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Accelerator Breeding Producer Group PIRD

Benchmarking the link between value export cuts and genetic traits

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Abstract

Genetic progress in the Australian Sheepmeat industry is currently underpinned by selection of and breeding from rams with Australian Sheep Breeding Values (ASBV's), however the dollar value of using these ASBV's is not passed on to commercial and seed-stock producers. In order to realise greater financial returns from genetic gain a group of seedstock producers (Accelerator Group) identified the need to measure the benefit of genetic improvements throughout the supply chain.

To achieve financial recognition for this genetic gain from the processing sector, the group aimed to quantify the dollar value of particular traits that may increase returns to the processing sector, stock agents, White Suffolk and Poll Dorset seedstock and prime lamb producers using those sires.

First cross Border Leicester / Merino ewes were inseminated with semen from a range of White Suffolk sires and one Poll Dorset sire that were selected as a result of demonstrating superior ASBV's or having been widely used in the industry up to 2003.
The progeny were slaughtered at 160 days of age having achieved export weights and the following traits were measured for each lamb: hot standard carcase weight, subjective fat score, fat depth, length of carcase, width of loin and rib to rump length. Also measured as an average across each sire, was the weight of shoulder, shin, neck, leg, trim, loin, rack, caps, flaps caps, flaps and length of loin.

The ASBV's of sires used in this trial predicted progeny performance accurately, therefore commercial producers can have confidence that sires will breed true to their ASBV's. The relationship between carcase weight and sire post weaning ASBV indicated that farm gate returns per head can be increased by increasing carcase weight.

Current combinations of ASBV's should have their relative weightings adjusted to more accurately predict an increase in financial return to the processing sector.

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1 Background

Ram breeders spend significant amounts of money each year on improving their genetics, whether it be through purchasing superior rams or employing the latest breeding technologies (artificial insemination (AI), embryo transfer (ET), or juvenile invitro embryo transfer (JIVET)).

In 2003, a shortage of lamb supply was forecast for 2004 and 2005. To improve their viability, a group of seed stock producers identified the need to measure the benefit of genetic improvements throughout the supply chain.

Genetic progress is currently focused around Australian Sheep Breeding Values (ASBV's) for birth weight, weaning weight, post-weaning weight, post-weaning fat depth and post-weaning eye muscle depth. A range of indices have also been developed based on these ASBV's, the most widely used being carcase plus, which incorporates post-weaning ASBV's for weight, fat depth and eye muscle depth.

However, the value of using these ASBV's and/or indices is not currently passed on to commercial and seed-stock producers, as their role in producing superior prime lambs is not recognised by the processors. If the value could be estimated, this could provide breeding direction to both commercial producers and ram producers.

2 Project Aim, Objectives and Expected Benefits

2.1 Project Aim

To quantify the dollar value of traits that will return more profit for processors and commercial lamb producers, so that processors will be able to recognise producers that use high performance prime lamb sires.

2.2 Flock ram buyers (commercial lamb producers)

2.2.1 Objectives

- Increase the level of understanding of how to use LAMBPLAN ASBV's as a tool to select rams to better match their production system, target market and ewe base
- Increase numbers of lambs being produced to heavy export weights from Accelerator Breeding producer members
- Increase carcase weights of lambs to over 24kg whilst maintaining the appropriate amount of fat on the carcase
- Build closer relationships (alliances) with founding seed-stock members
- Build closer relationships between commercial producers and processors, by increasing their reputation for producing quality product from superior genetics, which meet market carcase specifications and maximise lean meat yield

2.2.2 Expected benefits

A better understanding of:

- LAMBPLAN ASBV's and how to relate them to carcase performance
- how sires with varying ASBV's perform under commercial conditions in relation to market specifications
- traits that will convert into better farm-gate returns
- the appropriate ASBV's for flock rams

2.3 Seed-stock members

2.3.1 Objectives

- Identify economically important traits for the production of heavy export lambs, so that greater selection pressure can be applied to these traits
- Identify sire lines, which carry these traits so that widespread availability of genetics is available to industry through technologies such as JIVET

2.3.2 Expected benefits

- Identification of traits that generate value added primal cuts
- Identification of superior sires that carry these traits
- Provide direction to breed this type of ram according to their ASBV set
- Compare these ASBV sets with conventional ASBV's

- Provide breeding direction advice
- Development of closer relationships between seed-stock producers and commercial flock ram buyers

2.4 Processors

2.4.1 Objectives

- To work more closely with producer suppliers in the region, in order to capture more local supply to the abattoir, in addition to improving the flow of information and market signals by way of feedback to producers
- To work more closely with seed-stock producers, to ensure that the genetics being selected for use in large scale breeding schemes, matches the requirements of the industry and in particular the end consumer

2.4.2 Expected benefits

- Promote the wider use of traits that generate high value export meat
- Establish consistency of product
- Create greater awareness of the processing and customer requirements of lamb to producers

2.5 Stock Agents

2.5.1 Expected benefits

- Access to larger numbers of lambs that are more uniform and of a higher quality
- Potential of marketing more lambs that meet export quality
- Confidence to market superior rams that are more likely to maximise farm-gate returns

3 Methodology

Approximately 230 four year old, first cross Border Leicester/Merino ewes were inseminated to 12 White Suffolk sires and one Poll Dorset sire (Table 1). The 13 sires met at least one of the following:

- carried extreme genetic merit in at least one ASBV trait and/or
- had a high, balanced ASBV set and/or
- had been widely used in the seed-stock industry

Table 1 Sire ASBV's as at the October 2007 run (LAMBPLAN, 2007).

Sire	Birthweight ASBV	Weaning weight ASBV	Post-weaning weight ASBV	Post-weaning eye muscle depth ASBV	Post-weaning fat depth ASBV	Carcase +
211	0.18	8.10	11.97	2.28	-0.62	186.66
904	0.69	5.79	8.90	-0.55	-1.22	157.06
1985	0.16	6.92	12.61	-0.36	-0.69	170.20
196	-0.38	5.18	8.10	1.56	0.37	148.23
201	-0.01	3.94	6.60	1.41	0.06	143.60
360	0.14	6.77	10.60	-0.26	-0.91	163.77
10	-0.14	4.06	5.74	2.51	0.78	138.28
41	-0.10	5.18	7.50	0.09	-0.54	145.81
305	0.14	4.55	7.43	-0.03	-0.62	145.59
20	-0.03	4.60	6.51	0.68	-0.47	144.52
61	0.42	6.75	9.93	-0.54	-1.08	160.38
309	-0.07	2.87	3.97	1.77	0.25	130.63
362	0.24	4.99	7.09	-0.19	-0.71	143.79

Rams were selected on their ASBV's prior to insemination in 2003. As resources were unavailable earlier, the analysis of the trial data commenced in 2007 and the 2007 ASBV's of the rams have been used in the data analysis. This is so that results reflect the manner that ASBV's are currently determined so that the values can be assessed for current and future benefit rather than historic.

The correlation between 2003 and 2007 ASBV's is similar (Figure 1). The correlation (r^2 = 0.7269) given on this graph indicates that approximately 73% of the variation in the 2007 post-weaning eye muscle depth ASBV can be attributed to the 2003 ASBV. The other 27% of variation is likely to have occurred due to an increased number of progeny, which has increased the accuracy of ASBV's, but is also due to updates to the Lambplan models in 2005.

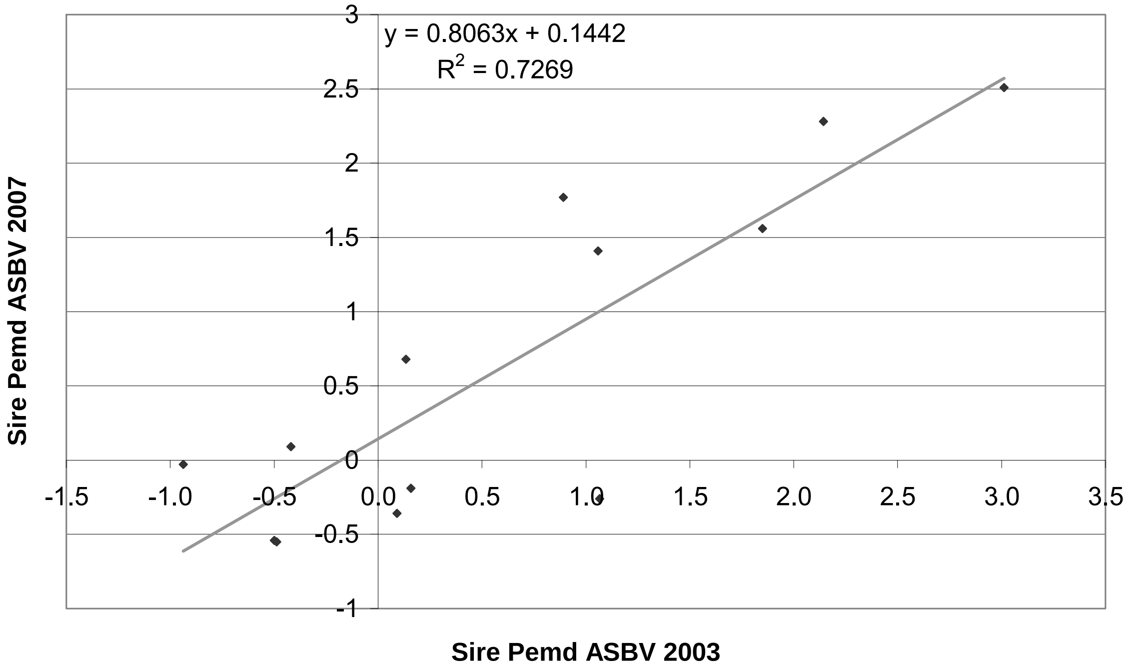

Figure 1 Relationship between the January 2003 and October 2007 post-weaning eye muscle depth (Pemd) ASBV's.

Ewes were run in one management group prior to insemination and throughout pregnancy. Over the lambing period, ewes were split into single sire management groups. All ewes were monitored daily and birth date and birth type was recorded.

Approximately two weeks from the start of lambing (after all ewes had lambed) lambs were weighed (referred to as birth-weight), and their sex and rear type were recorded. Lambs were managed in one group until slaughter.

Lambs were also weighed at 50, 100 and 150 days and scanned to assess fat depth and eye muscle depth at 150 days.

All lambs were slaughtered at heavy export weights at approximately 160 days of age at Tatiara Meat Company (TMC) and the following traits were measured:

- for each lamb:

- hot standard carcase weight
- subjective fat score (determined by a TMC employee)
- fat depth (mm) at the GR site
- length of carcase (cm) (length from base of neck to rump)
- width of loin (cm) (entire width of both loins and spine)
- rib to rump length (cm) (length from last rib to rump)

- as an average of each sires progeny:
  - average weight of:
    - shoulder
    - shin
    - neck
    - leg
    - trim
    - loin
    - rack
    - caps (females)
    - flaps (females)
    - caps/flaps (males)
  - loin length (length of boned out cut)

Due to time constraints and costs of collecting the data at slaughter, only female lambs were weighed pre-slaughter, therefore dressing percentage is only available on the female proportion.

The value of each prime cut was obtained from TMC and was considered representative of retail prices in November 2003.

Data was analysed using a general linear model in Minitab 15. Fixed terms included sire ASBV or carcase plus index, sex and birth type or rear type depending on the ASBV analysed. Post-weaning weight was accounted for in the analysis of post-weaning eye muscle depth and fat depth ASBV's. Data relating to the weight of individual cuts was obtained as an average per sire, therefore analysis of this data was based on correlations, fitting covariates where possible.

4 Results and Discussion

4.1 Results

4.1.1 Carcase specifications and value

Lambs averaged a carcase weight of 27kg at 160 days of age and ranged between 25 and 28.4kg. Based on the average carcase weight, lambs grew at approximately 300 grams per head per day.

The subjective fat score did not correlate to measured fat depth (r=0.246, P<0.001), therefore all further references to 'fat score' refer to an objective fat score derived from the measured fat depth (mm) (Table 2).

Table 2 Fat score as derived from measured fat depth (mm)

Fat score	Fat depth (mm)
1	≤5
2	6 to 10
3	11 to 15
4	16 to 20
5	≥21

Progeny fat scores ranged from 2 to 5 and averaged 3.9. Twenty five percent of lambs in the trial had a fat score of 5. There was no correlation found between hot standard carcase weight and fat score (r = 0.256, P<0.001) (Figure 1) or post-weaning weight ASBV and fat score (r=-0.099, P=0.096).

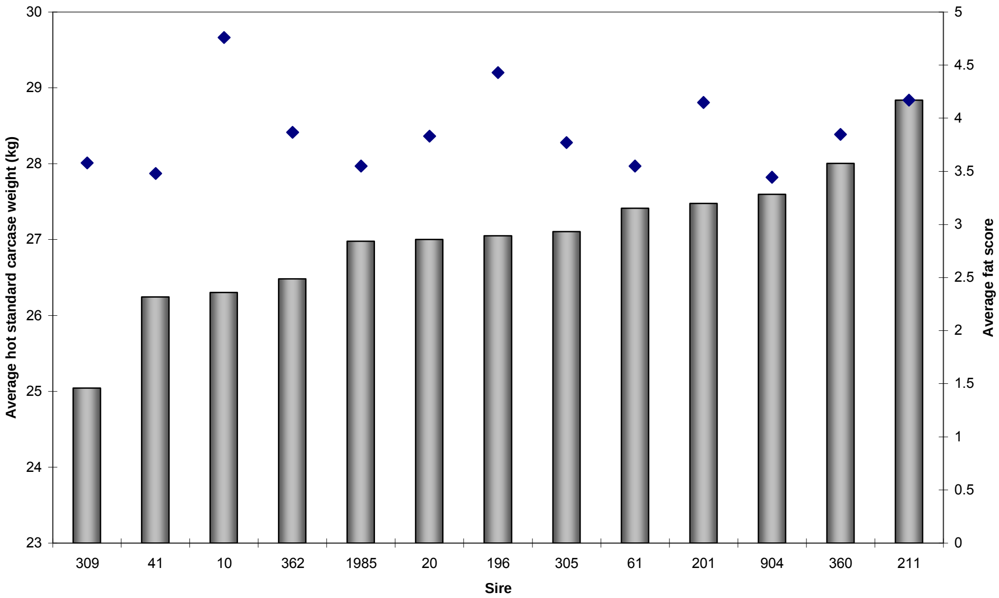

Figure 2 Average hot standard carcase weight (kg, grey column) for each sire and associated average fat score (♦).

The average progeny carcase value from each sire to TMC ranged between $120.53 and $135.95 while the average value of primal cuts ranged between $93.99 and $105.18. Hot standard carcase weight accounted for 84.3% of variation in total carcase value ($P<0.001$). Progeny with the highest valued carcases were sired by 211, while progeny with the lowest valued carcases were sired by 309.

4.1.2 Sire ASBV's and progeny performance

Progeny performance was significantly affected by sex, gestation length, birth type and rear type. Once these factors were accounted for, progeny performance was as expected based on sire ASBV:

- An increase in sire post-weaning weight ASBV of 1kg increased progeny 150 day weight by 0.48kg (± 0.20kg)
- An increase in sire post-weaning eye muscle depth ASBV of 1mm increased progeny 150 day eye muscle depth by 0.58mm (± 0.14mm)
- An increase in sire post-weaning fat depth of 1mm increased progeny 150 day fat depth by 0.43mm (± 0.19mm) (Figure 3).

Sire post-weaning ASBV's predicted their respective progeny traits more accurately than sire weaning weight and birth weight ASBV's.

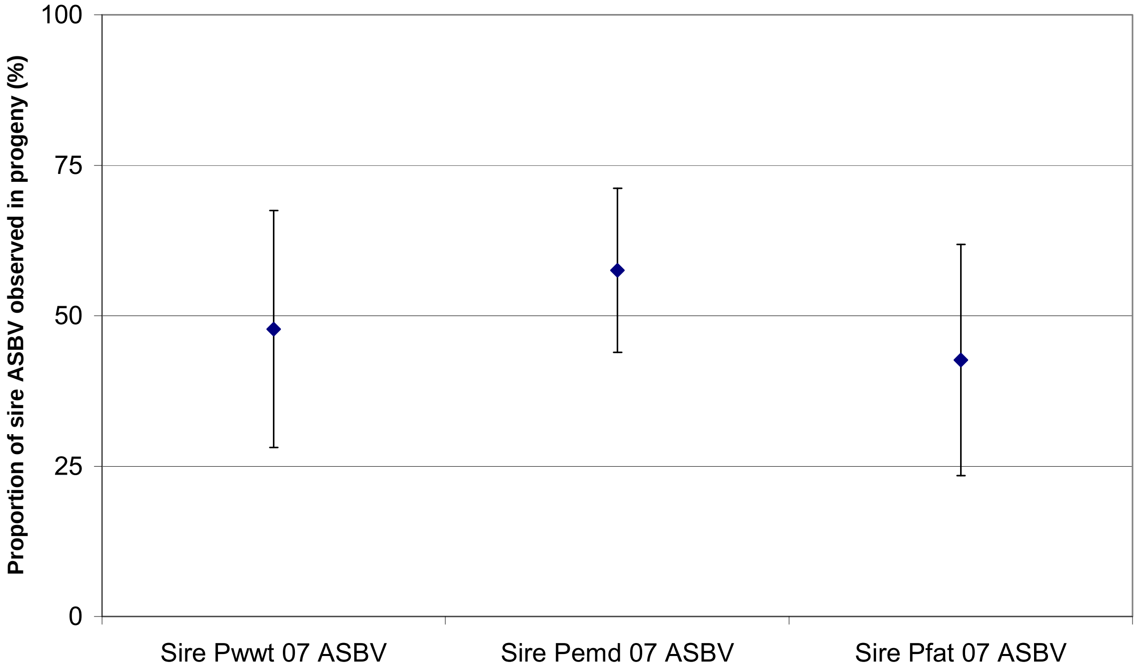

Figure 3 Proportion of sire post-weaning weight (Pwwt), post-weaning eye muscle depth (Pemd) and post-weaning fat depth (Pfat) ASBV's observed in progeny. Expected proportion is 50%.

4.1.3 Traits that will convert into better farm-gate returns

Producers are paid based on carcase weight. When adjusted for sex, gestation length and birth type, the sire post-weaning weight ASBV was positively associated with progeny hot standard carcase weight (r=0.44, P<0.001). The sire carcase plus index is also positively related to progeny hot standard carcase weight (r=0.45, P<0.001).

Sire carcase plus index predicted progeny total carcase value to TMC more accurately than the sire post-weaning weight ASBV. For the range of carcase plus indexes tested, every point increase in sire carcase plus index equated to 20.6 cents extra carcase value to TMC (Figure 4). The carcase plus index is a combination of sire post-weaning weight, eye muscle and fat depth ASBV's. Of these, sire post-weaning weight ASBV had the most influence on carcase value (r^2=0.4597) followed by Pfat (r^2=0.3612) and Pemd (r^2=0.0361)

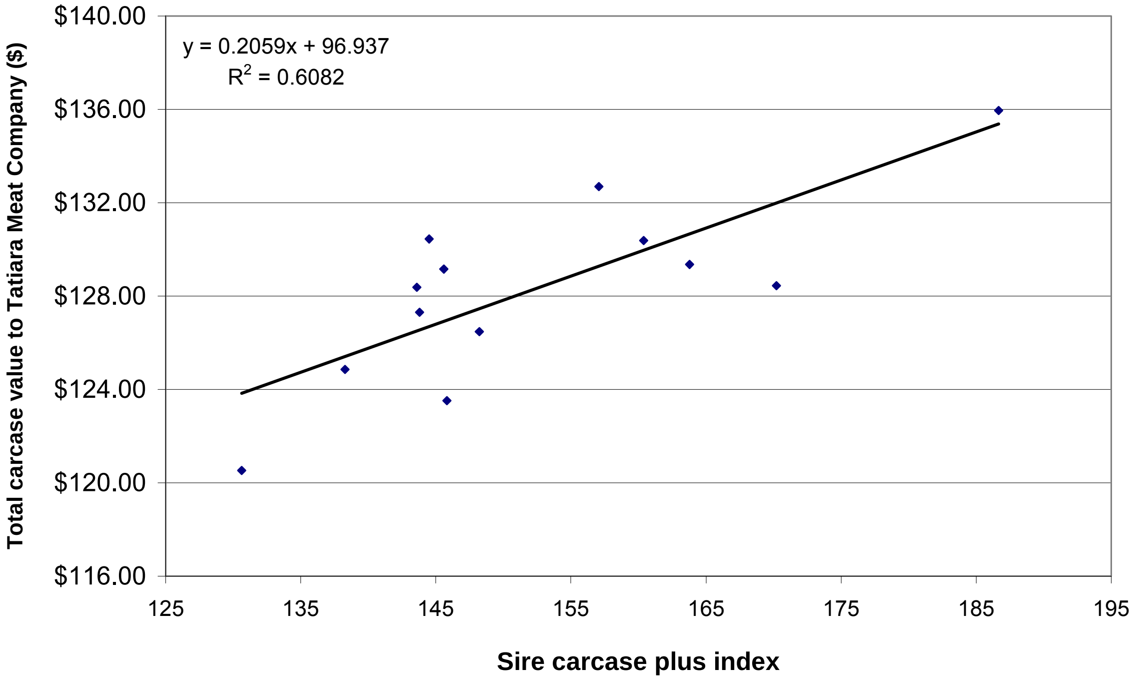

Figure 4 Relationship between sire carcase plus index and total carcase value ($) to Tatiara Meat Company.

The value of the three post-weaning ASBV's in predicting carcase value to TMC was assessed also against weaning weight and birth weight ASBV's. Of these ASBV's the best combination to predict carcase value to TMC was sire post-weaning weight, eye muscle depth and fat depth in the following combination (Model 1):

Carcase $ value (to TMC) = 119.2 + 0.51Sire Pwwt + 2.99Sire Pemd – 7.31Sire Pfat

While the sire carcase plus index accounted for 60.82% of variation in the total carcase value to TMC, Model 1 accounts for 72.08% of the variation.

Carcase length, rib to rump length, width of loin and loin length were also analysed against carcase value to TMC. Of these, carcase length was the only trait significantly related to carcase value to TMC ($r = 0.6$, $P=0.03$). Carcase length was also positively related to carcase weight ($r = 0.479$, $P=0.000$). Carcase length could not be related to any of the sire ASBV's analysed in this trial, however progeny carcase length was significantly different depending on sire ($P<0.001$). The other length and width measurements listed above were all positively related to carcase value, but their relationships were not significant.

4.1.4 Traits that generate value added primal cuts

Primal cuts comprise the leg, rack and loin. These cuts are worth the highest amount to TMC per kg and in 2003 were valued at $5.85/kg, $22.00/kg and $12.80/kg respectively.

Hot standard carcase weight was positively related to the leg, rack and loin weights ($P<0.05$, $P<0.01$, $P<0.05$ respectively). When hot standard carcase weight was accounted for, the adjusted leg, rack and loin weights were not associated with sire carcase plus index, individual ASBV's, or a combination of ASBV's analysed in this trial.

Adjusted loin weight was positively associated with loin length ($r = 0.708$, $P=0.007$), but no relationship could be found between adjusted loin weight and loin width. Rib to rump length was also positively related to adjusted loin weight ($P=0.065$), but the relationship was not as significant as that between loin length and adjusted loin weight. Loin length was measured on the boned out loin cut and is correlated with the carcase measurement of rib to rump length ($r = 0.819$, $P=0.001$). Progeny rib to rump length differed significantly depending on sire ($P<0.001$).

Adjusted leg and rack weights could not be related to any of the length or width measurements.

4.2 Discussion

4.2.1 Carcase specifications and value

To achieve a carcase weight of 25 to 28.4kg in 160 days, lambs grew at approximately 300 grams per head per day. This is above the generally accepted industry average growth rate of 250 grams per head per day (Jolly and Wallace, 2007). Growth rate is determined by a combination of both genetics and nutrition. All sires used in this trial had positive weaning and post-weaning ASBV's indicating they were above their respective breed averages for these traits. Given that the average industry growth rate refers to an average including merino, first cross and second cross lamb growth rates, as well as the range of sires used across the industry, it was expected that the lambs in this trial would grow faster than industry average. Nutrition would have also had a significant affect on growth rate. Unfortunately, limited information is available on nutrition of ewes during lactation and lambs after weaning. Depending on if their diet met their nutrient requirements, lambs may have been capable of higher growth rates.

It was interesting that the subjective fat score measured by the Tatiara Meat Company employee did not correlate to objective fat score. TMC does not currently penalise lambs of high fat score (D. Cameron 2008 pers comm.., 12 June) and the poor relationship was possibly due to an inexperienced operator conducting the measurement. It also may be possible that as they don't penalise according to the measure, TMC do not closely monitor subjective fat depth for its correlation with objective fat depth. It has been acknowledged that the accurate measurement of subjective fat score is difficult (D. Cameron 2008 pers comm.., 12 June). It is therefore recommended that an accurate method of determining fat score be employed before this processor considers penalising on fat score – be it through ensuring subjective fat scores are satisfactorily correlated to objective fat scores or through the implementation of a system to measure objective fat score.

A common misconception is that fat depth increases with carcase weight. However, within the carcase weights observed in this trial, fat depth was not related to hot standard carcase weight (Figure 2). With the average fat score being 3.9, the trial results indicate that lambs can be taken to heavy export weights (25 to 28.4kg) without becoming too fat for TMC's specifications. Approximately 25% of the lambs were a fat score 5 based on their objective fat depth measurement. Depending on the processor and supply of lambs at the time, these lambs may have been penalised.

The highest and lowest average progeny carcase values to TMC differed by more than $15. All progeny were subject to the same management from 2 weeks after lambing until slaughter, and the random affect of unknown ewe genetics was accounted for by the number of ewes mated to each sire. Therefore, the difference in carcase value between the average of each sires progeny could be attributed to two factors:

- Sire genetics
- Differences in management and feed availability during the two weeks that ewes were split into single sire groups for lambing

Any affect that may have occurred due to the ewes being split around lambing is likely to be minimal given that they had access to similar pastures and it was only for a short time (two weeks). Unfortunately, due to the experimental design, the effect of this management decision cannot be quantified. However, sire genetics were the most likely the cause of differences in progeny value to TMC.

Returns per carcase (to TMC) ranged between $120.53 and $135.95 based on cut values at the time of slaughter. This return must cover the cost of the lamb (that is, the price the producer was paid) as well as the costs of preparing the lamb for sale (overheads, wages, packaging etc.). Based on $3.00 per kilogram carcase weight and the average hot standard carcase weight (27kg), the commercial producer return equates to $81.00 per head. This is approximately 63.2% of the return that TMC receives for an average carcase. This leaves 37% of TMC's returns to cover the costs of preparing the lamb for sale as well as the profit margin.

4.2.2 Sire ASBV's and progeny performance

ASBV's represent the breeding value of a particular sire in terms of their superiority to the breed average. As the progeny receive half of their genes from each parent, only half of the sire's superiority (ASBV) is passed on to the progeny. Therefore the expected proportion of the sire ASBV observed in the progeny is 50%. We are 95% confident that the proportion of the sire ASBV observed in the progeny in this trial is 50% for post-weaning weight, eye muscle depth and fat depth (Figure 3).

Some commercial producers are sceptical about the application of ASBV's due to varied responses in their progeny. Arguably, the biggest cause of variability in progeny performance is variability in ewe genetics that are often unknown unless operating a stud enterprise. In saying this, progeny performance can also be influenced by nutrition, management, sex, birth type, rear type and many other factors. The results of this trial indicate that when these factors are accounted for, LAMBPLAN ASBV's do reflect the actual performance of progeny. Commercial producers should therefore be confident that rams with superior ASBV's will produce superior progeny.

Sire post-weaning weight, eye muscle depth and fat depth ASBV's were better indicators of their respective traits when compared to weaning weight and birth weight ASBV's. Weaning weight is more strongly influenced by maternal characteristics of the dam (that is, milking and mothering ability) than are the post-weaning ASBV's (A. Ball, 2008 pers comm., 19 May). As this sire does not express maternal traits, this is likely to be the cause of a lower correlation between sire weaning weight ASBV progeny weaning weight. Sire birth weight ASBV was analysed against progeny weight at two weeks of age. This weight is not likely to have been indicative of actual birth weight due to the strong maternal influence of the dam in the initial weeks after birth, so the lower correlation between this ASBV and weight should have been expected.

4.2.3 Traits that will convert into better farm-gate returns

Producers are paid based on carcase weight at most processors including TMC. Therefore, traits that increase carcase weight will also increase farm-gate (producer) returns per head. Post-weaning weight and carcase plus index were identified as being positively related to progeny hot standard carcase weight and are therefore critical in increasing farm-gate returns per head. The carcase plus index is a combination of post-weaning weight, eye muscle depth and fat depth ASBV's with a 60% emphasis on increasing post-weaning weight, a 20% emphasis on increasing eye muscle depth and a 20% emphasis on decreasing fat depth (Meat and Livestock Australia, 2004). This index is widely used and promoted across the industry to assess appropriate sires for prime lamb production.

Even though selecting sires based on post-weaning weight ASBV and carcase plus index to produce export weight lambs may increase farm-gate returns per head, it may not necessarily increase farm-gate returns per hectare.

There is scope for farm-gate returns per head to increase if the value of using specific ASBV's was recognised by processors. Tatiara Meat Company are paid based on the weight of each individual cut. To investigate the affect of ASBV's on returns to the processor, the average carcase value per sire was determined by summing up the retail value of all cuts. Carcase plus index predicted total carcase value to TMC more accurately than post-weaning weight. Trial results indicated that a one point increase in carcase plus index (between 130 and 187) resulted in 20.6 cents extra carcase value to TMC (Figure 4). This equates to a $10.30 difference to TMC in total carcase value for a lamb sired by a 135 carcase plus ram compared to a lamb sired by a 185 carcase plus ram.

The majority of variation in carcase value was due to carcase weight. This was indicated by the fact that the post-weaning weight ASBV had the most influence on carcase value out of the three ASBV's that make up the carcase plus index. When the affect of the post-weaning weight ASBV (hot standard carcase weight) was removed, 2.06 cents (10%) of the increase in carcase value attributed to sire carcase plus index was due to the combined affects of post-weaning eye muscle depth ASBV and post-weaning fat depth ASBV.

Of all ASBV's analysed in this trial, the most significant combination to predict carcase value to TMC were post-weaning weight, eye muscle depth and fat depth ASBV's, as indicated in Model 1. This model was derived from the data collected during the trial and is more accurate than carcase plus in determining total carcase value to TMC. Even though the model consists of the same ASBV's as the carcase plus index, they are subject to slightly different weightings which result in a more accurate indication of average progeny carcase value to TMC. The model indicates a linear relationship. The higher the sire post-weaning weight and eye muscle depth ASBV's and the lower the post-weaning fat depth ASBV, the higher the progeny carcase value to TMC. However, this model is limited by the range of ASBV's investigated in this trial. Therefore, the most extreme carcase value that can be predicted from this model is $135.95, which can only be predicted from the range of ASBV's indicated in Table 1 (that is, up to 12.61 for post-weaning weight, 2.51 for post-weaning eye muscle depth and higher than -1.22 for post-weaning fat depth).

Carcase length, rib to rump length, width of loin and loin length were all measured so that their affect on farm gate returns and the value of prime cuts could be determined. Carcase length was positively related to carcase value, therefore the longer the carcase, the higher its value. As expected, carcase length was also positively related to carcase weight, however not as strongly as it was to value. So it is possible that the extra carcase value attributed to carcase length is not solely due its affect on carcase weight. Carcase length was assessed for its ability to be predicted from ASBV's however could not be related to any ASBV's analysed in this trial (birth weight, weaning weight, post-weaning weight, post-weaning eye muscle depth and post-weaning fat depth ASBV's). Progeny carcase length did differ significantly depending on sire however, indicating that there is an opportunity to select animals based on their carcase length. Rib to rump length, width of loin and loin length all had positive relationships with carcase value, however these relationships were not statistically significant. More research would be required to make conclusions regarding their affect on carcase value to TMC.

4.2.4 Traits that generate value added primal cuts

Lambs with more of their weight in the prime cuts will return more per head to TMC. Although producers are not currently paid based on the value of prime cuts of their lambs, there is a marketing opportunity if the weight of prime cuts can be related to sire genetics.

The weight of the prime cuts is directly related to hot standard carcase weight. The heavier the carcase, the heavier the individual prime cuts. However, lambs with equivalent carcase weights but heavier primal cuts are of more value to the processor. When the affect of hot standard carcase weight on the weight of prime cuts was accounted for leg, rack and loin weights could not be related to sire carcase plus index, individual ASBV's or a combination of the ASBV's analysed in this trial. Due to time constraints and the costs of collecting the slaughter data, the cut weight data was generated as an average per sire. If more data had been available, for example, if the individual cut weights for each lamb were known, relationships between the cut weights and ASBV's or indices may have been more apparent.

It was hoped that measurements of rib to rump length and width of loin in particular would be positively related to the weight of the prime cuts (adjusted for hot standard carcase weight). However, the data collected in this trial indicated that there was no relationship between these traits. Once again, the analysis was limited as although the length and width measurements were taken for each lamb, the prime cut weights were only available as a progeny average for each sire. If individual cut weights for each lamb were known, the relationship to these measurements may have been clearer.

Loin weight was positively related to loin length. As loin length was measured as an average of each sires progeny, conclusions regarding significant differences in loin length between progeny depending on their sire cannot be made. The second best predictor of loin weight was rib to rump length, however the relationship was significantly weaker. Rib to rump length was measured on all progeny and significantly differed depending on sire. Due to the relationship between loin length and rib to rump length, we can speculate that the loin length of progeny would also differ significantly depending on sire. Even so, further research is required into the most accurate indicator of loin length that can be measured on a live animal or carcase as well as the heritability of this trait.

Limitations in the prime cut weight data have unfortunately limited the conclusions made. There is some evidence from this data to suggest that the weight of the prime cuts can be increased without increasing the carcase weight. In order to research the affects of ASBV's and other carcase measurements (in particular rib to rump length and loin length) on the weight of prime cuts, the weight of individual cuts needs to be determined for each lamb. This would be a significant amount of work and is unlikely to be able to be conducted by a commercial processor due to the cost of slowing down the kill line. If significant relationships were found which allowed producers to select on traits to increase the weight of prime cuts, this may give commercial producers grounds to market their lambs to processors. It would also give seed-stock producers an edge to market their rams to commercial producers. However, producers will only be able to respond in this way if processors offer a higher price for using the preferred genetics. The use of preferred genetics would not only increase the weight of prime cuts relative to carcase weight, it would also result in consistency of product.

4.2.5 Breeding direction

Commercial producers

Traits that increase returns to export prime lamb producers are those that increase carcase weight; that is, sire post-weaning weight ASBV and carcase length. It can often take a long to time for lambs to reach export weight requirements. Depending on the nutritive available, selecting on sire post-weaning weight ASBV will increase progeny growth rate and therefore decrease the time required to reach export weights. This is likely to reduce the costs associated with taking lambs to export weights in terms of both management and feed, thus increasing the profit margin. If possible, commercial producers should aim to choose sires with a positive post-weaning eye muscle depth ASBV and negative fat depth ASBV without compromising the post-weaning weight ASBV. While the processors don't pay based on carcase length, if the post-weaning weight ASBV is not compromised, commercial producers should aim to select longer rams due to this traits positive relationship with carcase weight.

Seed-stock producers

Seed-stock producers need to respond to the needs of their clients (commercial lamb producers). Therefore, they should aim to produce rams with high post-weaning weight ASBV's, increased carcase length, as well as a positive post-weaning eye muscle depth ASBV and negative fat depth ASBV. Seed-stock producers also need to respond to the needs of processors. The results of this trial also indicate that breeding to increase rib to rump length (as an indication of loin length) may be of advantage to processors. Even so, there will be no market advantage in breeding for this trait until processors recognise its value and are willing to reward producers accordingly. Seed-stock producers should keep up to date with any further research into the link between genetics and processor requirements so that any findings can be implemented as soon as possible.

Identification of sires with desirable traits
The desirable traits identified in this trial were sire post-weaning weight ASBV, carcase length, loin length and rib to rump length. The ultimate indicator of a sire that carries the desirable traits is their average progeny carcase value to TMC. Table 3 ranks all the sires investigated in this trial based on desirable traits and their average progeny carcase value to TMC.

Table 3 Sires ranked from highest to lowest/longest to shortest for traits identified as influencing farm-gate returns and returns to Tatiara Meat Company

Sire ranking	Sire post-weaning weight ASBV		Carcase length		Loin length		Rib to rump length		Average progeny carcase value to TMC	
	Sire	Value	Sire	Average length of progeny (mm)	Sire	Average length of progeny (cm)	Sire	Average length of progeny (mm)	Sire	$/carcase
1	**1985**	12.61	**1985**	613	**362**	21.49	**1985**	380	**211**	$135.95
2	**211**	11.97	**904**	612	**904**	21.45	**904**	376	**904**	$132.70
3	**360**	10.6	**211**	610	**360**	21.19	**61**	372	**20**	$130.44
4	**61**	9.93	**360**	608	**1985**	21.16	**211**	371	**61**	$130.38
5	**904**	8.9	**362**	601	**61**	20.90	**362**	371	**360**	$129.35
6	**196**	8.1	**305**	599	**305**	20.67	**360**	370	**305**	$129.16
7	**41**	7.5	**61**	598	**10**	20.52	**305**	368	**1985**	$128.45
8	**305**	7.43	**41**	597	**41**	20.49	**41**	365	**201**	$128.38
9	**362**	7.09	**201**	592	**211**	19.87	**10**	363	**362**	$127.31
10	**201**	6.6	**196**	586	**196**	19.81	**201**	362	**196**	$126.47
11	**20**	6.51	**10**	585	**20**	19.27	**196**	360	**10**	$124.87
12	**10**	5.74	**309**	581	**201**	19.25	**309**	358	**41**	$123.51
13	**309**	3.97	**20**	581	**309**	19.18	**20**	355	**309**	$120.53

Sires 211 and 904 performed best in most traits. Sire 211 had the highest average progeny carcase value to TMC, which is most likely to be a result of this sires high post-weaning weight ASBV, high post-weaning eye muscle depth ASBV and moderately negative post-weaning fat depth ASBV. While sire 904 was ranked second in terms of average progeny value to TMC, this sires figures aren't as balanced as sire 211 with a lower post-weaning weight ASBV and negative post-weaning eye muscle depth ASBV. However, sire 904 ranked higher than sire 211 for carcase length, loin length and rib to rump length. It is possible that the progeny of sire 904 had more weight in their prime cuts, increasing their average value to TMC. Both sires 211 and 904 have been used extensively throughout industry by seed-stock producers. Sire 1985 ranked high in all the identified traits, yet relatively low in average progeny carcase value to TMC. The reasons for this remain unclear.

Sire 309 ranked in the bottom two sires for all identified traits and had the lowest average progeny carcase value to TMC. This is likely to be due to the low post-weaning weight ASBV of this sire. This sire was chosen to increase the range of post-weaning weight and eye muscle depth ASBV's tested in this trial and wasn't expected to perform as well other sires in this trial.

5 Conclusions

Progeny of sires used in this trial out of Border Leicester/Merino ewes reared under pasture-based conditions clearly demonstrated that:

- Carcase weight was positively related to sire post-weaning weight ASBV and carcase length, both of which can be selected for
- As carcase value was mainly dictated by carcase weight, farm-gate returns per head can be increased by increasing carcase weight
- Sire ASBV's predicted progeny performance accurately therefore commercial producers can have confidence that sires will breed true to their ASBV's
- "Carcase plus" index predicted total carcase value to TMC more accurately than sire post-weaning weight ASBV
- Post-weaning weight, eye muscle depth and fat depth ASBV's were the most significant combination of ASBV's to predict carcase value to TMC, however this value could be increased if the weightings allocated to individual ASBV's were adjusted.
- Loin length was found to be a good indicator of loin weight
- Rib to rump length predicted loin length with reasonable accuracy and therefore could be used to select for loin length until more research is conducted into most accurate indicator of loin length on the live animal

The results of this trial support the use of ASBV's as a marketing tool for seedstock producers to their commercial clients.
If the weightings on the selection components of carcase plus were adjusted, carcase plus would enable producers to demonstrate more accurately the potential value of their lambs to processors.

Recommendations

Further research is required to:

- Quantify the relationship between ASBV's and prime cut weights due to limitations in this data set
- Determine the relationship between ASBV's and leg, rack and loin weights
- Determine the relationship between carcase length, rib to rump length and width of loin and leg, rack and loin weights
- Determine the most accurate indicator of loin length on live animals
- Based on relationships between length and width measurements, determine ASBV's to aid in the selection for these traits

- Determine the relationship between ASBV's and leg, rack and loin weights
- Determine the relationship between carcase length, rib to rump length and width of loin and leg, rack and loin weights

- Determine the most accurate indicator of loin length on live animals
- Based on relationships between length and width measurements, determine ASBV's to aid in the selection for these traits

If this additional research can be conducted in conjunction with commercial processors in order to meet their specifications, they will be more likely to develop relationships with commercial and seed-stock producers based on their genetics.

6 Bibliography

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