Technology – a resource to drive profit in beef operations

Breeding and associated genetic technologies can make a difference to the bottom line in beef cattle herds, says **Japie van der Westhuizen** of SA Stud Book.

Sustainability in any enterprise depends on long-term profitability. Many factors contribute to this, including the optimal use of available resources. One such resource, technology, plays a major role in successful livestock production.

Livestock feeding and nutrition technologies include evaluation and analysis methodologies, rumen and post-rumen digestibility and feed utilisation, harvesting techniques and treatment of feed, micro minerals and amino acid utilisation, utilisation of micro-organisms in feed, and automated intake control and recording. Equally important are the advanced technologies that influence physiological processes. These include rumen fermentation, hormonal control of reproduction cycles, immune system boosting and inoculation, product quality enhancement, fatty acid and amino acid manipulation, organism specific treatment, embryo, semen and cloning techniques, and automated production recording.

Animal breeding and genetics focus on making a permanent difference to livestock production efficiency. Technological development is currently driving genetic change. Some of these technologies include computing power and data base exploration, algorithm developments, integrating economics and genetic merit in genetic merit predictions, integrating quantitative and molecular genetics in determining genetic merit, genome projects and whole genome sequencing, video and ultrasound imaging and algorithms in assessing carcass and meat characteristics, application of bead chip technologies in next generation genetic merit predictions, and automated intake recording.

This article highlights a few of these technologies.

BELOW: Contemporary groups in the same environment under the same feeding regime are compared In BLUP testing. FW ARCHIVE

JAPIE VAN DER WESTHUIZEN

MOLECULAR GENETICS AND BREEDING VALUE PREDICTIONS

Significant advances began with the Human Genome Project in the late 1990s. The state-funded project to map the human genome took more than 13 years, and cost US$2 billion (R30,4 billion). The genome was mapped by government and (later) commercial organisations, with Craig Venter leading the field in private enterprise research. Venter developed his method using a different approach, and did it (for only) US$300 million (R4,5 billion). Although he began his investigation 12 years after the mainstream, his team soon caught up.

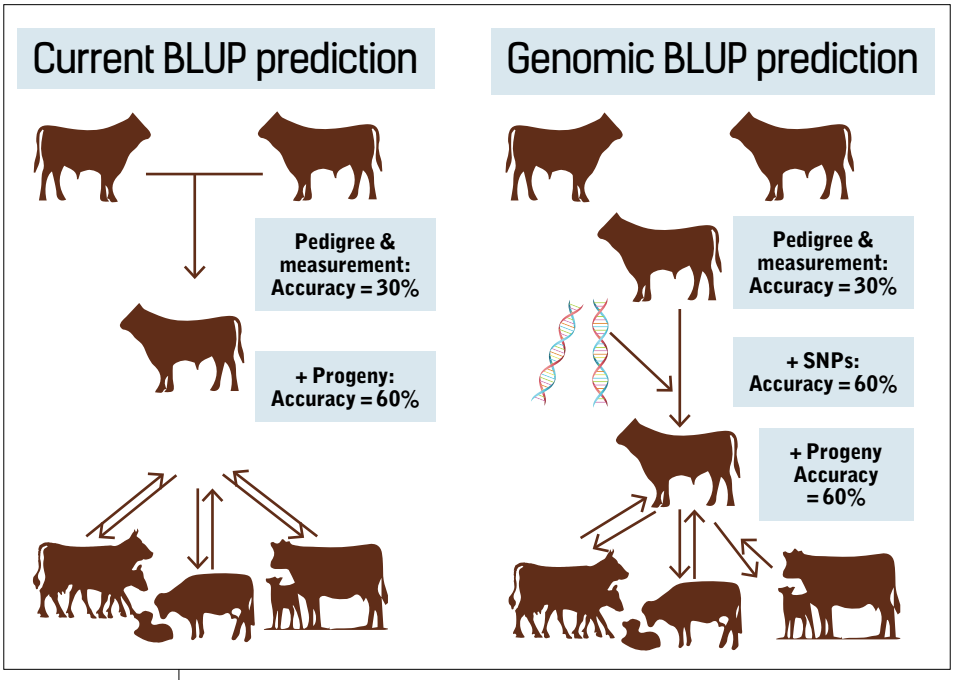
THE BOVINE GENOME WAS SEQUENCED IN 2009

After the sequencing of the human genome was completed, projects followed in which other species were sequenced. The genome sequence of the Hereford cow L1 Dominette, at Baylor University in the US, was first published in *Science* in 2009.

Today, after the development of the bead chip, it is possible to have a fairly good look at the genome of individual animals from most livestock species. These chips enable scientists to obtain information from exact locations on the chromosomes (usually at regular intervals or specific locations) of the combination of the so-called nucleotides. These are the base pairs that link the two chromatid backbones. There are four bases: adenine, cytosine, thymine and guanine; the four 'alphabet letters' of the genetic code. Although knowledge of the prevalence of these base pairs does not mean knowledge of the exact locations, nor the specific influence of genes on the traits selected, it serves another important purpose. This knowledge enables scientists to compute the relationships between specific patterns of occurrence and the genetic merit of animals where genetic merit can be predicted with high reliability. Only once this is established from the reference population can the information be used in breeding programmes.

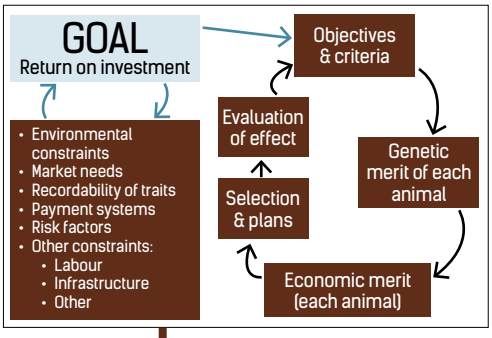
In the last three to four decades, genetic merit has been predicted through the use of BLUP breeding values. This efficient predictive tool uses the performance deviation of individual animals from contemporary mates in the group. All animals in the group are subjected to the same conditions and treatment. The average relationship among animals in a population that share common parts of chromosomes (and therefore genes), and the transferable part of the superior performance (the heritability of the particular trait), are taken into account.

The greatest shortcoming of BLUP is that the recording of the selection candidate (potential breeding animal) is sometimes not possible. The prediction must



ABOVE: (Figure 1) Genomic EBVs fast-track genetic progress in the herd, giving breeders improved selection ability.

RIGHT: (Figure 2) Genetic and economic integration is important so that the producer can work towards sustainable long-term goals.

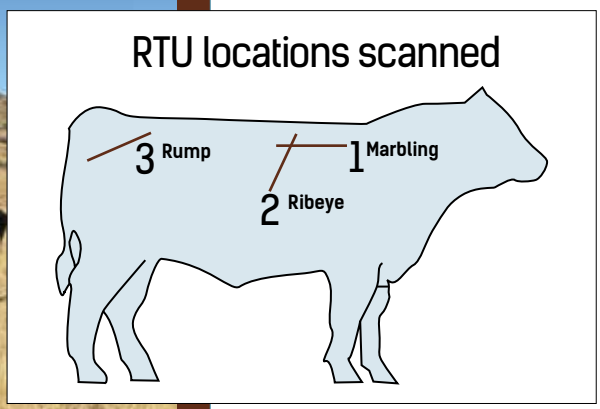


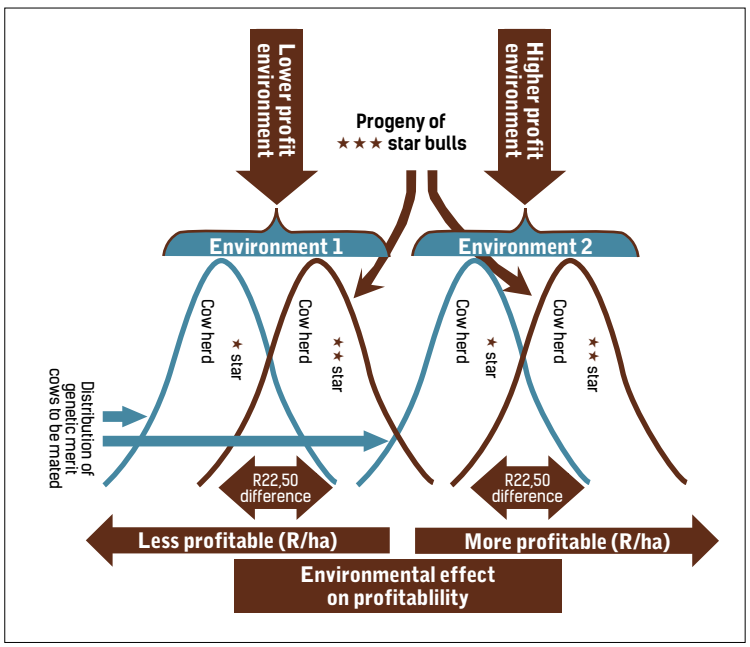
FAST FACTS

Technology is a valuable resource available to farmers.

The sequencing of the bovine genome has accelerated progress.

Integrated economic and genetic approaches will ensure profitability.





ABOVE: The ability to convert feed efficiently is a desirable trait in any beef herd. Successful commercial herds need animals that can maintain on low-grade forage during periods of shortage.

LEFT: (Figure 3) Genetic potential is not a silver bullet for difficult environments. Genetic structure should be matched to a suitable environment for the most profitable fit.

ABOVE RIGHT: (Figure 4) Reference points for scanning to predict carcass characteristics are the rump and the eye muscle at the 12th and 13th rib. Marbling is also considered.

then rely on the assumption that progeny will most probably 'inherit' the average genetic merit from its parents. Many traits of extreme economic importance fall into this category, namely those that can only be measured in one sex, such as milk production and female fertility. Other traits, such as longevity, can be recorded only later in life, while others (carcass and meat characteristics, for example) can be measured only once the animal has been slaughtered.

Genomic information, in combination with BLUP breeding values, opens up new possibilities. In essence, the inclusion of genomic information assists in greater knowledge of the sample of genetic merit that each offspring receives from its parents. The average value of the parental generation is therefore 'enhanced' by the added genomic information. This improves prediction accuracy, and means that potential breeding candidates can be selected with more confidence.

This technology has taken the breeding world by storm. Young bull calves are genomically tested at birth and the direct genomic value serves to enhance the BLUP EBV. In many cases, the newly calculated Genomic Estimated Breeding Values (GEBVs) for traits only recordable in females, will be at the accuracy level of a proven bull with 10 or more progeny recorded.

The roll-out and application of this technology will have a significant impact on beef cattle breeding. Currently, bulls are sold at an age where no progeny performance contributes towards traits such as milk or daughter fertility (age at first calving and calving interval). The calculated BLUP breeding value, at that age, is a function of the parent average genetic merit. GEBVs will improve the accuracy of the values. The big impact is therefore on the more precise evaluation, as well as the generation interval ruling annual genetic progress. Figure 1 illustrates the impact of this technology.

SELECTION VALUES THAT COMBINE GENETIC MERIT WITH ECONOMIC FACTORS

Without a proper breeding goal, breeding of livestock is pointless. Genetic merit for individual traits is only a small part in determining the end-goal of selection. Figure 2 shows the relationship between factors contributing to sustainable success and the continual cycle in animal breeding and selection.

Breeders have a choice on setting criteria to identify the most 'desirable' animal as a selection candidate. In many cases, minimum levels are set for individual traits. This is all

very well, but finding superior animals becomes difficult, especially when many traits are included in the criteria.

The most efficient way of reaching breeding objectives is when economically important traits are combined into single values, or 'super traits'. These reflect not only the heritabilities of the different traits and their genetic correlations, but their relative economic importance.

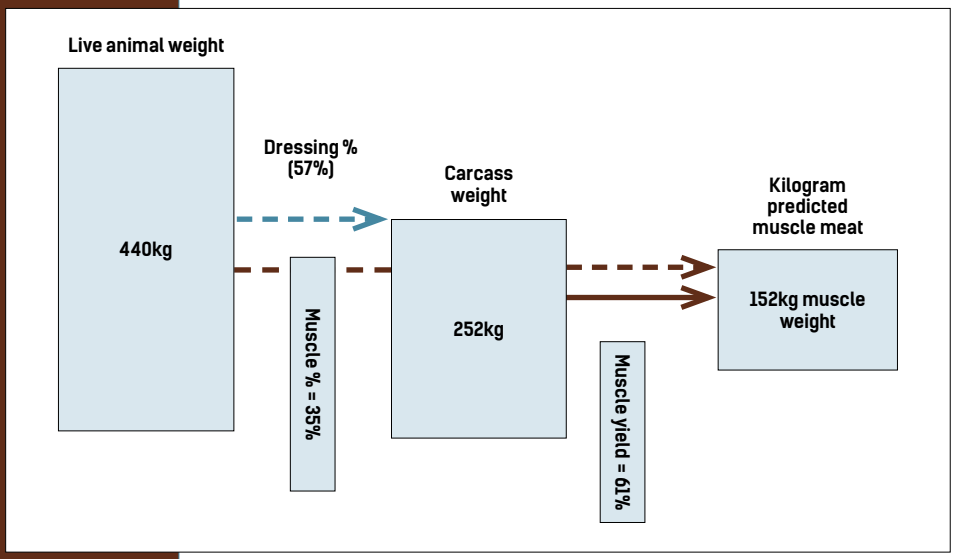
In a typical South African beef production system, the most profitable cow herd will have the following properties:

- Early calving in season;
- Regular calving;
- Easy calving;
- Milk for the calf to grow to full potential;
- Progeny with a good growth rate (especially pre-weaning);
- Low maintenance.

THE TECHNOLOGY WILL HAVE A MAJOR IMPACT ON BEEF CATTLE BREEDING

In effect, top performers will ensure the maximum income per unit (hectare). The Logix Cow values have been developed and adapted for each breed to fit into their market requirements. These values are also presented in actual monetary values as a deviation from the mean (where the average of the active animals in the breed is set to 100) and in a star rating. The rating is arranged in increments of half-star units with a maximum of five stars. Cow values are also made up of the following sub-values: ease of calving, pre-weaning growth, milk, female fertility and cow maintenance.

Figure 3 illustrates the financial impact of using a group of bulls with an average two-star rating on herds of cows with average one-star ratings in two different environments (and therefore



ABOVE: (Figure 5) Expected dressing percentages and muscle yield from a young beef bull of 440kg liveweight.

GOT SOMETHING TO SAY?
Send your letter to farmersweekly@caxton.co.za

different profitability per hectare).

The figure illustrates the impact of the more profitable daughters of the bulls used. Typically, in a 200-cow herd, the impact will be an instant R4 500 per year due to a genetic change in the progeny, excluding selection of the more profitable females.

REAL-TIME ULTRASOUND

The use of real-time ultrasound scanning on live animals, as a predictor of carcass characteristics, has been around for some time.

Differences in the muscle, fat and bone ratio can be profit drivers for the secondary industries. Variation in these ratios has a direct bearing on differences among animals for dressing percentages and ultimately, lean muscle tissue, sometimes called retail beef yield.

As for other production properties, genetic merit for these traits depends on recordings within properly constituted contemporary (test) groups. Typically, young bulls taking part in post-weaning growth tests will be scanned at the conclusion of the tests. Yearling heifers can also be scanned. The reference points for scanning (as illustrated in Figure 4) are on the rump (fat depth), on the eye muscle at the 12th to 13th rib (fat depth), eye muscle area and marbling.

Recording of these measurements, with the weight of the animals at the time of recording, helps scientists calculate the parameters that serve as predictors of dressing percentage and muscle yield. Figure 5 illustrates what can typically be expected from the recordings on a 440kg (liveweight) young bull.

Useful comparisons can only take place within contemporary (treatment) groups, resulting in the prediction of genetic merit for each animal. Variation between animals for these properties can therefore be directly linked to differences in profitability for feedlots and the retail industry.

EMBRACING RELEVANT TECHNOLOGY

In most businesses, managers and leaders can be classified in terms of their abilities to use the available resources to the best advantage of the business. Technological advances should be seen as such a resource. They make a difference to the bottom line, but consideration should be given to their usefulness. In most cases, successful businesses are known for the ability to embrace relevant technologies.

- *Phone Japie van der Westhuizen on 082 331 9923 or email japie@studbook.co.za.* ■ FW