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GENETICS

The accuracy and success of EBVs

Commercial producers can use estimated breeding values (EBVs) to select bulls that will increase on-farm efficiency, maximise profitability, and improve the consistency and quality of beef.

BREEDPLAN EBVs have been used in the beef industry since 1985. While initially only available for weight and milk, today the range of traits covered by EBVs has widened to include fertility, carcase traits and most recently, net feed efficiency.

Estimated breeding values, or EBVs, are figures that show an estimate of an animal's genetic merit for a particular trait. EBVs are calculated using measurements from live animals or carcases combined with pedigree information. The MLA Tips & Tools *Buying better bulls* provides further information about how EBVs can be used for more successful bull purchasing.

Recent practically based research projects have demonstrated how the information provided be BREEDPLAN (including EBVs and accuracy figures) can be used to achieve performance targets and improve profitability.

How accurate are EBVs

The accuracy of the EBV will depend on many things, including the heritability of the trait and the number and type of measurements that contribute to the EBV value (ie measurements from individuals, relatives or progeny).

Heritability

Heritability indicates how successfully a trait will be passed on to progeny. Heritability is shown as a percentage. This means a trait with a low percentage is less likely to be passed on to progeny, while a high heritability percentage tells us the trait is more likely to be present in progeny.

For example, the heritability of 'weight' is higher than for most fertility traits, so a single measure of weight on an animal will produce a more accurate EBV than a fertility EBV based on an individual measure.

Key benefits

- EBVs are the best selection criteria to use if you are trying to make genetic improvement
- EBVs predict progeny performance
- EBVs are available to allow genetic change for many of the economically important traits

Accuracy

The accuracy percentage given to each EBV is based on the amount of performance information available on the animal and its close relatives – particularly the number of progeny analysed. Accuracy also includes the heritability of the trait and the genetic correlations with other recorded traits. Therefore, accuracy indicates the confidence level of the EBV. The higher the accuracy the lower the likelihood of change in the animal's EBV, as more information is analysed for that animal or its relatives. EBV accuracies range from 0–99%.

Applying EBV accuracy in a practical situation

Individual EBVs will change, particularly if they only have moderate accuracy. This means that relying on individual sires to advance the genetics of your herd is not sound policy, especially if using young, relatively low-accuracy bulls. When striving for genetic improvement you need to hedge your bets by:

- Using as many bulls as you can afford – perhaps buy two bulls for $3,000 rather than one for $6,000, but make sure they are still of high genetic merit (high EBVs for the traits you want)
- Turning your bulls over regularly – budget to bring in new genetics even if the old faithful is still working; there is likely to be an affordable replacement with higher genetic merit

EBVs have an equal chance of moving up or down, so using more bulls will mean that while some will have EBVs that go up and some will have EBVs that go down, the average genetic value will remain close to the expected value.

Do EBVs work?

Since BREEDPLAN was introduced in 1985, hundreds of producers have used EBVs. The following case studies are just a few examples of how EBVs have helped producers increase the performance of selected traits.

Using EBVs to select for weight traits

MLA has funded three producer demonstration sites based in Queensland. In each case a team of high growth EBV bulls was chosen for comparison with a team of low growth EBV sires. The weight of progeny of the sires was compared at different ages.

Demonstration 1 – 'Birralee' near Collinsville, north Queensland

This demonstration used high 900-day EBV bulls with an average EBV value of +27.4 and low EBV bulls with an average 900-day value of –12.6 (note: 900-day EBVs are rarely used now, but are closely related to the 600-day EBV). Each group of bulls was randomly mated to a group of Brahman heifers.

Demonstration 2 – 'Bendemeer', Clermont, central Queensland

This demonstration used high and low EBV Belmont Red bulls. The high EBV bulls had an average 600-day EBV of +42 and the low EBV bulls averaged –9. The bulls were mated to Brahman-cross heifers.

Demonstration 3 – 'Swanlee', Aramac, north-western Queensland

This demonstration used high and low 600-day EBV Belmont Red bulls. These bulls were mated to Braford cows.

In each demonstration scenario, the high EBV sires had progeny that were heavier at most weighing periods and were worth more money in the target markets. A summary of the weight advantages for the three trials is shown in Table 1.

Demonstration 1 showed a 40kg difference between the EBVs of the sires and a 21.8kg difference in the progeny weights. After halving the difference (because half of the genetics comes from the cows), the expected difference is 20kg.

In demonstration 2 there was a 51kg difference between the average sire EBVs and a 22kg difference in the progeny weights – just under half the EBV difference, which would be 25.5kg.

There is often a difference between the EBV prediction and the actual results due to chance or the influence of environmental inputs, particularly feed. What is important to note is that the ranking of the high and low sire groups was always as expected (high EBV bulls produced the heaviest calves) and the differences observed in progeny were very close to the predictions from the sire EBVs.

Table 1: Comparative weight advantages of bulls selected on weight EBVs

Demonstration	Average EBV of high sires	Average EBV of low sires	Progeny age at weighing	Average progeny weight (kg) – high sires	Average progeny weight (kg) – low sires
1. Birralee	+27.4 (900-day)	–12.6	30 months	482	460
2. Bendemeer	+42.0 (600-day)	–9.0	18 months	456	434
3. Swanlee			18 months	360	342

Using EBVs to select for carcase traits

The Durham Research Project is a progeny test program for Shorthorn Beef and an MLA donor company project. The project tested 23 young BREEDPLAN recorded bulls from cooperating studs and evaluated progeny traits from birth to carcase.

Progeny were processed at both export weights and domestic weights.

Table 2 helps compare the carcase weights (CWt) of the steer progeny of the top five sires for CWt EBVs with the progeny of the five sires with the lowest EBVs for CWt. The predicted difference based on half the difference between the EBVs of the sires, was 14.3. This compares closely to the actual difference of 13.4.

Table 2. Carcase weight comparison between steer progeny of the top five CWt EBV sires, and the bottom five CWt EBV sires

	Average CWt EBV values	Predicted difference in CWt using EBV values‡	Average progeny CWt
Top 5 sires on CWt (carcase weight) EBVs	46.2		336.2
Bottom 5 sires on CWt EBVs	17.6		322.8
Difference	28.6	14.3	13.4

‡ Predicted difference if based on the differences seen in EBVs = 14.3 – ie half the difference between the EBVs of the sires

A similar comparison was made for the intramuscular fat (IMF) of the progeny. The IMF% was measured on a meat sample from the carcases of the bulls' progeny. The IMF values of the carcases show the advantage of high IMF EBV bulls.

In addition to the IMF%, the marble score of the carcases was recorded. As it is a trait related to IMF, marble score is expected to increase with increasing IMF EBVs. The carcase marble scores (see Table 3) showed a difference in favour of the high IMF EBV bulls. This shows that even though the trait is not directly recorded, selection on a related trait will promote genetic change.

Table 3. Carcase results of high and low IMF EBV sires

	Average IMF EBV values	Predicted difference in IMF% of carcase based on EBVs	Average progeny carcase IMF%	Average marble score
Top 5 sires on IMF (intramuscular fat) EBVs	1.1		5.5	2.8
Bottom 5 sires on IMF EBVs	–0.5		4.9	2.4
Difference	1.6	0.8§	0.6	0.4

§ Prediction if based on the differences seen in EBVs = 0.8 – ie half the difference between the EBVs of the sires

Selecting for multiple traits using EBVs

NSW Agriculture has been running a trial, in conjunction with the Beef CRC, using Angus bulls selected on EBVs for either high marbling, high yield, or high marbling *and* high yield. All the Angus bulls were mated to Hereford dams on commercial properties. The effectiveness of EBVs as a predictor of marbling and yield is shown in Table 4.

Table 4: Average carcase results for progeny of three Angus sire lines mated to Hereford cows

Angus sire line	High yield EBVs	High yield and marbling EBVs	High marbling EBVs
Yield%	67.8	67.5	67.0
IMF%	4.1	5.1	5.8
MSA eating score	62	68	69

The same research is underway in Western Australia, South Australia and Victoria and all sites are showing the same trends – EBVs work to improve the target traits. Some early Western Australian results (see Table 5) show improvement in some of the related traits.

The case studies and trial work reported show that using EBVs as a bull-purchasing tool is a reliable means of improving the performance of targeted traits.

Table 5: Average carcase results for progeny of high yield and high marbling Angus sire lines that were randomly mated to Hereford cows

Angus sire line	High yield EBVs	High marbling EBVs
EMA (eye muscle area)	69.5	65.8
Yield %	69.1	68.0
Marble score	1.15	1.34

Note: The three groups of bulls were chosen based on similar average EBVs for weight traits. Accordingly, the observed difference in eye muscle area (EMA) is essentially a difference at constant weight, in favour of the high yield EBV group.

Some of the progeny test Angus steers on display at Grafton with their Hereford dams

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