Goat selection and breeding

GOAT SELECTION AND BREEDING

Module 5 – Goat selection and breeding

Introduction

In most livestock enterprises the majority of variable costs that are encountered by producers are based on per head of livestock. For example, costs such as drenching, vaccinating and transport.

Furthermore, fixed costs, such as interest and rates, also need to be proportioned over the number of animals being run. Therefore, it is critical to the success of the operation that every animal that is being managed is the most appropriate and productive animal available.

Inferior and non-productive goats require the same inputs as those that are more productive and therefore a key focus of your goat business should be selecting and breeding the most productive animals available.

Selection and breeding influences the genetic make-up of your herd, which, when done properly, drives the profitability in your goat enterprise. This can also influence the markets which may be available to you.

From a genetic perspective, how well you can meet the requirements of a particular market is primarily influenced by:

- The bucks you purchase
- The does you retain
- The does you purchase as replacements

Accurate selection of does will raise the average productivity of the herd, however buck selection is the main driver of ongoing genetic improvement in your herd. A doe during her breeding life will generally contribute 6–12 kids, whereas a buck contributes 60–100 kids per year.

Goat breeds

Deciding which breed, or crosses of breeds, you are going to produce is an important starting point for any goat enterprise.

All breeds have their strengths and weaknesses and are suited to different environments and markets. For more information on common breeds for meat, fibre and milk production visit the Goat Industry Council of Australia (GICA) website **www.gica.com.au**.

It is important to remember that there is as much variation within breeds of goats as there is between breeds that are all bred for the same purpose (eg meat production). So before you change breeds, first consider if you can improve the breed you already have through sourcing higher performing genetics, or cross breeding with another breed to provide the benefits of hybrid vigour. This can be particularly useful if you are targeting high growth rates.

Photo courtesy of Idealview Dairy, SA

Setting a breeding objective

The first step in improving the genetics of your herd through selection and breeding is setting a breeding objective.

A breeding objective describes the goats that you would like to breed that are appropriate for your production system and market.

Setting a breeding objective will help you determine which breed, or crosses of breeds, you are going to produce, identify your genetic priorities and plan the selection methods that will allow you to achieve these.

To set your breeding objective you must identify the key characteristics, or traits, that:

- Deliver meat and/or fibre products suited to your target market,
- Contribute the most to your profitability,
- Are heritable and have genetic variation across the herd, and
- Can continue to be improved within the limitations of your environment and production system.

Typical traits that goat producers are aiming for in their selection and breeding program include:

- Growth rate
- Conformation such as feet, udder and jaw
- Frame size
- Carcase and meat characteristics
- Fertility and fecundity
- Ease of kidding
- Mothering ability
- Temperament
- Fibre characteristics
- Milk production
- Physical characteristics such as skin colour

It is important to remember that the more traits you include in your breeding objective, the slower the rate of progress will be for each trait. Therefore, it is important to identify those traits that are most important in your business.

A breeding objective should be measureable and include a timeframe in which the improvements will be made. A common mistake producers make when setting a breeding objective is to have no measure of success. For example: big, white goats with red heads that produce heavy carcases and have multiple births.

A much more effective approach is to set a breeding objective that focuses on measureable gains within a set timeframe that will enable you to keep track of your progress and allow you to adjust your selection and breeding priorities as you progress. For example, an appropriate breeding objective for a meat goat producer may be:

Within 5 years:

- 90% of progeny will be turned off at greater than 16kg carcase weight by eight months of age,
- Adult does will average 180% weaning rates versus number of does joined,
- Less than 20% of progeny will be culled for conformational faults.

An important part of setting your breeding objective is to be able to quantify your herd's current productivity. This will not only allow you to identify areas for improvement but also any potential limitations that your environment or production system may have.

Finally, when setting your breeding objective, it is important to take a long term view of markets. Breeding and selection is a long and, at times, slow process, whereas markets can swing back and forth in the space of only a couple of generations or sooner. Whilst breeding objectives should be flexible and allow room for adjustment, they should not be dictated by short term market signals that may result in you attempting to breed and select for an animal that is either unsuited to your environment or your long term market.

Breeding and selection tools

When selecting bucks or does to purchase or retain, there are three main tools available to you to aid in your decision. They are:

- Visual selection
- Raw data
- Estimated breeding values

You should seek to use all three tools in combination depending on the traits that make up your breeding objective. This approach will be far more likely to lead to success in meeting your breeding objective than using one tool in isolation.

Visual Selection

Visual selection is quick, efficient and cost effective for a large number of traits. It can occur at various times throughout a goat's life and should be an ongoing process.

Visual selection is an important tool that needs to be utilised, particularly for traits that raw data or EBVs are not available for. Examples include confirmation traits, temperament and physical traits such as skin colour.

Whilst visual selection can be used for traits that can be measured, such as growth rates, it is important to remember that what a goat looks like is not necessarily what they will pass on through their genes to their progeny. This is due to phenotype of the goat (what they look like) being a result of combining the genes of the goat with the environment within which it has been bred and raised.

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

Environmental factors that play a significant role in the phenotype of the goat will include, their birth type (single or twin), the age of their dam (maiden or mature doe), the season the goat was born in and whether they have been supplementary fed.

Raw Data

For traits that can be measured, such as weight, the use of raw data can improve the accuracy of selection and breeding decisions in comparison to visual selection for these traits.

Whilst the eye can be deceiving and using actual raw data will remove any uncertainty or bias that visual selection can result in, it needs to be remembered that the raw data is a combination of the goat's gene and the environment it has been bred and raised in. Therefore, as with visual selection, using raw data in isolation will not necessarily result in the best genes being retained or purchased.

In many cases, however, raw data and visual selection may be the only tools available for you to base your selection decisions on. If this is the case, the following rules should be followed in order to minimise the environment effect that different goats may experience. They relate to both selecting bucks and does to be retained from your own herd and purchasing bucks and does from an outside herd.

- Goats that are to be selected from should have all run in the one group. If the numbers of goats are too large to run in one group, it is important to select from within the groups separately as paddock differences may need to be taken into account when selecting.
- Goats should be managed so they are given a good commercial opportunity to express their genetic potential. A group of well grown goats will exhibit greater variation and facilitate better selection decisions compared to a group that has been held back either through health problems or lack of nutrition.
- Depending on the goats being selected, factors such as birth type (single or twin), the age of their dam (maiden or mature doe), spread of kidding date and number of kids raised, all have a significant impact on what you see and the raw data that might be presented. The younger the goat, the greater the impact these factors can have. Coloured ear tags can be useful to assist in identifying these factors without having to have detailed records to look up for every goat.

Estimated Breeding Values

Estimated breeding values (EBVs) are a tool that allow you to more accurately make selection and breeding decisions on a range of commercially important traits.

EBVs take into account the known environmental influences that can influence a goat's visual or measured performance such as birth type (single, twin), age of dam and whether the goats have been run together or separately. Information from relatives and the heritability of each trait are also used to determine an EBV.

EBVs for the Australian goat industry are provided by KIDPLAN which is operated by Sheep Genetics. KIDPLAN works similarly to the LAMBPLAN program that operates for terminal and maternal ram breeders.

KIDPLAN currently provides EBVs for the following traits:

- Live weight (including birth weight)
- Fat depth
- Eye muscle depth
- Carcase weight
- Number of kids born
- Number of kids weaned
- Scrotal circumference
- Worm egg count

When using EBVs, it is important to remember that the likely contribution of a goat's genes to its progeny is half of the EBV, as the other half of the genes come from the other parent.

EBVs for individual traits can also be combined into an index. Indexes are based on common breeding objectives to provide a single figure that will allow you to quickly identify animals that may be suitable to your enterprise.

Examples of currently available indexes from KIDPLAN include:

Self Replacing Carcase Index

Places emphasis on growth, maternal milking ability, leanness, muscling and reproduction. This index is designed for breeders that are using Boer bucks to produce slaughter kids and retaining a proportion of daughters for further breeding purposes.

Carcase Plus Index

Places emphasis on growth and carcase traits using post weaning EBVs. This index is for commercial producers who are joining Boer bucks to does from other breeds and are slaughtering all progeny.

Finally, it is important that EBVs and indexes not be used in isolation and always be used in conjunction with visual selection and raw data for traits for which EBVs are not available.

A selection and breeding program that has a balanced approach to all three tools will lead to faster genetic gain in the herd and help ensure that you produce goats suitable to your target market.

Artificial Breeding

Whilst purchasing and/or retaining bucks and does and naturally joining those to produce the next generation is the most common way of breeding goats in Australia, genetic gain can be sped up through the process of artificial breeding.

Artificial insemination (AI) and embryo transfer (ET) are both techniques that have been used successfully in goats and can rapidly increase the rate of genetic gain in your herd by selecting and breeding from those goats with superior genetics in much greater numbers than would be possible through natural joining alone.

AI involves collecting semen from leading bucks and inseminating it into multiple does. This technique allows breeders to be very selective in choosing a buck with specific traits that will be assist them in meeting their breeding objective. Often, these leading bucks are highly valuable and not for sale. AI allows a wider range of breeder's access to superior genetics without having to physically own or purchase the buck.

ET involves the hormonal stimulation of a superior doe to increase ovulation rates. The eggs that result are artificially inseminated with semen from a superior buck and then harvested from the doe, before being transferred to a recipient doe which carries the embryo through pregnancy.

Whilst coming at a considerable cost, ET greatly increases the rate of reproduction from both the superior bucks and does, leading to significant increases in reproduction rate.

Due to the additional cost associated with both AI and ET, it is important to ensure only the most genetically superior goats are used in the program. The use of EBVs from well measured goats, combined with a thorough visual selection program would be seen as a minimum standard in selecting goats to be involved in an artificial breeding program.

Induction of goats into your environment

When purchasing goats to improve the genetics of your herd, it is important to remember that they may be coming from a significantly different environment to yours. A rapid change in environment like this can lead to stress in goats that could result in a reduction in breeding potential, or even death.

In order to avoid any stress, it is advisable to carry out an induction program for new goats that come onto your property from a different environment.

The aim of the induction program is to slowly introduce them to their new environment, whilst at the same time weaning them off the factors that they were accustomed to on the property they came from.

Below are some ideas worth considering.

- If goats have had some level of supplementary feeding and yours have not, you may need to supplementary feed the purchased goats on a similar but reducing ration to that which they are accustomed until they become adjusted to their new diet.
- If goats come from a hot, dry environment and yours is cold and wet, adequate shelter will be required until they become used to the new climate. The same is true in reverse. If goats come from a cold, wet environment into a hot and dry one, shelter and additional water may be required.
- Young goats may be better able to cope with the change in the environment and have a reduced need for induction. Whilst age should not be the limiting factor when purchasing goats to improve your genetics, if similar quality young goats are available versus old goats, you would be better off with the young goats. Young goats tend to be more adaptable and have a longer working life ahead of them.

Finally, if you are introducing performance bucks that have been bred in a seed stock operation into a rangeland environment to improve the overall genetic base of the herd, some level of control over the local rangeland buck population will be necessary in order for the introduced bucks to compete and sire kids.

MEAT & LIVESTOCK AUSTRALIA

TOOLKIT 5

Toolkit 5 – Goat selection and breeding

Case Study

Tool 5.1
KIDPLAN Estimated Breeding Values Definitions

KIDPLAN EBVs include traits for:

- Liveweight
- Carcase
- Reproduction
- Worm resistance

Liveweight traits

Weight (kg) WT

Estimates the genetic difference between goats in liveweight.

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

Maternal weaning weight (kg) MWWT

Estimates the doe's potential for milk production and ability to provide a productive maternal environment. This EBV is expressed as the weight of the kids at weaning (kg).

Carcase traits

Fat depth (mm) FAT

Estimates the genetic difference between goats in fat depth at the GR site. The GR site is on the second last long rib (12th rib) at a point 110 mm from the midline (ridge of the spine).

Post weaning	PFAT estimates the genetic difference between goats in GR fat depth at 225 days of age.
Yearling	YFAT estimates the genetic difference between goats in GR fat depth at 360 days of age.
Hogget	HFAT estimates the genetic difference between goats in GR fat depth at 450 days of age.

Eye muscle depth (mm) EMD

Estimates the genetic difference between goats in eye muscle depth at the C site. The C site is the top of the backbone in the long rib and short loin areas.

Post weaning	PEMD estimates the genetic difference between goats in eye muscle depth at 225 days of age.
Yearling	YEMD estimates the genetic difference between goats in eye muscle depth at 360 days of age.
Hogget	HEMD estimates the genetic difference between goats in eye muscle depth at 450 days of age.

Reproduction traits

Number of kids born (%) NLB

Estimates the genetic difference between goats for number of kids born at each kidding opportunity.

Number of kids weaned (%) NLW

Estimates the genetic difference between goats for number of kids weaned at each kidding opportunity.

Scrotal circumference (cm) SC

Estimates the genetic difference between goats for scrotal circumference.

Worm resistance traits

Worm Egg Count (%) WEC

Estimates the genetic difference between a goat's likelihood of being affected by worms. WEC is expressed as a percentage relative to a count of 500 eggs per gram.

Tool 5.2
How to use KIDPLAN Results

Below is an example of results that can be found on the KIDPLAN page of the Sheep Genetics website along with an explanation of what some of the key terms and measurements mean. Regardless of which trait or index, the same process is used to compare goats.

Animal ID	BWT	WWT	PWT	PFAT	PEMD	PWEC	PSC	NKW	MWWT	Index
Apple Hills – 110112	0.33 *85*	0.3 *87*	0.5 *88*	0.1 *82*	0.3 *81*	-6 *42*	-0.6 *85*	-1 *32*	2.6 *65*	103 *60*
Bonville – 100306	-0.10 68	-0.02 70	-0.01 71	-0.4 78	-0.9 76	32 56	0.0 83	2 24	2.0 30	87 44

Weight (kg) WT

Apple Hills – 110112 has an EBV of 0.3kg for WWT.

Bonville – 100306 has an EBV of -0.02kg for WWT.

Therefore the difference in WWT between the two goats is **0.32kg**.

Half the goat's genes are passed to the progeny, therefore the difference between the progeny for WWT is estimated to be:

0.32/2 = 0.16kg

Apple Hills – 110112's progeny will be **0.16kg** heavier than **Bonville – 100306's** progeny at weaning.

Worm Egg Count (%) WEC

Apple Hills – 110112 has an EBV of -6% for PWEC.

Bonville – 100306 has an EBV of 32% for PWEC.

Therefore the difference in WWT between the two goats is **38%**.

Half the goat's genes are passed to the progeny, therefore the difference between the progeny for WWEC is estimated to be:

38/2 = 19%

Apple Hills – 110112's progeny will have a **19%** lower worm burden than **Bonville – 100306's** progeny at post weaning.

Indexes

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

Key

BWT: Birth Weight	**PFAT:** Post Weaning Fat	**PSC:** Post Weaning Scrotal Circumference
WWT: Weaning Weight	**PEMD:** Post Weaning Eye Muscle Depth	**NKW:** Number of Kids Weaned
PWT: Post Weaning Weight	**PWEC:** Post Weaning Worm Egg Count	**MWWT:** Maternal Weaning Weight

Case Study

BREEDING MEAT GOATS FOR MEAT PRODUCERS

NAME:	Colin and Rob Ramsay
PROPERTY NAME:	Dudauman Park
PROPERTY LOCATION:	Cootamundra, South West Slopes, NSW
PROPERTY SIZE:	1,000ha mixed farming + 600ha leased
NUMBER OF GOATS:	500 goats turned off per year (average)
MAIN GOAT ENTERPRISE:	Breeding
TARGET MARKET:	Commercial buck buyers. Domestic and export goat breeder and meat markets
OTHER ENTERPRISES:	Prime lamb production, cash crops

Colin Ramsay, together with his son Rob, have been in the goat industry long enough to see the best and the worst of what it has to offer – from the excitement of the introduction of a new breed, the Boer goat, and all the potential that came with the opportunity, to seeing that potential eroded through poor application of genetics and selection.

In Colin's opinion, "The Boer goat could have offered rangeland and wheat-sheep zone production systems the increase in profitability now being delivered by the Dorper sheep. Instead, poorly bred and selected animals were sent into the environment causing serious damage to many of the producers involved as well as the reputation of the Boer goat." But all is not lost.

Colin and Rob have set out on a path which they believe can redefine the role Boer goats can play in the Australian commercial goatmeat industry and complement the tremendous resources available in the rangeland goat and the businesses established to utilise this resource.

Making amends

The Ramsays run a commercial stud which is motivated by the objective of producing meat goats for meat producers. The breeding objective is to combine the best genetics available to deliver high performance animals with a conformation that will deliver good results in the commercial production environment, particularly when introduced to the rangelands to breed an improved rangeland product.

Colin is confident that the Boer goat can deliver spectacular results for rangeland goatmeat producers through delivering higher growth rates and heavier carcases – in other words, more kilograms of saleable meat per hectare. Unfortunately, when Boer goats were first promoted and introduced en mass to the rangelands in the late 1990s, the genetics and management were often inappropriate resulting in poor survival and production. Competition with feral bucks and acclimatisation were (and remain) particular problems.

A few producers persisted with the breed in the rangelands and invested time and money in identifying and breeding well suited animals. They are now seeing the returns, but many producers were discouraged and as Colin relates, "The industry now has a long road ahead of it to rebuild the Boer goat's reputation in the rangelands and among commercial producers."

The best of both worlds

Colin and Rob are fully aware of the merits and unique suitability of rangeland goats to Australian conditions and have worked for years to incorporate those characteristics into their breeding program. At start up in

Bucks at Dudauman Park.

1999, their herd was based on 3,000 rangeland does with another major introduction of similar does in 2006. About two thirds of the breeders in the herd are now Australian Boers, otherwise known as purebreds, which have been 'crossed up' from the rangeland doe base. Some experimentation continues with Kalahari Reds.

The remaining one third of the herd are full-blood Boers, traceable to their South African roots. All the does are run and assessed together and Colin comments that at this stage, the purebred Australian Boers are substantially out-performing the full-blood Boers on most criteria.

The opportunity

Colin sees two specific broad scale commercial opportunities for Boer goats.

The first is in infusing Boer genetics into rangeland goats to turn off a heavier, meatier carcase and therefore more kilograms of saleable meat per hectare in the rangelands. This can be achieved by introducing well bred, heavily selected Boer goat bucks to be joined to rangeland does in a semi-controlled (fenced) rangeland production environment. The Ramsays currently supply bucks for such enterprises.

The other opportunity which is yet to be realised involves large scale farmed goat enterprises in mixed farming operations in the wheat-sheep and marginal cropping zones. While these would still supply the commodity meat market, Colin thinks these enterprises will probably use animals with a higher Boer content, run at minimal cost and contributing to weed control.

The key to both opportunities is retaining a commercial focus, acknowledging the reality of trading goatmeat as a commodity and applying similar selection expectations to those which producers have become accustomed to within the cattle and sheep industries.

Selecting for profit

Everything the Ramsays produce is destined for a market but only a relatively small proportion of the progeny become breeders. Classing begins on the marking table where males demonstrating undesirable traits, such as poor mouths, bad teats or twisted testes, are wethered and destined for the domestic meat markets. Doe kids are also classed at marking with those classed out being run with the wethers to be sold for slaughter.

Visual selection continues as the goats mature with roughly 40% of male progeny ultimately making the grade and being offered for sale to commercial meat producers. This process ensures that only animals capable of performing in a commercial production environment are offered to clients.

The next step for the industry as the Ramsays see it is to marry this visual selection with objective genetic selection through KIDPLAN. Following in the tremendously successful steps of the LAMBPLAN program, KIDPLAN provides simple and practical information on the value of an animal's genetic merit for production in the form of estimated breeding values (EBVs). KIDPLAN allows producers to objectively benchmark the performance of their animals to make more informed selection and breeding decisions.

The Ramsays are now in the fifth year of KIDPLAN recording and selection and are already seeing substantial improvements in the herd.

KIDPLAN is currently experiencing a resurgence, notably through the Boer Select Breeders' Group, and is being enhanced through nine buck trial Producer Demonstration Sites including the Ramsay's property.

The future

Colin is quick to acknowledge the merits and potential of the rangeland goat and the commercial approach by rangeland producers which has contributed to the development of an industry worth well in excess of $100 million annually. What is really exciting is the opportunity to take this to the next level through selection and the introduction of commercially focused Boer genetics to produce more kilograms of meat per hectare.

Does in the paddock at Dudauman Park.