A new variety of sulla (*Hedysarum coronarium*) for forage production in southern Australia

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ABSTRACT

Sulla (*Hedysarum coronarium*) is a highly productive, deep rooted, short-lived perennial legume with excellent fodder quality suited to both pasture and fodder (hay or silage) production systems. A new variety developed in a RIRDC supported project is highly productive and has characteristics that confer lower costs of harvest and seed processing and was released to seed growers this year. This new variety is best suited to fertile soils in high rainfall (> 500 mm), long growing season areas with a restricted summer drought period, or to irrigation. Greatest productivity will be achieved on neutral to alkaline soils but the full extent of its adaptation to WA soils is still to be determined. It is ideally suited to short-term break crops or phase pastures and offers a new option in between regenerating annual legumes and longer-term lucerne pastures. This paper will outline the development and performance of the new variety of sulla together with its potential role for forage production in southern Australia.

INTRODUCTION

Sulla (*Hedysarum coronarium*) is a productive, deep rooted, short-lived perennial legume currently used in New Zealand and parts of the Mediterranean region (notably Italy and North Africa) as a specialty forage plant. It can be grazed directly early in the growing season (of regenerating pastures) and cut for hay or silage in spring. It is keenly sought in intensive pasture systems for sheep milk and cheese production, where it is fed green or used for silage or as hay [1].

Although sulla is the second-most widely used forage legume (after lucerne) in Mediterranean Europe, it is virtually unknown in Australia agriculture. A major reason for the lack of an Australian sulla market is the constraint of high seed prices (currently in the order of \$16 - \$24 per kg). In addition to the requirement to import seed, these high costs are due to low seed yields and high post-harvest seed processing costs. Sulla produces a high level of hard-seeds at maturity [2] and its segmented pods must be dehulled after harvest to remove seed, which must then be scarified to increase germinability. The dehulling process to date has been inefficient and added considerably to seed cost. The other reason for the low level of adoption is the lack of a suitable variety for Australian conditions. Two cultivars of sulla, Grimaldi and Commerciale, are used extensively in Italy, while two cultivars, Grasslands Necton and Grasslands Aokau, have been released in New Zealand. However, previous experience with these cultivars indicates that their maturity is not suited to Australian conditions. Sulla was unlikely to achieve large-scale adoption unless the constraints of low seed production and ease of dehulling were overcome.

METHOD AND RESULTS

Sixty accessions of sulla were evaluated in both Western Australian and Eastern Australian trials. Considerable emphasis in the selection program was placed on seed production and herbage production. HRN83-A, selected from a Tunisian accession, emerged as the most productive and highest seed producing variety. A highly erect selection, it sets pods high in the canopy, has high pod retention at maturity and is earlier maturing than other sulla cultivars from overseas. These features enable direct harvesting with conventional cereal harvesters. At Northampton (WA) 40% of HRN83-A plants had flowering by mid-October, (Table 1) compared to no plants of Grasslands Aokau and 5% of Grasslands Necton. This earlier flowering characteristic makes HRN83-A much more suited to seed production than other cultivars in the relatively short springs of southern Australia.

The outstanding seed production potential of HRN83-A, in comparison with other sulla cultivars, was also confirmed in two South Australian field trials at Petersville and Booborowie in 2004. Averaged over both sites, HRN83-A seed production was 90% more than Grasslands Necton, 273% more than Grimaldi and 339% more than Grasslands Aokau [3].

Table 1. Field performance data of HRN83-A, Grasslands Aokau, Grasslands Necton and Sceptre lucerne at Northampton, Western Australia in 2002. Flower abortion score: 1 = nil flowers aborted, 5 = all flowers aborted; Sown May 2002 at 10 kg/ha.

Variety	Biomass t/ha Sept 2002	% of plants flowering Mid Oct	Flower abortion 1-5 Oct	Seed yield kg /ha Dec	Biomass t/ha July 2003
HRN83-A	7.8	40	2	73	4.6
Grassland Necton	5.5	5	3	35	-
Grasslands Aokau	5.1	0	4	12	3.7
Sceptre lucerne	1.9	25	3	14	1.5

Sulla contains condensed tannins in the foliage, flowers and stems, conferring the additional advantages over lucerne, of anti-bloating properties [4] and anthelmintic properties that assist in internal parasite control [5]. Although this anthelmintic effect has not been extensively tested under Australian conditions, a small grazing trial in Western Australia found there was a very marked reduction in the amount of scouring of sheep grazing the sulla pasture compared to kikuyu / clover treatments. This is a significant finding, as scouring leads to wool fault around the hind-quarters and increases the risk of fly strike. A pasture that reduces scouring incidence would be very beneficial especially with the upcoming ban on mulesing [6]. However, more research is needed to give recommendations about the length of time that sulla can be fed as a sole diet to animals.

This new variety is best suited to fertile soils in high rainfall (> 500 mm), long growing season areas with a restricted summer drought period, or to irrigation. Seed should be inoculated with the correct strain of rhizobia (*Rhizobia hedisari*) and sown at rate of 8-10 kg/ha into a firm, weed free seed bed at a depth of 10-20 mm. A new commercial sulla inoculant has been developed with better soil persistence and should improve productivity. Preferably sow in early to mid-autumn, when warm to mild conditions allows sulla to compete strongly with annual weeds during the establishment phase. Greatest productivity will be achieved on neutral to alkaline soils but the full extent of its adaptation to WA soils is still to be determined.

CONCLUSION

HRN83-A sulla is a new forage option for high rainfall pastures in southern Australia. It combines early maturity and an erect growth habit (for early vigour and ease of forage production) to maximise seed production.

KEY WORDS

Sulla, Hedysarum coronarium, forage legume.

ACKNOWLEDGMENTS

HRN83-A was developed through a RIRDC-funded CLIMA project “Seed production limits sulla and purple clover as fodders” based at the Centre for Legumes in Mediterranean Agriculture. Thanks go to Dr Hayley Norman (CSIRO) who conducted some of the initial trial work and later undertook forage quality analyses, Dr Brown Bessier (Department of Agriculture) for collaboration in anthelmintic studies.

Paper reviewed by: Dr Clinton Revell

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Mating – Short and fast is better

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BACKGROUND

Maximising stocking rate is clearly the key short-term driver of profit in wool and sheepmeat enterprises. As we consider the medium and longer terms, however, other factors become increasingly important. First, as the industry generally moves towards increases in stocking rate, there will be a need for more animals and there will be competition for those animals in the marketplace, not only among farmers but also between farmers and meat processors. Second, high rates of reproduction are essential for maximising the gain from genetic selection and for earning a good return on investments in top-class genetics.

In a prime-lamb enterprise, the need for efficient reproduction is self-evident: the ewe flock must generate plenty of lambs because they are the source of income. In a wool-only enterprise, there is less pressure on reproduction because ewes that don't have a lamb still produce wool for sale. Reproduction is usually seen only as providing flock replacements, but genetic improvement is still slowed by poor reproductive efficiency. In any case, wool-only enterprises are becoming rare and the dominant situation is now becoming a mixed meat-wool enterprise based on Merino mothers.

Efficiency can be improved at all stages of the reproductive process so it is necessary to prioritise those stages on the basis of where we can have the greatest impact. Currently, most attention is being placed on lamb survival, and for very good reasons. Lamb losses probably average 30% and are a disastrous waste of investment in labour, pasture and genetics. In addition, the associated ethical issues could lead to closure of our most profitable markets.

Addressing lamb mortality is not easy because the causes are complex, involving genetics, nutrition and management. However, most lambs are lost in the first few days after birth and most of the losses are among twins, so we know where to focus our efforts. The major causes of mortality can be rectified by clever and precise management but this is really only feasible if the mating period is restricted so that the timing of lambing is known and the duration of lambing is short. In this paper, we will look at short matings and begin by considering the arguments for and against it (see the table of "pros and cons" below). We aim to show that the arguments against are either not important in the context of the need to improve efficiency or, if they are important, we can manage them so they have minimal impact.

The Arguments For

1) Avoid the effects of the autumn feed gap

The problem with extended autumn matings in WA is that the ewes that attempt to mate late (second or third cycle) are more likely to be losing weight. They might not conceive due to the deterioration in feed quality at that time of the year, especially if the feed gets rained on. They are also less likely to have twins. None of this necessarily reflects their genetic potential … they are less likely to get into lamb or conceive twins simply because of a drop in body weight. The only way to avoid this is an expensive program of feed supplements.

Pros	**Cons**
Avoid the effects of the autumn feed gap	*Lost opportunity to conceive, low lambing percentage?*
Mate while the ewes are still in good condition	Yes, no "tail" … but how much is lost?
Concentrated, short lambing period	*Need more rams?*
Focus feeding becomes efficient	Yes, but it can be managed.
Feeding for twinning	*Avoid the impact of weather events at lambing?*
Feeding for colostrum	Yes, but only partially … still a disaster.
Lambing management for lamb survival	A substitute for poor management?
Marketing simplified (no "tail")	
Weaner management simpler (no "tail")	
Labour management at lambing, tailing, drafting	
Increased value from scanning	
Separation of dries, singles, twins	
Lamb survival (focus on twins)	
Minimise autumn feed costs	
Manage lambing as 1st and 2nd cycles (survival)	
Strategy for late start to season	
Pressure on genetics of ewe fertility	

2) Concentrated, short lambing period

A short mating period leads to a short lambing period in which intensive activity becomes cost-effective. If the ewes are lambing in a relatively tight pattern, then the lambing environment can be managed and strategies such as "Focus Feeding" become efficient. This means that we can consider supplements that will promote twinning and increase the production of colostrum. Extra twins, as long as they are gained at minimum cost and then managed correctly at lambing, will improve profitability. Extra colostrum will probably help lamb survival. Lamb mortality can also be reduced by improving the conditions in which ewes lamb, including the provision of feed, water and shelter by, for example, the provision of "edible shelter" such as a standing oat crop or fodder shrubs. With a combination of a short mating and ultrasound scanning, this investment can be focussed on twin births in the first 10 days of lambing, with cost-effective outcomes.

A concentrated lambing period has additional benefits in that the "tail" in the lamb crop is avoided, so the cohort is of a more even size. This simplifies marketing into prime lamb supply chains and simplifies the management of weaners over their first summer and autumn.

The difficulties with farm labour in the current economical and social climate, as well as the diverse demands placed on the farmer's time in a crop-sheep enterprise, have led to great interest in the reduction of labour inputs. In turn, this has led to the development of the concept of an "easy care ewe". Here too, short mating can help because it leads to a short and intensive period of lambing at a known time, so labour inputs can be planned well ahead. Again, ultrasound scanning is a vital source of information for that planning process.

3) Increased value from ultrasound scanning

With a short mating period, all conceptions could be limited to a single cycle, perhaps two. This increases the value of ultrasound scanning because it allows the segregation of ewes into flocks of dries, single-bearers and twin-bearers. The dries can be managed as wethers, or culled to improve fertility or, if they are excessively numerous, mated as a separate flock with a slightly later (but still concentrated) lambing.

This segregation is the first step towards "focus feeding" for colostrum production, or "feeding to meet the need" so that supplements and feed resources are not wasted on non-pregnant and single-bearing ewes. This is perhaps most important when there is a very late start to the growing season. Finally, the ability of high quality scanners to detect twins and even differentiate between fetuses conceived in different cycles allows efficient planning of lambing conditions and thus excellent opportunities for reducing lamb mortality.

4) Pressure on genetics of ewe fertility

A short mating period gives the ewe only one chance to conceive. If she fails that test, she faces culling, particularly if it is her second year in succession. Thus, as soon as the results of ultrasound scanning are known, a strategy for genetically improving fertility can be implemented. Clearly, culling for single-cycle fertility needs to be a flexible strategy, with variations made according to ewe body condition and age. It also needs to be matched with an equally careful strategy for ram management (see below).

In contrast to traditional practice, it is important to tighten-up matings with maidens too. Provided they are of adequate weight (above 2/3 mature body weight), not losing weight when joined and have been teased (even for a post February mating), they really should be able to get into lamb with a short mating. If they don't, it may be best to be cull them since they may well become the perennial dries (barren ewes) or "laggards" (never having twins or skipping a lamb every second year) throughout their life. This needs further scientific investigation because we have no solid data for Merino ewes, but the phenomenon is appreciated for cattle so top beef and dairy producers have short matings for their heifers. It nevertheless seems sensible to avoid handicapping maiden ewes and give them every opportunity to quickly get into lamb and cull them if they don't.

The Arguments Against

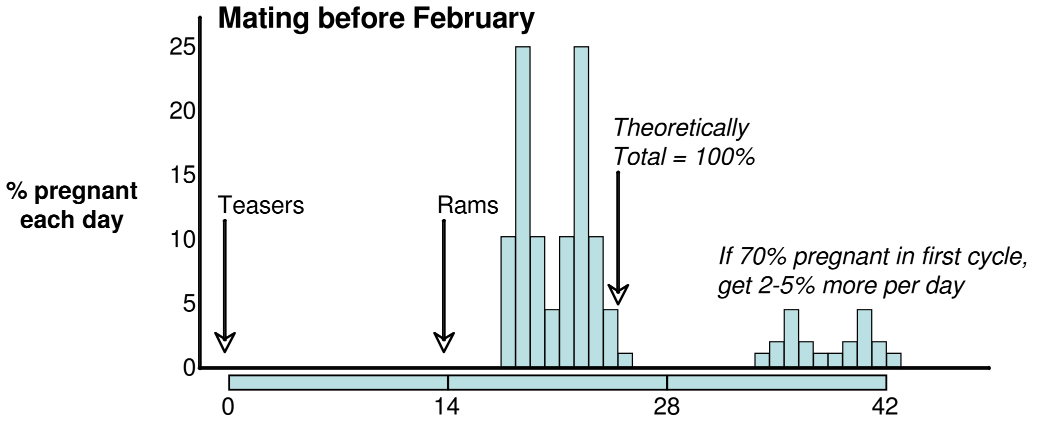
1) Lost opportunity to conceive, so low lambing percentage?

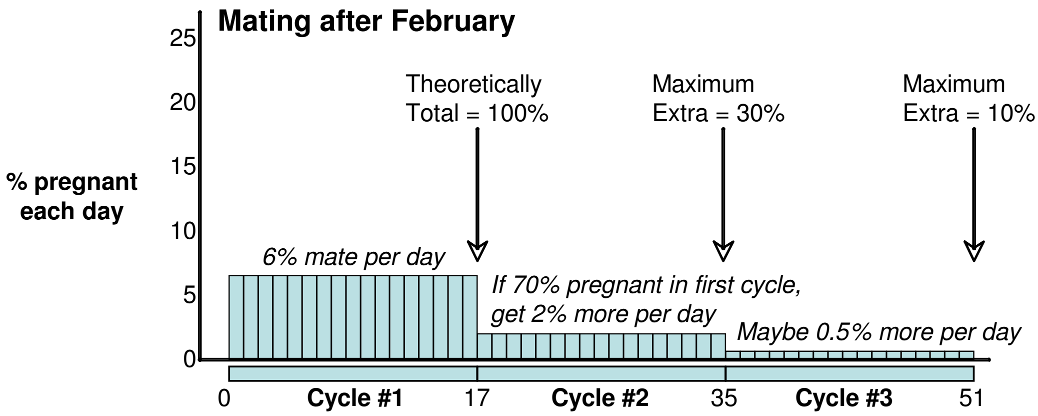
It is self-evident that a drawn-out mating period will increase the percentage of ewes that conceive, simply because those that mate and fail have a second or third opportunity. Two issues are relevant here. First, as discussed above, the late conceivers may need to be culled because of their poor fertility genetics (assuming all other factors equal, such as ewe body condition and ram performance). Second, the lambs gained in the second and third cycles may actually be a cost rather than a benefit. As well as forming the "tail" of the lamb crop, there may be fewer of them than we realise. This issue is demonstrated in the figures below.

2) Extra rams needed

It is clear that we need to have a higher ram percentage for short matings if we are to offer the ewes a reasonable probability of conception. This is especially important in flocks mated before February because the ewes will be teased and thus synchronised. Instead of the rams having to serve 6% of the ewes every day, as happens during the breeding season (February to May), they will encounter as many as 30% of the ewes in oestrus on some days. In this situation, 4% rams might be needed.

In this light, it is essential for short matings that the rams are managed correctly so that each individual is contributing their best. This means ensuring that they have maximum mass of testes … feed them with 500 g per head per day) for 8 weeks before they go in with the ewes. It also means that they must be anatomically sound, healthy and fit. For matings before February, extra rams are needed and, if this seems excessively expensive, we may need to explore new strategies, such as sharing rams with producers who mate at a different time. This might raise issues such as concern for disease control, but such issues should be addressed not avoided.





3) Avoiding the impact of weather events at lambing

There is no doubt that we are horrified by the impact of a weather event, such as heavy rain with high wind-chill, during lambing. In fact, lambing over 6-8 weeks does not guarantee a good result because most lambs (70% on average) are born within the first 17-day cycle and a random weather event is just as likely to fall during that period as during the second or third cycles when relatively few lambs are dropped. In any case, rather than give in to this risk, we should plan for it and manage the lambing flock correctly. This brings us back to concepts such as "edible shelter". The basic fact is that 20 cm of grass or crop is enough for a lamb to drop down out of the wind-chill zone. If the surroundings are managed so that the ewe does not need to wander from the birth site, lamb mortality will not be a major issue.

Conclusion

There are problems with short mating periods, but they are either minor or they can be managed so they have little impact. They are then greatly outweighed by the benefits.

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Breech strike protection in sheep post 2010

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ABSTRACT

AWI and its partners have made significant progress in developing intradermal injectable treatments and clips as mulesing alternatives. Genetic solutions to breech strike are also being examined.

INTRODUCTION

Mulesing has always been controversial, and many attempts have been made over the years to develop alternatives (for a summary see Rothwell *et al* 2006). In November 2004, responding to concerns raised by retailers of Australian wool, the Australian Sheep and Wool Industry Taskforce announced that the practice of mulesing would be phased out by 2010. An existing program of research by Australian Wool Innovation Limited (AWI) to develop viable alternatives to mulesing was accelerated and broadened in scope. This paper reports on progress.

REVIEW

AWI has examined a very broad range of ideas for modifying the breech of sheep to make it less attractive to flies. The current focus of the R&D program, however, is on three areas: intradermal injection and clip products, which offer pre-2010 alternatives to mulesing; and genetic solutions.

Intradermal injections

The current developments in intradermal treatments originated with research by the University of Adelaide into the use of collagenase as a permanent depilatory agent. The injection of collagenase into the skin caused disruption of blood vessel walls, causing local anoxia, tissue death, scab formation and subsequent contraction of surrounding skin. Alternatives to collagenase were developed because it had a number of potential weaknesses. The agents now being used are well-known chemicals with disinfectant properties. In comparison with collagenase they are stable, easy to formulate, inexpensive, and well known to regulators, all of which will simplify registration.

AWI has identified an effective needleless injector manufactured by Medical International Technologies of Montreal, Canada. The MIT device is driven by CO_2 and has a multi-pronged head specifically developed for the purpose. It has performed well in field trials, consistently delivering the fluid to the correct depth of 1-2mm across the area.

Current research is focusing on optimisation of the formula of an intradermal product, placement of the injections and the effect of operator pressure. Once the formulation is fin alised, the product must undergo efficacy trials (depending on the label claim) and residue, safety and environmental studies. A commercial partner is being sought and it is hoped a registration dossier will be submitted later in 2006. This would lead to a commercial product being available in 2008.

Clips

Clipping works in a similar manner to elastrator rings. The clip creates a linear occlusal surface that isolates a flap of skin from the blood supply. The flap becomes anoxic and dies. In most cases, the clip and shrivelled flap fall off after a few weeks leaving a low-profile linear scar.

The perineum and tail are likely to require different clips because of the three-dimensional curvature of the tail and tight adherence of tail skin to underlying tissue. The breech clip design appears to be finalised. Two designs for the tail are being evaluated: the one-piece ‘dog-bone’, centred on the top of the tail; and the bilateral ‘hockey-sticks’, the crook of which capture the skin fold at the base of the tail.

Clips offer two major advantages. First, they can be immediately re-positioned if the operator is not happy with the effect achieved (e.g. asymmetry). This is in contrast to mulesing or injectables. Second, there is no introduction of agents into the body, and therefore no residues or human / sheep health concerns. Clips do not have to be registered (which shortens time to market by 18 months).

Commercialisation is expected in 2007. The major threat to this target is the identification of a suitable degradable material for manufacture. A number of materials are being tested under conditions of accelerated weathering. The option of re-usable clips, which would be removed a few weeks after application, may be a possibility in more intensive grazing situations.

Genetic solutions

AWI has been pursuing two approaches to the development of genetic solutions: breeding of sheep with desirable breech traits using index-based selection; and the exploitation of ‘extreme phenotype’ sheep found in a number of flocks. A review conducted for AWI (James 2004) concluded that ‘*there appears to be significant opportunity to reduce the susceptibility of Merinos to breech strike by genetic means although it appears unlikely that breeding alone will be able to confer the degree of protection provided by surgical mulesing and tail docking, at least in the short term.*’

AWI, the Department of Agriculture and Food WA, and CSIRO have established breeding flocks at Mt Barker and Armidale with the aim of testing the degree of breech strike resistance that can be bred into flocks. At each site there are: 200 randomly-selected ewes mated with randomly-selected sires; 200 randomly-selected ewes mated with sires selected for ‘desirable’ breech characteristics (high breech bare area, low dag score, low wrinkle); and 200 ‘desirable’ ewes mated with ‘desirable’ sires.

In each mob, half of the offspring will be mulesed and the other half unmulesed. Two lamb drops will be generated. A wide range of traits is being measured in all sheep (including body and fleece weights, fibre diameter, staple measurements, worm egg count) to determine what trade-offs are made when desirable breech traits are included in the breeding program. No results are yet available.

The second area of investigation is into sheep with extreme phenotypes. The focus of this work is at Calcookara Stud in South Australia where a large number of sheep with very bare breeches have been produced (although such sheep have been identified in other flocks). The sheep typically lose their breech wool at about 18-24 months of age.

Early results from the University of Adelaide suggest that the bare-breech trait is highly heritable (0.46), that there are favourable correlations with skirted fleece weight and staple strength, and that there are no correlations with fibre diameter or staple length. Results from the Mt Barker / Armidale trial will also generate genetic parameters for use in the analyses offered by Sheep Genetics Australia.

CONCLUSION

Mulesing is highly effective, quick and relatively inexpensive. Finding a replacement with all of these features is a challenge. However, AWI is confident that at least one product will be available in advance of 2010. At the same time, our understanding of genetic resistance to breech strike is rapidly improving and may provide the most attractive longer-term solution.

KEY WORDS

Sheep; flystrike; mulesing

ACKNOWLEDGMENTS

The research described in this paper has been ably led by Ms Jules Dorrian and Prof Jim Rothwell. The concept of using intradermal necrosing agents owes much to the work of Prof Phil Hynd and his team at the University of Adelaide. The concept of clipping was developed by the Hon. Ian McLachlan AO and Dr Chris Abell, directors of AWI, and Dr Jack Coffey. All intellectual property associated with the clips was assigned to AWI.

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How the West can win!

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ABSTRACT

The Australian lamb and sheepmeat industries have been star performers over recent years and prospects for these industries remain strong as international demand continues to increase.

West Australian sheep producers are in an ideal position to capitalise on the sustained demand for lamb and sheepmeat due to their proximity to high growth markets and their ability to capitalise on a range of emerging opportunites within the sheep industry. These include the production of feeder lambs, breeding ewes and the live exports trade.

INTRODUCTION

Key international growth markets for sheepmeat include the USA, Japan, China and the Middle East and African regions. Meat & Livestock Australia (MLA) is focused on maintaining access and maximising consumption of Australian sheepmeat both domestically and in these and other regions while looking to develop emerging markets.

Growth across this range of diverse markets is being increasingly met by Australian exporters suppling products on a cut or item basis depending on price and suitability for traditional cooking methods in that region or country.

The West Australian sheepmeat industry has the ability to capture a large share of the growth in the Middle East and African markets due to proximity and the ability to supply the entire range of meat and livestock products. Exports to the Middle East have increased signifacently in 2005, with lamb up 36% to 14,100 tonnes sw and mutton exports up 24% to 36,100 tonnes sw due to growing populations with more disposable income, improved Australian supply, higher prices for competitor products and a rejuvenated live export trade.

REVIEW

The key drivers of demand for Australain lamb and sheepmeat include international supply, prices of competitor proteins, economic prosperity, both domestically and abroad, the impact of exchange rates, disease outbreaks and access to global markets.

A 10% increase in slaughter of Australian lamb in 2005 to 18.23 million head, combined with reduced supply from New Zealand sheepmeat, has assisted growth of Australian exports throughout the year. This combined with the increased prevlance of avian influenza (AI) and outbreaks of foot and mouth disease (FMD) in some Brazilian and Argentinian states has meant that Australian sheepmeat was more competivie in international markets.

As a result, Australian lamb exports for 2005 reached 141,000 tonnes worth approximately $760 million, a 26% increase in volume and value on 2004 exports. Exports are expected to grow a further 5% in 2006; volumes are expected to increase to 173,000 tonnes by 2010 accounting for virtually all the extra increase in supply.

The USA remains the main lamb market accounting for 29% of volume, 43% of value and 40% of recent growth reaching 41,000 tonnes sw in 2005 worth $324 million. Exports, dominated by leg and loin cuts, are projected to reach 43,000 tonnes in 2006.

In Japan, the development of specialist Genghis Khan restaurants has seen consumption of lamb boom, reaching 11,000 tonnes sw in 2005. Exports, consisting mainly of bone less and bone in shoulders are expected to grow by 14% to 12,500 tonnes sw in 2006 exceeding $79 million in value.

Despite China's large sheep population, exports of predominately breast and flap, jumped 44% to 13,494 tonnes sw in 2005 and are expected to increase to 15,000 tonnes sw in 2006.

The Middle East market is changing rapidly, stimulated largely by revenues from oil reportedly generating a net profit of US $2,000 per second or US $1.67 billion day. The region is home to 237 million consumers; approximately 70% are under 20 years of age.

Throughout the region, international retailers are opening western style hypermarkets. These are influencing the way people shop and the products they buy. This is causing a shift from frozen products, supplied to butcheries and corner stores, to chilled carcases and cuts, including legs and square cut shoulders suitable for larger scale retailing

Consumer research shows that a focus on new factors, including flavour, convenience, and enjoyment, will play a more important role in capturing the younger generation of consumers in this region.

Growth in the number of middle income earners in South Africa has resulted in stronger exports of lamb to this market, up by 51% to 4,400 tonnes sw while mutton exports are up 21% to 13,700 tonnes sw, almost 90% of these exports are the two items of neck and breast and flap.

Live sheep exports to the Middle East provide producers in Western Australia with another option for marketing their sheep. Live sheep exports reached 4.1 million head in 2005 driven by the return of Saudi Arabia to the trade. Exports are projected to reach 4.5 million head in 2006 and expand to 5 million head by 2010 due to sustained higher oil prices and strengthing competitor prices.

CONCLUSION

The Western Australian sheepmeat industry is ideally positioned to capture growth opportunites for sheepmeat, especially in the Middle East and African markets, due to proximity and the ability to supply the wide range of products required.

The ability to supply by a cut or item basis means that exports of the 'traditional' higher value cuts to a wide range markets including Europe and America complements the demand from the Middle East and Africa.

Future success will be reliant on the ability of the industry to maintain high standards of production and meet year round demand, lead the change to cut or item based supply, while improving supply chain knowledge and capabilities to these regions.

KEY WORDS

International markets, Middle East, cut or item based.

ACKNOWLEDGMENTS

Paper reviewed by: Ian Ross, Meat & Livestock Australia Ltd.

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The Merino Company (TMC) – Active marketing and supply chain management

Mark Suttie, General Manager Marketing – The Merino Company (TMC)

ABSTRACT

- The Merino Company (TMC): Marketing and supply chain management in the wool value chain
- Basic introduction into our business model
- A simple case study of how the model is being applied effectively for Tasmanian wool growers and specifically for Roberts Wool Link.

AIMS

The Merino Company (TMC) is a marketing and distribution platform designed to give wool growers and key participants stable and sustainable returns. The fundamental aim of The Merino Company is to promote consumer awareness of and demand for the unparalleled quality of Merino Wool. In so doing TMC has the express intent of bringing benefits to both buyer and seller, through the implementation of collaborative marketing aimed at building the Merino brand. TMC is a wool textile marketing entity focusing on retail marketing, demand generation, and market-linked R&D. TMC enables both producers and processing partners to generate sustainable demand, price stability, and increased value from innovative wool brand development. The end result is that we'll better meet the needs of retailers and consumers. TMC is working in association with leading grower services providers to implement this innovative new concept; A Merino fibre initiative designed to bring about the sustained profitability of Merino stakeholders, from growers right through to retailers.

METHOD

There are two key areas of activity practiced simultaneously by TMC; the first is to take a corporate approach to marketing on behalf of Roberts Wool Link (RWL) and the second is supply chain management.

TMC – Marketing & Supply Chain Management for RWL

<u>RWL Marketing:</u>

A comprehensive marketing strategy has been prepared for RWL by TMC; the following are the key success factors;

1. Customer and consumer orientation.
2. Differentiation of Tasmanian wool brands based upon origin and ongoing innovation.
3. Relationship building with existing customers and the development of new relationships.

4. Traceability, authenticity and certification programs.

5. The relative scarcity of Tasmanian wool.

RWL Supply Chain Management (the following are the key outcomes from TMC's supply chain management process):

1. The channel is significantly shortened, physical ownership changes much less meaning the ability to supply quality product at a fair price and ensure margin for aligned channel partners

2. Channel participants are aligned toward best meeting consumer needs and delivering customer satisfaction and loyalty

3. TMC has the responsibility of effecting greater bi-directional communication through the channel; especially focusing upon better communication of customer / consumer wants and needs

4. The entire channel is aligned towards ensuring customer satisfaction with the end result being greater loyalty

5. The channel is marketing and relationship oriented

RESULTS

The Roberts Wool Link program does not launch until July 1 this year. Even so the marketing efforts for RWL commenced in late October 2005. In fact the collaborative development of this program has been many years in the making.

There are many case studies where we can illustrate the demonstrable results that these programs have already achieved on behalf of Tasmanian wool growers and these will be prepared for the presentation in July.

CONCLUSION

Active marketing and supply chain programs are absolutely vital if wool is to become a relavent fibre in the future. In the early days of the RWL program, TMC is able to demonstrate some significant success and strong returns to wool growers.

KEY WORDS

- Strategic Marketing
- Demand generation
- Supply chain management

ACKNOWLEDGMENTS

The strategic thinking which is the basis of the TMC business model has come through the vision and experience of Lempriere (Australia) and Roberts Pty Ltd. There are many people dedicated to this program but significant credit must be given to William Lempriere (Managing Director of Lempriere (Australia)) and Eric Hutchinson, Marketing Manager of Roberts Pty Ltd who championed this project for several years.

Paper reviewed by: Eric Hutchinson – Roberts

Driving on-farm productivity: the next 20 years

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ABSTRACT

New Zealand now exports about the same amount of lamb[1] as in the late-1980s from a ewe flock which is 40% smaller. There has been a major increase in productivity from 12.7 to 21.3 kg of meat per ewe, a compound rate of 3.3% per year, due to increases in both weaning percentage and carcase weight. While there are opportunities to further increase per ewe productivity, the focus must be on factors that impact on overall efficiency of the farming business, which includes both income and expenditure. A method of analysis that focuses on the drivers of profitability is described, while some of the technologies that will impact on the business of sheep farming are outlined.

INTRODUCTION

New Zealand now exports about the same amount of lamb as in the late-1980s from a ewe flock which is 60% the size. Hence there has been a major increase in productivity. While this is interesting, the real challenge is to consider the opportunities to further enhance productivity over the next 20 years. Much of the recent focus has been on individual animal productivity, but it is the overall financial efficiency of the enterprise which determines economic viability and success. Therefore the focus must be on factors that impact on overall efficiency, which also includes consideration of both income and expenditure.

REVIEW

Productivity gains over the last two decades

The comparative productivity data on a per ewe basis are summarised in Table 1.

Table 1. Productivity in the NZ sheep industry from the 1980s to 2004/05

	Total gain over period			**Rate of gain per year (16 yrs)**	
	82-88	**04/05**	**Overall % increase**	**Annual rate**	**Compound rate (% pa)**
Components of productivity[2]					
Overall lambing rate per adult ewe[3]	1.0	1.29	29	1.8 % units	1.6
Lamb carcase weight	13.2	17.1	29	3.9 kg	1.6
Ewe carcase weight	19.3	24.5	27	5.2 kg	1.5
Overall productivity per ewe[4]					
Productivity (kg carcase /ewe)	12.7	21.3	68	8.6 kg	3.3

The gains in productivity are impressive but followed many years of relatively static performance. To put these gains in perspective, the annual compound rate of gain in ewe productivity over the last 16 years is 3.3%, which is due to equivalent gains in lambing percentage, lamb carcase weight and ewe

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[1] Lamb exports: expressed as bone-in carcase equivalent to allow comparisons across years; the actual tonnage is less as much is exported as processed cuts (current exports are more than 400,000 tonnes of carcase equivalent); sheep numbers: late-1980s: 45 mn ewes and 12 mn ewe hoggets; current: 27 mn ewes and 8 mn ewe hoggets.

[2] Source: Meat and Wool NZ Economic Service & Statistics NZ (www2.akl.obm.co.nz/meatnz/Livestock.htm)

[3] Clarification: the overall lambing rate counts all lambs but counts only the adult ewes; hence lambs from 1 year old sheep (hoggets) are included in the total, but their dams are not. The actual number of lambs weaned per adult ewe has increased from 1.0 in the 1980s to 1.20 now; that is, lambs from hoggets account for one-third of the increase.

[4] Productivity (kg of carcase weight produced per ewe) = [(Total lambs weaned per MA ewe – 0.30 for replacements) x Lamb Carcase Wt] + [Ewe slaughter rate x Ewe Carcase Wt]

carcase weight. The data do not include wool but production per ewe has not changed over the period.

What are the factors that have driven the increase in productivity? Competition for land and resources had a major impact on the decline in sheep numbers in the 1980s. While the loss of land to agriculture had an impact, the demise of wool and the relative prices of lamb and dairy milk solids were both important. However over the last 10 years, the dairy advantage in terms of price per kilogram of product has all but disappeared, with the prices of lamb and milk solids now about the same. In reality a number of factors drove the resurgence, and helped halt the decline in sheep numbers. There has been an increase in focus on farming as a business driven in part by 'over the fence' comparisons with dairying, while newer pasture cultivars and the progress in sheep breeding have also contributed to improvements in productivity. While these productivity gains are very satisfying, the real challenge is the next 20 years. However, the gains of the last 20 years provide a solid basis from which to go forward.

Scenarios for the next two decades: individual ewe productivity

The gain in productivity per ewe over the last 16 years is around 9kg. Table 2 presents three scenarios showing how the same gain could be achieved over the next two decades.

Table 2. Scenarios around increasing productivity in the NZ sheep industry in the next 20 years

			Flock Performance Data				
Year		**Productivity (kg per MA ewe)**	**Total lambs weaned per MA ewe**	**Lambs weaned from MA ewes**	**Lamb Carcase Weight (kg)**	**Ewe slaughter rate**	**Ewe Carcase Weight (kg)**
Actual data over the last 16 years							
1988-89	9	**12.7**	1.00	1.00	13.2	0.18	19.3
2004-05	25	**21.3**	1.29	1.19	17.1	0.18	24.5
Actual change over period							
		8.6 (68%)	***0.29***	***0.19***	***3.9***	***0***	***5.2***
Scenarios for the next 20 years: Scenario 1							
Current	25	**21.3**	1.29	1.19	17.1	0.18	24.5
2014-15	35	**25.6**	1.40	1.30	19.1	0.18	25.5
2024-25	45	**30.0**	1.50	1.38	21.1	0.18	26.5
Projected change over 20 years							
		8.7 (41%)	***0.21***	***0.19***	***4.0***	*0*	***2.0***
Scenario 2							
Current	25	**21.3**	1.29	1.19	17.1	0.18	24.5
2014-15	35	**26.1**	1.47	1.35	18.1	0.20	24.5
2024-25	45	**30.0**	1.59	1.44	19.1	0.22	24.5
Projected change over 20 years							
		8.7 (41%)	***0.30***	***0.25***	***2.0***	***0.04***	*0*
Scenario 3							
Current	25	**21.3**	1.29	1.19	17.1	0.18	24.5
2014-15	35	**25.6**	1.49	1.37	17.4	0.20	24.5
2024-25	45	**30.0**	1.69	1.52	17.7	0.22	24.5
Projected change over 20 years							
		8.7 (41%)	***0.40***	***0.33***	***0.8***	***0.04***	*0*

Each scenario involves an increase in lambing percentage, with varying changes in lamb carcase weight. The views of NZ marketers on the preferred carcase weights for international markets are always controversial, so that scenario 3 assumes virtually no change. This scenario requires an increase in weaning percentage of 33% units in adult ewes to around 150%. While this is achievable on individual farms (numerous flocks already perform at such levels), it is very challenging at a national level.

The basis of the gains in terms of the relative contributions of genetics and management is of interest in considering future opportunities. The increase in the adult ewe lambing is around 20% with an increase of about 10kg in ewe live weight. Based on the rate of genetic gain in the NZ sheep flock (Sheep Improvement Ltd, www.rampage.co.nz) and the overall impact of recorded flocks, genetic gain would account for about one-third of the live weight change. The weaning rate – ewe liveweight relationship indicates that a 10kg lift in live weight should generate about 13% increase in weaning rate. The actual increase was 20%. Hence by difference, one-third would be due to genetics independent of ewe live weight. The genetic contribution to live weight would also account for some of the effect on live weight. Therefore we estimate that about half the gain in weaning rate and about one-third of that in live weight are due to genetics.

A focus on enterprise profitability

The emphasis above is on individual animal productivity, but it is enterprise profitability that determines economic success. Therefore the focus must be on factors that improve financial efficiency, but typical analyses of farming businesses do not delve deeply enough to uncover the effects of underlying factors on earnings. Analysis of farm performance usually focuses on farm surplus (gross income less working expenses). Crude indicators such as lambing rate and lamb weights may also be included. From our perspective, the focus on outputs impedes our view of the actual root contributors to farm profitability.

A more recent approach involves an analysis that focuses on the four main drivers of profitability namely feed consumed, feed conversion efficiency, product price, and costs. A further sophistication involves breaking down the four main 'drivers' to their component parts, so that we can see where improvements can be made, and the effect that such improvements would likely have on profitability. We can then assess the source of our expenses and revenue and the specific areas where we are performing well, or poorly, and where there are opportunities for improvement. Therefore it is important to understand the factors or drivers that determine the ultimate output, *Earnings before interest and tax* (EBIT) per ha.

Secondary drivers

↓

Primary drivers

(the four drivers are feed consumed, feed conversion efficiency, product price, and costs)

↓

EBIT/ha (Profit)

The data required for this type of analysis are commonly collected by farmers, and many are doing so with simple farm recording systems or through Farmax software. The primary drivers approach provides a new way of interrogating data. Farmax provides farmers with a number of insights about their business and also provides the ability to "benchmark" year to year, but we find that it does not go far enough. Therefore we are developing a new level of analysis to help understand the underlying factors that drive productivity.

Component drivers of productivity *(The new level of analysis)*

(key factors that each impact on one or more of the secondary drivers)

↓

Secondary drivers

↓

Primary drivers

↓

EBIT/ha (Profit)

In a sheep enterprise, the key secondary driver is the efficiency of the ewe flock:

Number of lambs weaned [(Lambs available – Females for replacements) x Weaning weight]/Ewe weight

The number of lambs surviving is a function of the scanning percentage, and of ewe and lamb deaths, while the number of females required for replacements is a function of the number of ewe deaths and the rate of culling in the ewe flock. The average weaning weight is a function of the ewe feeding from lambing to weaning, ewe condition and average pasture cover at lambing, and pasture quality and availability. This set of parameters and functions has lead to the development of a set of relatively simple records that a farmer can collect. Currently we use about eight key indicators including live weight at mating, scanning percentage, weaning percentage, lamb growth rate pre- and post-weaning, drafting or selling dates of lambs, carcase weight, and ewe deaths. The value comes from analysing the relationships between these factors and their relationship to profit. However the analysis is relatively complex and we are currently developing a software package to analyse and help interpret these data.

How will newer technologies impact

Technologies will continue to impact at several levels of the business. New knowledge will greatly assist in the management of higher litter sizes, and in the management of animal health. New pasture cultivars that make better use of water and nutrients will be important. Some of the newer DNA technologies will have a major impact on ram breeding enterprises and will therefore accelerate genetic gain through the industry. However the greatest direct impact at the individual farm level will come through new systems of data collection, data analysis and the use of information. While the overall impact will be cumulative across the whole supply chain, we see three types of technologies that will impact in particular. They are:

- electronic identification of individual animals using RFID (radio-frequency identification) that will enhance the links from the processor to the farmer to the breeder, and facilitate management decisions (such as recording details at pregnancy scanning, frequent recording of animal live weights);
- systems to measure and allocate feed supplies such as electronic systems to record pasture cover and growth to enable much better allocation of feed, and the assessment of performance of individual paddocks on a farm;
- systems to reduce labour, such as rapid on-farm diagnostics to identify health or disease status.

The management skill will be in the distillation and integration of these various sources of information.

CONCLUSION

The challenges to maintain the momentum of increasing productivity in the New Zealand sheep industry are not to be underestimated. However the reality is that the international market will ultimately determine the future of the sheep industry. While the medium-term market prospects are bright, an on-going focus around on-farm efficiency will be critical to a vibrant long-term future.

KEY WORDS

Sheep productivity, lamb, New Zealand, efficiency, farm profitability

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Novel selection traits – what are the possible side effects?

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ABSTRACT

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

AIMS

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

METHOD

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

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

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

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

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

RESULTS AND DISCUSSION

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

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

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

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

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

CONCLUSION

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

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

KEY WORDS: Breech bareness, temperament, shearing time

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

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Genetic Changes in the Australian Merino since 1990

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ABSTRACT

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

AIMS

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

METHOD

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

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

RESULTS

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

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* AGBU is a joint venture of NSW Department of Primary Industries and The University of New England

However, variation between groups was appreciable, ranging from -1.5% to +2.6% per annum. Most of the genetic changes in HBW (upwards) and HFDCV (downwards) seem to have occurred since about 1994-95. Annual average trends for individual groups over the entire reporting period ranged from -0.5 kg to + 0.8 kg for BWT and from -0.23% to +0.16% for HFDCV.

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

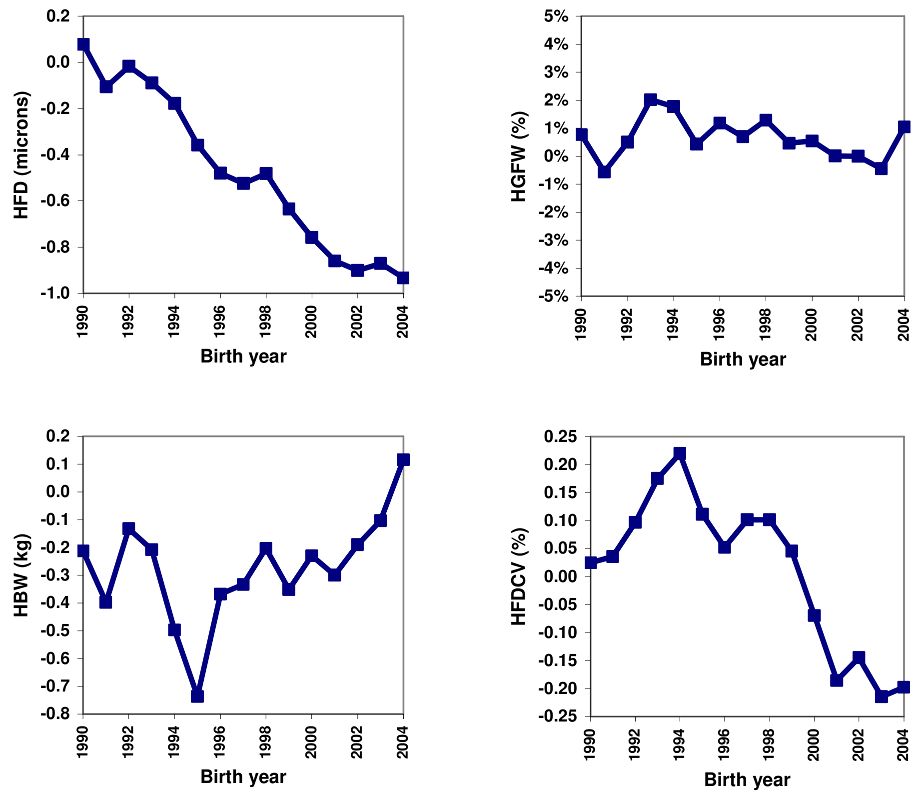

Figure 1. Genetic trends in hogget fibre diameter, hogget greasy fleece weight, hogget body weight and hogget coefficient of variation of fibre diameter in a sample of Merino flocks since 1990. Each Y-axis is scaled to represent a range of approximately 0.7 phenotypic standard deviations.

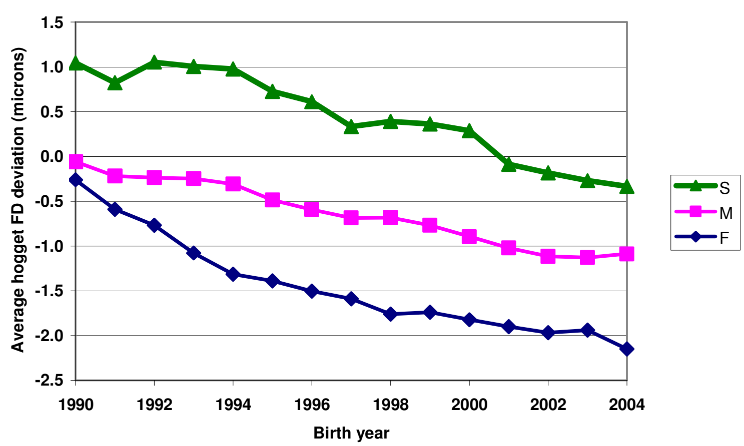

Figure 2. Average solutions for 105 genetic groups classified by year of birth and hogget fibre diameter category in 2000.

CONCLUSION

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

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

KEY WORDS

Genetic trends, Merino, breeding

ACKNOWLEDGMENTS

This work is funded by Australian Wool Innovation and Meat and Livestock Australia.

Paper reviewed by: Dr Andrew Swan.

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

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ABSTRACT

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

AIMS

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

METHOD

Experiment 1

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

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

Experiment 2

Poll Dorset sires selected for growth (PDg), for muscling (PDm), for growth and muscling (PDgm) and control sires were used across Merino ewes. The lamb types were generated by artificially inseminating ewes using 5 sires per sire group (i.e. 5 x 4 = a total of 20 sires). Progeny were weaned at either 20 or 30 kg and within each weaning group half the lambs were maintained at their weaning weight for 8 weeks or grown on full feed. After the maintenance period lambs were realimented. Lambs were slaughtered when each weaning/growth path group (n = 4) reached 45 kg on average.

Ewes were separated into the 20 sire groups for lambing (July 2004). Lambs were tagged within 15 h of birth and their birth weight, dam identification, sex, type of birth (number of lambs in the litter), and birth date were recorded. From birth to weaning lambs were run with their mothers at pasture. The lambs were weighed at marking (20 days after birth), the early weaners at 62 days after birth and the late weaners at 95 days after birth. Liveweight at each age was analysed using a linear mixed model in ASReml. The fixed effects in the model were sex (wether, ewe), birth type (1-4), rearing type (1-3) and the covariates sire post weaning weight (PWWT) EBV, sire post weaning eye muscle depth (PEMD) EBV, birth weight and animal age. Sire and dam identification were included as random terms.

RESULTS

Experiment 1

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

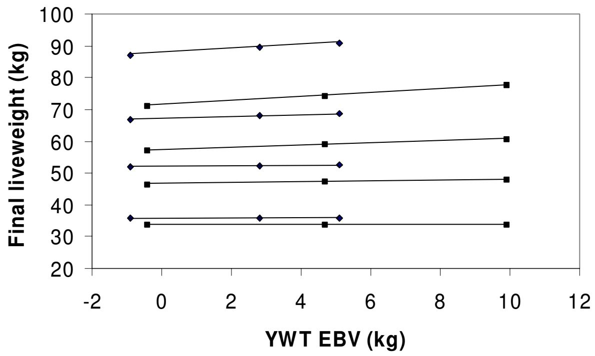

Figure 1. Relationship between final liveweight (kg) and sire YWT EBV at different slaughter ages, within genotype (♦ BLxM; ■ M×M).

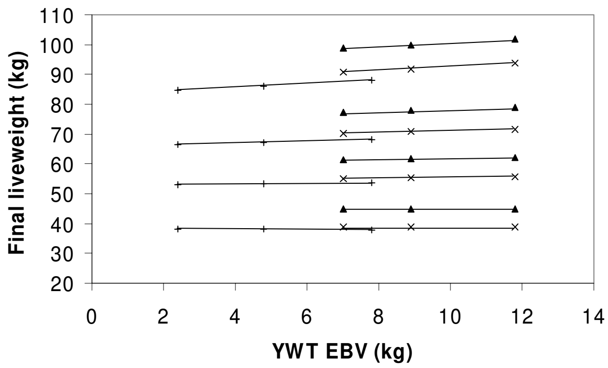

Figure 2, Relationship between final liveweight (kg) and sire YWT, EBV at different slaughter ages, within genotype (▲ PDg×BLM; × PDg×M; + PDm×M).

The overall coefficients for YWT were -0.01, 0.14, 0.34 and 0.65 for slaughter ages 108, 234, 398 and 657 days respectively indicating that while in young animals there was no effect of sire EBV on liveweight, as the animals aged there was an increasing effect such that progeny of sires with high sire

YWT EBVs were heavier. As shown in the Figures 1 & 2 this effect is evident within all genotypes. This data is unique because previous studies have focussed on weaned lambs and none to our knowledge have included 14 or 22 month old animals.

Experiment 2

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

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

Terms	Birth weight	20 day weight	62 day weight – early weaned	95 day weight – late weaned
Birth weight	**Not applicable**	**	**	**
Birth type	**	**	**n.s.**	*
Rearing type	**Not applicable**	**	**	**
Gender	**	**n.s.**	**	**
Age	**Not applicable**	**	**	**
PWWT	**n.s.**	**n.s.**	**n.s.**	*
PEMD	**n.s.**	**n.s.**	**n.s.**	*

n.s.; not significant; *P<.05; **P<0.001

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

CONCLUSIONS

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

KEY WORDS

Sires, growth, lambs

ACKNOWLEDGMENTS

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

Paper reviewed by: Dr Alex Safari

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

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ABSTRACT

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

AIMS

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

METHOD

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

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

Study		1	2	3	4	5	6	7
Breed		TxMer	2nd cross	2nd cross	2nd cross	TxMer	Mer	TxMer
Starting Weight	kg	35	36	36	36	36	42	40
Final weight	kg	49	43	43	52	50	54	55
HCWT	$/kg	3.50	3.50	3.50	4.50[A]	3.50	3.20	3.50
Dressing%	%	46	43	43	45	44	42	45
LWT gain	g/h/d	165	240	265	235	190	138	180
Intake(DM)	%LWT	2.6	3.5	4.7	2.8	2.8	2.9	3.2
Intake(DM)	kg/h/d	1.09	1.38	1.85	1.23	1.20	1.39	1.52
Feed convDM	DM/LWT	6.6	5.8	7.0	5.2	6.3	10.0	8.5
Ration		Grain/hay	Grain/silage	Grain/silage	Grain/hay	Grain/hay	Pellets	Pellets
Feeding		Separate	Separate	TMR	TMR	Separate	TMR	TMR
Ration Cost	$/t fed	191	123	123	264	171	300	300
Ration Cost	$/t DM	214	215	215	298	193	333	333

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

RESULTS

Lamb Profit

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

Input Sensitivity

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

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

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

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

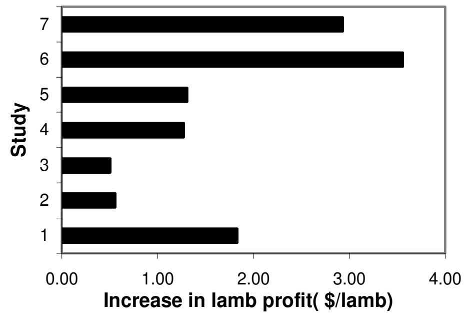

Figure 1. Gain in lamb profit by increasing daily growth rate by 10 g/h/d when intake is maintained.

CONCLUSION

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

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

KEY WORDS

Feedlot, lambs, profit

Paper reviewed by: Mr. Ashley White

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Annual ryegrass toxicity (ARGT) in WA – 2006

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ABSTRACT

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

REVIEW

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

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

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

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

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

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

Control Options:

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

In spring, the use of slashing or heavy grazing to remove infected seed-heads before toxicity develops can vastly increase the safety of affected paddocks. Spray-topping with gramoxone or glyphosate at the correct times will also prevent further development of toxicity and make paddocks safer to graze, but both these treatments are very damaging to legume seed set. Glyphosate (450g/L) @ 350mL/ha when ryegrass seed-heads first begin to emerge or gramoxone (250g/L) @ 400mL/ha about 10 days after head emergence can be very effective treatments (Note that these timings are much earlier than those for seed-set control).

After haying-off has occurred, toxin levels increase, and in crop, removal of seeds/galls using chaff carts can increase the grazing safety of stubble. In pasture, burning affected patches is also an option when permitted. By January, galls have begun to shed naturally and can be assisted by dragging heavy chain or railway iron over affected patches in pastures.

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

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

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

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

	Bacterial galls per kg of pasture	
	Season before treatment (Oct 2004)	One season later (Oct 2005)
Untreated area	>1000	>1000
Area treated with Safeguard + Twist		8 (range 1-21)

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

KEY WORDS

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

ACKNOWLEDGMENTS

Project funding: Meat & Livestock Australia

Project support: Glenda Smith-Beaumont, Linda Leonard, Jeremy Allen, Alan McKay & Ian Riley

Paper reviewed by: Jeremy Allen and Ian Riley

Poor ewe nutrition during pregnancy increases fatness of their progeny

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ABSTRACT

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

AIMS

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

METHOD

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

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

RESULTS

- The 'Low' group grew slower than the 'High' group during the first 4 weeks of *ad libitum* feeding (172 *vs*. 238 g/d; $P <0.01$) and this trend continued over the 8-week period (131 *vs*. 173 g/day; $P = 0.06$).
- There were no significant differences in average daily feed intake between the 'Low' and 'High' groups (1.51 *vs.* 1.65 kg DM/day) or feed conversion efficiency (11.4 *vs.* 10.0 kg gain/kg intake). However, the 'High' group tended to eat more and be more efficient at converting feed into liveweight gain.

- There were massive differences in whole body lean and fat tissue mass measured by DEXA; on average, after correction for liveweight, the proportion of fat was greater (33.8 *vs.* 24.0%; P<0.001) and lean was less (63.1 *vs*. 72.0%; P<0.001) for the 'Low' than 'High' groups. These differences in whole body fat and lean were not reflected in difference in average depth of back fat (4.2 vs. 3.9 mm) and eye muscle (30.3 vs. 28.8 mm) after correction for liveweight.
- Body composition of adult wethers was most closely related to their liveweight. After correcting for differences in liveweight, lambs that were smaller and grew more slowly to weaning had less lean tissue and were fatter at mature size. More than 80% of the variance in the proportions of fat and lean was explained by differences in liveweight of progeny (PLW; kg), ewe liveweight at joining (ELW_0; kg) and changes in ewe liveweight between joining and day 90 of pregnancy (LWC_0-90; kg) and day 90 and lambing (LWC_90-L; kg).

Fat (%) = -5.0 + 1.12 PLW – 0.60 ELW_0 – 0.67 LWC_0-90 – 0.58 LWC_90-L (r^2 = 0.83; P<0.001)

Lean (%) = 102.2 – 1.00 PLW + 0.50 ELW_0 + 0.54 LWC_0-90 + 0.50 LWC_90-L (r^2 = 0.84; P<0.001)

CONCLUSION

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

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

KEY WORDS

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

ACKNOWLEDGMENTS

The authors wish to thank Australian Wool Innovation and the Department of Primary Industries, Victoria for funding this work.

Paper reviewed by: Ralph Behrendt and Geoff Saul, DPI Victoria.

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Making better use of clover

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ABSTRACT

To make better use of the high nutritional value of clover, we need to grow more of it and utilise it more efficiently. One way to do this is to grow clover separately from grass rather than as a conventional mixture. This removes the competitive suppression of clover by the grass, and allows each species to be managed for their maximum production. Growing grass and clover separately and allowing sheep to choose their preferred diet of about 70% clover and 30% grass can also increase lamb growth rates by 20-30% compared to a mixture. The production benefit achieved by having continuous free-access to both species is due to higher intakes of clover, higher feed conversion efficiency, and possibly reduced energy expenditure as less time is spent searching for the preferred diet.

AIMS

Pastures for sheep production are typically sown with mixtures of grasses and legumes. These species are complementary to each other in many ways. The legume fixes nitrogen from the atmosphere and supplies nitrogen to the grass. They are also complementary in nutritional attributes. Clover has a high concentration of protein, which is rapidly degraded in the rumen. Grass by comparison has a higher concentration of fibre. A combination of the two species should match the nutritional requirements of the sheep or cattle more closely than either species alone.

In practice, grass-clover mixtures do not consistently perform to their theoretical potential because the clover content of mixed pastures is often less than 10 to 20% (Quigley *et al.* 1992). Maintaining a high proportion of clover is especially difficult in rotational grazing systems, and the proportion of clover varies seasonally and from year to year. When offered a free choice of grass and clover *ad libitum* both sheep and cattle consistently choose a diet containing around 70% clover and 30% grass. The high proportion of clover that they like to eat is in marked contrast to the proportion offered to them in mixed pastures. Growing grass and clover side by side in the same paddock may be an effective way to grow more clover and allow animals to select their preferred diet.

METHOD

The concept of splitting grass and clover was tested during 2002 and 2003 near Hamilton in southwest Victoria. There were four pasture treatments; (i) pure perennial ryegrass; (ii) pure subterranean clover; (iii) mixture of ryegrass and subterranean clover (85:15 mix); and (iv) side-by-side blocks of ryegrass and subterranean clover (50:50 by area). Feed on offer was maintained at greater than 2000 kg DM/ha at all times. Three replicates of each pasture system were grazed by 120 Coopworth/Corriedale ewes with two-month-old twin lambs over 7 weeks from mid-October 2002. The experiment was repeated in 2003 with 4 replicates grazed by 180 twin-bearing ewes from 2 weeks prior to lambing in August until weaning at 12 weeks of age. Pasture quantity and quality was measured 2 weekly, sheep were weighed every 1-2 weeks and feed intake was measured using the alkane technique on 3-4 occasions each year.

RESULTS

- Lambs grew faster on pastures with high clover content or where they could select more clover, than on traditional mixed pastures (see Figure 1). The boost in lamb growth rate was between 20% and 30% in each year. These growth rate differences resulted in higher weaning weights (up to 7 kg) for lambs grazing pure subterranean clover or grass-clover side by side compared to the other pasture systems.

- Ewe liveweight gains followed a similar pattern such that ewes grazing pure subterranean clover and grass-clover side by side were up to 10 kg heavier at weaning than those grazing the other pasture systems. In 2003, ewes on the choice system gained more weight than those grazing pure clover. The differences in weaning weights would be expected to have impacts on ewe reproductive performance in the following year.

- The production benefit achieved by having continuous free-access to both species is due mostly to higher intakes of clover. Preliminary estimates of dry matter, metabolisable energy and protein intake suggest that the increases in animal performance on the choice pasture system were also partly due to increases in the efficiency of digestion and utilisation. Reduced searching for the preferred diets and therefore less energy expenditure may have also contributed to the production gains.

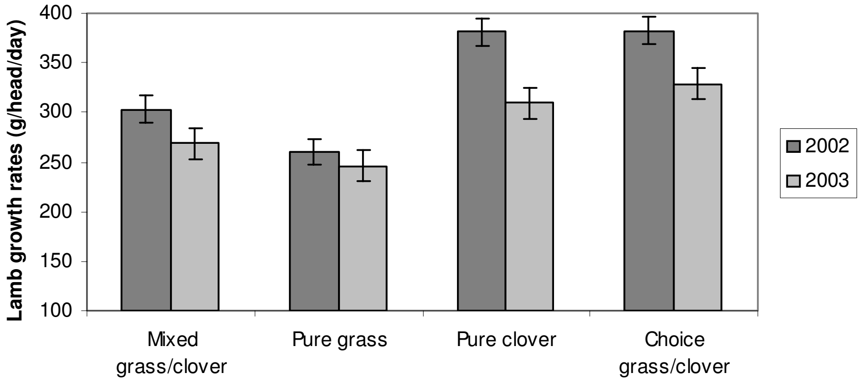

Figure 1. Growth rates of twin second-cross lambs grazing traditional mixed grass/clover, pure grass, pure clover, or the side-by-side grass/clover choice.

CONCLUSION

Growing grass and clover monocultures side by side can increase the proportion of clover in the diet and per head production. The growth rate and feed conversion efficiency of animals with about 70% of their diet comprising clover (30% grass) was equal to or better than that for ewes or lambs grazing mixed pastures or monocultures of grass or clover. This means that growing grass and clover separately could also increase production per hectare if total dry matter production is similar for ryegrass and clover. Cocks (1974) found minimal differences in total production from ryegrass and clover when grown as monocultures and provided with adequate water and nutrients. Indeed, clover produced more dry matter than grass when defoliated to maintain less than 2000 kg DM/ha.

Separating grass and clover allows each species to be managed more specifically to maximise their production. This could include tactics such as targeting nitrogen fertiliser to the grass component of the paddock, P and K to the clover, and herbicide use for weed control to a broadleaf or grass species background. Pure clover pastures would need to be rotated with grass pastures or crops every 2-3 years to minimise leaching of nitrogen below the root zone causing soil acidification and nitrate contamination of ground water. Growing the grass and clover alternately on each half of individual paddocks on a short-term rotation would allow the new grass or crop to benefit from the build-up of N under the previous clover monoculture while the clover should prosper in the low-N environment created by the previous grass or crop monoculture. This system implemented on a portion of the farm could improve lamb growth rates and efficiency of production.

KEY WORDS

Diet choices, perennial ryegrass, subterranean clover, lamb growth

ACKNOWLEDGMENTS

The authors wish to thank Meat and Livestock Australia and the Department of Primary Industries, Victoria for funding this work

Paper reviewed by: Ralph Behrendt and Geoff Saul, DPI Victoria.

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Grazing systems demonstration to optimise pasture utilisation and stocking rate

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BACKGROUND

Pasture utilisation under continuously set stocked regimes is generally low (<40%), especially where stocking rates (SR) are conservative and determined by poor seasons. Methods for calculating the potential SR, using rainfall (French 1991) or estimates of yearly feed intake (Grimm 1998), suggest the potential is 2-3 times the district average SR. Results from the Lifetime Wool Project suggest the potential SR could be even higher if ewes are managed to achieve target condition score (CS) during the reproductive cycle. A grazing systems demonstration comparing lamb production from annual *vs*. annual+perennial pastures and designed to manage breeding ewes to target CS during pregnancy and lactation has been established at Mount Barker Research Station. The "farmlets" comprise two adjacent paddocks: one containing annual pastures which are being partially replaced by perennial pastures (kikuyu, lucerne and tall fescue). The other paddock contains only annual species (sub-clover, annual grasses, capeweed). The aim of the demonstration is to compare, over 5-7 years, the increase in production, profitability and sustainability of two systems managed to optimise pasture utilisation and stocking rate using a combination of grazing management and agronomic tactics. These tactics should permit stocking rates to increase from the average district SR (9 DSE/ha) to the theoretical potential for the Plantagenet Shire (20 DSE/ha). Each farmlet is treated as a closed system, and all inputs (including labour) and outputs are recorded. Management decisions are made by consensus between a producer advisory group and research, technical and extension personnel.

AIMS

The aim of the demonstration is to emulate the purchase of a conservatively stocked property in the Plantagenet Shire and compare, over 5-7 years, the increase in production, profitability and sustainability of two pasture systems (annual+perennials *vs*. annual) managed to optimise pasture utilisation and SR using a combination of grazing management and agronomic tactics. Central to the demonstration is the recognition that the breeding ewe represents the 'engine room' of each system, so managing ewes to defined nutritional targets underpins all decisions. This should permit stocking rates to increase from the average district SR (9 DSE/ha) to the theoretical potential for the Plantagenet Shire (20-25 DSE/ha). Two trainees assigned to the demonstration for a 12 month period will learn valuable skills in pasture/animal production research.

METHOD

2005 was designated a 'pilot study' year where the infrastructure was established for each plot, new (perennial) pastures sown and methodologies for animals/pasture measurement developed. Feedlots were constructed in each plot to allow for destocking if groundcover reached wind erosion limits. 'Purchase' of the farm (Plot 1: Annual+Perennials, 25.5ha; Plot 2: Annuals, 18.8ha) occurred at the break of season (23 March). Merino ewes, which were mated to Merino rams, fed 'off-farm' to follow a target CS profile, and scanned at day 74 to identify single and twin bearing ewes, were randomly allocated to farmlets on day 74 of pregnancy (15 May; 110 and 85 ewes, respectively). Ewes were monitored for liveweight/condition score (CS) at 4-8 weekly intervals or at times when sheep were yarded for husbandry operations. Feed on offer (FOO, kg DM/ha) was assessed using a calibrated visual method at 4-6 weekly intervals during the growing season, and pasture cages used to estimate pasture growth rate (PGR, kg DM/ha/d). Dry matter production was estimated by summing the growth between short-term periods.

RESULTS

2005 was an atypical season for the Plantagenet Shire, with the annual rainfall exceeded on only two occasions since 1913. In summary: break of season 23 March (long-term average 15 May); annual rainfall 830mm (average 605mm); total DM production from annual pasture 17.8 t DM/ha (average 9.2 t DM/ha); potential SR 35 dse/ha (average 21 dse/ha).

In plot 1, 14 ha (56% of the total area) was sown to perennials. These contributed 37% of the total grazing days (break to break). Pasture hay was conserved from both plots (27 and 33 t DM for plot 1 and 2, respectively). Lambs were weaned on 23 November, and lot-fed using oats/lupins/hay during autumn. Despite feed rates approaching 1.4 kg/h/d supplied from self feeders, as of June 1 only 37 (38%) and 43 (55%) lambs exceeded 40 kg in liveweight for plot 1 and 2, respectively. This slow growth and low feed conversion partly reflects a poor genetic base, thus 8 Poll Dorset rams were purchased and mated to ewes in March 2006. In addition, 230 large-frame Merino ewes mated to prime sires in December were purchased with the intention to replace a proportion of the current breeding ewes. The number replaced will depend on the seasonal conditions for 2006.

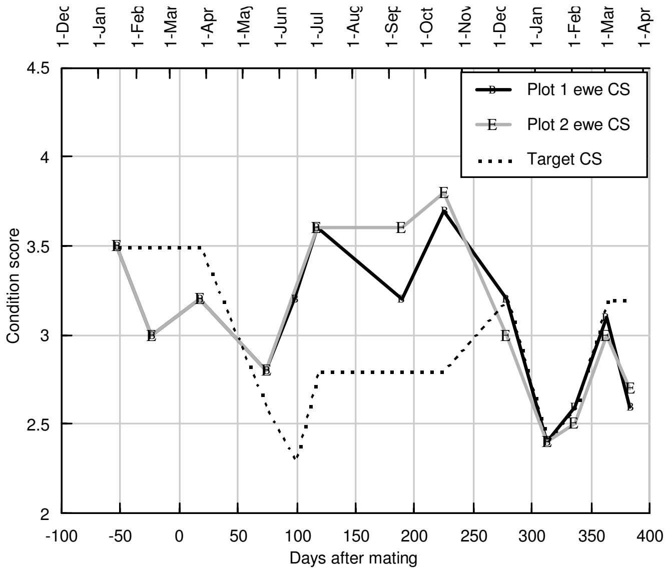

Figure 1. Target condition score profile (dashed line), and measured CS for ewes on plot 1 (■) and 2 (○)

The target CS profile, and measured CS profiles, for ewes from plot 1 & 2 are shown in Figure 1. Ewes were mated in good condition, and despite CS declining to mid-pregnancy, were well above the target condition at day 100. Scanning results indicated the reproductive rate (RR) to be 1.36, with 50% ewes single-bearing (SB), 43% twin-bearing (TB) and 7% dries. CS throughout lactation was maintained above 3 as a result of green FOO exceeding 2.5 t DM/ha. CS declined for both plots post senescence to day 300, then increased with the commencement of supplementary feeding to reach CS~3.1 by mating in March 2006. Scanning of these ewes indicate the RR to exceed 1.5 for both plots (43% and 40% SB, and 55% and 58% TB for plot 1 and 2, respectively).

CONCLUSION

The farmlet comparison will provide valuable information regarding the optimal management of breeding ewes, and give insight into the potential contribution perennial pastures could make to the productivity of a prime lamb enterprise in the Plantagenet Shire. The delayed break to the 2006 season and predictions for a dry season will ensure a range of grazing management tactics will need to be employed to reach FOO boundary levels and attain CS targets of breeding ewes.

KEY WORDS

Lifetime Wool, feed on offer, condition score, perennials, grazing systems.

ACKNOWLEDGMENTS

The author acknowledges the invaluable technical assistance from Tom Plaisted, Helen Hoult, Elysha McCreedy, Dallas Griffiths, Brad Seib, and staff at Mt Barker Research Station.

Paper reviewed by: Sue-Ellen Shaw

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Know your audience to increase their rate of practice change – Lifetime Wool as an example

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Carolyn Kabore, Kazresearch

ABSTRACT

The Lifetime Wool (LTW) project has developed guidelines that will help wool producers increase profit from Merino ewes and their progeny. A survey of wool producers has established a target audience willing to change ewe management. These wool producers are more aware of LTW and its messages and use consultants, sheep producer groups and pregnancy scanners more than those wool producers less willing to change. The most effective way increase the coverage to these willing wool producers is to include consultants, sheep producer groups and pregnancy scanners in the communication of the guidelines.

AIMS

LTW has developed guidelines to manage the nutrition of Merino ewes to meet production targets for themselves and their progeny. These guidelines will increase profit from sheep and increase wool producers' confidence when making ewe management decisions (1). Now that the research is over the priority for LTW is to communicate the benefits of these guidelines to wool producers. Historically the adoption of pasture and livestock assessment skills in Australia has been low (2). To improve the likelihood of adoption of the LTW guidelines the communication needs to target the wool producers that are more willing to change their ewe management. The hypothesis tested in this paper is that by working with wool producers willing to change, LTW can find better ways to deliver the guidelines.

METHOD

A phone survey was done with 1738 wool producers across Southern Australia. All participants surveyed had more than 500 sheep. Participants were asked how willing they are to change five aspects of their management of Merino ewes on a quantitative scale. This willingness to change was used to allocate each wool producer to the categories in figure 1. Those that were most willing to change or have already changedall 5 aspects of their ewe management were allocated to the innovators category (technology enthusiasts). Those that were not willing to change anything were allocated to the laggard category. The target audience for the Lifetime Wool project are the early adoptors and the first 12.5% of the early majority (cautious and pragmatic adopters); a total of 25%. The early majority are a priority for LTW because these wool producers are willing to change but have not been involved in the project. These wool producers were also asked questions to benchmark knowledge and current practice when managing their ewes. There were also questions about where they get information about sheep management. The target audience does not include innovators because it is likely that they have already had involvement with LTW.

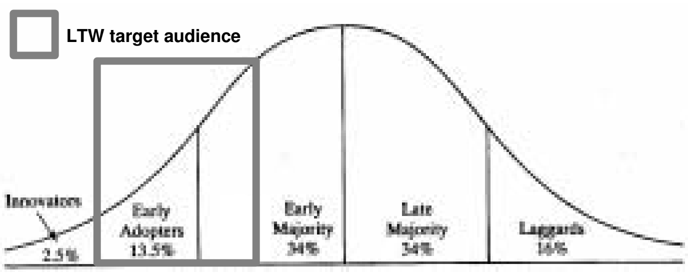

Figure 1. Adopter categorisation based on how quickly an individual adopts an innovation. Innovators are the first and laggards are the last to adopt an innovation (3).

RESULTS

The target audience for Lifetime Wool have more sheep (p<0.001) than wool producers not in the target audience (table 1). They are more likely to use consultants and be a member of a sheep producer group than those not in the target audience (table 1). There are wool producers in the target audience that are aware of LTW and doing the recommended practices but none of the target audience are doing all recommended practices (table 1).

Table 1. Comparison in the characteristics of wool producers in the LTW target audience and those not in the target audience.

Characteristic	Target audience (n = 448)	Not target audience* (n = 1243)
Average no. sheep	4594	3891
Use consultants	**244 (54%)**	**418 (34%)**
Member of sheep producer group	**76 (17%)**	**76 (5%)**
Aware of LTW project	235 (52%)	440 (35%)
Knowledge (agree with the statements below)		
You need to put your hands on ewes or weigh them to accurately assess their body condition	323 (72%)	449 (40%)
Improving the condition of a ewe during pregnancy and early lactation can increase the fleece weight in progeny	384 (76%)	936 (75%)
Improving the condition of a ewe during pregnancy and early lactation can decrease the fibre diameter of progeny wool	162 (36%)	286 (23%)
It is profitable to scan for twin bearing ewes and run them as a separate mob	323 (72%)	499 (40%)
Current practice		
Scan ewes for pregnancy	**229 (51%)**	**307 (25%)**
Scan ewes for twins and separate into different mobs	138 (31%)	103 (8%)
Weigh, condition score or fat score ewes for targets at joining and lambing and separate based on condition	164 (37%)	150 (12%)
Formal assessment of pasture or pasture growth rate	212 (47%)	222 (18%)

* Not target audience does not include innovators

CONCLUSION

The communication of LTW guidelines will include consultants, sheep producer groups and pregnancy scanners because this will provide better coverage of the target audience. The communication will also emphasise the information that the target audience know less about. For example, only 36% of the target audience are aware that improved ewe condition during pregnancy will decrease the fibre diameter of progeny. LTW is confident that the target audience are in a position to use the guidelines that will help them increase their profit from sheep.

KEY WORDS

Target audience, extension, ewe management, Lifetime Wool

ACKNOWLEDGMENTS

LTW is funded by AWI, DPI Vic, DAFWA, SARDI, DPI NSW, DPI Tas., Austral Park & Billandri Merino Stud and 120 woolproducers across southern Australia.

Paper reviewed by: Perry Dolling, Chris Oldham and Andrew Thompson.

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Lifetime Wool – Ewe Management Guidelines

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ABSTRACT

Lifetime Wool is a national project that has developed draft management guidelines that will assist sheep producers to optimise production from their Merino ewe flocks. Central to the guidelines are condition score targets for ewes at key times during the reproductive cycle, and feed on offer boundaries to meet these targets are also provided. This essential information will allow better management of sheep and pastures.

INTRODUCTION

Lifetime Wool (LTW) is a national project developing guidelines for the nutritional management of ewes. The guidelines are based on condition score (CS) targets at key times during the reproductive cycle, and have been derived from five years of research and development that has taken place on commercial properties across southern Australia. Intensive plot-scale research in Western Australia and Victoria involving more than 10,000 sheep was initially used to develop relationships between ewe CS profile and: the reproduction, mortality, and wool production of ewes, and the survival and lifetime performance of progeny (Thompson and Oldham, 2004). A draft set of guidelines and decision support tools (DST's) were developed using these prediction equations. Results from the plot-scale research were supported by the outcomes of the paddock-scale research (Behrendt, 2006), and the resultant draft guidelines and decision support tools (DSTs) were road-tested for their feasibility and practicality by over 120 farmers involved in the demonstration/development phase of Lifetime Wool in 2005-06.

REVIEW

Ewe condition score profiles

Sheep producers from four states involved in the demonstration/development phase of LTW managed their ewes to an "optimum" CS profile devised for spring lambing flocks. The CS profile has five key targets during the year: joining (ram introduction), day 90 after joining (pregnancy scanning), just before lambing (pre-lambing vaccination and/or drenching), weaning (approximately day 240 after joining) and at joining in the following year. These targets were shown to produce the "optimum" return (90% of the maximum values of the various dose response curves for ewe and progeny parameters) based on economic modelling of the self replacing merino ewe flock enterprise and the likely pasture season and ewe response (Young and Oldham, 2005).

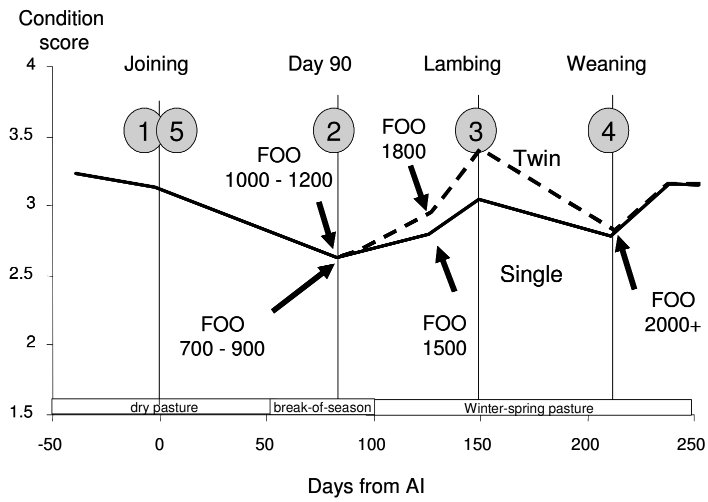

Figure 1. Schematic representation of a condition score profile for a winter-spring lambing in Western Australia, showing separate profiles for single and twin bearing ewes and feed on offer (FOO) boundaries at the break of season, leading up to lambing and at weaning.

Two crucial points in the ewe reproductive calendar (condition at joining and condition at lambing) set the framework of the profile and the environmental conditions, including expected level of supplementary feed, then dictate the shape of the profile for a particular region. CS at joining sets the reproductive rate (RR) and determines the potential number of lambs to be born. Our analysis has shown that the RR is linear with increasing CS to at least CS 3.5 although there are different slopes for different genotypes. Producers need to set the RR they want to achieve, and manage their ewes to attain the CS target by joining (and maintain over the joining period). CS at lambing influences the lamb and ewe mortality, lamb birth weight and progeny wool production. There are differences in the profile for singles and twin bearing ewes.

Depending on the probability of green feed in late pregnancy and lactation and the ewe's response to it, the shape of the CS profile from joining to the point of minimum CS and then to lambing can be determined. For example, in WA, LTW has shown that ewes can gain in condition on as little as 700 FOO from day 90 of pregnancy and will rapidly respond to increasing availability of FOO as late as day 130. Hence, average flock CS could be as low as CS 2.5 at day 90 but recover to CS 3 for singles (requires 1500 FOO at day 130) and 3.5 for twins (requires 1800 FOO at day 130) and therefore achieve targeted performance by lambing if sufficient FOO were available. However, in other areas, and during autumn lambing, the minimum CS should never be allowed to fall below their chosen target by lambing. This requires the ewe CS profile to be quite flat and closer to the original 'maintain at condition score 3' recommendations that have been promoted previously.

Key messages from 'Lifetime Wool'

- Whole farm profit is sensitive to the changes in condition of ewes during the year.
- Production from ewes and their progeny can be predicted from knowledge of the ewe's condition score profile.
- 'Measure to Manage' – CS is a quick and reliable tool for managing ewes to targets.
- CS can be managed to achieve predictable ewe fleece weight, fibre diameter and staple strength outcomes.
- Ewes higher in CS at joining conceive more lambs and the response varies between farms.
- Lamb survival can be predicted from changes in CS between joining and lambing; however, the response is modified by environmental conditions at lambing.
- Improved ewe condition during pregnancy increases the clean fleece weight of progeny by up to 0.2 kg and decreases their mean fibre diameter by up to 0.4 um.
- These effects are permanent for the lifetime of the progeny and are independent of birth type and sire source.
- Managing twin bearing ewes better will increase production.
- Ewes with higher CS at lambing will have less mortality than ewes with lower condition score.

CONCLUSION

Further economic analysis is being undertaken for five regions across Australia and at differing lambing times to provide optimal ewe management and decision tools for a particular enterprise. The setting of targets by the producer for joining and lambing provides the framework for managing ewes over the rest of year. The response of the flock to a particular target can be predicted and will give important information as to how supplementary feeding regimes and pastures are managed.

KEY WORDS

Lambing, ewe management, Lifetime Wool

ACKNOWLEDGMENTS

Lifetime Wool is funded by AWI, DPI Vic, DAFWA, SARDI, DPI NSW, DPI Tas., Austral Park, Billandri Merino Stud and 120 farmers across southern Australia.

Paper reviewed by: Dr Chris Oldham, Dr Andrew Thompson

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Achieving the best reproductive performance from your hoggets

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ABSTRACT

Management practices farmers should use to ensure high reproductive performance in their hoggets include; maximising hogget breeding weights, utilising Fn or EF composites, vaccinate against abortive diseases, shear hoggets pre-mating, utilise an up to 40 day breeding period, ensure a high number of rams are used and separate single- and multiple-bearing hoggets during lactation.

AIMS

Currently less than 30% of New Zealand hoggets (ewe lambs 8 – 9 months of age) are presented for breeding. A reason often given by farmers for this poor figure is the low reproductive performance of hoggets. Therefore the aim of the present study was to identify management practices that maximise the lambing percentage from ewe hoggets.

METHOD

A survey of 629 New Zealand sheep farmers gathered data on the practice of hogget lambing, in particular on the numbers and breeds of hoggets and rams used, selection criteria used for hoggets, use of teasers (vasectomised males), length of breeding period, live weight of hoggets, use of mating crayons, vaccinations and trace element supplements given, pregnancy scanning, management during pregnancy and lambing, number of lambs present at docking and shearing schedules of hoggets. This information was then used to identify individual factors that affected hogget lambing percentage (number of lambs present approximately 1 month after lambing / number of hoggets put to ram X 100) (LP). Hogget lambing percentage was used as the dependent variable, when assessing the effect of independent covariates on productivity. A multivariate model containing only significant ($P<0.05$) variables was then determined (1).

RESULTS

The hogget lambing percentage range from New Zealand farms in this study was from less than 10% to greater than 120% with a mean value of 60%. This 60% mean was similar to that reported in previous studies. Factors that increased LP included: vaccination against both camplylobacteriosis and toxoplasmosis, shearing pre-breeding, increasing the length of breeding period up to 40 days, increasing the number of rams per 100 hoggets, weight of hoggets at breeding and separation of singleton- and multiple-bearing hoggets during lactation (1). The breed of hoggets also affected LP. Such that composite hoggets which included 1/16 to 3/8 East Friesian (EF) or Finn (Fn) breed types displayed a 13% higher LP compared to Romneys, which are the dominate breed type in New Zealand, and those with 1/2 or greater EF or Fn had 23% higher LP. Coopworth hoggets also displayed 11% higher LP than Romneys. No other breed types differed. Every 1kg increase in liveweight above 36kg at breeding was approximately worth an extra 2% of LP. The only significant negative factor affecting LP was the number of hoggets presented for breeding, as the number of hoggets increased to 600, LP decreased. The final multivariate linear model explained 45% of the variation in LP (r^2=0.45), with live weight of hoggets at breeding and breed having the greatest effect on LP. Factors which did not affect LP, included use of iodine supplementation, use of vasectomised males before breeding, change in weight from breeding to lambing, separating singleton- and multiple-bearing hoggets or shearing during pregnancy, frequency of supervision during the lambing period and pasture mass or height at set-stocking.

CONCLUSION

The results clearly indicate that farmers should aim to have their hoggets as heavy as possible at breeding. Previous research has also identified this relationship (2). Heavier liveweights within breed are associated with more hoggets in oestrus (3). A further advantage of ensuring hoggets are as heavy as possible at breeding is that these animals will be more likely to cope with the demands of pregnancy and lactation and will have less weight gain before breeding as a two-year old ewe. In studies in which hogget mating has had a negative effect on two-year old ewe liveweight at breeding reproductive performance has often been disappointing.

The greater the percentage of either EF or Fn genes, the greater the LP compared to all other breeds. In addition, the Coopworth displayed higher LP. These results indicate there are some breed types more suitable to hogget lambing. Improved reproductive performances of Fn hoggets and composites have been previously reported (2, 3). However it is unlikely that farmers will change their breed types completely just to maximise hogget performance as these breeds may have other traits which make them unsuitable for some production systems (i.e. higher wool micron). However these results do indicate that even a minor influx of EF or Fn genes (1/16 – 3/8) can dramatically improve hogget reproductive performance.

An increase in the length of the breeding period, up to 40 days in the present study, was associated with an increase in LP. However it should not be forgotten that hogget breeding often occurs later than that of mature breeds. Thus while a longer mating period may improve the number of hoggets that lamb it can result in later born lambs, which may be relatively light weight at the normal weaning date and result in the young ewe having less time to gain weight post-lambing before being bred as a two-year old ewe.

An optimum ram to ewe hogget ratio of 2.5 to 3.5% was identified, while in mature ewes 1% is an often accepted ratio. It is known that ewe hoggets have a shorter oestrus period compared to the mature ewes and are less likely to seek out and stand for the ram (2). Therefore it is not surprising that having more ram power is associated with more pregnant hoggets and therefore a higher lambing percentage overall.

Maiden ewes are known to be at greatest risk of abortion from either camplyobacteriosis or toxoplasmosis. Vaccination against these organisms is therefore prudent. However vaccination needs to occur at least one month pre-breeding, therefore farmers need to identify relatively early which hoggets are going to be presented for breeding.

Separation of singleton- and multiple-bearing hoggets for the lambing period resulted in higher LP. Multiple-bearing hoggets should be offered more sheltered flatter paddocks and be at a lower stocking density with higher pasture availability compared to their singleton-bearing counterparts.

Shearing pre-mating had a positive affect on LP. It is possible, although not known, that shearing the young ewes over the summer period pre-breeding resulted in an increase in intake and therefore liveweight pre-breeding.

In conclusion this survey indicates that to maximise hogget lambing percentage farmers should; ensure hoggets are as heavy as possible at breeding, utilise Fn or EF composites, vaccinate against camplylobacteriosis and toxoplasmosis, shear pre-mating, use a 40 day breeding period, ensure a high number of rams are used and separate single- and multiple-bearing hoggets during lactation.

KEY WORDS
Ewe hoggets, lambing percentage

ACKNOWLEDGMENTS
The authors wish to acknowledge the funding provided Massey University and Meat and Wool Innovation New Zealand. The paper was reviewed by Dr Jennifer Burke.

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Lifetime Wool: Twin Futures

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ABSTRACT

The Lifetime Wool project has confirmed plot-scale observations that twin-bearing ewes produce fleeces of lower weight and lower tensile strength, while their progeny suffer high mortality, reduced weaning weight and produce less wool of higher diameter. However, improving ewe nutrition can improve the performance of twin bearing ewes and the future lifetime performance of their progeny.

AIM

The Lifetime Wool project established 18 paddock-scale research sites in cooperation with wool producers across southern Australia to confirm the research results in commercial situations and to develop practical guidelines for ewe management during pregnancy and lactation.

METHOD

Lifetime Wool is a national project developing ewe management guidelines for woolgrowers. The project comprised plot-scale research that determined the response in wool production of ewes and the lifetime performance of their progeny to graded levels of ewe nutrition at different stages of pregnancy (Thompson and Oldham 2004). The Lifetime Wool project also established 18 paddock-scale research sites in cooperation with wool producers across southern Australia.

Oldham et al. (2004) have described the protocol for each paddock-scale site. In brief, cooperators joined 1000 mixed aged adult Merino ewes in a single flock at day 0. Ultrasound scanning of the ewes at day 50 identified those ewes that had conceived during the first 21days of joining. These ewes were then randomly split into 2 treatments receiving either high or low nutrition. The liveweight (LW) and condition score (CS) targets for the high and low nutrition treatments were based on the LW and CS profiles of the CS3 and 3000 kg DM/ha feed on offer, and the CS2 and 1100/1500 feed on offer treatments of the plot-scale experiments (Ferguson et al. 2004). The quantity and quality of wool produced by the ewes was measured on a random sample of 25 single and 25 twin-bearing ewes from each nutritional treatment. The carryover reproductive performance of the ewes was measured using ultrasound scanning after their following joining. Wool production and quality was measured on all progeny for each flock up to 2.5 years of age.

RESULTS

Condition Score & Liveweight

Ewes on high and low nutrition diverged by 0.8 of a condition score to produce an average 6.6kg difference in liveweight between high and low nutrition treatments at day 140. After lambing this difference decreased but never completely closed up by the following joining (day 365).

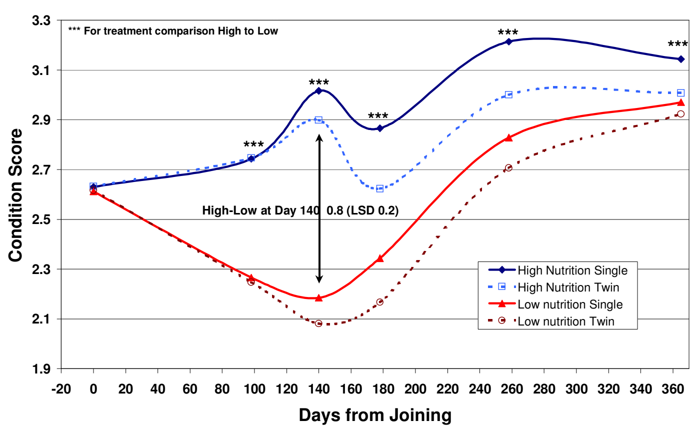

Figure 1.The average condition score profile of single and twin-bearing ewes managed on high or low nutrition across Lifetime Wool paddock scale sites in southern Australia.

Ewe and Progeny Performance

Table 1 shows the impact of high and low nutrition on single and twin-bearing ewes and their progeny. Improved ewe nutrition during pregnancy led to higher condition score and live weight at lambing. This increased the fleece weight and fibre diameter of wool produced by commercial flocks of Merino ewes. Higher ewe live weight and condition score during pregnancy also increased survival of progeny, increased their wool production and reduced their fibre diameter. These results are consistent with the plot-scale observations that showed a strong relationship between live weight profiles and wool production of ewes and the subsequent lifetime performance of their progeny.

Twin-bearing ewes produced fleeces of lower weight, staple length and strength, while their progeny suffered higher mortality, reduced weaning weight and produced less wool of higher fibre diameter. Ewes that conceived and carried twins were more likely to have twins in subsequent years despite being slightly lower in condition score at the following joining. If twin-bearing ewes receive low nutrition the impact is additive and the ewe wool production and progeny performance results become worse. Conversely, better nutrition can improve twin performance. These results are consistent with Lifetime Wool plot-scale observations that showed a strong relationship between ewe parity and ewe wool production and the effects on lifetime performance of their progeny. The results show that there are opportunities to strategically manage twin-bearing ewes and their progeny for improved performance through better nutrition, particularly during mid and late pregnancy.

Table 1 The average performance of single and twin-bearing ewes and their progeny managed on

high or low nutrition across Lifetime Wool paddock scale sites, in Southern Australia

Production Parameter	***Ewe and Progeny Performance***					
	Sites	**Single**		*Twin*		**LSD (5%)**
		High	**Low**	**High**	*Low*	
Average condition score at Day 140	15	3.0	2.2	2.9	2.1	0.2
Average live weight at Day140	15	56.2	49.7	60.5	53.9	2.1
Ewe clean fleece weight (kg)	15	3.4	3.0	3.3	2.8	0.1
Ewe mean fibre diameter (µm)	15	20.4	19.5	20.2	19.5	0.3
Ewe staple length (mm)	15	93.0	89.1	91.7	87.3	1.9
Ewe staple strength (N/ktex)	15	36.8	31.4	33.5	30.2	2.8
Average condition score at Day 365	15	3.1	3.0	3.0	2.9	0.08
Ewe carryover reproduction (scanning %)	15	123	116	135	133	7
Progeny survival to marking (%)	15	89.6	83.2	66.7	57.5	7.5
Progeny live weight at weaning (kg)	15	25.5	23.2	22.7	20.8	1.2
Progeny live weight at 12months (kg)	14	33.0	32.2	31.8	31.2	0.7
Progeny 1st clean fleece weight (kg)	15	1.63	1.52	1.46	1.37	0.07
Progeny 2nd clean fleece weight (kg)	10	2.99	2.93	2.83	2.75	0.06
Progeny 2nd mean fibre diameter (µm)	10	18.38	18.49	18.65	18.79	0.14

CONCLUSION

Twin bearing ewes and their progeny can suffer large performance deficits. However, improving twin ewe nutrition during pregnancy and lactation can substantially improve twin ewe and progeny performance. Further work is required on the extent to which twin ewe and progeny performance could be improved and whether it is economic to provide even higher levels of nutrition to twin ewes.

KEY WORDS

Twins, Nutrition, Condition Score, Wool

ACKNOWLEDGMENTS

The author wishes to thank Australian Wool Innovation and the collaborating State Departments within the Lifetime Wool project team for funding and collaboration in the collation of this national dataset.

Paper reviewed by: Andrew Thompson, Chris Oldham.

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Wool and meat traits in Merino flocks in different regions

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ABSTRACT

Wool and meat traits including fibre diameter profiles were measured in 15 fine wool Merino flocks in four different climatic regions. Genetic parameters for the traits were generally favourably positive apart from an undesirable positive correlation between eye muscle depth and fibre diameter. Fibre diameter profiles showed greatest variation in WA where average staple strength was lowest, and least variation in northern NSW where average staple strength was greatest. Improvement in staple strength could be made through selection for lower CV of fibre diameter and/or through feeding and management to flatten profiles.

AIMS

To determine characteristics and opportunities for improvement in wool and meat traits in 15 fine wool Merino ram breeding flocks in four different climatic regions.

METHOD

The data analysed with up to 4459 observations for each trait were from 15 flocks in Northern NSW (5), South Australia (2), Southern NSW (4), and West Australia (4). Measurements on the progeny of 148 sires included greasy fleece weight (GFW), fibre diameter (MFD), CV of fibre diameter (FDcv), staple strength (SS), maximum minus minimum fibre diameter (FDdiff) from OFDA2000, body weight (WT) and ultrasound eye muscle (EMD) and fat depth (FAT). Average fibre diameter profiles within flocks were plotted by the method of G. Mata (unpublished). Flock means, heritabilities and genetic correlations were estimated in multivariate analyses using ASReml (Gilmour *et al*, 2006). Genetic effects were fitted in sire models, and animal permanent environmental effects were included for traits where there were significant numbers of repeated records (WT, EMD and FAT). Numbers of observations for each trait are shown in Table 1.

RESULTS

Ranges in flock means with phenotypic and genetic parameters in Table 1 show large variation between flocks and relatively high positive correlations between wool and meat traits and heritabilities in comparison with Safari and Fogarty (2005) and Huisman and Brown (2005). There was some antagonism with EMD positively related to MFD while FDcv showed a good relationship with SS.

Table 1: Ranges in flock means (Range), phenotypic variances (Variance), and genetic parameters for wool and meat traits: Heritabilities in bold on diagonal and genetic correlations below diagonal.

Trait	GFW	MFD	FDcv	SS	FDdiff	WT	EMD	FAT
Units	(Kg)	(micron)	(%)	(N/Ktex)	(micron)	(Kg)	(mm)	(mm)
No. obs.	3513	3989	3985	3809	3365	5719	4459	4459
Range	1.7 – 5.4	15.2 - 19.2	16.7 - 21.9	24 - 57	1.5 - 5.2	32 - 67	17 - 28	1.1 – 3.6
Variance	0.4	1.3	4.7	84	0.9	22	3.6	0.2
GFW	**0.61**							
MFD	0.40	**0.57**						
FDCV	-0.17	-0.23	**0.35**					
SS	0.16	0.27	-0.54	**0.41**				
FDdiff	0.35	0.48	0.39	-0.12	**0.24**			
WT	0.55	0.20	-0.39	0.04	-0.15	**0.54**		
EMD	0.45	0.39	-0.43	0.15	-0.21	0.64	**0.25**	
FAT	0.23	0.31	-0.39	0.13	-0.15	0.67	0.73	**0.14**

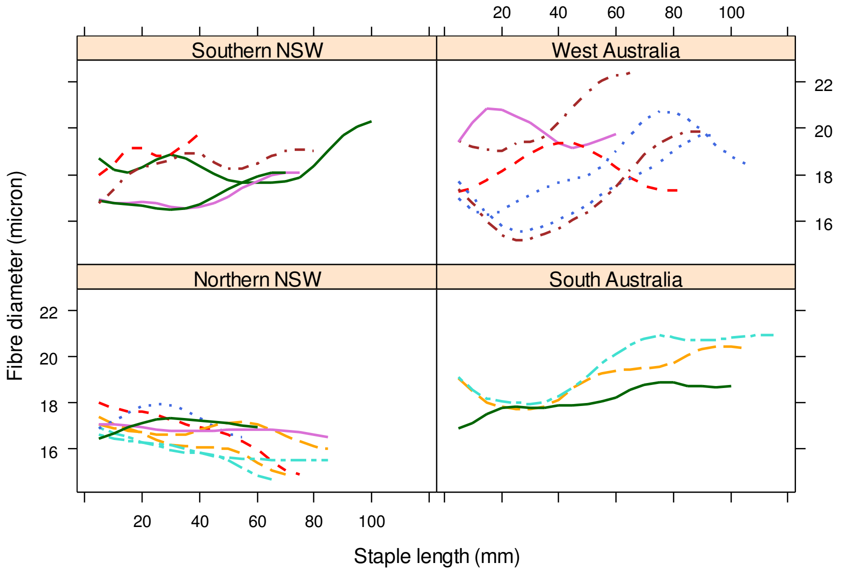

Figure 1: Fibre diameter profiles for ewe and ram yearlings/hoggets in the 15 flocks in four climatic regions (note that both ewe and ram groups were represented in many of the flocks).

Fibre diameter profiles for the ewe and ram yearlings or hoggets are shown in Figure 1. There was least variation in MFD in northern NSW and most in WA with southern NSW and SA intermediate. Means for these regions respectively for FDdiff (mm) and SS (N/ktex) were 2.1 and 47, 3.7 and 32, 2.9 and 39, and 3.2 and 33.

CONCLUSION

The positive correlations between wool and meat traits, along with relatively high heritabilities, means breeders in these fine wool flocks can make good genetic progress generally without antagonisms. However there is the consequence that wool becomes broader with selection for muscling. In agreement with previous studies (Huisman and Brown) genetic improvement for staple strength is possible using FDcv. Feeding and management measures to flatten fibre diameter profiles, particularly in WA, may result in higher SS, but with the possible adverse effect of increasing MFD.

KEY WORDS

Merinos, wool and meat traits, fibre diameter profiles

ACKNOWLEDGMENTS

The project was supported by Australian Wool Innovation and Meat Livestock Australia, with assistance from Alex Ball and Richard Apps including provision of data through Sheep Genetics Australia. Skilled technical support came from Christine Dennis and Heather Brewer, CSIRO, Chiswick. Shelly Anderson from the Interactive Wool Group carried out the OFDA2000 measurements and the Australian Wool Testing Authority provided in-kind support with wool measurements. This project would not have been possible without the cooperation of the Merino breeders.

Paper reviewed by: Dr Ian Purvis and Dr Sonja Dominik

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Fat score or Condition score? - It all depends on what you want to do!

Chris Oldham, Department of Agriculture and Food Western Australia

ABSTRACT

Condition score (manual assessment over the short ribs; score 1 is thin and 5 is very fat) and fat score (manual assessment over the long ribs at the GR site; estimated tissue depth in mm) are both used by industry to assess the fatness and condition of sheep for management and marketing, and there is debate and confusion over the relative merits of the different methods of assessment. In this experiment we measured condition score, fat score and C-site ultrasound fat and C-site ultrasound eye muscle depth were recorded for a group of 92 live Merino sheep in 6 months wool (45 young and 47 mature). All scores and measurements were done by two to four experienced assessors and repeated three times (runs) in a random order. The sheep were then slaughtered at an abattoir where the tissue depth at the GR site over the 12^{th} rib (fat + muscle) was recorded on the hot carcass.

The repeatability or precision of all operators was very high (≥ 0.90). However, in the case of fat score where estimated GR tissue depth could be compared with actual GR tissue depth measured on the carcass, only one assessor was accurate. The fat scores of this assessor (average of 3 runs) explained 88% of the variance in the average condition score of the sheep (4 assessors x 3 replicates).The relationship between estimated GR and condition score was not linear and in the condition score range of 2 to 3, which is considered to be critical for the management of commercial flocks of Merino ewes, there was very little variation in GR tissue depth (1 to 5 mm). Future recommendations for management of Merino ewe flocks should be framed in terms of condition score targets rather than fat score.

AIMS

Condition score (CS) relates to the tissue cover (fat + muscle) as manually palpated over the loin (short rib) area of sheep. Whereas fat score (FS) relates to the tissue cover (fat + muscle) as manually palpated over the 12^{th} rib (1^{st} long rib from the short loin) at the GR site, approximately 110 mm from the vertical processes of the spine. Traditionally, CS has been used to estimate the 'energy status' or 'nutritional well-being' of adult ewes (Russell et al. 1969, J. agric Sci. Camb.72, 451-454; Feeding standards for Australian livestock, Ruminants p 58-68). FS was also promoted by programmes such as Prograze as also being a suitable tool for assessing nutritional well-being. It has also been used to help estimate the yield of lean meat (%) of young sheep being marketed for meat; whole scores are related to 5 mm ranges in total tissue (fat + muscle) at the GR site over the 12^{th} rib (see Fat Score on NSW DPI website).

During the MLA Prime Time Roadshows in 2004 it became very clear that both academics and producers were confused with respect to the pros and cons of the 2 approaches to estimating fatness. This confusion was also reflected in the results from a survey of 2100 sheep producers across Australia which indicated that most producers use both methods to assess the condition of reproducing ewes (Ian Rose, 'Lifetime Wool', EC298, unpublished).

Hence, MLA commissioned an experiment to establish;

1. The relationship between CS and FS in both adult and young Merino ewes as assessed by skilled industry recognised assessors.
2. The relationship between subjectively assessed CS, FS and objectively measured C site fat and eye muscle depth in the live animal and measured GR site tissue depth in the hot carcass.

METHOD

The CS, FS and C-site ultrasound fat and C-site ultrasound eye muscle depth were recorded for a group of 92 live Merino sheep in 6 months wool (45 young and 47 mature). All scores and measurements were done by two to four experienced assessors and repeated three times (runs) in a random order. Approximately 24 hr after the above measurements, the sheep were slaughtered at an abattoir where the tissue depth at the GR site over the 12^{th} rib (fat + muscle) was recorded on the hot carcass for 89 of these sheep. This measurement was also done by two experienced assessors using standard GR knives and repeated three times in random order.

RESULTS

- All CS and FS assessors showed very high repeatability (Precision; av. correlation between runs = 0.90 to 0.95).
- There was no direct measure of the accuracy of CS but all assessors scored similarly with only very small biases between assessors. By contrast, there were considerable between assessor biases for the FS. Only one assessor was accurate when compared to the actual GR tissue depth measured in the chiller. The other three fat score assessors over estimated the tissue depth by an average 3 to 6 mm.
- There is a strong significant relationship between CS and FS and the more objective measurements at the C and GR sites. Both methods could be used to predict actual GR tissue depth with an average erroe of 2 mm (95% confidence limit of approximately 5 mm).
- In the original FS scale, 1 = 1 to 5 mm; 2 = 6 to 10 mm and 3 = 11 to 15 mm of actual GR tissue depth. However, in this experiment, the 95% confidence limits for actual GR tissue depth for FS 1 = 1 to 5 mm; FS 2 = 3 to 13 mm and FS 3 = 5 to 15 mm.
- There is a strong significant relationship between CS and FS. However, in the range CS of 2 to 3, that is considered to be critical for the management of ewes in the Lifetime Wool project, there was very little variation in estimated or actual GR tissue depth.

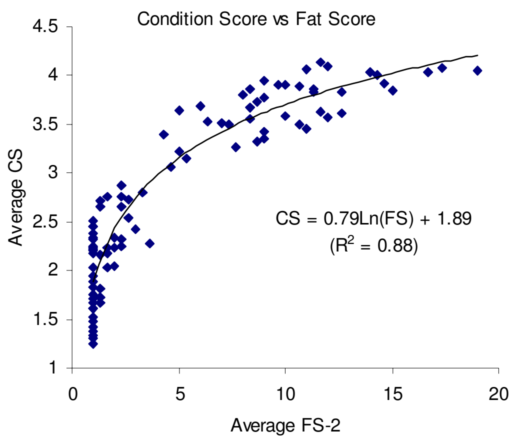

Figure 1. Relationship between the only accurate fat score assessor (FS-2) and average condition score for each sheep for 4 assessors

CONCLUSION

We conclude that recommendations for management of ewe flocks should be framed in terms of CS targets as this offers far greater control than FS. On the other hand, FS should remain the preferred tool for helping estimate the yield of lean meat (%) of young sheep being sent to the abattoir.

However, while a skilled operator could accurately estimate FS, there was sufficient variance about the estimates to cause significant overlap in the boundries of the fat score grids currently used by the industry for setting price. This issue could be addressed by replacing the current scoring system with training in assessing GR tissue depth in mm rather than FS as categories. Timely and accurate abattoir feedback on actual GR tissue depth would be an essential part of the training and ongoing calibration of all assessors.

KEY WORDS

Sheep, condition score, fat score, C site, GR site, prediction and fatness

ACKNOWLEDGMENTS

This project was jointly funded by MLA, DAFWA, VicDPI, NSWDPI, SARDI and WAMMCO. Colaborators included, Geoff Duddy, John Sullivan, Rob Davidson, Bob Marchant, Katrina Copping, Barb Sage, Andrew Kennedy, Tom Plaisted, Stephan Spiker, Peter Moore, Roger House, Mandy Curnow and Gus (Ian) Rose. Special thanks to Andrew Van Burgel for the statistical analysis.

Paper reviewed by: **Andrew Thompson, Vic DPI and John Milton, UWA**

Sheep worm control - the latest for Western Australia

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ABSTRACT

The world of sheep worm control is changing as drench resistance becomes worse. This presentation summarises the key points regarding sheep worm control decisions and planning for a typical Western Australian sheep property. This includes new work about drench timing in WA. The choice of effective treatments, biosecurity against resistant worms and non-chemical worm management strategies are also discussed.

AIMS

With sheep worm resistance to drenches continuing to worsen in Western Australia (WA) and the contribution of summer drenching to the severity of the problem (Besier *et al.*, 2001), the Department of Agriculture and Food Western Australia (DAFWA) undertook a planned monitoring program on several properties in WA to gather information about sheep worm burdens and general, animal health and paddock management activities.

METHOD

A total of 38 properties have been involved in the monitoring activities at various times since 2001. These were located between Northampton, Eneabba and Moora in the north and Albany and Esperance in the south. Since 2004 the monitoring work has concentrated on six main properties (Eneabba, Northam, Narrogin, Yealering, Kojonup and Kendenup) as part of Australian Wool Innovation Limited's national Integrated Parasite Management of Sheep (IPMs) Project.

During each property visit, between 10 and 20 fresh faecal samples were collected off the ground in the paddock in which each mob of sheep was running. Mob details, including treatments and paddock history, and any other management activities that had occurred on the property since the last visit were also recorded.

The faecal samples were transported to the parasitology laboratory at DAFWA in Albany and a mean strongyle faecal worm egg count (WEC) and larval coproculture and differentiation were completed for each mob.

Weaner (born in the year of measurement) and mature (older than 2.5 years old) sheep mobs with a WEC in November or December 2001, 2002, 2003 or 2004, and no known treatment within 60 days prior to the WEC, were included in this preliminary analysis. The proportions of mobs with a mean strongyle WEC greater than or equal to or less than 200 eggs per gram (epg) were calculated.

During summer 2005/2006 a faecal egg count reduction test (FECRT; Corner and Bagust, 1993) was also carried out on eight properties (Northam, Narrogin, two properties at Kojonup, Boyup Brook, Mount Barker and two at Kendenup).

RESULTS

Preliminary analysis of the WEC monitoring of mobs of weaner sheep revealed 4 out of 42 mobs that had mean WEC below 200 epg and more than 60 percent of mobs had mean WEC greater than 500 epg.

In mature sheep 65, 78, 77 and 87 percent of the mobs had mean WEC below 200 epg during November or December 2001 (n=26), 2002 (n=37), 2003 (n=35) or 2004 (n=38) respectively.

Four properties had a mean percentage reduction of strongyles, in the FECRTs, for benzimidazole plus levamisole combination products less than 95 percent. Six and four properties had mean percentage reductions against *Ostertagia* for ivermectin and abamectin respectively less than 95 percent. Three and two of the properties had mean percentage reductions against *Ostertagia* for oral moxidectin and ivermectin plus benzimidazole and levamisole combination respectively less than 100 percent. Abamectin plus benzimidazole and levamisole combination and closantel was the sole product tested that remained 100 percent effective on all properties.

CONCLUSIONS

Monitoring of WEC suggested the need to continue to treat weaner sheep with a single, fully effective summer drench in WA.

Monitoring of WEC in mature sheep highlighted the generally low egg output from these animals at the time of the traditional first summer drench and hence suggested that a broad-spectrum***** summer drench could be avoided in these sheep. Further work is investigating more detailed recommendations to help avoid a summer drench, including the potential costs of such a strategy.

While based on an extremely small sample size, the levels of drench resistance measured in summer 2005/2006 supported the current expectations of the severity of drench resistance in sheep worms in WA. The approaching exhaustion of effective treatment options, especially against *Ostertagia*, reaffirmed the need for the inclusion of non-chemical approaches as a key part of an overall effective and sustainable sheep worm control program (Woodgate, 2005a), This so-called integrated parasite management approach includes breeding worm-resistant sheep (Karlsson *et al*., 2002). Effective biosecurity strategies to reduce the risk of introducing worms more resistant than those currently on a property are also critical (Woodgate, 2005b).

***** NOTE: None of the monitored properties had significant levels of barber's pole worm and so it was not possible to evaluate the effects of avoiding summer treatments on the control of this worm. It is strongly recommended to maintain current barber's pole worm control practices if this worm is present on a property. If in doubt, seek local advice from a veterinarian or qualified sheep worm adviser.

KEY WORDS

Sheep worms, worm control, drench resistance, integrated parasite management

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support, interaction and collaboration of the many sheep producers who have been involved in this work. The staff of the DAFWA parasitology laboratory in Albany are thanked for their testing of samples. Financial support for parts of this work was provided through Australian Wool Innovation Ltd's Integrated Parasite Mangement of Sheep Project.

Paper reviewed by: Brown Besier

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No. 4/2002
Date: October 2002

Sheep worms — summer-autumn worm control

Rob Woodgate, Veterinary Officer, Albany and Brown Besier, Principal Veterinary Parasitologist, Albany

Background

Resistance by sheep worms to drenches in Western Australia is rapidly reaching a crisis point. There are worms resistant to white (benzimidazole or BZ – e.g. *Valbazen, Panacur, Alben, Fenbendazole, Nemadet, Oxfen, Fencare*, etc.) and clear (levamisole or LEV – e.g. *Nilverm, Levamisole, Ripercol*, etc.) drenches on virtually all farms. Worms on about 80 per cent of farms tested show resistance to BZ/LV combination drenches (containing a white and clear drench, e.g. *Combi, Salvo, Scanda*, etc.).

Of most concern, testing between 2002 and March 2004 showed resistance on about 60 per cent of properties to the macrocyclic lactone group of drenches (the MLs – active ingredients ivermectin, abamectin and moxidectin) in the brown stomach worm (*Ostertagia*.).

Unless current drenching practices change, drench resistance will continue to increase. As it is unlikely that new sheep drench groups will become available within the next few years, there is a real risk of running out of effective drench options. This would place profitable sheep production in some areas of WA under serious threat.

Summer drenching - a two-edged sword!

Research by the WA Department of Agriculture has shown that the traditional practice of summer drenching all of the sheep on a property can make drench resistance worse. Summer drenching provides extremely effective sheep worm control but it also places very high selection pressure on sheep worms for drench resistance. This is because the only worms left in the sheep after a summer drench are resistant to the drench given. In areas with a hot, dry summer very few worm eggs and larvae survive on the pasture over summer and so most of the future worm population develops from eggs put out during the following autumn by the resistant worms surviving in the sheep. Consequently, there is an increased level of drench resistance in the worm population.

However, this research also showed that if summer drenching of all sheep on a property was simply abandoned, there is a serious risk of worm contamination levels building up dangerously during the autumn. This could result in major worm problems affecting sheep during the following winter and spring.

What is the answer?

Since 2001, Ag Department officers have monitored worm levels in weaners, ewes and dry sheep on more than 20 properties (‘demo farms’) throughout the State. This has included 6 key IPM-s sites (as part of the national Integrated Parasite Management - sheep project funded by Australian Wool Innovation Ltd) since 2004. The work involves collecting on-farm worm and management data at locations covering all major sheep producing regions (from Northampton and Moora in the north to Albany and Esperance in the south). The program is aimed to provide good worm control while reducing the selection pressure for drench resistance.

On results to date the following approach is recommended:

- **Weaner and hogget sheep: give a single, fully effective* summer drench after the pasture has dried off towards the end of spring or early summer.** These sheep are ~~more~~ susceptible to worms and monitoring has virtually always shown high faecal worm egg counts during summer.
- **Adult sheep: no summer drench is usually necessary, provided they are in good condition and appear healthy.** More than half of the mobs of mature ewes monitored around the State had very low faecal worm egg counts in early summer. IPM-s trials have shown that missing a summer drench in such mobs did not cause major liveweight or wool growth losses.
- **Mobs that are not summer drenched should be monitored visually and faecal worm egg counts checked no later than the first week of April. Drench if the result is greater than 200 eggs per gram**. If it is not possible to do a worm egg count at this time then a **routine autumn drench** should be given.
- **A second summer drench is very rarely needed.** If it is thought a second summer drench may be necessary, faecal worm egg counts should be checked first to make sure that the drench is worthwhile. This applies especially in high worm risk areas, such as where barbers pole worm exists.
- **Additional pre-lambing drenches** may be required in some years depending on the season. This is especially likely in ewes lambing later than mid-June.

Other findings from the research include:

- Extra faecal worm egg counts are advisable if sheep or seasonal conditions are poor, or following atypical events such as summer rain or false breaks. It is recommended to perform extra checks 4 weeks after such an event.
- **If barber's pole worm (*Haemonchus contortus*) is present on the farm then local advice should be sought to include barber's pole treatments in the program.**
- Worm control during winter and spring should be based on mob observations and faecal worm egg counts.
- Paddock management to ensure resistant worms coming from summer drenched sheep are diluted on the pasture is important during the autumn and winter and should be discussed with a veterinarian or sheep consultant.

As this is a major change from traditional summer drenching, it is important to **remain vigilant and regularly monitor general sheep health** (including sheep condition score, the presence of scouring, etc.). For the latest information on sustainable worm control, contact your local veterinarian or sheep consultant. Further information can also be found at **www.wormboss.com.au**

If in doubt it is advisable to measure faecal worm egg counts and seek advice from your local veterinarian or sheep consultant. You can also contact the WormWise adviser at your local WA Department of Agriculture office.

* A fully effective drench is one that has been shown to be more than 95 per cent effective (and preferably 100 per cent effective) in a drench resistance test carried out within the last couple of years.

Other recommended reading

Farmnote 51/2002	Sheep control in Western Australia
Farmnote 53/2002	Sheep worms – breeding worm resistant sheep
Farmnote 54/2002	Sheep worms – worm egg counts
Farmnote 55/2002	Sheep worms – testing drench resistance and effectiveness
Farmnote 57/2002	Barber's pole worm in sheep
Factsheet 3/2002	Sheep worms – quarantine drench to combat resistance

November 2005

Sheep worms — quarantine drench to combat resistance

Rob Woodgate, Veterinary Officer, Albany

Background

Resistance by sheep worms to drenches in Western Australia is rapidly reaching a crisis point. There are sheep worms on virtually all farms that are resistant to white (benzimidazole or BZ – e.g. *Valbazen, Panacur, Alben, Fenbendazole, Nemadet, Oxfen, Fencare* etc.) and clear (levamisole or LV – e.g. *Nilverm, Levamisole, Ripercol* etc.) drenches. BZ/LV combination drenches (containing a white and clear drench, e.g. *Combi, Salvo, Scanda, Nucombo* etc.) only remain fully effective* on about 20 per cent of properties and resistance testing between 2002 and March 2004 showed resistance on about 60 per cent of properties to the macrocyclic lactone group of drenches (the MLs – active ingredients include ivermectin, abamectin and moxidectin) in the brown stomach worm (*Ostertagia*).

Unless current drenching practices change, drench resistance will continue to worsen and spread. One strategy that farmers can use to help reduce the risk of introducing new strains of resistant worms on their property is effective quarantine drenching of introduced sheep.

If new sheep are being introduced to a property or sheep are returning after agistment, it is critical to follow a quarantine procedure to avoid the introduction of resistant worms. Sheep coming on to a property may carry worms that are more resistant than those already on the property.

What should I do?

All introduced sheep should be treated immediately before or after they enter the property.

Treatment with products from at least three different drench groups is recommended. If the drench resistance status of the source of the sheep is unknown the current minimum recommendation is:

Moxidectin (*e.g. Cydectin oral liquid for sheep*) + a BZ/LV combination (white and clear) drench (*e.g. Combi, Salvo, Scanda, etc.).*

Moxidectin is the ML product of choice due to its superior potency. Ivermectin or abamectin (the other MLs) should not be used because the incoming sheep could be carrying worms against which these products are no longer fully effective.

Sheep should be released into a wormy paddock to help dilute any surviving 'super-resistant' worms amongst the resident population of worms already on the property. If a wormy paddock is not available then other options should be discussed with your local vet or sheep adviser.

For more information talk to your local vet or sheep adviser or contact your local WormWise contact at the WA Department of Agriculture (see over).

WormWise contacts

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* *A fully effective drench is one that has been shown to be more than 95 per cent effective (and preferably 100 per cent) in a drench resistance test within the last couple of years.*

Other recommended reading

Farmnote xx/2005	Sheep control in Western Australia
Farmnote xx/2005	Sheep worms – breeding worm resistant sheep
Farmnote xx/2005	Sheep worms – worm egg counts
Farmnote xx/2005	Sheep worms – testing drench resistance and effectiveness
Farmnote xx/2005	Barber's pole worm in sheep
Factsheet xx/2005	Sheep worms – 'summer-autumn' worm control
Farmnote 4/2004	Worm drenches for sheep in Western Australia

Further information

More information about sheep worms and sheep worm control is available on the internet at www.wormboss.com.au

Rethinking pasture production - STEPS to greater productivity with perennials

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ABSTRACT

The road to greater productivity is considered by many to be difficult and often more trouble than its worth. This paper outlines the experiences of two growers who have adopted more productive and sustainable farming systems incorporating planned or rotational grazing and perennial pastures. Both producers have implemented their new farming system in an orderly, somewhat stepwise manner with each step building on the previous one. The paper includes a STEP evaluation (Simulated Transitional Economic Planning model) of both systems against district practice.

AIMS

The paper documents the development of two different high productivity, sustainable farming systems incorporating planned grazing management and perennial pastures, and evaluates their economic performance over a 10 year transitional period.

METHOD

The two growers who supported this study - Rob and Jenny Warburton and David and Lyn Mathwin - had previously participated in semi structured interviews as part of a wider survey to identify attitudes, barriers and benefits associated with increasing adoption of perennial pastures into South West farming systems. The survey results showed clearly that perennials established in a set stocked or standard grazing management regime did not persist, however the survey also identified significant barriers to the widespread adoption of rotational grazing. Both Warburtons and Mathwins had identified rotational grazing as a critical element of their farming system, essential for the persistence of the perennial component of their pastures. Both growers were operating relatively mature farming systems based on rotational (planned) grazing utilizing perennials; Warburtons for 10 years, Mathwins for 8 years.

Financial data was collected and a STEP (Simulated Transitional Economic Planning model) analysis undertaken to assess the profitability of these systems against current standard district practice. Assumptions used for production, costs, yields and carrying capacities for the standard practice models were based on Bankwest benchmarks, Gross Margins Guide and on-ground knowledge of industry professionals .

RESULTS

The genesis of each farming system was driven by slightly different goals; Mathwins' goal was based mainly on ecological considerations, Warburton's was primarily aimed at maximising farm productivity and secondly at farming sustainably. Though the path and drivers to their new systems were quite different, both systems evolved in a rational and step-wise manner.

In both cases, benefits have included reduced erosion, reduced runoff and waterlogging, reduced salinity, healthier and more productive pastures, 6 -8 weeks extended green feed, automatic vitamin E supplement for sheep, increased biodiversity, increased stocking rate, improved amenity values and reduced reliance on summer and autumn supplementary feeding. Mathwins also noted a reduction in input costs, increased staple strength and reduced worm egg counts. Warburtons are able to wean merino lambs later in the season, allowing later lambing, and reducing the need for supplementary feeding for weaners during summer.

Problems and issues both growers overcame included high establishment costs of perennial pastures, competitiveness of annual ryegrass and cape weed during establishment, additional initial capital costs associated with rotational grazing eg. fencing and water points, the requirement for new management practices to fit the requirements of perennials and a scarcity of professional advice available on managing perennials. These issues were also identified in the survey as barriers to adopting rotational grazing and perennial based systems. Warburtons observed also that some sheep genotypes performed poorly under the high stocking rates and intense grazing pressure of rotational or planned grazing.

Steps toward a more productive and sustainable farming system

Identify a problem

For Mathwins, the problem was mainly soil conservation related (waterlogging, erosion and salinity problems). Their goal is "to utilise all water that falls to prevent these problems from occurring". Warburtons' 'problem' was to maximise their farm productivity in order to grow his farming business in a sustainable way.

Solving the problem

Warburtons' Steps:

1. Introducing rotational grazing into farming system. This gave them the capacity to run larger mobs reducing time spent handling and feeding sheep throughout the year. Rotating the mobs through the growing season allowed pastures to be spelled, leading to improved pasture composition and density and an increased total amount of feed on offer on the property. There was also more surface cover protecting soils in summer.

2. Introducing deferred grazing. Sheep are confined in their large mobs to sacrificial paddocks (earmarked for cropping or pasture renovation) during the break of the season and fed a complete maintenance ration.

3. Put back lambing to coincide with peak availability of spring pasture growth. Warburtons now mate their sheep in March so that peak lactation demand (85% lambs down) occurs around the third week of August when pasture growth rates jump from around 25kg/ha/day to 40 kg/ha/day.

There is minimal additional cost to implementing the first three steps – including the deferred grazing - as the same amount of feed is used but in a more strategic manner.

4. Increasing fertiliser applications to compensate for the increase of exports from the farm to maintain soil fertility and pasture productivity.

5. Increasing annual cropping area. The stubble paddocks provide another useful feed source for summer, allowing an additional increase in stocking rate as the need to conserve spring grown feed is reduced.

6. Introducing perennials. Initially perennials were not the driving motivation for Warburtons system, they were the backstop. They extend the green feed season, reducing the risks associated with later lambing and providing greater nutritional value for younger stock through the summer and autumn months. They start growing well before annual pasture species, especially if summer rain has fallen, minimising the period of deferred grazing and costs of confinement feeding. Later it was found that they provide better quality feed through the winter as they are able to access nutrients from deeper in the soil not available to annuals. Perennial pastures allow the Warburton's to "push all the limits of high stocking rate grazing"; they also make soils more resistant to soil compaction and absorb water at a greater rate, increasing organic matter and overall soil health.

Implementing each step resulted in an increase in carrying capacity. These steps have enabled the Warburtons to increase their winter grazed stocking rate from 10 to 17 DSE / ha.

For the Mathwins:

1. Introduce planned rotational grazing to improve pasture quality and protect the soil resource at the same time. Removing the grazing pressure from the pastures in a planned manner ensures a good cover throughout the year.

2. Introduce cattle to utilise the extra pasture and increase species biodiversity. Cattle graze differently to sheep and can be used to create a break in the worm cycle for sheep.

3. Introduce perennial pasture plants to use out of season rainfall, increase soil water holding capacity and reduce waterlogging, runoff and salinity.

Mathwins have increased there carrying capacity from 8 to 12 DSE / ha while maintaining excellent ground cover and achieving the other environmental outcomes targeted.

STEP analysis

Simulated Transitional Economic Planning model (STEP) is a whole of farm economic assessment model. We ran the model for each property over a 10 year period to arrive at a 10 year cumulative position generated from cumulative annual farm surpluses; results are shown in Tables 1 and 2. Key assumptions were annual interest on investment at 6%; initial working debt of $0.00, and tax calculated at 30% of taxable income. Final cumulative position was discounted at 7% back to net present value (NPV), all costs were increased by 3%/year and all returns increased by 2%/year to simulate terms of trade. A full description of other assumptions can be seen in Tables 3.1, 3.2, 4.1, 4.2 and 5.

Table 1: Enterprise mix and farm profit for Warburtons' farm in their current system and as modelled as standard practice.

	Warburton Farm Current Management with Rotational Grazing	Warburton Farm modelled with standard district practice.
Farm Size (ha arable)	1280	1280
Average Area of Pasture (ha, % of farm)	756(59%)	890 (70%)
Average area of Crop (ha, % of farm)	524 ha (41%)	390 (30%)
Carrying capacity winter grazed DSE per ha	17	10
Discounted 10 year cumulative financial position	**$1 811 000**	**$1 145 000**
% Improvement of Warburtons' Rotational Grazing system over Current standard practice over 10 years	37% increase in profit	

The results of the modelling for Warburtons' (Table 1) indicates that under a more intensive and yet more environmentally sustainable system, large increases in profit can be achieved above standard practice. This system is achieving higher production and still maintaining good ground cover through summer reducing the risk of erosion and increasing water use.

Mathwin's system is much more relaxed and less intensive than the Warburtons' system; the focus is on sustainable farming and easy paced lifestyle. The result of modelling indicates that under their rotational grazing system they are slightly more profitable than current standard practice (Table 2), and they also achieve their environmental and lifestyle outcomes.

Table 2: Enterprise mix and farm profit for Mathwin's farm in their current system and as modelled as standard practice.

	Mathwin Farm Current Management with Rotational Grazing	Mathwin Farm modelled with standard district practice.
Farm Size (ha arable)	735	735
Average Area of Pasture (ha, % of farm)	606 (82%)	470 (64%)
Average area of Crop (ha, % of farm)	129 (18%)	265 (36%)
Carrying Capacity winter grazed DSE per ha	12	9
Discounted 10 year cumulative financial position	**$ 762 000**	**$ 658 000**
% Improvement of Mathwin's Planned Rotational Grazing system over Current standard practice	14% increase in profit.	

Table 3.1: Cropping and pasture input assumptions utilized in the model for Warburtons' current system and standard practice.

Enterprise	Wheat		Barley		Canola		Pasture	
	Warburton	SP	Warburton	SP	Warburton	SP	Warburton	SP
Yield ($/t)	3.5	2.8	3.5	2.8	2	1.8		
Price ($/t)	150	150	148	148	298	298		
DSE/ha winter grazed							17	10
Fertiliser ($/ha)	110	95	110	87	110	101	35	20
Sprays ($/ha)	70	35	70	35	70	74	5	5
Fuel/oil grease ($/ha)	30	25	30	27	30	24	5	5
Repairs ($/ha)	25	24	26	26	25	25	2	2
Crop ins. ($/ha)	6	2.5	6	2.5	6	2.5		
Seed / treatment ($/ha)	17	17	17	17	16	16		
Contractor ($/ha)	3	2	3	2	3	25		

CONCLUSION

Based on the Warburtons' and Mathwin's case studies, the STEP modelling results indicate that rotational grazing systems can be more profitable than current standard district practice even when practised at relatively low intensity. Adoption of the system requires a new approach to achieving management objectives that may not be obtainable in a conventional annual based pasture system relying on set stocking.

Both Warburtons and Mathwins acknowledge that more work can be done to improve the composition of pastures, trialling different species to provide more options for pastures that respond better to rotational grazing. Both producers continue to expand the area sown to perennial pastures; ultimately Warburtons envisage about 30-40% of the property under permanent perennial pasture and Mathwins hope to have 90 to 100%.

Table 3.2 Livestock assumptions in the model for Warburton's current system and standard practice.

	Ewes		Weathers		Lambs	
	Warburton	SP	Warburton	SP	Warburton	SP
Sale Price ($/hd)	40	40	65	65	45	45
Kg wool cut /hd	4.8	5.5	5	6	2.5	3.5
Price / Kg wool	4.70	4.70	4.70	4.70	4.70	4.70
Lambing % Older ewes	100%	85%				
Lambing % Maiden ewes	60%	75%				
Vet Costs $/ hd	0.75	0.65	0.75	0.65	2.00	2.00
Shearing Costs $/hd	4.55	4.55	4.55	4.55	4.55	4.55

Table 4.1: Cropping and pasture input assumptions utilized in the model for Mathwins' current system and standard practice.

Enterprise	Wheat		Barley		Canola		Pasture	
	Mathwin	SP	Mathwin	SP	Mathwin	SP	Mathwin	SP
Yield ($/t)	1.5	2	3.5	3	2	1.8		
Price ($/t)	150	150	148	148	298	298		
DSE/ha winter grazed							12	9
Fertiliser ($/ha)	57	57	57	57	77	77	20	20
Sprays ($/ha)	25.5	25.5	25.5	25.5	25.5	25.5	0	5
Fuel/oil grease ($/ha)	15	15	15	15	15	15	2	5
Repairs ($/ha)	5	5	5	5	5	5	2	2
Crop ins. ($/ha)	3	3	3	3	3	3		
Seed / treatment ($/ha)	16	16	16	16	12	12		
Contractor ($/ha)	2	2	0	0	0	0		

Table 4.2 Livestock assumptions in the model for Mathwins' current system and standard practice.

	Ewes		Weathers		Lambs	
	Mathwin	SP	Mathwin	SP	Mathwin	SP
Sale Price ($/hd)	40	40	65	65	45	45
Kg wool cut /hd	4.5	4.5	5	5	4.5	4.5
Price / Kg wool	5.30	5.30	5.30	5.30	5.30	5.30
Lambing % Older ewes	85%	85%				
Lambing % Maiden ewes	85%	75%				
Vet Costs $/ hd	0.65	0.65	0.65	0.65	1.5	1.5
Shearing Costs $/hd	3.40	3.40	3.40	3.40	3.40	3.40

Table 5: Other assumptions

	Mathwins' Property		Warburton's Property	
	Current Sys	Standard Pra	Current Sys	Standard Pra
Summer Fodder Costs	$1 800	$11 000	$15 000	$23 000
Annual Depreciation on Plant	$8 000	$16 000	$40 000	$20 000
Interest Repayment on Loans on Plant	$4 000	$8 000	$20 000	$10 000
Principle Repayment on Loans on Plant	$4 000	$8 000	$20 000	$10 000
Capital Development (Crops)	$4 000	$7 950	$15 720	$11 730
Capital Development (Stock)	$18 000	$9 960	$26 560	$21 104
Personal Drawings	$50 000	$50 000	$60 000	$60 000
Additional Labour			$50 000	$50 000

KEY WORDS

Perennial Pasture, Rotational Grazing, Planned Grazing, Economics

ACKNOWLEDGMENTS

Thanks go to the Growers involved in the analysis Rob and Jenny Warburton and David and Lyn Mathwin for their time and patience and the Department of Agriculture and Food and the SWCC (South West Catchments Council) for funding the work.

Paper reviewed by: **Heather Percy and Caroline Peek**

Sheep Returns from Saltland Pastures

Allan Herbert, Senior Adviser, WA Department of Agriculture and Food

ABSTRACT

Salt-affected land in WA agricultural areas is a potentially large resource if managed for livestock grazing. 14 case study 'Producer Network' sites in the WA wheatbelt were established with improved salt-tolerant pastures during 2002 to 2005 under the Sustainable Grazing on Saline Land (SGSL) project. Average cost of establishment was $277/ha with a range of $100/ha up to $700/ha. Investment analysis indicates that grazing returns are expected to pay for the initial investment inside 10 years for 8 of the sites – with a range of 3 years to over 20 years depending on site characteristics, the cost of establishment, and management intentions for the site.

AIMS

To provide guidance on the financial implications for farmers of saltland pasture development options. The 2 main questions by farmers when confronting their saltland pasture management options are – "What is it going to cost?" and "How much will I get back for it?"

METHOD

Under the Producer Network component of SGSL, 69 sites in Western Australia were subsidised to assist interested farmer groups to explore options for managing salt-affected land. 26 sites were visited by the author with 14 providing reasonable data for analysis. Sites included in the analysis were located at Wubin, Morawa, Moora, Ballidu, Bonnie Rock, Koorda, Trayning, Dowerin, Quairading, Corrigin, Katanning, and Tambellup. Establishment techniques varied from hand-spreading pasture seed onto lightly cultivated soil to machine-planted close-spaced saltbush seedlings with a tree planter. Sites chosen for demonstration included the very hostile 'samphire' land ranging up through the moderately affected 'barley grass' zone to the more slightly affected 'crops at risk' type of land. All sites were based on saltbush with or without various mixes of annual and/or perennial legumes and/or grasses.

Establishment costs

All the cash costs of establishment were collected. Unfortunately, there had been high failure rates from the late winter plantings due to a run of abnormally dry spring conditions. However, the costs of replanting were included as legitimate costs to systems where pastures are being introduced into unfavourable situations. Any subsidy was disregarded. The farmer's labour cost was not included.

Costs of fencing and water supplies were also documented. These costs were somewhat inflated due to the demonstration nature of the (small) sites and their location in the landscape. Farmers managing their saltland in a normal commercial context could be expected to get these costs down considerably. Nevertheless, these infrastructure costs are an important component of the saltland grazing system and should be budgeted in any development plan.

Grazing returns

All sites were aimed at autumn grazing – to supplement stock during the period of lowest feed supply and to reduce the normal cost of supplementary feeding. However, most sites were still in the establishment and consolidation phase and hence there was little production information. Documentation of grazing returns was limited to sheep grazing days – numbers of sheep for a number of days. (The other 'research' component of SGSL is gathering more sophisticated performance data from study sites at Tammin, Yealering, and Pingaring). Nevertheless, some reasonable estimates of possible grazing returns were made by associating similar sites. These were placed into a 10-year cash flow analysis framework (discounted at 7%) from which **benefit:cost ratio** and **years taken to recover costs of establishment** were calculated. Sensitivity analysis was done on the various assumptions (results not shown). The opportunity cost was set at zero – most farmers said that production from the site was neglible prior to the improvement program and the land had been abandoned. The value of a sheep grazing day was assumed to be 10 cents. This is based on the approximate equivalent cost per day to feed a maintenance ration to an adult dry sheep at current feed prices – e.g. 4.1 kg grain + 1 kg hay per week.

RESULTS

Site conditions and purpose of establishment need to be understood to interprete the results. The pasture species (mix) chosen and methods of establishment will vary with specifications of the site. The following Table 1 summarises analysis outcomes for each of the sites.

Table 1: Costs and returns for 14 WA wheatbelt saltland sites.

Location	Area	Establishment Cost* ($/ha)	Assumed Grazing days per ha per year	Years to payoff	Benefit:Cost Ratio
Koorda	4 ha	$305	400	> 20	0.50
Dowerin	35 ha	$195	850	5	1.81
Quairading 1	38 ha	$151	1000	5	2.03
Quairading 2	9 ha	$352	900	11	0.85
Bonnie Rock	33 ha	$73	400	4	1.54
Morawa	5 ha	$717	800	> 20	0.38
Ballidu	41 ha	$159	500	7	2.48
Moora	30 ha	$103	850	4	2.68
Tambellup	19 ha	$280	800	6	1.32
Katanning	40 ha	$305	800	7	1.29
Wubin	35 ha	$298	400	> 20	0.44
Corrigin	20 ha	$145	800	3	2.70
Trayning	14 ha	$514	140**	> 20	0.20

* Excludes the costs of fencing and water supplies.

** The Trayning site was grazed with cattle – close-spaced saltbush supplemented with barley straw.

Eight of the 14 sites have a BCR greater than 1 indicating a worthwhile investment and will pay off the investment cost in under 10 years.The less profitable sites either had high costs (e.g. re-establishment after failures) and/or inappropriate establishment techniques and/or wrong species mixes. It is expected from the 'trial' nature of the sites.

A wheel-type ready reckoner '$ Investment in Saltland Pastures' was developed to allow potential investments in saltland to be assessed for possible profitability. Copies are available from the author.

CONCLUSION

The analysis provides encouragement that, where appropriate pasture improvement is done, there is a good chance of retrieving those investment costs in a reasonable period. The cost of establishment compares favourably with the purchase price of additional pasture land.

Farmer experience suggests that once the area of improved saltland pastures increases, it impacts more widely on the whole farming system. Modelling indicates that whole-farm profitability can increase through combinations of more sheep being carried on the farm, autumn deferment of pastures improving carrying capacity, and even creating the opportunity for more crop – as well as reductions in costs of autumn hand-feeding.

KEY WORDS

Sheep, salt-tolerant pastures, financial return.

ACKNOWLEDGMENTS

Case study farmers have participated enthusiastically in the project and provided the details to allow the analysis to occur. The national SGSL project has been funded by Australian Wool Innovation and Land & Water Australia in partnership with Meat & Livestock Australia, CSIRO, the CRC for Plant-based Management of Dryland Salinity, and the WA Department of Agriculture.

Paper reviewed by: Felicity Byrne

Pasture legumes and grasses for saline land

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ABSTRACT

Research over the past 3 years has confirmed the best perennial grass options for saline land are puccinellia on waterlogged soils and tall wheat grass on better drained soils. Balansa and Persian clovers are the most waterlogging tolerant annual legumes but have little salt tolerance, often resulting in poor persistence. Scimitar and Cavalier burr medics, on the other hand, are more salt tolerant and very productive, but are not as waterlogging tolerant. There are no perennial legume cultivars adapted to Western Australia with tolerance to both salinity and waterlogging. Pasture mixtures are recommended to take account of the heterogeneity of saline land for waterlogging and salinity.

AIM

To measure herbage production of a range of commercial and experimental pasture legumes and grasses in saline and waterlogged environments of Western Australia.

METHOD

Three sites in Western Australia with differing surface salinity and waterlogging levels were sown: Tammin with moderate salinity and low waterlogging, Cranbrook with mild salinity and high waterlogging and Duranillin with moderate salinity and high waterlogging (Table 1). Annual legumes numbered 32 at Tammin and Duranillin and 14 at Cranbrook, while each site contained 10 perennial legumes and 8 perennial grasses. Entries were replicated five times and sowing rates were 10 kg/ha. Plots were adequately fertilised. Standard herbicides and insecticides were applied where necessary. Trials were not defoliated during growing seasons but grazed by sheep over summer.

Peak biomass production, measured in the spring of each year, is used in this paper as the primary measure of site adaptation. Total plot biomass was estimated by a visual rating from 0-400, which was calibrated with 15 oven-dried herbage cuts. This value was then multiplied by a visual estimate of the sown variety proportion in each plot to give an estimate of sown variety biomass. Only the results for commercially available pasture cultivars are considered in this paper.

Table 1. Site details for Tammin, Duranillin and Cranbrook

Site	Annual rainfall (mm)	Soil pH_{CaCl}	Soil texture	$EC_{1:5}$ (mS/m)*	Waterlogging	Year sown	Plot size
Tammin	350	6.5	Sandy clay loam	70	Low	2003	2 m x 1 m
Duranillin	525	5.6	Sandy loam	75	High	2003	2 m x 1 m
Cranbrook	525	5.5	Sandy clay loam	45	High	2004	5 m x 2 m

*Values in winter. Salinity levels, particularly at Duranillin were much higher in summer-autumn

RESULTS

Relative variety performance differed between sites and between years within sites (Table 2), indicating susceptibility differences to both salinity and waterlogging. Of the annual legumes, Frontier and Paradana balansa clovers, Scimitar and Cavalier burr medics and Prolific Persian clover performed well at Tammin in Year 1. In subsequent years Scimitar and Cavalier performed well, while the balansa and Persian clovers were disappointing. At Cranbrook all annual legumes performed well, particularly in Year 2, with Frontier being the outstanding performer in both years. At Duranillin the balansa clovers performed well in Year 1, but all annual legumes performed extremely poorly in subsequent years. Of note was the establishment failure of the least tolerant varieties to salinity. The perennial legumes failed to establish at Duranillin and failed to persist at Tammin. However, at Cranbrook Palestine strawberry clover was very productive in Year 2, indicating good waterlogging tolerance in the presence of low salinity stress.

Puccinellia was the only grass to perform at Duranillin. Its production was low in Year 1 but plots continued to thicken thereafter. Dundas and Tyrell tall wheat grass were the only varieties to persist into Year 3 at Tammin, while grass persistence was poor at Cranbrook. It is likely that production of all grasses would have been greater at Tammin and Cranbrook with better annual ryegrass control.

Table 2. Peak annual biomass (kg/ha) of pasture cultivars at Tammin, Duranillin and Cranbrook.

Species	Variety	Tammin			Duranillin			Cranbrook	
		2003	2004	2005	2003	2004	2005	2004	2005
Annual legumes									
Medicago polymorpha	Scimitar	741	2491	2369	606	11	0	4101	5549
Medicago polymorpha	Cavalier	834	1759	2012	759	22	3	3087	3995
Medicago scutellata	Sava	319	931	341	0	0	0		
Medicago truncatula	Caliph	516	1350	1244	194	0	0		
Trifolium glanduliferum	Prima	369	0	0	0	0	0		
Trifolium michelianum	Frontier	818	402	434	943	12	0	5010	7683
Trifolium michelianum	Paradana	1096	235	302	2456	18	1		
Trifolium resupinatum	Prolific	692	57	0	1438	48	2	3106	5131
Trifolium resupinatum	Nitro Plus	265	9	0	20	9	0	3387	3666
Trifolium subterraneum	Dalkeith	97	189	109	0	0	0		
Trifolium subterraneum (yanninicum)	Trikkala	218	13	0	94	0	0	554	2750
Significance level[a]		***	***	***	***	***	ns	***	***
lsd		381	539	484	791	42		1164	1992
Perennial legumes									
Medicago sativa	Sceptre	564	51	18	0	0	0		
Medicago sativa	Salado	293	26	0	98	0	0	933	140
Trifolium fragiferum	Palestine	424	0	0	0	0	0	965	3294
Significance level[a]		***	ns	ns	***	ns	ns	***	***
lsd		198			182			221	493
C3 perennial grasses									
Phalaris aquatica	Sirolan	340	35	21	200	0	0	1026	179
Puccinellia ciliata	Menemen	67	352	86	108	460	988	247	125
Thinopyrum ponticum	Dundas	234	134	227	525	61	67	192	189
Thinopyrum ponticum	Tyrell	130	135	259	485	69	102	333	267
Significance level[a]		*	**	**	***	***	***	***	*
lsd		134	169	177	217	119	147	263	195

[a] *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, ns not significant

CONCLUSIONS

These results confirm the conclusions of Barrett-Lennard (2003). Puccinellia is the best pasture option for saline waterlogged soils, while tall wheat grass can be productive on better drained soils. Balansa and Persian clovers have high waterlogging tolerance but low salinity tolerance, while burr medics have greater salinity tolerance but are susceptible to waterlogging. There are no perennial legume cultivars adapted to Western Australia with tolerance to both salinity and waterlogging. The heterogeneity of saline land for salinity and waterlogging indicates the need to use pasture mixtures. There appear to be good prospects for development of improved cultivars for saline land.

KEY WORDS

Pasture cultivars, salinity, waterlogging, biomass

ACKNOWLEDGMENTS

This work was funded by Land Water and Wool and the Grains Research and Development Corporation. Thanks to Tony York, Ian Peirce and Andrew Toovey for use of their properties.

Paper reviewed by: Ron Yates

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Towards 'clean, green and ethical' sheep production

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INTRODUCTION

Animal industries around the world are being challenged by changing attitudes in consumers that are having an impact in the marketplace: there is an increasing demand for products that are "clean, green and ethical". What do these three words signify?

Clean

We should look for practices in the industry where drugs, chemicals and hormones are used, and try to find ways to reduce the usage and, perhaps, eliminate it. There is little doubt that, in general, this demand is driven by market forces that are not themselves generated by scientific argument – hormonal treatments rarely leave residues, especially after withholding periods, and it is relatively easy to demonstrate that products from animals that have not been treated with exogenous hormones can contain significant amounts of the same hormone. The positive aspect of the demand for "clean" products is that the demand comes from modern, high-priced markets where farmers can make large profits (eg, the market for "organic" products).

Green

We should minimise the impact of the industry on the environment so it is more sustainable for the long-term future. On farms, the most important issues are the production of greenhouse gases by ruminants, the production of animal waste (especially for feedlots), and the excessive use of fertilisers to generate animal feeds. This also applies to the allied industries … those that participate in the processing of the products from the farm (eg, transport, abattoirs, processors). If we can say that our industry is "green", it will help with the marketing in highly developed economies and, at the same time, guarantee the long-term future of the industry.

Ethical

'Animal welfare' is a major concern for all industries that are working in sophisticated markets, where the consumers expect their products to be derived from animals that have been managed sympathetically. This can be a complex issue because, by avoiding the use of antibiotics, for example, we may compromise the welfare of the animals. In addition, the application of ethical judgement needs to be broader than animal welfare: as well as practices in animal management on farms, it should include 'clean' and 'green' aspects of the transport, manufacturing and processing sectors – the processing, packaging and marketing of the products.

CASE STUDY: REPRODUCTION IN MERINO SHEEP

The productivity and profitability of our sheepmeat industry effectively depends on reproductive performance. We can greatly improve reproductive output with exogenous hormone regimens or high-level reproductive technology and molecular genetics. These technologies are remarkable and effective, but we need to find alternatives so we can cope with the changes in consumer sentiment. In addition, these technologies have little direct, short-term benefit in the extensive management systems that typify the Australian industry.

At the University of WA, we have chosen to concentrate on the natural control systems that the animals themselves use to cope with environmental challenges and ensure reproductive success. Most important here are inputs from the external environment: photoperiod, socio-sexual stimuli and nutrition. Most reproductive responses to environmental factors are coordinated at brain level where all external and internal inputs ultimately converge into a common pathway that controls the secretion of gonadotrophin-releasing hormone (GnRH). This hormone is the ultimate controller of the reproductive system of all animals.

This mix of endogenous inputs into the control of the reproductive system provides us with three major opportunities for management of reproductive efficiency:

1) To control the timing of reproductive events, we can use the 'ram effect' (or 'teasing') to induce synchronised ovulation in ewes that would otherwise be anovulatory; this allows for short mating periods and concentrated lambings and opens up a wide range of management possibilities, including tightly-focussed supplementary feeding and strategies for reducing lamb mortality;

2) In 'focus feeding', we can use the responses of the ewe to nutrition to design supplements that are aimed precisely and specifically at each individual event in the reproductive process, such as egg production, embryo survival, and colostrum production;

3) To maximise the survival and development of the new-born, we can use a mix of environmental management, nutrition and genetic selection:

a) Nutritional input – feeding a high energy supplement for the last week of pregnancy can double colostrum production; this is most important for Merino ewes carrying twins;

b) Genetic selection for 'calm temperament' – improving the temperament of ewes will increase lamb survival;

c) Better management practices at birth – to improve the survival of the new-born lambs, it is important to provide a calm environment, and shelter, feed and water close to the birth site. This is increases the amount of time spent at the birth site and therefore improves the development of the mother-young bond.

Ultrasound

Skilled operators with modern instruments can identify dries, single-bearing and multiple-bearing ewes, allowing the use of specific strategies to manage their nutritional requirements. In addition, accurate estimation of the age of a fetus will allow the use of precisely timed nutritional supplements during pregnancy.

CONCLUSION

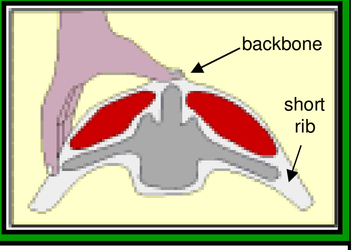
For farmers, 'clean, green and ethical' production need not be difficult because, as we work towards a better understanding of the physiology and behaviour of our farm animals, we can improve productivity and profitability and, simultaneously, promote a modern image. Understanding the reproductive responses of animals to factors such as photoperiod, nutrition, socio-sexual signals and stressors, can help us develop 'natural systems' as replacements for exogenous hormones and drugs for controlling and improving the productivity of our sheep.

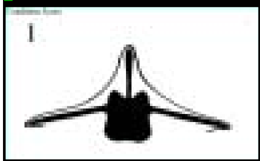
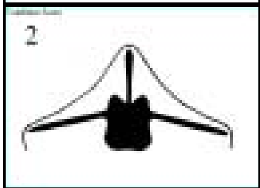
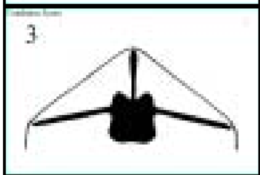
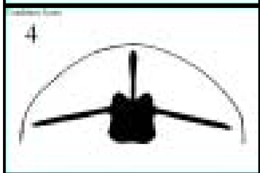
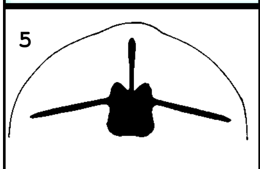
In addition, we can easily genetically improve our animals (eg, ovulation rate, calm temperament) to greatly improve many aspects of their productivity. The use of such 'clean, green and ethical' tools in the management of our sheep flocks can be cost-effective and improve profits, at the same time greatly improving the image of our industries in society and the marketplace. All we need is a little more research and development.

DEPARTMENT OF PRIMARY INDUSTRIES

Condition Scoring

The animal should be standing in a relaxed position. It should not be tense, crushed by other animals or held in a crush. If the animal is tense it is not possible to feel the short ribs and get an accurate condition score



	**Backbone** The bones form a sharp narrow ridge. Each vertebra can be easily felt as a bone under the skin . There is only a very small eye muscle. The sheep is quite thin (virtually unsaleable)	**Short Ribs** The ends of the short ribs are very obvious. It is easy to feel the squarish shape of the ends. Using fingers spread 1cm apart, it feels like the fingernail under the skin with practically no covering
	**Backbone** The bones form a narrow ridge but the points are rounded with muscle. It is easy to press between each bone. There is a reasonable eye muscle. Store condition- ideal for wethers and lean meat.	**Short Ribs** The ends of the short ribs are rounded but it is easy to press between them. Using fingers spread 0.5cms apart, the ends feel rounded like finger ends. They are covered with flesh but it is easy to press under and between them.
	**Backbone** The vertebrae are only slightly elevated above a full eye muscle. It is possible to feel each rounded bone but not to press between them. (Forward store condition ideal for most lamb markets now. No excess fat).	**Short Ribs** The ends of short ribs are well rounded and filled in with muscle. Using 4 fingers pressed tightly together, it is possible to feel the rounded ends but not between them. They are well covered and filled in with muscle.
	**Backbone** It is possible to feel most vertebrae with pressure. The back bone is a smooth slightly raised ridge above full eye muscles and the skin floats over it.	**Short Ribs** It is only possible to feel or sense one or two short ribs and only possible to press under them with difficulty. It feels like the side of the palm, where maybe one end can just be sensed.
	**Backbone** The spine may only be felt (if at all) by pressing down firmly between the fat covered eye muscles. A bustle of fat may appear over the tail (wasteful and uneconomic).	**Short Ribs** It is virtually impossible to feel under the ends as the triangle formed by the long ribs and hip bone is filled with meat and fat. The short rib ends cannot be felt.

Average condition score of a flock is very difficult to assess visually. The sheep pictured are condition score 2 (on left) and condition score 4 (on right).

A flock is made up of a range of condition scores and will include a range of up to 3 condition scores. Randomly assess 25 sheep and use the average of these.

The following is reprinted from SARDI Demo Flock Field Day. Turretfield, 6June 06

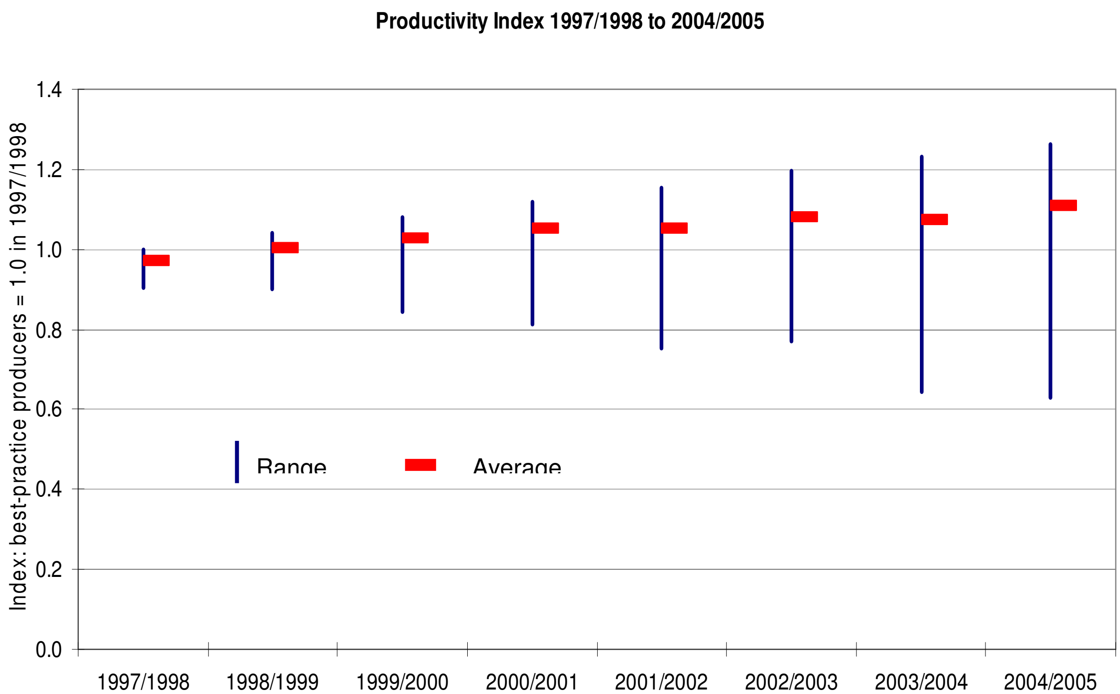
Making Dollars from Merinos

David Sackett, Holmes Sackett & Associates Pty Limited, Wagga Wagga, NSW.

Productivity gains are essential in any industry for it to remain competitive. The sheep industry has a poor track record of achieving productivity gains but recent work has shown that at least a portion of the industry has been achieving quite spectacular gains in their sheep enterprises.

A study conducted by the Sheep CRC of data from a number of benchmarking studies has shown that some producers are achieving 3-5% per annum gains in productivity (see Graph 1). These gains mean that the performance of the business has outstripped the decline in terms of trade over the same period (-2.1%, ABARE 2004). Therefore these businesses have enjoyed a relative improvement in returns.

Graph 1: Productivity Gains



Source: Euan Fleming, UNE and Sheep CRC

However, whilst some sheep enterprises have been performing well, and the average has generated gains of 1.7% per annum, there is a trend for the productivity gap between the better producers and the bottom to be increasing. Productivity of the bottom producers has actually declined over the same eight year period. Is this a concern? It should be if you are one of those producers. Businesses with declining productivity will ultimately disappear, either through erosion of equity or inability to provide a viable business to the next generation. If you are in the group achieving good gains it should not be a concern because it ultimately provides an opportunity for business expansion.

So what are the characteristics of those businesses that are achieving high levels of productivity gain, and conversely those that are achieving low rates of gain? Work is still being done analysing this question but early indications show two things:

- Those that are achieving gains are not necessarily the innovative producers. They are more likely to be adopting proven technology rather than experimenting and taking risk with as yet unproven technology
- They are doing a range of things such as:
  - Some reduced fibre diameter by 1-2 microns
  - Some increased wool per hectare
  - Some improved labour efficiency
  - Some introduced (terminal sire x merino ewe) dual purpose enterprises
  - Combinations of above

This indicates that there is no simple recipe for improving productivity- it is very dependant on where the opportunities are in the individual business. It is also important to remember that productivity is about outputs relative to inputs and therefore productivity can be changed by changing either the quantity of product produced or the value of inputs required for a given level of output.

So where will the future productivity gains come from in the sheep industry?

- Getting the mix between wool and meat right.
- Maximising genetic gain in the economically important traits.
- Continuing to improve the efficiency with which labour is used in the business. This includes shearing as well as all other aspects of sheep management.
- Ensuring pasture is produced efficiently and then converted efficiently into as much saleable product as possible.

Continue to look for the incremental gains that provide most of the productivity improvements over the short term while being vigilant for the quantum leap. As more technology becomes available, it will be increasingly important for managers to be able to discriminate between technology which is likely to have an impact on the business productivity versus the technology that offers little but which is often seductive, either due to its nature or the way it is marketed.

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