Sheep Updates 2008 - part 2

Meredith L. Sheil  
*Sydney University Faculty of Veterinary Science*

Di Evans  
*Department of Agriculture and Food, Western Australia*

Brown Besier  
*Department of Agriculture and Food, Western Australia*

Tim Scanlon  
*Department of Agriculture and Food, Western Australia*

Andre Martinho de Almeida  
*Instituto de Investigacao Cientifica Tropical, Lisbon, Portugal*

See next page for additional authors

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The Sheep Room

Analgesia for Surgical Husbandry Procedures in Sheep and Other Livestock

Dr Meredith L Sheil MBBS FRACP PhD, Animal Ethics Pty Ltd, Associate Sydney University Faculty of Veterinary Science

SUMMARY

Surgical husbandry procedures in livestock are invariably associated with pain and stress, yet are traditionally performed without analgesia. Concern for the welfare of animals undergoing these procedures is contributing to major conflicts between farmers and animal advocacy organisations with important negative trade implications. Whilst the ultimate long term solution is to breed animals that do not require these procedures, or to find painless alternative practices, this will take time and a significant research effort in most cases. In the meantime, there is an urgent need to find a more immediate way to alleviate welfare concerns. This can be achieved by developing effective low-cost analgesia for on-farm use, to allow surgical procedures in livestock to be performed as humanely as surgical procedures in domestic animals and humans, while long term solutions are pursued and implemented. The first step in reaching this goal was realised with the development and commercialisation of Tri-Sollen® (Bayer Animal Health, Gordon NSW). Tri-Sollen® is a low-cost, farmer-applied topical anaesthetic, haemostatic and antiseptic wound care product that significantly alleviates pain associated with mulesing. Subsequent research identified that pre-operative administration of Carprofen enhanced the analgesic effects. Used together these agents eliminate pain-related behaviour for 24 hours post mulesing and abolish the cortisol response, thus providing highly effective analgesia that equates to (if not surpasses) that which is achieved for routine surgical procedures in veterinary clinics, such as spaying or castration of cats and dogs. New evidence is presented that Tri-Sollen® is also highly effective to alleviate pain associated with castration and tail docking in sheep. These developments are critically important because they indicate that there is a new way forward to address welfare concerns over mulesing, castration and tail docking and prevent conflicts while sustainable long term solutions such as genetic breeding are pursued and implemented. They highlight the need for a concerted research and development focus to fast track the availability of effective farm-based analgesia for all surgical husbandry procedures in livestock.

BACKGROUND

Surgical husbandry procedures in livestock, including mulesing, castration, tail docking and dehorning are associated with pain, bleeding and stress, yet are traditionally performed without analgesia or attempt at haemostasis. This not only results in production losses, but consumer concern for the welfare of animals undergoing these procedures is posing a significant threat to trade in several markets. The most obvious example is that of the Australian wool industry which is facing international boycotts of wool due to concern for the welfare of lambs undergoing mulesing. The pig industry in the European Union is facing a similar conflict, as consumer concern for the welfare of piglets undergoing castration without analgesia has led to a legislative ban on the procedure in some countries, and supermarket boycotts of produce from pigs castrated without analgesia in others.

Conflicts such as these are set to escalate in the coming years. Animal welfare is becoming increasingly consumer driven. Many retailers are incorporating strict animal welfare standards into their corporate social responsibility policies, and, in some cases requiring that their suppliers are audited to ensure that their standards are met. The European Commission is undertaking The Welfare Quality® project to develop European standards for on-farm welfare assessment and product labelling systems. This is designed to link informed animal product consumption to animal husbandry practices on the farm and offer market advantages to producers with the highest welfare standards. This means that in the future, producers will need to meet the welfare obligations of the markets into which their produce goes, as well as the legal requirements in their own countries.

Whilst the ultimate long term solution is to breed animals that do not require these procedures, or to find painless alternative practices, this will take time and a significant research effort in most cases. In the meantime, there is an urgent need to find a more immediate way to alleviate welfare concerns. This can be achieved by developing effective analgesia for on farm use, to allow surgical procedures
in livestock to be performed as humanely as surgical procedures in domestic animals and humans, while long term solutions are pursued and implemented.

To achieve this, significant constraints must be overcome to ensure that analgesic products are safe, practical and affordable enough to be viable for farming operations in Australia. This is likely to require a step-wise approach. Nevertheless, recent research and developments indicate that this can be achieved very successfully. The first major step towards achieving this goal was achieved with the development and commercial availability of Tri-Solfen® to alleviate the pain associated with mulesing.

Tri-Solfen® is a farmer applied spray-on anaesthetic, haemostatic and antiseptic agent that is applied to numb the wound immediately post mulesing. It has a significant analgesic effect eliminating or significantly reducing wound pain and pain-related behaviour up to, and including, 8 hours post mulesing. It also lowers peak cortisol response, dramatically reduces bleeding and speeds up wound contraction. Subsequent research has identified that pre-operative administration of a non-steroidal antiinflammatory agent significantly enhances the analgesic effect such that the combination not only abolishes pain-related behaviour up to and including 24 hours post mulesing, but also abolishes the cortisol response. In terms of pain alleviation and mitigation of stress response, this exceeds that which is achieved during equivalent surgical procedures in pets, such as ovariohysterectomy (spaying) of cats and dogs.

These recent developments have critically important welfare implications for sheep undergoing mulesing. The overwhelming weight of scientific evidence supports the fact that mulesing is the single most effective preventative health measure to protect susceptible sheep against blowfly attack, yet under pressure from animal rights organisations Australian sheep farmers have committed to cease the procedure by the end of 2010. Should the procedure be stopped prematurely, (that is before genetic breeding is sufficiently advanced or before viable alternative practices are available to prevent flystrike), it is predicted that there will be a major increase in the incidence of flystrike, with up to 7 million sheep suffering the condition annually and 1 – 3 million succumbing to the disease. The current and future availability of effective analgesia for this procedure provides a new humane approach to protect the welfare of sheep as long as necessary, while genetic breeding and other solutions are pursued to allow the procedure to be phased out safely, without a major increase in suffering and death due to flystrike in the Australian merino flock.

There are also important welfare implications for other “open wound” surgical husbandry procedures such as castration, tail docking and dehorning. The local anaesthetic agents in Tri-Solfen® work directly on nerve fibres to block pain signals. They are highly effective where nerve tissue is exposed or close to the surface – such as in open wounds and mucosal tissue (such as the spermatic chord). The success of Tri-Solfen® for mulesing suggests that it may be equally effective to alleviate pain associated with procedures such as castration and tail docking. The following report from Sydney University Veterinary School (investigators H Dickinson, S Lomax and P Windsor) in conjunction with Animal Ethics Pty Ltd (investigator M Shell) presents findings on the impact of using Tri-Solfen® on pain alleviation, wound healing and systemic absorption of local anaesthetic actives in sheep undergoing routine castration and tail docking.

**PROCEDURE**

Randomised, placebo-controlled trials were performed on 8 groups of 6-12 week old lambs (n=8 in each group) undergoing routine castration and tail docking. Surgical castration and hot knife tail docking was performed with and without topical anaesthetic or placebo application, and compared with ring castration and tail docking or handled but unmarked controls. In treated lambs, Tri-Solfen® or placebo gel was applied by spray-on metered dose directly to the tail docked wounds and onto each of the exteriorized spermatic cords (prior to their being severed), as well as to the scrotal sac and cut skin edge immediately post castration. Wound pain was assessed using 10 and 75 gram calibrated Von-Frey monofilaments to determine response to light touch and pain stimulation over a 4 hour period. Pain-related behaviour was assessed by trained observers using a numerical rating scale over a 5 hour period. Wound healing was assessed by veterinary inspection and palpation 14 and 28 days following the procedures. Plasma lignocaine and bupivacaine levels were determined using HPLC from jugular venous blood samples collected at 0, 30, 90 and 120 minutes following the procedures.
RESULTS

**Castration wound pain:** Rapid (1 min) and prolonged (up to 5 hr) primary hyperalgesia developed in untreated and placebo treated sheep but not in Tri-Solfen treated sheep (p < 0.0001).

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**Tail docking wound pain:**

*a) Surgical:* Primary hyperalgesia (p = 0.02) and primary allodynia (p = 0.01) developed post surgical tail docking in untreated and placebo treated sheep. This was either abolished (p = 0.009, primary allodynia) or significantly reduced (p = 0.02, primary hyperalgesia) in Tri-Solfen treated sheep.  

*b) Hot-Iron docking* abolished the development of primary allodynia and hyperalgesia in all treatment groups. Pain-stimulus response scores were significantly lower in Tri-Solfen treated sheep compared with untreated and placebo treated sheep 4 hours post hot-iron docking (p = 0.03).

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**Pain-related behaviour:** There was a significant change over time (p < 0.001) with a significant group effect (p < 0.001). Behaviour scores in Tri-Solfen treated sheep were not significantly different from unmarked controls and were significantly below untreated and placebo treated sheep throughout the observation period. The highest pain related behaviour scores occurred in lambs that were castrated and docked with rings, particularly during the first 2 hours after application.

**Plasma lignocaine and bupivacaine levels:** Mean plasma lignocaine levels were 0.17 +/- 0.09, 0.12 +/- 0.06 and 0.1 +/- 0.06mg/L at 30, 90 and 120 minutes post treatment, which is well below the toxic threshold of 6mg/L (humans) and toxic convulsive plasma levels (of 40mg/L) in sheep. The maximum recorded level at any time point was 0.39mg/L at 30 minutes post treatment. Mean plasma bupivacaine levels were below the level of detection (<0.0025mg/L) or quantification (<0.01mg/L) in 5 sheep, with a mean value of 0.014 +/- 0.003mg/L in the remaining sheep 30 minutes after treatment. Thereafter bupivacaine levels at 90 and 120 minutes were either at or below the level of quantification in 10 sheep with mean +/- SD of 0.013 +/- 0.003 in remaining sheep and were well below toxic thresholds in all tested sheep.

**Ongoing Investigations:** Studies investigating biochemical pain and stress responses, plus the effect of additional pre-operative analgesic regimens, such as non steroidal anti-inflammatory administration or the use of cryoanaesthesia are currently under way.
CONCLUSION

Effective and affordable “farm-based” analgesia is required to alleviate pain associated with surgical husbandry procedures in livestock. This is needed to address welfare concerns, prevent conflicts and trade embargoes, and support the ongoing use of these important health and production procedures while long term solutions are pursued and implemented to support ultimate cessation of the procedures. The availability of Tri-Solfen® provides an important first step. Highly effective analgesia, haemostasis, and improved wound healing is achieved in sheep post mulesing using this low-cost farmer-applied formulation. The product is also highly effective to alleviate pain associated with castration and tail docking in sheep and studies are underway to investigate similar applications in cattle and pigs. Well known low cost non steroidal antiinflammatory medications further enhance the analgesic effect when administered prior to mulesing. Additional research and funding is required to support and stimulate registration and commercialise these medications for sheep. Studies are also required to investigate whether similar synergistic effects occur for castration and tail docking. These, as well as studies of other low cost practical analgesic strategies such as cryoanaesthesia for pre-procedural local anaesthesia are currently under way. A concerted research and development focus and funding commitment is needed to ensure that affordable analgesic products are developed, supported through registration and become commercially available for all surgical procedures in livestock. This will place Australian farmers ahead of the pack and provide them with vital tools to face the animal welfare challenges in the years to come.

KEY WORDS

Analgesia, topical anaesthesia, Tri-Solfen, Carprofen, pain, livestock, sheep, cattle, pigs, husbandry, mulesing, castration, tail docking

ACKNOWLEDGMENTS

Co-investigators Sydney University Faculty of Veterinary Science; H Dickson, S Lomax, P Windsor
Farm managers; Aurthurssleigh – S Burgen, Yerilla - G Moore

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The Wool Enterprise

Unmulesed sheep - implications for chemical use
Di Evans & Brown Besier, Department of Agriculture and Food WA

SUMMARY
As producers begin to adopt changes to management to prevent a higher risk of strike in unmulesed sheep, there may be an increase in chemical usage, at least in the short term until there is confidence in the effectiveness of other IPM strategies including genetic selection and possible changes in shearing and crutching times. However, prior to using chemicals, it is essential to ensure that wool withholding periods, export slaughter intervals, the required length of protection, costs and the risk of resistance developing are considered.

INTRODUCTION
As mulesing is at present an integral part of an integrated pest management (IPM) approach to fly control, it will be a challenge to maintain flock protection once mulesing ceases. This will mean greater reliance on other aspects of IPM, such as time of shearing and crutching, effective worm control, genetic selection and sustainable chemical usage (1). Shearing and crutching have traditionally been timed to help avoid flystrike problems. However, since the late 1980s when it was recognized that there were economic benefits in moving to an autumn shearing, as well as greater shearer availability, the role of shearing in helping reduce sheep susceptibility to flies has decreased. The need for chemical treatments must be examined carefully regarding residues (withholding periods and export slaughter intervals), resistance status, length of protective period, application method and costs. Hence, blanket recommendations are not appropriate, as each enterprise will require a specific approach. Another important aspect to consider is the expected need for more stringent monitoring for flystrike, especially in the early periods of transition to a non-mulesed flock.

ASSESSING THE RISK
With the threat of flystrike likely to increase in an unmulesed flock, it is essential to assess the risks to help develop an action plan to minimize the risks. Risk assessment involves determining the likelihood of strike occurring under specific circumstances and the impact of this, such as potential numbers of animals involved, and the ability to respond at the expense of other farming operations such as seeding and harvesting. By relating periods of high fly risk to current management and chemical treatment practices, a better understanding of key risk periods can be gained. The key objective is to avoid sole reliance on chemical treatments to prevent strike. Where chemicals are to be used the aim is for strategic treatment only of susceptible animals or flocks, and only using breech applications if body strike is not considered to be a risk. It is useful to develop a simple calendar to show the overlaps between specific management activities in relation to seasonal fly waves to identify potential changes that may need to be considered such as adjustments to times of shearing, extra crutching etc. Also, developing a genetic improvement program for ‘strike resistant’ traits (including sourcing rams, and selecting adult and replacement ewes), as well as current wool quality traits, will help reduce reliance on chemical usage and potential disruption to current management practices (2).

Lambs – the first risk period for lambs will depend on wool length at the expected high risk period. For example, early-born lamb (April/May) which aren’t shorn until late October or November may need to be crutched or jetted just prior to spring. For later-born lambs (Jul/Aug), a breech application at marking (Aug/Sep) may need to be considered, if approaching a fly risk time and when there is also a high risk of scours.

Adults – the time of shearing and crutching will be critical. For spring shearing, consideration may need to be given to bringing shearing forward to early spring and/or adjusting the pre-shearing crutch (either increase the number of sheep crutched or add a second crutching to clean up additional sheep that have developed significant dags following the first crutching). For summer/autumn shearing, the spring crutch may need to be brought forward to early spring and/or a breech chemical treatment applied.
CHEMICAL SELECTION

Chemical treatments are used to prevent or treat strike. Chemical treatment of unmulesed sheep may raise specific questions such as ‘Will lambs need a breech treatment at marking?’, ‘Will the effectiveness of current treatments be similar on unmulesed versus mulesed sheep?’, or ‘Will chemicals with longer protection periods be more effective?’ Currently, some of these questions remain unanswered. Resistance to chemicals is a key consideration, and farmers should avoid those to which flies have developed resistance such as organophosphates. Resistance to diflubenzuron (e.g. Fleececare and Strike) has been reported on properties in the eastern states where reduced effectiveness was identified (3). It is also essential to avoid using ectoparasite products repeatedly, including those used for lice treatment (4). Complying with wool withholding periods will help minimize pesticide residues. However, it is essential to remain watchful of market requirements. For example, the European Eco-label, which is a voluntary standard, may not be met for some chemicals even if label directions are adhered to. Currently, there are no maximum residue limits set for the commonly used fly preventatives cyromazine (Vetrazin etc) and dicyclanil (Clik), as well as ivermectin (Coopers Blowfly and Lice Jetting Fluid), although this may change. Similarly, Export Slaughter Intervals for chemicals applied to sheep for slaughter must be observed.

Preventative treatment of adults – these treatments can be applied as a jet, dip or spray-on. Whole mob treatments are normally done strategically (in anticipation of high strike risk) or tactically (some animals already struck). If done strategically, trial work using dicyclanil (Clik) showed that longer protection was achieved by applying the chemical six weeks after shearing or crutching compared to treatment at shearing or crutching (5). The table below summarises currently available treatments (not all registered products are included).

<table>
<thead>
<tr>
<th>Group</th>
<th>Products</th>
<th>Application</th>
<th>Length of protection</th>
<th>Wool WHP</th>
<th>ESI (days)</th>
<th>Cost*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGR</td>
<td>Fleececare etc</td>
<td>Jet</td>
<td>12 wks</td>
<td>6 mths</td>
<td>Nil</td>
<td>34c</td>
</tr>
<tr>
<td></td>
<td>Magnum</td>
<td>Spray-on</td>
<td>12 wks</td>
<td>6 mths</td>
<td>42 days</td>
<td>$1.15</td>
</tr>
<tr>
<td></td>
<td>Clik</td>
<td>Spray-on</td>
<td>18-24 wks</td>
<td>3 mths</td>
<td>120 days</td>
<td>$1.44</td>
</tr>
<tr>
<td></td>
<td>Magik#</td>
<td>Spray-on</td>
<td>18-24 wks</td>
<td>3 mths</td>
<td>70 days</td>
<td>$1.65</td>
</tr>
<tr>
<td></td>
<td>Vetrazin, Cyrazin</td>
<td>Spray-on</td>
<td>11 wks</td>
<td>2 mths</td>
<td>14 days</td>
<td>45c</td>
</tr>
<tr>
<td></td>
<td>Vetrazin, Cyrazin</td>
<td>Jet</td>
<td>12-14 wks</td>
<td>2 mths</td>
<td>14 days</td>
<td>48c</td>
</tr>
<tr>
<td>IVM</td>
<td>Coopers Blowfly &amp; Lice Jetting Fl</td>
<td>Jet</td>
<td>12 wks</td>
<td>6 wks</td>
<td>7 days</td>
<td>36c</td>
</tr>
<tr>
<td>SPN</td>
<td>Extinosad</td>
<td>Jet</td>
<td>4 weeks</td>
<td>Nil</td>
<td>Nil</td>
<td>48c</td>
</tr>
</tbody>
</table>

*IGR – Insect Growth Regulator; IVM – Ivermectin; SPN – Spinosyn WHP; WHP – Withholding Period; ESI – Export Slaughter Interval

# for use off-shears or up to 7 days after shearing only

Breech application at marking

Presumably all chemicals registered for preventative treatment could be applied to the intact breech area at marking. This would only be considered if there was a high risk of a dirty breech occurring during the high fly risk period. Given the very short length of wool on lambs, a spray-on formulation may be more effective than using jetting fluid. The options are Clik or Vetrazin Spray-on. Relative costs and protective periods can be compared in the table above.

Treatment of breech strike
Current recommended treatments for individually struck animals should suffice for those that are unmulesed. Cleaning up the strike wound area on plainer breeched sheep will be easier and may have a lower risk of re-strike than their more wrinkly and woolly counterparts.

**Paper reviewed by:** Brian Horton, Wool Quality Officer, Tas DPIW

**REFERENCES**


Are Damara and Dorper sheep better adapted than Merinos to nutritional stress? – Growth rates

Tim Scanlon¹, Andre Martinho de Almeida², Johan Greeff¹, Tanya Kilminster¹, John Milton³, Chris Oldham¹, Department of Agriculture and Food WA¹, Instituto de Investigacao Cientifica Tropical, Lisbon, Portugal², University of Western Australia³

ABSTRACT
Damara, Dorper and Merino ram lambs were fed to either gain or lose weight over 42 days to investigate the response and adaptability of these breeds to nutritional stress. The sheep grazed a bare paddock and were penned and fed individually each day. Dorpers either gained weight faster or lost weight more slowly than Merinos or Damaras, but the difference between the breeds was not significant in the weight loss group.

INTRODUCTION
Sheep grazing on commercial farms in south-western Australia face extreme fluctuations in the quantity and quality of feed on offer throughout the year. Seasonal fluctuations in liveweight of up to 25% have been reported for Merino sheep (Doyle, 2003). The Damara and Dorper, both introduced from southern Africa, are non-wool breeds that have been bred to survive in a harsh environment and under poor nutrition. In WA, Damara ewes have lower seasonal variations in liveweight than Merino ewes when grazed together (Tanya Kilminster pers.com.). Similarly, Dorper sheep in South Africa out performed Merinos when grazing veldt grass (Synman and Herselman 2005). Hence, it was hypothesised that the Dorper and Damara would perform better than the Merino when hand-fed to gain or lose weight over summer.

METHOD
Twelve rams of each breed (aged 4 – 6 months) were fed to either gain or lose 100 g/hd/d for 42 days. GrazFeed (Freer et al. 1997) was used at the start of the trial and day 21 to calculate the amount fed based on individual liveweight. The lambs were run in a bare paddock (< 50 kg DM/ha) and individually fed each day a pelleted diet (9.3 MJ ME/kg and 11.5% CP, DM-basis) and the weight of pellets not eaten after 2 hours was recorded. The lambs were weighed and condition scored twice weekly. Analysis of Variance was performed using Genstat with breed and feeding level as fixed factors and initial liveweight as a covariate.

RESULTS
All animals lost weight up to day 10 of the trial while adjusting to the individual daily feeding regime. Day 10 was used as the starting liveweight for the trial and the pattern of change in liveweight is shown in Figure 1. Average growth rates differed significantly (P < 0.001) between feeding groups. The group fed to gain 100 g/hd/d gained weight faster than predicted whereas the other group lost weight slower than predicted. There was no significant diet by breed interaction. The Dorpers gained weight faster (188 g/hd/d; P < 0.05) or lost weight more slowly (-19 g/hd/d) than the Merinos (139 and -28 g/hd/d) or the Damaras (148 and -48 g/hd/d), but the difference between breeds was not significant (P > 0.05) for the weight loss group.
CONCLUSION

This study shows that young Dorper sheep may have a nutritional advantage over Merinos and Damaras when hand-fed to gain weight over summer in W.A. In other words, Dompers may be more efficient converters of supplements to liveweight gain. However, when fed to lose weight young Dorper and Merino sheep lost weight at a slower rate than Damaras. While all sheep had equal access to the limited dry pasture in the bare paddock, the relative performance of the breeds may differ under conditions where they were more able to express possible differences in foraging ability. Furthermore, as all breeds adapted rapidly when feed was restricted with little or no further weight loss after 20 days, a comparison of breeds under a range of grazing conditions and a longer period is needed.

KEY WORDS
Damara, Dorper, Merino, sheep breeds, nutrition, liveweight, growth rate

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Paper reviewed by: Andrew Thompson

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Are Damara and Dorper sheep better adapted than Merinos to nutritional stress? Carcass attributes

Tanya Kilminster¹, Andre Martinho de Almeida², Johan Greeff¹, John Milton³, Chris Oldham¹, Tim Scanlon¹, Department of Agriculture and Food, WA¹, Instituto de Investigacao Cientifica Tropical, Lisbon, Portugal², University of WA³

ABSTRACT

Damara, Dorper and Merino ram lambs were fed to either gain or lose weight over 42 days to investigate the response and adaptability of these breeds to nutritional stress and subsequent impacts on carcass traits. Damara and Dorper lambs had significantly higher dressing percentages than Merino lambs despite only small differences in liveweight at slaughter. The Dorper lambs fed to gain weight also had a greater GR tissue depth than the other two breeds. Meat from Damara lambs was darker in colour than meat from Dorper and Merino lambs.

INTRODUCTION

The Damara and Dorper are non-wool sheep breeds that have been bred to survive in a harsh environment and under poor nutrition. Both breeds were introduced from southern Africa and have been promoted as meat breeds that could provide an alternative to the Merino in WA. Data on the carcass attributes of Dorpers and Merinos has been published, but there is no such data on the carcass characteristics of the Damara or direct comparisons between the three breeds. The aim of this experiment was to compare the carcass characteristics of Damara, Dorper and Merino lambs fed at two different feeding levels. Details on the liveweight profiles are provided by Scanlon et al. (these proceedings).

METHOD

Twelve rams of each breed (aged 4 – 6 months) were fed for 42 days to either gain or lose 100 g/hd/d (for detail refer to Scanlon et al. these proceedings). Subsequently the lambs were slaughtered at a commercial abattoir without electrical stimulation. Hot carcass weight (HCW) and GR (total tissue depth over the 12th rib, 110mm from the midline) were measured post slaughter. Colour and ultimate pH (pHu) of the loin (m. longissimuss thoracis et lumborum) were measured 48h post slaughter. Data were analysed using analysis of variance in Genstat version 10. Breed and feeding level were tested as fixed effects and initial liveweight as a covariate.

RESULTS

As expected, HCW (P<0.001) was higher for lambs fed to gain weight than those fed to lose weight. Carcasses from Dorper lambs tended to be heavier than those from Damara and Merino lambs regardless of feeding level as there was no feed x breed interaction for HCW (P>0.05). Dressing percentage was not affected by feeding level, but was higher for Damara and Dorper lambs compared to Merino lambs (P < 0.001). Fatness indicated by GR tissue depth was greater (P < 0.001) for lambs fed to gain weight and at heavier weights was significantly greater (P < 0.001) for Dorper than for the Damara and Merino lambs.

The meat from all groups was generally light in colour perhaps being indicative of young animals and the relatively low carcass weights. Meat from Damara lambs was darker in colour (P < 0.001) than meat from Dorper and Merino lambs both visually and for L value (higher the L value the lighter the meat in colour). This occurred irrespective of feeding level and HCW. The reason for this was unclear and cannot be explained by pHu value. Meat from Damara lambs tended to be more red in colour (lower a value) than meat from other breeds. This along with the lower L value might suggest higher concentrations of myoglobin (muscle pigment) and or differences in muscle fibre composition compared to other breeds. However further investigation would be required to confirm such speculation. There was a significant interaction for redness (P < 0.05). Meat from Merino and Dorper lambs were less red in colour when fed for weight loss compared to weight gain whereas meat from Damara lambs was no different. The b value was not affected by either breed or feed level.

The pHu values were relatively high and suggestive of poor eating and keeping quality for both feeding levels and all breed types (Hopkins & Fogarty, 1998). Animals fed to lose weight had a higher
PHu than those fed to gain weight \((P < 0.001)\) consistent with glycogen concentration of muscle being influenced by metabolisable energy intake (Pethick et al., 1999).

Despite this difference, the pH values for the lambs fed to gain weight were also above the threshold value of pHu 5.7 required for good eating quality. This might suggest that significant depletion of muscle glycogen occurred during the curfew transport and lairage periods. Meat from Dorper lambs had a higher pHu than that from Merino and Damara lambs \((P < 0.001)\). This was not expected as merino lambs are thought to be more stress responsive than other breeds (Hopkins et al., 2005). As there was no feed x breed interaction, this finding warrants further investigation to determine if this was in fact due to an increased rate of glycogen depletion in response to stress prior to slaughter. However this result may be a coincidental finding due to pHu values being generally high in all groups.

Table 1: Carcass attributes for Merino, Dorper and Damara lambs fed to weight gain or weight loss for 42 days prior to slaughter (values are means).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Weight gain</th>
<th>Weight loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Merino</td>
<td>Dorper</td>
</tr>
<tr>
<td>HCW (kg)</td>
<td>16.4b</td>
<td>18.7a</td>
</tr>
<tr>
<td>Dressing percentage (%)</td>
<td>39.8b</td>
<td>43.9a</td>
</tr>
<tr>
<td>GR tissue depth (mm)</td>
<td>2.0b</td>
<td>4.2a</td>
</tr>
<tr>
<td>Visual colour score</td>
<td>2.1b</td>
<td>2.8b</td>
</tr>
<tr>
<td>&quot;L&quot; value (lightness)</td>
<td>42.2a</td>
<td>40.2b</td>
</tr>
<tr>
<td>&quot;a&quot; value (redness)</td>
<td>14.5abc</td>
<td>14.4a</td>
</tr>
<tr>
<td>&quot;b&quot; value (yellowness)</td>
<td>6.2a</td>
<td>5.9a</td>
</tr>
<tr>
<td>pHu</td>
<td>5.8b</td>
<td>5.9a</td>
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Values within a row with different superscripts are different \((P < 0.05)\).

CONCLUSION

Differences in carcase and loin meat characteristics were seen between breeds and between feeding levels. Dorper and Damara lambs had a higher dressing percentage than Merino lambs that might partially be explained by differences in fleece weight. Dorper lambs had heavier carcasses generally and higher GR values when fed to gain weight than the Damara and Merino lambs. Meat from Damara lambs was darker in colour than for the other breeds and this may be indicative of a metabolic difference. Feeding to lose weight reduced carcase weight and fatness but not dressing percentage. Meat from lambs fed to lose weight tended to be lighter and less red in colour than meat from lambs fed to gain weight.

KEY WORDS

Damara, Dorper, Merino, sheep breeds, nutrition, liveweight, carcass attributes

ACKNOWLEDGMENTS

This project was funded by the Department of Agriculture & Food and the Tropical Scientific Research Institute (Lisbon, Portugal). The authors thank Hall Damara for kindly supplying the Damara ram lambs. Diamond Dorper Stud, Independent Livestock Services and LeChem and Australian International Sheep Company for kindly supplying the Dorper ram lambs. The technical support of staff at the Merredin Research Station was also greatly appreciated.

Paper reviewed by: Andrew Thompson, Robin Jacob

REFERENCES


The Beef Room

Benefits of matching animal requirements with pasture feed supply and animal supply with market requirements
B.L. McIntyre, Department of Agriculture and Food WA

SUMMARY
This paper explores the benefits of more closely matching animal requirements with pasture supply. In the breeder herd this requires a shift in the normal autumn calving time to winter. Benefits include reduced need for supplementary feeding, increased stocking rate and increased profitability. Secondly the later calving regime provides animals which offer greater versatility in their ability to produce a consistent year round supply of high quality cattle and offer the possibility of developing export markets and growing the beef industry.

BACKGROUND
The traditional beef production system in the Agricultural Areas of WA involves calving between February and April with the calves being raised on their mothers through winter and spring and sold for slaughter immediately after weaning between late spring and late summer. This production system produces milk-fed vealers, locally known as “baby beef” for the domestic market at around 10 months of age. Typically the market requires carcase weight of 220-280kg and fat thickness between 4 and 20 mm. The increasing demand for heavier carcases has created pressure for even earlier calving so that calves have the time to grow sufficiently to meet these requirements. A second possible reason for the tendency towards earlier calving is the prestige associated with producing the biggest and heaviest weaner in the sale.

This system does not necessarily result in either the most efficient use of the pasture resource or the most desirable pattern of supply of cattle for the marketplace. The aim of this paper is to explore some of the benefits that might arise from more closely aligning animal requirements with pasture production patterns and the implications for meeting market requirements.

PROCESS
The pasture feed supply and matching animal requirements with feed supply
The Mediterranean environment of the south West of WA produces a seasonal pasture growth pattern such as that illustrated in Figure 1. Beef cattle production systems that can be implemented are subject to the limitations imposed by the pasture growth pattern and how well the pasture resource can be manipulated by management strategies.
Figure 1. Typical seasonal pasture growth pattern in the Agricultural areas of WA and the feed requirements of an autumn (AC) and winter (WC) calving beef breeding unit

Figure 1 also compares two possible options for the breeder herd. The first shows the seasonal feed requirements of a breeding unit (including cow, calf and foetus) for the typical March/April autumn calving (AC) pattern with weaning in January. This production pattern means lactating cows can often be at peak of production at a stage when pasture quality and quantity is at its lowest point. For this system to match or be in balance a large amount of the excess pasture generated in the spring has to be transferred to autumn as supplementary fodder to make up the deficit. The second option shows the requirements for a later winter calving (WC) time at the same stocking rate per breeding unit again with weaning in January. In this case the peak demands are pushed into a period where pasture growth has normally begun, quality is high and quantity is increasing so that the pasture is more able to provide the feed requirements of the breeder unit and less feed has to be transferred to fill the autumn feed gap. The lower overall feed requirement for the WC option is largely because of the reduced time the calf has to be fed and that it is lighter at weaning. The WC option provides a much closer alignment with the pasture feed supply.

These two scenarios were compared in an experiment at Wagerup and Pinjarra over a three year period. The difference in feed requirement between the two systems was reflected in the stocking rate which was maintained at about 20% higher for the WC. Economic analysis indicated that the gross margin of $88/ha for AC was increased to $135/ha for WC at a 20% higher stocking rate. The improvement in financial performance was primarily due to the substantial reduction in the cost of supplementary feeding. The return per head was reduced with WC due to the lighter animals but this was partly offset by increased numbers of calves, as well as cull cows that were available for sale.

Market requirements and matching the supply of animals to market requirements

Markets simply require a consistent supply of animals of consistent quality all year round. The lack of a regular year round supply is cited as one of the major obstacles to the development and expansion of beef exports from WA. The “baby beef” production system produces a glut in the market as a result of the growth and fattening of cattle during the spring flush. These cattle are unrivalled in quality but are only available for a limited time. Supply greatly exceeds the processing capacity and producers have to wait for extended periods on occasion before they can get their cattle slaughtered. The delays in slaughter mean that animals have to be retained on the farm at a time when pasture quantity and quality may be declining. Once pastures dry off and growth rates fall the risk of dark cutters is increased. Where animals continue to grow, possibly with the use of supplementary feeding, costs of maintaining cattle are unnecessarily increased and they are likely to become overfat and over the carcass weight range required.

There is an obvious need to shift some of these cattle from the peak supply to other times in the year when it is not possible to finish cattle from pasture. For the most part these gaps are filled by feedlotting. However in order to maintain constant weight and fat specifications at slaughter the animals entering feedlots must enter at appropriate weights. The preferred liveweight for cattle entering feedlots is between 300 and 350 kg where they are fed for up to 100 days and are turned off at around 500 kg and produce carcasses of 250-280 kg for high quality markets. Many of the autumn
calves that cannot be slaughtered due to unavailability of killing space are too heavy and too fat. The lighter, leaner WC calves provide a more attractive alternative for feedatters. Any that are too light to enter feedlots are suitable for backgrounding before the feedlotting phase. In our work less than 1% of the WC weaners were above the 350 kg feedlot entry weight at weaning compared with 35% of AC calves. As a result of their greater versatility WC calves may also command higher price / kg.

CONCLUSION
Matching animal requirements with pasture supplies produces a number of benefits for individual beef producers and the broader industry. For the breeder herd, it is best achieved by timing the calving period for early winter or possibly later. When compared with autumn calving, this results in a greatly reduced need for conservation of pasture and subsequent supplementary feeding, it enables stocking rates to be increased, especially if combined with rotational grazing, and improves profitability. The lighter weaner calves produced from this alternative system would ease the current surplus of animals entering the market in spring and early summer, and provide a more versatile animal for finishing at other times of the year. This in turn enhances the consistency of year round supply of animals of high quality and creates greater possibilities for expanding markets.

KEY WORDS
Feed supply, animal requirements, market requirements

Paper reviewed by: Eric Taylor, Mudoch University.
Optimal grazing for beef

Alison Wheatley, Beef farmer Winnejup, John Lucey, DAFWA Manjimup

SUMMARY

Beef grazing rotation should be based predominantly on leaf regrowth stage, and this should be used within feed planning strategies (short-term plans such as feed budgets or grazing plans, and long-term plans such as feed profiles) to make strategic decisions regarding stocking rate, calving date and supplement policy.

INTRODUCTION

At the farm level, grazing management has generally focused on meeting the animal’s nutritive requirements rather than understanding the manner in which plants respond to the management imposed upon them and how this is modified by the prevailing environment. Effective pasture management can only be based on plant factors, not animal or human factors. The act of defoliation (grazing or cutting for silage, hay) is a major management imposition on the pasture plant with its impact dependant on severity and timing of defoliation. The plant’s goals are simply to survive the defoliation (individual survival) and then propagate (species survival).

In the first instance then, stock should be grazed in a manner that provides optimal conditions for sustainable growth (persistence and production) of the pasture. This should provide maximum pasture available for stock with any feed deficit filled by supplementing stock in the second instance. Fortunately the four factors involved in pasture management - productivity, quality, utilisation and persistence of pasture - are linked, and recent research has proven that similar management can maximise all four factors.

PROCESS

Ryegrass is termed a ‘3-leaf’ plant, as each tiller maintains around 3 live leaves - as each new leaf emerges after this ‘3-leaf stage,’ the oldest leaf dies. This is a basic principle on which sound pasture management practices are based, that leaves have a limited lifespan, and if they are not harvested (grazed), they will die and be wasted.

The leaf appearance interval (the time between appearance of one leaf and the next) is influenced predominantly by temperature and soil moisture availability. Nutrient supply has no real effect on leaf appearance interval. Leaf regrowth stage, representing tissue turnover at a plant level, may be viewed as a generic ‘clock’ in pastures, and has been used as an indication of when plants are ‘ready’ to graze. The regrowth of grasses from defoliation follows a sigmoid growth pattern. Up to around the 4-leaf stage in ryegrass plants, each new leaf is generally about ¼ longer than the leaf before it. Therefore, grazing at a leaf stage less than 3 leaves will result in about 30 - 40% less feed being grown each time.

There is substantial evidence that the availability of water soluble carbohydrates (WSC) in ryegrass tillers has a marked effect on the plant’s regrowth potential and ability to persist. At the 2-leaf stage of regrowth, WSC reserves have been built up sufficiently for the plant to again cope with being grazed. Supply of WSC to daughter tillers begins again, and new tillers start to emerge. For these reasons, the 2-leaf stage is considered to be the minimum grazing interval. As the tiller expands another leaf (3-leaf stage), root growth and tillering are now fully active, WSC levels in the tiller bases have been further replenished, and overall growth is at a maximum. As the 4th leaf emerges, the oldest leaf (leaf 1) begins to die, so that the tiller maintains 3 live leaves. At this stage, pasture quality begins to decline and increasing amounts of pasture are wasted. For these reasons, the 3 to 3½-leaf stage is considered to be the maximum grazing interval.

There are 3 aspects to grazing management - these are interval (when to graze), intensity (how hard to graze) and duration (how long to graze). A grazing interval coinciding with regrowth of 2 to 3 leaves/tiller is optimal for ryegrass persistence, productivity, utilisation and quality. This is based on allowing plants time to recover from the previous grazing and build up their WSC levels (2 leaves), but grazing before leaf death occurs and quality declines (3 leaves). The ideal grazing intensity is to leave a residue for ryegrass pasture of an average of 4 to 6cm of stubble in grazed areas. In general,
grazing duration should be no more than 2 to 3 days. In a longer grazing duration, animals are able to regraze the new leaves and shoots which have grown from WSC reserves, and this severely reduces subsequent regrowth and jeopardises survival of tillers. If cows are grazed in larger paddocks for more than 2 days, a back fence should be used to prevent them regrazing the previous area.

RESULTS

Alison Wheatley and her husband Ric have two farms. “Aldervale”, 404ha (320 grazeable) situated at Winnejup 25km East of Bridgetown on the Blackwood River with some steep and rocky country. “Wilgarup”, 209ha (180 grazeable) situated 25km South of Bridgetown and is gently undulating and rough. Average annual rainfall at Winnejup is 662mm with a maximum growing season of 6 months and Wilgarup is 910mm with a longer growing season of up to 8 months. It is this longer growing season along with exorbitant land prices that have made us hang onto Wilgarup even though it is 50km away.

In 1996 we took over the running of the farm and wanted to farm better and make the farm as profitable and sustainable as possible. At this time we met James Dee from the Department of Agriculture at a beef grazing field day and were convinced that rotational grazing was the way to go. We basically went home and split one 40ha paddock up into 4ha lots with electric tape and stocked it with 40 cows and calves. As the season progressed we realised we had more feed on that one paddock than we had on the rest of the farm, even though the stocking rate was higher. James convinced us to become a Satellite Farm for a rotational grazing study and his advice was invaluable.

Two years later we started rotationally grazing the whole farm but had trouble splitting it up with the electric tapes due to the topography. We were unable to do major remodelling of our paddocks as the banks were not keen to loan us money so we made the decision to use the paddocks that we already had and just move bigger mobs.

Stock are deferred at the break of season usually to a paddock that will be reseeded or one that needs renovating (although we usually find that it does the pasture the world of good anyway with the heavier stocking pressure). They are fed in one big mob (quicker and easier) until the grass reaches the 2 to 2½ leaf stage when the rotation usually starts. This year we were talked into starting the rotation later than usual and found that the pasture got away too much and now we can’t get on top of it - it is getting too long. We like to graze at the 3 leaf stage and only graze for 3 days maximum. However, although we check any new pasture to make sure it is at the 3 leaf stage and ready to graze, we just do a visual assessment of other pastures.

The rotations are different on the two farms as we live on one and the other is 50km away. Winnejup can be split into 21 paddocks and Wilgarup into 4 paddocks, so stock graze each area longer at Wilgarup. Depending on the move we may just go and open the gate and then go back later and chase any stragglers out. As stock get older they are usually easier to move. Moves must fit in with our lifestyle, eg going past Wilgarup for footy, going to Perth for the Eagles! The speed of the rotation varies from year to year and at different times of year but could be from 21 days to 35 days.

It seems to us that the cheapest way to increase productivity is to start rotational grazing and increase stocking rate. We have been talked into spending too much on fertiliser and pasture renovation and then found ourselves with no money left to purchase additional stock. We have also found that it pays not to be too sentimental with stock agents.

Stocking rates in 1998 were 12.31dse/ha over both farms. Now we graze at 20.44dse/ha overall, with 23.64dse/ha at Winnejup and 14.75dse/ha at Wilgarup.

Rotational grazing does make more work but it has rewards that far outweigh the commitment. The stock are checked more regularly so we can catch problems early. We have a problem with boundary fences and absentee neighbours so we need to check what is happening regularly. Also looking at neighbouring farms, we realise that we have much more feed at the start of the season and into winter and we feel our feed hangs on longer at the end of the season even though our stocking rates are higher.

We set stock through calving, mainly because we put the cows in the Front paddock where they are easy to check and we want to mark the calves each day. Once cattle get the idea of the rotations they will move to a gate waiting for us to move them whenever they see us, however we don’t always want to move them!!!

We have been tested with the seasons – the system needs to be flexible. We always have a dry summer, but sometimes we have a late break or an early finish, or, as in 2006 a bad year all round. We hope to carry 1 cow-calf/ha year round with trading stock increasing the pressure over winter to
around 2 cow-calf/ha. Our aim at present is to run a viable beef cattle business by increasing pasture production and utilisation and having more time to enjoy life!

CONCLUSION

Leaf regrowth stage is a practical and accurate field-based indicator of when a paddock should be grazed. Measuring leaf regrowth stage allows shortfalls (indicating a need to supplement) or surpluses (indicating a need to conserve grass as silage or hay) in pasture to be predicted before they show up through measuring pasture DM.

Paper reviewed by: Fiona Jones
Grain Introduction in commercial cattle feedlots.
Fiona Jones1,2 and Nick Costa2, 1Department of Agriculture and Food WA and 2Murdoch University.

SUMMARY
In Australia, beef is the second most popular fresh meat, after chicken, consumed through the foodservice industry (BIS Shrapnel/Penfold Research). In addition, during 2006-07, Australia exported 67.1% of its total beef and veal production (DAFF/ABS) with a value of $4.9 billion (ABS). Increasingly, on-farm and commercial feedlot systems are the basis of beef production in Australia. To consistently meet the production levels required, feedlot cattle are fed grain-based rations. However, if grain is not introduced to the system in an appropriate manner this can be associated with the digestive disorder acidosis at the clinical and sub clinical level. Preventative measures such as inclusion of antibiotics like virginiamycin and ionophores such as monensin can reduce the risk of acidosis during a rapid introduction to grain-based diets. While effective, these measures are under public pressures to reduce their use for the domestic market and pressure from export markets that will not accept beef produced with feed additives. Therefore, the feedlot industry must establish a two-fold response: firstly to define the underlying causes of rumen acidosis and secondly to use this knowledge, combined with feed management practices, to formulate the most effective commercial rations and feeding systems.

Our research has demonstrated that, as long as ruminants are given sufficient roughage and an appropriate grain introduction system, there is no need to use antibiotics or ionophores to reduce acidosis. The cattle that we sampled were kept under commercial feedlot conditions. These cattle showed some minor signs of clinical acidosis (a slight drop in rumen pH but not rumen lactate) when fed grain diets with or without ionophores or with hay and grain fed separately. This linked with all cattle under all feeding regimes showing some signs of loose faeces at about seven days into introduction and a slight drop in rumen pH for single animals, as is shown in ranges on table 1. However, on average, rumen pH and lactate concentrations were still within normal levels. Good stockmanship is also important to ensure close and regular monitoring of stock during the first week after introduction, particularly ensuring that cattle are introduced to grain with a full stomach of hay.

INTRODUCTION
The rumen is the basis of all ruminant production. In fact, a healthy and productive microbial environment is a prerequisite for the profitability of a feedlot enterprise. The microbial environment of the rumen is quite unique; highly buffered to a relatively neutral pH of 6-7 by the production of copious quantities of saliva containing bicarbonate and phosphate, and supported by physiological processes that ensure mixing and flow of nutrients (Theodore and France 2005). Ruminants have a symbiotic relationship with ruminal bacteria, fungi and protozoa that have the enzymic capacity to break down polysaccharides such as cellulose (hay) and starch (grain) in diets (Russell and Rychlik, 2001). However, cellulytic ruminal bacteria cannot function at the ruminal pH below pH 6 that modern grain feeding systems can create (Russell and Wilson, 1996).

Modern feeding systems can produce greater rates of growth and production from ruminants by transitioning cattle from relatively high fibre diets to higher grain diets. If ruminants are fed diets lacking in fibre, the physiological mechanisms of homeostasis are disrupted, leading to a decline in ruminal pH and undesirable alterations of the rumen ecology, resulting in animals becoming more susceptible to metabolic disorders such as rumen acidosis at both a clinical and sub-clinical level. The major indicators of poor feeding practice in feedlots and acidosis are increases in ruminal lactate and decreases in ruminal pH. To prevent ruminal acidosis, farmers use management systems such as slow grain introduction to allow adaptation of the rumen ecology, or they may use antibiotics such as virginiamycin and rumen modifiers ionophores.

This paper reports a component of a larger PhD project in which we monitored rumen pH and lactate levels under commercial feedlot conditions to assess the effects of slow introduction, separate feeding of hay and grain, or the use of virginiamycin.

PROCESS
Rumen fluid was collected from cattle in several commercial feedlots during the introduction of increasing amount of grain. These samples were collected using oesophageal tubes with a brass
attachment so that it drops to the bottom of the rumen to minimise saliva contamination. All rumen
samples were collected during the introduction period at days 0 (just prior to feedlot entry), 3, 7, 14,
21, 28 and 64. Rumen pH of each sample was measured immediately in the field via a portable pH
meter and lactate concentrations were measured via enzymic assay later in the laboratory.

Three different feedlots were sampled at varied times and seasons of the year. Each feedlot aimed to
feed a final ration based on 10-20% roughage.

Feedlot 1: Virginiamycin with a total mixed ration (TMR) - March
Feedlot 2: TMR with no additives - December
Feedlot 3: Grain fed in troughs and hay fed separately as rolls with no feed additives - January

OUTCOME

There were no clinical signs of acidosis in a majority of the cattle in these feedlots.

Table 1: Ranges for rumen pH and rumen Lactate (mM) during introduction of feedlot cattle to grain
based diets

<table>
<thead>
<tr>
<th>Feedlot</th>
<th>Range of rumen pH</th>
<th>Range of lactate concentration (mM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedlot 1</td>
<td>5.32 – 6.9</td>
<td>0.002 - 0.54</td>
</tr>
<tr>
<td>Feedlot 2</td>
<td>5.84 - 7.1</td>
<td>0.002 - 0.43</td>
</tr>
<tr>
<td>Feedlot 3</td>
<td>5.46 – 7.1</td>
<td>0.002 – 0.07</td>
</tr>
</tbody>
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Rumen pH and rumen lactate were not significantly different (p <0.05) between the feeding regimes.
However it must be noted that, in most cases, there was one animal that was low during introduction
for all groups but the average was still within a pH of 6-7.

CONCLUSION

Cattle can be successfully introduced to grain based diets under commercial feedlot conditions and
under varied feeding regimes without the addition of virginiamycin or rumen additives. It is imperative
that you keep to the rules of slow introduction such as:

1. Ensuring cattle are not hungry prior to introduction and are supplied with excess roughage.
2. Grain is introduced slowly, that is, in increments from 20% - 40% to 60% then to maximum grain
   usually recommended at 80-85% over a 3 week period.
3. Grain is not crushed too finely and hay is not less than 10 mm in length in a total mixed ration with
cattle monitored daily for signs of acidosis.

KEY WORDS

Grain introduction, rumen adaption

ACKNOWLEDGMENTS

Alan and Harold Manton, John Fry and Vasse Research Centre

Paper reviewed by: Bill Russell

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Mixed Systems

Confinement feeding stock in mixed enterprises

John Milton
The University of Western Australia & Independent Lab Services

SUMMARY

Confinement feeding of stock is a management strategy to improve the compatibility of livestock and grain production by making best use of the complimentary components of both enterprises. The better control provided by confinement feeding should allow mixed enterprises to increase production of quality wool and meats while maintaining a viable cropping program. This in turn should create a profitable, robust and sustainable farming system while spreading the financial risk.

INTRODUCTION

The current high prices for grain together with the problems that beset the wool industry and the drop in profits from lamb and beef has led many producers in Western Australia to increase the cropping component in their mixed enterprises at the expense of livestock. However, cropping, too, is experiencing new difficulties including the recent series of poor seasons for grain production, the possibility of more to come and an unprecedented escalation in costs of inputs associated with producing crops. This has caused many mixed farmers to reconsider the role of stock in their enterprises. They are seeking options to continue to run stock while maintaining their opportunities for cropping profitably including retaining essential farm staff. One such option is to feed stock in confinement over summer and through the break-of-season until the green feed gets away and, in so doing, to hold them in ideal body condition for optimum production of either wool or meat. An advantage of this option from a cropping perspective is that removing sheep from paddocks at these times avoids potential damage from either wind erosion in the dry season or pugging during the wet. Feeding stock in confinement may also allow farmers to increase their area under crop while running a viable number of breeding stock and so diversify their income and spread their financial risk.

METHOD

Sheep and cattle are selective grazers and walk a lot to choose the components they want from the feed on offer (FOO). If the material the animals prefer to eat is sparse, the extra distance that they must walk lifts their maintenance requirement for energy, so less of the nutrients consumed are available to produce meat, wool or milk. This applies to both summer- and winter- feeding.

In summer after a few weeks of continuously grazing stubble paddocks, stock begin to expend more energy than they can consume and they lose body condition. This is especially crucial for breeding stock or weaners both of which need to be doing more than merely maintaining themselves. In addition, stock continuously trafficking over stubble paddocks in search of feed break-up the top soil, especially many of the light textured soils of Western Australia and leave it exposed to wind erosion. The valuable top soil, if lost, takes with it nutrients that are increasingly expensive to replace.

After the break-of-season rains, stock soon begin to ‘chase the green pick’, to the detriment of the animals, the pasture and the soil. Similarly to when they graze stubble in the summer, the stock spend a lot of time walking while trying to select and harvest enough nutrients to meet their requirements and the walking increases their requirements for maintenance. In addition at this time, the short plant material they consume contains a lot of water, is low in functional fibre and plant sugars and is often high in rumen degradable protein, all of which may lead to an asynchronous fermentation in the rumen. Jointly, these factors do not promote optimum production especially from stock whose physiological state obliges them to have a high demand for nutrients. Cattle may be even more affected than sheep in this case because cattle need more FOO to be able to prehend the pasture. A further threat is that stock may ingest worm larvae by continuously grazing the short, green pick. So, ewes and cows under stress can build-up a worm burden and pass it onto their young by infecting the pastures. From the plant’s perspective, the frequent removal of leaf material through continuous grazing can limit subsequent plant growth and ultimately the total amount of plant material produced.
over the growing season. Growth of plants is also compromised by the continual trafficking by stock over the wet soil at the break-of-season which can lead to compaction and pugging and ultimately structural problems in the soil. Therefore, it is prudent to suggest that, if stock have been confined, they should be released from confinement gradually to avoid digestive upsets and only when there is about 1,000 kg of FOO for sheep and above 2,000 kg of FOO for cattle.

**Facilities, feedstuffs and techniques for feeding stock in confinement**

During the recent tough seasons many producers have successfully fed pregnant and/or lactating females and weaners in confinement, but there have been some problems with ewes when they lamb in confinement. This is because pregnant stock or weaners are generally fed a ration that has been limited to meet their demands for pregnancy or modest growth but lactating females must be fed much more than this to support rapid growth of their young. When feeding is limited, animals must be able to get their fair share of feed when offered as 2 or 3 feeds per week, so it is essential that there be adequate feed space. Without sufficient feed space ‘shy feeders’, especially in sheep, become a problem. Different feeding systems have been used but, among the best of them, the Nepowie Merino single-sided feeding system for sheep that can be purchased in modules has many advocates. If the stock have access to both sides of a feed area, the total length of feed space can be halved. The length of feed space required per animal depends on the size of the animal, the length of wool, stage of pregnancy of females and the bulkiness of the feed. Quality water is essential for stock fed in confinement and the pen area for 300 to 500 sheep varies in a range from 4 to 10 metres² per sheep. Generally, the facilities for cattle need to be about 8 to 10 times the dimensions of those for sheep.

Many feedstuffs have been fed to stock in confinement varying from pelleted diets fed with cereal hays and straws through to total mixed rations (TMRs). On-farm TMRs generally contain hays, straws and/or silages plus cereal grains and mineral and vitamin additives. Some specialist producers who currently lot-feed prime lambs or cattle have mixer wagons to make-up TMRs appropriate for their different classes of stock and the ingredients they have available. Many of these producers have their rations professionally formulated after analysis of the main ingredients and incorporate minerals and vitamins in the rations so the diets are nutritionally complete. This is ethically responsible as confined stock have no option other than to eat the ration provided and if the ration is inadequate it could become a welfare issue, as well as limiting the performance of the stock.

Components of the ration may become more or less available from season to season and the mix needs to change accordingly. For example, with the recent run of dry seasons there has been a lot of grain seconds and screenings on farms and these have been widely used in confinement rations for sheep. However, technology is now available for grain seconds to be also utilised successfully in cattle rations. In addition, straw from droughted crops has proven to be a valuable component in maintenance rations for stock and even straw from high yielding crops can be useful if only flag and fine stem material with higher nutritive value is baled. Another potential component that has been underutilised is silage. More silage could be fed in confinement rations in the cropping areas of Western Australia if more producers used silage as a tool to help control herbicide resistant weeds. The aerial seeding legumes used in phase farming systems to supply the soil with nitrogen and organic matter for subsequent crops provides an ideal pasture mix with herbicide resistant ryegrass to produce quality silage in the spring when shut-up after being grazed. Another useful component currently used in TMR rations is chaff-cart residues, collected to help control herbicide resistant ryegrass. However, it is essential that cocky chaff residues be free of ARGT and phomopsin toxins.

**CONCLUSION**

Confinement feeding can therefore tie in well with whole-farm management strategies but it also has the potential to eliminate the summer/autumn/early winter feed-gap that, at present, constrains focused feeding strategies to improve the efficiency of producing quality wool from Merinos and meat from both sheep and cattle. Adoption of confinement feeding as a regular practice should also help buffer the impact of dry winters on animal production. Nevertheless, the site where stock are to be fed in confinement needs to be carefully selected before establishing facilities to ensure that there is little detrimental impact on the surrounding environment. For this, we need objective, long-term data to make informed decisions on the siting of confinement lots rather than relying on possibly inappropriate data extrapolated from other intensive industries. A factor that needs to be considered here is the potential to return mulched excreta from the confinement area back onto cropping paddocks.
KEY WORDS
sustainable, farming system, financial risk, herbicide resistant weeds, quality wool and meats
The Sheep Enterprise

MAKING MORE THAN SHEEP

Ed Riggall, Australian Wool Innovation and Meat & Livestock Australia

INTRODUCTION

Making More From Sheep is a world class information and support program that provides sheep producers with proven tools and techniques to boost their production and profitability. Developed by Australian Wool Innovation Limited (AWI) and Meat & Livestock Australia (MLA) along with almost 250 leading sheep and wool producers and technical experts, the package enables sheep producers to maximise the potential from key aspects of their enterprise, from the soil through to making the sale.

Making More From Sheep is the first time that the industry’s best practices and research has been assembled in the one place and made accessible to all. While the research and development behind the package is the best available, the centrepiece of the program, Making More From Sheep – A producer’s manual, is designed for sheep producers as a reference that is practical and straightforward. A do-it-yourself approach is encouraged, so that sheep producers work through the Making More From Sheep modules as they develop their own skills and strategies to suit their situation.

Making More From Sheep is also being supported by forums and workshops and the program has a comprehensive website, www.makingmorefromsheep.com.au.
Sheep Cost of Production - the enemy is at the gate!

JRL (Bob) Hall, JRL Hall & Co

Once the sheep industry got over the effect of the reserve price scheme debacle in the 90s, apart from the season, life has generally been pretty good for the sheep man. Put another way, if it was not for you, then your business had real problems.

By way of example let us examine a typical modern flock of self replacing merinos in the 500 mL rainfall zone stocked at 10 DSE/ha. Ewes with 90% lambing, wethers kept until 1.5 years old, 20 micron average for the clip.

### Income Per DSE

- Profit from livestock trading: $11.38
- Wool: $20.96
- Total: $32.34

### Variable Costs

- Sheep (shear/crt/mules/DDM/packs/dogs/feed/freight): $8.16
- Fertilisers: $2.38
- Crop for sheep: $0.45
- Total: $10.99

### Gross Margin

Total: $21.35

At 10 DSE/ha the gross margin became $213.50/ha which should have been satisfactory for a low overhead cost sheep system.

### What Has Happened And Will Happen?

Output is static. Wool and meat prices should have risen but have not. They seem to defy the basic laws of supply and demand. Higher prices tend to be promised for the future but as yet, no sign of them.

### Costs Have Risen

For the same flock/DSE, the cost structure and hence the gross margins have changed.

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable costs</td>
<td>$10.99</td>
<td>$15.97</td>
<td>$17.94</td>
</tr>
<tr>
<td>Gross margin</td>
<td>$21.35</td>
<td>$17.19</td>
<td>$15.23</td>
</tr>
<tr>
<td>Gross margin/ha</td>
<td>$213.50</td>
<td>$171.90</td>
<td>$152.30</td>
</tr>
</tbody>
</table>

A decline of 28.67%

Big ticket cost rise items/DSE are:

- Shearing/crutching (DIY crt): Up $2.56
- Fertilisers: Up $3.08
- Freight: Up $0.72

Total $6.36 out of a total cost rise of $6.95

### COST OF PRODUCTION

Convention allocates costs in proportion to output. The typical farm has 65% to wool and 35% to livestock trading profit.

The farm is 10000 DSE with 1000 cleared ha used for sheep. Overheads to allocate are:

<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating costs</td>
<td>$90000</td>
</tr>
<tr>
<td>Depreciation</td>
<td>$15000</td>
</tr>
<tr>
<td>Labour (drawings)</td>
<td>$50000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$155000</strong></td>
</tr>
</tbody>
</table>

Wool cut 4.19 kg/DSE

The current price, net sweep the floor is approximately $5.00/kg.

### Cost Of Production: Wool

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable costs/DSE</td>
<td>$10.99</td>
<td>$15.97</td>
<td>$17.94</td>
</tr>
<tr>
<td>Allocated to wool/DSE</td>
<td>$7.14</td>
<td>$10.38</td>
<td>$11.66</td>
</tr>
<tr>
<td>Therefore per kg wool</td>
<td>$1.70</td>
<td>$2.48</td>
<td>$2.78</td>
</tr>
<tr>
<td>Add share of overheads</td>
<td>$2.41</td>
<td>$2.41</td>
<td>$2.41</td>
</tr>
</tbody>
</table>
Over the three years a decent surplus will decline to a loss.

**Cost Of Production: Meat**

Overhead allocation $54250 (35% of 155000). Meat output was $11.38/DSE (with average stock prices $36.39/head).

<table>
<thead>
<tr>
<th>Per DSE</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable costs</td>
<td>$10.99</td>
<td>$15.97</td>
<td>$17.94</td>
</tr>
<tr>
<td>Cost share to meat</td>
<td>$3.85</td>
<td>$5.59</td>
<td>$6.28</td>
</tr>
<tr>
<td>Plus share of overheads</td>
<td>$5.42</td>
<td>$5.42</td>
<td>$5.42</td>
</tr>
<tr>
<td>Total COP</td>
<td>$9.27</td>
<td>$11.01</td>
<td>$11.70</td>
</tr>
</tbody>
</table>

**Per Head: $36.39 sale price original**

| COP              | $29.64 | $35.21 | $37.41 |

Again the original surplus had vanished.

**Why Is This So?**

In two words:  - Currency (the exchange rate)  - Labour shortage

Yes, perhaps mining is to blame.

Take wool $5.00 at 92 cents US becomes $7.08 at 65 cents US.
For meat $3.50 at 92 cents US becomes $4.95 at 65 cents US.

No, it does not happen that perfectly but it does illustrate the problem.
At the same time it should and possibly has created lower input costs.
US$600 for urea at 92 cents is AUD$625. At 65 cents that would be $923.
However as imported inputs are, or should be, much less than sales, there would be a net benefit for lower currency.

Will it alter? This simply cannot be predicted but:
  1. It is up to the United States more than us. They need to recover.
  2. High values tend to drop.
  3. The Australian dollar will not tend to drop as we sell MORE minerals.
  4. No one cares!

It will be, as usual, simply up to farmers to survive. Previously, it used to be that an increase in stocking rate, available to most people, solved the problem of declining terms of trade. This has stood the test of time for over 40 years. For example:

<table>
<thead>
<tr>
<th>Originally 10 DSE/ha gross margin</th>
<th>$213.50</th>
<th>New situation</th>
<th>The Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less overheads</td>
<td>$155.00</td>
<td>$155.00</td>
<td>$155.00</td>
</tr>
<tr>
<td>Leaves</td>
<td>$58.50</td>
<td>-$2.70</td>
<td></td>
</tr>
<tr>
<td>Add 1 DSE</td>
<td>$21.35</td>
<td>$15.23</td>
<td></td>
</tr>
<tr>
<td>New margin/ha</td>
<td>$79.85</td>
<td>$12.53</td>
<td></td>
</tr>
</tbody>
</table>

It does bring back some surplus but look at the difference. Small margins are also high risk.

**What To Do?**

Crop for some, while it lasts, BUT you will find that crop also suffers from the same problem. I do not think many experts believe that the current record prices will last. Crop margins will be squeezed like those of sheep. This will be an unpopular comment at the moment but there are already signs and comments to support this claim. Therefore, be very careful going into crop if it requires considerable plant purchases. DIY crutching, etc. will be of some use. Lower shearing costs if that can be arranged. DIY classing, etc. Mulesing is getting the blame for potential problems. It will be a net cost but perhaps not too high especially compared with other rises. Sheep selection NOW is vital to keep the mulesing effect down. Fertilisers. Less or none. A slippery slope but perhaps required for survival.

**A Challenge**

Take comfort from the sayings: “Nothing defeats high prices like high prices.” “Nothing defeats low prices like low prices.”

But there is a major challenge facing all within the industry. There will be solutions and indeed an industry into the future. However, beware for the enemy is no longer at the gate but within the gate.
ACKNOWLEDGMENTS

Paper reviewed by: A Ritchie, JRL Hall & Co
ABSTRACT
To position Australian lamb as a premium meat that is profitable to produce, it is necessary to understand the genetic basis of meat yield, eating quality and nutritional value. Sheep Genetics will provide tools to Australian farmers to understand this genetic basis and improve Australian lamb. The CRC for Sheep Industry Innovation (Sheep CRC) commenced a project in 2007 to measure traits for meat yield, eating quality and nutritional value in 2000 lambs a year for 5 years. The first lambs were slaughtered in December of 2007.

INTRODUCTION
To successfully improve the value of lamb carcases, attention to eating quality and nutritional value as well as meat yield is important. A lamb carcase consists of meat, fat and bone. The meat yield of a lamb denotes the percentage of a carcase that can be sold as meat. Lambs that have a high meat yield are efficient to produce and process. Being able to predict meat yield also allows for better sorting of carcases for cutting purposes.

However, consumers are interested in enjoyment, convenience and nutritional value in addition to value and efficiency. Enjoyment relates to eating quality measures such as tenderness and flavour. Nutritional value relates to content of nutrients like omega-3 fatty acids and minerals (iron and zinc). Previous research has shown that yield may be linked to eating quality and nutrient factors; sometimes in a negative way.

The aim of project 3.1.1 (Phenotyping the information nucleus flock) of the Sheep CRC is to gain an understanding of the genetic background to yield, eating quality and nutritional value with the view to improving the value and profitability of Australian lamb meat.

METHOD
Approximately 2000 lambs will be slaughtered each year for 5 years at commercial slaughter plants. These lambs will be sourced from information nucleus flocks based at 8 sites across Australia (Katanning, Struan, Turretfiel, Rutherlgen, Hamilton, Cowra, Armidale and Trangie). Second cross, first cross and Merino lambs will be slaughtered and meat yield will be measured along with traditional carcase measurements. A range of samples will be collected and tested for new or novel eating quality and nutritional value traits. These traits include tenderness (shear force, compression and collagen content), colour, shelf life, pH, iron, zinc, and omega-3 fatty acid content.

RESULTS / OUTCOME
In December of 2007 the first crossbred lambs were slaughtered and this is expected to continue until the end of May 2008. Merino lambs will be slaughtered later in 2008. Considerable progress has been made in developing the methodology for measuring new traits including meat yield. Descriptive data is being collated for genetic analysis and laboratory analyses of meat samples is about to commence.

CONCLUSION
Considerable potential exists to improve lamb yield and at the same time maintain or improve eating quality and nutritional value to consumers.

KEY WORDS
Lamb, yield, eating quality, nutritional value

ACKNOWLEDGMENTS
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