2009 Kellogg Rural Leaders Program

What will influence the future direction of New Zealand sheep genetics?

By Hamish Craw

EXECUTIVE SUMMARY

The New Zealand sheep breeding industry in the next ten years is likely to be more focused on breeding for traits that meet market requirements rather than breeding for on farm production.

This is being driven by meat companies starting to pay on the meat value of the carcass.

With the assistance of breeding tools such as Gene Markers that are currently available in the market place and SNP (single nucleotide polymorphism) technology being likely introduced in late 2009 the New Zealand sheep breeders are well placed to meet market requirements in the future

The New Zealand sheep breeding industry has come forward in leaps and bounds over the last 30 years from a base of registered breeders to today where the majority of breeders are using performance recording (Sheep Improvement Limited) to achieve faster genetic gains.

It is likely there will be consolidation within the ram breeding industry as individual breeders retire, have reduced customer demand, lack the scale to uptake new genetic tools and have limited genetic selection pressure. It is unlikely it will get to the extreme of the dairy industry in the near future due to the range in climate and typography of New Zealand sheep and beef farms and farmers individualism.

It is going to be important that commercial farmers make sure their ram breeder is using these technologies to ensure they receive the financial benefits that are going to be available from meat companies. This will mean meat companies will be able to meet market requirements to ensure the sheep industry remains a competitive meat industry.

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INTRODUCTION

New Zealand sheep genetics has had a history of focusing on producing maximum production to achieve profitability. This has resulted in product being delivered to the market not always meeting and taking advantage of market requirements. Meat companies are starting to reward producers for supplying product that can be processed to meet customer expectations and deliver higher returns.

The objectives of this report

1. Understand the history of sheep industry.
2. Find out the about the genetic tools currently available to ram breeders and ram purchasers.
3. Explore the genetics tools becoming available in the future.
4. Investigate the technologies being adopted by meat companies to analyze animal composition.
5. Understand how commercial businesses are aligning breeding with markets.
6. Canvas opinions of industry leaders of their attitudes towards the direction of NZ sheep genetics.

This report has been prepared in a way that gives a brief overview of what will influence the future direction of New Zealand sheep genetics with information gathered through rural publications, ram breeders, representatives from meat companies, SIL and industry field days. The focus has been mostly on the meat component but some information incorporates wool.

BRIEF HISTORY OF SHEEP INDUSTRY

One of the first sheep breeds to be imported into New Zealand was the Romney in the 1870's. The first registered Romney sheep were imported into New Zealand in 1880 and the New Zealand Romney Sheep Breeders' Association was founded in 1904. Romney today makes up 39% of the national flock.

One of the first Romney's to be imported into New Zealand

Large numbers of small scale registered breed groups have dominated the breeding industry, breeding on type, with the show ring being the measure of their success.

In the 1970's performance recording started to be used by groups of ram breeders. These performance breed rams found favor with commercial farmers in areas like the Wairarapa. In more conservative areas like Canterbury and Southland they weren't used widely until the mid 1990's. Cross-breeding also found favor in the 1990's with Jock Alison introducing the East Friesen for its fecundity and high growth rate and the Finished Landrace also being introduced to increase lambing percentages. This has meant over time registered breeders have lost most of their market share.

Ever since S.S. Dunedin first set sail from Port Chalmers to London over 125 years ago farmers have been focused on making on farm production gains, because of payments being made on the Y P F grading system, or lambs being purchased on a dollars per kilogram basis which has meant in general the more kilograms produced the more profit made. This is all about to change with yield grading coming in, and the technology to help breed towards yield grading.

GENETIC TOOLS

A number of breeding tools have been developed by Meat and Wool NZ and industry groups to help ram breeders select genetically superior animals and to increase genetic gains being achieved by the sheep industry. These tools have also aided ram purchasers decisions as to the ram breeders he chooses and in selecting individual rams.

CENTRAL PROGENY TEST

In 2002, the Alliance Central Progeny Test (CPT) was established. Lambs are assessed for growth rate and carcass merit, making use of Alliance's VIAscan technology for carcass assessment.

Background

Progeny tests are used to 'prove' the genetics of a ram by comparing how his progeny perform relative to progeny from other rams under the same conditions. Rams can be compared across multiple flocks through use of rams common across sites (often called reference sires) that create genetic connections between flocks.

Objectives

- Identify sources of high performing rams by extending and strengthening comparisons across flocks and breeding groups.
- Develop genetic parameters for, and industry understanding of, novel traits.
- Foster links between ram breeding groups.
- Provide a genetic resource for add-on projects of value to meat and wool farmers and allied industries.

ULTRASOUND SCANNING

Measures width and depth of the loin at the 12^{th} rib, the device is portable and relatively inexpensive and therefore economic to measure all animals in the flock. It is a moderately accurate predictor of weight of muscle and fat in the carcass. Breeding values are available through SIL'MEAT' module.

CT SCANNING

Measures weight of muscle and fat in the whole carcass and in the hind leg, loin and shoulder cuts. A relatively expensive device which is not portable and there is only a limited number in New Zealand.

However it is very accurate predictor of meat yield. It is only economic to CT scan a subset of ram lambs after first screening with ultrasound. Breeding values are available through SIL 'CT MEAT' and 'INNERVALUE' modules.

VIASCAN YIELD MEASUREMENT

Uses muscle weight in the hind leg, loin and shoulder cuts from VIAScan system. Routine meat plant measurements are used and animals have to be slaughter to collect data. Progeny test design, so it takes time to get results. Breeding values from the SIL 'MEAT YIELD' modules.

SIL – SHEEP IMPROVEMENT LIMITIED

Sheep Improvement Limited is the world's biggest database for sheep. SIL has been operating for over 10 years; it is a division of Meat & Wool New Zealand and provides state of the art genetic information to ram breeders. It is an across-flock evaluation and has access to the services of New Zealand's leading geneticists and genetic specialists who are continually working on the genetic parameters to further improve the quality of the New Zealand flock.

750 active flocks

500 active breeders

10 million animals on database

SIL-ACE

SIL-ACE is a large across-flock, across breed genetic evaluation for NZ sheep. Over 3 million sheep from more than 330 flocks are in the analysis. Good connections are required for fair comparison of animals on the genetic merit. SIL only reports on sires from genetically connected flocks.

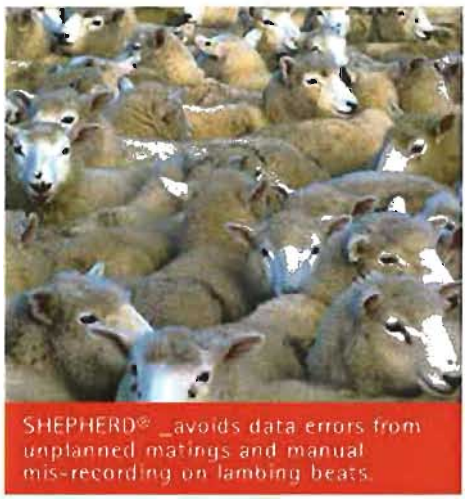
CURRENT GENE MARKERS

Sheep DNA gene and marker tests available

DNA gene and marker tests have been available for several years. The gene is either present (gene test), highly likely to be present (gene marker test) or absent in a tested individual. The DNA gene and marker tests currently available on the market are:

Shepherd

DNA based parentage system which not only determines pedigrees but also breeding value and selection indices.



Shepherd uses DNA to generate pedigree and family information. Traditional parentage recording is not required at mating or lambing. Instead, a Pfizer Animal Genetics DNA sample is needed from each sire, dam and lamb along with ewe scanning data, and mob records. Pfizer Animal Genetics DNA profiling and analytical software generates the family information and interfaces with breeding value software to produce breeding values and genetic indexes.

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MyoMAX

MyoMAX is a DNA test for a gene which increases a lamb's carcass weight and muscle yield.

The DNA marker test identifies animals carrying a gene that increases muscling on the leg and rump by at least 5% and decreases carcass fat by at least 7%.

From left: First lamb carries no copies of MyoMAX and the second lamb has two copies. Both lambs were produced from the same sheep flock run under exactly the same conditions and slaughtered on the same day.

The MyoMAX gene is naturally only found in Texels.

LoinMAX

LoinMAX is a DNA test for a gene which increases the size of the loin muscle in sheep.

Sheep identified with the LoinMAX effect have 10% more muscle in the loin compared to non-LoinMAX animals of the same genetic background.

The loin muscle is the source of the highest value cuts of lamb and is a key driver of carcass value. Poll Dorset sheep are the only breed with the LoinMAX gene occurring naturally.

Above: Loin cut

Above: Poll Dorset rams

i-SCAN

DNA marker test that identifies animals carrying the deleterious microphthalmia gene which can cause blindness in lambs.

Microphthalmia is a recessive gene disorder that causes a developmental malformation in the eyes of affected lambs. Typically such animals are entirely blind, although some retain the ability to detect movement.

Microphthalmia occurs when a lamb inherits, from both parents, damaged copies of a gene needed for eye development. An animal which inherits a damaged gene from only one parent is termed a 'carrier'. Carrier animals have normal, functional eyes because they also carry a copy of the normal, functional gene. If an animal inherits two copies of the damaged gene, it will be born with the eye disorder. When blind progeny are observed, there are likely to be multiple carriers in the flock and DNA testing may be required to remove the condition from the flock.

The eye of a microphthalmia affected sheep

Inverdale

Gene test that identifies animals carrying an increased fertility gene that can increase pregnancy scanning rates by as much as 40%. The Inverdale gene is naturally occurring and increase in fertility can be controlled through feed management.

WormSTAR

Identifies animals that shed fewer eggs onto pasture and grow well in the presence of parasite challenge. An environmentally sustainable genetic solution that draws on the sheep's natural ability to counter parasites.

Footrot gene-marker

The Foot rot gene-marker in sheep will help farmers get to the stage where there is a very low incidence of foot rot in the flock. The sheep will need less treatment so the need for vaccines, antibiotics and constant use of zinc sulphate or Formalin is reduced or eliminated.

The heritability of foot rot is quite high (about 0.3-0.4 where 1 is totally heritable). Farmers using rams selected for resistance to foot rot should notice a major improvement from the birth of their first lamb crop. Over a period of up to 5 years, the entire flock could include at least first cross foot rot-resistant ewes. It is possible that resistance to foot rot will be included as a genetic trait in the Sheep Improvement Ltd (SIL) genetic database. This means breeders can incorporate the trait into their overall selection criteria. At this stage there seems to be no negative spin-off between foot rot resistance and production traits.

Cold Tolerance gene-marker

Sheep gene that influences heat generation in response to cold stress, farmers can now access this technology to improve lamb survival rates.

The testing procedure involves sending sheep blood samples to the Lincoln University Gene-Marker Test Laboratory where animals receive a tolerance grade of A, B or C. A is the most desirable grade and C the least. This coding system promotes a conservative approach to selecting for cold-tolerance by focusing on removing sheep with "bad" cold tolerance genetics rather than selecting for sheep with "good" tolerance.

BREEDING TOOLS BECOMING AVAILABLE IN THE FUTURE

ESEARCH FOR SIL-ACE

SIL is developing eSearch, an internet based tool to search for sheep genetics that meet particular specifications. This breeding tool is due to be release for industry use in 2010.

Features of eSearch

- User defines merit criteria
- Can select for
  - "more" of some traits
  -"less" of some traits
  - "window" for other traits

For example: look for high index animals, with weaning weight breeding value> 2kg, number of lambs born breeding value between 0.15 and 0.25, in a particular breed.

Results are depicted graphically for individual animals as percentile bands, as well as in table form. Visual depiction of the data allows rapid comparison of animals and easy to pick up.

SNP (single nucleotide polymorphism) Technology

The whole DNA of an individual animal is broken into many small fragments each of which can be identified, by a SNP test on a glass slid.

Each fragment contains a number of genes. Test populations with a lot of performance measurements are used to see which fragments are regularly associated with a particular trait, and how they influence performance for that trait. To find the associations between DNA fragments (snips) and traits, a large amount of performance data (about 2000-4000 animals with many traits measured) is required. We are likely to see SNP chip products produced where there are many "genes" per trait, overcoming the disadvantage of current gene tests which only show one gene which is only part of the genetic variation of the trait.

It is envisaged that when the SNP-based breeding values are available they will be combined with SIL BVs, based on the accuracy of each component.

SNP technology has the potential to significantly increase the rate of genetic gain in the sheep industry. Benefits will come from increased accuracy of early selection decisions and adding new traits to the selection process.

TECHNOLOGY BEING ADOPTED BY NZ MEAT COMPANIES

ALLIANCE

Yield Quality Contract

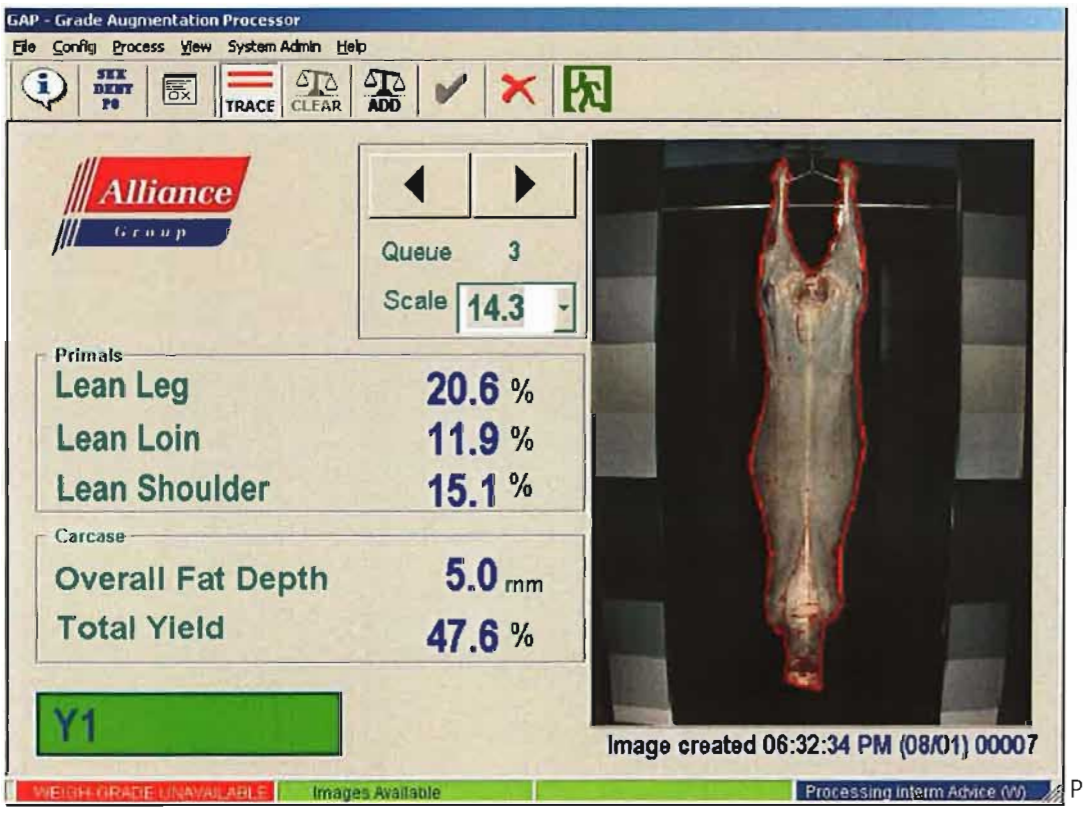
Alliance Group believes that improved market returns come from quality product, professionally marketed meeting customer expectations. This has been the basis for establishment of the Yield Quality Contract.

Objective information about market requirements and the science to allow suppliers to achieve those requirements are the key components. The company has progressively tackled these two issues.

The Yield Grade Contract this season has on average returned shareholders an extra $4 a lamb.

VIAscan Yield Grading

VIAscan takes an image of the whole carcass and uses complex algorithms to compare the shape and colour profile of the carcass with a very large database of boning trail results. It divides the carcass into three primal areas – leg, middle and shoulder – and reports a meat yield result for each. Alliance Group has identified an ideal market weight range and yield for each area of the carcass. Kill sheets provide a profile showing how each mob performs against ideal market requirements.



Central Progeny Trials (CPT)

Alliance Group wanted to ensure suppliers had access to objective genetic information. Genetic selection is a critical component to consist achievement of market requirements. Alliance Group does not believe there is a perfect breed. Rather different breeds and traits within breeds need to be matched to each supplier's situation. The critical aspect for Alliance Group is that its suppliers have access to good, objective scientific data to assist decision-making.

SILVERFERN FARMS

X-ray and robotic cutting technology has been developed by Silver Fern Farms as they chase full traceability from the farm to the consumers. The X-ray system named Market Value Traceability System (MVTS) provides 3D imagery on the carcass confirmation and weight ratio for the three primal cuts; hind legs middle and shoulders.

Further development of the technology will mean the system will also be able to calculate the meat, fat and bone ratios for each lamb before it is processed. Performance premiums will then be paid on this information.

COMMERCIAL BUSINESSES ALIGNING BREEDING WITH MARKET REQUIREMENTS

HEADWATERS

Headwaters are a breeding/marketing company 50 percent owned by farmers and 50 percent owned by Andy Ramsden. Headwaters will breed its own ¼ Finn, ¼ Texel, ¼ Romney and ¼ Perendale genetics from a small nucleus flock, highly recorded and DNA tested which will supply rams to Minaret Station which will act as a multiplier flock. These genetics will be selected to meet specific market requirements for meat and wool characteristics, while maintaining the attributes that make them thrive in the environment in which they are breed in. The product will be marketed under the Headwaters brand, designed to show the consumer the origin the product was produced, the clean green environment in which it is produced and being fully traceable. It is hoping to bring increased returns back to its shareholders and other associated benefits.

RISSINGTON BREEDLINE

Rissington Breedline is a global sheep & cattle breeding company breeding animals to meet market requirements. Rissington is trying to brand their product all the way through to the consumer with a story based around it to try and achieve higher returns for their ram purchasers. To date they have been supplying lamb to Marks and Spencer in the United Kingdom. The marketing arm of Rissington has recently been sold to Silver Fern Farms.

FARMPURE

In parts of Japan a house wife can scan a steak pack with her cell phone and find out the meat's origin. In Europe premium meat packaging carries a photo of the farm of origin, complete with smiling farmer and happy looking stock. The international market now demands a fully traceable product, and our local market is fast following suit.

The Te Mania brand has been available at selected North Island Woolworths, Foodtown and Countdown supermarkets for a year. The supermarkets guarantee Te Mania Certified Premium Angus is a premium beef product providing a superior eating experience to local consumers. It is hormone free, grass fed product of consistently high quality. Benefitting both consumers and producers, the certification represents a unique development in the local supply chain – a product with full traceability from the farm gate to the plate.

The brand satisfies consumers demand for a fully traceable product – one which is healthy, natural and grown humanely, and also offers a chance for farmers to capitalize on the substantial rewards for meeting that consumer demand. The program provides an opportunity for Progressive Enterprises (PEL) to secure guaranteed supply of high quality, traceable product from high achieving local producers.

Vital to the brands success has been its consistent presence on supermarket shelves – a secure supply chain guarantees the consumer can rely on a product which is always superior in quality and availability.

RM Williams

RM Williams has partnered with Sydney-based Primary Holding International to create a vertically integrated pastoral company.

It will be known as RM Williams Agriculture Holdings and will produce a range of branded beef, organic chicken, lamb and grain.

OPINIONS OF INDUSTRY LEADERS OF THEIR ATTITUDES TOWARDS THE DIRECTION OF NZ SHEEP GENETICS

The following questions were put to ram breeders Derek Daniels (Wairere) and Keith Wilson (Kelso) and below is a summary of their responses

Q. Do you think genetic providers will produce genetics more to meet the market place requirements (on *farm productivity linked to customer needs/wants) in the future. Why or why not?*

Both agreed that it was imperative that genetics were focused to meet market requirements to ensure they want to stay in business. With more Keith believing more emphasis will be put on traits like MyoMax and Tenderness traits for the market place.

Q. Will more rams breeders try and align (brand) their business in the market place (consumer end) e.g. Risslington, Headwaters?

Two different responses were received; Derek believed this is not easily done, because processor/marketers struggle to make a sufficient profit to allow room for another party, so the other party has to have a convincing story, and one that the processor cannot easily pinch. It is expensive to run such a program as we have seen Risslington being bought out by external parties.

Keith said that Kelso is going to be paying an 8 cent premium for Kelso Ranger sired lambs this season. With the aim of taking the story of their Ranger breed to the market place in the future.

Q. Brief view as to where you see the industry in five to ten year's time. e.g. Independent ram breeders verse group breeding schemes. Technology adoption etc

Derek: Group breeding schemes; allow information exchange, cheaper R&D, more muscle to get the attention of scientists and marketers. Technology may allow, via DNA, the recognition of outstanding productive ram lambs in commercial flocks. But somehow, I think that the peak of the breeding pyramid will be managed by a small number of dedicated breeders. I don't think we will quickly follow the very concentrated elite breeders of pigs, or dairy cows, because of the extensive nature of sheep farming and individualism.

Keith: There will be approximately 10-12 main ram breeders in New Zealand in the future. A lot of the smaller breeders are exiting the industry because of reducing ram sales due to clients converting to Dairying or reducing sheep numbers. Bigger ram breeders have much more selection power to make faster genetic gains.

Wool Partners International (Ian Abacrombie)

"There is an opportunity for pooling wool into supplier groups but it is small, and expensive. The main opportunity is to market wool through an organisation like WPI with an established and recognised brand like Wools of NZ where growers can benefit from the economies of scale and receive accurate feedback from the market.

We don't know what proportion of consumers are looking for a story about the product. We do know that there is a growing number of consumers interested in natural products which are sustainable and do not harm the environment.

We also know that manufacturers generally are not interested in developing regional provenance stories like Banks Peninsula. They believe that New Zealand is the best provenance story that is readily understood by most consumers."

Government: David Carter (Minister of Agriculture)

"There has been a change in the in the way New Zealand's agricultural goods are positioned in the world market. We are no longer a low-cost producer. That mantle has passed to countries like Uruguay and China.

What this means is that New Zealand's brand has shifted to a higher-cost, higher-quality product aimed at a more discerning consumer. A consumer with a conscience.

Over the last decade, our customers-both here and overseas- have started to ask searching questions about the environmental impact of our agricultural systems.

They have developed a sharper focus on issues of animal welfare, and they have set a very high bar for food safety" South Island Farmer.

SYNLAIT: John Penno

"What New Zealand has got to do is focus on what it does well, and do it better and better, accelerate the things we do well where we have fundamental strengths and stop trying to do too much,"

Synlait is targeting the top end market. To do so it looks to breed better cows, tailor the product and create product integrity for customers. They are looking to create extra value before it leaves the farm gate rather than after it leaves the farm gate. (The Press, business section, Saturday 25, E1)

Below is a summary of the document 'THE FUTURE OF THE MEAT INDUSTRY" produced by the Agriculture and Forestry Ministry

Slippery slope: Failure to address key opportunities and challenges leads to a substantial reduction in the sector's size and scope. Profits not only retain their cyclical variations, but become systemically lower.

A new market orientation: The sector is able to diversify into new markets and overcome the production challenges of greater year-round supply and product specification. Improved economies of scale lead to successful processor consolidation.

Shrink-to-fit: The sector reduces in size, but is able to stabilize due to increased returns from reduced supply. Competitive advantages are achieved in areas such as environmental performance and the sector is able to meet exacting consumer requirements in traditional markets.

The knowledge industry: The sector makes a step-change in innovation investment, allowing for greater product and process innovation. Strategic alliances are increasingly entered into with customers, allowing greater transmission of customer requirements through the value chain. Increased capabilities and intellectual property from research and development allows for the internationalization of the meat sector and associated industries.

CONCLUSIONS

The New Zealand sheep breeding industry has been based around registered breeders breeding more for physical and appearance type attributes than production up until the mid 1980's. During the 1980's groups of new breeders started to performance record animals for traits that effected on farm production. Registered breeder groups have since struggled to maintain their market share because there physical performance of their animals has not kept up with the performance of performance recorded flocks.

During the late 1990's until 2009 a number of gene markers have been developed to increase on farm production, with the likes of the Inverdale gene marker helping to increase lambing percentages and the Cold Tolerance gene marker improving lamb survival which has helped increase on farm animal performance. There has also been two gene markers developed MyoMax and Loinmax that identify animals with increased carcass weight and muscle yield which will deliver higher returns to sheep farmers from there processor as yield payments become the basis for payment rather than the current system of being paid per kilogram of carcass weight or on schedule which grades lamb at their 12^{th} rib as lean, prime, fat and cutters. During this period there has also been breeding tools developed to aid ram breeders and commercial breeders to make faster genetic gains with Sheep Improvement Limited being developed to genetically evaluate sheep and SIL ACE to evaluate across-flock and across breeds. This has meant faster genetic gains being made, and enabled this information to be much easier accessed by sheep breeders and commercial farmers. There has also been an uptake of ultrasound Scanning and CT Scanning to increase meat yield to produce an animal with higher financial returns.

In the near future we are going to see eSearch introduced to help ram purchasers search for sheep genetics that meet particular specifications. Once you have decided what type of animal and what attributes you want that animal to have to suit the market you are supplying you will be able to search using eSearch as to where to access this type of animal.

SNP technology is going to enable us to read the DNA of an individual animal and significantly increase the rate of genetic gain. It will enable breeders to test animals at a young age to explain the genetic variation in an animal. It is expected to increase genetic gain in the dairy industry by 50-70%.

Meat companies are starting to introduce Via Scan Yield Grading and X ray technology which is going to provide a profile showing how each mob performs against market requirements. Sheep producers will be rewarded for producing animals that meet these market requirements and in conjunction with the Central Progeny Test, this will enable commercial farmers to make breeding decisions as to which breeds of animal and breeders are producing animals which meet market requirements.

There a number commercial businesses starting to align breeding with the end market. They are trying to breed an animal that meets market requirements and supply the product twelve months of the year along with the story of where it was produced to try and achieve higher returns. This option tends to incur higher costs and there is divided opinion as to whether this should be left to the main meat

companies or individual breeding groups. I believe we need to be marketing our product as New Zealand produced which consumers recognize rather than a whole lot of small little splinter groups. I feel that the way forward for the New Zealand sheep industry is for the sheep meat processors and marketers to give clear indications to farmers as to what the market requirements are so that it gives genetic providers the opportunity to produce animals that will result in high-quality, sustainably produced meat and rewards farmers for meeting consumer expectations.

It is likely there will continue to be consolidation within the ram breeding industry as individual breeders retire, face reduced customer demand, lack the scale to uptake new genetic tools and have limited genetic selection pressure. It is unlikely it will get to the extreme of the dairy industry in the near future due to the range in climate and typography of New Zealand sheep and beef farms and farmers individualism.

It is going to be very important in the future that genetic providers breed animals that are perceived as environmentally sustainable for New Zealand's climate at the same time as being production driven to meet higher end markets and not fall into the trap of being only production driven like the pork and chicken industry which consumers are increasingly finding issue with.

RECOMMENDATIONS

1. Meat companies take the lead and give clear signals to farmers about the product they require and reward farmers financial for supplying product of that specification.
2. Sheep farmers select a breeding policy and genetic package that complements their farming environment, meets market requirements and continues to be perceived as environmentally sustainable.
3. Breed an animal that is capable of producing a 25kg lamb carcass. A 25kg carcass would allow profitable boning out of hind leg segments, have a lower carbon footprint and more efficient to produce.
4. Ram breeders continue to adopt new technology and work together in breeding groups to achieve faster rates of genetic advancement and align their genetics to market requirements to ensure commercial sheep farmers can continue to make production and profitability gains.
5. The industry as a whole needs to continue to invest in research that creates measures and tools to aid ram breeders in their selection processes to breed and farm sheep which are better at converting feed to produce a higher value carcass and improve the profitability of lamb producers.

In a presentation given by Silver Fern Farms Chief Executive Keith Cooper he said the following which very much sums up the future direction and the way farmers must think "on farm productivity linked to customer needs and wants".

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