“Science for Quality Beef” is the second booklet for the beef industry from the Beef Cooperative Research Centre, following “Producing Quality Beef” (2003 and 2004 editions). The purpose of these booklet is to identify the opportunities for beef producers to profit from research carried out since the establishment of the first Beef CRC (1993-2000).

This booklet features selected research highlights, mainly from the second Beef CRC (CRC II, 1999-2006). It is in three sections:

- “Messages for producers” includes stories that reflect on what has been learned about producing quality beef and how producers can take advantage of the opportunities on farm.
- “Advances in meat quality” explains some recent discoveries about the factors affecting carcase and meat quality along with their commercial implications.
- “Work in progress” contains some brief information about current research in the new CRC for Beef Genetic Technologies (CRC III, 2005-2012) and where it is taking us.

CRC III has a vastly increased commitment to the implementation of new technologies that are emerging quickly from research. To support this, we are constantly adding to information on the Beef CRC’s web site (www.beefcrc.com.au) and the Livestock Library (www.livestocklibrary.com.au).

In addition, there is a strong commitment by the beef extension network across Australia and New Zealand to integrate the important messages into their regular programs. The key contacts are listed on the final pages.
The Australian beef industry has undergone remarkable changes in the last 15 years and now produces beef of much higher quality for local and export markets. Profitability in the live export market continues to be driven by the fertility of the breeder herd and increased growth rates in progeny meeting market specifications. These developments have been helped significantly by research by the Beef CRC which was set up in 1993 to enhance Australia's ability to produce high quality beef.

High quality beef is attracting increased support globally and has replaced manufacturing product as our biggest earner of beef export dollars. The quality of our beef going to Japan and the emerging Asian markets, as well as our domestic beef supply, has improved significantly.

The feedlot sector has come of age and now finishes 35% of the adult cattle slaughter, including the vast majority of steers born in southern Australia. However this section is now under increasing pressure due to exceptionally high grain prices resulting from the ongoing drought and competition for grain from the biofuels industry. Globally there is increased demand for heavier cattle at the same or a younger age. Younger age of turnoff places increased pressure on herd reproduction.

An increasing focus on the NLIS will further support processors and the feedlot industry to collect detailed information on the performance of cattle from individual breeders. This information is being used to influence decisions on the suitability of those cattle for market suitability and thereby value.

The potential of cattle for marbling, meat yield and feedlot growth is primarily determined by bull selection, followed by growth, management and health, well before cattle enter the feedlot. The Beef CRC has conducted huge progeny testing programs overlaid with experiments on nutrition, health and meat science to reveal the underlying principles.

Recent work explores the positive and negative associations with fertility and herd productivity, essential knowledge for keeping the production sector viable.

This research has complemented consumer studies by MLA to define consumer expectations and the factors important to meeting market specifications. Producers now have much better information to guide their decisions in key areas, including:

- Using genetics to increase herd profitability
- Managing trade-offs between carcase traits and herd productivity
- Temperament and its connections to performance and meat quality
- Using MSA to guarantee tender meat
- Setting breeding objectives for targeted markets
- Improving feedlot performance by yard weaning and vaccination

The CRC for Beef Genetic Technologies is developing the use of DNA marker assisted selection to further enhance beef quality and herd productivity. We can look forward to new gene markers for new traits such as carcase yield, feed efficiency, female reproduction and parasite resistance. Importantly, the research will define both the positive effects of promising gene markers and any negative correlations with herd productivity and reproduction.

We are on the doorstep of a dramatic increase in available knowledge to improve selection practices and profitability of tomorrow’s production systems. Our world leading research is an ambitious program, but exciting progress is already in the pipeline. To take advantage of the opportunities, breeders will require market awareness, an open mind and preparedness to modify some traditional practices.
About the Beef CRC

The first Beef Cooperative Research Centre (Beef CRC) (1993 – 2000) was established to provide Australia with the tools to capitalise on rapidly expanding export and domestic opportunities for quality beef. It brought together the existing resources of CSIRO, NSW Agriculture, Queensland DPI and University of New England.

Following its success, a second seven year contract was awarded, to further develop and enhance application of new meat quality technologies. Many of these are described in this booklet.

The current, third Beef CRC (2005-2012) is Australia’s largest integrated beef research program bringing together leading beef researchers from across Australia along with prestigious national and international beef industry partners.

The world class research underway by the Beef CRC aims to increase profits for Australia’s cattle industry by at least $179 million per annum from 2012.

To do this, the Beef CRC is focusing on gene discovery and gene expression which will create precision breeding and management strategies to improve profitability for all sectors of the Australian beef industry - breeding, growing, finishing, processing and retailing.

Established and supported under the Australian Government’s Cooperative Research Centres Program
Impact of the Beef CRC

Bob Gaden

Since the first Beef CRC was established in 1993 it has given Australia the tools to produce a new range of world class beef products. This has had a profound impact on the Australian beef industry, making it possible to capitalise on the liberalisation of the north Asian markets and to produce beef that keeps pace with the worldwide change in consumer attitudes to meat quality.

The early research taught us how genetic and non-genetic factors work together to produce the consumer’s eating quality experience. More than 100 scientists across Australia worked together like never before in a program costing $146 million in the first 12 years.

The centrepiece of the early research was a huge experiment involving 12,000 pedigreed progeny, bred, grown, slaughtered and evaluated at a range of research sites in eastern Australia. Along with studies of nutrition, health and processing, this enabled a much more detailed understanding of the factors affecting meat quality and their relationships with each other.

This new knowledge created new opportunities. Feedlots expanded and increased their ability to meet high quality specifications, feedlot diseases were reduced, branded beef products could guarantee consistent eating quality and breeders could use BREEDPLAN more effectively to improve carcase traits.

Molecular genetics research grew rapidly during this period and the CRC ensured that new work on gene markers was integrated into the existing programs. The foundation was laid for the new range of genetic technologies being developed in the current CRC, and more importantly, paved the way for the industry to apply them.

Achievement highlights of the Beef CRC include:

- BREEDPLAN with much improved accuracy and new traits covering carcase and meat quality and feed efficiency
- Accurate EBVs on hundreds of industry sires from the progeny testing program
- The first use of indirect selection for difficult-to-measure traits like “flight time” to improve meat quality and IGF-1 to improve net feed efficiency.
- A blueprint for crossbreeding in the north, including sire breed effects in eight breeds for growth, yield, fatness, marbling and full range of meat quality traits including tenderness and consumer score
- The world’s first gene markers for livestock production commercialised, opening new frontiers for genetic improvement in the future
- Nutrition and growth path strategies to maximise marbling and feedlot performance
- Pre-boosting programs, including yard weaning and two new feedlot vaccines, to reduce feedlot sickness
- The science enabling the Meat Standards Australia (MSA) grading program to guarantee eating quality, which in turn has changed many production and processing practices across the industry
- Defining best practice in processing including management of pre-slaughter stress, hanging method, electrical stimulation and chilling
- Identifying the effects of HGP and breed type on eating quality, and strategies to minimise their negative effects commercially
- Direct and indirect training of thousands of graduate and undergraduate students entering the meat industry workforce
- Local information on feedlot waste management, used to set Australian regulatory guidelines.

Many of the benefits from this work are difficult to measure but there is no doubt the return on investment is handsome. Without it, would Australia have been able to step into the Japanese market so successfully after the US was locked out because of BSE in 2003? Would our domestic consumers be so happy with the quality and consistency of local beef?

The MSA program alone has been estimated to have returned $244 million to the Australian industry between 1999 and 2006.

The current CRC III (2005-2012), while researching new genetic technologies, has a strong commitment to ensuring the industry does not miss opportunities for profit from applying technologies developed in previous CRCs and elsewhere. This publication, and some of the CRC’s extension activities described in it, are part of meeting that commitment.
Key messages for southern commercial breeders

Bob Gaden

The Beef CRC has put together the blueprint for producing tender beef for a variety of markets around the world. All sectors of the industry, including commercial breeders, must play their part if the final product is to be satisfying to the consumer, competitive in price and profitable to produce.

In 2006 a group of beef advisers in NSW Department of Industries selected the primary key messages from CRC research and presented them at a series of field days for commercial producers in southern NSW. The following is a brief summary of what they presented.

Genetics

- To benefit most from CRC technologies you should ensure your herd is tuned to your environment and markets (see separate article “Basics First”, pg 8). Technology can help you select the right bulls for balanced on-going genetic improvement.
- BREEDPLAN’s Estimated Breeding Values (EBVs) are now much more accurate and cover more traits, thanks to CRC research. There are now more reasons to use BREEDPLAN, along with a physical inspection, to help select your bulls.
- New gene markers are available and many more will be discovered and commercialised in coming years. It is becoming quite complicated to work out how to use them properly, but it will become easier soon, when BREEDPLAN will be able to use them to improve the accuracy of EBVs.

Action

- Make sure you select the appropriate breed(s) and breeding system to suit your property and markets
- Get to know BREEDPLAN and use it with confidence to select sires for growth, fertility and carcase traits
- If you are aiming at markets requiring marbling, consider gene marker information as well as EBVs to help choose bulls
- Encourage bull breeders to measure all traits rather than rely on BREEDPLAN to predict them. This will increase the accuracy of EBVs
- Encourage seedstock producers and their breed organizations to measure and produce EBVs for temperament (docility).

Growth to weaning

- Overall, cattle can tolerate quite a wide range in nutrition in early life without serious adverse effects on meat quality, but severe restriction can reduce their future growth potential.
- Cows severely restricted during pregnancy will give birth to lighter calves that have reduced ability to grow during pre-weaning, backgrounding and finishing.
- Calves restricted in early life, between birth and weaning, or severely restricted at weaning (around 200kg) will only partly catch up when returned to good feed.
- Once cattle are finished for market, eating quality of meat is virtually unaffected by a period of growth restriction earlier in life, except for a slight reduction due to increased age at slaughter.

Action

- Ensure cows are adequately fed during pregnancy, to ensure cow fertility and future growth potential of the calf
- Ensure cows and calves are adequately fed so calves grow at a minimum of 0.6kg/day (to reach a minimum of 140kg at 6months, 180kg at 9months)
- If weaning calves early, make sure they continue to gain at least 0.6kg/day to preserve their future growth potential. This may require specialized feed supplements
- Set market targets for growing stock. Manage their growth to achieve targets and make best use of pasture growth
- If supplements are needed, make sure they complement the available feed and are cost effective and practical to feed
- For maximum marbling, aim for an uninterrupted growth rate of around 0.8kg/day from weaning to feedlot entry
- If backgrounding growth is slower than about 0.7kg/day, cattle will show faster, more profitable compensatory growth in the feedlot. See if you can get paid for this.
- Beware of buying weaner or yearling cattle that have had a significant early growth check. Their potential for growth may be reduced and they may reach market limits for age (dentition) before they reach weight targets.
- Results of the latest series of CRC experiments on growth to be released in 2008 will be used to refine these recommendations.

At weaning

- Weaning is a critical time for calves. Earlier weaning is good for cows and pasture utilization but calves need proper nutrition to continue development and retain their potential for later growth.
- Weaning is also a key time to give them health treatments
and learning experiences that will affect their future growth, health, meat quality and profitability.

**Action**
- In southern Australia, wean earlier (5-6 months) rather than later. This helps lift cow fertility and lets you target the best pasture to the weaners.
- Wean down to 100 days of age or 100kg liveweight for maximum feed efficiency, but if you do, it is critical to feed the weaners a high quality diet to ensure growth of 0.6kg/day.
- Yard wean by confining calves for 5-7 days at 4sq m per head on good quality hay or silage and clean water from a trough. This is a learning experience that greatly improves their feedlot performance later in life and makes replacement females easier to manage.
- Be particular about health – drench, and if necessary, use fly control to reduce pink-eye during yard weaning.
- Dehorn well before weaning if possible.
- Measure temperament on all calves using flight time or crush test. Cull any with unacceptable temperament.

**After weaning - backgrounding**

The period of growing out after weaning and before entering a grass or grain finishing system is known as backgrounding. The CRC has shown that growth rate during backgrounding has significant effects on growth rate in the feedlot, carcase yield and marbling.

Backgrounding is also a time when cattle can be given special vaccines to prepare them for optimum feedlot performance.

**Action**
- Define your target markets (e.g. feedlot entry or slaughter specifications), set target growth rates and manage the feed quality/quantity to achieve them.
- Develop a relationship with your markets - seek feedback on the growth of your cattle and their compliance to key carcase specifications (yield, fatness, marbling).
- Understand the differences between breeds with respect to growth, carcase yield and marbling, and market preferences, so you can target the right markets.
- If the cattle are not yard-weaned or their history is unknown, give them a "yard weaning" experience for 5-7 days.
- New vaccines and other pre-feedlot health treatments given during backgrounding may help your cattle perform better in the feedlot. Discuss the best options with your feedlot buyer well before sale time.
- Consider retaining ownership (custom feeding) if your cattle are above-average performers. This allows you to capture some of the benefit.

**Nutrition and pasture management**

Beef output per hectare is a key profit driver for commercial beef producers. In both breeding and growing enterprises, you can aim for the best output by finding a balance between increasing stocking rate and performance per head.

The Beef CRC has not studied techniques of grazing management. Rather it has focused on the factors affecting growth and meat quality of individual animals.

You can use knowledge of the effects of different growth rates in early life to manage grazing and achieve market targets.

**Action**
- Maintain a restricted joining/calving period and calve before the peak of seasonal pasture growth.
- Plan your main turnoff of sale stock to take place near the end of the growing season.
- Wean calves early and ensure calves receive the best pasture or suitable high quality supplements to achieve growth targets. Cows can utilise lower quality feed after their calves are weaned.
- Manage the nutrition of cows and feed them if necessary to ensure fertility.
- If you buy feed supplements, make sure they supply missing nutrients rather than replace paddock feed. Supplements should be practical to store and feed out.

**Further information**

Fact Sheets and “Key messages for commercial breeders in southern Australia” are available on the Beef CRC website – www.beefcrc.com.au
For commercial producers, maximum profit comes from getting the “basics” right first, and then adding value by applying the new technologies that Beef CRC research has given us.

In simple terms, this means having healthy cattle, adapted to their environment and producing marketable progeny. Ask yourself these basic questions:

- Breeds – is my breed or breeds the best adapted to low cost breeding, growth and market suitability for my environment?
- Breeding system – could I be more productive with a crossbreeding or composite system that combines higher female productivity with higher turnoff rates and market suitability?
- Feed utilization – do I have a fertile herd that calves at the best time of year to turn the available feed into beef? Do I have the best balance between breeding and growing stock? How well does this system handle drought?
- Age and weight of turnoff – am I adding the most value to my progeny by making best use of the growing season and suiting market demand?
- Market suitability – Do my turnoff stock match buyer requirements for breed, age and weight and time of year? Are there alternative markets for animals that miss targets, or markets that change?

The production and market environment is constantly changing. Review these points occasionally and revise your on-going plans. Recovering after the drought is an ideal time for a review – an outside professional may see opportunities you may not think of.

You can then use the research information to fine-tune your production system, add to your profit and set the direction for on-going improvement in the future.

Up to 50 producer groups are working with the CRC to check they have the basics right and add the most useful technologies to increase their profit. The groups are known as Beef Profit Partnerships (see page 39 for more detail).

Groups in NSW are using Beef-n-omics software to examine today’s changed market opportunities and find the most profitable way to manage their herd to meet them. It involves working through the complex interactions such as a change in calving time and its effects on stocking rate, age and weight of turnoff and pasture utilisation.

Questioning calving time

Calving time is a good example. In the days when vealer and weaner breeding were the main enterprises in NSW, winter calving was important to ensure the sale calves were as heavy as possible in autumn. A later calving was a problem because calves had less time to grow before selling time and would be smaller.

These days many breeders are carrying weaners through the second season to feedlot entry weight. Later-born calves can still reach marketable weights although they are usually lighter.

The real advantage of later calving comes in the cow herd. It is much easier for the cows - they need less winter feeding and have a higher natural fertility. You can run more cows and get more calves at a cheaper cost on the same area.

By targeting the highest quality feed to the young stock, calves can be weaned earlier, taking more pressure off the cows and helping keep up their fertility and stocking rate.

The key is to keep the young stock on good pastures so they will reach saleable weights the following summer and not compete with cows and young weaners over autumn.

Beef-n-omics analysis

Beef-n-omics works out the paddock feed requirements of your current herd and a gross margin profit analysis. You can then compare it with the feed balance and gross margin of alternative management options.

In this case, it can show that the weights of the best calves may not be as impressive as they used to be. But the same paddock feed could produce a lot more of them, more total kilograms of beef and more money in the bank.

Contact your state department representative for more information about Beef Profit partnerships and other services.

A list of contact details is on page 47.
CAAB uses CRC technology

Bob Gaden

The Certified Australian Angus Beef (CAAB) brand is synonymous with good eating quality, and uses much of the CRC’s meat quality technology to guarantee a tender, juicy product.

CAAB was established by Angus Australia in 1996 and now processes 2,000 cattle each week, supplying high quality beef to international markets as well as hotels, restaurants and supermarkets across Australia.

CAAB recognises that a good eating experience does not come from a good animal alone. There are many points between paddock and plate that can have a substantial negative effect on tenderness. That’s why they use a PACCP (Palatability Analysis of Critical Control Points) approach to managing these critical points.

Under PACCP, procedures are put in place to preserve maximum eating quality at all the critical points from conception, through production and processing, to the consumer’s plate.

The Beef CRC’s research program has been instrumental in defining exactly what must be done at each of these points. Meat Standards Australia (MSA) has included them in its regular package of requirements for carcases to be MSA-graded.

CAAB has all its carcases graded by MSA, and raises the bar by requiring higher standards in genetics, finishing nutrition, carcase specifications and ageing of the product.

All cattle are grain-fed to meet carcase specifications and this usually takes 120-130 days in CAAB-licensed feedlots including Cargill Foods’ Jindalee Feedlot near Cootamundra, NSW, and the Kerwee Feedlot in south-east Queensland.

The basic MSA requirements mean that producers and feedlots must follow a set of rules, many of which are designed to minimise pre-slaughter stress.

Carcases must pass MSA minimum grading requirements and in addition must achieve a minimum of AUS-MEAT Marble Score 1 and be eligible for the top 7 of the 17 MSA Boning Groups. These are the groups with the greatest proportion of higher grading cuts.

Cuts are aged for a minimum of 21 days to further enhance eating quality with the striploin being aged for 28 days.

In Japan, CAAB is steadily increasing its share of the Australian supply of high quality chilled beef. In Australia, the program has been very successful in its aim to market high quality Angus beef and expand the demand for Angus cattle.

Supplier workshops

Even with a proven set of specifications for feedlot entry, there is a wide variation in the performance and profit from cattle from different breeders. Some of these differences relate to the end product (fatness, marbling, yield) but many relate simply to feedlot performance (levels of sickness, growth rate and maturity).

CAAB regularly runs workshops for cattle suppliers to explain how these can be improved. The workshops draw heavily on findings from the Beef CRC’s research.
The modern feeder cattle supplier

Bob Gaden

When Cargill’s then-livestock procurement manager Harry Waddington spoke to a series of Certified Australian Angus Beef (CAAB) supplier days in late 2006, he didn’t mince words.

He said Cargill’s want committed producers who can supply larger runs of suitable cattle that meet specifications. And if they want to stay on as regular suppliers, they must develop a more positive attitude to producing what the buyer wants.

CAAB processes about 2000 cattle each week for a domestic and international trade in premium cuts. Most of these come from Angus breeders in southern Australia and many pass through Cargill’s Jindalee feedlot and Wagga abattoir.

He asked producers to manage their herds so they can send in younger, faster-grown cattle that are better prepared for the feedlot. Cattle must be yard-weaned, and he says they are now moving to require a dose of the new Bovilis-MH® feedlot vaccine be given during backgrounding.

Harry made a strong point about successful producers having the right attitude, saying the time has passed for producers to argue about things like National Vendor Declarations, NLIS and lifetime traceability. For CAAB and Cargill, these are essential to gaining marketing advantages over competitors.

While the supply of suitable livestock is tight at present, Harry says buyers are forced to accept some cattle that are not ideal. This gives producers the impression that attention to detail is not critical. But this is not the case.

He pointed out that when the US re-enters the Japanese market, competition will increase and the Australian share of the market is expected to come under pressure. When that happens, only the committed livestock suppliers will find a market in CAAB.

**Market focus**

Harry says the modern supplier will have a focus on satisfying the market rather than turning off what he can conveniently be produced. Making an effort to suit the buyer can create a relationship that brings benefits like preferred market access and the best price.

These are some features of a market focused attitude:

- Get the specifications right – with no fudging. Don’t supply cattle if they are outside requirements or doubtful performers
- Look at it from the processor’s point of view, and organise turnoff in larger groups
- Schedule supply ahead and especially work with the processor to help fill times of the year when supply is tight
- Supply the information required with the cattle and the correct paperwork
- Be prepared to negotiate changes to production and turnoff to suit the buyer
- Don’t argue about price before attending to the issues above. Do the other things right and price will look after itself.

**Market pressures to increase**

Australian grain-fed product was significantly discounted by up to $450 per head in Japan compared to US product before the BSE case in December 2003 closed US access to the Japanese market, according to Cargill’s former procurement manager Harry Waddington.

Since then Australia has had easy access to Japan. But he says this opportunity will be temporary. The long term goal must be to match the US product and carve out a sustainable segment of the market at a higher price.

Waddington says one of the issues will be the age of cattle. When the market reopens, US beef is expected to have strict age limits to minimise risk of BSE. This will put pressure on Australian producers to match the quality and deliver faster-grown young cattle into the feedlots.

To achieve consistent high quality and be able to differentiate their product from other grain-fed beef, he believes Cargill needs to focus on the quality of our southern cattle and work with producers to make sure they are using the best available knowledge.

He believes that CAAB can achieve a strong niche if producers, feedlots and processors pull together to focus on the end product, maximise compliance to specifications and improve the performance of their cattle.
**New payment systems**

Looking further ahead, Harry sees clearer payment for producers based on the performance of their stock. Technology is being implemented to directly reward carcase weight, carcase yield (proportion of saleable cuts in the carcase), marbling content and weight-for-age.

Payment for individual offal and hide value is also being developed, as well as discounts for dark cutters.

These will give producers clearer incentives to use carcase feedback to identify how they are performing and where to improve their stock.

**Improving performance**

Harry suggests that because improvement in livestock doesn’t happen overnight, producers should not wait, but start working now to improve the performance of their stock.

He says the important areas are:

- Genetic improvement of growth, marbling and carcase yield through BREEDPLAN
- Faster and more consistent growth, leading to earlier feedlot entry and younger carcases
- Yard weaning to reduce stress and improve feedlot performance
- Vaccination with Bovilis-MH® a few weeks before feedlot entry to protect against feedlot respiratory disease
- Improve temperament, as this is strongly related to feedlot performance.

*Producers should start working now to improve the performance of their stock.*
Hung up on BREEDPLAN?

Bob Gaden

“Why do these old blokes get so hung up on using BREEDPLAN?” The words came from an intelligent 30-year-old producer, voicing his gripe after a forum where scientists and leading producers presented some of the latest ideas for improving herd profit.

One message from the scientists was that big advances are taking place in beef genetics, and that most of the new genetic technologies will be made available to producers through BREEDPLAN EBVs.

The forum’s discussion was dominated by the over-55’s in the audience and revealed a healthy level of scepticism about the credibility of BREEDPLAN. This frustrated the young producer - his generation is growing up with computer-based decision aids that are a normal part of life.

He believes if BREEDPLAN has been constantly developed by world class scientists for more than 30 years, it must have something to offer – and nothing is perfect. Surely it’s better than Dad going off in total ignorance to buy a nice-looking, overfat bull at a sale somewhere.

Use BREEDPLAN to help select bulls – new technologies including gene markers will make EBVs even better in future

BREEDPLAN is not much different to a car really. You just turn the key and have faith it will work. New models come out each year with more advanced features.

New cars now have antilock brakes, traction control and better engine design to improve fuel economy. BREEDPLAN has new carcase EBVs and better genetic correlations to improve predictions. They each get better every year.

The modern car engine is far too complex to understand. The pistons still go up and down, but research has delivered sophisticated electronics that fine-tune fuel injection for every conceivable situation.

BREEDPLAN also has a simple basis, comparing the performance of individuals. But complex calculations account for the nutrition differences between herds and the performance of relatives. CRC research has added a network of genetic correlations to fine-tune EBVs and the influence they have on each other.

Current research in CRC III will widen the scope of BREEDPLAN by including measures of cow efficiency and the trade-offs with carcase traits. So producers in future will be able to use it improve traits impossible to see, as well as antagonistic traits, at the same time.

While it has come a long way in recent years, scientists will keep working at improving the underlying structure of BREEDPLAN and stud breeders can help its accuracy by recording more traits.

In separate molecular genetics research, the number of individual genes known to affect production traits is about to explode, and so is our ability to test for them. Thank goodness the work is being done to get both technologies together and deliver all this simply through our familiar BREEDPLAN system.

Maybe our young friend has a point – it’s time to accept BREEDPLAN, learn to use it and spend more energy on the important things that determine profit on the farm.
Buying the right bull

Buying the right bull is a key decision for the future of your beef herd. It’s natural to focus on what you can see in the bull, but how important is this for the bottom line?

If you keep your own replacement heifers, buying a bull has very long term implications. What’s more, the really important features he contributes are female breeding traits – fertility, calving ease, maternal ability and adaptation to your environment.

Estimated Breeding Values (EBVs) are what they say – estimates of the breeding value of the bull for a range of traits. Some of these are related to what you can see (growth, muscling) but others are even more important but invisible (days to calving, fertility, feed efficiency).

EBVs are not a guarantee of performance, any more than an assessment of two human parents would guarantee the future of their children. Individuals vary, that’s biology. But when you average it out, EBVs are very consistent.

The important point is that EBVs are getting more accurate as technology improves.

If your bull works for say three seasons, think of the time span:

- Calves will be born over the next 4-5 years;
- The genetics of your weaners will be 50% influenced by the bull – the first drop at least 18 months away, and the last about 5 years away;
- Your first calvers will be 50% influenced – they start 3-4 years away and will still be entering the herd in 6-7 years;
- The heifers you keep will be cows in your herd for up to 15 years.

Having a clear plan

No-one can predict the future with certainty, but it is important to have a clear plan of where you want your herd to be in the future. Use this plan to guide your bull selection decision.

The plan needs to be based on:

- Market suitability, and
- Low cost, efficient production

Market suitability

Markets will keep changing and it is impossible to know exactly what they will want. Experience tells us that there are some fairly certain common factors:

- A high yield of saleable meat, with minimum waste fat. This means cattle with heavier rather than lighter muscling (avoiding extremes of course). It also means being careful about getting cattle too big and late maturing – they lose versatility and the females may be less efficient.
- Tender meat. Much of the variation in tenderness is determined by how the animals are produced, and how the meat is handled and cooked. For British and European breeds, there is little genetic variation in tenderness so this is a low selection priority. In tropical breeds there is considerable genetic variation, and the technology for improving it has arrived, so selection for tenderness is worth considering.
- A wide range of weight. Markets for beef continually evolve around the availability of livestock, so there will always be a market for your animals. The most economical age and weight to turn off your stock will depend on many factors that need to be assessed locally.
- Feeder cattle. The feedlot industry has been growing steadily and is the major buyer of young stock over most of southern Australia. There are a wide range of feedlot markets looking for cattle with growth potential to grow fast and produce a high yield of saleable meat. Some specialized lines need the ability to marble.
- High quality markets with special requirements (marbling). As Asian markets grow and become more discerning, demand for marbled beef is expected to continue rising. A number of Australian feedlots specialize in these products
- Niche markets with restricted access. In most parts of Australia there are opportunities to supply niche markets at a higher-than-average price. These can be mainstream markets like the European Union (EU), branded products or organic lines. Each has their own requirements for type of cattle, production system and documentation.

Low cost, efficient production

There is plenty of technology to help with breeding decisions. But this technology is not much use unless you know where your herd is now, and where you want it to be. Thinking long term means thinking about future markets and what it will be like in the future for producing breeding cattle and finishing cattle.

Breeding cows will need to be resilient and efficient. Land prices and alternative uses are forcing breeding cattle out of...
the reliable districts into more marginal areas. Climate change may impose extra pressures.

The main ways to cope with this are:

- Crossbreeding, to combine the strengths of two or more breeds. For example a Brahman/British cross cow is much more hardy and productive in marginal conditions in sub tropical areas. This may preclude you from some markets where purebreds are required, but consider the overall gains in productivity.

- Feed efficiency. There are many ways to address this, for example targeting high quality feed to young growing cattle; calving at the best time of year; early weaning; adjusting age and weight of turnoff to use the natural growing season. We now have the EBV technology to identify and select for more feed-efficient cattle within breeds, and this adds another important approach.

Where are you now?

To know exactly what direction to change your herd breeding, it is important to look at the key areas and identify what needs changing. If you sell weaners, how are your calves performing for your customers? Do your cattle produce enough lean meat yield, or marbling, to suit market requirements? Is your herd fertility as good as it can be? How heavy are your yearlings at the end of the growing season?

You can use your own records to analyse some of these areas, but you need market feedback for others. It is vital information for deciding what areas you need to change.

Consider antagonisms

It is well known that improvements in one area can often be at the expense of another. If market feedback indicates you could improve yield by making your steers leaner, be aware that leaner females may not be as hardy and fertile as breeders. The ability to put on fat quickly is an old survival trait, and it is much cheaper if cows store their own energy on their back compared to having to store fodder and feed it out.

A Victorian experiment demonstrated that a cow’s ability to store extra fat and use it later in the year was equivalent to half a tonne of grain, or 3 tonnes of silage. If we select for high yielding, leaner steers, we may lose this ability in their sisters.

Many of these antagonisms have been studied and are well known. When BREEDPLAN calculates EBVs, it considers any known relationships between traits. This is also true with the BREEDOBJECT selection index which combines all EBVs into a single dollar value.

The Beef CRC is collating a suite of new information on the relationships between cow body composition and fertility by scanning and recording breeding performance in several large commercial herds.

Crossbreeding

Crossbreeding is far more than utilizing hybrid vigour. By carefully selecting the right breeds and breeding system, you can vastly improve herd efficiency.

For example, it can be used to create moderate sized, feed-efficient cows that rear large, fast-growing progeny. The Brahman/British cross cow on sub-tropical areas is a good example of an efficient, fertile cow that can be joined to a large European or part-European sire to add value to the calves. In this case it is very important to realize that the big heifer calves will look great, but may not be worth keeping as they may be less efficient breeders in your environment compared to their mothers.

An effective crossbreeding program is not as easy to run as straight breeding, but is still quite feasible, even in quite small herds. Some innovative breeders are creating composite breeds for particular situations, with the best combination of breeds already built in. If you have a reliable source of composite bulls, you can enjoy most of the benefits of crossbreeding with the convenience of a single straightbred herd.

Buying bulls

The two main considerations are physical soundness and genetics. The bull is a delivery system for his
genetics, and he must be sound enough to be able to do so under paddock conditions.

A good way to balance these two vital requirements when looking for a new bull is to get the catalogue before going to the sale and study the EBVs. Use them to develop a short list of bulls that meet your requirements. When you get to the sale, you don’t have to check all the bulls for physical soundness and will have more time to relax and socialise.

**Visual assessment**

Be aware that a bull’s physical appearance can mask the true underlying genetics. The heritability of growth rate is moderate at around 30%, but this means that even among groups of young cattle reared together, 70% of the differences you see are due to factors other than genetics. At multi-vendor sales, bulls are often given different preparation, so the problem of deciding how much of the difference is due to genetics is even greater. Remember, the non-genetic factors are not passed on to the progeny.

EBVs are a much better guide to progeny performance, because they estimate the genetic merit of your potential bulls, without the masking effect of the feed and preparation. EBVs also take into account the performance of other relatives, adjusted for how closely related they are. It is a much more powerful piece of knowledge and impossible to replace with a visual judgement. And it’s pretty hard to assess the potential productivity of daughters!

Scrotal size is a physical trait that is easy to see in a bull at a sale. Like weight, it will be influenced markedly by nutrition as well as age and breed. EBVs are a much better guide to the true breeding merit.

Crossbreeders often don’t worry about using EBVs because the breed effects contributed by each breed, and hybrid vigour, provide the main advantages. If they use EBVs to select more productive bulls in each of the component breeds, they would actually get a much better result. Otherwise, they are missing the opportunity to lift the base by selecting bulls with better performance.

Crossbreeding will give the biggest initial lift in production, but is a one-off event. Buying bulls is part of continuous improvement from wherever you are now.

The quality of EBV information depends on the amount and accuracy of the data as well as accuracy of the BREEDPLAN calculations developed by research. Since BREEDPLAN began, research has used a range of cattle experiments to continually add new traits and improve its accuracy. This remains an ongoing process.

**Dollar indexes**

Once you have decided your breeding objective, and are ready to select your bull, the challenge is to decide which EBVs are relevant and what emphasis to place on each of them. The BREEDOBJECT system has been designed to do this and bring all the EBVs together into a single $ Index Value that represents the combined value of all of them.

The $ Index Value can then be used to pick the bulls that give an overall best combination for your situation. For example, a bull with a $ Index Value of $10 better than another bull would add $5 extra to each of his calves (assuming they were joined to equivalent cows). This advantage includes the value of all traits in both sexes including growth, fertility and carcase, and includes value to all sectors of the supply chain.

To set up an index to match your situation can be quite complicated. But the major breeds have done this for typical herds, markets and production systems in their breed. All you need to do is use the index closest to your production system and your main target market.

Using the index, you can go onto the breed society web site and obtain a list of all the available bulls in order of your preferred index. This is a great way to conduct a preliminary screening of bulls you may consider buying or using by AI.

If the standard indexes are not suitable, you can visit the BREEDOBJECT web site (www.breedobject.com.au) and complete a simple series of questions to design your own index.
While much has been learned about the practical factors affecting tenderness of meat, investigations continue into what happens inside the cells. Scientists in CRC III are aiming for a deeper understanding of body chemistry and its genetic controls in the hope this knowledge will lead to new ways to produce more tender beef.

This article explains some of the body chemistry and the current theory on why factors such as Bos indicus content and hormonal growth promotants (HGPs) affect tenderness.

**Protein turnover**

In the live animal, muscle is being synthesized and broken down in a continuous cycle referred to as protein turnover. When the animal is growing, synthesis is faster than breakdown, resulting in increasing muscle weight.

The calpains (calpain-1 and calpain-2) are the principal enzymes responsible for protein breakdown. Calpastatin is a specific natural inhibitor of calpains and the balance between calpain and calpastatin helps determine the animal’s rate of muscle growth.

HGPs are thought to act by boosting the proportion of calpastatin. A relatively high proportion of calpastatin means lower rates of protein breakdown and faster growth. Bos indicus cattle also have naturally higher levels of calpastatin.

**Calpains and tenderness**

In the few hours after slaughter, the calpains continue their task of breaking down the protein bonds within the muscle fibres, helping to produce tender meat. If higher amounts of calpastatin are present, they reduce the ability of the calpains to break these proteins down and meat is likely to be less tender.

As rigor mortis takes place and the pH (acidity) drops from around 7.0 to about 5.5, the activity of calpastatin is restricted. When beef is further aged after slaughter, the calpains slowly break down the protein bonds in muscle and make it more tender. This is thought to be the main mechanism by which beef improves with ageing.

It follows that muscles with higher levels of calpastatin will initially be less tender, but with ageing will improve substantially.

**Muscles age differently**

Meat from the loin muscles (cube roll and striploin, including cuts such as scotch fillet, T-bone and porterhouse) will improve significantly with ageing. These cuts have low levels of connective tissue and are known to have low levels of calpastatin, allowing the calpains to quickly break down and tenderize the meat.

Other cuts such as the oyster blade for example hardly improve at all with ageing. This is probably because their lower level of tenderness is due to more natural connective tissue, and connective tissue is not affected by the action of calpains.

At this stage there has been limited study of calpain/calpastatin levels in other cuts and muscles.

**Effect of hormonal growth promotants (HGPs)**

A CRC experiment in Western Australia examined both steers and heifers to study the effects of an appropriate growth implant. There were positive growth rate responses, as expected, but the study also looked closely at meat quality effects in a number of different muscles.

When the striploin was aged for 5 days and cooked, MSA taste panels reported a very significant 10-point reduction in MSA tenderness score in the HGP-treated steers and heifers. The treated animals also had a significantly lower ratio of calpain to calpastatin in the striploin at slaughter.

Samples of oyster blade from the same animals showed almost no HGP effect on tenderness, and had no difference in their calpain to calpastatin ratio.

This suggests that HGPs cause a change in the calpain to calpastatin ratio in some muscles, causing the live cattle to grow faster, but reducing the ability of the meat to tenderize after slaughter. This effect is likely to be different for different types of HGPs.

When the striploin samples were aged for 21 days, the differences were much smaller. The extra 16 days of ageing improved the striploin from HGP-treated cattle by 13 tenderness points while the more tender controls improved by only 3 points. This effectively eliminated the large HGP-induced eating quality difference present at 5 days.

It is thought that calpastatin activity stops during post-mortem ageing and the calpains are allowed to get on with the job of improving the tenderness.

Commercially, this means that extra ageing can be used to offset the toughening of prime cuts caused by the use of some types of HGPs in live cattle production.

These effects have recently been incorporated into the MSA grading model which now adjusts the estimated eating quality of each cut according to whether the animal has been treated with HGP.
**Bos indicus effect and temperament**

Research in CRC I showed that cattle with high Bos indicus content often produce beef that is less tender, with the toughening affecting some cuts more than others, particularly the high priced cuts along the back. The striploin and cube roll (scotch fillet) are high-value cuts and are the most affected.

The MSA grading model has for some time adjusted the eating quality of each cut by the appropriate amount according to the animal’s Bos indicus content.

The research also revealed a strong genetic correlation between tenderness and flight time (a measure of temperament – see CRC fact sheet). This suggests there is a common factor in the underlying genetics of both temperament and tenderness. This intriguing concept is being explored further in CRC III.

Bos indicus carcases also respond differently to processing and a number of theories have been advanced to help explain these differences. Tropical breeds are more sensitive to having the optimum amount of electrical stimulation. With tenderstretch hanging, their tenderness is improved more than British breed types.

To be eligible for grading, MSA now requires processors to follow best practice in electrical stimulation and chilling to minimize detrimental effects.

**Links between HGPs, Bos indicus content and ageing**

Cattle with a higher Bos indicus content are known to have a higher proportion of calpastatin. Eating quality studies have revealed that the cuts affected by Bos indicus content are essentially the same ones affected by treatment of the animal with HGPs. That these are the same cuts that improve most with extended ageing.

This has led to the theory that all three phenomena are primarily caused by changes to the calpain/calpastatin mechanism in muscle.

**Possible links with Net Feed Intake**

Selection to improve NFI (net feed intake, a measure of feed efficiency) is already progressing in some breeds, following studies that showed substantial genetic variation exists between animals in feed efficiency. Feed intake measurement is now being used by breeders to identify feed-efficient sires.

Calpain and calpastatin have recently emerged as playing some role in NFI. It seems that more efficient cattle may also have slightly higher natural levels of calpastatin.

This suggests there will be genetic connections between meat quality and feed efficiency, and that selection for improved feed efficiency.

**DNA tests for tenderness**

DNA markers for tenderness have recently been commercialised. These have been identified by screening the data from CRC’s cattle experiments to find genes that are associated with differences in tenderness. The key genes that emerged were the calpain (CAPN1) and calpastatin (CAST) genes. These now form the basis of the commercial DNA marker tests.

**Current research**

The interactions between genetics, behaviour, biology and meat quality continue to unfold. Two large experiments underway in CRC III have been designed to enlighten us on all these issues.

The experiments include Bos indicus and British breed types carrying known tenderness genes. They have been divided into groups to compare HGP/non-HGP effects, differences in temperament and stress response and tenderstretch or normal carcass hanging.

In addition to providing definitive measures of these effects, tissue and meat samples will provide a huge resource for further studies on the underlying mechanisms controlling tenderness.

Meat scientists are looking at other ways to offset the meat quality effects in cattle that are profitable to produce, but have high calpastatin levels. They may find a way to inactivate calpastatin at or shortly before slaughter, to allow the calpains to tenderize the meat.

Other breeding experiments are checking for any positive or negative genetic associations between tenderness genes and the breeding efficiency of females. This work is vital to ensure a profitable balance in genetic improvement of our production systems into the future.
Tenderstretched hanging from the pelvis improves the tenderness of valuable cuts

Bob Gaden

Tenderness of many major cuts in the carcase can be significantly improved simply by hanging the carcase by the aitch bone (pelvis) instead of the usual achilles tendon (hock) at slaughter. Known as tenderstretch, this technique was proven to be effective by CSIRO in the early 1970s.

Eating quality studies by the Beef CRC in conjunction with Meat Standards Australia (MSA) now show that tenderstretch has a number of other significant advantages that should give it wider application in today’s quality-conscious markets.

Adding value

The key benefit of tenderstretch is that it improves the tenderness of cuts such as the cube roll (scotch fillet), loin cuts (striploin, T-bone and porterhouse steaks), rump and topside. In a typical yearling carcase, these improvements can add value in the order of $100 per head to consumers. But to recoup this, retail cuts must be priced according to their eating quality.

Additional benefits

Tenderstretch has been included in a wide range of CRC experiments conducted over more than a decade. These have included live animal experiments (including breed, growth, HGP treatment, finishing system) and a range of processing environments (rates of carcase chilling, pH/temperature drop, electrical stimulation and ageing).

Out of these studies, a number of important advantages emerge:

- As expected, tenderness is consistently better in premium grilling cuts
- The need for ageing is reduced, as tenderstretched beef is already tender
- Carcases with Bos indicus content are improved more by tenderstretch than British breed types (these effects are related to individual genes being studied further in CRC III)
- Leaner cattle and those from lower quality pasture-based finishing systems are improved substantially by tenderstretch
- The toughening effect in high-priced cuts caused by Hormonal Growth Promotants (HGPs) is largely neutralised by tenderstretch
- Tenderstretched carcases retain their eating quality better when outside the optimum pH/temperature window, i.e. they are more tolerant of variable processing conditions.

Why does it work?

Tenderstretch keeps many of the hindquarter muscles from shortening while the carcase undergoes rigor mortis (“sets”) in the hours following slaughter. Stretched muscles are tenderer to eat.

The main tenderising effect appears to be from the physical stretching of the muscle fibres, although small biochemical differences have been observed due to tenderstretch. The calpain/calpastatin enzyme systems do not seem to be responsible.

Research in CRC III studying tenderness genes and their expression may help better explain why tenderstretch is so effective.

Adoption of tenderstretch

Why have all but a few processors ignored this simple technique almost completely for more than 30 years?

This is a sad reflection on the industry’s interest in supplying its customers beef of the best possible eating quality. It reflects a number of practical issues such as:

- Extra labour required at the abattoir
- Possible alterations required to chiller rails and loading practices
- Different shaped cuts, requiring training in the boning room
- Retailers and customers may baulk at unfamiliar shaped cuts
- Quality improvements are invisible but the “problems” are visible

Despite these issues, a number of quality-conscious branded products now recognise its value and include tenderstretch in their program to underpin quality.

One way to receive recognition for the value added is to have carcases graded by MSA and sell the cuts according to their predicted eating quality.

Further information

Since its establishment in 2004 Nolan Meats Private Selection has quickly become Australia’s leading privately-owned brand of quality table beef. It is the culmination of many years of effort by Nolan Meats using the Beef CRC’s state-of-the-art technologies to produce high quality, tender beef for the domestic market.

Private Selection is now marketed through restaurants, retailers and wholesalers throughout Australia and appears on menus at prestigious venues such as Brisbane’s Breakfast Creek Hotel and Sydney’s Prime Steakhouse.

The Gympie, Queensland-based company processes 1800 cattle each week, almost all grain fed, from their own Wide Bay feedlot and two other local custom feedlots. Carcases are graded to Meat Standards Australia (MSA) standards and drafted into boning groups to suit the Private Selection brand criteria.

Terry Nolan is one of three brothers who have been the driving force behind their move into high quality beef. Since their parents Pat and Marie Nolan established a butcher shop in Gympie in 1958 the family-run business has expanded steadily into pig and cattle breeding, lot feeding, processing, retailing and marketing.

Nolans have been innovative in both livestock and processing areas. For more than a decade they have been leaders in developing, applying and fine-tuning new meat quality technologies developed by the Beef CRC.

Terry Nolan remains the longest serving member of the MSA steering committee, joining David Crombie, Rod Polkinghorne and others when it was established in 1996. He strongly believes that meat producers must get closer to the consumer and has played a leading part in the development and marketing of branded beef products in Australia.

Nolans were the first processor for the Australian Agricultural Company’s well-known 1824 brand, helping to establish its specifications and fine-tune northern breeding and production systems to achieve high levels of compliance to MSA eating quality.

In 2002 Nolan Meats joined AA Company and former Woolworths meat chief Pat Dempsey to establish Chefs Partner, a food service provider specialising in high quality beef for restaurants. This brought them another step closer to consumers.

Terry Nolan manages operations, livestock and marketing for Nolan Meats. His brother Tony handles the company’s administration, finance, feedlot nutrition and information technology while Michael handles construction and maintenance.

Tony Nolan, a qualified electrical engineer, was a board member of CRC II. This was a dynamic period when the MSA grading system grew rapidly, influencing abattoirs throughout Australia with technologies developed by the Beef CRC. Most significant of these were the correct use of electrical stimulation (to control the rate of pH drop and optimise tenderness), and pre-slaughter management to reduce stress.

Michael Nolan, a butcher cum self-taught engineer, has complemented his brothers’ work by steadily re-building the plant with a host of engineering innovations to achieve exceptional levels of food safety, animal welfare, environmental management and labour efficiency.

Consistent quality
To help ensure consistent eating quality, Nolans Private Selection is a brand underpinned by MSA. This means cattle must meet grading criteria which aim to minimise pre-slaughter stress and then use best practice processing technologies to ensure tenderness.

Carcases are graded after chilling. The brand specifications require carcases better than MSA 3 star level with respect to meat colour (minimum chip 2) and ossification (maximum score 250). This ensures cattle are younger and less stressed than other typical 3-star carcases.

Pre-slaughter stress
Minimising stress before slaughter is a key factor for Nolan Meats. To achieve this, cattle are transported to the abattoir and placed on feed at the small on-site feedlot for a few days, remaining in their peer group. This allows them to settle and recover from any stress from travel.

This practice began in the 1980s when they began buying grain-fed cattle in truck lots each fortnight, establishing a small feedlot on the abattoir site to spread the slaughter over two weeks. They noticed that feeding on site for a few days before slaughter gave significant benefits in meat and fat colour, eating quality and reduced stress.
The abattoir handling yards were recently re-built by Michael Nolan to a low-stress design. They incorporate many features inspired by the internationally-respected livestock handling authority Temple Grandin. Yards are under cover and the main working areas feature solid concrete walls, curved and tapered race and revolving, electrically operated forcing yard gates.

**Slaughter**

The near-new slaughter floor incorporates features to enable effective cleaning and sterilisation to maximise food safety and shelf life of the product.

A low voltage stimulator early on the chain is tuned to ensure the pH and temperature decline are in accordance with the optimum "window" for tenderness, defined by research in CRC I. The graders regularly monitor the rate of carcass pH and temperature drop to ensure they stay within specifications.

**Tenderstretch**

At the end of the slaughter chain, hot carcases are re-hung by the pelvis before chilling. They need to be hung this way as they go through rigor mortis, to achieve the beneficial tenderstretch effect.

Terry chuckles when he remembers that they used to do tenderstretch for some service kill clients in the 1970s and early 80s. He was given the job in the 1980s to convince clients not to request tenderstretch - the carcases took up too much room and were too hard to carry.

His outlook on tenderstretch was changed when the steering committee reviewed MSA taste panel results from an experiment in 1997. There was a huge advantage of 4-12 eating quality points to beef from tenderstretched sides compared to the same cuts from the other side of the same animals, hung traditionally by the achilles tendon.

If Nolan Meats were serious about meat quality, this was too good to ignore – so they began hanging carcases by tenderstretch immediately.

They were quickly convinced that improvement in eating quality vastly outweighs any inconvenience at the abattoir and Nolans have been tenderstretching their entire production ever since.

**Grading**

After overnight chilling, carcases are graded by one of 11 trained staff graders under head grader Mick Senini. Mick is one of the most experienced MSA graders and completed his grader training with Cameron Dart who now manages the MSA program for Meat and Livestock Australia.

After grading, the carcases are re-hung by the achilles tendon as the beneficial effects of tenderstretch are complete. Before boning, for convenience of packing the cuts, carcases are drafted into boning groups.
which have cuts of similar eating quality grade.

**Livestock supply**

Mainly British type and crossbred feeder cattle are sourced from saleyards anywhere from central NSW to central Queensland, depending on availability and time of year. A proportion of Bos indicus content is an advantage during the summer months to help them tolerate the Queensland heat.

Cattle are grain fed to a carcase weight of 200-280kg and 5-12mm P8 fat depth. The company has around 5,000 head on feed at its own Wide Bay feedlot and others are custom fed at two other feedlots in the area.

Even though their business is based on quality, Terry Nolan believes the key factors to look for in feeder cattle are their potential for growth and yield of muscle. This is because good eating quality is achieved in most cattle by slaughtering them young, feeding them well, minimising stress and applying the best processing technologies including tenderstretch.

Feeding mainly fills out their muscle potential and he aims to slaughter cattle before they start to get too fat. Terry says this ensures high yields in the boning room. He believes the end result is achieved 70% by nutrition and 30% by genetics.

The grading process adjusts the eating quality grade of each primal cut according to tropical breed content, so there are no fears of breed type interfering with eating quality. The breed effect is further offset by use of tenderstretch which results in a greater tenderness improvement in tropical breed types.

Higher levels of marbling are not needed for short-fed young animals although Terry acknowledges that feedlots supplying the long-fed, Japanese market need to work with livestock suppliers to improve genetics and backgrounding techniques. For Nolans’ markets, Terry does not see any need for this.

**Marketing**

Terry Nolan describes the promotion of Nolans Private Selection brand as “quiet, not noisy”. He admits they have spent nowhere near as much on marketing as some of their competitors. But so far this has not been a problem because Nolans has a strong reputation among the wholesalers who effectively market the product for them.

In some cases, chefs promote Nolans Private Selection on their restaurant menus. But more often they just buy it from their wholesaler because they know it is a dependable product.

Sometimes chefs and wholesalers put their own brand on it, but Terry is not concerned. He says as long as consumers have a good eating experience and keep eating Nolan Meats beef, this saves his company big dollars in promoting the brand directly to restaurants, retailers and consumers.

Nolans Private Selection is distributed from their Gympie plant as boxed beef, mainly to wholesalers throughout Australia, the majority in the eastern states.

He says gaining a reputation for the quality of their
product was a struggle in the early years. But MSA helped straighten out processing technology and provided the credibility to guarantee the eating quality.

They now sell significant quantities of their high quality product into Victoria. This is ironic, as Victoria has been very slow to adopt MSA, believing they already produce the best beef.

Describing himself as a ‘great fan of MSA’, Terry says MSA was instrumental in helping Nolans break through the perception barrier that consumers and the meat trade held against northern beef.

He says the MSA generic brand was a flop to consumers because there was no point of difference between company products. But since establishing the Private Selection brand, Nolans have been able to steadily build a loyal following.

**Future**

Nolans see their priority is to consolidate their position in the domestic market where they see plenty of potential for their brand of lean and tender beef.

The opportunity to expand to overseas markets is not being ignored. If Nolans choose to move this way, it will not be to produce marbled beef which they consider wasteful and inefficient.

Nolans believe that when the time is right, they will tap into what they believe is ample potential around the world for their type of leaner, tender product.

Meanwhile, Terry and his brothers are actively developing management teams around them, to share responsibilities with staff and prepare them to take responsibility for expansion in the future.
THE VALUE OF MUSCLING AND
YIELD

Brian Sundstrom

The Beef CRC has a significant commitment to lifting the proportion of saleable meat (retail yield) in Australian beef carcasses. There is substantial existing knowledge about yield in the industry but it has been poorly understood and applied by producers because market signals for yield are not clear.

This article explains why muscling is important, while others outline the CRC’s research projects which aim to build on existing live assessment skills and the new genetic technologies. CRC Partnership projects with commercial supply chains are being used to validate the technologies and facilitate adoption.

Muscling or conformation?

For quite some time in the 1980s and 90s a minor controversy bubbled away in the beef cattle research and extension communities. The issue was the merit of visually assessing conformation and using it in selection.

Many researchers felt conformation was at best overused and usually a waste of time leading to selection for fatness. Some extension people, meatworks buyers and stud breeders argued that carefully used, it was a good indicator of retail beef yield. Adding a little curry to the debate, was the feeling of some Queenslanders, that some southerners in supporting the value of thicker conformation animals, were denigrating Bos indicus stock! As is often the case, both parties were probably partly right at the time.

Certainly many people when assessing conformation, were favouring fatter animals that have more waste fat and lower yield. They were making little progress in their selection for yield.

One group of extension people, led by Bill McKiernan and Sandy Yeates in NSW Department of Primary Industries, argued that conformation was indeed a confusing term and that those who believed in visual selection were really assessing muscle score (see box).

Validating Muscle Score

Bill McKiernan, Sandy Yeates and a research colleague Diana Perry, set out to define the value of muscle score in domestic and export steers. Using large lines of slaughter cattle, they proved conclusively that:

- Experienced and/or well-trained assessors could repeatably assess muscling.
- Visual muscle score, when assessed by such people, was closely linked to retail beef yield percentage and dressing percentage.
- For every increase in muscle score, at the same liveweight and fatness, an increase of one muscle score raised dressing percentage by 1.5 – 1.7% and retail yield by 1.5 – 2.0% of carcase weight. There was also a trend towards increasing proportion of hindquarter cuts.

The same advantages also held for Bos indicus (tropical) breeds, i.e. even though Bos indicus have a higher dressing percentage than Bos Taurus (British) breeds, the better muscled Bos indicus lines are further ahead of poorly muscled lines.

These results have also been replicated in the US.

The work improved understanding of the fact that extra muscling increases both dressing percentage and retail yield in the carcase. But while extra fatness also increases

**Muscle Score** describes the thickness of the muscles after allowing for fatness. There are five Muscle Scores from A (very heavy) to E (light). Each score is sometimes split for further accuracy into plus and minus.


**Dressing percentage** is the percentage of carcase weight recovered from the live animal.

**Retail Yield** is the proportion of saleable meat recovered from the carcase.
dressing percentage, higher levels of trimming mean it decreases retail yield in the carcase.

In southern Australia, this work led to new muscle/fat descriptions being adopted by the saleyard market reporting systems. By reporting muscle score (A-E) as well as fat score (1-6) they effectively separated the two key predictors of yield.

**Breeding for better muscling**

Bill McKiernan continued his strong interest in muscling research with NSW Department of Primary Industries, in particular the positive and negative aspects of improving muscling by breeding.

More recently his experiments have been included in the CRC’s program for further in-depth studies. The questions being looked at include:

- The effect of muscle score selection on female traits such as calving ease and fertility.
- Further clarification of the effects on carcase yield and muscle distribution such as proportion of hindquarter cuts.
- What is the role of the so-called, ‘double muscling genes’? Are they so deleterious in normal commercial production system to be dangerous or can we use gene marker technologies to develop safe systems for using them in selection?
- How do these genes work, and can we modify the way they are expressed?

These questions are being investigated in other CRC work and in BREEDPLAN, the National genetic evaluation program that produces Estimated Breeding Values (EBVs) for traits including yield in most Australian breeds. BREEDPLAN utilises considerable CRC research in its methodology.

For more information see related articles –

- Visual selection for muscling in a breeding herd (pg 25)
- The Myostatin gene promises better yield (pg 27)

In dollars to the producer…for a typical 450kg steer worth $2.00/kg liveweight:

- An extra 1% dressing percentage is worth about $15 per head in extra carcase
- An extra 1% retail yield is worth about $13 in extra beef
Producers have long been concerned that selection for heavier muscling in a breeding herd would bring penalties in the performance of females. Fears include poorer fertility, lower milk production and greater calving difficulty.

This article outlines a long-running experiment with a commercial breeding herd set up by NSW Department of Primary Industries and now included in the Beef CRC. It aims to establish the progress that can be made in improving the value of steers and examine any negative impact of extra muscling on the breeding females.

Muscling selection experiments

Bill McKiernan, NSW DPI Livestock Research Leader (Orange) and Greg Meaker, Beef Officer from Goulburn, have been running a selection program for and against muscle score since the early 1990s, concentrating on selection for muscling and measuring the consequences.

The experiment was started at NSW DPI Elizabeth Macarthur Agricultural Institute at Camden in 1991. It continued there until 2002 when drought and alternative demands on the site necessitated moving the herd to the DPI’s Glen Innes Research Station. Since then there has been increasing CRC involvement.

Originally a random selection of Hereford females were used, representing breed average muscularity. High and Low muscle score Angus bulls were selected visually and used to produce progeny for comparison. In 1997 females from these matings were selected on their High or Low muscle score pedigree and on their own muscle score, to form High and Low female lines. They have been subsequently run as separate breeding groups, mated to High or Low muscle score Angus bulls respectively, sourced from industry herds. Subsequent generations of females have been selected on muscle score to be replacements for the respective herds.

Currently two herds of more than 70 cows are being run. The average muscle score of the Low herd is D muscle score and the High cattle are a little over muscle score C (i.e. one full muscle score separation, average of both male and females).

A third, related herd is also run at Glen Innes and includes cows carrying the ‘double muscle gene’ (myostatin deletion gene). This research is helping to understand the biology of muscling and the potential use of DNA tests to improve retail yield. Information from this herd is reported independently, but also compared with the two selection lines described above.

Selection line results and implications

- There is now a full muscle score difference between the herds in both males and females, which has given a clear economic advantage to the High muscling herd. In saleyard terms, one full muscle score advantage across all stock categories attracts a premium of 10c to 20c per kg liveweight, currently worth more than $100 per animal sold.
Implications:

- Visual muscle scoring by experienced people does work – it is repeatable and heritable
- Selection adds substantial value to sale stock in an average commercial herd

Selecting for cows and sires on muscle score has also increased the eye muscle area (EMA) of progeny. Measured at any age up to slaughter, there is a difference of 5 to 10 cm² between the lines at the same weight.

Implications:

- The objective measure, eye muscle area, is correlated to visual muscle score.
- The two can be used as alternative or preferably complementary, selection tools.
- BREEDPLAN EBVs for EMA can be used in bull selection for herds and breeds with this information of sufficient accuracy.
- Visual selection becomes more important for breeds without accurate EBVs.

Fatness has decreased in the High muscling line, although the decrease is only marginal at the rib site. Results from over 200 steers slaughtered from these lines show a decrease of about 2mm at the p8 site on a 350kg carcase from the High muscling line at 2 years of age. Rib fat has been relatively constant. Marbling fat has slightly decreased in the High muscling line.

Implications:

- Selection for muscling need not reduce growth – a common industry concern.
- Weight can also easily be monitored via BREEDPLAN weight EBVs
- The shorter stature is in keeping with industry perception of “dumpiness” in more heavily muscled animals. However, the experimental lines are the same weight at any age.
- Contrary to common industry perception, heavier-muscled, ‘dumpier’ animals are in fact the same maturity pattern if not later maturing than their low muscle counterparts.
- Store steer buyers should not only rely on animal height as a gauge of maturity and growth potential but should consider musculature in combination with height and weight to assess finishing performance.

Japanese market Sindex

- Compared to the Low muscling line, High line steers after three generations of selection had: 1% extra dressing percentage; 1.25% better retail yield percentage and the proportion of hindquarter primal cuts was over 1% higher.

Implications:

- These changes combine for a very significant increase in beef value per kg liveweight or dressed weight.
- This is in keeping with crossbreeding experiments using heavily muscled breeds such as Limousin, but had not until now been so clearly shown for a British breed.
- The widely held view that “selection on conformation cannot change the distribution of cuts” is not always true.
- There has been little or no effect on growth rate between the lines. High line cattle are however shorter as measured by hip height.

Implications:

- Selection for muscling results in higher-yielding cattle that are more attractive for most markets
- For the high quality long-fed Japanese and Korean markets, to avoid losing marbling, watch EBVs for marbling and use the

Possibly the most difficult trait to measure accurately is female fertility and performance, as very large numbers of calvings are needed.

- There is currently no difference in weaning weight of progeny between the High and Low muscle lines, indicating that milk production has not been adversely effected.
- Serial ovary scanning of weaner and yearling heifers found no differences in “active ovaries” as heifers achieved sexual maturity. This indicates sexual maturity of females from the two muscle lines is the same.
- There has been virtually no calving problems within the muscle line herds. The Low muscle line has slightly heavier calves at birth – the opposite to what most producers would expect.
- Overall fertility, number of calves born or weaned relative per cow mated, is effectively the same in each herd.

At a recent field day, Bill McKiernan summed up, "We are now confident of the results that selection for muscling within British breeds, at least to these levels, will result in substantial economic benefit with little impact on other herd productive traits".

He also stressed: "This is an experiment to study the effects, by selecting on a single trait. This does not imply that single trait selection should be pursued commercially. We recommend that muscling can and should be included in multiple trait selection programs. This can be either by straight or cross breeding, depending on the situation”.

Further information, see related articles:

- The value of muscling (pg 23)
- Myostatin gene promises higher yield (pg 27)
Breeding to improve carcase yield is being studied in a number of experiments using traditional selection techniques. At the same time, scientists are searching for the genes responsible for the resulting yield differences.

One experimental herd carries a gene known as myostatin which has a substantial effect on yield. In both field and laboratory experiments, the CRC is examining how this gene might contribute to practical improvement programs in the future.

**Current double muscling work**

The ‘double muscle’ condition in cattle (muscle hypertrophy) is well known and studied. While there are potential big increases in the percentage yield of saleable meat, there are many problems with the full double muscled animals for commercial production, including extreme leanness, poor temperament and calving difficulty. These problems have prevented their widespread use in Australia.

It is also known however, that a milder variant of the condition occurs where cattle carry only one of the ‘double-muscling genes’ i.e. are heterozygotes. (For simplicity in this article, hereafter termed mild-double muscling MDM).

MDM cattle display many advantages of double muscling in meat characteristics but also carry subcutaneous fat and are just as functional as normal animals. For more detail on double-muscling and the genes involved, see the box story on the next page.

Following his many years of studying the effects of increasing muscling through visual selection, as described elsewhere, Bill McKiernan has become interested in this ‘mild double muscling’ as a tool to speed up progress for some specialist producers. He and colleagues in NSW DPI with funding from MLA and close CRC links, are now studying the effect of this condition over and above that effect of visual selection for muscling in their selection lines.

**Two herds**

Two herds are being studied, a 300 cow NSW DPI research herd at Glen Innes, and a commercial pure-bred Angus herd in the Hunter Valley. Both herds are carrying...
a number of animals with the myostatin gene.

**Early results**

Results and observations to date:

- In both herds eye muscle area is higher in MDM cattle by 12 to 20% at the same age and muscle score by almost one full muscle score. These cattle were already known for high levels of muscling.
- MDM cattle were only slightly leaner and slightly smaller in stature or height than normal cattle.
- MDM cows and heifers in both herds were the same weight and condition as normal animals. Records indicated they were equally productive in maternal traits.
- The most dramatic result so far has been the enormous impact a single copy of the gene had on carcase traits. 40 steers from the Glen Innes herd were slaughtered in 2006 and assessed for carcase traits. The carcases were boned out and meat yield information collected. 11 MDM steers were compared with steers from the High and Low muscle selection lines. Full detail is in the table above.
  - MDM steers dressed 1% more than High line steers and 2% more than Low line steers.
  - All steers had the same fatness at the P8 and rib sites (24 and 16mm respectively).
  - Once boned out however, both higher muscled groups had less total body fat percentage.
  - MDM steers yielded an extra 5% of retail cuts compared to Low steers, with High steers intermediate.
  - Finally and very significantly, there was a 2.5% advantage to the MDM steers over Low steers in the proportion by weight, of primal cuts in the hindquarter. High steers were again intermediate.

**Future application**

Summing up at a recent field day, Bill McKiernan stated; “With careful planning and DNA testing now offered by the Genetics laboratory at NSW DPI’s Elizabeth Macarthur Agricultural Institute, self-replacing breeding programs can be designed to take full advantage of these improvements. Incentives for producers to make these improvements to meat yield need the support of processors by implementing systems of better carcase feedback and price incentives on percentage yield.

He also sounded a word of warning. “This technology is not for everyone. It is only for producers prepared to instigate a rigorous breeding program using DNA testing to ensure the deleterious full double-muscled (homozygous) form of the condition does not occur.”

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**Double-muscling genes**

A single gene, myostatin, has a major effect on the regulation of skeletal muscle development and normally inhibits excessive muscle growth. A mutation in this gene reduces its powers, resulting in increased muscularity or muscular hypertrophy. There is an increase in both the number and size of muscle fibres, particularly in the hindquarters or the extremity muscles.

There are six known different myostatin mutations, each having a slight variation in their effect. All cattle have two copies of the myostatin gene and animals without a mutation exhibit normal muscling. Those with a mutation in each copy of the gene (2 copies) exhibit the extreme ‘double’ muscled phenotype and depending on the mutation, can experience production problems.

Animals with one copy of the myostatin deletion mutation (heterozygotes) offer superior muscling advantages over cattle without a mutation, including increased muscle mass, increased rib eye area (EMA) and a small reduction in fat.

A DNA test to determine the number of copies (0, 1 or 2) of any of the six known myostatin mutations causing muscular hypertrophy is offered by the Genetics laboratory at NSW DPI’s Elizabeth Macarthur Agricultural Institute.
HGPs - GOOD FOR PROFIT, NOT SO GOOD FOR MEAT QUALITY

Bob Gaden

The extra growth seen by producers and feedlots from using hormonal growth promotants (HGPs) boosts their profits. But there are mounting concerns the beef industry is not doing its customers any favours when HGPs may cause tougher meat.

Several CRC experiments have defined the eating quality effects on important cuts of the carcase and have come up with processing strategies to offset them.

This article summarises the main issues for beef producers as the Beef CRC continues its ground-breaking work on the underlying genetics and biology.

Good for growth…

- HGP treatment of backgrounding or finishing cattle adds significantly to their weight gain.
- The faster the gain, the greater the response – the greatest response occurs in the feedlot and least during periods of slow or negative growth on pasture.
- The vast majority of cattle in feedlots destined for the domestic market are treated and the boost is important for their profit margin.
- Additional gain in weight gives a substantial return in the order of $30 to $50 for the few dollars it costs to treat them.

Not so good for meat quality…

- Consumer studies by Meat Standards Australia (MSA) and the Beef CRC confirm that HGP treatment reduces tenderness, especially in the main grilling cuts.
- HGP treatment affects some cuts more than others:
  (i) Those cuts which improve most with post-mortem ageing showed the largest decrease in palatability (eg the striploin).
  (ii) Cuts that do not improve with post-mortem ageing showed no effect of HGP implants on palatability (eg the oyster blade).
- HGP treatment reduces marbling, important in some markets (e.g. high quality Japan/ Korea).
- Grading by Meat Standards Australia (MSA) reduces the estimated eating quality of some cuts in HGP treated carcasses.

Studying the effects

The Beef CRC is continuing to examine the underlying biology of tenderness, and more recently, the individual genes and how they are expressed.

An experiment in Western Australia showed the expected positive growth rate responses in steers and heifers treated with an appropriate growth implant. The study looked closely at meat quality effects in a number of different muscles.

- When the striploin (a highly valuable grilling cut) was aged for 5 days and cooked, MSA taste panels reported a very significant 10-point reduction in MSA tenderness score in the HGP-treated steers and heifers.
- Samples of oyster blade (a harder-working muscle with more connective tissue) from the same animals showed almost no HGP effect on tenderness.

Other studies show that muscles that improve fastest with ageing have a higher rate of protein turnover in the live animal. Protein turnover is the balance between the on-going natural processes of protein synthesis (buildup) and protein degradation (breakdown).

HGP treatment increases protein synthesis and reduces degradation, resulting in...
in more muscle growth. Protein synthesis does not affect palatability; the negative impact on eating quality is caused by reduced degradation.

**Processing to maximise tenderness**

The MSA grading model now estimates the eating quality of each cut according to whether the animal has been treated with HGP.

- Additional ageing of HGP treated carcases after slaughter (3 weeks) will significantly improve tenderness. Meat from non-HGP treated cattle does not improve as much with ageing.
- Tenderstretch hanging will also make a greater improvement than in non-tenderstretch carcases, going a long way towards offsetting the negative HGP effect.
- If management of the abattoir chiller and electrical stimulation are not coordinated to give the optimum pH/temperature drop, this seems to magnify any negative effects.

**Related effects**

Researchers believe that changes to the synthesis and degradation rates of protein in the live animal are involved in a number of factors known to affect eating quality. These include Bos indicus content, temperament, hanging method and ageing.

For example, some Bos indicus genotype animals naturally carry genes that cause slower protein degradation. If these animals have been HGP-treated, especially if other processing technologies are not used or optimised, the meat can be very tough.

These relationships and the underlying genetics are being further studied in CRC III (see “New Light on Tenderness”, p16).

**Market signals**

Only a few specific markets discriminate against HGP treatment. These include:

- The European Union (EU) where HGP-freedom is a requirement and livestock suppliers must be accredited.
- Most feedlots and processors supplying the long-fed Japanese and Korean markets where marbling is more important than yield.
- Some branded products and boutique lines where tenderness is very important.
- Branded products that promote their product as “HGP-free” beef.

**Consumer perceptions**

HGPs are registered for use in cattle and are widely used in USA and Australia. The way they work is to produce a hormone which is very similar in structure to the animal’s natural hormones. There are no known health issues associated with consuming beef from treated animals.

Some consumers have a negative attitude to hormone treatment of food animals, largely stemming from side effects of very early synthetic oestrogens used to sterilise male chickens (these have long since gone out of use).

Consumers are naturally concerned that their food is safe and wholesome, and fortunately they have a high level of confidence in Australian beef. They are generally not aware of the details of how our beef is produced.

Given this background, Australian consumers are mainly concerned with consistent eating quality and price.

Many retailers are reluctant to raise the subject of HGPs in case it causes unnecessary fears. For example, to promote a “HGP-free” product would alert many consumers for the first time that hormones are still used in some beef production systems.

**Implications for industry**

- If you don’t use HGPs, you are missing out on potential profit from the extra growth achieved by increased feed intake and better feed conversion efficiency. To make up the difference you would need substantial premiums for HGP-free stock.
- Processors should use best practice eating quality technology – tenderstretch, optimal pH/temperature management – to maximise tenderness and offset the negative effects of HGP treatment and high Bos indicus content.
- If retailers are concerned about meat quality they should market beef cuts by their predicted eating quality, using MSA grading. This adjusts for many factors affecting eating quality, including HGPs.

**Bottom line for producers**

- HGPs produce more beef and in most cases increase profit.
- HGPs may not be suitable in cattle supplied to some niche and high quality markets, especially EU and the high marbling markets such as Japan and Korea.
- Check the market premiums for HGP-free cattle – are they high enough to offset the extra weight they produce?
- For all beef markets where eating quality is important, make sure processing is optimised.
- To maximise meat quality, don’t use HGPs at all… but you might miss out on some profit unless you are receiving a premium for eating quality.
To make the most of export opportunities for high quality beef, Australia needs to know how to maximise marbling in the short term. The Beef CRC has given us a blueprint for now, but current research hopes to unlock new ways to produce high quality beef more efficiently.

A team of international researchers including the Beef CRC’s Professor Dave Pethick has been studying the basic biology of intramuscular fat (marbling). Their work includes the intimate details of how marbling cells are formed, how genes control their development and the environmental triggers that modify how genes are expressed.

These studies are part of a network of linked projects in the CRC discovering the genes that govern how the animal uses its nutrients to grow and develop carcase tissues.

In a recent paper, the team outlined its present knowledge of the biology of marbling. The following is a summary:

- **Intramuscular fat content (IMF%) or marbling score** is “late maturing”, meaning that marbling is usually seen later in life, as the animal matures.
- **Fat is made (synthesised) within muscle throughout life when nutrition is adequate and does not only occur as animals get older. The growth of muscle slows as animals get older, and if good nutrition allows fat synthesis to continue, intramuscular fat, and therefore marble score, will increase.**
- **IMF% develops in three stages. There is no increase up to about 200kg carcase weight, a steady increase from 200 to 450kg and it peaks around mature body size (about 500kg carcase weight, depending on genotype). Carcase weights rarely reach mature size in commercial systems.**

- **Expression of marbling after extended grain finishing is driven by three main genetic influences:**
  1. overall fatness, i.e. fatter cattle tend to have more marbling
  2. the degree of muscle development, i.e. cattle with thicker muscling (and later maturing types) tend to have less marbling
  3. marbling genetics, i.e. some cattle deposit more fat as marbling rather than in their other fat depots (subcutaneous, between muscles or internal).

- **There is not enough yet known about how genetic factors (including new gene markers) affect the final marble score.**

- **The level of intramuscular fat at feedlot entry is the main factor that determines marble score after finishing. This suggests that ultrasound scanning could be used at feedlot entry to identify animals that will develop superior marbling (and those that won’t).**

- **Intramuscular fat cells are not the same as fat cells in other depots. Their development is determined relatively early in life (3-8 months of age) which is consistent with the conclusions of CRC growth and development studies. Beef CRC scientists are now exploring the possibility that intramuscular fat can be controlled separately from fat in other depots.**

- **The best nutritional and/or management tool for increasing marbling is to finish cattle on a highly digestible, grain-based diet. This provides the highest level of net energy (leading to high blood glucose levels) and promotes fat synthesis.**

- **Grain feeding (compared to grass) results in a higher marble score at equal carcass weights. This is probably because grain provides a higher level of available net energy.**

- **Heavier British type cattle (over 540kg live and 12mm P8 fat) have a low need for protein. Adding extra protein makes the ration more expensive but doesn’t promote extra marbling.**

- **Increased processing of the grain ration (by steam flaking compared to dry rolling) improves digestion of starch and this produces better marbling.**

**Further reading**

FAST FACTS…….

- Marbling is the small flecks of fat scattered throughout the muscle.
- Marbling contributes to flavour, juiciness and tenderness, especially of grilling cuts.
- Marbled beef is used mainly by the restaurant and food service industry.
- A growing number of our export markets (Japan, Korea) pay a premium for marbled beef.
- Cattle develop more marbling as they fatten, especially on high grain diets.
- Producers can increase marbling through genetic selection and improved nutrition.

Why is marbling important?

Marbling is defined as small flecks of fat distributed through the muscle of cattle. It is important because it contributes to flavour, juiciness & tenderness.

Although it is possible to achieve good eating quality without marbling, large consumer studies with cooked beef confirm that marbling improves eating quality. This is especially true for the grilling cuts and to a lesser extent roasting cuts of beef.

Markets for marbled beef

Consumer studies also revealed that while Australian consumers liked marbled beef when cooked, they generally don’t like to buy meat with visible fat in the supermarket. Therefore in Australia, marbled beef is used mainly by the restaurant and food service industry. This meat comes mainly from the short-fed feedlot market.

Japan is the major market for marbled beef. The value of beef in Japan is strongly related to its marbling content. Newer markets for marbled beef are opening in other countries, especially Asia. Australia’s third biggest export customer, Korea, has reduced their demand for grass-fed beef and increased demand for marbled, grain-fed beef.

Australia produces different levels of marbling for a range of market segments. They are commonly referred to as Short-fed B1 (100-120 days on feed, aiming for Marble score 1), Medium-fed B2 (150-180 days on feed, aiming for Marble Score 2) and Long-fed B3 (more than 250 days on feed, aiming for Marble Score 3 or better).

What influences the development of marbling?

Marbling develops readily in animals with the right genetics, when given the right nutrition.

Without the genetic potential, cattle will not develop marbling no matter how long, or how well they are fed.

Grain is much better than pasture at achieving high levels of marbling due to its higher energy levels. This is why cattle targeting the Japanese marbled market are finished in feedlots.

Breed

Some breeds are known to produce more marbling than others. As the market for marbled beef developed in the late 1980s and early 1990s, the industry quickly focused on Angus, Shorthorn and Murray Grey as the preferred breeds for the B3 segment.

The Angus and Shorthorn breeds have responded by producing bigger, later maturing cattle that have marbling genetics. Later maturity helps the steers grow out bigger and carry heavier weights without becoming too fat.

Although there are only small numbers of the Japanese Wagyu breed in Australia, significant numbers of Wagyu cross cattle are now being bred in the eastern states and are being fed for the high quality segment.

Although some other breeds are quite capable of producing marbling, the major feedlots have generally simplified their buying policy down to their choice of a few proven breeds.

Genetics

Cattle with the genetics for marbling will marble at a faster rate than cattle with lower genetics for marbling no matter what the diet. The advantage will only increase when on a high energy, feedlot diet.

The heritability of marbling is quite high, 30 to 50%. So, it is possible for producers to select for marbling just as they would for growth or fertility.

Commercial breeders are now able to use EBVs for marbling to select bulls that will improve marbling performance.

Rather than select on marbling alone, it is important to balance it with other important production traits including both male and female traits affecting total herd productivity. BREEDOBJECT enables all the available EBVs to be given a weighting according to their economic importance, and converted into a single $ Index Value.

DNA technology

Several DNA markers associated with marbling have been identified and tests are now commercially available. An Australian company, Catapult Genetics tests for four markers associated with marbling, as well as other traits.

Bull breeders can send samples to the laboratory.
where DNA is extracted and the presence or absence of the particular DNA markers is reported.

The Genestar® tests are only part of the marbling story, as the proportion of genetic variation explained by these genes is different in different breeds, and there are many other genes as well as non-genetic factors that decide the expression of marbling.

Research at Armidale’s, Animal Genetics and Breeding Unit is currently under way to include DNA test results into the calculation of BREEDPLAN EBVs. The priority is to provide Australian breeders with a single, balanced EBV to guide genetic selection, rather than confusing them with bits of information on single DNA tests.

**On-farm nutrition**

Cattle that have been on poor nutrition prior to feedlot entry generally have less marbling at slaughter than those that have had good nutrition. So it’s important to ensure that young cattle grow steadily from birth without any significant growth setbacks. A target of 1kg/day from birth to weaning is ideal.

The period after weaning is critical. Animals should achieve minimum growth rates of 0.6kg/day from weaning to feedlot entry.

**Feedlot nutrition**

A few generalisations can be made about improving marbling in a feedlot.

- The higher the energy in the diet, the more animals will marble
- The longer the time on feed, the more animals will marble
- The better animals were fed before arriving at the feedlot, the more they will marble
- HGPs delay deposition of marbling, similar to the effect of a later maturing animal
- Finer grain processing leads to better absorption by the animal. This makes more net energy available which leads to higher marbling. Steam flaking of grain is ‘best practice’ for processing of whole grains.

The Beef CRC trialed a range of diets thought to increase marbling. These included canola oil plus calcium, Rumentek™, low and high protein diets and different grains (maize, barley and oats). None of these diets especially increased marbling.
Tick vaccine promises big benefits

Ala Lew

A single, annual vaccination that provides strong immunity to cattle to ticks is the aim of a new project in the Beef CRC led by the Queensland Department of Primary Industries and Fisheries.

The vaccine has potential to stem losses caused by ticks and tick-borne diseases estimated at $175 annually to the northern industry, or $US2.5 billion worldwide.

A Queensland government grant has enabled the United States Department of Agriculture (USDA) to join the Beef CRC’s research team which includes collaborators from the University of Queensland and WA’s Murdoch University.

If the group is successful, the vaccine would greatly reduce the impact of ticks and tick-borne diseases in Australia and offer extensive opportunities for international marketing of the vaccine itself.

The cattle tick (Boophilus microplus) was introduced to Australia in 1872 on 12 Brahman cattle imported from Batavia. The tick was initially identified in Queensland in 1891 and has since had a significant impact on the Northern Australian cattle industry.

Infestations of ticks reduce productivity, and if severe enough, can cause death. But the main damage is by introducing blood diseases to the beast.

There are three key blood-borne pests and associated diseases transmitted by ticks. They are Babesia bovis (‘red water’ or babesiosis), Babesia bigemina, (red water) and Anaplasma marginale, (anaplasmosis).

These diseases are commonly termed as ‘tick fever’ and have a substantial influence on beef and milk production levels in affected regions.

Queensland is the most developed region affected by cattle tick. This, combined with the state’s proven track record in animal health and vaccine development, make it an ideal location for this innovative project.

The USDA has provided their tick DNA sequence data, essential for the project’s success. The sequence data is used in a computer modelling approach known as ‘reverse vaccinology’ which identifies potential vaccine candidates.

Each of the candidates is then laboratory tested, followed by trials in cattle.

The potential economic benefit of the new vaccine is approximately $98 million to Queensland alone, through increased beef and milk production.
On the surface, cattle breeding still happens the same as it always has. However, the tools available to the producer making the critical decisions today have never been more complex. With advances in genetic technologies, you will have heard terms used and wondered about their meaning and application to your decisions in setting breeding objectives. Let’s make an attempt at unravelling the “barbed-wire” surrounding the genetic make up of an animal that has some similarities to the two strands of wire that frequently coil up at some time in a fencing career!

Each characteristic of an animal is controlled by a string of protein molecules joined together in a distinctive pattern referred to as a gene. Many genes are linked together to form a chromosome. Genotype is the set of genes found within an organism’s cells. A genome is all the DNA in a complete set of chromosomes. In all body tissues, the chromosomes are found in pairs within the nucleus of each cell. Each species has different numbers of chromosomes with cattle having 30 pairs of chromosomes. Humans have 23 pairs; 46 in all: 44 autosomes and two sex chromosomes. These chromosomes are threadlike “packages” of genes and other DNA in the nucleus of a cell. Deoxyribonucleic acid or DNA is the chemical inside the nucleus of a cell that carries the genetic instructions for making living organisms. Each parent contributes one chromosome to each pair, so progeny get half of their chromosomes from their dam and half from their sire.

The structural arrangement of DNA or “double helix” looks something like an immensely long ladder twisted into a helix, or coil. The sides of the “ladder” are formed by a backbone of sugar and phosphate molecules, and the “rungs” consist of nucleotide bases joined weakly in the middle by hydrogen bonds as shown in the attached figure.

Two base pairs form a “rung of the DNA ladder”. A DNA nucleotide is made of a molecule of sugar, a molecule of phosphoric acid, and a molecule called a base. The bases are the “letters” that spell out the genetic code. In DNA, the code letters are A (adenine), T (thymine), G (guanine), and C (cytosine) which are chemicals. In base pairing, adenine always pairs with thymine, and guanine always pairs with cytosine.

A “nucleotide” is one of the structural components, or building blocks, of DNA and RNA (ribonucleic acid). A nucleotide consists of a base (one of four chemicals: adenine, thymine, guanine, and cytosine) plus a molecule of sugar and one of phosphoric acid.

A “marker”, also known as a DNA marker or possibly like “a sign post” on the chromosome, is a segment of DNA with an identifiable physical location on a chromosome whose inheritance can be followed. A marker can be a gene, or it can be some section of DNA with no presently known function. Because DNA segments that lie near each other on a chromosome tend to be inherited together, markers are often used as indirect ways of tracking the inheritance pattern of genes that have not yet been identified, but whose approximate locations are known. Microsatellite (type II marker) is a type of marker made up of a simple pattern of nucleotides repeated over and over. Single Nucleotide Polymorphisms (SNPs) are another form of DNA markers.

The appearance and performance of an animal is determined by the pattern of proteins (genes) and thereby the genetic make-up of an animal or genotype. Multiple genes may collectively influence a trait which is the characteristic we record or measure in an animal. Therefore the more markers that are closely aligned to genes on the chromosome, the greater opportunity we have to more effectively make selection decisions that will meet our desired breeding objectives. At some point in time, as the number of identified markers increases, there will be a time when the costs associated with finding additional markers will not return an equal additional benefit of increased animal performance. Therefore an optimal number of markers for any particular trait may describe the majority of variation in that trait.

Beef CRC research has identified a number of markers that have already been commercialised for Marbling, Tenderness and Net Feed Intake. Current research is identifying additional markers for reproductive, adaptive and various welfare traits. The commercially reported values for any DNA marker show one of three variables e.g. not present, one copy or two copies of the gene are present. The future of genetic selection will lie in the combination of marker technology in association with Estimated Breeding Values (EBVs) as marker assisted EBVs.
Assessment of cattle temperament by beef producers to select the more docile animals has frequently had very variable outcomes. Animals can be docile because they are genetically docile or they have had positive handling experiences through life causing them to be more docile. The Beef CRC has established beneficial relationships between docility measures and meat quality attributes, feedlot performance and ease of transport.

Many beef producers continue to use various ‘home-made’ assessments of docility during selection conducted in the ‘round yard’ or during mustering. This article reports three measures of docility used on a central Queensland property by students using the same group of animals and a practical application of the objective measure on a commercial beef property. The alternatives included a very objective measure – ‘flight time’, a less objective ‘crush test’ and then an even more subjective ‘yard test’.

The selection of genetically docile animals is very important to beef producers as the desirable trait of “quiet temperament” is passed on from parent to progeny. In fact the trait is moderately heritable - about 33%. Any additional low stress handling through the animals life can further cause the animal to be more docile; but that does NOT change the genetic characteristics of that animal. Hence, there are many beef producers who have bought what they, in all good intention, thought was a quiet bull and it has produced aggressive flighty progeny.

CRC research has demonstrated that more docile animals:
- have a greater average daily (ADG) gain in the feedlot,
- have less sickness in the feedlot
- have heavier hot standard carcase weights (HSCW),
- better feed conversions,
- more tender meat and, higher Meat Quality scores.

This article reports on flight time measures that were recorded by students on yearlings at ‘Berrigurra’. The yearlings were released from the head bail-crush and while exiting the race through another crush, the time was recorded for each to break two beams of light 1.7 metre apart. The majority of animals (67%) took between 0.41 and 1.4 sec to travel the 1.7m with 28% being the next slowest group taking between 1.41 and 2.2 sec to cover the same distance.

On another commercial property, individual flight time (seconds) was measured on 445 tropically adapted composite 5-6 month-old weaners. Sire lines were grouped and averaged to compare flight time differences between the progeny groups. The flight time across all these 2003 calves was 1.34 seconds (ranging from 0.35 to 1.69 seconds) and the phenotypic difference in the average of the most temperamental sire compared to the average of the most docile sire was 0.34 seconds (0.61 – 0.95sec).

This difference may not seem considerable but when viewed in the context of CRC research, the values are relevant. In those studies, for each 0.1-second increase in flight time, daily gain in the feedlot (ADG) increases by an average of 0.04 kg/day, and carcase weight increases by 2.3 kg on average. Although the accuracy of this prediction was not tested in the commercial herd, if the CRC results are applied to this herd, we could expect the more docile animals to gain 0.12 kg more per day than the temperamental animals and produce 6.9 kg heavier carcasses. The owner could see differences in the docility of the sire group calves and despite the small differences within the group, was able to relate these differences to the temperament of the sire.

An additional observation relating to these weaners was that 6-7 months later, a sample of three groups (very docile, average docility and poor temperament) was yarded in three respective yards for a large field day on the property. The majority of field-day attendees were surprised the groups of animals responded according to their anticipated docility measure when people approached the yards where they were confined.

The crush test at “Berrigurra” recorded the animal’s response to an approaching person.
This observation as well as the extrapolation of the CRC results to the herd has provided the producer with confidence that measuring temperament objectively is useful and will provide benefit along the supply chain.

At ‘Berrigurra’ the students also compared the flight time measure with two subjective scoring systems.

**Crush Test at Berrigurra**

The first approach assigned scores of 1 to 5 by restraining the animal in the crush and with a side upper door open. Each animal was approached at the same speed and from the same direction and the animal response was recorded as shown in the photograph using the following scores:

1 = Docile, stands quietly to be touched in the crush and accepts a person at all times

2 = Restless in the crush but can be touched at arms length

3 = Nervous when approached, shies uncomfortably, may accept touch after persistence

4 = Flighty, moves away in the crush from approaching person, and always tries to avoid being touched

5 = Aggressive to the approaching person, stirred up and extremely mobile in the crush, always tries to escape from being touched

The yearlings assessed for docility were between 331 and 431 days of age. The average crush test score was 2.83 with a tendency to more docile scores as shown in Figure 1.

**Yard Test at Berrigurra**

The yard scoring system was conducted after each animal was let out into a yard about 10 metres wide by 15 metres long. Each animal was scored individually by a handler who approached the animal, in the corner of the yard, the same way each time as follows:

1 = Docile, stands quietly to be touched with a poly-pipe stick and accepts person at all times

2 = Restless, but can occasionally be touched at a distance with a poly stick

3 = Nervous when approached, shies uncomfortably, may accept touch with persistence over time

4 = Flighty, moves away from approaching person, cannot be touched and stands a distance way from the person

5 = Aggressive to approaching person, stirred up and extremely mobile, tries to escape from yards, stays away from the person.

The relative performance of the animals using each docility measure is presented in Figure 2. The yard test when used at ‘Berrigurra’ was unable to separate the relative differences that were evident in the objectively measured flight time test. Both scoring systems were not able to sufficiently separate the differences between animals using a 1 to 5 system nor were they able to effectively differentiate the very ‘flighty’ from the very docile animals.

**Genetic links between temperament and tenderness**

There is a relatively strong common factor between genes responsible for temperament and those responsible for variation in tenderness, at least in tropical breeds. The genetic correlation was defined in CRCI experiments in Queensland.

This correlation means that selection of breeding cattle on flight time to improve temperament will bring a corresponding improvement in meat tenderness in their progeny.

Commercial gene marker tests for tenderness are now available. These are based on the genes controlling calpain and calpastatin.

BREEDPLAN is expecting to release the first EBVs for tenderness in 2007, and the EBV is based on information from flight time, gene markers as well as meat quality assessments from progeny test.
Moving towards a polled future for Australia's national herd

Kishore Prayaga & Désirée Jackson

The practice of dehorning cattle could soon be a thing of the past, with Meat and Livestock Australia supporting a Beef CRC project aimed at developing DNA tests for the genes responsible for polled, horned and scur characteristics in cattle.

The ability to DNA test to identify homozygous polled bulls would have a particularly strong application in the tropically adopted breeds, where there is a large number of horned bulls that are believed to carry a gene known as the “African horn” gene. The ability to select for the polled characteristic, without compromising other genetic traits, would be an enormous asset to producers.

Dehorning is widely practiced across Australia and plays an important role in reducing bruising, hide damage and injuries caused by horned cattle, not to mention the increased risk of injury to people handling stock on farm and along the marketing chain.

Community concerns about animal welfare will maintain pressure to eliminate the practice of dehorning. But until there is a practical alternative, dehorning will continue. This means extra expense for the producer – costs of equipment, expertise and additional time spent in the yards.

Best practice demands that dehorning occurs before calves are 6 months of age, but even at this age, there is the risk of secondary infection, fly strike, reduced growth rates through stress and the chance of stock losses.

The CRC's research program aims to identify the genes which produce polled, horned and scur characteristics in beef cattle. Studies to date have been promising, with the polled gene being mapped to a region of the bovine chromosome in international laboratories. However, at this stage it has not been specifically located. The genetics of African horns and scurs have not yet been thoroughly investigated.

Considering the complexity of inheritance of these characteristics, particularly in Zebu-derived breeds, the research is challenging. However, an initial review into the project, conducted by Dr Kishore Prayaga, has shown the potential for significant economic benefits.

At property level, Kishore estimates that eliminating dehorning would lead to an additional return of $1.70 per weaner. This figure takes into account the 1% mortality rates of dehorning in the hot and humid northern Australian climate and the reduced time spent in the yards.

On a broader scale, increasing the use of polled breeding will contribute to the protection of international markets for Australian beef, especially with the increasing awareness of animal welfare practices impacting on consumer sentiment across the globe.
The Beef CRC is committed to growing the profitability of the Australian beef industry. A major strategy of the Beef CRC, working in close collaboration with Meat and Livestock Australia, is to establish 5 supply chain partnerships in Australia and New Zealand to achieve improved profit and efficiency for both suppliers and processors. The supply chain partners will include breeders, backgrounders and feedloters working in collaboration with a processor. The beef producers will form groups, called Beef Profit partnerships (BPP) to investigate and evaluate technologies to enable them to better meet market specifications, improve their production efficiency and impact on their profitability.

Historical data from the processor and producer suppliers is being analysed to identify opportunities and problems in compliance with carcase specifications. This may highlight factors such as seasonal variations in carcase characteristics that can be overcome by simple adjustment to feeding regimes. Or it may indicate the suitability of a particular production system or breeding regime for a particular market.

Communication within the supply chains will be a key focus of the supply chain partnerships. The provision of improved systems of feedback data to finishers, backgrounders and breeders will provide an opportunity to benchmark performance of individual businesses both across regions / market types and over time for compliance with specifications. This feedback is crucial in identifying areas where continual improvement in performance is possible.

Both current and new measurements at all points in the supply chain will be evaluated for their usefulness in better describing the value of an animal or carcase. These measurements will be used to develop prediction models to assist in procurement of animals that will perform better during the finishing phase and better meet market specifications at slaughter.

In addition, the supply chains will provide an invaluable source of information in the field-testing of gene markers and prediction models. Carcases from some BPP members will be sampled to determine a) the frequency of gene markers for quality and yield, and b) the size of the effects of gene markers on quality and yield.

BPPs will be formed in association with each of the cooperating processors. These will consist of between 10 and 15 producers who have a commitment to improving the profitability of their beef business. The initial target for the BPPs is to achieve a 5% improvement in annual business profit.

In these BPPs producers will:

- Work with other producers with a common interest in achieving improvement in productivity, profit and business growth.
- Be supported to take effective, ongoing actions to achieve rapid and measurable improvements in the profit drivers that are relevant to their own business.
- Work with a dedicated facilitator and have access to key researchers and other professionals that are experts in a wide range of beef production and related technologies and who are also committed to improving growth and profit in the industry.
- Be equipped to use a simple process and proven tools and technologies to achieve improvements now, and to create new ways to increase profit in the future.
- Have opportunities to share experiences and knowledge with people from across the BPP network through newsletters, information packages and BPP meetings.

BPPs are targeting measurable improvements in profit in individual businesses as well as on a regional and national basis. BPP members will be supported to track changes in key drivers of profit, such as costs, prices and throughput and in those productivity indicators most relevant to the changes they have made in their own business. These might be growth rate, reproductive rate, mortality or stocking rate. Facilitated BPP meetings are scheduled every 90 days to ensure team members have adequate support, achieve their relevant targets, and are able to monitor the relevant measurements and change in business profit.

Every two years, producers will have the opportunity to participate in a BPP Impact Forum, where producers from different BPPs gather together to share knowledge and experiences for their mutual benefit.

The Beef CRC will assist the supply chain by providing:

- analysis of historical data from processors and feedloters as well as ongoing benchmarking of performance over time
- assistance with trials
and demonstrations that have potential to lead to adoption of technologies that increase production efficiency and compliance with specifications and profitability of the supply chain.

- **Financial support for BPPs** to allow visits from researchers and other technical specialists, materials and equipment costs associated with BPP meetings and forums and travel costs for BPP facilitators.

- **Information packages** for BPP team members on a broad range of beef production issues.

- **Support from specialist beef economists** to assist in monitoring changes in growth and profitability of individual businesses and the BPP network. All financial and production data will be treated in confidence and will not be used in any way that would enable individual businesses to be identified.

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Better steers or more efficient cows? can we have both?

Bob Gaden

For most commercial breeders, the ability of their cows to utilise pasture and breed efficiently in variable seasons has a far greater influence on profit than the finer points of carcase quality. They may well ask: why risk selecting for better steers if their sisters are less efficient as breeders?

A major project on maternal efficiency in CRC III is uncovering the important genetic connections between carcase quality, feed efficiency and breeding performance in southern (temperate) environments. It will answer the concerns of breeders who are cautious about using new EBVs to improve traits like carcase yield and marbling, in case there are negative effects on the breeding herd. It follows a similar study in CRC II that investigated these effects in tropically adapted genotypes in northern Australia.

Maternal efficiency

In a breeding herd, about 70% of the feed is consumed by cows for their maintenance, so from the breeder’s point of view, overall profit is much more closely connected to the feed efficiency in cows rather than in the steer progeny.

But first things first. Before worrying about new technologies, breeders already can choose from a wide range of options to make sure they are making the best use of their feed. There is often potential to make significant improvements by fine-tuning their management of three critical factors:

- Seasonal feed variation by choosing the best calving time, weaning early and using carefully targeted feeding of appropriate supplements
- Condition (fat score) of cows and heifers at key points during the year to maximise their fertility
- Breeding techniques, using well-proven methods such as crossbreeding, using breeds that offer the right traits, and using BREEDPLAN to select replacements.

With these in place, new EBVs resulting from the CRC’s maternal efficiency projects will enable on-going improvement, keeping an economic balance between the carcase composition and feed efficiency of steers and the efficiency of the cow herd.

Feed efficiency

EBVs for Net Feed Intake (NFI) have recently become available in some breeds. They are based on the fact that some animals require less feed to grow at the same rate as others. The difference between individuals is quite strongly controlled by genetics (i.e. is moderately heritable).

The foundation research with Angus cattle at Trangie demonstrated that if we identify and breed from the more efficient animals, we will gradually improve the ability of our cattle to convert grass into beef.

At Trangie in the 1990s, researchers created separate herds, selected for high and low efficiency. This demonstrated the rapid improvements in feed efficiency that can be made. (These cattle are now a resource for CRC III research, identifying the genes controlling feed efficiency).

In the research, it was noticed the more feed efficient cattle tended to be slightly leaner, although not different in growth or frame size. This raised the possibility that selection for feed efficiency could bring about changes in body composition, with possible effects on carcase value and cow productivity. This required further investigation and led to the new project in CRC III.

Body composition

Since its inception in 1993, the Beef CRC’s main focus has consistently been on improving steers and their ability to hit target market specifications. To achieve improvements in yield and quality for most markets this means reducing fat depth and increasing muscling.

In beef females throughout most of Australia, the ability to put on fat quickly when feed is plentiful is a very positive trait. The “haystack on their back” helps them retain their fertility through seasonal feed shortages and of course, drought (see box story, next page).

Does this mean aiming for higher carcase yield will mean less profitable cows? How does this connect with feed efficiency? Can we improve carcase yield and cow efficiency at the same time?

These are the questions being answered in CRC III by a series of experiments across southern Australia.

Maternal efficiency project

Trangie-bred Angus females with known genetic profile for high or low NFI have been transferred to Struan (SA) and Vasse (WA) research stations for detailed studies into their growth, carcase composition and reproductive performance over a number of years.

The data will provide information on the genetic relationships underlying all these traits. It will be possible to answer important questions including:

- Can we improve NFI and carcase traits simultaneously?
- If we select for steers with improved carcase traits (marbling, fatness, yield), what effect will this have on female reproductive performance?
If we select for steers with improved yield, will their sisters lose their ability to deposit fat?

The project will have strong links to industry with a number of Angus and Hereford BREEDPLAN herds tracking the same key traits under commercial conditions.

These breeders will record detailed conception and calving information for a number of years. Newly born females will be weighed and scanned regularly as they grow, develop and mature, to monitor body composition as they develop and rear calves of their own.

Ultimately, this data will allow BREEDPLAN to produce more balanced EBVs, calculated taking into account the positive and negative associations between the carcase, fertility and feed efficiency traits. The new EBVs will give breeders the power to make positive progress in important traits at the same time, even if they are negatively correlated.

**Future technologies**

While some practical answers are not far away, the foundation is being laid in these experiments for the new genetic technologies to play their part well into the future. DNA from these cattle is being stored for future validation of new gene marker tests and to identify the genes and gene combinations associated with differences in their performance.

Already, there is a change of focus from a few individual gene markers for important traits, to suites of markers, indicating the technology to screen for thousands of genes will soon be delivered by the CRC’s ambitious research programs.

Now that Australia is seriously working to deliver future DNA technologies through the BREEDPLAN system, we can be confident that cattle breeders will be given unprecedented power to find cattle with the genetics that not only meet market specifications, but will be profitable to breed and produce.

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**Fat or muscle - which form of energy storage?**

The ability of a cow to put on extra body weight and then use it to get through times of feed shortage is a very useful feature in Australia’s variable environment.

According to Dr Peter Parnell of NSW Department of Primary Industries, it makes a lot of difference whether a cow stores extra weight as muscle tissue or as fat. This is because the tissues have different concentration of stored energy, and have different maintenance costs.

A kilogram of stored body fat contains about 39 megajoules (MJ) of energy, more than 5 times that of a kilogram of muscle, which contains about 7 MJ. A cow can therefore store more energy in the same weight of fat compared to muscle.

Despite this difference, it only takes 25% more energy from feed to store a kilogram of fat compared to a kilogram of muscle.

And once fat is deposited in the body reserves, it takes less than half as much energy to maintain it there compared to the same weight of muscle. This is because muscle is a much more active tissue than fat and is constantly being turned over.

Dr Parnell says that in a typical cow herd, 70% of the energy used to maintain cows is used for maintaining muscle tissue, not fat.

At any given liveweight, mature cows that tend to store surplus energy as fat tissue should therefore be “cheaper to run” than those accumulating it as muscle. Any change towards leaner cows, whether by selecting for higher carcase yield or improved feed efficiency, could have serious consequences.

The Beef CRC’s maternal efficiency project will spell out these consequences and present breeders with a balanced story. More importantly, the data will equip BREEDPLAN with the genetic correlations to produce more balanced EBVs that account for the trade-offs. The new EBVs will enable breeders to improve both carcase quality and female efficiency at the same time.
Beef courses delivered in Australia and New Zealand

Kellyanne Semple

VICTORIA
Department of Primary Industries
www.dpi.vic.gov.au

BeefCheque
BeefCheque is a program about growing more grass, utilising more grass, growing more beef (or lamb, mutton, wool) and, ultimately making more money. As well as looking at pastures and livestock, participants spend time looking at the financial results of their action. To make these discussions useful, participants are encouraged to participate in a financial and physical analysis of their farm businesses.

Practical Beef Marketing
Practical Beef Marketing is a course that aims to improve industry and on-farm profitability through an increased number of cattle meeting target market specifications. This is achieved through improving producers' understanding of standard industry language, the varying markets and their requirements.

Producers also gain the skills and knowledge required for accurate live animal assessment, enabling more detailed and specific description for potential customers and therefore superior marketing opportunities.

Southern Beef School
Based at Glenormiston campus of South West TAFE, this two and a half day school utilises key Beef Industry contacts through DPI, Beef CRC, Angus Australia and Independent Breeding Services. Participants learn skills in pasture establishment, structural assessment, meat quality, herd health and market specifications. The school is run annually in July.

QUEENSLAND
Department of Primary Industries & Fisheries
www.dpi.qld.gov.au

Better Business, Better Profits through Better Bulls
This is a one day workshop to assist beef producers in effective bull selection practices by setting breeding objectives and applying bull breeding soundness evaluations to their selection decisions. Producers are provided with evidence of the financial benefits of using sound genetic differences in association with EBVs in their bull selection decisions.

Breeding For Profit
This is a one day workshop focussed on the opportunities afforded the beef producer with various breeding systems and tools at their disposal to better meet market specification through a planned breeding programme. It includes a practical component and utilises the outcomes of CRC I mating results across breeds to assist producers with their breeding decisions.

Bull selection
This one-day hands-on workshop shows participants how to improve their breeding program by evaluating a bull’s genetics and its ability to serve and reproduce. The workshops
also examine the technology that can impact on a herd’s genetics.

**BREEDPLAN Workshops**

This one day workshop assists producers with the knowledge and skills to apply genetic differences in the form of EBVs in their selection decisions. Many producers appreciate the practical aspects of basic genetics and genetic progress to then understand the relevance of EBVs versus ‘raw data’. This activity links DNA marker technology with genetic differences as they apply to genetic progress in the herd.

**EDGE Grazing Land Management**

An area-specific three day workshop for northern producers (with a follow up day) covering:
- maintenance of native and improved pasture systems;
- relationships between water, soil, woodlands, biodiversity, fires and weeds;
- climate variability management;
- meeting target markets while remaining sustainable in the long term; and,
- determining the financial implications of grazing management options.

**The Breeding EDGE**

This workshop is conducted over three days and focuses the northern beef producer on setting breeding objectives and includes such topics as understanding Bull Breeding Soundness Evaluations, Breeding Systems, Female selection and the basis of genetic progress in the herd. It includes a half day practical demonstrating EBVs and bull fertility.

**The Nutrition EDGE**

This three-day interactive workshop and practical session for northern producers covers all aspects of animal nutrition, including how nutrition affects animal growth rates, financial returns and market access. Participants learn what nutrition and supplements are required to improve the health and growth of their stock, and assess the level of nutrition provided by their pastures.

**EDGE Marketing**

The Marketing EDGE is a 2-day workshop designed to assist producers set their long-term direction and strategies for the marketing function of their livestock business. The workshop is designed to help producers discover the benefits their business can gain from adopting a greater marketing focus, rather than a production-only focus. It aims to broaden producers’ understanding of marketing, rather than focus on selling only, to enable the development of longer-term marketing strategies and better marketing decisions. These long-term decisions help improve overall business performance and therefore success.

**CRC Outcomes**

This one-day interactive workshop presents the latest research findings from the Beef CRC, Australia’s largest
integrated beef research program. The workshop provides information on gene markers, temperament assessment, net feed efficiency, weaning and health and shows how producers can use this information to improve profitability.

**Beef options analysis**

During this four-day workshop, participants use a comprehensive herd simulation and economic model to describe and simulate their existing enterprise, assess its performance, and compare options (profitability, performance, risks, cash flow). Expert presenters help participants translate complex financial data into user-friendly information that can be used to improve their business profitability.

**Enhanced property management**

Over two one-day workshops, participants analyse their current business situation. They are then introduced to innovative management techniques that help improve their profitability by improving their herd base; analysing marketing decisions; benchmarking their business performance (relative to their district and industry); and identifying key production and profitability drivers. Management techniques are explained in terms of actions that can be undertaken on farm.

**Storelink**

This 2-day workshop examines the Australian supply chain. Participants gain a better understanding of customer requirements and how they can alter their property management to better meet customer needs.

**NEW SOUTH WALES**

*Department of Primary Industries*

www.dpi.nsw.gov.au

**Beef-N-Omics**

A three day program to assist commercial beef producers to improve the productivity and profitability of their beef enterprise. The course uses the Beef-N-Omics computer program to deliver a total analysis of each beef herd integrating herd management, feed balances and economic variables, culminating in an assessment of options for improved profitability.

**Stockplan**

A three day training program backed by three computer-based decision support programs that enable all sectors of the beef and sheep industries to develop least-cost strategies to manage drought and drought recovery periods.

**Prograze**

Eight workshops spread over 8 to 12 months, covering pasture and livestock assessment, fodder budgeting and species identification skills, and the integration of these into improved grazing management systems.

**Better Breeding – Beefing up your Business**

A three day course aimed at providing the skills and knowledge to develop a breeding plan for your beef herd. This course is based around example producers who show how they plan and manage their breeding herds. It covers which traits are important to different markets, and how to select these traits and the different breeding systems that can be used.

**Calculating Cost of Production**

A half-day workshop teaching beef producers how to use the Cost of Production calculator, demonstrating why cost of production is an important key performance indicator, and identifying opportunities to improve the business management of their enterprise.

**Stocksafe – Safe Cattle and Sheep Handling**

A two-day workshop which begins with routine husbandry, handling and health, before working through workplace OH&S, animal welfare, impact of handling on meat quality, and all aspects of correct handling in yards and paddocks.

**Better Bull Buying**

A practical workshop to help beef producers select, purchase and manage bulls appropriate to their beef enterprise and market objectives. This includes structural assessment, breeding soundness, understanding of Breedplan and EBVs, and interpretation of sale catalogues.

**StockAssess – Live Cattle Assessment and Marketing**

A two day hands-on workshop addressing cattle assessment to meet market criteria, selling systems, preparation for transport, quality assurance procedures and marketing options.

**Beef Care and Handling**

A one-day program mixing practical and discussion sessions including cattle husbandry, identification, handling, live animal assessment, yard design and health programs.
**TopFodder Silage**
A three day course covering all aspects of the production, storing and feeding of both bulk and baled silage.

**NORTHERN TERRITORY**
Department of Primary Industries, Fisheries & Mines
www.nt.gov.au/dpifm

**Nutrition EDGE**
The Nutrition EDGE workshop provides a comprehensive look at ruminant nutrition. It will assist you to better match your pasture and feed options to your livestock needs.

**Breeding EDGE**
The EDGE Network Breeding EDGE workshop is a comprehensive workshop designed to help you develop a cattle breeding program, or improve your existing one.

You will see how to use reproductive and genetic knowledge and technologies to achieve your target production.

**Grazing Land Management**
The Grazing Land Management workshop will develop your understanding of the various factors that interact in the rangeland regions of Northern Australia to develop grazing management strategies to increase profit and sustainability.

**WESTERN AUSTRALIA**
Department of Agriculture & Food
www.agric.wa.gov.au

**Agribusiness Livestock Updates**
The Agribusiness Livestock Updates replaces the Agribusiness Sheep Updates. With the addition of beef topics, the Agribusiness Livestock Updates is now the primary event in Western Australia for the meat and wool industries. This event provides the most up to date information on sheep and beef production and industry issues. It provides an excellent opportunity for the release of applicable research results and networking with other industry professionals.

**Regional Livestock Updates**
The one - day regional updates are held at ten locations within Western Australia. The updates provide producers and industry with relevant and up to date information on sheep and beef production.

**Vasse Research Station Open Day**
This is a one - day event that provides producers and industry professionals with information on current beef cattle research projects taking place at the Vasse Research Station.

**SOUTH AUSTRALIA**
Department of Primary Industries & Resources
www.pir.sa.gov.au

**Prograze**
Prograze is an Edge Network course giving producers an understanding of pasture management and grazing techniques.

**Cost of production workshops**
These workshops give producers the opportunity to drill down into their beef enterprises and determine what the profit drivers are and what factors they have influence over.

**TASMANIA**
Department of Primary Industries & Water
www.dpiw.tas.gov.au

**Red Meat Targets**
A program of research, development, marketing and extension projects for Tasmania’s red meat industry.

Within Red Meat Targets DPIW delivers on-farm, practical training courses in:
- Prograze (grazing management skills training),
- Better Fertiliser Decisions (nutrient management), and
- Species for Profit (selecting and managing the right pasture species).

“Red Meat Targets” development projects conduct field days on sites such as the Winnaleah Towards 2000 beef grazing trial, Cressy Arrotas management site, and the Circular Head and King Island grazing and nutrient trials.

DPIW also coordinates and conducts field-days and workshops as a part of MLA’s “More Beef From Pastures” program. These focus on key elements of beef producing enterprises, from pasture utilisation to managing cost of production and setting enterprise directions. These activities have a focus on practical tools and producer experiences.

**NEW ZEALAND**
Meat & Wool New Zealand
www.meatandwoolnz.com

New Zealand is looking forward to fully utilising knowledge and information from Beef CRC.

The expectation is three Beef Profit Partnerships will be established in New Zealand in the second half of 2007.
# Beef Officer Contact Details

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## Queensland

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Organisers and participants of the Armidale Feeder Steer School are calling the 2007 Feeder Steer School in Armidale another rousing success.

More than 80 participants from across New South Wales, Queensland and Victoria representing all levels of the cattle and feedlot industry attended the school, with a particular focus from the feedlot and stock agent sector.

The program featured the beef industry’s biggest players delivering the latest Beef CRC research and practical skills to help improve the paddock-to-plate supply chain.

Representatives from Australia’s largest cattle producer, the Australian Agricultural Company, Australia’s largest processor, Australian Meat Holdings and one of the country’s largest feedlots, Rangers Valley, addressed participants.

Beef CRC Extension Specialist, Bob Gaden of the New South Wales Department of Primary Industries says the ongoing popularity of the school confirms the right information is being delivered.

“Word of mouth about the school has been phenomenal, so we are obviously hitting the mark. But I’m not surprised considering we are putting up some of the best speakers in the industry.” Mr Gaden said.

“Not everyday do you get to hear the likes of President of the Australian Lot Feeders’ Association, Malcolm Foster, offer his thoughts on the strength of the feedlot industry or Brett Campbell of Australian Meat Holdings, the biggest buyer, processor and exporter of cattle in Australia.”

From tree changers to intensive feedlotters, Mr Gaden says the school is able to target all levels of the industry. But he emphasises it’s not all theory.

“The opportunity to visit Rangers Valley, a 24 thousand head feedlot, as well as hands-on sessions enables participants to go home with practical skills. And we can’t forget the networking opportunities, enabling cattle producers to mix and meet major players in the industry.”

Substantial feedlot industry growth in Queensland resulted in a sharp increase in the number of northern participants and was a key reason why Tom McLeish, a stock and station agent with ‘TopX’ in Longreach attended the school.

Mr McLeish said TopX management identified the school as a good education opportunity.

“There has been a dramatic increase in-the domestic demand for beef and that has prompted resurgence in the domestic feedlot industry throughout Queensland,” he said.

“I hope to learn skills from this school to allow me to give producers, from whom we source feedlot cattle, relevant market information and the best way they can meet that market.”

The school was a mixture of young and old with teenager Andrew Black from Charters Towers making the long trip to take part. With an upcoming role planned in his family’s beef cattle operation, the school provided a valuable grounding.

“It’s really good and I’m learning some things that will be pretty handy at home,” he said.

“We get a chance to look at new methods and better ways of doing things.”

The Armidale Feeder Steer School is held each year in early February. Contact the CRC for details of coming schools.