reviewed by: Paul Greenwood and Linda Cafe, NSW DPI, UNE Armidale
REFERENCES
Accelerating beef industry innovation through Beef Profit Partnerships

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SUMMARY

The Co-operative Research Centre for Beef Genetic Technologies (Beef CRC) has initiated a network of partnerships among beef businesses focused on achieving sustainable impact on business profit and industry growth. There are currently 33 partnership teams involving 349 businesses in the Beef Profit Partnership (BPP) network across Australia and New Zealand. Although it is too early to obtain definite quantifiable outcomes from the project, initial results indicate that BPPs may be an effective mechanism to accelerate the rate of improvement and innovation in the beef industry.

INTRODUCTION

The Beef CRC “Beef Profit Partnerships” project has established a network of partnerships among beef businesses across Australia and New Zealand designed to achieve and accelerate improvements and innovations for sustainable impact on business profit and industry growth. The initial focus of the project is to demonstrate the achievement an additional 5% average improvement in annual profitability of BPP participants within 2 years. Three target outcomes will contribute to achieving this focus: (i) rapid and measurable improvements among partners in productivity, profit and growth; (ii) a supportive network of rewarding partnerships, contributing to accelerated industry growth; and, (iii) partners equipped to achieve sustainable improvement and innovation.

METHOD

The key difference in the adoption strategy being implemented by this project is an emphasis on the use of industry partnerships focused on achieving continuous innovation, instead of simply relying on broad communication and awareness activities. The Continuous Improvement and Innovation (CI\&I) process used in the project involves rapid cycles of focus, design, action, measurement, evaluation and re-focus (see Figure 1). This process has been implemented successfully in other sectors of the economy, especially in manufacturing. However, the approach has not been widely applied in the agricultural sector, especially in developed economies.

The key principles of the CI\&I approach include:
(i) purposeful partnership design for mutual benefit;
(ii) focus on the key drivers of innovation and business growth;
(iii) designed and structured process for rapid improvement, monitoring, feedback, support and response;
(iv) targeting specific, achievable improvements and making success measurable;
(v) use of best practice innovation methods, tools and technologies;
(vi) development of a culture of business creativity;
(vii) effective communication and networking;
(viii) capacity building for sustained improvement and innovation and
(ix) sharing experiences, results and successful methods, and celebrating success (Clark & Timms, 2007).

Figure 1. The Continuous Improvement and Innovation (CI\&I) process
It is anticipated that the development of a supportive culture for innovation across the BPP network will contribute to the development of an industry environment that will accelerate the transformation and integration of Beef CRC-derived technology into beef businesses as well as enhancing the adoption of other relevant technologies and business tools. An important objective of the project is to build the necessary capacity for the partnership network to become self-sustaining and to continue to contribute to industry innovation and improvement beyond the life of the Beef CRC.

RESULTS

There are currently 33 effective BPPs established, involving 349 businesses across Australia and New Zealand. In addition, there are several additional partnerships under development, including large beef businesses (the corporate sector), and some private sector sponsored BPPs. Several unsuccessful BPPs which were initially established during the early stages of the project have been discontinued. Figure 2 shows the extent of the BPP network as at May 2008.

Many of the BPP partners have already implemented practice changes as part of their improvement and innovation focus. However, insufficient data has yet been collected from the BPP network to enable an evaluation against the project's target outcomes or to enable an analysis of aggregated project outcomes. This has been at least partially due to the need to achieve a paradigm shift amongst many facilitators and partners in accepting the role of measurement, monitoring and evaluation as a critical component of CI&I. This is being addressed through the provision of further capacity building opportunities and support in implementing CI&I in individual businesses and partnerships.

CONCLUSION

Initial results indicate success in the establishment of a supportive partnership network involving beef businesses in Australia and NZ. Work is still underway to evaluate the effectiveness of this strategy to accelerate the process of innovation and to achieve improved profitability in the beef industry.

Paper reviewed by: Paul Hyland, Garry Griffith, Janice Timms and Andrew Alford
KEY WORDS
Continuous improvement and innovation; beef industry; profit; capacity; partnership.

ACKNOWLEDGMENTS
The considerable inputs from numerous strategy leaders, co-ordinators and BPP facilitators and leaders involved in this project are gratefully acknowledged.

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Sustainability

The WA Sheep Industry – is it ethically and environmentally sustainable?

Danielle England, Department of Agriculture and Food WA

KEY MESSAGES

- WA livestock producers must meet growing community, government and market demand for ethically and environmentally sustainable products.
- “Recommended” on-farm practices (current recommended practices – CRPs) are being identified, and documented by the Department of Agriculture and Food to meet domestic and international government and market demands.
- WA livestock industries need to provide leadership in demonstrating ethical and environmental stewardship or risk losing control of their farming system.

REPORTING SUSTAINABILITY THROUGH ON-FARM PRACTICES

Western Australia’s livestock industries market environment is rapidly changing. Attendance at any industry event, or a read of the ‘rural weeklies’, will present you with a discussion on animal welfare; environmental impacts; and ethical livestock production.

So how are Western Australian livestock industries meeting community, government and market demands for ‘sustainable production’? And how do we define ‘sustainable production’ in WA farming systems?

There is no universal method of documenting or reporting the livestock industry’s on-farm environmental or animal welfare practices. Yet the industry is expected to demonstrate the use of appropriate on-farm practices to satisfy changing market demands.

It is an expectation of the community, government and international markets that WA’s livestock producers adhere to a range of ‘acceptable’ production and environmental practices. These are often called Current Recommended Practices (CRP), Good Agricultural Practices (GAP) or Better Management Practices (BMP). Mulesing is just one practice in a suite of many in our broadacre farming system that are increasingly likely to attract international market attention.

These recommended on-farm practices are being set by a range of organizations at different levels within market and government organisations. It is important for industry representatives and livestock producers to have an understanding of how these on-farm practices are defined, by whom and the important role industries have in meeting these market requirements.

Internationally, the Sustainable Agricultural Initiative (SAI) Platform is an organisation that aims to support the development of, and communicate sustainable agriculture through the value chain. In doing this it has defined “guidelines and standards” for “good working practices” for sustainable agriculture globally. While it has focused initially on six ‘case study’ industries, including dairy and grains, it is expected that all industries will be examined. Members of the SAI Platform include Fonterra, McDonalds, Nestle, Unilever and other large multi-national food companies. An Australian chapter has recently formed and is currently calling for members of its working groups to set production standards for Australian agriculture.

THE WA EXAMPLE

In Western Australia, the Department of Agriculture and Food (DAFWA) has been developing CRP’s for the livestock industries. They outline the practices research has identified as sustainable for WA farming systems. The complete set of practices have been included in a baseline, and as new research or CRPs are developed, the baseline will be updated.
Livestock industries are adopting, and reporting the use of CRPs’s through industry programs such as DairySAT and Landleader. Australian Wool Innovation (AWI) and Meat and Livestock Australia (MLA) are currently using the Landleader survey to benchmark the adoption of on-farm environmental and production practices.

The results of the Landleader survey will allow individual landholders to compare their practices to those in their shire, state and industry. They will also allow industry bodies and regional natural resource management councils an opportunity to assess the adoption of sustainable practices on-farm, and their effect on desired environmental and production outcomes.

INTERNATIONAL REQUESTS

Major International markets are challenging livestock industries to adopt CRPs, and demonstrate their adoption. The implementation of the Japanese Preferred Supplier List in 2006 and the expansion of the European Union Eco-Label and the Chinese Green Label are examples. All three programs provide sets of environmental, animal welfare and/or food safety standards which their suppliers are expected to meet if they wish to continue trading in these markets.

A number of WA livestock producers are already meeting these international market requirements for ethically or environmentally friendly produce, and are selling through organised supply chains. They include i-Merino and The Merino Company. Producers are receiving compensation for the extra effort required or in some instances premiums for ethically produced wool, with The Merino Company for example paying 4% more for Certified non-mulesed wool sold through its value chain.

CONCLUSION

Environmental and ethical marketing is becoming more ‘fashionable’. But to access this growing market the WA livestock industries need to work together to ensure that the definition of CRPs meets the needs of their complex farming systems.

DAFWA is working with the livestock industries, researchers and development officers to ensure that any CRPs that are developed for the WA livestock industry are practical, sustainable, and backed by rigorous research. But more importantly, that the on-farm practices lead to good environmental and animal welfare outcomes whilst maintaining or enhancing production levels.

KEY WORDS

Environmental and ethical production, marketing, sustainable livestock farming systems, current recommended practices

ACKNOWLEDGMENTS

Paper reviewed by: John Noonan, Department of Agriculture and Food.

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Overview of ruminant agriculture and greenhouse emissions.

Fiona Jones, Department of Agriculture and Food WA

SUMMARY

Over the last three centuries, the atmospheric methane burden has grown 2.5-fold reaching levels unprecedented in at least 650,000 years. Agricultural expansion as played a large role in this (Lassey, 2007). Agriculture is estimated to contribute 90% of the world’s emissions of nitrous oxide and 50% methane emissions. Within Australia it is estimated that 85% of emissions are from nitrous oxide and 60% from methane. In terms of total emissions Australian agriculture is estimated to contribute 16% of the total national emissions with methane from livestock being 13% which is similar to the whole transport sector (Ugalde, 2007). Enteric fermentation from livestock is a large source of methane, which has a global warming potential 23 times that of carbon dioxide (Charmley et al, 2007). Abatement techniques are being researched internationally and this paper is to give you an overview of the state of greenhouse emissions, particularly methane and techniques which are being researched.

BACKGROUND

We have to become more aware of what greenhouse gases our industries are contributing to the system and remember that agriculture is not just small sectors working separately, we should be working together as an industry united. Climate change is becoming a very integral part of how we are to function as an industry and how purchasers look at the products that they are about to buy.

Methane is produced as a by-product of digestion of forages, of which a majority is belched during the digestive process. There is a very minor component which is emitted from the anaerobic decomposition of dung. With 97% of livestock greenhouse emissions arising from enteric rumen fermentation (Hegerty, 2001). Emissions from animals are influenced by several factors, these include feed type, feed intake, feed processing, rumen microflora and the addition of rumen modifiers eg ionophores, tannins and antibiotics. Methanogens play an important role in maintaining optimum conditions in the rumen, methane is a normal product of fermentation and is used as a hydrogen sink. Without removing the hydrogen source it can lead to a detrimental effect on the animal and farm productivity due to leading to a drop in rumen pH. Therefore just removing the methanogens produced without finding an alternative sink for the hydrogen is not a viable option.

The quantity of methane released is affected by the amount of feed eaten, feed composition and the extent of digestion by the microflora. As a general rule forages that have high fibre content are digested more easily and release more methane per unit of feed eaten compared to less fibrous diets. (Pastoral greenhouse gas progress report, 2007). They see that desirable properties of forage are thought to be low in fibre and high in readily fermentable carbohydrates provide the animal with energy but limit methane production (see table 1). It must also be considered though that excessive nitrogen in diets can contribute to nitrous oxide emissions through urine patches leading to leaching and volitisation.

Table 1 Estimated annual emissions of methane from enteric fermentation across several livestock classes (Mt CO₂-e; adapted from AGO National Inventory report 2007).

<table>
<thead>
<tr>
<th>1990</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef cattle (grazing)</td>
<td>32.9</td>
</tr>
<tr>
<td>Feedlot cattle (grain)</td>
<td>0.4</td>
</tr>
<tr>
<td>Dairy cattle</td>
<td>5.8</td>
</tr>
<tr>
<td>Sheep</td>
<td>24.6</td>
</tr>
</tbody>
</table>
Previously there was little knowledge on the methanogens but with new molecular technologies we are able to identify variations in the population which we were unable to achieve through older culturing techniques. This lack of information on the predominant species and types of rumen methanogens in Australian ruminants has previously placed seriously constraints on developing biological approaches to emissions control (Hegerty, 2001). However, work being undertaken internationally and predominantly in CSIRO Brisbane and AgResearch in New Zealand has been able to determine methanogen diversity. Methanogens belong to the ancient lineage called the Archaea and share many common features for potential inhibition, allowing them to be targeted while not harming the other useful rumen microbes. The key in reducing methane is finding an alternative source for the hydrogen that is converted to CH$_4$ during normal fermentation. Work done by Kleive and Joblin, (2007) has been looking at using acetogens from the stomach of marsupials and termite hindguts to utilise hydrogen and produce acetate. It has not been determined if they are able to out compete ruminal methaegons.

The agricultural industry is presently getting more involved in getting on the ground values for emissions from agriculture. There is a need to look at how we can over a long term impact on greenhouse gas emissions. This may be through use of genetic selection of livestock with low methane emissions, testing of varied feed sources and possible grazing techniques. It is imperative that we look at long and short term solutions to this problem.

CONCLUSION

Greenhouse mitigation is becoming an important aspect of the agricultural industry and how it will fit into policy in the future is still being determined, we as an industry need to get more on the ground values which can accurately be fed into models from predicted outputs of greenhouse gasses from the agricultural industry. We also must remember our markets, we as an industry should be working towards reduction of greenhouse gases, for the future of the industry as well as to maintain or obtain more markets in the future.

KEY WORDS

Greenhouse gas, enteric methane and greenhouse mitigation

ACKNOWLEDGMENTS

Paper reviewed by: Heidi Berendsen

REFERENCES


Grazing for Nitrogen Efficiency

John Lucey, Martin Staines and Richard Morris  DAFWA Dairy Team

ABSTRACT

There is still much reluctance among farmers and advisors to accept the compelling evidence that grazing of ryegrass pastures by leaf stage (LS) should be the determining factor in setting grazing interval. Ryegrass pasture growth rates (PGR) and total pasture production per year are maximised and pasture quality optimised if ryegrass pastures are allowed to reach the 3-leaf stage (Fulkerson and Donaghy 2001). Put simply, the three live leaves per ryegrass tiller each take the same time to develop but get progressively bigger. For ryegrass grown to 3 leaves, the 1st leaf contributes 15-20% of total pasture biomass, the 2nd leaf 30-35% and the 3rd leaf 45-50%. There is little difference in ME content between the 1st and 3rd leaf.

Research by the DAFWA dairy team as part of the Greener Pastures project at the Vasse Research Centre in Western Australia provides further insight into the intricacies of grazing by leaf stage, and in particular the impact of fertiliser nitrogen (N).

AIMS

The Greener Pastures research team suggest that increased use of N fertiliser on Australian dairy and beef farms frequently results in farmers reducing grazing interval by increasing rotation speeds to manage the higher pasture biomass and/or “canopy closure” associated with higher pasture growth rates. This Greener Pastures research demonstrates that increasing rotation speed cancels out part of the potential pasture growth response from N fertiliser, and impacts adversely on the nutritional balance of pasture for dairy cows.

METHOD

During January to May 2007 a cutting trial was conducted with irrigated perennial ryegrass to investigate what happens when different cutting intervals (‘rotation speed’) were combined with different N fertiliser rates. The trial consisted of 6 treatments; with ryegrass defoliated (‘cut’ to 5 cm above ground level) when tillers had grown either 1½ or 2 or 2½ leaves. This resulted in 10, 7 and 5 cuts respectively over the 20-week trial, or mean rotation speeds of 14, 19 and 26 days.

Ryegrass at each leaf stage treatment received N fertiliser after each cut in amounts equivalent to 1 or 2 kg/ha/day. At each cut, the amount of harvested pasture was recorded and analysed for quality, particularly ME, CP and sugar (water soluble carbohydrates). At the end of 20 weeks, root dry matter was determined.

RESULTS

The mean pasture growth rate (PGR over 20 weeks) for the 6 treatments ranged from 48 to 95 kg DM/ha/d (Table 1).

With defoliation at 2½ leaves, an increase of fertiliser N from 1 to 2 kg/ha/d increased PGR from 61 to 95 kg DM/ha/d, which is an extraordinary response of 34 kg DM/kg N. With defoliation at 2 leaves, an increase of fertiliser N from 1 to 2 kg/ha/d increased PGR 29 kg DM/kg N (78 - 49 kg DM/ha/d). With defoliation at 1½ leaves, an increase of fertiliser N from 1 to 2 kg/ha/d increased PGR 23 kg DM/kg N from (71 - 48 to 48 kg DM/ha/d).

Table 1. How cutting interval (leaf stage) and N fertiliser rate influenced PGR (kg DM/ha/day) of perennial ryegrass.
If a paddock is grazed at 2½ leaves and N fertiliser is increased from 1 kg to 2 kg/ha/day then mean PGR increased from 61 to 95 kg DM/ha/d (56%), if that grazing is maintained at 2½ leaves (Table 2).

Table 2. How the PGR response of perennial ryegrass to N fertiliser is influenced by leaf stage (kg DM/ha/day).

<table>
<thead>
<tr>
<th>Leaf Stage</th>
<th>Plant Growth Rate</th>
<th>PGR Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 N</td>
<td>2N</td>
</tr>
<tr>
<td>1½</td>
<td>71</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>78</td>
<td>17</td>
</tr>
<tr>
<td>2½</td>
<td>61</td>
<td>95</td>
</tr>
</tbody>
</table>

If, due to increased PGR, the rotation speed is increased and the paddock is grazed earlier at 2 leaves, the mean PGR achieved is 78 kg DM/ha/d, not 95 kg DM/ha/d. This has reduced the PGR response to the extra kg of N fertiliser (per ha per day) from 34 to 17 kg DM/kg N. If the paddock is grazed earlier still, at 1½ leaves, the mean PGR achieved is 71 kg DM/ha/d, instead of 95 kg DM/ha/d. This has reduced the PGR response from 34 to 10 kg DM/kg N.

Extra fertiliser N is applied with the primary goal of increasing PGR, but if in response to the increased PGR farmers shorten grazing rotation so that they graze at 2 leaves per ryegrass tiller, or even earlier, this suppresses PGR because it does not let the ryegrass plant develop its biggest (third) leaf.

In addition the nutritional balance of ryegrass at 1½ - 2 leaves is much less suited to the dairy cow than ryegrass with 2½ (or 3) leaves. The difference is not in ME content, but in protein content and sugar content (Table 3) which is important for rumen health and cow health. The optimum protein to sugar ratio for rumen bugs on a diet of high-quality pasture is about 1.1. In ryegrass with 1½ leaves this ratio was found to be 1.7 in our trial, mainly due to low levels of sugar in ryegrass. The ratio dropped to the ideal of 1 to 1.2 when pastures developed 2 or 2½ leaves.

Pastures grazed at 1½ leaves had insufficient fermentable sugars to allow rumen microbes to use the high pasture protein levels. This excess protein is converted to ammonia in the rumen which then needs to be converted to urea and excreted in urine. This metabolic process requires energy, which reduces production and/or body condition and may also negatively affect fertility. 

Table 3. How cutting interval (leaf stage) influenced protein and sugar content of perennial ryegrass.

<table>
<thead>
<tr>
<th>Leaf stage at grazing</th>
<th>Pasture protein %</th>
<th>Pasture sugar %</th>
<th>Protein: sugar ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½ LS</td>
<td>16</td>
<td>10</td>
<td>1.6</td>
</tr>
<tr>
<td>2 LS</td>
<td>15</td>
<td>12</td>
<td>1.2</td>
</tr>
<tr>
<td>2½ LS</td>
<td>13</td>
<td>14</td>
<td>1.1</td>
</tr>
</tbody>
</table>

CONCLUSION

Pasture quality and quantity for grazing by dairy cows is optimized by grazing at 2 ½ - 3 leaves. Only graze ryegrass earlier than 3 leaves per tiller if pasture is being wasted. Try not to graze earlier than 2½ leaves.

Fast rotations (grazing at 1½ or 2 ryegrass leaves) can be expected to result in considerably less pasture being produced compared to slower rotations (grazing at 2½ to 3 ryegrass leaves). Fast rotations (grazing at 1½ or 2 ryegrass leaves) result in pasture that is poorly balanced to the needs of the dairy cow, with excess protein but low sugar levels. High urea (=N) losses in urine can result in pasture scalding and have an adverse environmental impact.

If canopy closer is consistently occurring before 2½ leaves, the first response should be to reduce the amount of N fertiliser applied, rather than to speed up your rotation.

KEY WORDS

Grazing management, nitrogen efficiency
ACKNOWLEDGMENTS

Paper reviewed by:

REFERENCES

Investigating potential adaptations to climate change for the low rainfall farming system

Megan Abrahams, Caroline Peek, Dennis Van Gool, Daniel Gardiner, Kari-Lee Falconer, Department of Agriculture and Food WA

SUMMARY
- The current low rainfall farming system may be unsustainable due to the predicted negative impacts of climate change on crop yields
- Higher wheat prices and more favourable terms of trade may extend the life of the low rainfall farm in its current form
- Adaptation to a combination of a low cost livestock enterprise and oil mallees for carbon sequestration with reduced investment in cropping may be a viable alternative.
- Further analysis of a range of potential adaptations needs consideration.

AIMS
There is significant uncertainty over the impact of climate change on farm businesses. Knowledge of the nature of the impacts of climate change will facilitate planning, strategic decision-making and policy processes at a farm, regional, state and national level. Our study uses the STEP (Simulated Transitional Economic Planning) tool to: (i) examine the consequences of possible climate change effects on the productivity and profitability of the Northern Agricultural Region's low rainfall farming system and (ii) test the financial viability of potential adaptations to climate change.

METHOD
The low rainfall farm - current system

A farm was constructed in STEP to represent an average farm business in the low rainfall zone (<325 mm) of the north-eastern wheat-belt. Soil types were based on data from the Pindar-Tardun catchment (Clarke, 1995). The 4315 ha mixed enterprise farm comprised 60% cropping and 40% volunteer pasture, which supported a self replacing merino flock of 2042 Dry Sheep Equivalent (DSE). The lambing rate was 85% for mature ewes and 75% for maiden ewes. The greasy wool yield was 5 kg and 5.5 kg per head for ewes and wethers respectively. The wool price was $4.50/kg (greasy) and animals were culled at 7 years.

The cropping and livestock rotations reflected the current land use of local farming systems (Sandison, 2002) with yields and variable costs based on a survey of local farmers and yields being long-term averages for each soil type. Other financial data were obtained from Bankwest Benchmarks and DAFWA Gross Margins Guides. To simulate the cost-price squeeze, costs were increased at 3% per annum and returns increased at 2% per annum. A discount rate of 8% was applied to the cumulative financial position to yield the net present value (NPV) of the farm's land use strategy. The long-term crop yields were increased by 0.5% per annum to simulate technological advances in management and breeding.

Impact of climate change

Two climate change scenarios were generated using the CSIRO-developed program ‘OzClim’. OzClim generated projected monthly rainfall and temperatures at 5-yearly intervals from 2005 to 2055 based on the (i) CSIRO Mk II or (ii) Hadley Centre (HADCM2 & HADCM3) climate models. Both climate scenarios were based on the SRES A2 emissions scenario (IPCC, 2001), which describes a medium to high level of projected greenhouse gas (GHG) emissions under a set of defined demographic and technological advances. Both scenarios were also run with a high sensitivity of climate change to GHG emissions.
Both scenarios projected an increase in minimum and maximum temperatures and a decrease in annual and growing season rainfall. The trend of climate change over the 50-year period was approximately linear.

Land use capability data and climate information were then combined with a modified French and Schultz equation (Van Gool and Vernon, 2005) to produce predicted potential crop yields. Both scenarios predicted declining yields at an average annual decline of 1.2% and 1.5% per annum for the CSIRO Mk II and Hadley scenarios respectively. An annual penalty on stocking rates was applied, being the percentage difference in pasture growth rates (PGR) between the current system and each climate change scenario. PGR was calculated using the modified French and Schultz equation shown below (personal communication, T. Wiley & R. Grima, 2007).

\[
PGR = (GSR - 100 \text{ mm}) \times 28 \text{ kg DM/ha} \quad \text{(where GSR = growing season rainfall, DM= dry matter)}
\]

The impact of reduced yields from climate change in the north-eastern low rainfall farming system was analysed over 50 years using the STEP model (Peek and Abrahams, 2005). The main output is the annual surplus/deficit of each year being analysed. Annual surplus/deficit was calculated as gross farm income minus expenditure (all capital, fixed and variable costs, taxation, personal drawings but excluding loan repayments). Hence, the model reveals the financial viability of a farm reliant on the current farming system, yet experiencing different climate scenarios. The role and value of adaptation strategies can also be considered in STEP. The STEP analyses of the current low rainfall farming systems considers two possible climate change scenarios and the average climate conditions associated with those scenarios.

Testing adaptations to climate change using STEP

STEP was used to test the financial viability of two adaptation strategies:

1) An alliance with pastoral regions for trade cattle grazed over winter/spring. This system has been successfully trialled by a farmer in the low rainfall area (Grain and Graze, 2007). Farmers paid half the freight cost to port and a commission on sales. Upon sale of the animal, the farmer received income for two-thirds of the weight gained while on his property. The costs and livestock prices used in the analysis are shown in table 1.

2) An alliance with pastoral regions for trade cattle combined with oil mallee alleys for carbon sequestration and opportunistic cropping. In addition to trade cattle, the best soils were opportunistically cropped 1:5 years and oil mallee belts were planted on the deepest soils for carbon sequestration. Cattle were stocked at an average of 3 DSE/ha.

It was assumed that an adequate supply of cattle was available each year at the time when pasture was also available.

were $22/ha.

<table>
<thead>
<tr>
<th>Stock sale price</th>
<th>Livestock prices and costs to the farmer in the pastoral alliance system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 360 kg live weight</td>
<td>$1.70/kg</td>
</tr>
<tr>
<td>&gt; 360 kg live weight</td>
<td>$1.50/kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock capital development - infrastructure</td>
<td>$10/ha in first year, then $10,000/yr</td>
</tr>
<tr>
<td>Maintenance of livestock infrastructure</td>
<td>$5,000/yr</td>
</tr>
<tr>
<td>Vet costs (drench/vaccinations)</td>
<td>$2.20/hd</td>
</tr>
<tr>
<td>Commission</td>
<td>3% of farmer’s returns on animal</td>
</tr>
<tr>
<td>Farmer’s share of freight costs</td>
<td>$12.50/hd</td>
</tr>
<tr>
<td>Pasture costs – fertiliser, repairs</td>
<td>$45/ha*</td>
</tr>
</tbody>
</table>

* At 3 DSE/ha stocking rate, pasture costs

RESULTS

Effect of climate change on the current system

The farm, as modelled, became financially unviable under both the CSIRO Mk II and Hadley climate scenarios (figure 1) in which annual crop yields declined at 1.2% and 1.5% per annum, respectively. For these scenarios, average annual deficits were consistently generated over the 50 years. In
contrast, the current farming system under no projected climate change maintained an annual surplus, mainly due to the annual improvements in crop yield (0.5% per annum), even under declining terms of trade. The “no yield decline” scenario, where yield improvements from technology balanced out the yield decline from climate change, was also unviable in the long term due to the impact of declining terms of trade. Further analysis at higher wheat prices and neutral terms of trade (i.e. costs and returns increasing at the same rate) showed a less severe effect of climate change on the viability of the farm.

Figure 1. Annual surplus or deficit of the low rainfall farm for different climate scenarios.

Testing adaptations to climate change using STEP

Transition to a system of trade cattle acquired through a pastoral alliance was tested for sensitivity to winter/spring stocking rate (3, 5 and 7 DSE/ha) and weight gained per head (120 kg and 180 kg). These values cover the range experienced by farmers in the region. The farm only maintained an annual surplus where the higher stocking rate of 7 DSE/ha and weight gain of 180 kg/head was achieved. Whether these values are achievable in the low rainfall area would need to be assessed, as would the potential environmental consequences of higher stocking rates. A stocking rate of 7 DSE/ha and 180 kg weight gain may be achievable with an extra two months of high quality feed, denser pastures, superior animal genetics and good management.

The financial position of the combination system of trade cattle, opportunistic cropping and oil mallees was tested for sensitivity to wheat price, live weight gain of cattle, future trend in terms of trade and carbon returns from oil mallees over 30 years (table 2).

Table 2. Average annual surplus or deficit of the farm over 30 years for different wheat prices, carbon returns and weight gain per head at declining (↓) or neutral terms of trade (T of T).

<table>
<thead>
<tr>
<th>Cattle weight gain/head</th>
<th>120 kg</th>
<th>180 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat price* $/t</td>
<td>Carbon returns $/t CO₂ eq</td>
<td>T of T ↓</td>
</tr>
<tr>
<td>$165</td>
<td>$10</td>
<td>-$50,000</td>
</tr>
<tr>
<td>$50</td>
<td>-$40,000</td>
<td>-$21,000</td>
</tr>
</tbody>
</table>
Weight gain per head is a particularly strong driver of profit in the system. In general, at a stocking rate of 3 DSE/ha, cattle must achieve a weight gain of 180 kg/head for the farm to remain viable. A weight gain of 120 kg/head was only profitable at the highest wheat price and rate of carbon returns. Wheat income is a secondary driver of the system so high wheat prices improve profitability. The price of carbon returns has only a small influence on the profitability of the system as the oil mallee comprise only 6% of the farm area. Increasing the stocking rate, weight gain or stock price could also improve the viability of this system.

**Conclusion**

The predicted negative impact of climate change on crop yields could make the current low rainfall farming system financially unsustainable within a few decades. Uncertainties include the future wheat price, the direction of the terms of trade and the effect that new technologies, new markets and other factors may have in alleviating the impact of reduced yields on farm profitability.

The STEP tool was used to assess the financial viability of two possible alternatives to the current farming system. A trade cattle enterprise has the potential to be a high risk alternative. It relies on the supply of the trade cattle and achieving the required stocking rate and weight gain. Weight gain was a key driver of profitability and its management involves lower input costs and less risk in a poor season than increasing stocking rate. Perennials in the system may provide adequate pasture to improve achievable weight gain but there has been very limited testing of perennial fodder options in this region to date. Analysis of environmental and other impacts need further consideration.

STEP analysis of the combined trade cattle /oil mallee / opportunistic cropping system resulted in identification of some of the drivers of the system and threshold values which need to be achieved to make the system successful. Cropping opportunistically increases the profitability of the system, particular with high wheat prices, and it lessens the reliance on cattle. However, the pastoral alliance must be flexible enough to handle the reduced demand for cattle in a year where large areas are opportunistically cropped. While the oil mallees are only a small part of the system they provide an additional income stream which contributes to payment of the farm’s fixed costs. There is also the potential for additional future income from harvestable products of oil mallees.

Further exploration of alternatives for the low rainfall farm and analyses of their financial viability is needed. Such analyses will facilitate the determining of appropriate policy and research agendas for the region.

**Key Words**

Climate change, low rainfall, STEP, farming system, financial viability, adaptation

**Acknowledgments**

Funding provided by the AGO, Pindar farmers for survey information, Ian Foster for climate advice

Paper reviewed by: Rob Grimna and Tim Wiley

**References**


Grain and Graze (2007). Case study – Colin and Jill McGregor, Maya. See www.liebegroup.asn.au


**Sheep**

**Benchmarking ewe productivity through on-farm genetic comparisons**

Sandra Prosser, Mario D’Antuono and Johan Greeff; Department of Agriculture and Food Western Australia

**SUMMARY**

On-farm benchmarking demonstrates that breeders can improve traits without compromising others. The latest combined analysis of the Western Australian ewe productivity trials shows a wide range in fleece weight, fibre diameter, body weight, weaning rates (41%) and weaning weights (4.2 kg) between flocks.

**INTRODUCTION**

The linked sheep genetic benchmarking scheme allows the sheep producer to compare their flock against others throughout the state. Whereas wether trials focus on wool traits and liveweight, there has been a shift to benchmarking both the wool and reproduction traits of the sheep enterprise, as this is more representative of on-farm sheep profit. Although trials are carried out at different sites, flocks can be compared across sites because of the introduction of link teams (4). Since 1998, a total of 96 flocks in 16 trials have been benchmarked or are currently in ewe productivity trials.

Previous wool and bodyweight analysis have been reported (3, 4) and preliminary reproduction results have also been reported in the popular press. This paper presents wool, body weight and reproduction results on 36 flocks.

**METHOD**

Participants supply 50 ewe lambs that have been drafted off randomly to the host farm. The ewes run together from weaning until hogget shearing. After the first shearing, the ewes in a trial are mated to the same group of rams for their first lambing, go through a second shearing, a second lambing and finally a third shearing. Procedures are outlined in (1).

Ewe greasy fleece weights and body weights are collected at shearing. Wool measurements including fibre diameter and yield are reported from midside samples sent two weeks prior to shearing to a wool testing laboratory. Lambs from different ewe teams are identified using the udder marking technique (2) or by lambing them in separate paddocks. Lamb weaning weights and number of lambs weaned per team are collected at weaning.

Thirty six teams have so far completed a trial and their data have been analysed using multivariate statistical analysis procedures to estimate the performance of each team for the different traits.

**RESULTS**

The average clean fleece weight had a range of 1.4 kg between the top and bottom flock (Table 1). The average fibre diameter was 19.9 microns, with a range of 3.77 microns. There was a difference of 41% in weaning percentage (lambs weaned per ewe joined) between the top and bottom flock. This value includes the maiden and second lambing, and sometimes a trial will have a third lambing, which will be included too. There was 4.2 kilogramme difference between the top and bottom team for average weaning weights. For producers looking for flocks with above average body weight, weaning percentage and weaning weights, and a low fibre diameter, flocks 171, 381, and 384 do this (although they are all slightly negative for fleece weight). Flocks 382 and 433 are above average for all the above traits, although they are slightly positive for fibre diameter.

**CONCLUSION**
The results show that there is large variation between teams for the economically most important production traits. This information allows participants to identify and source superior genetic material for breeding purposes to improve their profitability.

Table 1: Wool and reproduction traits measured or recorded on ewes in ewe productivity trials from 2001 to 2008. Bodyweights recorded at each shearing.

<table>
<thead>
<tr>
<th>Team</th>
<th>Fibre Diameter (µ)</th>
<th>Clean Fleece Weight (kg)</th>
<th>Body Weight (kg)</th>
<th>Weaning rate (%)</th>
<th>Wean Weights (kg)</th>
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<tr>
<td>4</td>
<td>1.12</td>
<td>0.20</td>
<td>0.74</td>
<td>3.47</td>
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<td>18</td>
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<td>Ave</td>
<td>19.86</td>
<td>2.99</td>
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<td>39.11</td>
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<td>50.73</td>
<td>97.41</td>
<td>27.72</td>
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</tbody>
</table>

**KEY WORDS**
Sheep, benchmarking, genetics, ewe productivity trial

Paper reviewed by: John Karlsson

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(4) Butler L (2006) Ewe and Wether Trials – benchmarking your sheep genetics, *Btn 4676*
Increasing profitability by pregnancy scanning ewes

John Young¹, Andrew Thompson² and Chris Oldham²; ¹Farming Systems Analysis Service, Kojonup, WA, ²Department of Agriculture and Food WA

ABSTRACT

Scanning to detect empty, single- and twin-bearing ewes in flocks is being adopted by a growing number of producers because it allows them to target the nutrition of their ewes more accurately. The intake of the empty ewes can be reduced which may allow more ewes to be carried, and the intake of the twin-bearing ewes can be increased which should lead to higher production from these ewes and their progeny. This paper describes an analysis for a property in south west Victoria which used feed budgeting and the relationships developed in the Lifetime Wool project to calculate the impact on wholefarm profit from scanning ewes and adjusting management of the empty, single- and twin-bearing ewes.

For a spring lambing flock, scanning ewes to identify pregnancy status increased profit by nearly $9000 ($1.80/ewe). The management of the empty ewes is very important because about 75% of the benefit resulted from allocating less feed to them and more to the pregnant ewes. Only 25% of the benefit was achieved by allocating different amounts of feed to the single- and twin-bearing ewes.

INTRODUCTION

Scanning for pregnancy status is being adopted by a growing number of producers because it allows them to target the nutrition of their ewes more accurately. Survey data suggests that between 30 and 40% of ewes are pregnancy scanned each year. Identifying empty, single- and twin-bearing ewes allows targeting of specific nutritional requirements to each group of ewes. The intake of the empty ewes can be reduced which may allow more ewes to be carried and the intake of the twin-bearing ewes can be increased which should lead to higher production from these ewes and their progeny.

The relationships developed in the Lifetime Wool project (Young 2007) have been used in this analysis to calculate the production from ewes and the progeny of single- and twin-bearing ewes. Feed budgeting allows the impacts on stocking rate and supplementary feeding to be calculated. Combining the flock productivity and feed budgeting allows the impacts on whole farm profit to be examined. This paper describes the analysis carried out for a property in south west Victoria to quantify the benefits from pregnancy scanning and the optimum management of empty, single and twin-bearing ewes.

METHOD

The calculations were done using the Hamilton Lifetime Wool version of the MIDAS model (Young 2007). The features of MIDAS that make it suited to this task are that the model includes the changes in production for single and twin born lambs if the nutrition of the ewes is altered during pregnancy and it also includes a powerful feed budgeting module that optimises animal and pasture management across the whole farm.

The model represents a ‘typical’ 1000 ha farm in the Hamilton region of south west Victoria. The analysis is based on a self replacing Merino wool producing flock using a fine wool genotype, lambing in Aug/Sept and running 5100 ewes. Surplus ewes are sold as hoggets off shears at 1.5 years old. Cast-for-age ewes are sold at 5.5 years. Wethers are sold at 2.5 years of age. The pasture is a moderately productive perennial ryegrass and sub-clover mixture that is typical of pastures on farms in the region, the level of production is based on the top 20% of the Monitor Farm Project (Beattie 2004).

Scanning for pregnancy status was done at day 90 after the start of joining. At this point the management of the empty, single- and twin-bearing ewes can be differentiated. Three strategies were evaluated for the management of the empty ewes: (i) retain and feed less, (ii) feed less and sell after shearing, (iii) sell immediately. If empty ewes were sold it was assumed that there was a 12.5% reduction in the number of empty ewes in subsequent years. If ewes were sold immediately
it was assumed they received a 25% price premium compared with selling after shearing – to account for the value of the wool on their backs.

RESULTS
Scanning ewes for pregnancy status and altering the management of the ewes can increase profitability by nearly $9000 (Table 1). Optimum management of the ewes involves retaining the empty ewes and then selling them after shearing, during this period they are offered less feed than the pregnant ewes, particularly during the period from scanning to weaning. The optimum management of the twin-bearing ewes involves their preferential treatment and achieving a higher condition score profile to lambing.

Table 1: Increase in profit ($/farm and $/ewe) from pregnancy scanning ewes and adopting optimum management for empty, single- and twin-bearing ewes.

<table>
<thead>
<tr>
<th>Cost of scanning (c/ewe)</th>
<th>Increase in profit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/farm</td>
</tr>
<tr>
<td>50</td>
<td>8820</td>
</tr>
<tr>
<td>70</td>
<td>7820</td>
</tr>
<tr>
<td>90</td>
<td>6810</td>
</tr>
</tbody>
</table>

The majority of the benefit achieved from scanning and differential management is a result of the management of the empty ewes. Approximately 75% of the total benefit of scanning is achieved if ewes are only scanned for their pregnancy status. The more empty ewes in the flock the greater the value of scanning (Figure 1). However, beyond about 11% of empty ewes it is more profitable to retain these ewes than to sell them because the ability of the flock to replace itself is compromised.

CONCLUSION
Determining pregnancy status increased profit by nearly $9000. The management of the empty ewes is very important because about 75% of the benefit results from allocating less feed to empty ewes and more to the pregnant ewes. A smaller proportion (~25%) of the benefit was achieved by a re-allocation of feed between single- and twin-bearing ewes. The analysis indicates that the greatest benefits are to be achieved from scanning maiden ewes and/or ewes that have a high risk of being dry. The cost of scanning is only a minor consideration in the profitability of the operation.

KEY WORDS
ACKNOWLEDGMENT
This work was funded by the Lifetime Wool project and the Department of Primary Industries Victoria.

Paper reviewed by: Keith Croker

REFERENCES

Targeted treatment of worm-affected sheep – more efficient, more sustainable?

Brown Besier, Department of Agriculture and Food WA

ABSTRACT / SUMMARY

Research into the “targeted treatment” concept has indicated that drenching only individual sheep judged as affected by worms is likely to reduce the development of drench resistance but in growing sheep may result in a small loss of production. Further work is planned to develop practical systems which maintain the drench sustainability benefits with minimal production effect. Targeted treatment strategies aim to simplify drench resistance management while increasing the efficiency of the effort and cost of effective worm control.

BACKGROUND

For many years, research into sheep worm control has been directed largely at limiting the development of resistance to anthelmintics (drenches), while attempting to minimise the impact of worms on sheep production and health. More recently, the need to reduce the time and effort needed for all sheep production operations has become a major requirement.

However, recommendations to achieve all three worm management goals - sustainability, effectiveness and efficiency – are considerably more complex than the basic strategies used before drench resistance became common. The introduction of the “refugia” concept (ensuring that a source of worms not exposed to drenches is present to dilute resistant worms; Besier and Love 2003) has increased the risk of excessive worm burdens and hence the need to monitor worm egg counts to avoid this. Simplifying recommendations so they are easy to understand and require the minimum effort to implement has been a major aim of recent sheep worm research.

The “targeted treatment” approach may provide some solutions to labour efficiency (only part of a flock is drenched) and sustainability (undrenched sheep are a source of worms in refugia) (Besier 2008). In any flock of sheep, some individuals are better able to tolerate parasites (more “resilient”) than others, regardless of the size of their worm burdens, and may suffer no loss of production while others in the mob are losing weight. Drenching only the worm-affected individuals would therefore prevent the loss due to worms on a flock basis without the need to treat all sheep at any one time. Current research aims to test the effectiveness of this approach as the basis for practical drench decision systems.

METHOD

Trials were conducted in the Great Southern region from 2005 to 2007, comparing groups drenched according to a conventional program (“Normal”) with “Targeted groups” which were drenched on an individual sheep basis on signs of scouring or on a comparative weight gain (or loss) index aiming to maintain weights at a similar level to the “Normal” groups. At each of 4 sites, a flock 12-month old ewe lambs (hoggets) were divided into 2 groups each of approximately 150-200, and run in separate paddocks of similar pasture and worm-contamination history. Worm-suppressed sub-groups ran in each paddock to enable adjustments for pasture nutritional effects on production. The sheep were weighed at 2-weekly intervals, and body condition scores, worm egg counts and the pasture larval status were monitored. Changes in drench resistance levels were estimated using a computer simulation model (Barnes et al 1993).

RESULTS

Results are reported from 3 trials in which there was a heavy worm challenge, at Albany and Mt Barker Research Station (July to December 2005) and at Mt Barker R.S. from July 2006 to December 2007. In all three trials drenches were required in late winter due to widespread scouring. In the 2 short-term trials 50% and 80% of the “Targeted” groups were treated compared with all sheep in the “Normal” groups. In the longer-term Mt Barker RS trial, an average of 2.2 drenches were given to the
“Targeted” groups (mostly on the weight gain index) compared with only 2 to the “Normal” group. About 12% of “Targeted” sheep did not require drenching at any time, but 6% needed 3 - 5 treatments.

Weight gains in the “Targeted” groups were reduced compared to the “Normal” treatment in all trials by up to 5% (statistically significant in 2 cases), with the divergence commencing when treatments were given in response to scouring (all “Normal” sheep drenched at one time, but staggered over weeks for the “Targeted” group). Levels of worm larval on pasture were higher on paddocks of the “Targeted” group, which probably contributed to the weight differences. However, the “Targeted” group sheep did achieve good weight gains, and in the Mt Barker trial they have since caught up to the “Normal” group.

Computer modeling in the 18-month trial indicated a 50% increase in the rate of development of drench resistance in the “Normal” group, and double this if a drench less than 100% effective was used. These effects resulted from the timing of drenching, not from fewer treatments.

CONCLUSION

Targeting drenches to sheep judged to be parasite-affected appears likely to reduce the rate of drench resistance development, although not always the total drench requirement. The staggered timing of treatments presumably ensures a continual source of worms in refugia from drenches. However, the sign of scouring was not an effective basis for decisions on treatments to individuals, and in hoggets at least, all in the flock should be treated once scouring commences as a general flock problem.

Some production loss resulted from the targeted approach (up to 5%), although compensatory growth appeared to occur. This reflects the effectiveness of the timing of treatments, given that similar numbers of drenches were given to each group, which was also the basis of the reduced selection for drench resistance. This therefore raises the question: “what is an acceptable cost for the benefits regarding resistance development ?” – and whether this penalty is likely only in young growing sheep.

Differences between individuals in their apparent need for drenching suggest the possibility of culling those needing frequent treatments, and possibly breeding from the best performers (resilience is heritable, though less so than worm resistance).

Further research is aimed at developing the targeted treatment concept into practical strategies, as frequent weighing was never considered feasible. It is proposed to use a combined flock worm egg count and body condition score index to indicate the percentage of the flock which should be drenched, and then a visual assessment to indicate the individuals to target. Further investigations into the longer term effects of the higher pasture contamination with worm eggs when some sheep are not drenched are also needed. It is planned to work initially with mature ewes, though a weight-gain based targeted treatment index has proved effective in meat-breed lambs in Scotland (Kenyon et al in press).

If successful, targeted treatment will underly simplified strategies integrating resistance avoidance with labour and cost efficiency, hence reducing the complexity of worm control recommendations. Under this approach, sheep farmers planning to drench a flock would not routinely expect to drench all sheep, but would use a simple decision guide to indicate which individuals should be treated.

KEY WORDS
Sheep worms; drench resistance; targeted treatment; anthelmintics

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Improving Weaner Sheep Survival

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SUMMARY

Excessive mortality of weaner sheep in the first year after weaning is a large, hidden problem on many Australian farms. Mortality over the first year post-weaning was analysed and strong associations were found between mortality, bodyweight and average growth rate. These results could be used by farmers to guide supplementary feeding and other management interventions in order to cost-effectively and efficiently reduce weaner sheep mortality.

INTRODUCTION

There are compelling reasons for ewes to lamb in spring on wool-producing farms in southern Australia (Lean et al. 1997). However, many farmers have difficulty managing spring-born Merino sheep from weaning until about 15 months of age (Vizard and Foot 1994) and weaner ill-thrift (Gordon 1981) is a common occurrence. A generally accepted target is for post-weaning mortality to be less than 4% in the year after weaning, although this figure appears to have been arbitrarily determined. Few farmers actually calculate post-weaning mortality figures in their flocks but data from field experiments and farm surveys suggest that weaner mortality usually exceeds 4% per annum and that the long-term average may be about 12% in many parts of Australia (for example, see Norris 1984; Harris and Nowara 1995).

Weaner mortality was recently estimated to cost about A$89 million annually and was ranked the fourth most costly endemic health problem in the Australian sheep industry (Sackett 2006). The current scenario of deaths frequently exceeding 4% per annum represents a significant animal welfare issue. Other analyses also suggest that improving weaner survival will improve profitability of individual farms. A preliminary analysis suggested that increasing survival by four percentage points would improve farm profit by $1.20–$2.20 per weaner, across a range of price scenarios for Merino, and first- and second-cross sheep enterprises in the Great Southern and Central Wheat Belt regions of Western Australia, western Victoria and southern New South Wales (Brown and Young 2008). Another analysis suggests that reducing post-weaning mortality from 12% to 4% per annum would improve net farm profit by $14/hectare or about $0.80/DSE across the whole farm (Mackinnon Project, unpublished). In both analyses, improving weaner survival results in a younger flock age structure, extra surplus sheep sales and increased value of wool sales from the younger sheep in the flock.

METHOD

Weaner mortality data were used from two field trials conducted under commercial conditions on a wool-growing farm located 15 km west of Geelong, Victoria (average annual rainfall 535 mm), from 1996 to 2003, inclusively. In total, records from the first year after weaning of 3,657 spring-born weaners in nine ‘drops’ were analysed for associations between mortality and bodyweight, average mob growth rate, sex and shearing time.

RESULTS AND DISCUSSION

Overall, 522 (14%) of 3,657 weaners died during the year after weaning, with a range between drops of 4.5% to 27.1%. The overall mortality rate in the post-weaning period was 1.5% deaths/month (i.e. 15 deaths/1000 weaners/month). In all but one drop, mortality rate increased soon after weaning, peaked at an average of 2.9%/month about two months after weaning and decreased thereafter.

Over all years analysed, the lightest 20% of weaners at weaning were 3.5 times more likely to die than weaners from the middle 20% of weaning weights, regardless of the average weight of the mob in any one year. The next-lightest 20% of weaners were at 1.5 times the risk of dying of the middle 20% but mortality risk amongst weaners heavier than the median did not vary.
These results clearly show that the lightweight tail of the weaner flock should be drafted off at weaning for differential management. Currently, many farmers would draft off the tail of the weaner flock at some time over summer, but the persistent association between weaning weight and mortality suggests that benefits would be derived from doing this sooner. Increasing the weaning weight of the lightest fifth of weaners might eliminate 71% of the deaths amongst this group and 31% of deaths across the entire weaner flock. In other words, increasing the weight of just one fifth of the flock could address nearly one third of all mortalities among weaners.

Increasing weaning weight up to about 22kg (or 45% of their adult weight) reduced the risk of weaners dying. For example, increasing weaning weight from 8 kg to 10 kg or 18 kg to 20 kg reduced the risk of death throughout the whole first year after weaning by about 38% and 29%, respectively.

The mob’s average growth rate was even more strongly associated with mortality risk than weaning weight. Increasing average weaner growth rate in the first five months after weaning (i.e. December–April, inclusive, in Victoria) from 0.25 to 0.5 kg/month reduced the risk of death by 85%. This would be equivalent to decreasing average weaner mortality in a mob from 12% to approximately 2%. Increasing average growth rate above 1 kg/month did not reduce mortality risk further. Increasing average growth rate over late winter and early spring also decreased mortality risk by about 30%.

Measurement of mortality risk means that the increase in growth rate or bodyweight required for a specific reduction in mortality can be calculated accurately. The strong associations between mortality, growth rate and bodyweight make it likely that providing additional supplementary feed to weaners would be a very cost-effective way to reduce the high weaner mortality present on sheep farms, particularly if feeding was directed to the lightweight weaners, which are at greater risk of death.

Wether weaners were 1.3 times more likely to die than ewe weaners. Shearing in March was associated with the greatest increase in deaths compared to unshorn weaner, followed by May and December (lamb) shearing. Shearing in June or July did not affect mortality.

**CONCLUSION**

The results presented here indicate steps farmers can take to reduce post-weaning mortality in their sheep flocks, including drafting off the lightweight tail of weaners, at weaning, for differential management and feeding. In addition, small amounts of targeted supplementary feeding, especially during the summer months, that modestly increase bodyweight and average growth rates across the flock are likely to dramatically, and cost-effectively, improve weaner survival. The CRC for Sheep Industry Innovation is currently integrating these results into a ‘weaner mortality matrix’ that could form the basis for a decision-support tool, which farmers would use to calculate the change in bodyweight and/or growth rate required to bring existing mortality levels in line with the industry’s target of <4% per annum. These results and tools will be developed into a course and manual offered to sheep producers, to enable them to take control of this common problem.

**KEY WORDS**

Sheep, weaner, mortality, survival, supplementary feeding, shearing

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