Making More From Sheep

MODULE 9

Gain From Genetics

A joint initiative of Australian Wool Innovation and Meat & Livestock Australia

CONTENTS

Procedures

Tools

Cover photo courtesy of Andrew Michael, Leahcim Poll Merino Stud and Sheep Genetics

9

Gain from Genetics

What does this module do for you?

This module is designed to assist a commercial flock owner to capture the benefits that improved genetics offers the business.

Genetics sets the potential for critical traits that drive profitability in sheep enterprises. Flock genetics also determines the markets for wool and/or meat that might be targeted.

This module outlines an effective approach to genetic selection in a commercial flock that enables you to:

➜ Recognise how selecting the right genetics can contribute to sheep enterprise productivity

➜ Select the most appropriate rams for your enterprise

➜ Enhance profitability by achieving ongoing genetic improvement.

In the sheep industry, technologies and tools are now available to accurately source rams that meet the genetic requirements of your flock.

Procedure 9.1

Identify the key production traits that drive your sheep enterprise profit

Background information

Genetic decisions have long-term impacts on your flock. Take a longer-term view of the market when planning your flock structure and production targets. Considerations include the opportunities for premiums or adding to the relative value of wool and meat. These considerations need to be part of a 10-year time frame as it can easily take 7-10 years to see change in your flock.

Key decisions, critical actions and benchmarks

In general, the more traits you select, the slower the rate of progress on each trait. Therefore it is important to identify those traits that are most important in your business. This involves:

➜ Determining target markets (see procedure 2.1 in ***Market Focused Wool Production*** and procedure 3.1 in ***Market Focused Lamb and Sheepmeat Production***). This is likely to include consideration of:

➜ Fibre diameter, staple length and staple strength

➜ Lamb markets (export, domestic or finisher)

➜ Breeding ewe replacements.

➜ Using feedback from your wool, lamb and sheep sales to evaluate performance. Objectively quantify your flock's current productivity, eg, kilograms of wool or liveweight of lamb or surplus sheep per hectare to highlight what might be genetic limitations or a mismatch between your current genetics and your market opportunites.

➜ Participating in formal or informal benchmarking programs to identify the strengths and weaknesses in your enterprise and align your breeding objectives accordingly (see procedure 1.3 in ***Plan for Success***).

AT A GLANCE

➜ Identify the most profitable traits for your enterprise

➜ Quantify current productivity levels to identify opportunities for gain

➜ Designing the breeding program to meet production targets and fit physical production capability. This involves consideration of the:

- Breeding system: straight-bred Merino or dual-purpose maternal breeds? Composite maternal flock, first- or second-cross prime lambs?
- Design of your breeding program to account for your on-farm resources, eg, consider the number of replacement ewes required annually.

The Australian Sheep Industry Cooperative Research Centre (Sheep CRC) has developed tools to help answer these questions, including:

- Tool 9.1: a 'wether calculator' to help determine the economic consequences of varying the portion of wethers in a Merino flock, and
- Tool 9.2: a 'Merino versus terminal sire flock' model to help assess the balance of self-replacing Merino and terminal sire matings.

➜ Identify key traits essential for achieving production targets. In this module a 'trait' is defined as a production characteristic that you may select for, eg, fibre diameter, fleece weight, growth rate, eye muscle depth or number of lambs weaned (see tool 9.3 for sheep breeding value definitions).

The traits to identify, and relative importance may include:

- Reproduction: weaning rate, mothering ability
- Growth traits: weaning, post weaning, yearling or adult weight
- Fleece traits: fibre diameter, fleece weight, staple strength, staple length
- Carcase traits: fat and eye muscle depth, yield
- Disease resistance: worms, footrot

Another useful Sheep CRC tool 'Selection assist' enables advisers or classers to help sheep producers decide on a breeding direction that is applicable to their flock (see http://www.sheepcrc.org.au/resources/software--selection-assist-2.php). It provides additional information on the likely outcome of a breeding objective. It also shows the impact of reproductive rates and where progress can be achieved within a flock.

Table 9.1 illustrates the relative importance of the key traits for a range of enterprises. For example, a medium wool Merino producer may want to maintain fibre diameter while increasing fleece weight, growth rate, reproduction rate and worm resistance. Note that the key traits and their relative importance will vary regionally and between businesses.

Feedback from wool and lamb sales will help sheep producers prioritise the traits to focus on. However, when interpreting market feedback remember:

a) To take a longer-term view of the market, and

b) That flock genetics is only one contributing factor.

Signposts

View

The Sheep CRC: technology, tools and know-how to assist the sheep industry to deliver, in a profitable and sustainable manner, products highly desired by domestic and export customers. Visit: www.sheepcrc.org.au

Maternal Central Progeny Test: compares the merit of maternal sires where it counts - their ability to produce crossbred lambs and ewes that have superior production and are efficient and profitable for the sheep producer. Visit: http://www.dpi.nsw.gov.au/agriculture/liestock/sheep/breed-select/meat/dams

Selection Demonstration Flock: proving the effect of alternative selection strategies and increasing the rate of adoption of genetic technology in South Australian Merino sheep by establishing demonstration flocks that become a focus of education programs. Visit: http://www.sardi.sa.gov.au/livestock/meat_wool/selection_demonstration_flocks

QPLU$: over the last decade, this program showed that sheep producers can significantly boost returns from existing Merino flocks if they breed from animals selected on the basis of measured fleece weight and fibre diameter. Visit: http://www.dpi.nsw.gov.au/agriculture/livestock/sheep/breed-select

Table 9.1: Example of relative emphasis of traits when selecting rams for a range of enterprises
(✓✓✓ = High, ✓✓ = Moderate, ✓ = Low)

1 Includes characteristics such as fibre diameter, staple strength, crimp, style.

2 May vary noticeably across regions.

Enterprise	Fine Merino	Medium Merino	Strong Merino	Maternal – self replacing	Maternal – 1st cross	Terminal
Wool quality[1]	✓✓✓	✓✓	✓✓	✓	✓	
Fleece weight (kg)	✓	✓✓	✓✓✓	✓✓	✓✓	
Growth rate (g/head/day)	✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Carcase attributes Fat & eye muscle depth	✓	✓	✓✓	✓✓	✓✓	✓✓✓
Worm resistance[2] Worm egg count	✓✓	✓✓	✓	✓✓	✓✓	✓✓
Reproduction Lambs weaned	✓	✓✓	✓✓	✓✓✓	✓✓✓	✓
Fleece rot resistance	✓✓✓	✓✓	✓	✓✓	✓✓	
Structural soundness	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓

Procedure 9.2

Identify the genetic opportunities to improve key production traits

Background information

Your potential production (wool, lambs and surplus sheep) is largely determined by the flock's genetics and farm feed supply. Genetic gain is primarily influenced by the:

- ➜ Rams purchased
- ➜ Ewes retained in the flock
- ➜ Bought-in replacement ewes.

Selection of both ewes and wethers can raise the average productivity of animals retained however ram selection is the main driver of ongoing genetic improvement of your flock. A ewe, over her breeding life, will generally contribute 3–8 lambs, whereas a ram can contribute 40–60 lambs per year.

The best rams, and retained or replacement sheep, will be determined by production targets (fibre diameter, fleece weight, finisher or prime lamb turn-off, surplus sheep sales, etc) and production systems on your farm (see procedure 2.1 in ***Market Focused Wool Production*** and procedure 3.1 in ***Market Focused Lamb and Sheepmeat Production***). Whilst flock genetics determines production potential, the value will only be realised when the flock is managed to fully express the benefits.

Key decisions, critical actions and benchmarks

Large genetic differences exist among the rams available for selection each year that can be used to improve your sheep. These differences provide the opportunity to increase productivity. The following examples show what can be achieved in wool and meat production.

You can gain from using genetics to:

Lower fibre diameter and increase fleece weight at the same time

Figure 9.1 illustrates 24 years of hogget fibre diameter and fleece weight records from a commercial flock. Rams were sourced from the same stud during that time. The result has been a reduction in fibre diameter by approximately 4 microns, and a simultaneous increase in fleece weight of 1kg per head.

Most of the gains were made after 1992, when the selection emphasis in both the flock and its ram source moved from within-flock performance measurements to across-flock breeding values.

Increase growth rate and reduce sale age

Table 9.2 illustrates the performance of progeny from two sire teams (one selected for high growth and the other for low growth) joined to similar flocks of ewes. At 16 weeks of age, the lambs from the high growth sire team had 46.6% of lambs reaching target sale weight (at least 43 kg). The low growth sire team had only 11.6% of lambs reaching sale weight.

AT A GLANCE

- ➜ Informed decisions at ram selection are the key to improving sheep genetics
- ➜ Draw on the large pool of genetic differences among rams to improve your flock

In this example, lambs sired by the high-growth sire team grew at 50g/head/day more than lambs by the low-growth sire team. The higher growth rate allows lambs to be sold earlier, or at higher weights

Using genetics in the breeding program

The opportunity to genetically change characteristics in your flock is determined by a combination of how heritable (genetically controlled) the trait is, how much genetic variation exists and how well you can identify the genetic differences in the sheep you select.

Table 9.3 illustrates the opportunity to make genetic change in several key traits relative to a highly heritable trait such as fleece weight.

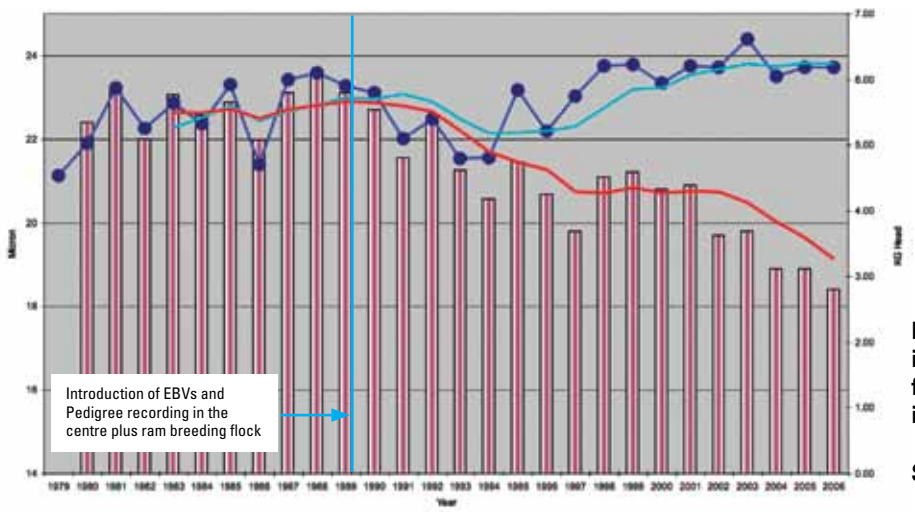


Figure 9.1: Change in fibre diameter and fleece weight in an industry flock

Source: R.Gill, Trundle

Table 9.2: The impact of growth rate on age of turn-off

Sire Group	Av. post weaning wt. breeding value	43 kg+ at 16 weeks of age
High growth	8.9	46.6%
Low growth	1.6	11.6%

Source: Sheep Cooperative Research Centre – commercial flock, 2000 1st cross ewes

While fibre diameter has a higher heritability than clean fleece weight (55% vs 39%) there is more opportunity to make genetic change in clean fleece weight because it has more than double the variation within most flocks. In the same way, the variation in lambs born per ewe joined enables much more progress than the low heritability of 5% would suggest is possible.

The Merino Bloodline Package, funded by AWI in conjunction with the NSW Department of Primary Industries, helps sheep producers to compare Merino sheep bloodlines based on the results from wether trials and on-farm comparisons run across Australia over the past 10 years.

The package highlights relative performance in relation to wool production, wool quality and profitability, and allows sheep producers to easily compare the different bloodlines' strengths and weaknesses.

You can use this tool to help identify the best ram source for your breeding objective. The analysis takes out all environmental factors between trials and years, leaving only the genetic variation between the bloodlines.

Table 9.3: Expected relative response to selection for major traits

Trait	Heritability	Variation (%)	Relative response[1]
Clean fleece weight	42%	16.3	100
Fibre diameter	68%	7.5	75
Hogget weight	38%	11.8	66
Lambs born per ewe joined	5%	63.2	50

1 The genetic change achievable compared to change that can be achieved in clean fleece weight.
Source: Fogarty et al, Sheep CRC

Signposts

View

The Merino Bloodlines Package: compares Merino bloodlines from wether trials and on-farm comparisons that have been run across Australia over the past ten years. Visit: http://www.dpi.nsw.gov.au/agriculture/merino-bloodline-performance

The opportunity to genetically change characteristics in your flock is determined by a combination of how heritable (genetically controlled) the trait is, how much genetic variation exists and how well you can identify the genetic differences...

Procedure 9.3

Select the best genetics for your business

Background information

When you buy a ram, you are purchasing its genes and it is important to separate out the genetic component of its expressed performance. Breeding values are used to describe the genetic potential independent of the rearing conditions and how the ram is presented for sale.

Breeding values are the only way to objectively describe genetic differences between rams across years, across flocks within a breed and, for terminal sire breeds, across breeds.

Introduction

Breeding values

The performance of a ram (body weight, fleece weight, fibre diameter, carcase quality, daughters' maternal characteristics), is a reflection of the genes and rearing/growing environment. This is often expressed as:

Performance = Genes + Environment (P = G+E)

Breeding values take account of the known environmental influences such as birth and rearing type, age, age of dam and management group that can significantly influence an animal's measured performance. Breeding values also take account of management differences between flocks and groups within flocks.

The use of breeding values can greatly improve ram selection. As an example, lambs born and reared as twins have, on average, lower fleece weight, higher fibre diameter and lower body weight when compared to singles. For ram selection, these are not genetic differences that will be passed to their progeny in your flock.

Similarly, visual assessment of hoggets favours early-born single lambs from mature ewes over twin born and reared lambs, or lambs born to maiden ewes.

Two forms of breeding values are available to assist in gaining from genetics. These are the Australian Sheep Breeding Values (ASBV) that enable genetic comparisons across flocks within a breed and across flocks across breeds in the terminal sire breeds group and the Flock Breeding Values that enable genetic comparisons of sheep only within a flock (see tool 9.4))

AT A GLANCE

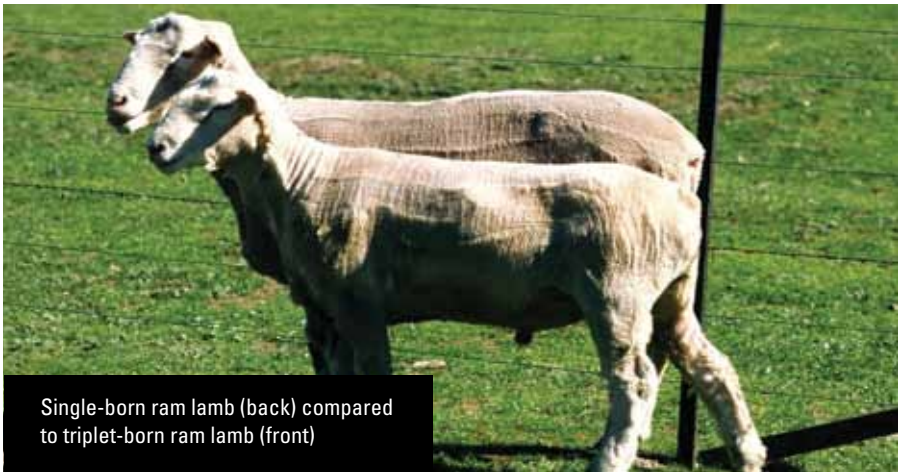
- Set breeding goals based on an assessment of future market requirement
- Use Australian sheep breeding values and visual assessment to select rams
- Seek professional advice to fine-tune the genetics in your breeding program

Interpreting ASBVs

The most useful tool to interpret an ASBV, and where it ranks an animal compared with all other genetically evaluated animals, is the percentile band table. The percentile band table (see tool 9.5 for an example) shows the range in ASBVs for each trait and breaks that variation into 5% steps. It can be used to benchmark both ASBVs and indexes.

As percentile band tables change over time, source a current version from your ram supplier or the Sheep Genetics website at: www.sheepgenetics.org.au. Select either the LAMBPLAN or MERINOSELECT menu options, select 'reports' and then select 'percentile reports'.

Tool 9.6 provides an interpretation of the key terminal, maternal and Merino breeding values or refer to the Sheep Genetics website: http://www.sheepgenetics.org.au/InformationItem.aspx?ITEM=140



Single-born ram lamb (back) compared to triplet-born ram lamb (front)

Key decisions, critical actions and benchmarks

Selecting rams with breeding values

Sheep Genetics calculates breeding values for all sectors of the sheep industry, for many traits of economic importance (see tool 9.3 for definitions). When buying rams from ram breeders who provide ASBVs, it is important to compare the average values for your current rams with your breeding targets. A useful rule of thumb for converting ram ASBVs into sheep and wool production differences is to simply halve the ASBV (because rams contribute half the genes of the lamb).

Before buying rams, sheep producers may like to benchmark the ram breeder's ASBVs and index values so they can make their selection relative to the breeding objective for their flock. Ask your ram source for the average ASBVs and indexes of their latest lamb drop.

This information can be used as a benchmark to make effective genetic progress toward the breeding objective.

It is best practice to combine breeding values with physical checking and visual assessment of those traits that do not not have an ASBV, such as soundness traits, wool character and fleece rot.

Research has been completed allowing visually assessed traits to be scored and reported as breeding values in the same way as measured traits. Traits such as wool colour and character, and conformation traits such as body development and face cover, can now be scored http://www.sheepgenetics.org.au/Document/105/VisualSheepScores.pdf and reported to Sheep Genetics to obtain breeding values. ASBVs for breech wrinkle, breech cover and dag score have been released to assist in selecting sheep with a lower chance of breech flystrike. See the signposts for tools to help you visually score these traits.

Use of genetic indexes

Breeding values can be used directly in ram selection when you know the traits needed in your enterprise. Breeding values are calculated for many traits and Sheep Genetics combines these values to calculate a small number of genetic indexes. The role of these indexes is to identify sheep that best suit a general breeding direction.

Before using a genetic index, know what traits it contains and their weighting, to ensure the index suits your breeding program. When assessing high-index rams make sure that no single trait's breeding value is dominating the index value, or the desired balance may not be achieved.

Use tool 9.7 to obtain Sheep Genetics indexes and details of the emphasis placed on the various traits or go to the Sheep Genetics web site: http://www.sheepgenetics.org.au/InformationItem.aspx?ITEM=140.

Sire evaluation sites independently do progeny tests on industry sires. Progeny are evaluated for both measured and visually assessed traits and reported firstly at the site and then in a combined site report called 'Merino Superior Sires' http://www.merinosuperiorsires.com.au/. The ASBVs reported in Merino Superior Sires can be directly compared with MERINOSELECT ASBVs. Merino Superior Sires reports on rams from many flocks that are not currently clients of Sheep Genetics flocks. Because of its comprehensive list of traits and the additional sires included, Merino Superior Sires can be of value when considering rams to use in an artificial insemination program.

Combine breeding values with physical checking and visual assessment of traits such as breech cover that do not yet have an ASBV

Australian Sheep Breeding Values can help you compare the key traits of rams so you can readily calculate the value of better genetics

Comparing rams with different breeding values

By comparing the ASBVs of rams on offer for key traits, you can readily calculate the value of better genetics. Worked examples are included of how to estimate the value of superior genetics for fleece weight (tool 9.8) and growth rate (tool 9.9). These tools provide a simple calculation of the additional value a ram with higher breeding values can deliver. It is important to discount that additional value to some extent because the benefits can take some years to accrue.

Selecting rams without breeding values

Ram breeders without calculated breeding values may be able to provide some limited performance information. This information may be based on sire evaluations, Merino Superior Sires, bloodline comparisons, wether or ewe trials or long-term trends in average flock performance for production traits such as micron, fleece weight, body weight or weight and age of lamb turn-off. Long-term trends for these traits are best assessed as rolling 3–5 year averages to minimise the influence of seasonal fluctuations.

Bloodline comparisons, wether trials and ewe trials are useful when comparing whole bloodline performance rather than individual ram performance. The Merino bloodline performance report (http://www.dpi.nsw.gov.au/agriculture/merino-bloodline-performance) analyses 58 wether trial comparisons conducted in NSW, SA, WA, Tasmania, Victoria and Queensland from 1994 to 2012. This information is useful when seeking a new ram source or benchmarking a current source. Some participants in wether trials, ewe trials and on-farm bloodline comparisons also have ASBVs available on individual rams.

The 'Merinos to Match' project evaluated 29 Merino studs for wool and meat traits. The project evaluated teams of wethers at four sites across Victoria. The 2007 Merino bloodline performance results include the wether trial data. Merinos to Match can be accessed through www.dpi.vic.gov.au/; select 'agriculture and food', then 'animals and livestock', 'sheep and wool' and 'Merinos to Match'.

Searching for ram breeders using genetic evaluation

The Sheep Genetics website enables you to search for ram breeders using genetic evaluation. You can refine this search with criteria such as breed, state, region or postcode to find contact details of ram breeders using genetic evaluation in your area.

➜ To search for maternal and terminal breeders go to www.sheepgenetics.org.au and select LAMBPLAN, then 'search', breed of choice in 'ASBV enquiries' and 'member enquiry'

➜ To search for Merino breeders go to www.sheepgenetics.org.au, select MERINOSELECT, 'search', 'ASBV enquiries', and 'member enquiry'.

Searching for rams with genetic profiles

The Sheep Genetics website also allows you to search for rams with specified genetic profiles. You can refine this search with criteria such as 'minimum', 'maximum' or 'range' of ASBVs for specific traits, trait leaders or indexes. You can also specify details such as breed, state, region or postcode to refine your search for rams in your area.

➜ To search for maternal and terminal breed rams, go to www.sheepgenetics.org.au, select LAMBPLAN, then 'search', breed of choice in 'ASBV Enquiries' and enter your search criteria.

➜ To search for Merino flocks go to www.sheepgenetics.org.au, select MERINOSELECT, 'search', then 'ASBV enquiries' and enter your search criteria.

In the case of artificial insemination programs, Merino Superior Sires may also provide extra information to help refine decisions.

On-farm Fibre Measurement can enhance selection accuracy, and in turn, profitability

Selecting ewes and wethers

Generally, genetic information will not be available to select retained ewes and wethers.

Beyond the base level of traditional visual assessment for fleece characteristics and body conformation, there are opportunities to use on-farm fibre measurement (OFFM) to enhance selection accuracy and, in turn, profitability.

AWI and the Sheep CRC have developed an online tool called the OFFM Calculator (tool 9.10). You need basic information on your flock size and structure and average (adult) fibre diameter. The OFFM Calculator assesses the expected financial benefits of applying OFFM to wool enterprises, separated into clip preparation, breeding and selection.

Sheep producers with commercial Merino flocks can benefit from using OFFM and can obtain breeding values and index values for a group of ewes or wethers they wish to make selections on. Some fleece measurement laboratories provide this service, known as 'RAMPOWER".

The Sheep CRC has also developed simultaneous assortment (tool 9.11) to help determine those ewes best suited to 'wool' and 'meat' based mating groups. You need fibre diameter, fleece weight and body weight data on individually identified ewes to use this tool.

By comparing the ASBVs of rams on offer for key traits, you can readily calculate the value of better genetics ... a ram with higher breeding values can deliver

Signposts

View

Visual Assessment Scores: a guide containing a national set of standardised visual scores to consistently describe, record and class sheep for accelerated genetic gain. The guide focuses on conformation, wool quality and breech traits. Copies of the guide can be ordered via the AWI Helpline 1800 070 099.

For a range of ***sheep genetics information*** visit:
www.sheepgenetics.org.au

Attend

The MLA EDGE*network*® program is coordinated nationally and has a range of courses to assist sheep producers.

Contact can be made via:

- ➜ Phone: 1800 993 343
- ➜ Email: edgenetwork@mla.com.au
- ➜ Website: www.mla.com.au/edgenetwork

PROfarm is the training program developed by NSW DPI to meet the needs of farmers, primary industries, agribusiness and the community. NSW DPI PROfarm short courses are available by contacting:

- ➜ 1800 025 520 in northern NSW
- ➜ 1800 628 422 in southern NSW

The PROfarm course most relevant to this procedure is Lamb Assessment and Marketing. This is a course for lamb producers, livestock agents and buyers in assessing lambs and understanding markets and their specifications.

Website link not working?

Go to the Making More From Sheep website:

www.makingmorefromsheep.com.au

and follow the links to updated signposts

Tool 9.1
Sheep CRC wether calculator

Web contact:
http://www.sheepcrc.org.au/management/measuring-recording-and-decision-making/decision-making-software.php or http://www.sheepcrc.org.au/resources/software-wether-calculator.php?rt=1314927285

The wether calculator was developed to show the economic consequences of varying the proportion of wethers within flocks of varying fibre diameter over a range of meat values for surplus stock. A range of selection options are also available for consideration.

This calculator does not take into account some other important reasons for running wethers such as ease of management, worm control and land suitability. These considerations will need to be superimposed on the results from the calculator.

Users need to enter very simple base flock information and select a pricing (average or current) and selection option. The calculator provides a graph of predicted gross margins (five years after selection commences) over a range of wether proportions. This allows the optimal proportion of wethers to be estimated under those parameters.

The second section of the calculator allows you to specify a proportion of wethers within the flock, shows where the benefits and costs come from and calculates the gross margin/DSE.

This tool may be run on-line or downloaded and saved to your computer as a Microsoft Excel file.

Tool 9.2
Sheep CRC Merino versus terminal sire flock model

Web contact: http://www.sheepcrc.org.au/management/measuring-recording-and-decision-making/decision-making-software.php or http://www.sheepcrc.org.au/resources/software-merino-v-terminal-sire-flock-model.php?rt=1314927285

This tool is a model to assist sheep producers decide the appropriate number of ewes to allocate to self-replacing Merino joining and a first cross joining, with the aim of maintaining a sustainable, self-replacing flock.

After entering flock structure data (number of age classes, weaning percentages etc) and a figure for the proportion of ewes to be joined to terminal sires, choose the 'calculate' button and the service will indicate whether there will be a deficit or surplus of hogget ewes to maintain numbers in the self-replacing Merino flock.

Alternatively, a manager can indicate the production figures and then check the 'break even' checkbox and click 'calculate' to find out the number of ewes to allocate to each flock to break even, that is finding the maximum number of ewes to be joined to terminal sires, while just maintaining the self-replacing Merino flock.

This tool may be run on-line or downloaded and saved to your computer as a Microsoft Excel file.

Tool 9.3
Australian Sheep Breeding Value definitions

SHEEP GENETICS

mla MEAT & LIVESTOCK AUSTRALIA

awi Australian Wool Innovation Limited

Australian Sheep Breeding Value Definitions

LIVEWEIGHT TRAITS Weight (kg) WT

Estimates the genetic difference between animals in liveweight.

Birth:	BWT estimates the genetic difference between animals in liveweight at birth.
Weaning:	WWT estimates the genetic difference between animals in liveweight at 100 days of age.
Post Weaning:	PWT estimates the genetic difference between animals in liveweight at 225 days of age.
Yearling:	YWT estimates the genetic difference between animals in liveweight at 360 days of age.
Hogget	HWT estimates the genetic difference between animals in liveweight at 450 days of age.
Adult:	AWT estimates the genetic difference between animals in liveweight at 540 days of age.

Maternal Weaning Weight (kg) MWWT

MWWT ASBVs are an estimate of the ewe's potential for milk production and ability to provide a better maternal environment. They are expressed as kilograms of liveweight at 100 days of age (weaning).

CARCASE TRAITS Fat Depth (mm) FAT

Estimates the genetic difference between animals in fat depth at the GR site.

Post Weaning:	PFAT estimates the genetic difference in GR fat depth at 45kg liveweight
Yearling:	YFAT estimates the genetic difference in GR fat depth at 60kg liveweight.
Hogget:	HFAT estimates the genetic difference in GR fat depth at 70kg liveweight.

Eye Muscle Depth (mm) EMD

Estimates the genetic difference between animals in eye muscle depth at the C site.

Post Weaning:	PEMD estimates the genetic difference in EMD at the C site at 45kg liveweight.
Yearling:	YEMD estimates the genetic difference in EMD at the C site at 60kg liveweight.
Hogget:	HEMD estimates the genetic difference in EMD at the C site at 70kg liveweight.

REPRODUCTION TRAITS

Number of Lambs Born (%) NLB

Estimates the genetic difference between animals for number of lambs born at each lambing opportunity.

Number of Lambs Weaned (%) NLW

Estimates the genetic difference between animals for number of lambs weaned at each lambing opportunity.

Scrotal Circumference (cm) SC

Estimates the genetic difference between animals for scrotal circumference.

Post Weaning:	PSC estimates the genetic difference for scrotal circumference at 225 days of age.
Yearling:	YSC estimates the genetic difference for scrotal circumference at 360 days of age.
Hogget:	HSC estimates the genetic difference for scrotal circumference at 450 days of age.

WOOL TRAITS

Fleece Weight (%) FW

Estimates the genetic difference between animals for greasy (G) or clean (C) fleece weight.

Note: Both greasy and clean fleece weight are expressed in percentage terms.

Yearling:	YGFW or YCFW estimate the genetic difference in fleece weight at 360 days of age.
Hogget:	HGFW or HCFW estimate the genetic difference in fleece weight at 450 days of age.
Adult:	AGFW or ACFW estimates the genetic difference in fleece weight at 540 days of age.

Fibre Diameter (micron) FD

Estimates the genetic difference between animals for fibre diameter.

Yearling:	YFD estimates the genetic difference in fibre diameter at 360 days of age.
Hogget:	HFD estimates the genetic difference in fibre diameter at 450 days of age.
Adult:	AFD estimates the genetic difference in fibre diameter at 540 days of age.

Fibre Diameter Coefficient of Variation (%) FDCV

Estimates the genetic difference between animals for fibre diameter coefficient of variation.

Yearling:	YFDCV estimates the genetic difference in fibre diameter coefficient of variation at 360 days of age.
Hogget:	HFDCV estimates the genetic difference in fibre diameter coefficient of variation at 450 days of age.
Adult:	AFDCV estimates the genetic difference in fibre diameter coefficient of variation at 540 days of age.

Staple Strength (N/Kt) SS

Estimates the genetic difference between animals for staple strength.

Yearling:	YSS estimates the genetic difference in staple strength at 360 days of age.
Hogget:	HSS estimates the genetic difference in staple strength at 450 days of age.
Adult:	ASS estimates the genetic difference in staple strength at 540 days of age.

Staple Length (mm) SL

Estimates the genetic difference between animals for staple strength.

Yearling:	YSL estimates the genetic difference in staple strength at 360 days of age.
Hogget:	HSL estimates the genetic difference in staple strength at 450 days of age.
Adult:	ASL estimates the genetic difference in staple strength at 540 days of age.

Curvature (degrees per mm) CURV

Estimates the genetic difference between animals for staple length.

Yearling:	YCURV estimates the genetic difference in curvature at 360 days of age.
Hogget:	HCURV estimates the genetic difference in curvature at 450 days of age.
Adult:	ACURV estimates the genetic difference in curvature at 540 days of age.

WORM RESISTANCE

Worm Egg Count (%) WEC

The WEC ASBV describes the value of an animal's genes for carrying worm burdens - a combination of being genetically less likely to pick up worms and being able to cope immunologically with the worm burden. WEC ASBVs are expressed as a percentage relative to a count of 500 eggs per gram.

Weaning:	WWEC estimates the genetic difference in worm burden at 100 days of age.
Post Weaning:	PWEC estimates the genetic difference in worm burden at 225 days of age.
Yearling:	YWEC estimates the genetic difference in worm burden at 360 days of age.

Tool 9.4
Breeding values explained

The use of breeding values can greatly improve ram selection. All breeding values published by Sheep Genetics meet a minimum accuracy threshold before they are released to the ram breeder as shown in the Reporting Criteria diagram (next page). All breeding values reported by Sheep Genetics are based on data that is collected and reported using sound quality assurance procedures.

Two forms of breeding values are available.

1. Australian Sheep Breeding Values (ASBV)
ASBVs enable genetic comparison across:

- ➜ Flocks within the Merino and Poll Merino breeds;
- ➜ Flocks within the maternal and dual purpose breeds; and
- ➜ Flock and across breed for the terminal sire group of breeds.

ASBVs for Merinos are presented under the brand **MERINOSELECT**.

ASBVs for all other breeds are presented under the brand **LAMBPLAN**.

Use ASBVs as the basis for ram selection, combined with physical checking and visual assessment of those traits that do not yet have an ASBV (soundness, wool character, fleece rot, body wrinkle and breech bareness). Other approaches are included in this module.

2. Flock Breeding Values (FBV)
Across-flock comparison requires a ram breeding flock to have adequate genetic linkage to other flocks undergoing evaluation. Flocks with inadequate across-flock genetic linkages receive FBVs that only enable genetic comparison of sheep within the flock and at times only a comparison within a group, such as an age group of rams.

This means that if you buy rams from a supplier without ASBVs, the FBVs can help you select the most suitable rams from such a flock, but FBVs do not allow you to compare rams between flocks.

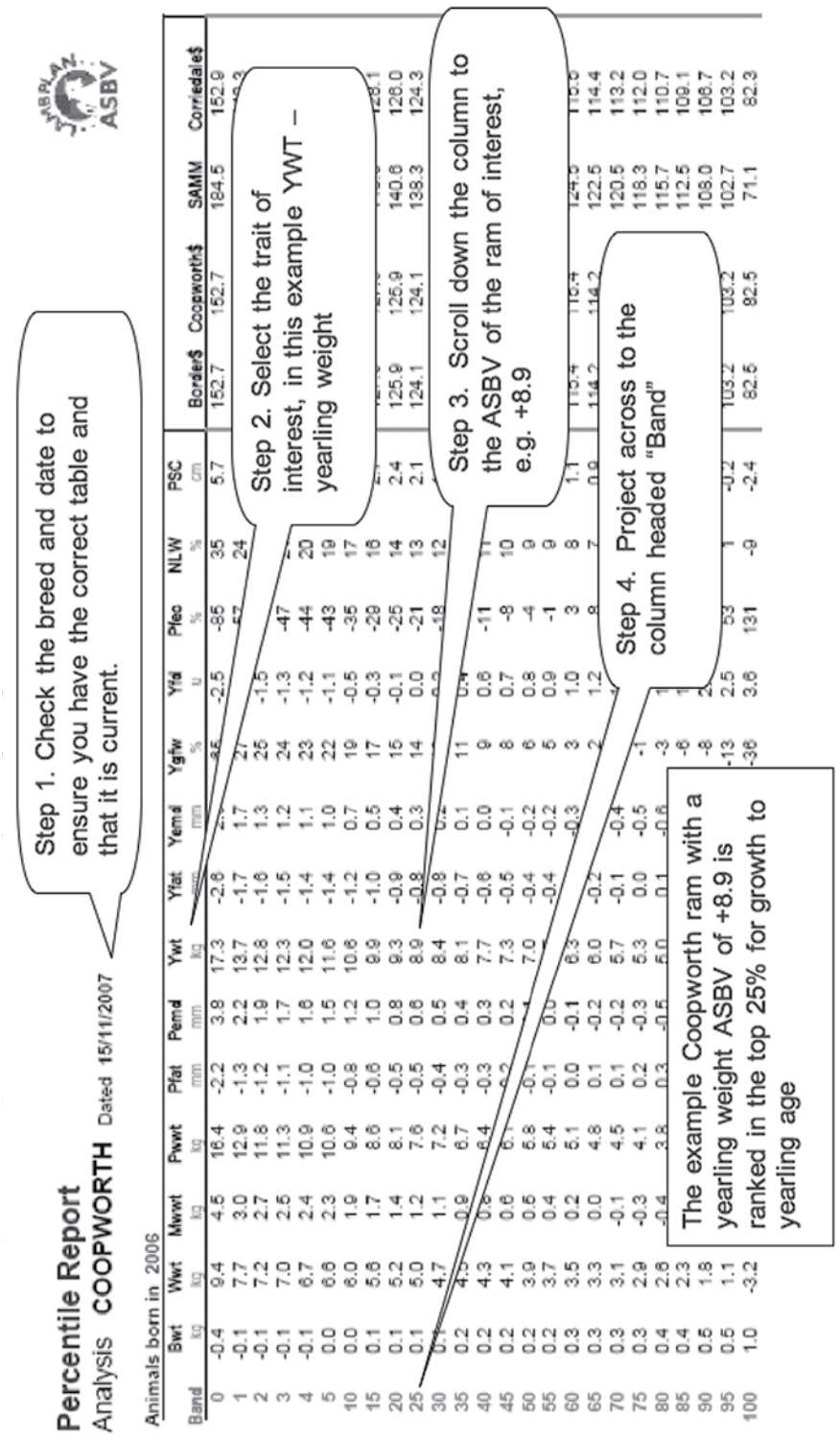
Reporting criteria for Sheep Genetics breeding values

ASBV or FBV?
It is relatively easy to clarify whether ASBVs or FBVs are being used, because ASBVs are always reported with an accuracy percentage and FBVs are not.

Tool 9.5

Using a percentile band table

Note this is an example only. Obtain a current percentile band table from your ram supplier or Sheep Genetics. Consider an example of a Coopworth ram that has a yearling weight ASBV +8.9.



Band	Bwt kg	Wwt kg	Mwwt kg	Pwwt kg	Pfat mm	Pemd mm	Ywt kg	Yfat mm	Yemd mm	Ygfw %	Yfat u	Pfec %	NLW %	PSC cm	Border$	Coopworth$	SAMM	Corriedale$
0	-0.4	9.4	4.5	16.4	-2.2	3.8	17.3	-2.8	2.1	-8	-2.5	-85	35	5.7	152.7	152.7	184.5	152.9
1	-0.1	7.7	3.0	12.9	-1.3	2.2	13.7	-1.7	1.7	2	-1.5	-57	24	3.7				133
2	-0.1	7.2	2.7	11.8	-1.2	1.9	12.8	-1.6	1.3	25	-1.5							
3	-0.1	7.0	2.5	11.3	-1.1	1.7	12.3	-1.5	1.2	24	-1.3	-47	21					128.1
4	-0.1	6.7	2.4	10.9	-1.0	1.6	12.0	-1.4	1.1	23	-1.2	-44	20	2.4	125.9	125.9	140.6	126.0
5	0.0	6.6	2.3	10.6	-1.0	1.5	11.6	-1.4	1.0	22	-1.1	-43	19	2.1	124.1	124.1	138.3	124.3
10	0.0	6.0	1.9	9.4	-0.8	1.2	10.6	-1.2	0.7	19	-0.5	-35	17					
15	0.1	5.6	1.7	8.6	-0.6	1.0	9.9	-1.0	0.5	17	-0.3	-29	16					
20	0.1	5.2	1.4	8.1	-0.5	0.8	9.3	-0.9	0.4	15	-0.1	-25	14	2.4	125.9	125.9	140.6	126.0
25	0.1	5.0	1.2	7.6	-0.5	0.6	8.9	-0.8	0.3	14	0.0	-21	13	2.1	124.1	124.1	138.3	124.3
30	0.1	4.7	1.1	7.2	-0.4	0.5	8.4	-0.8	0.2	11	0.4	-18	12					
35	0.2	4.5	0.9	6.7	-0.3	0.4	8.1	-0.7	0.1	11	0.4		11	1.1	115.4	115.4	124.5	115.6
40	0.2	4.3	0.8	6.4	-0.3	0.3	7.7	-0.6	0.0	9	0.6	-11	11	0.9	114.2	114.2	122.5	114.4
45	0.2	4.1	0.6	6.1	-0.2	0.2	7.3	-0.5	-0.1	8	0.7	-8	10				120.5	113.2
50	0.2	3.9	0.5	5.8	-0.1	0.1	7.0	-0.4	-0.2	6	0.8	-4	9				118.3	112.0
55	0.2	3.7	0.4	5.4	-0.1	0.0	6.8	-0.4	-0.2	5	0.9	-1	9				115.7	110.7
60	0.3	3.5	0.2	5.1	0.0	-0.1	6.3	-0.4	-0.3	3	1.0	3	8				112.5	109.1
65	0.3	3.3	0.0	4.8	0.1	-0.2	6.0	-0.2		2	1.2	8	7				108.0	108.7
70	0.3	3.1	-0.1	4.5	0.1	-0.2	5.7	-0.1	-0.4	-1		53	1	-0.2	103.2	103.2	102.7	103.2
75	0.3	2.9	-0.3	4.1	0.2	-0.3	5.3	0.0	-0.5	-3	1	131	-9	-2.4	82.5	82.5	71.1	82.3
80	0.4	2.6	-0.4	3.8	0.3	-0.5	5.0	0.1	-0.6	-6	2							
85	0.4	2.3								-8	2.5							
90	0.5	1.8								-13	3.1							
95	0.5	1.1								-36	3.6							
100	1.0	-3.2																

Tool 9.6

Understanding Sheep Genetics breeding values

Understanding MERINOSELECT ASBVs

Rams with a higher greasy fleece weight (GFWT) will produce progeny that cut more wool. A ram with an ASBV of 20% will produce progeny that cut 10% more wool than the progeny of a ram with an ASBV of 0.

Animals with lower fibre diameter coefficient of variation (FDCV) ASBVs will genetically have a lower variation in fibre diameter. A higher CV% is often associated with lower staple strength.

Animals with more positive staple strength (SS) ASBVs will, on average, have genetically stronger wool. This ram will, on average, sire progeny with 7.5 N/Kt stronger wool than an average sire.

Rams with a more positive ASBV for eye muscle depth (EMD) produce lambs that have a higher lean meat yield. A ram with an ASBV of 1.0 will breed lambs with 0.5mm more EMD than a ram with an ASBV of 0.

Worm egg count (WEC) ASBVs estimate an animal's genetic potential for worm burden. More negative FEC ASBVs are desirable. This ram will, on average, sire progeny that will have 10% fewer eggs/gram than a ram with an ASBV of 0.

WT (kg)	GFWT (%)	FD (µm)	FDCV (%)	SS (N/Kt)	SL (mm)	EMD (mm)	NLW (%)	WEC (%)	INDEX
4.0	20	-0.80	1.24	15	10	1.0	10	-20	138.6
65*	68	75	70	53	56	58	35	45	

Animals with a more positive ASBV for weight (WT) will produce lambs that grow faster and therefore reach target weights in a shorter period of time.

More negative fibre diameter (FD) ASBVs are generally desirable. A ram that has an ASBV of –0.8 will produce progeny that are genetically 0.4 microns finer than a ram with an ASBV of 0.

Animals with more positive staple length (SL) ASBVs will, on average, have greater genetic potential for longer fibre length. This ram will sire progeny that grow, on average, 5mm longer wool than progeny of a ram with a 0 ASBV for SL.

Rams with a more positive number of lambs weaned (NLW) ASBV will sire daughters that wean a higher percentage of lambs. A ram with an ASBV of 10 will sire daughters who on average will wean 5% more lambs than daughters of a ram with an ASBV of 0.

An index is a guide to the value of a ram for a particular market. Rams with higher indexes will produce sheep that are more suited to that particular breeding objective.

Note: A useful rule of thumb for converting ram ASBVs into sheep and wool production differences is to simply halve the ASBV (as rams contribute half the genetics of the lamb).

* Accuracy: published as a percentage, is a reflection of the amount of effective information that is available to calculate the ASBV. All ASBVs are now published with accuracies. The higher the percentage, the closer the ASBV is to the true breeding value of the animal. An ASBV of 0 is the average of the 1990 drop.

Breeding values without accuracies are Flock Breeding Values (FBVs) and can only be compared within flock.

Understanding LAMBPLAN ASBVs

Rams with lower ASBVs for birth weight (BWT) produce lambs with lower birth weight. Both low (lamb survival) and high (lambing difficulties) birth weights should be avoided.

Rams with more positive ASBVs for post weaning weight (PWWT) produce lambs that grow quicker and reach target weights in a shorter time. This ram will produce lambs that are, on average, 3kg heavier at post weaning age (7.5 months) than a ram with an ASBV of 0.

Worm egg count (WEC) ASBVs estimate an animals genetic potential for worm burden. More negative WEC ASBVs are desirable. This ram will, on average, sire progeny that will have 5% fewer eggs/gram than a ram with an ASBV of 0.

BWT (kg)	WWT (kg)	PWWT (kg)	PFAT (mm)	PEMD (mm)	WEC (%)	INDEX
0.3	4	6.0	-1.5	1.0	-10	
43*	63	71	59	69	37	170

Rams with a more positive ASBV for weaning weight (WWT) will, on average, produce lambs that grow quicker to weaning. This ram will produce lambs that are 2kg heavier than a ram with a 0 ASBV for WWT.

Rams with a more negative ASBV for fat will produce lambs that are leaner, at the same weight. This ram will produce lambs that are, on average, 0.75mm leaner at the GR site when compared to a ram with a FAT ASBV of 0.

Rams with more positive ASBVs for eye muscle depth (EMD) produce lambs that have more muscle, independent of weight, and a higher lean meat yield. This ram will produce lambs that have, on average, a 0.5mm deeper eye muscle than a ram with a 0 EMD ASBV.

An index is a guide to the value of a ram for a particular market. Rams with higher indexes will produce lambs that are more suited to that particular market target. It is important to understand what market the index applies to before using an index.

Note: A useful rule of thumb for converting ram ASBVs into lamb production differences is to simply halve the ASBV (as rams contribute half the genetics of the lamb).

* Accuracy, published as a percentage, is a reflection of the amount of effective information that is available to calculate the ASBV. All ASBVs are now published with accuracies. The higher the percentage, the closer the ASBV is to the true breeding value of the animal. An ASBV of 0 is the average of the 1990 drop.

Breeding values without accuracies are Flock Breeding Values (FBVs) and can only be compared within flock.

Understanding LAMBPLAN Maternal ASBVs

WWT (kg)	MWWT (kg)	PWWT (kg)	FAT (mm)	EMD (mm)	NLW (%)	GFWT (%)	SC (cm)	WEC (%)	INDEX
0.8	1.0	2.5	-0.4	0.4	4	5	0.6	-10	
51*	53	61	45	38	33	37	44	37	105.6

Weaning weight (WWT) ASBVs estimate the genetic difference between animals in liveweight at 100 days of age. This ram will produce lambs that are, on average, 0.4kg heavier than a ram with a 0 ASBV for WWT.

Rams with more positive ASBVs for post weaning weight (PWWT) produce lambs that grow quicker and reach target weights in a shorter time. This ram will produce lambs that are, on average, 1.25kg heavier than a ram with a 0 ASBV for PWWT.

Rams with more positive ASBVs for eye muscle depth (EMD) produce lambs that have a higher lean meat yield. This ram will produce lambs that have a 0.2mm deeper eye muscle than a ram with a 0 EMD ASBV.

Rams with a higher greasy fleece weight (GFWT) ASBV will produce progeny that cut more wool. This ram will produce progeny that, on average, cut 2.5% more wool than a ram with an ASBV of 0.

Worm egg count (WEC) ASBVs estimate an animals genetic potential for worm burden. More negative WEC ASBVs are desirable. This ram will, on average, sire progeny that will have 5% fewer eggs/gram than a ram with an ASBV of 0.

Rams with more positive ASBVs for maternal weaning weight (MWWT) will produce daughters which will wean heavier lambs. This ASBV reflects a combination of the daughter's ability to milk and provide a better maternal environment.

Rams with a more negative ASBV for fat produce lambs that are leaner, at the same weight. This ram will produce lambs that are 0.2mm leaner at the GR site when compared to a ram with a FAT ASBV of 0.

Rams with a more positive number of lambs weaned (NLW) ASBV will sire daughters that wean a higher percentage of lambs. This ram with an ASBV of 4 will sire daughters which, on average, will wean 2% more lambs.

Rams with higher scrotal circumference (SC) ASBVs will sire daughters that are, on average, more fertile.

An index is a guide to the value of a ram for a particular market. Rams with higher indexes will produce lambs that are more suited to that particular market target. In many cases the indexes used for maternal breeds are in $ terms.

Note: A useful rule of thumb for converting ram ASBVs into lamb production differences is to simply halve the ASBV (as rams contribute half the genetics of the lamb).

* Accuracy: published as a percentage, is a reflection of the amount of effective information that is available to calculate the ASBV. All ASBVs are now published with accuracies. The higher the percentage, the closer the ASBV is to the true breeding value of the animal. An ASBV of 0 is the average of the 1990 drop.

Breeding values without accuracies are Flock Breeding Values (FBVs) and can only be compared within flock.

Tool 9.7

Sheep Genetics indexes

1. MERINOSELECT standard indexes http://www.sheepgenetics.org.au/Document/140/MERINOSELECT%20Indexes.pdf

2. LAMBPLAN standard indexes http://www.sheepgenetics.org.au/lambplan/

To access the home page of Sheep Genetics and details of the LAMBPLAN and MERINOSELECT indexes visit the Sheep Genetics website: www.sheepgenetics.org.au and go to either the MERINOSELECT or LAMBPLAN sections.

Tool 9.8

Valuing genetic merit for fleece weight

This tool demonstrates a simple method of calculating the value of improved fleece weight to your business. Use fleece weight ASBVs to estimate the genetic improvement in fleece weight that can be achieved when choosing between two rams (remember it is half the difference between the ASBVs). Use the template to calculate for your flock.

$ from extra wool per fleece				**(Example)**		**Your flock**
Offspring increased fleece weight				0.3	kg clean	
Expected wool price				1000	Cents/kg clean	
Increase $ per fleece				$3.00	(0.3 x 1000)	
Offspring expected						
Ram mated at …….	2	%		50	ewes a year	
Lambing expected				90	%	
Years ram used				4	years	
Total offspring				180	(50 x 0.9 x 4)	
Wether offspring (½)				90		
Ewe offspring (½)				90		
Number of fleeces expected						
Times wethers shorn		1	=	90	fleeces	
Times ewes shorn		5	=	450	fleeces	
Total fleeces				540	fleeces	
Total return						
Increase $ per fleece				$3.00		
Number of fleeces				540	fleeces	
Increased $ return				$1,620	($3.00 x 540)	

Tool 9.9
Valuing genetic merit for growth rate

This tool demonstrates a simple method of calculating the value of improved growth rate. Use post weaning weight ASBVs to estimate the value that genetic improvement in growth rate can bring when choosing between two rams. Remember - the predicted progeny difference is half the difference between the ASBVs. Follow the steps to calculate the value to your flock.

	Post weaning weight ASBV
Ram A	11
Ram B	7
ASBV difference (11 – 7)	4 kg
Predicted progeny difference (4 / 2)	2 kg
The predicted weight difference between progeny of these rams at 7.5 months of age is 2 kg (half the difference between PWT ASBVs because lambs get half their genes from the sire).	
Predicted progeny live weight difference	2 kg
Predicted difference in carcase weight (CWt) assuming 46% dressing	
Predicted progeny CWt difference (2 x 0.46)	0.92 kg

Assume your rams are joined at 2% for 4 years producing 100% lambing.

50 ewes joined per year x 100% lambing x 4 joinings

50 x 1 (100%) x 4 = 200 lambs

Now multiply the number of lambs produced by the predicted difference in CWt (200 lambs x 0.92 kg CWt)

Total predicted gain in carcase weight (CWt) =184 kg

Average price received (¢/kg CWt) = 400¢/kg

Finally, multiply the average price received by the total predicted gain in CWt (3.00 x 184) to give the:

Value of total predicted gain in carcase weight = $736

Ram A will provide an additional 184 kg carcase weight if joined to 50 ewes with a conception rate of 100% for 4 years. Assuming an average price of $3.00/kg, Ram A will deliver an additional $565 in value compared to Ram B.

Tool 9.10
On-farm fibre measurement (OFFM) calculator

Web contact: http://www.sheepcrc.org.au/resources/software--offm-calculator.php

The OFFM calculator is available to sheep producers and wool brokers to assess the expected financial benefits of applying OFFM to wool enterprises, separated into clip preparation, breeding and selection.

This easy-to-use analysis tool provides an OFFM 'profit map' over time, as well as the impact of altering structure and breeding and selection criteria for individual sheep flocks.

Use the OFFM calculator to analyse your potential profits from improved selection and breeding.

Tool 9.11
Simultaneous assortment of sheep into joining flocks

Web contact: http://www.sheepcrc.org.au/resources/software-simultaneous-assortment.php

Simultaneous assortment was developed to allocate sheep into their most appropriate 'meat' or 'wool' groups according to individual information on the sheep, eg, fibre diameter (FD), body weight (BW) and/or fleece weight (FW).

Simultaneous assortment has three options for sorting sheep into wool, meat and/or cull groups.

- For the 'wool' selection option the sheep are ranked according to their fibre diameter. Those with the lowest FD are used for the wool flock, the highest FD are removed as culls and the remainder of the animals are used for the meat flock.
- The 'meat' selection option is calculated in a similar way. The sheep are ranked according to body weight. The heaviest are used as the meat flock, the lightest as culls and the remainder for the wool flock.
- The process for 'dual' selection is more complicated, but uses an index to allocate higher body weight sheep into the meat group and sheep with lower fibre diameter into the wool group. This selection option has two groups of potentially valuable animals, rather than a 'select' group and an alternative.

Users enter a list of RFIDs (electronic eartags) for the animals, with corresponding FD, BW and/or FW measurements. Then allocate the percentage of the flock to be removed as culls (if any) and allocate the percentages for the meat/wool flock split. The simultaneous assortment program will show a table giving the average FD, BW and FW for each flock. It also shows which animals would be selected into which flocks according to the three selection options.

This tool may be run on-line or downloaded and saved to your computer as a Microsoft Excel file.

Notes

Notes

For the most up-to-date Making More from Sheep information, including web signposts, products, publications and events, visit **www.makingmorefromsheep.com.au**

Australian Wool Innovation and Meat & Livestock Australia acknowledge the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Published by Australian Wool Innovation Limited (ABN 12 095 165 558) and Meat & Livestock Australia Limited (ABN 39 081 678 364)
June 2011

ISBN 9781741911817