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Producer Research Report

Benchmarking Genetic Traits

Accelerator Breeding Producer Group

The Accelerator Breeding Producer Group identified the need to measure the benefit of genetic improvements throughout the supply chain, aiming to quantify the cost of traits that may increase returns to the processing sector, stock agents, White Suffolk and Poll Dorset seedstock and prime lamb producers using those sires.

The results of this trial support the use of ASBVs 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.

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The project

Genetic progress in the Australian sheepmeat industry is underpinned by selection of – and breeding from – rams with Australian Sheep Breeding Values (ASBVs), however the cost of using ASBVs is not passed on to commercial and seedstock producers.

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

Objectives

Flock Ram buyers (commercial lamb producers)

1. Increase the level of understanding of how to use Lambplan EBVs as a tool to select rams to better match their production system, target market and ewe base;
2. Increase the numbers of lambs being produced to heavy export weights from producer members;
3. Increase the carcase weights of lambs to over 24kg, while reducing the amount of fat on the carcase;
4. Build closer relationships (alliances) with founding seedstock members; and
5. 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 maximises lean meat yield.

Seedstock members

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

Processors

1. Work more closely with producer suppliers in the region, in order to increase local supply to the abattoir, in addition to improving the flow of information and market signals by way of feedback to producers; and
2. Work more closely with seedstock 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.

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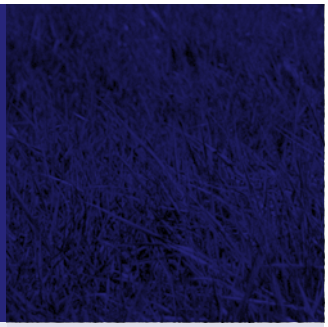

Key Points

- Carcase weight was positively related to sire post-weaning weight ASBV and carcase length.
- As carcase value was mainly dictated by carcase weight, farm gate returns per head can be increased by increasing carcase weight.
- Sire ASBVs predicted progeny performance accurately therefore commercial producers can have confidence that sires will breed true to their ASBVs.
- Carcase plus index predicted total carcase value to the processor more accurately than sire post-weaning weight ASBV.
- Post-weaning weight, eye muscle depth and fat depth ASBVs were the most significant combination of ASBVs to predict carcase value to the processor, however this value could be increased if the weightings allocated to individual ASBVs 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.

What was done

Approximately 230 four year old, first cross Border Leicester/Merino ewes were inseminated to 12 White Suffolk sires and one Poll Dorset sire.

The 13 sires met at least one of the following:

- Carried extreme genetic merit in at least one ASBV trait;
- Had a high, balanced ASBV set; and/or
- Had been widely used in the seedstock industry.

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

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 160 days and the following traits measured:

- Hot standard carcase weight;
- Subjective fat score (determined by a slaughter house 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); and
- Rib to rump length (cm – length from last rib to rump).

As an average of each sire's progeny, the average weight of shoulder, shin, neck, leg, trim, loin, rack, caps (females), flaps (females), caps/flaps (males), and loin length (length of boned-out cut) was also recorded.

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 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 ASBVs. 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.

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What happened?

Carcase Specifications And Value

Lambs averaged a carcase weight of 27kg at 160 days. Based on the average carcase weight, lambs grew at approximately 300g per head per day.

The subjective fat score did not correlate to measured fat depth, therefore all further references to fat score refer to an objective fat score derived from the measured fat depth (mm).

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 five. There was no correlation found between hot standard carcase weight and fat score, or post-weaning weight ASBV and fat score.

The average progeny carcase value from each sire to the processor ranged from $120.53 to $135.95, while the average value of primal cuts ranged from $93.99 to $105.18. Hot standard carcase weight accounted for 84.3% of variation in total carcase value.

Sire ASBVs 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 based on sire ASBV as expected:

- 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); and
- An increase in sire post-weaning fat depth of 1mm increased progeny 150 day fat depth by 0.43mm (± 0.19mm).

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

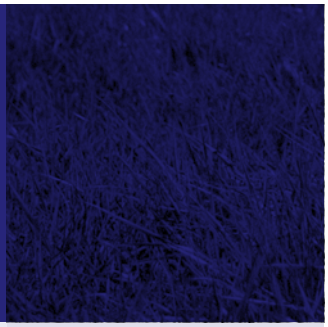
Traits That Will Convert Into Better Farm-Gate Returns

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. The sire carcase plus index is also positively related to progeny hot standard carcase weight.

Sire carcase plus index predicted progeny total carcase value more accurately than the sire post-weaning weight ASBV. For the range of carcase plus indices tested, every point increase in sire carcase plus index equated to $0.206 extra carcase value to the processor. The carcase plus index is a combination of sire post-weaning weight, eye muscle and fat depth ASBVs. Of these, sire post-weaning weight ASBV had the most influence on carcase value.

The value of the three post-weaning ASBVs in predicting carcase value was assessed against weaning weight and birth weight ASBVs. Of these ASBVs, the best combination to predict carcase value was sire post-weaning weight, eye muscle depth and fat depth.

Carcase length, rib to rump length, width of loin and loin length were also analysed against carcase value. Of these, carcase length was the only trait significantly related to carcase value. Carcase length was also positively related to carcase weight. Carcase length could not be related to any of the sire ASBVs analysed in this trial, however progeny carcase



length was significantly different depending on sire. The other length and width measurements listed above were all positively related to carcase value, but their relationships were not significant.

Traits that generate value added primal cuts

Primal cuts comprise the leg, rack and loin. These cuts are worth the highest amount per kilogram 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. When hot standard carcase weight was accounted for, the adjusted leg, rack and loin weights were not associated with sire carcase plus index, individual ASBVs, or a combination of ASBVs analysed in this trial.

Adjusted loin weight was positively associated with loin length, 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, 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. Progeny rib to rump length differed significantly depending on sire.

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

Discussion

Carcase Specifications And Value

To achieve a carcase weight of 25-28.4kg in 160 days, lambs grew at approximately 300g per head per day. This is above the generally accepted industry average growth rate of 250g 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 ASBVs 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 also have had a significant effect on growth rate. Unfortunately, limited information was available on nutrition of ewes during lactation and lambs after weaning. Depending on whether 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 abattoir employee did not correlate to the objective fat score. This processor does not currently penalise lambs of high fat score and the poor relationship was possibly due to an inexperienced operator conducting the measurement. It may also be possible that as they don't penalise according to the measure, the processor does not closely monitor subjective fat depth for its correlation with objective fat depth. It has been acknowledged in the literature that the accurate measurement of subjective fat score is difficult. It is therefore recommended that an accurate method of determining fat score be employed before this processor considers penalising on fat score – either through ensuring subjective fat scores are satisfactorily correlated to objective fat scores, or through the implementation of a system to measure objective fat score.

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A common misconception is that fat depth increases with carcase weight, however fat depth was not related to hot standard carcase weight in this trial. With an average fat score of 3.9, trial results indicate that lambs can be taken to heavy export weights (25–28.4kg) without becoming too fat for the processor's specifications. Approximately 25% of the lambs were 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 the processor differed by more than $15. All progeny were subject to the same management from two weeks after lambing until slaughter, and the random effect of unknown ewe genetics was accounted for by the number of ewes mated to each sire. The difference in carcase value between the average of each sire's progeny could be attributed to two factors:

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

Any effect 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.

Returns per carcase 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/kg carcase weight and the average hot standard carcase weight (27kg), the commercial producer return equates to $81.00/hd. This is approximately 63.2% of the return that the processor receives for an average carcase. This leaves 37% of the producer returns to cover the costs of preparing the lamb for sale, as well as the profit margin.

Sire ASBVs And Progeny Performance

ASBVs 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.

Some commercial producers are sceptical about the application of ASBVs 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 ASBVs do reflect the actual performance of progeny. Commercial producers should therefore be confident that rams with superior ASBVs will produce superior progeny.

Sire post-weaning weight, eye muscle depth and fat depth ASBVs were better indicators of their respective traits when compared to weaning weight and birth weight ASBVs. Weaning weight is more strongly

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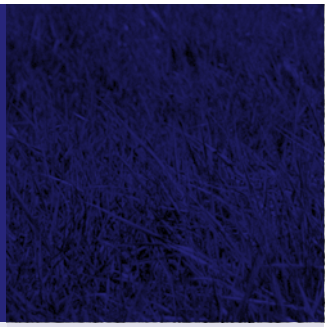

influenced by maternal characteristics of the dam than are the post-weaning ASBVs. As this sire does not express maternal traits, this is likely to be the cause of a lower correlation between sire weaning weight ASBV progeny weaning weight. Sire birth weight ASBV was analysed against progeny weight at 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.

Traits That Will Convert Into Better Farm-Gate Returns

Producers are paid based on carcase weight, therefore increasing carcase weight will also increase producer returns. Post-weaning weight and carcase plus index were identified as being positively related to progeny hot standard carcase weight. The carcase plus index is a combination of post-weaning weight, eye muscle depth and fat depth ASBVs 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.

There is scope for farm-gate returns per head to increase if the value of using specific ASBVs is recognised by processors. Carcase plus index predicted total carcase value more accurately than post-weaning weight. Trial results indicated that a one point increase in carcase plus index resulted in $0.206 extra carcase value to the processor. This equates to a $10.30 difference 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 ASBVs that make up the carcase plus index.

The most significant combination of ASBVs to predict carcase value were post-weaning weight, eye muscle depth and 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 and weight. It is possible that the extra carcase value attributed to carcase length is not solely due to its effect on carcase weight. Carcase length was assessed for its ability to be predicted from ASBVs, however could not be related to any ASBVs analysed in this trial. 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.

Traits That Generate Value Added Primal Cuts

Lambs with more of their weight in the prime cuts will return more per head to the processor. 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 effect of hot standard carcase weight on the weight of prime cuts was accounted for leg,

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rack and loin weights could not be related to sire carcase plus index, individual ASBVs or a combination of the ASBVs 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 ASBVs or indices may have been more apparent.

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. 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.

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 trait's positive relationship with carcase weight.

Seedstock producers

Seedstock producers need to respond to the needs of their clients (commercial lamb producers). They should aim to produce rams with high post-weaning weight ASBVs, increased carcase length, as well as a positive post-weaning eye muscle depth ASBV and negative fat depth ASBV. Seedstock 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. Seedstock 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 the processor.

Next steps

The ASBVs of sires used in this trial predicted progeny performance accurately, therefore commercial producers can have confidence that

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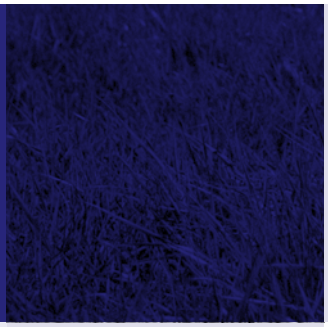

sires will breed true to their ASBVs. The relationship between carcase weight and sire post weaning ASBV indicated that farm gate returns per head can be increased by increasing carcase weight.

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

Further research is required to:

- Quantify the relationship between ASBVs and prime cut weights due to limitations in this data set;
- Determine the relationship between ASBVs 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 ASBVs to aid in the selection for these traits;
- Determine the relationship between ASBVs 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; and
- Based on relationships between length and width measurements, determine ASBVs 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 seedstock producers based on their genetics.

MLA also recommends

Sheep Genetics Australia

Sheep Genetics Australia (SGA) is the national genetic evaluation service for the Australian sheep industry. It is built around the world's most comprehensive sheep genetics database, and will deliver genetic information on a fee-for-service basis.

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