

Unpublished Report

Document ID:	SheepCRC_2_24a
Title:	Outcomes and Future Directions for the Sheep CRC
Author:	Rowe, J.B.
Key words:	sheep; genomics; productivity; wellbeing meat quality

This report was prepared as part of the Sheep CRC Program 2007-2014. It is not a refereed publication. If the report is quoted it should be cited as:

Sheep CRC Report 2_24a

Outcomes and Future Directions for the Sheep CRC

James Rowe

Sheep CRC, Homestead Building, UNE, Armidale NSW 2351 jrowe@une.edu.au

Introduction

Central the Sheep CRC's research over the last six years has been the Information Nucleus program, set up to provide a resource for collecting genetic, biological and production data. Each year approximately 100 young rams were selected that were representative of the major breeds and joined, using AI, to around 5,000 ewes distributed across 8 sites in different climatic zones throughout southern Australia. The progeny were measured for a very wide range of traits including a number of novel and expensive parameters such as consumer tests for eating quality, intra-muscular fat and omega-3 fatty acids. Samples of DNA were analysed using the 50 k SNP-test and sub-samples of DNA stored for future analysis as DNA technologies develop further. With measurements for over 18,000 lambs and more than 10,000 genotype analyses the new data has provided a rich resource for researchers and formed the basis for developing new predictions of breeding values based on genomic data.

The addition of genomic information to the measurement of performance and use of pedigree data adds to the accuracy of predicting true genetic merit and is particularly useful in selecting younger animals for use in breeding programs and for incorporating difficult-to-measure traits in selection indexes. It is estimated that the use of genomic data can improve accuracies by around 40% when selecting month old Merino rams and around 12% when selecting rams at 18 months of age. For meat breeds, the main benefits of genomic information are seen in selection for eating quality traits and parasite resistance.

Meat science and eating quality

The breeding direction set by the lamb industry around 1990 was to produce larger leaner carcases by increasing muscling, producing less fat and achieving faster growth rates. This approach has successfully changed the lamb product for export and domestic markets. The clear market signals and relatively straightforward set of traits to select for, made this transition relatively fast and effective.

The CRC's Information Nucleus program showed that a number of rams, considered to be elite sires on the basis of growth rate, muscling and lean meat yield were amongst the poorest performers in terms of consumer scores for eating quality. The characteristics of sheep meat having the greatest influence on consumer perception of eating quality within a cut were deemed to be the content of intramuscular fat (IMF) and shear force of the muscle, where the latter is an objective measure of tenderness. While there is a strong negative relationship between increased lean meat yield and decreasing eating quality, there is sufficient variation around the relationship to provide good opportunities for selecting animals that can deliver both increased lean meat yield (LMY) and superior eating quality.

Measuring IMF and shear force in breeding programs is very expensive and would be impossible for most breeders. The development of genomic predictions of breeding values for these key traits is an important outcome from the CRC's research. It means that selection for parallel improvements in lean meat yield and eating quality are now possible. The development of new genetic parameters for traits, such as omega-3 fatty acids and retail shelf life and meat colour, paves the way for further positive differentiation of lamb as a premium product.

It is, however, imperative that measurements continue to be made on reference flock animals in order to ensure that genomic selection accounts for the variation in eating quality and maintains the high industry standards for this critical factor underpinning the high value of lamb.

Wool – lightweight next-to-skin knitwear

The Sheep CRC has produced a quality management system for wool knitwear that will allow retailers and manufacturers to produce next-to-skin wool garments with predictable comfort and handle. At the heart of the system are two breakthrough technologies: The Wool ComfortMeter and The Wool HandleMeter.

After five years of comprehensive consumer wearer trials and parallel development of the new measuring system, we have an instrument that accurately predicts next to skin comfort. The Wool Comfort Meter allows retailers and manufacturers to specify a numerical value for comfort in their buying orders. This means that for the first time, retailers and manufacturers have a means of objectively specifying and promoting a garment on the basis of superior comfort and thereby overcome a concern of many consumers that wool garments can be itchy or prickly.

A parallel program focused on defining and calibrating handle measurements with expert assessors and consumers. As a result, we have developed an instrument that objectively measures the handle attributes of next-to-skin wool knitwear. The Wool HandleMeter measures the seven core attributes of handle: smoothness, softness, warm feel, dry feel, hairiness, tightness and perceived weight as well as an overall luxury handle index. The Wool HandleMeter allows retailers to specify a value for fabric handle in their buying orders, generating specifications for wool types and processing procedures to ensure buyer requirements are met by the supply chain.

A research pilot project is currently underway with AWTA providing a testing service with the Wool ComfortMeter and HandleMeter in Australia and in China. The new measurement systems offer retailers and knitters the ability to:

- Differentiate their next-to-skin wool products on the basis of elite comfort and hand feel;
- Develop a new range of second generation next-to-skin products that perform on comfort and superior handle;
- Transparently source and supply product against clear, objective specifications for comfort and handle, removing reliance on human estimation and the accompanying risk of customer dissatisfaction and product returns; and
- Consistently provide elite quality next-to-skin products, ensuring product comfort levels and handle standards are met not only between batches, but across seasons.

It is anticipated that the new measurement system will support and expand the demand for wool in the high-value market for lightweight base-layer garments worn next to skin. The high heritability of both fibre diameter and fleece weight will allow the sheep industry to rapidly respond to any change in market signals for finer wools suited to lightweight knitwear.

Sheep and their management

Reproduction efficiency - number of lambs weaned (NLW) is an increasingly important trait as the income from livestock sold and the importance of having surplus animals from which to select are both recognised profit drivers in a number of production systems. This is a relatively new development for many Merino breeders traditionally focusing on a self-replacing Merino flock where large numbers of wethers were kept for wool production.

With low heritability of the trait 'number of lambs weaned' and with relatively few rams having data available for this trait, the CRC focused on management options for improving reproductive efficiency. Two programs initiated by the CRC were the 'Lifetime Ewe Management' (LTEM) training program and the workshop series 'Managing Scanned Ewes'.

The small group training program – LTEM has been very successful in achieving practice change and improvement in lambs weaned as well as increased stocking rates through better feed budgeting. It is now being supported by AWI and continues to be run and coordinated by RIST.

The Managing Scanned Ewes workshop was conducted with the pregnancy scanning contractors and their clients. It promoted similar principles of ewe management to those used in the LTEM program - i.e. ensuring that ewes are kept around condition score 3 during key periods of the reproduction cycle. It too has been a very successful program and has resulted in widespread practice change and improved lamb weaning percentages by those attending the workshops.

As more data becomes available from the Information Nucleus flocks there is growing evidence that number of lambs weaned (NLW) may soon become one of the traits that we can predict from genomic analysis with sufficient accuracy to be useful in commercial breeding operations.

Management of parasites (worms, flies and lice) and associated losses - remains one of the major costs for the sheep industry. One of the major contributions of the Sheep CRC in this area has been the development of a coordinated national approach to parasite management through development of WormBoss, FlyBoss and the re-writing of LiceBoss. With assistance from AWI, the CRC has produced an up-to-date web-based national resource that is increasingly used by parasitologists, veterinarians, producers and service providers as information of choice in making decisions on parasite management. The integrated 'ParaBoss' program will be launched by June 2013 and in this form will be managed and updated outside the CRC with support during the transition from AWI and MLA.

The CRC has also contributed to an improved understanding of factors contributing to sheep that are better adapted to the production systems and environments in which they are run. The workshop series 'Bred-well Fed well' was developed by the CRC for this purpose and its continued delivery is now supported by MLA and AWI. The publication '*Sheep – the simple guide to making more money with less work*' has been prepared for WA producers and adapted for producers in the sheep-cereal zones. Further versions will be produced for the high rainfall zones.

There is also considerable research still underway to understand the impact of genetic parameters, management decisions and environmental factors on the well-being and productivity of sheep. Preliminary results indicate a positive effect of the trait PFAT on reproductive performance of progeny under harsh seasonal conditions. Still under study is how to balance this benefit against the impact of higher fat levels on lean meat yield and wool production.

Future opportunities

The CRC is preparing an application for a five year extension program that will build on three areas of research successfully completed and delivered during the current seven-year term. The focus for the next five year business plan will be to:

- build on the success of the genomic technologies;
- develop eating quality to a cuts-based grading system; and
- evaluate new approaches for pro-active management of animal wellbeing that will also improve productivity.

Successful outcomes in these three areas will also contribute to the development of the Australian sheep industry by making it more profitable and sustainable.

Genetic and genomics

The Sheep CRC was set up to develop the use of genomic technologies for the Australian sheep industry. When the program was designed in 2006 it was already clear that searching for genes of major effect as a basis for genetic selection was likely to be of little value. The potential of whole genome association analysis appeared to hold the greatest potential and the CRC's Information Nucleus Program was a world-first design to take advantage of the features of whole genome association analysis. The program has been very successful and places the Australian sheep industry in a good position to take advantage of this new technology in commercial breeding programs. However, new genomic technologies are developing very quickly and there are now new opportunities that offer the sheep industry even greater potential improvements.

Full DNA sequencing for individual animals was not even considered at the start of the CRC, but is now becoming a mainstream technology in human genetic analysis and in predicting breeding values in production livestock species. The potential benefits of full sequencing key rams in the Australian sheep flock are the possibility of:

- more accurate predictions of breeding values;
- predictions of breeding values for minor breeds not currently possible; and
- accuracies of prediction which retain their value over time and reduce the cost of resource flocks.

The use of genomic information in breeding programs provides the basis for introducing new design concepts and it is important that these options are developed and evaluated with commercial ram breeders. The extension application will focus on applying the latest genomic technologies in the sheep industry through further research on DNA analysis and by working with ram breeders to maximise the potential benefits from the commercial application of the new technologies.

Further value for lamb and sheep meat

The new understanding of genetic and management inputs to manage improvement of LMY and eating quality will be extended to focus on cuts based grading and methods of obtaining best value from heavier lambs (over 25kg carcase weights) and for yearling Merino product in the export market. A major component of the work plan for the next five years is to work closely with participants in the supply chains to convert new information on genetics, management and processing into additional value.

Improved wellbeing and increase productivity

The Information Nucleus program has produced invaluable data that can now be used to review the implications of various combinations of genetic potential, patterns of production and challenges of different environments on survival and wellbeing. Varying survival of progeny and different levels of productivity, under a range of environmental conditions, provides a basis for understanding genetic selection for well-adapted animals and opportunities for making better culling decisions.

The work program will also include development and evaluation of auto-monitoring such as accurate roll-call, walk-over weighing and behavioural changes such as position in the flock when moving between paddocks or into water. Reducing the labour requirement while improving early detection of sheep needing attention is expected deliver better welfare outcomes and improve productivity.

Acknowledgements

I would like to thank Michael Thomson for his constructive suggestions on an earlier draft of this paper. This paper is an extract from a similar prepared for the Graham Centre Sheep Forum in Wagga Wagga (28 June 2013) and is printed in the proceedings of this conference with kind permission of the Graham Centre.