LAMB PRODUCTION from DIVERSE GENOTYPES

1994-1997

FINAL REPORT

Cowra Agricultural Research and Advisory Station

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SUMMARY

The objective of the project was ***to assess the variation in performance of lambs from the diverse range of genotypes*** slaughtered in Australia, including variation amongst progeny of individual sires. In particular, the variation in ***lamb growth, carcase characteristics, meat yield, aspects of meat quality, lamb skins and worm resistance*** were investigated.

Over 3000 lambs representing the major types slaughtered in Australia (2ndX, 1stX and straight Merino) were evaluated over three years. The lambs were the progeny of 41 selected sires, including 12 from the recently imported Texel breed. The individual sire matings to Merino (M) and Border Leicester x Merino (BLM) ewes produced six genotypes of lambs (**DxBLM, TxBLM, DxM, TxM, BLxM and MxM**, where D=Poll Dorset, T=Texel, BL=Border Leicester). Lambs were slaughtered at target carcase weights of 19kg for ewes and 24kg for cryptorchids. Some 591 ewe and cryptorchid carcases were also boned out for detailed yield and composition studies.

BREEDS

dams:

BLM	Border Leicester x Merino
M	Merino

sires:

D	Poll Dorset
T	Texel
BL	Border Leicester
M	Merino

lambs:

six genotypes
- D x BLM
- T x BLM
- D x M
- T x M
- BL x M
- M x M

The results showed important differences between the lamb types in growth which affects the **time to reach slaughter**. 2ndX lambs grew 10% faster and reached target slaughter weights 3-4 weeks earlier than 1stX lambs by the same sires. The BLxM 1stX lambs were lighter and took 1-2 weeks longer than the DxM and TxM 1stX types and MxM lambs took a further 6-8 weeks to reach target slaughter weights. The differences between breeds within the crossbred types were generally smaller than the differences in the growth of progeny of individual sires.

The 2ndX carcases were 1.0 mm (GR) **fatter** than 1stX (except BLxM which was the same as 2ndX) and 2.7 mm fatter than MxM at the same carcase weight. The D and T crosses had similar fat levels. There was no difference in **eye muscle area** between the 1stX and 2ndX carcases by D and T sires, although T were 4% larger than D crosses. The BLxM carcases had 10% smaller eye muscle area than the other 1stX and 2ndX, with the MxM intermediate, at the same carcase weight.

Saleable meat yield, from boned out carcases of the same weight, was 2.7% less for the BLxM than all other genotypes, due to more trimmed fat and bone. MxM carcases produced similar amounts of saleable product to 2ndX carcases when compared at the same carcase weight. T sired carcases produced about 1% more product than D crosses, which represents 210g in a 24kg carcase. Hindleg muscularity values were significantly higher for the D and T crosses than the other genotypes.

Meat quality. Indicators of **meat quality**, pH, colour and tenderness, were measured. The MxM and BLxM carcases had higher average pH and more carcases above pH 5.8 (at which spoilage bacteria are more prevalent), than other genotypes. There were no significant differences between the genotypes for colour or tenderness. There was some evidence of differences in tenderness between the progeny of individual sires.

Lamb survival. There were no differences in **lamb survival** between the sires or sire breeds, but survival of lambs was higher from BLM than Merino ewes. The majority of lamb deaths was due to spinal and cranial damage indicating trauma during birth.

Lambskins. The utility and quality of **lambskins** was also examined. The results showed that large high grade skins can be produced for wool-on products from all genotypes. MxM pelts were unsuitable for conventional lamb leather production because of a high incidence of ribbyness and associated damage from shearing and processing.

Worm resistance was assessed by faecal egg count (FEC). There were no differences in FEC between the genotypes. However there were significant differences between sire progeny groups, indicating that selection would be expected to improve worm resistance.

LAMBPLAN across-flock EBVs for the sires used were good predictors of their crossbred progeny performance for weight, fat and muscle. The testing of more BL animals and development of greater pedigree linkage between BL flocks would be expected to improve the accuracy of BL across-flock EBVs.

The results from this project provide producers and processors with a sound basis for decision making on the optimum usage of the diverse genotypes that are available to produce Australian slaughter lamb. While the number of sires of each breed was limited, the results clearly demonstrate differences between lamb types for economically important growth and carcase characteristics. There was considerable variation between the sires used within breeds, which were selected for high genetic merit, in the performance of their progeny. The variation in lamb performance is expected to be greater across the range of sires available in the industry. While there were significant differences between lamb types in growth and carcase traits, the differences for measures of meat quality were small. In particular, the industry perception of poorer meat quality, such as darker colour, from Merino compared to crossbred carcases was not substantiated, when all the lambs were grown together under conditions of good nutrition and management.

1. INTRODUCTION

Australian slaughter lambs are traditionally produced from a diverse range of genotypes and production systems. The main types (% of total slaughter) are:

- ***second cross (2ndX)*** (40%) - terminal sire x 1stX (Border Leicester x Merino) dam
- ***first cross (1stX)*** (25%) - Border Leicester x Merino and terminal sire x Merino
- ***straight Merino*** (20%) - Merino x Merino

There are large differences in growth rate and carcase traits between these types, as well as between sires within types. However there is very little comparative information on meat yield, carcase and meat quality for the various types.

The Texel breed has recently been imported to Australia. In overseas studies Texel cross lambs have produced leaner carcases with more muscling than other crosses. However performance of the Texel relative to traditional meatsheep sires under Australian conditions needs to be evaluated as well as the variation amongst individual sires.

This project was carried out ***to assess the variation in performance of lambs from the diverse range of genotypes*** slaughtered in Australia, including variation amongst progeny of individual sires. In particular, the variation in ***lamb growth, carcase characteristics, meat yield, aspects of meat quality, lamb skins and worm resistance*** were investigated.

THE PROJECT

This project was carried out to assess the variation in performance of lambs from the diverse range of genotypes slaughtered in Australia... in particular, the variation in lamb growth, carcase characteristics, meat yield, aspects of meat quality, lamb skins and worm resistance.

THE PROJECT

Merino (M) and 1stX Border Leicester x Merino (BLM) ewes were individually mated to 41 sires from a range of breeds at the Cowra Agricultural Research Station in three years (1994 - 1996). The sires used were; Poll Dorset (D, n = 7), Texel (T, n = 10), Border Leicester (BL, n = 12) and Merino (M, n = 12). The matings resulted in more than 3000 lambs of six genotypes (**DxBLM, TxBLM, DxM, TxM, BLxM and MxM**). The sires came from several flocks and were selected for high growth and leanness using Central Progeny Test performance data, LAMBPLAN indices or other progeny test data. Both artificial insemination (AI) and natural service were used depending on the availability of rams, with common sires providing genetic links for performance over the three years.

Lambings occurred in July/August of 1994 to 1996. Male lambs were made into cryptorchids at marking. Weaning occurred at 12 weeks, after which ewe and cryptorchid lambs were grown separately to slaughter, at target carcase weights of 19kg for ewes and 24kg for cryptorchids. Because of the large range in growth rates of the diverse genotypes, lambs were slaughtered in three groups within each sex each year, as they reached their target weight (approx. 50% of the lambs were slaughtered in the second group).

This report is a summary of the main findings of the project. Results on the variation amongst the lamb types for growth, carcase characteristics, meat yield and meat quality, as well as lamb survival, skin characteristics and worm resistance are presented.

NB. Histograms - genotypes with the same letter above the bar are not statistically different.

While only a limited number of sires of each breed have been tested, these results provide producers and processors with a sound basis for decision making on the optimum usage of the diverse genotypes that are available to produce Australian slaughter lamb.

BAR CHARTS

NB. In this report genotypes with the same letter above the bar, in each chart, are not statistically different.

2. LAMB GROWTH

Average performance of lambs from the various genotypes is shown for birth weight (Fig. 2.1), postweaning weight (Fig. 2.2) and age at slaughter for cryptorchids at 24kg (Fig. 2.3). The cryptorchids had better grazing conditions than the ewes from weaning to slaughter in all years which resulted in relatively better growth rates. Hence the differences between the cryptorchids and ewes are due to the effects of both sex *and* nutrition.

1. The 2ndX lambs grew faster than 1stX lambs, which in turn grew faster than MxM lambs. The 2ndX lambs grew more than 10% faster and reached target slaughter weights 3-4 weeks earlier than the 1stX lambs by comparable sires. This represents the difference in growth potential of crossbred lambs from BLM and M dams.
2. The BLxM 1stX lambs were 4-8% lighter and took 1-2 weeks longer to reach target slaughter weights than the terminal sire 1stX types.
3. The BLxM 1stX lambs were 14-17% heavier and took 6-8 weeks less to reach the target slaughter weights than the MxM lambs.
4. The D sired lambs had a slight advantage in growth (2-3%) and reached target slaughter weights 1-2 weeks earlier than T sired lambs from both BLM and M dams.
5. The differences between breeds within the crossbred types were generally smaller than the differences between individual sires. There was significant variation amongst individual sires for average progeny postweaning weight (Fig. 2.4) and age at slaughter (Fig. 2.5). It is important to note that these sires were generally selected for high growth and carcase traits using progeny test data or LAMBPLAN EBVs. Hence the variation amongst the progeny groups would be much greater if randomly selected sires of each breed had been used.

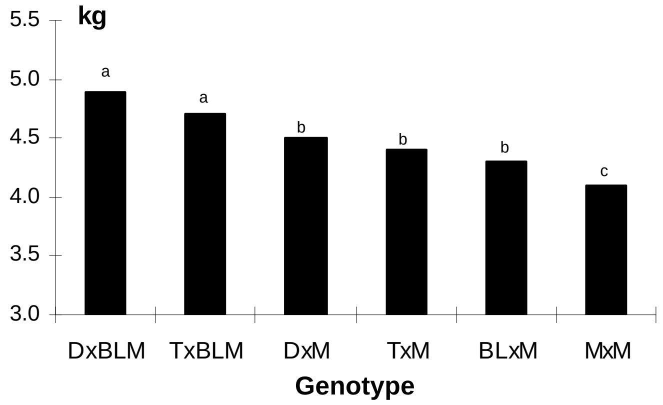

Fig. 2.1 Birth weight
(adjusted to twin born rams)

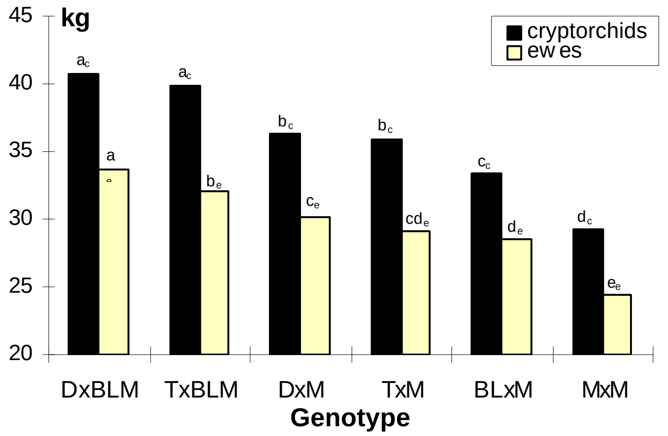

Fig. 2.2 Post weaning weight
(adjusted to 156 days for twin born and reared lambs)

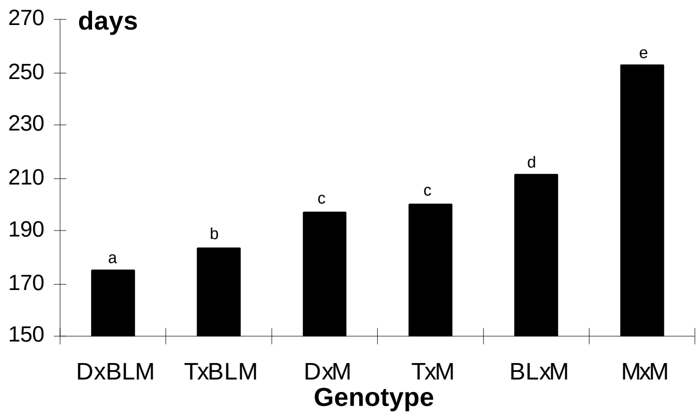

Fig. 2.3 Age at slaughter days
(adjusted to cryptorchids at 24kg carcase weight)

NB. Histograms - genotypes with the same letter above the bar are not statistically different.

TAKE HOME MESSAGES

- there are important differences in growth between lamb types which affect the time to reach slaughter at a particular carcase weight
- there are considerable differences between sires in the growth of their progeny

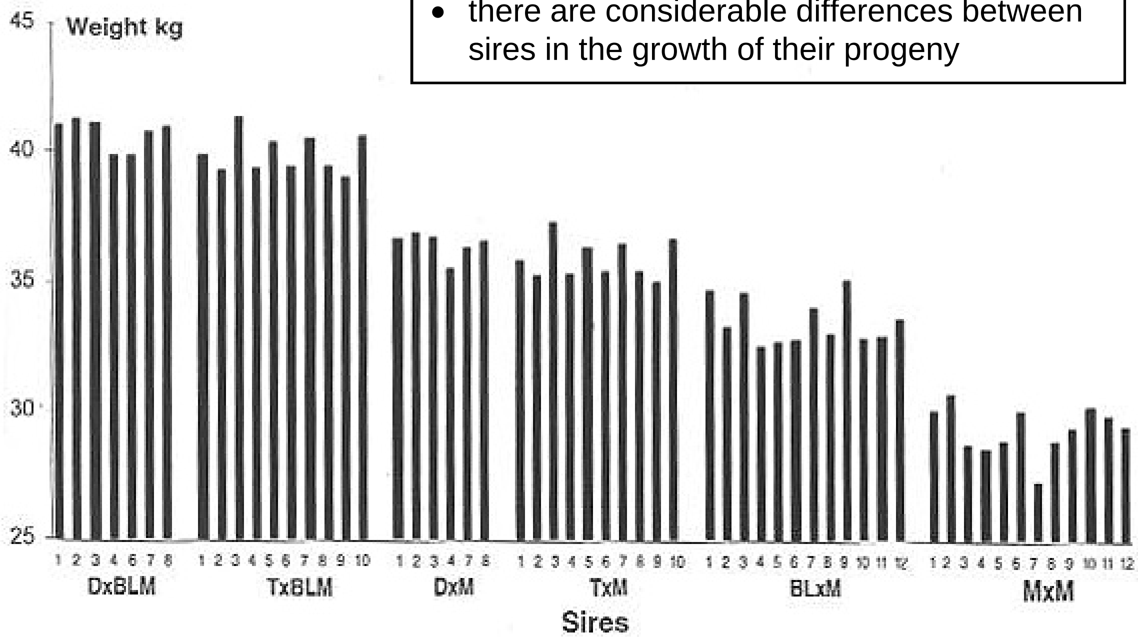

Fig. 2.4 Sire progeny means for post weaning weight
(adjusted to cryptorchids at 156 days, twin born and reared)

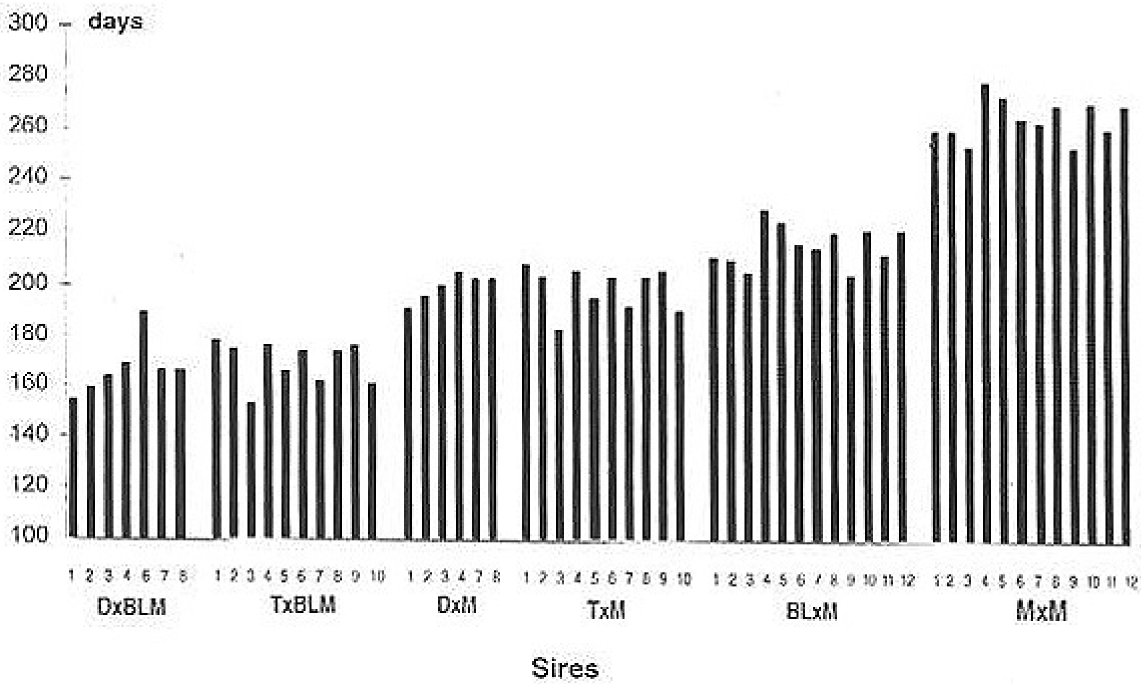

Fig. 2.5 Sire progeny means for age at slaughter
(adjusted to cryptorchids @ 24kg carcase weight)

3. CARCASE CHARACTERISTICS

Carcase measurements were obtained from 2400 lambs over the three years. The ewe and cryptorchid lambs were grown out separately from weaning until slaughter at average carcase weights of 19kg (ewes) and 24kg (cryptorchids). All genotype comparisons are made after adjustment to the same carcase weight.

FAT

Carcase fat depth was measured at the GR site (total tissue depth to the 12th rib, 110mm from the midline) and the C site (depth of fat over the maximum depth of eye muscle at the 12/13th rib).

1. The D and T 2ndX carcases were fatter (GR, 1.0mm; C, 0.7mm) than the D and T 1stX carcases, with little difference between the D and T genotypes, especially for GR.
2. The BLxM 1stX had the same GR and higher C fat depth than the 2ndX carcases, whereas the MxM was leaner (GR, 2.7mm; C, 1.5mm) than the BLxM at the same carcase weight.

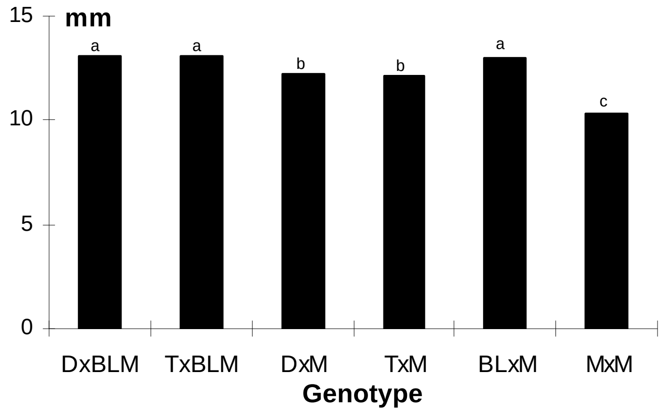

Fig. 3.1 Fat depth - GR
(adjusted to cryptorchids at 24kg carcase weight)

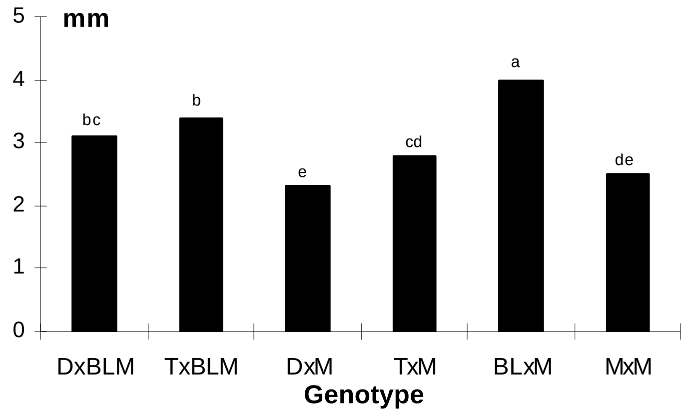

Fig. 3.2 Fat depth - C
(adjusted to cryptorchids at 24kg carcase weight)

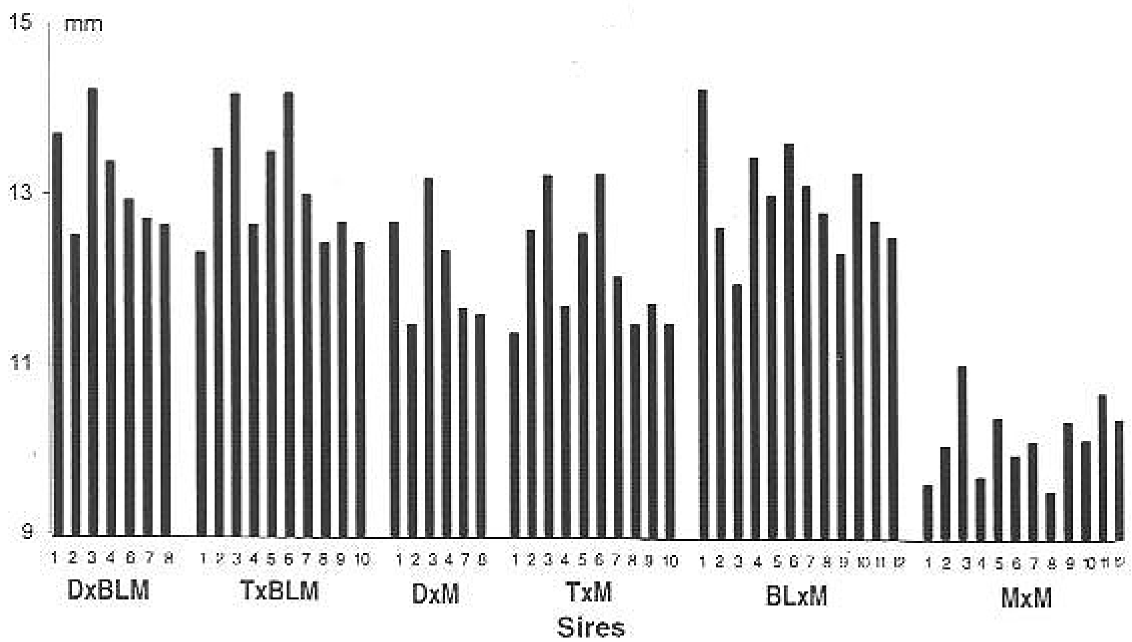

Fig. 3.3 Sire progeny means for GR fat depth (adjusted to cryptorchids at 24kg carcase weight)

3. Fat increased with greater carcase weight and the rate of increase was 50% higher for the ewes than cryptorchids for both GR and C.
4. There was considerable variation between sire progeny groups for fat depth (Fig.3.3).

EYE MUSCLE AREA

The maximum depth and width of eye muscle was measured after cutting the carcases at the 12/13th rib. Eye muscle area was estimated from depth x width x 0.8.

1. There was no difference in eye muscle area between the 1stX and 2ndX carcases by D and T sires.
2. The MxM was 3-4% smaller than the D and T crosses and the BLxM was smaller than the MxM, when they were compared at the same carcase weight.
3. The T cross had 3-5% larger eye muscle area than D cross carcases.
4. Eye muscle area increased by $0.4 cm^2/kg$ carcase weight.

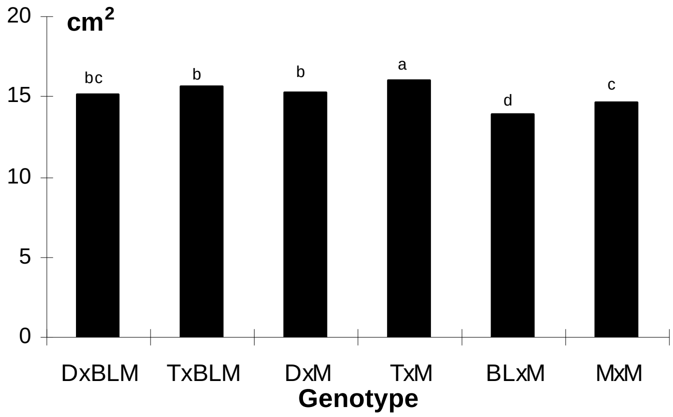

Fig. 3.4 Eye muscle area
(adjusted to cryptorchids at 24kg carcase weight)

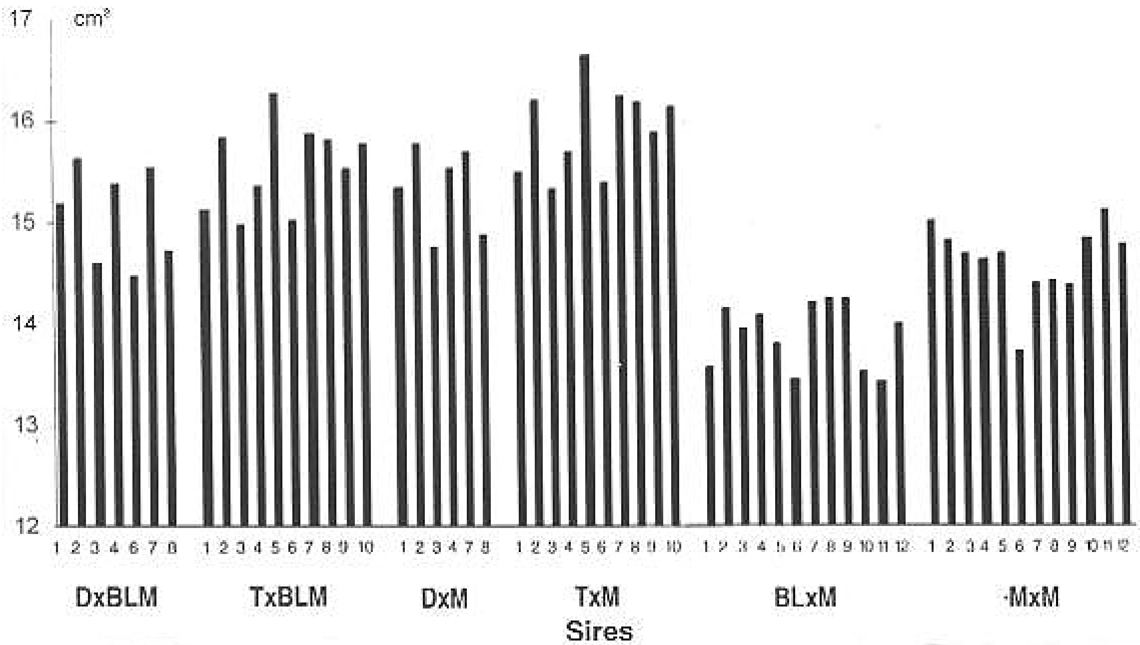

Fig. 3.5 Sire progeny means for eye muscle area (adjusted to cryptorchids at 24kg carcase weight)

5. There was no difference between the ewes and cryptorchids in the muscle measurements, when they were compared at the same carcase weight.
6. There was variation between sire progeny groups for eye muscle area (Fig.3.5, previous page).

DRESSING PERCENTAGE

Dressing percentage is calculated from the ratio of hot carcase weight to preslaughter liveweight. Lambs were fasted overnight (15h), weighed (preslaughter) and allowed to graze and drink for 4h prior to trucking to the commercial abattoir for slaughter the next morning. The carcase weight was not standard AUSMEAT trim as internal fats were retained in the carcase.

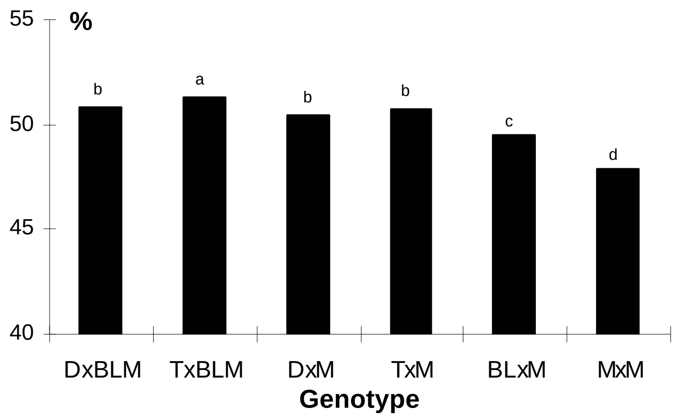

Fig. 3.6 Dressing percentage
(adjusted to cryptorchids at 24kg carcase weight)

1. There was little difference in dressing percentage between the D and T crossbred genotypes, although they were 1% higher than the BLxM and 2% higher than the MxM.
2. Dressing percentage increased significantly with carcase weight, with the increase amongst ewes being twice that for cryptorchids (0.8 *v* 0.4 %/kg). This resulted in ewes having a 2.3% higher dressing percentage than cryptorchids, when compared at the same mean carcase weight (22kg).

CONFORMATION

Conformation of all carcases was assessed by the same person throughout the project using the EUROP system (1= very good to 5 = very poor).

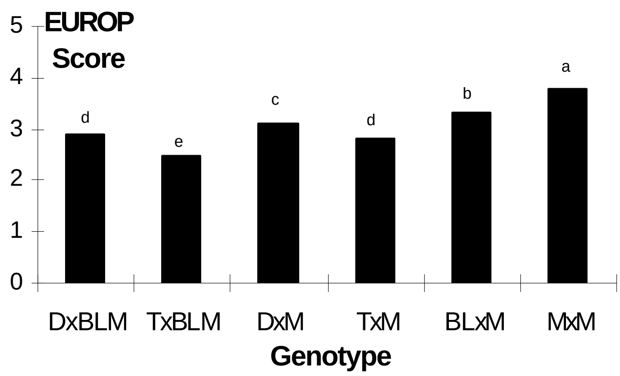

Fig. 3.7 Conformation (EUROP) score
(adjusted to cryptorchids at 24kg carcase weight)

1. 2ndX carcases had better (lower) conformation scores than 1stX carcases, with the T cross lower than the D cross.
2. BLxM carcases had higher (poorer) scores than the D and T 1stX, with MxM having the highest.
3. Conformation score improved with increasing carcase weight.

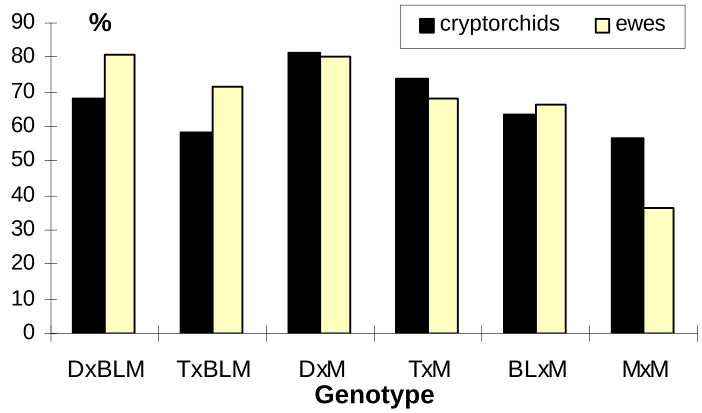

Fig. 3.8 Percentage of carcases fat score 2&3 and greater than or equal to 22kg cryptorchids and greater than or equal to 18kg ewes

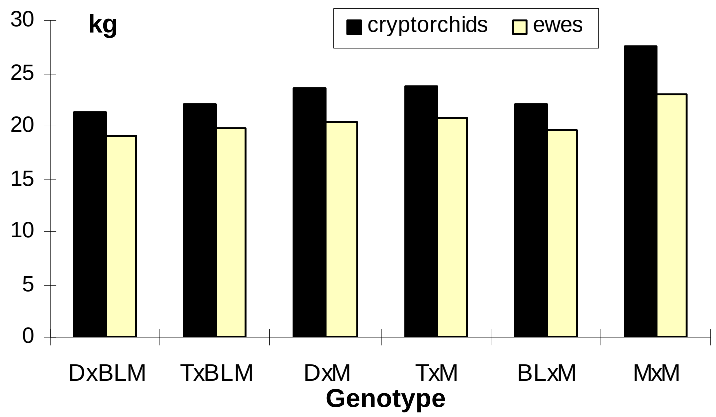

Fig. 3.9 Carcase weight at 12 mm GR fat depth

TAKE HOME MESSAGES

- this extensive study has shown that there are significant differences in carcase characteristics of the major slaughter lamb types produced in Australia.
- when comparisons are made *at the same carcase weight* the differences between terminal sire cross genotypes in fat and muscle are relatively small.
- variation amongst average progeny groups of sires within the genotypes is substantial and often greater than the differences between genotypes for eye muscle area and especially for fat.

CARCASE SPECIFICATIONS

There is an increasing demand for heavier carcases with reduced fat (fat score 2-3 or 6-15mm GR) for domestic and export markets. Fig. 3.8 shows the proportion of lambs of each genotype slaughtered in this study with carcases that fitted the 6-15mm GR specification and were at least 18kg for ewes and 22kg for cryptorchids.

1. A high proportion of the crossbred lambs met these carcase specifications when they were slaughtered.
2. The DxM had the highest proportion in specification, with more 2ndX carcases being excluded because of higher fat levels (especially cryptorchids which averaged over 25kg carcase weight).
3. The T cross lambs were slower growing and slightly lighter at slaughter than the D cross, as were the fatter BLxM, which accounted for fewer carcases of these genotypes meeting the specifications.
4. Despite the MxM being very lean, their slower growth rate meant that only 57% of cryptorchids and 37% of ewes met these specifications.
5. Another way of expressing the relative performance of the genotypes is in terms of carcase weight adjusted to a constant fat level (Fig. 3.9). The carcase weight at 12 mm GR for the cryptorchid lambs was 27.5kg for MxM, and ranged from 21.5 to 23.8kg for crossbreds, and for the ewe lambs was 24.2kg for MxM and 20.5 to 22.0kg for crossbreds.

4. MEAT YIELD AND CUTS

Some 591 ewe and cryptorchid carcases from all genotypes over the three years were cut up by the same experienced butcher to provide meat yield and composition data. The kidneys, kidney and channel fat and skirt were removed from these carcases to give an AUSMEAT standard carcase weight. The carcases were broken into primals and prepared as trim lamb cuts.

MEAT YIELD

For saleable meat yield the comparisons are made at the same carcase weight and the results are presented for 24kg cryptorchids.

1. Saleable meat yield for the BLxM carcases was significantly less than all other genotypes (Fig. 4.1), due to more trimmed fat and bone. This represents 3.2% less saleable meat than from T sired carcases of the same weight or 750g less meat in a 24kg carcase.
2. Merino carcases produced similar amounts of saleable product to 2ndX carcases, when compared at the same carcase weight.
3. T sired carcases produced about 1% more product than Poll Dorset carcases, which represents 210g in a 24kg carcase.
4. T sired carcases had significantly heavier hindleg and forequarter cuts than those by D sires.

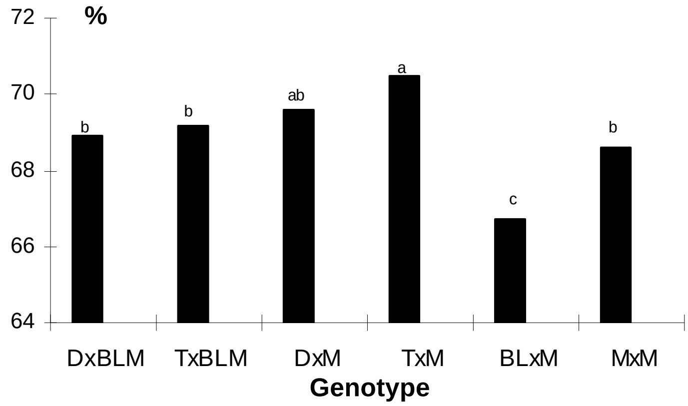

Fig. 4.1 Saleable meat yield
(24kg cryptorchid carcases).

TAKE HOME MESSAGES

- saleable meat yield was lower for BLxM than all other genotypes, at the same carcase weight.
- saleable meat yield for the MxM was similar to 2ndX carcases, at the same carcase weight.
- there were small differences between genotypes for proportions of the various cuts.

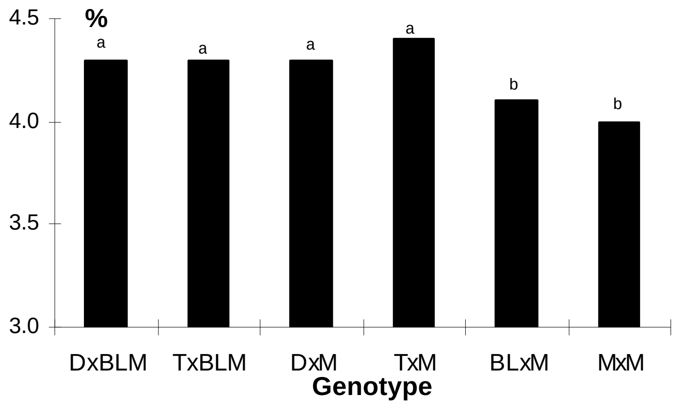

Fig. 4.2. Proportion of topside
(% of carcase weight at 13.5mm GR)

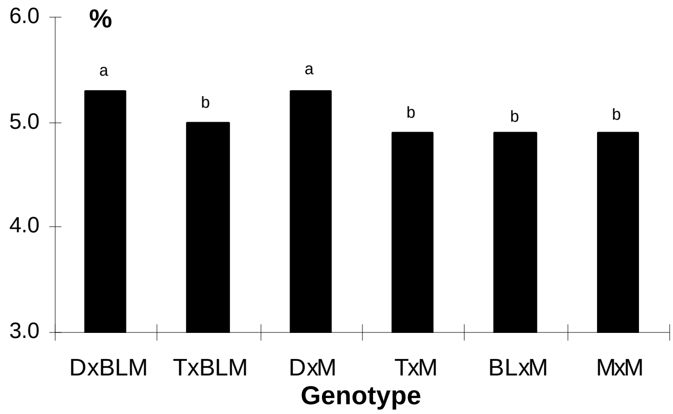

Fig. 4.3. Proportion of boneless loin
(% of carcase weight at 13.5mm GR)

TAKE HOME MESSAGES

- the VIASCAN® has some potential to replace the current method of estimating yield (based on CWT and GR).
- further research is needed to develop technology to estimate muscle dimensions.
- a new probe that has recently been released may be useful, but requires evaluation in practice.

CUTS

To investigate the proportion of various cuts, carcases were compared at the same level of fatness. The results are presented for cryptorchids at 13.5 mm GR.

1. Hindleg cuts (topside, silverside) from BLxM and MxM genotypes were a smaller proportion of the carcase than for the other crosses (Fig. 4.2).
2. Boneless loins from the Poll Dorset crosses were a greater proportion of carcase weight than from all the other genotypes (Fig. 4.3).

PREDICTION OF MEAT YIELD

The usefulness of a prototype Video Image Analysis system (VIASCAN®) for predicting various carcase characteristics was investigated. VIASCAN® consists of a video camera linked to a computer, which together capture dorsal images of lamb carcases on the moving slaughter chain and measure dimensions and colour from these images. The lamb unit only takes whole carcase images, whereas the beef unit can be used to collect images of the eye muscle after quartering.

The ability of the prototype to predict saleable meat yield was compared to the currently used measurements - carcase weight (CWT) and fat (GR), for 84 carcases prepared into 'Trim' lamb cuts.

1. VIASCAN® has a similar accuracy to CWT and GR for predicting meat yield.
2. The variation in yield was poorly explained by both VIASCAN® and by CWT and GR.
3. Inclusion of eye muscle area with CWT and GR dramatically improved prediction of meat yield.

VIASCAN® is the registered trade name of Video Image Analysis Systems developed by the Meat Research Corporation, Australia.

5. CARCASE MUSCULARITY AND COMPOSITION

The hindlegs from 198 cryptorchid and ewe carcases were dissected into muscle, bone and fat to study variation in carcase composition. The composition of the hindleg is closely related to the composition of the whole carcase. Muscularity was further examined by dissecting out the four main hindleg muscles. Muscularity values were determined from the weight of these muscles and the length of bone (femur).

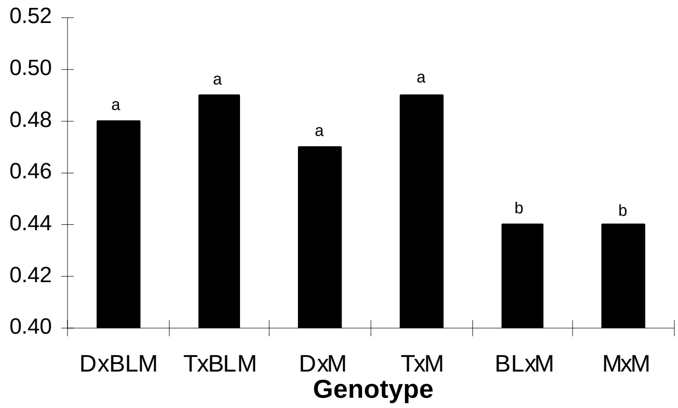

Fig. 5.1 Hindleg muscularity values
(adjusted to 24kg cryptorchid carcases)

MUSCULARITY

1. Muscularity values for the BLxM and MxM lambs were significantly lower than the other crosses (Fig. 5.1).
2. T cross had significantly higher muscularity values than D cross, when they were averaged over 1stX and 2ndX carcases.

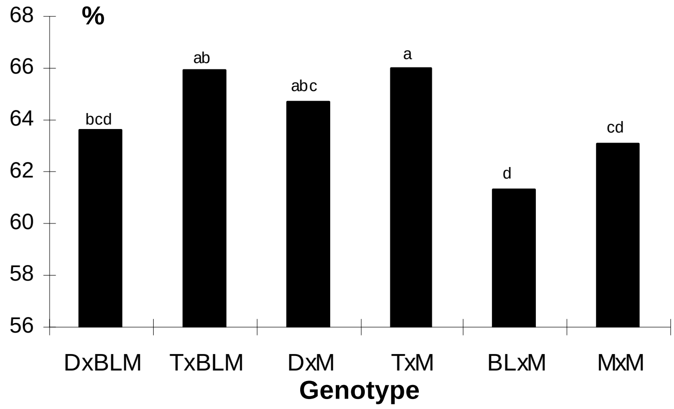

Fig. 5.2 Hindleg muscle percentage
(adjusted to 24kg cryptorchid carcases)

COMPOSITION

1. Differences between the genotypes in composition of the hindleg were generally small. The exception was for the BLxM carcases which had significantly less muscle (Fig. 5.2) and more fat (Fig. 5.3) than most other types. This means the BLxM had 200g less muscle in a 4.2kg hindleg than the TxM carcases of the same carcase weight (24kg).
2. The T cross had significantly more muscle in the hindleg than the D cross, when they were averaged over 1stX and 2ndX carcases. The difference of 1.8% represents 80g in a 4.2kg hindleg.
3. BLxM carcases had the lowest hindleg muscle:bone ratio and TxM the highest with MxM carcases having similar ratios to carcases from D sired lambs.

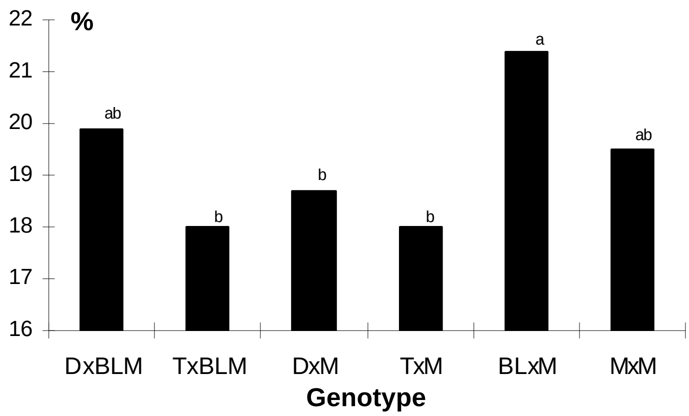

Fig. 5.3 Hindleg fat percentage
(adjusted to 24kg cryptorchid carcases)

TAKE HOME MESSAGES

- the relatively poor hindleg muscularity of the BLxM carcases was due to higher fat levels and a lower muscle:bone ratio (selection for increased muscling within the BL would be expected to improve these aspects in BLxM carcases).
- T cross had superior hindleg muscle content than D cross carcases, mainly due to a better muscle:bone ratio, and also less dissectible fat.
- an objective basis for defining muscularity is possible, similar to muscle:bone ratio, and there is scope to measure this on the slaughter chain using VIASCAN®

6. ASSESSMENT AND VALUATION OF CARCASES AND CUTS

Industry opinion varies considerably about which characteristics should be used to describe lamb carcases to reflect their value. In Australia most carcases are described by their weight and the GR measurement to indicate fat level. Meat industry personnel also use subjective descriptors to differentiate carcases which influence wholesale and retail carcase prices.

In the first year a study was run to examine how subjective and objective carcase characteristics related to the valuation of carcases and cuts by both five wholesalers and five retailers.

CARCASE

The wholesalers and retailers scored each of 47 carcases (1 = very good to 5 = very poor) for the following characteristics; fat distribution, fat level, meat colour and conformation (hindlegs, forequarter, loin and overall). Carcases were also valued, with each wholesaler using his current wholesale prices (cents/kg) and each retailer assigning the price he would pay.

1. Conformation was the most important of the subjective characteristics affecting the value given to carcases.
2. Retailers considered more characteristics eg. meat colour, than wholesalers when determining the value of carcases.
3. Overall there was poor agreement between subjective carcase characteristics and the valuation of carcases.
4. The relationship between carcase weight, GR and carcase value was ***no*** better than for subjective characteristics.
5. There was significant variation between personnel and their valuations, as expected.

TAKE HOME MESSAGES

- the development of a general system using subjective characteristics to describe carcases and their value is not workable.
- a ‘grading’ system based on subjective assessment has limited scope to segregate carcases.
- the current objective methods, using weight and GR, need additional measures, but are easier to standardise.
- visual assessment of meat colour on external surfaces of lamb carcases is unlikely to indicate bloomed muscle colour of valuable retail cuts such as loins.

Assessment of meat colour is often made from the external muscle surfaces of lamb carcases, such as the diaphragm and abdominal muscle. The relationship between the colour of these external muscle surfaces and the cut eye muscle, measured objectively using a chromameter, was investigated. The chromameter measures three aspects of colour: lightness/darkness (*L** value), redness (*a** value) and yellowness (*b** value).

6. There was a moderate association between eye muscle and abdominal muscle for lightness (*L** value), but no association for other measures (*a** or *b**) or with diaphragm values.

CUTS

Retailers assessed boneless lamb cuts (topside, round, eye of loin) from carcases with a range of weights (20 to 31kg) and conformation classes. The retailers assessed the size (too small, ideal, too large) and shape (ideal or unacceptable) and provided a suggested retail sale price ($/kg) for each cut.

1. Assessments of neither size nor shape of the topside, round or eye of loin were related to the nominated retail prices for the three boneless cuts *(further work is needed to see if this holds for bone-in cuts, particularly from carcases under 20kg).*
2. There was a large variation in price between retailers for the eye of loin and topside cuts (eg. eye of loin, $15/kg to $24/kg). Variation in price for the round was much less, reflecting the limited marketing/value adding options for that cut.
3. An optimum carcase weight of 25kg would be required to produce round and topside cuts of the ideal weight for retailers.

TAKE HOME MESSAGES

- the size and shape of boneless cuts did not affect retail price.
- differences in carcase conformation are of minor importance in the value of boneless cuts.
- these results have a bearing on arguments for the use of conformation in a carcase description system.

7. MEAT QUALITY - pH, COLOUR AND TENDERNESS

Meat quality is difficult to define and measure objectively. However ultimate pH (pH declines slowly from slaughter to a constant level after about 24h), colour and tenderness are known to affect storage life, consumer appeal and eating qualities of meat.

MEAT pH

Higher pH results in darker meat colour reduced storage life and tougher meat (when pH is in the range 5.8 to 6.2). Adverse effects on flavour and aroma have also been associated with high pH. Carcases with pH of 5.8 or higher are regarded as undesirable and consequently the proportion of carcases with pH above this level is important.

1. The BLxM and MxM carcases had significantly higher average muscle pH values than the other genotypes (Fig. 7.1). This indicates that the BLxM and MxM genotypes may be more susceptible to preslaughter stress than other genotypes commonly used in the industry.
2. Within both ewes and cryptorchids the MxM and BLxM genotypes had a higher proportion of carcases above pH 5.8 than the other crosses (Fig. 7.2)

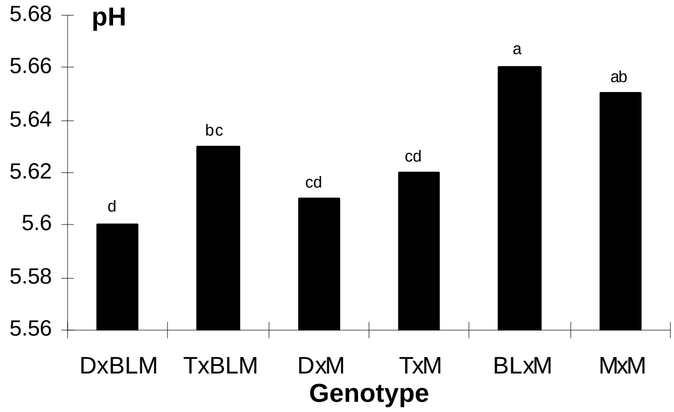

Fig. 7.1 Mean pH for the eye muscle

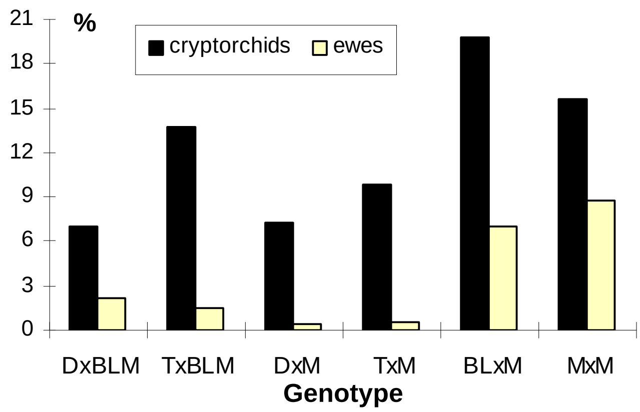

Fig. 7.2 Proportion of cryptorchid and ewe carcases with muscle pH of 5.8 or higher

MEAT COLOUR

There is anecdotal evidence from industry that Merino lambs produce darker meat than crossbred lambs. In Australia, Merino lambs commonly graze low quality pastures and are generally slower growing and older than crossbred lambs at slaughter. These environmental factors may lead to meat colour differences between genotypes that are not due to intrinsic breed effects.

Meat colour is measured objectively using a chromameter, which measures

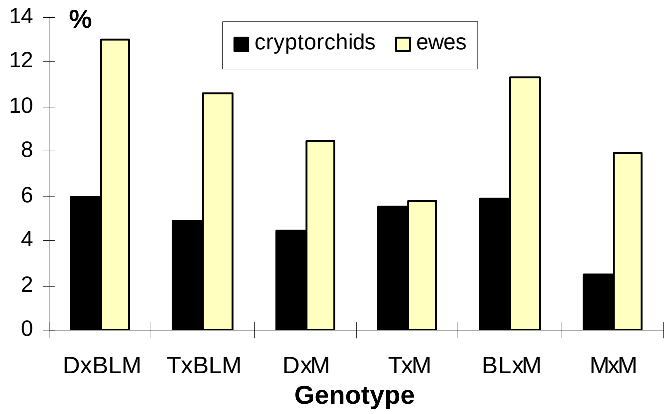

Fig. 7.3 Proportion of cryptorchid and ewe carcases with dark colour (L*<34)

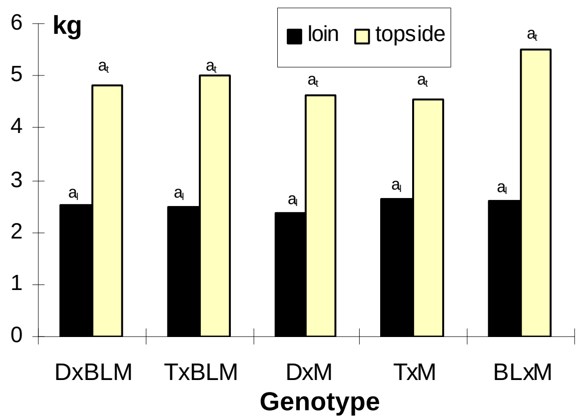

Fig. 7.4 Tenderness of the loin and topside muscles (aged for seven days; insufficient MxM samples to include in results)

three aspects of colour: lightness/darkness (*L** value), redness (*a** value) and yellowness (*b** value).

1. There were no differences between any of the genotypes for colour on the lightness (L*) and yellowness (b*) scales.
2. There were some small differences on the redness scale (a*), but all genotypes were within the acceptable range.
3. Some 7.5% of all carcases had measured L*<34, which is regarded as dark colour. There was no significant difference between the genotypes in the proportion of dark carcases (Fig. 7.3).

TENDERNESS

Tenderness was tested by measuring the Warner-Bratzler shear force (kg) on a limited number of cooked muscle samples that had been aged for seven days, taken from carcases in the last year of the trial. There were insufficient samples from MxM carcases to include in the results.

1. Genotype had no effect on tenderness of the loin or topside muscles (Fig. 7.4).
2. The topside muscle was tougher than the loin, as expected.
3. The amount of moisture lost during cooking was largely unaffected by genotype.

TAKE HOME MESSAGES

- the higher pH for BLxM and MxM carcases has ramifications for exporters who vacuum pack product, particularly during winter when these genotypes are often used to fill shortages in supply of traditional 2ndX lambs (bacteria which cause spoilage, are more prevalent at higher pH levels).
- it remains to be established if higher pH leads to a greater likelihood of sheep meat and foreign flavours.
- the Merino does not produce darker meat than other genotypes when they are raised under similar conditions.

SIRE EFFECTS ON TENDERNESS

The variation in tenderness amongst progeny of particular sires was assessed. In Year 2 loin muscles from 88 1stX ewe lambs sired by three D and three T rams were tested for tenderness after aging for four days. One of these D sires (D7) was suspected of carrying a gene for increased muscling. In Year 3, loin muscle samples from 78 1stX and 2ndX cryptorchid progeny by the same three D sires were tested for tenderness after aging for seven days. Aging carcases or meat for longer periods improves tenderness.

1. Differences between the sires in tenderness of loins from their ewe progeny in Year 2 were not significant (Fig. 7.5), although there was a tendency for muscles to be tougher from sire D7 (suspected of carrying a muscling gene).
2. Cryptorchid progeny by sire D7 in Year 3 had significantly tougher loins than progeny from the other two sires tested (Fig. 7.6). Other differences were minimal. Four of the 29 loins tested from sire D7 progeny had shear force values above 5kg, although the toughest sample came from sire D1 (8.6kg).
3. In Year 3 the cryptorchid progeny of all three rams grew at 350 g/d in the month prior to slaughter whereas in Year 2 the ewe progeny only grew at 110 g/d. The different growth patterns may have played a part in the differences observed between years.
4. There was no difference between the sires in eye muscle area of their progeny, but the boneless loins from carcases sired by D7 were significantly heavier than those from progeny of the other two sires. This may indicate a localised effect on muscle growth. The difference (10%) represented about 120 g for a boneless loin in a 24kg cryptorchid carcase.

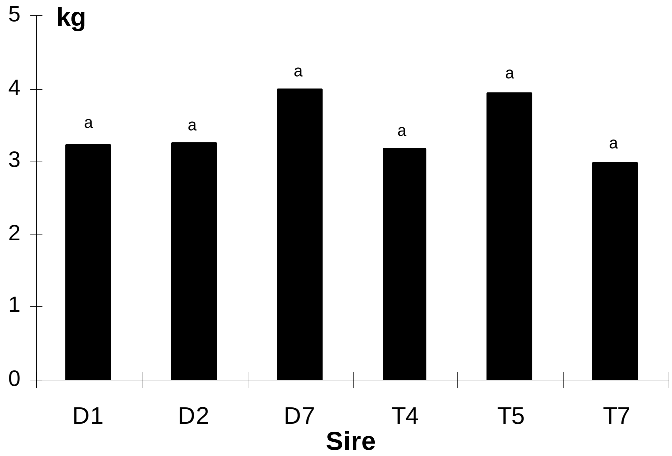

Fig. 7.5 Tenderness of loins from ewe progeny of three Dorset and three Texel sires (loins aged for four days)

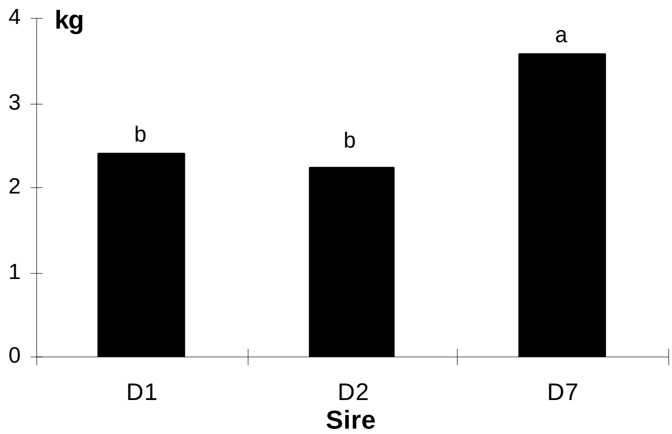

Fig. 7.6 Tenderness of loins from cryptorchid progeny of three Dorset sires (loins aged for seven days)

TAKE HOME MESSAGES

- no conclusive evidence was found for the presence of a major gene affecting eye muscle area in the progeny of sire D7.
- heavier boneless loins amongst D7 progeny indicates there may be some localised effect on muscle growth which requires further study.
- there was an effect of sire on tenderness in Year 3 progeny which requires further research.

8. WORM RESISTANCE

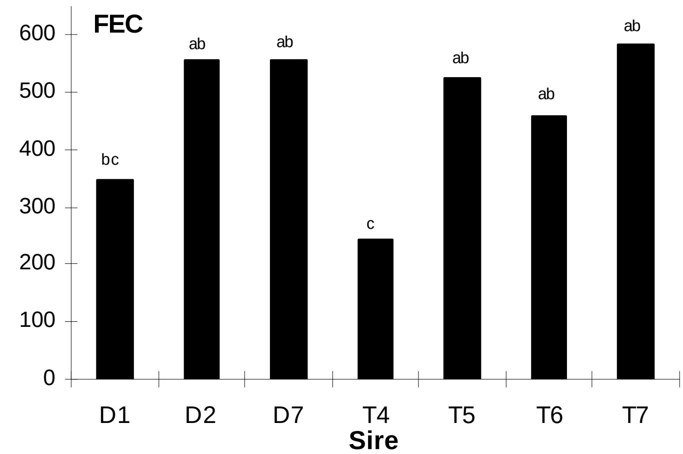

Fig. 8.1 Average worm faecal egg count (FEC - eggs per gram) for lambs sired by T and D rams

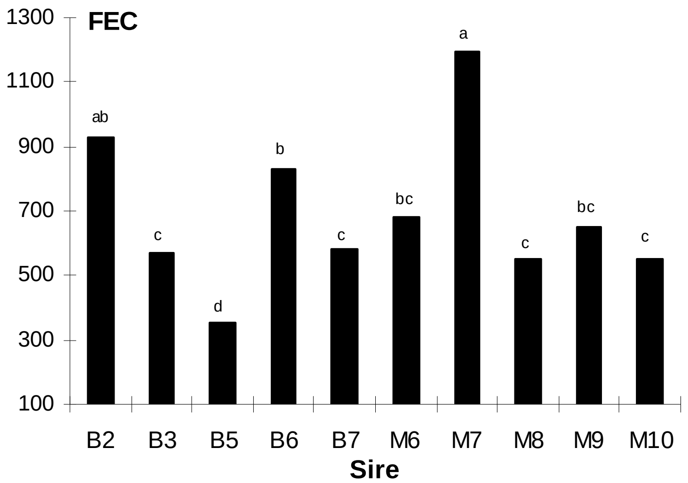

Fig. 8.2 Average worm faecal egg count (FEC - eggs per gram) for lambs sired by BL and M rams

Worm control is particularly important in prime lamb flocks because:

- young lambs are prone to parasite infection.
- worm burdens severely affect lamb growth rate.
- lamb production areas generally have favourable conditions for worm development.

Australian research in the Merino has shown resistance to worms can be enhanced by breeding and selection. Faecal worm egg count (FEC) is a good guide to the genetic resistance of individual sheep and has been used successfully to select for worm resistance.

Preliminary studies were undertaken in the second year of the project, in association with the University of New England, to examine FEC amongst lambs of the various genotypes and the variation between sire progeny groups.

1. There were large differences between individual sire progeny groups in FEC (Fig. 8.1, Fig. 8.2)

2. There were no differences between either sire breeds or M and BLM dams in average FEC

TAKE HOME MESSAGES

- there is considerable variation in worm resistance of progeny from individual sires.

- selection would be expected to improve worm resistance in lamb breeds as has been achieved in the Merino.

9. SIRE ACROSS-FLOCK EBVS AND PROGENY PERFORMANCE

The progeny weight, carcase fat and muscle of the D, T and BL sires was compared to their LAMBPLAN across-flock EBVs (Sept 1996). The analysis provides information on the accuracy of the EBVs in predicting performance of crossbred lamb progeny. The regression values (slope) between progeny performance and sire EBV are expected to be approximately 0.3 for each trait.

1. On average the sire progeny means (1stX and 2ndX) for post weaning weight (Fig. 9.1), carcase fat GR (Fig. 9.2) and muscle depth (Fig. 9.3) were greater for D and T sires with higher EBVs for weight, fat and muscle respectively. The slopes of the regression lines were close to the expected values for each trait.

2. For BL sires the relationships between progeny performance and sire EBVs were lower and less accurate than for D and T sires. This probably reflects lower accuracy of across-flock EBVs for the BL because fewer animals have been tested and there is less pedigree linkage between BL flocks than exists in the terminal sire breeds.

TAKE HOME MESSAGES

- LAMBPLAN across-flock EBVs of sires are good predictors of the performance of their crossbred progeny for weight, fat and muscle.

- testing of more BL animals and development of greater pedigree linkage between BL flocks would be expected to improve the accuracy of BL across-flock EBVs.

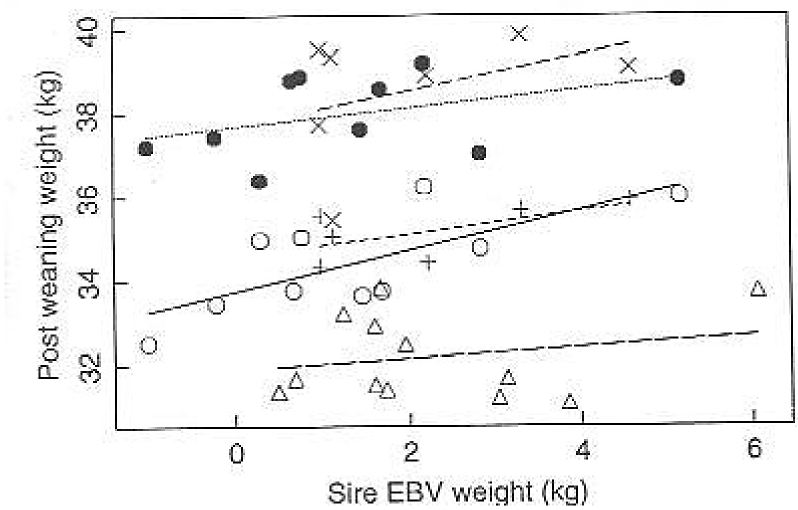

Fig. 9.1 The relationship of average progeny post weaning weight and sire EBV weight

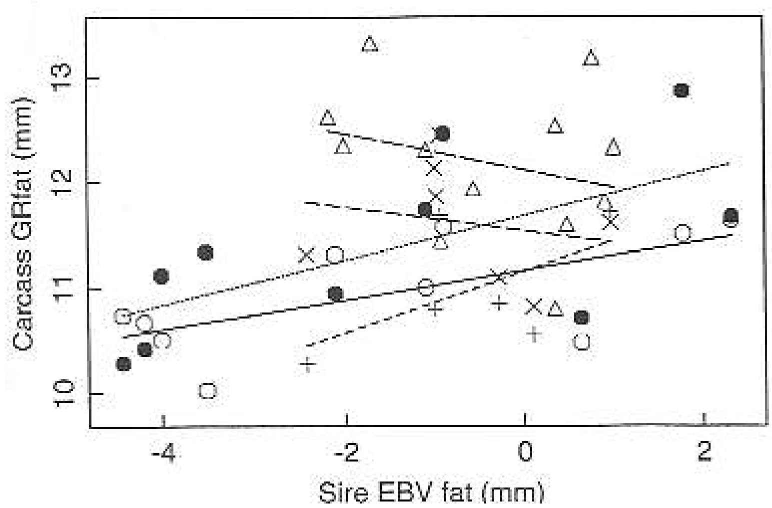

Fig. 9.2 The relationship of average progeny carcase fat GR and sire EBV fat

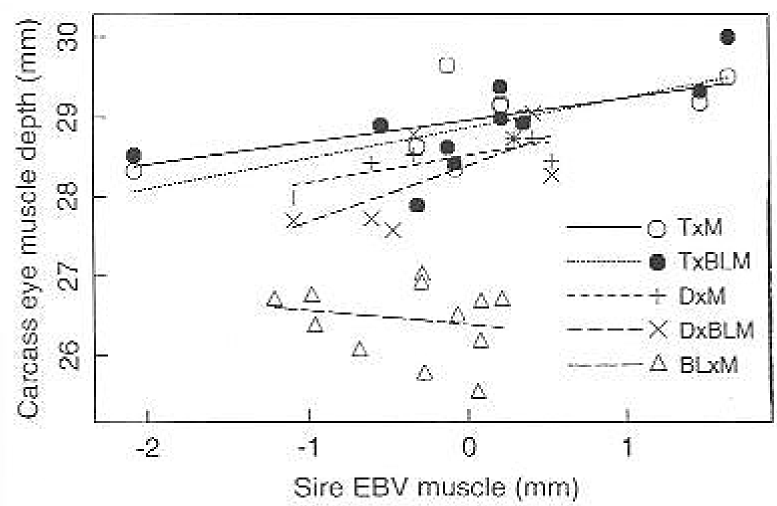

Fig. 9.3 The relationship of average progeny carcase muscle depth and sire EBV muscle

10. LAMBING RATE

The project involved matings of over 800 ewes in February in each of three years (1994-96). Each year, half the ewes were mated using thawed frozen semen and laparoscopic artificial insemination (AI), and the other half were mated in groups to individual rams for 35 days. Overall 84% of ewes lambed with no difference between the AI and single ram natural matings. There was a high proportion of multiple births with an average of 170 lambs born per 100 ewes lambing. There were more multiple births from BLM than M ewes from both AI and natural matings (AI, BLM 200 *v* M 179; Natural, BLM 188 *v* M 157, lambs born per 100 ewes lambing).

1. The laparoscopic AI gave excellent results each year with the lamb weaning rates being 119% for BLM and 112% for M ewes (% lambs weaned/ewe inseminated).
2. Fertility from the individually mated rams varied and was related to their age and experience. Some old (4-5 years) and very young (9 months) inexperienced rams had lower fertility than 2-3 year old experienced rams, that achieved very good coverage of ewes.
3. In the mixed groups of BLM and M ewes mated naturally, the M ewes had higher fertility (M 91% *v* BLM 81% of ewes lambing).
4. There was a significant difference in lambing rate between M ewes that were from different sources or origin (fertility 90% *v* 80%; lambs born 151% *v* 131%). At least part of these differences are likely to be genetic as they were adjusted for age and liveweight of the ewes.
5. Gestation length was 2.3 days longer for M than BLM ewes (148.7 *v* 146.4 days), although there was no difference between D and T sires.

TAKE HOME MESSAGES

- good results can be achieved using frozen semen and laparoscopic AI, provided there is strict attention to detail, good ewe management and an experienced operator.
- age and experience of rams is important when they are mated individually.
- lambing rate can vary considerably with the source and genetic background of ewes.

11. LAMB SURVIVAL

All lambs were identified, tagged and weighed at birth. Any lamb dead at birth or within three days of birth was autopsied, including examination for presence and severity of cranial and spinal meningeal lesions, which indicate trauma during birth.

1. There was no significant difference between the sires or sire breeds in lamb survival of their progeny, but lambs from BLM ewes had higher survival than those from M ewes.

2. The type of birth and birth weight both affected lamb survival (Fig. 11.1). Although it should be noted that there was little effect of birth weight on survival in the range 3.5 to 6.0kg amongst single and twin born lambs.

3. Over 75% of single and 60% of multiple birth deaths were attributed to the effects of dystocia and trauma during birth, with 12% of single and 30% of multiple birth deaths attributed directly to starvation-mismothering.

TAKE HOME MESSAGES

- the effect of genotype on lamb survival is small when ewes lamb under similar management.
- a majority of dead lambs have cranial and spinal damage, suggesting dysfunctional parturition.
- our knowledge of the factors contributing to cranial or spinal damage is limited although it may be affected by the nutrition of the pregnant ewe (subject of further study).

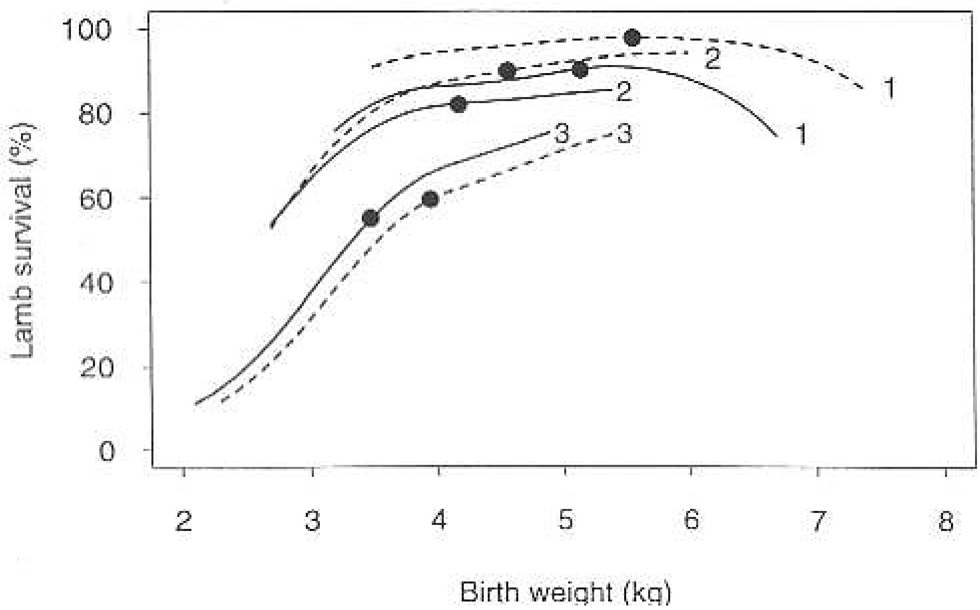

Fig. 11.1 The relationship between lamb survival and birth weight for single (1), twin (2) and triplet (3) born lambs from BLM (-----) and Merino (——) ewes

12. LAMB SKIN CHARACTERISTICS

Lambskins are an important co-product of the prime lamb industry. Most are used as wool-on skins for floor rugs, seat covers, bed underlays, medical rugs, footwear and apparel, with some skins fellmongered and tanned for leather. The utility and value of lamb skins are affected by area, wool length and quality (pigmentation, seed and raddle contamination and take-off damage). All these factors may be influenced by genotype and management.

In the first year, skins from 133 cryptorchids were processed to wool-on tannage and skins from 150 ewes were fellmongered and the pelts processed to leather (nappa). The lambs were shorn after weaning and slaughtered about 20 weeks later as large lambs. In the second year wool length was measured post-shearing to determine the time required to reach the preferred (by lamb skin buyers) wool length of 25-50 mm.

1. There were large differences in wool type between the lamb genotypes, but this was of little practical importance at the final wool-on stage of processing. All genotypes produced suitable wool-on skins.

2. Physical properties of leather from all genotypes was satisfactory.

3. There was a high incidence of the fault pinhole in pickled skins from all genotypes.

4. The MxM pelts had a high incidence of ribbyness, which was associated with more damage from shearing (scars) and processing (grain damage), than pelts from other genotypes. The MxM pelts were less desirable for production of conventional lamb leather than pelts from the other genotypes.

5. Ten weeks from shearing to slaughter provided a commercial minimum wool length for the wool-on trade of 30 mm in most lambs of all genotypes.

TAKE HOME MESSAGES

- large high grade skins can be produced for wool-on products from all genotypes.
- Merino pelts may have a high incidence of ribbyness and damage from shearing and processing making them unsuitable for conventional lamb leather.

Market value of summer lambskins is lower than winter lambskins because of grass seeds, weathering and discolouration of the wool and other factors. The availability of new breeds and changes in management practices prompted a re-examination of the quality of unshorn summer lambskins. Lamb-skins from four of the genotypes (DxBLM, TxBLM, DxM and TxM) of both sexes from a December slaughter were tanned and assessed. The tanned skins will also be dyed to determine the effects of fibre weathering on the dying process.

6. Most skins were assessed as second grade lambskins based on yellow discolouration and handle. There were no significant sex effects, but skins from the 1stX lambs appeared to have better handle than skins from 2ndX lambs.

TAKE HOME MESSAGE

- fibre weathering and grass-seed contamination of summer lamb skins prevents their use in the quality rug trade.

APPENDIX 1. PUBLICATIONS

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- CSIRO Division of Leather Research,

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- University of New South Wales.

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