Sheep Updates 2014

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Sheep Updates 2014
‘Breeding better sheep’
Proceedings

Supporting your success
Foreword

On behalf of the Department of Agriculture and Food WA it gives me great pleasure to welcome you to the 2014 Perth Sheep Updates: Breeding better sheep.

The WA sheep industry is at an exciting time but will need to make the most of new technology in order to be internationally competitive, to grow in value and provide good returns for all those in the supply chain. Genetic research is providing a deeper understanding of meat and reproduction traits that will provide opportunities to manage sheep in ways to maximise their performance and target markets like never before. The widespread adoption of Australian Sheep Breeding Values (ASBVs) will assist producers and processors in the value chain to meet the demanding eating quality standards of Australia and emerging markets in China and the Middle East.

The proposed State Government investment of $10 million over four years to create a Sheep Industry Business Innovation Project centred at Katanning will support the drive to produce the smartest, most sustainable and financially robust sheep industry.

I hope that you take advantage of the networking and learning opportunities that this year’s program provides. Delegates have commented in the past that one of the benefits of the Sheep Updates is the opportunity to network with other industry people. We hope that you enjoy the program and take advantage of every opportunity to share your knowledge and friendship – both during the conference and after.

Kevin Chennell
Executive Director Livestock Industries
Department of Agriculture and Food WA
Committee 2014 Perth Sheep Updates

Rosanne Andrew-Baxter
Meghan Cornelius
Mandy Curnow
Stephen Gherardi
Anne Jones
Peter Robson
Julia Smith
Perth Sheep Updates Program and Booklet Index

8:30am  Welcome and housekeeping
Kevin Chennell, Executive Director, Livestock Industries, DAFWA and Anne Jones, Convenor, DAFWA

Session 1: Genetic Research: A brave new world of opportunities
8:40am  Keynote: “China’s appetite” - the implications for WA
James Kynge, Chairman, FT Confidential Research

9:35am  The genetics warm-up – the secret language of genetic research and its impact on WA’s sheep flock
Emeritus Professor David Lindsay, UWA

10:05am  Morning Tea

Session 2: The strength of genetic data: is it really valuable?
10:35am  Genetic research in Western Australia – what have the compromises in production been?
Johan Greeff, DAFWA

11:05am  Show me the money: the case for genetic selection
John Young, economic analyst

11:35am  Using ASBVs and indexes
Luke Stephen, Sheep Genetics

12:05pm  Lunch

Session 3: Tools to make the most of genetic information
1:00pm &  New traits for meat and wool
Dr Graham Gardner, Murdoch University

1:00pm &  Genomics and DNA testing: new tools for ram breeders to accelerate genetic gain
Dr Stephen Lee, University of Adelaide, SA

2:00pm  Ram assessment exercise
Johan Greeff, DAFWA

2:50pm  Afternoon tea

Session 4: Life lessons and into the future
3:15pm  Breeder case study: improving the service by providing quality data
Brett Jones, Ejanding Stud, Dowerin

3:30pm  Producer case study: using genetic data and tools to make a better product
Bindi Murray, Kunmallup Pastoral Co, Woodanilling

3:45pm  The new Sheep CRC: a vision for genetics research
James Rowe, CEO, Sheep CRC

4:05pm  Questions and closing by SILC Chair Rob Egerton-Warburton

4:30pm  Sundowner
“China’s Appetite” - The implications for WA

James Kynge, Chairman, FT Confidential Research, Emerging Markets Editor, Financial Times, London.

Information about the presenter

James is a researcher/journalist specialising on China and in particular the way in which the world’s second largest economy influences the rest of the world. His award-winning book, China Shakes the World (2006), was an international bestseller translated into 19 languages. He has lived and worked in China for 16 of the past 30 years, for eight years as the FT’s Beijing bureau chief and three heading up the business operations of Pearson Plc in China. Since 2008 he has lived in London, and set up the FT’s “Confidential” suite of research services, which collect data to provide research insights into the economies of China, Latin America and Southeast Asia.

His current post is as Associate Editor and Emerging Markets Editor at the Financial Times.

Information about the presentation

Taking advantage of the promise that China represents, while minimising the risks, requires not only an understanding of likely demand trends stretching years into the future but also a knowledge of the volatility inherent in dealings with Chinese customers, companies and government actors.

In the context of WA’s farm sector, the main interaction with China in coming years is likely to derive from a) Chinese demand for meat, wool and other produce b) Chinese companies wanting to buy land c) Chinese companies wanting to buy WA businesses. Therefore, the Chinese opportunity is two-way; from WA to China and from China to WA.

This presentation will attempt to illuminate some of the key trends informing these trends. First, it will look at the “quiet revolution” underway in China’s own farm sector, which itself provides the structural underpinnings for what is expected to be an explosion in demand for some – but not all – agricultural imports. Second, it will look at some of the trends governing Chinese demand for key food and commodities and some of the challenges (logistics, bureaucracy, changing tastes) in accessing China’s fast-changing domestic market. Third, it will look at volatility – particularly through the prism of food safety scandals, environmental degradation and food security phobias.

Lastly it will look at some of the bigger Chinese companies already scouring the world for land, farm produce and farm business acquisitions, their approaches, the barriers they face and the priorities that motivate them.

Notes
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The genetics warm-up – the secret language of genetic research and its impact on WA’s sheep flock

Professor David Lindsay, University of Western Australia, Perth WA

Information about the presenter

David Lindsay was Professor of Agriculture—Animal Science at UWA specialising in reproduction of sheep and sheep production in general. He also ran a superfine merino stud for 20 years that produced some of the finest wool in the State. He still lectures in communication of science and maintains an active interest in sheep production as an advisor to the Wool Council of WAFarmers. He is an Officer of the Order of Australia, a member of the Australian Academy of Technological Sciences and Engineering and an inductee to the WA Agricultural Hall of Fame.

Information about the presentation

Animal Breeding is an art that has been with us for at least 300 years and, until relatively recently, that art was the basis of livestock improvement throughout the world. By contrast, Animal Genetics is a science that is much younger; it has only been used in animal industries for the last half century and new concepts and improvements have been added constantly during that time. Different animal industries have had very different levels of enthusiasm for grasping the concepts of genetics and using them to improve animals. Those industries that have applied genetics on a large scale have changed dramatically. Those which have not, have seen little change in their animals and have consequently had fewer options for adapting to changes in the economic and physical environment that have characterised modern farming. For example, the structures of the modern poultry, pig and dairy industries are completely different to those in place as little as 40 years ago while the sheep industry, particularly the wool industry, operates much as it did 100 years ago and the relative productivity of its animals has changed very little.

Genetics may be relatively new but it is still animal breeding; animals have to be selected on some criterion or other and mated to produce offspring that the breeders hope will be better than their parents. But, it differs from the traditional form of animal breeding because it applies the latest advances in sciences like mathematics, molecular biology, precise measuring techniques and computer science to the task of increasing the accuracy of selecting animals. In so doing it increases the speed and efficiency of improving productivity. This improvement in the industries that have embraced genetics is staggering: two, three, four or even more fold increases over 50 years in important productive characteristics depending on the industry and the characteristic being sought.

So, why has the sheep industry been so slow— even reluctant — to take it up? Part of the reason is undoubtedly tradition, particularly in the wool industry which has built up a powerful social structure that resists change. Part is distrust of the unknown as a result of breeders not being familiar with the sciences behind genetics and unwillingness to trust those who are with the responsibility of breeding their sheep. This is a pity because it is not necessary to understand the details of the science behind the genetics but only the principles of how it affects the broader goals of animal breeding. After all, not all scientists know a lot about the on-farm needs and problems of the sheep industry and require help from producers who do, to achieve any degree of success. That is why, if we look at those industries that have made strong progress, we find the most successful formula is a partnership where the strengths and knowledge of all the parties are coordinated. So, breeders attending this Sheep Updates will not need a PhD in Mathematics or Molecular Biology to understand the presenters, just an appreciation of the principles behind the science and how and why they can accelerate the standard practices of animal breeding that have been used for centuries.
Australian Sheep breeding Values or ASBVs are case in point. They are merely an estimation of how good an animal is relative to the breed average for a particular trait. On the face of it one would think that would be a useful, even essential, piece of information for someone selecting breeding animals. Yet many breeders feel that it is a piece of witchcraft designed to displace a keen eye and a lifetime of experience. Others who don’t fully trust their eye and actually measure things think that the only measurements they can trust are those taken on the animal itself. In fact, an ASBV for a particular trait in a particular animal does include the measurements on the animal itself but also considers measurements taken from every other animal that is closely or remotely related genetically to that animal, adjusts them for a wide range of factors like age, sex, season, year and many others and comes up with a combined figure, the ASBV, that is far more accurate than a single measurement. The mathematics behind this exercise is very complex and the computer power involved is enormous. But who cares? Who needs to know about the Maths or the computer? Certainly not the breeder. All breeders need to know is that, if they can interpret and use ASBVs for a certain trait, they will make progress in that trait faster than breeders who don’t because they will have selected their animals more accurately.

But, which traits should they be selecting for to end up with the best animals? The mathematicians and the computer programmers probably wouldn’t have a clue. This is a decision that is entirely up to the individual breeder. And, some breeders will differ with other breeders just as they have done for hundreds of years. In other words, breeders are not being replaced by the scientists as some claim. They are merely entering into a partnership that will enable them to achieve their breeding goals more efficiently.

The same story can be told about other techniques that go beyond the realm of traditional breeding such as the use of Indexes and techniques to avoid inbreeding. The breeder is always in control of how these tools are used. Even more exciting, it will continue to be true for the newer science of Genomics where the genes themselves are scanned for evidence of superiority in traits including new ones like resistance to disease which could never have been measured by traditional methods.

The urgent need is for buyers of rams to understand sufficient of the principles to seek out and reward the progressive ram breeders who have taken on these new techniques to speed up genetic progress in sheep. Unfortunately, in the sheep industry most flock owners who buy rams have no idea of what an ASBV is, let alone what it can be used for. In the dairy industry the equivalent to ASBVs are EBVs or estimated breeding values. Every dairy farmer with more than a hand full of cattle knows what EBVs are and what they are for and uses this information to select breeding stock. Why is the sheep industry dragging its feet?

Notes
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Genetic research in Western Australia - What have the compromises in production been?

Johan Greeff, Senior Geneticist, Department of Agriculture and Food Western Australia, South Perth

Information about the presenter

Johan Greeff originated from South Africa and has been involved in genetic research in WA for the past 20 years. He has been involved in the Base flock at Katanning and since 2007 involved in the Information Nucleus Flock at Katanning and the Breech strike flock at Mt Barker.

Background

The WA sheep industry has been strongly supported by genetics research for many years. This research has had a broad focus including improvements to the production and quality of wool and meat, disease resistance and sheep robustness under harsh environmental conditions.

The research has shown that nearly all production traits in sheep are heritable and that it is possible to breed sheep for specific characteristics. However, the research have also shown that selection for body weight, fleece weight, fibre diameter, staple strength, growth could result in undesirable trade-offs between economically important traits such as meat and wool quality, reproduction and robustness. However, Australian Sheep Breeding Values (ASBV) makes it possible for breeders to manage these trade-offs, in order to make genetic progress in all production traits simultaneously.

The research flocks in WA have been and will continue to be valuable assets. Therefore it is essential that these flocks should be maintained in order to carry out genetic research for new and novel traits that cannot be carried out on commercial properties, especially disease resistant traits, traits that are expressed later in life, and traits that cannot be measured on live animals.

Notes
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Show me the money – the case for genetic selection

John Young, Farming Systems Analysis Service, Kojonup WA.

Information about the presenter

John has been working as an agricultural economist for the last 20 years working with researchers to help evaluate the on-farm applicability of different research projects.

He has been involved in a number of projects including involvement in the economic analysis of the Lifetime Wool project, evaluation of alternative pasture systems, determining the priorities for research into improving reproduction in wool and meat enterprises, examination of critical control points in lamb production enterprises and determining priorities for research into labour use on farms.

He has also been involved in calculating the value of genetic improvement in merino sheep being part of the analysis of the SA Selection Demonstration Flocks and part of Sheep CRC projects evaluating and quantifying the value of a wide range of traits for merino sheep breeding. The presentation today draws from those projects.

Information about the presentation

This paper discusses the profitability of using genetic selection to improve the productivity of animals. Results from the improvements achieved in the selection demonstration flocks are used to demonstrate the profitability of alternative selection strategies. These results are compared with the observation from on-farm benchmarking that there is no consistent observable trend that genetic improvement is associated with increased profitability. The assumptions made by economists and geneticists when calculating the increase in profit from genetic selection are examined and differences between production per head and production per hectare are discussed as a possible explanation for this disconnect. Recent research into ‘new’ traits that would appear to help bridge this gap are discussed.

Selecting animals that have superior production is relatively cheap and can result in permanent improvements in production and profitability. The South Australian Selection Demonstration Flocks (SASDF) compared the genetic gain achieved using either of 3 selection methods; measured performance recording utilising quantitative genetics (MPR), professional classer appraisal using visual and tactile appraisal (PCA) and an elite wool flock (EWF). Each selection method achieved genetic gain relative to a randomly mated control (Table 1). These results demonstrate that selection of sheep can lead to improvements in the productivity of the animals.

Table 1: Production of the SASDF 2004 drop hoggets. Control values are the actual performance and the 3 selection lines are their values relative to the control. Note: SASDF trial started in 1996.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Control</th>
<th>Measured Performance</th>
<th>Classer Appraisal</th>
<th>Elite Wool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Fleece Weight (kg)</td>
<td>3.55</td>
<td>+0.17</td>
<td>+0.16</td>
<td>+0.14</td>
</tr>
<tr>
<td>Fibre Diameter (µ)</td>
<td>20.8</td>
<td>-2.6</td>
<td>-1.7</td>
<td>-2.0</td>
</tr>
<tr>
<td>Staple Strength (N/kTex)</td>
<td>34.7</td>
<td>-1.4</td>
<td>-1.6</td>
<td>+2.4</td>
</tr>
<tr>
<td>Liveweight (kg)</td>
<td>47.1</td>
<td>+1.3</td>
<td>+2.5</td>
<td>+2.7</td>
</tr>
</tbody>
</table>

An economic analysis was carried out (Brien and Young 2006) using actual genetic gain from the trial and it showed that all 3 of the selection methods evaluated increased profitability, gross margin summary of the results is presented in Table 2. The improvement was greatest for MPR and resulted in a 36% increase in the gross margin per hectare compared with the randomly mated control flock.
Table 2: Gross margins of each flock, expressed in $/DSE and $/ha, based on 10 year average prices.

<table>
<thead>
<tr>
<th>Flock</th>
<th>GM/DSE</th>
<th>GM/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>18.60</td>
<td>144</td>
</tr>
<tr>
<td>Measured Performance</td>
<td>24.20</td>
<td>196</td>
</tr>
<tr>
<td>Classer Appraisal</td>
<td>21.40</td>
<td>166</td>
</tr>
<tr>
<td>Elite Wool</td>
<td>23.10</td>
<td>181</td>
</tr>
</tbody>
</table>

The improvement was greatest for MPR and resulted in an increase in the gross margin per hectare compared with the control flock of $52/ha which was a 36% increase. This is a substantial improvement in estimated profitability and was achieved from identifying outside sires for 2 matings and then a further 5 years of selection within the flock.

In contrast to the above results, consultants who carry out on-farm benchmarking report that they do not observe consistent differences in profitability between genotypes (Herbert pers. comm.). Whereas differences of 30-40% between genotypes should be easily observed. This raises the question as to why the differences aren’t observed. Is the effect of genotype being overridden by the effect of management or is there a problem with the practical implementation of breeding programmes associated with which traits increase profitability in extensive animal production systems. The remainder of the paper examines this second issue.

Current genetic selection is based on improving production per head whereas profitability is more closely associated with production per hectare. The difference between the two is associated with the number of animals that can be carried per hectare. In carrying out economic analysis of different genotypes a range of assumptions have to be made regarding the carrying capacity achievable for each genotype. The assumptions made are similar for most genotype evaluations and are:

1. The feed requirement of animals is proportional to their metabolic liveweight\(^1\) and the foraging ability of animals are similar. This means that fewer large animals can be carried than smaller animals and that the level of pasture utilisation is similar regardless of genotype.

2. Increases in clean fleece weight are achieved without increasing the energy requirement of the animal.

These assumptions may not be correct, however, the underlying biology is difficult to measure and quantify for more accurate economic analyses. But sensitivity analysis carried out to determine the importance of these assumptions shows that varying the assumptions within a sensible range has a major effect on the profitability of different genotypes (eg Young et al. 2011—see Table 3). Further analyses (Young & Ferguson unpub) showed that developing a selection index from the values calculated within this range of assumptions would lead to very different breeding directions.

Table 3. Whole farm profit ($) for different pasture and animal production systems based on a standard genotype and changes in profit for more resilient genotypes achieved through increased capacity to consume low quality feed or lower energy requirements for maintenance. Source: Young et al. 2011

<table>
<thead>
<tr>
<th></th>
<th>Wool enterprise</th>
<th>Prime lamb enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor pasture</td>
<td>Good pasture</td>
</tr>
<tr>
<td>Standard genotype</td>
<td>38 000</td>
<td>92 000</td>
</tr>
<tr>
<td>Higher intake of low quality feed</td>
<td>+8 800</td>
<td>+700</td>
</tr>
<tr>
<td>Reduced maintenance requirements</td>
<td>+10 500</td>
<td>+11 000</td>
</tr>
</tbody>
</table>

It is commonly observed that the number of animals that farmers carry is associated with the number of animals that can be carried in a poor season and the cost of maintaining the animals during the poor season. Recent work (Ferguson et al. 2011) has shown that there are marked differences between genotypes in their resilience when faced with a feed restriction. Much of the work has revolved around differences in genetic fat and muscle. Animals with higher genetic fat and muscle are more resilient and are able to maintain production when feed supply is short.

\(^1\) Metabolic liveweight is LW\(^{0.75}\) and is closely associated with the amount of energy an animal requires for maintenance.
A recent analysis presented by Trompf (2014) compared, for 2 different nutritional scenarios, the estimated profitability of a genotype selected for high fleece value with a genotype selected for improved resilience (Figure 1). The nutritional scenarios where

1. maintaining ewes at condition score 3 from joining, day 90 and through to lambing (CS 3-3-3)
2. allowing half a condition score loss during pregnancy from joining in CS3 and lambing in CS 2.5 (CS3-2.7-2.5)

The analysis showed that the more resilient genotype was $100 000 pa more profitable when animals were fed to maintain condition and this increased to $250 000 pa if there was a nutritional challenge and animals were losing 0.5 CS during pregnancy.

This analysis varied the production assumptions outlined above based on some experimental evidence and some anecdotal evidence and therefore is not proof that a more resilient genotype is more profitable and is only a suggestion that this area needs further work to decide if it is part of the reason for the divergence between the theory and the on-farm observations.

Figure 1: Profitability of a high fleece value genotype with a genotype selected to be more resilient. The comparison includes 2 nutritional scenarios, when there is sufficient feed to maintain the ewes in condition score 3 from joining to lambing and a second scenario when less feed is available and the ewes lose 0.5 CS during pregnancy.

References


Using ASBVs and Indexes

Luke Stephen, Project Officer MERINOSELECT, Sheep Genetics, Armidale NSW

Information about the presenter

Luke Stephen has been with MLA and Sheep Genetics for five and a half years and is the project officer for MERINOSELECT, the national genetic evaluation service for the Australian sheep industry. Luke has a strong history in genetic evaluation working in the beef industry for BREEDPLAN previously. Luke is born and bred in the New England and grew up on the family superfine wool and beef operation at Armidale helping to run the 30000 merinos and 2000 cattle in his spare time. Luke has a Bachelor in Rural Science from the University of New England and has recently completed his Masters in Project Management with a major in leadership from the University of Southern Queensland.

Information about the presentation

Australian Sheep Breeding Values (ASBVs) are a selection tool that enables sheep producers to identify animals of differing genetic merit. ASBVs are available for a range of different production ctraits at different age stages. ASBVs are available from the following major analyses that Sheep Genetics run:

LAMBPLAN Terminal
LAMBPLAN Maternal
MERINOSELECT
DOHNE

ASBVs are available for the following production areas:

- Fleece
- Growth
- Carcase
- Reproduction
- Worm Resistance
- Welfare traits

The different age stages that ASBVs are produced for are

- Birth
- Weaning
- Post Weaning
- Yearling
- Hogget
- Adult

ASBVs are depicted by the age stage and the trait measured e.g. Yearling Staple Length is YSL, Weaning Weight is WWT etc.

ASBVs use pedigree and performance information while correcting for non-genetic effects to provide the animals estimated genetic merit for any given trait that is included in the LAMBPLAN,
MERINOSELECT and DOHNE analyses. ASBVs have accuracy and linkage thresholds that ensure the information presented for producers to select on is credible and accurate.

Selection indexes are available for commercial producers to use. Indexes use a range of ASBVs and present this as one figure which ranks the animals’ suitability to the breeding objective in question. The following indexes are available:

**LAMBBPLAN Maternal**
- Maternal $
- Dual Purpose $ (DP$)
- Self-Replacing Carcase $ (SRC$)

**LAMBBPLAN Terminal**
- Carcase Plus
- Lamb2020
- Trade $
- Export $

**MERINOSELECT**
- Fibre Production plus (FP+)
- Merino Production plus (MP+)
- Dual Purpose plus (DP+)

In using indexes it is important to:
1. Identify the index that best suits your production system
2. Rank the animals on the relevant index
3. Look at the individual animals ASBVs to ensure that all the traits in your breeding objective are met.
4. Look at other ASBVs

**Notes**

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New traits for the sheep industry

Dr Graham Gardner, Associate Professor in Biochemistry, Toxicology and Nutrition at Murdoch University, WA

Information about the presenter

Graham is an Associate Professor in Biochemistry, Nutrition, and Toxicology at the School of Veterinary and Life Sciences at Murdoch University. Graham’s research is predominantly focused on the impact of selection for growth, leanness and muscling within the sheep and cattle industries, looking at aspects of carbohydrate and intermediary metabolism, stress sensitivity, and growth and maturity, as well as the metabolic changes that take place in muscle. He supervises 8 PhD students working in these areas, and his work is predominantly funded by the Sheep CRC, and Meat and Livestock Australia. Graham coordinates Sheep CRC project 3.3 “Lean Meat Yield and Supply Chain Adoption”, and is therefore heavily involved in the development of new traits meat for the sheep industry.

Information about the presentation

Within the last 7 years the Australian lamb industry has taken massive steps forward in knowledge of a vast array of production traits. These have included lambing performance traits, growth, lean meat yield and meat quality traits. This has been driven by research conducted by the Cooperative Research Centre for Sheep Industry Innovation (Sheep CRC), which has run an information nucleus experiment that has enabled the identification and quantification of the production and genetic factors affecting these traits. Furthermore it has also identified antagonisms between key traits of economic importance. To manage these antagonisms, a number of new breeding values have been developed. Furthermore, industry systems are being designed and adapted to facilitate price signals to drive the uptake of these new breeding values.

One of the most important examples of antagonistic traits is the relationship between lean meat yield and eating quality. While industry has long known the importance of lean meat yield, and selected for characteristics to optimise this trait, it is only since the inception of MSA for sheep meat that there has been a real focus on production to optimise eating quality. Using MSA taste panel methodologies, lambs from the information nucleus flock with better lean meat yield attributes have correspondingly poorer eating quality. This is in part a reflection of the impact of lean meat yield on intramuscular fat, which also diminishes in higher yielding lambs. Therefore breeding values are being developed to enable improved selection for lean meat yield, but also to maintain threshold levels of intramuscular fat. These opposing traits will be managed through selection indices, and payment systems developed to reward producers for taking a balanced approach to optimising lean meat yield while also maintaining eating quality. Importantly the effect of lean meat yield and intramuscular fat on eating quality will need to be reflected within the next generation MSA system. To enable this, measurement technologies are required to enhance the prediction of lean meat yield and eating quality. This represents just one example of the antagonistic traits that will be discussed in this presentation.
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Genomics and DNA testing: new tools for ram breeders to accelerate genetic gain

Dr Stephen Lee, School of Animal and Veterinary Sciences, University of Adelaide, Roseworthy Campus, SA 5371

Information about the presenter
Stephen is based in the School of Animal and Veterinary Sciences at the University of Adelaide where he has a multifaceted role focused on applying technology in the livestock industries. Stephen works with the Sheep CRC and sheep breeders on effective implementation of genomics into sheep breeding programs. This includes developing strategies to optimise investment in genomics for genetic gain.

Information about the presentation
DNA technology has developed rapidly over the past decades and we can now relatively cheaply generate information from the DNA of individuals. The Sheep CRC has developed a number of DNA tests useful for sheep enterprises. These are the Low Density (LD) test, Parentage test and Poll test. A DNA test requires the collection of a small blood sample on a blood card. This can be done, for example, by making a small cut on the ear. Blood cards are provided when ordering tests, they are specially designed for collecting blood for the purpose of DNA testing. The cards are bar-coded and the identification number of the animal that the sample belongs to must be provided on the card.

Sheep CRC LD test
The LD test provides information about an animal’s breeding value for four breeds of sheep Merino, White Suffolk, Poll Dorset and Border Leicester. Information from the test is combined with pedigree and performance data in the Sheep Genetics database to increase the accuracy of Australian Sheep Breeding Values. The LD test increases accuracy of breeding values, especially for young animals and for traits that are generally measured later in life or not measured at all. This is important as genetic gain in sheep breeding programs is made by identifying and selecting the best animals. Greater genetic gain is achieved when animals can be more accurately selected and mated at younger ages.

The LD test is expected to increase rate of genetic gain for Merino breeders that use the test by between 10-15%. Importantly, it is expected that testing about the top 20% of the ram drop will give more than 90% of the potential genetic gain. Terminal ram breeders are also expected to benefit from use of the LD test as it provides ability to identify and select rams that are superior for lean meat yield (LMY) and eating quality traits. To date, terminal ram breeders have successfully used current selection indexes and measurements for growth, muscle and fat depth to achieve substantial genetic gain. The LD test will allow breeders to incorporate selection for eating quality, for which there was previously limited information.

Sheep CRC LD 12K test key points
- Genomic tests increase ASBV accuracy and, therefore, rate of genetic gain.
- The increase in ASBV accuracy is highest when there are limited measurements available, for example in young animals.
- The most cost effective use is to test mainly rams.
- Testing about 20% of the ram drop to achieves most of the extra genetic gain.

Parentage test
The Parentage test is accurate and suitable for all breeds of sheep. It requires a DNA sample from an animal and its probable parents and provides an alternative, labour saving method for determining sire only or full pedigree. In addition, it can be used to determine sire pedigree in syndicate matings. As the test is compatible with the other Sheep CRC SNP-based tests animals
tested using the LD test will not need to be re-sampled by the breeder for parentage, as the genotype has already been recorded.

**Poll test**
The Poll test is predictive of the horn status of tested animals. HH rams are almost always horned, whereas PH rams are rarely horned and PP rams are always polled. The poll test is based on a genetic marker and not on the gene itself. The accuracy of predicting poll status is about 95%. Prior to development of the Poll test, breeders relied on progeny testing, which takes many years to confirm whether a phenotypically polled ram is PP or PH. Overall, the Poll test will allow ram breeders to increase the number of PP rams and potentially capture the rewards given the commercial preference for polled Merinos. Rapid reductions in the number of horned animals can be achieved simply through testing sires and using only PP sires. Even greater reduction in horn genes can be achieved by testing ewes as well, but this comes at a substantial cost.

**Poll test key points**
- Poll status is completely controlled by genetics; environmental factors have no impact.
- Development of horns in sheep appears to be mostly controlled by a single gene.
- The Poll test identifies carriers of the horn gene and can assist in eradicating horns.
- Producers should consider horned status as only one trait in a breeding program.
- The use of Poll test can reduce the chance of breeding horned Merino rams by 75% in just one year.

**How do I get a DNA test?**
The blood cards needed for DNA testing will be provided when the genetic test is ordered via a designated website (via Sheep Genetics or another provider, currently the Sheep CRC). The card must clearly identify the animal being tested using its 16 digit Sheep Genetics identification code. Once the blood cards are returned to Sheep Genetics, they are forwarded on to a laboratory for analysis. The test results are returned to Sheep CRC and Sheep Genetics. Parentage and Poll results are returned directly to the breeder, whilst LD tests results are incorporated into the ASBVs provided by Sheep Genetics.

The current test costs (June 2014) are:
- Parentage only $17 + GST per test
- Poll only $17 + GST per test
- Parentage and Poll tests only $17 + GST per test
- LD test only $50 + GST per test
- LD test + Parentage and Poll tests $55 + GST per test

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Producer case study: using genetic data and tools to make a better product

Bindi Murray, Livestock Manager, Kunmallup Pastoral Co, Woodanilling WA.

Information about the presenter

Bindi is a commercial woolgrower and prime lamb producer. She runs a self replacing merino flock, which also provides replacements for a first cross terminal sire flock and mates about 8500 ewes each year. She farms on a mixed farming property in the Great Southern region with her extended family. Bindi is a graduate of the UWA Animal Science degree and has previously worked in sheep genetics research.

Information about the presentation

- Background info on property and business

Having seen the power of genetics while involved in research at DAFWA in Katanning, I was keen to increase the use of genetics in our sheep enterprise. When I returned to the family farm we were using ASBVs to a limited extent in Terminal Sire selection and not at all in Merino ram selection. We purchase all of our terminal sires and purchase Merino rams for our nucleus flock, which our flock rams are then bred from.

- Role of genetics on business: current flock improvement strategy?

The first step was to set our breeding objective. What animals were we trying to produce? For our prime lambs we are looking for a lamb that can be easily delivered by a maiden merino ewe, has good muscling, rapid growth for sale as a store lamb at weaning and is easily distinguishable from a merino lamb. For our merino progeny we wanted a productive, easy care flock. For the production component we want to increase reproduction rate, bodyweight at weaning and hogget age and clean fleece weight, while maintaining fibre diameter. The key easy care traits are polled horns, low wrinkle, dag, face cover and wool colour scores, and increased staple strength, yearling fat depth and worm resistance measures.

- What (genetic) tools / information / resources are used?

I used the Merinoselect and Lambplan databases to assess what individual animals and studs were performing well in the areas that we were interested in and also met the practicalities I needed, such as selling structure and proximity, as we buy live rams rather than semen. Then after much discussion within the business and with some valued minds outside the business we decided on which ram sources we wanted to inspect and eventually purchase from. The ASBVs provided prior to ram sales form the basis for ranking rams with a quick check of physical confirmation and fitness prior to purchase. The Merinoselect and Lambplan databases also allow for a quick and easy desktop comparison of studs.

- What gain from the use of genetics?

The gains in prime lamb production have been quite clear with improved growth rates and much less lambing difficulty, which has resulted in a higher quality and more saleable product. The inclusion of easy care traits in the merino flock has been very effective and has allowed us to reduce the labour required in most areas and especially to manage flystrike in un-cruched merino ewes. The physical measurements of the rams produced from our nucleus flock are heading in the right directions, with notable and consistent gains in averages of physical clean fleece weight and staple strength measurements over 3 years. In time this will flow through to the remainder of the flock.
• Any hiccups / what you might have done differently?
Our worm egg count monitoring has to be spot on now that the level of dag has been reduced in the flock, as dags are no longer an early indicator. Moving from a private selection at one stud to buying at auction and from different sources within the season can be a juggling act to ensure we end up with the right number of suitable rams and remain within budget.

• What challenges you would like to see future genetic research tackling?
I think that we are at the cusp of very exciting times with the increased accessibility of genomics and the precision that genomic values can bring to sheep breeders and breeding decisions. I would also love to be able to manipulate the genetic component of feed efficiency conversion.

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New Sheep CRC – vision for future genetic progress

James Rowe, CEO, Sheep CRC, Homestead Building, UNE, Armidale NSW 2351

Information about the presenter

James Rowe is Chief Executive Officer of the Australian Sheep Industry Cooperative Research Centre based in Armidale. Before taking on this role in 2001 he was the Professor of Animal Science at the University of New England. He has over 30 years experience in research and development that has included work in the private sector, universities, government organisations and international development programs. He spent 12 years in WA during the 1980s and 90s, in the Sheep and Wool Branch and as Head of the Cattle Industries Branch in the Department of Agriculture.

The role of genetics in determining production potential and product quality has been central to the CRC’s research program over the last seven years and is a key component of the program planned for the next five years. As the potential for fast, well-targeted genetic gain becomes a reality for the Australian sheep industry the CRC has a commitment to develop new technologies through world class research and to ensure the effective use of the new genomic products by ram breeders, commercial sheep producers and the post farm gate supply chain.

Information about the presentation

The current Sheep CRC has been successful in establishing a new capability for Australia’s sheep breeders to use genomic selection. The accuracy of using DNA data to predict breeding values is moderately high (between 0.20-0.50), and with the price of genomic testing around $50/test there are well defined benefits for sheep breeders using the new technology to achieve faster genetic gain.

One of our goals for the next five years is to halve the cost of DNA testing. We believe this to be realistic based on progress in developing new DNA tests for applications such as plant breeding. Development of lower-cost testing systems for use in sheep is anticipated to have a transformational impact on sheep breeding. There are also prospects for increasing the accuracy of predicting breeding values. As genomic technologies become cheaper and more accurate, research is also needed on new designs for breeding programs to ensure that breeders capture the full benefits of the new technologies.

The current DNA testing (based on 50k SNP-chip data) does not allow prediction for animals that are genetically too far removed from the reference populations. Denser marker information, such as that provided with high-density SNP chips and full sequence information, is expected to predict over a longer genetic distance and also maintain better prediction accuracies over time.

The ‘bio-bank’ of DNA stored from the Information Nucleus program provides an invaluable, and globally unique, resource for assessing the value of full-sequence DNA analysis. This was an option not contemplated just five years ago. Around 500 rams will be chosen for full genome sequencing. Most will be the sires of progeny with abundant phenotypic measurement from the Information Nucleus program and MLA’s Genomic Resource Flock initiative.

Research on full sequence databases is a new field of science. Close collaboration with the Dairy CRC is planned, as well as with a range of international groups with expertise in this area. The Sheep CRC’s entry to full sequence research is well-timed as progress currently being made in parallel studies with other species will be of great value and improve the probability of success.

The research program on cheaper genotyping will focus on methods for combining affordable lower density genotype testing with imputation techniques to capture the benefits of full sequence data in order to deliver cheaper yet more reliable genomic predictions.
Over the next five years the following outputs are expected from genomic research:
- new methods for using lower-priced genomic tests and improved accuracies (through imputation and sequencing) to underpin faster genetic gain and reduce costs of a resource flock; and
- novel strategies for optimal use of genomic tests in commercial breeding programs for cost-effective acceleration of genetic gain.

Sheep Genetics is the organisation responsible for providing estimated breeding values (ASBVs) to ram breeders and ram buyers in the Australian sheep industry. The CRC and Sheep Genetics have an agreement to commercialise all CRC genetic outputs via Sheep Genetics. Through this arrangement any improvement in the accuracy of predicting breeding values, developed by the CRC, is passed on immediately, through Sheep Genetics, for use by ram breeders. Accuracy of predicting breeding values has a direct impact on rate of genetic gain. Therefore benefits from using the improved breeding values flow automatically through to delivering industry scale benefits of improved productivity and more control over product quality.

Better use of genetic and genomic information

The CRC and Sheep Genetics recognises the important role that leading breeders and private sector genetic service providers play in effective use of new technologies and the next five years will see increased training and support for these specialists as details of new genomic tools are produced. The CRC will also continue to provide training support through programs such as RamSelect to help sheep producers to purchase the best rams for their production systems.

The effective use of new genetic and genomic technologies depends on ram breeders and commercial sheep producers being able to use the new products and information effectively to improve productivity as well as ensuring product quality. It is also important for post farm gate supply chains for meat and wool to understand the potential benefits of producers using best-practice genetics and ensure that they provide the appropriate incentives and feedback to encourage innovation and continuous improvement.

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