BREEDPLAN INTERNATIONAL

FERTILITY | GROWTH | CARCASE | CALVING EASE

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What is BREEDPLAN?

Introduction

BREEDPLAN is a modern genetic evaluation system for livestock breeders. It is offered by ABRI to the cattle industries in many countries but it can be customised for other species. BREEDPLAN offers you the potential to accelerate genetic progress in your herd, tighten up your breeding operations, improve productivity and increase the prices of your livestock. It can put a lot more cash in your pocket.

BREEDPLAN uses the world's most advanced genetic evaluation system (ie. an "animal model" which incorporates multi-trait analysis procedures) to produce Estimated Breeding Values (EBVs) of recorded cattle for a range of traits (e.g. birth, weight, carcase and fertility). In North American countries, BREEDPLAN produces Estimated Progeny Differences (EPDs) to conform with the local reporting conventions.

BREEDPLAN is integrated with the pedigree systems of many breeds. With the increasing use of artificial breeding, most herds in a breed have genetic links with other herds. BREEDPLAN technology can be used at a number of levels, for example, within-herd analyses for individual breeders, across-herd analyses for members of a breed association or breeding group, or international genetic evaluations where breed associations from a number of countries pool their data for analysis.

BREEDPLAN is the national beef recording scheme in Australia, New Zealand, Namibia, Thailand and the Philippines. Its use is increasing in the United States, Canada, United Kingdom, Hungary, South America and South Africa. This brochure explains some of the concepts used in BREEDPLAN.

Why should you be in it?

BREEDPLAN takes the guesswork out of selection decisions. You can't see an animal's genes! Two animals might look the same, but genetically they could be quite different. From just looking at a bull you can't tell:

- **whether his daughters will be good milkers**
- **how fertile his daughters will be**
- **how big his calves will be at birth and how they will grow**
- **what will be the carcase yield of his progeny**

These are the very factors that determine the profitability of your enterprise. By giving you the EBVs of animals, BREEDPLAN takes the guesswork out of your selection program. Stud and commercial cattle breeders can accelerate genetic progress and improve profitability. That's why you should be in it.

Understanding and Interpreting EBVs

What is Heritability?

In simple terms heritability is the proportion of the genetic superiority or inferiority of an animal that is passed on to its progeny. Heritabilities vary for different traits and breeds, but some commonly used values are given below, and their use is described below.

Milk	10%
Gestation length	22%
Weaning growth	20%
Marbling	20%
Eye muscle area	25%
400 day weight	30%
Fat depth	30%
Birth Weight	40%
Scrotal size	42%

What are EBVs and EPDs?

An animal's breeding value is its genetic merit, half of which will be passed onto its progeny. While we will never know the exact breeding value, for performance traits it is possible to make good estimates. These are called Estimated Breeding Values (EBVs).

They are expressed as the difference between an individual animal's genetics and the genetic base to which the animal is compared. EBVs are reported in the units in which the measurements are taken eg. kilograms for weight.

Thus a value of +12kg for 400-day weight means the animal is genetically superior by 12kg at 400 days compared with the genetic base of the relevant cattle population.

GROUP BREEDPLAN EBVs are calculated from all relevant information available in a breed's database. The resultant EBVs provide predictions of the animal's genetics on an across-herd basis. EBVs are the BEST genetic predictions that modern technology can provide.

An Estimated Progeny Difference (EPDs) is the prediction of the genetic merit which an animal passes on to its progeny. Since calves receive half their genes from each parent, an EPD = ½ EBV. EPDs are used in North America where the weight traits are also usually expressed in pounds (rather than kg).

The discussion below is based on EBVs but the same principles apply to North American breeders who are receiving BREEDPLAN EPDs.

How is an EBV calculated?

In a simple situation an EBV can be calculated from the records on an animal's performance, the heritability of the trait and knowledge of the genetic base of the population.

For example, if an individual animal weighed 60kg above the average of its contemporaries at 400 days and no other information was available on the performance of relatives, its EBV would be calculated as follows:

Performance	+60kg
Heritability	30% (or 0.3)
EBV	$60 \times 0.3 = +18kg$

In real life the calculations become more complicated as in a GROUP BREEDPLAN situation they include:

- **the animal's own performance**
- **the performance of all known relatives in all herds**
- **the relationship between the different traits**
- **the performance of all herds over all years of recording**

That is, there are literally thousands of calculations that go into producing an EBV for every animal in a large performance recorded population. You can't do these calculations "on the back of an envelope". That's why BREEDPLAN uses a powerful computer to do the job.

BREEDPLAN and GROUP BREEDPLAN results are calculated using software developed by the Animal Genetics and Breeding Unit (AGBU), a joint institute of NSW Agriculture and the University of New England. Meat and Livestock Australia Ltd contributes research funds to these developments.

What EBVs are available? Most breeds currently have the options of estimating the following traits:

WEIGHT	FERTILITY	CARCASE	OTHER
Birth Weight	Scrotal Size	Eye Muscle Area	Docility
Milk	Days to Calving	Fat Depth	Net Feed Intake*
200-Day Growth	Gestation Length	Retail Beef Yield	Structural Soundness*
400-Day Growth	Calving Ease	Intramuscular Fat	Flight Time*
600-Day Growth	-	Carcase Weight	-
Mature Cow Weight	-	Shear Force*	-

*Trial EBV

It should be noted that EBVs will only be calculated if sufficient data has been recorded for that trait. When BREEDPLAN is applied to species other than cattle, different EBVs are generated.

What's so good about EBV's? Consider GROUP EBVs for two sires:

	GROUP BREEDPLAN EBVs				
	Birth Wt (kg)	200 Day Wt (kg)	400 Day Wt (kg)	600 Day Wt (kg)	Scrotal Size (cm)
Sire A	+3.5	+29	+45	+65	+1.6
Sire A	+7.7	+11	+18	+25	-0.1
Breed Avg EBVs 2008 Calves	+4.2	+26	+41	+58	+1.3

Using the above data and assuming that you have joined both sires to groups of cows with similar average EBVs, the 600 day weights of the two sires' progeny would differ considerably. Let's compare the expected performance of progeny of Sires A and B - remembering that in each successful mating the sire contributes 50% to the genetics of the resultant calf.

Comparing Sires Progeny (eg. 600 day weight)
Half of (EBV of SIRE A – EBV of SIRE B)
Half of (65 – 25) = 20kg

ie. Progeny from SIRE A are expected to be on average 20kg heavier than progeny from SIRE B

Thats worth over $40 per calf. A very good reason for knowing about the EBVs of all your breeding stock. When the EBVs of A and B are compared to breed average, we can also see B is below average for all traits whereas Sire A is above average for all traits.

How reliable are EBVs?

By definition, EBVs are estimates of an animal's true breeding value. The estimate is made from the analysis of all known information that is available on the animal.

The "accuracy" figure produced with each EBV provides a measure of the stability of the EBV and gives an indication of the amount of information that has been used in the calculation of that EBV.

The higher the accuracy the lower the likelihood of change in the animal's EBV as more information is analysed for that animal, its progeny or its relatives.

"Accuracy" ratings are reported as a percentage (%) from 0-99. In most cases where an EBV is presented, the accuracy of the EBV will be reported in the column immediately following the EBV or the row beneath the EBV (as presented in the example below).

GROUP BREEDPLAN EBVs					
	Birth Wt (kg)	200 Day Wt (kg)	400 Day Wt (kg)	600 Day Wt (kg)	Scrotal Size (cm)
EBV	+4.2	+26	+41	+58	+1.3
ACCURACIES	56%	52%	55%	55%	46%

The following guides may be useful for interpreting accuracy:

ACCURACY RANGE AND INTERPRETATION

Less than 50%: The EBVs are preliminary. EBVs in this range will have been calculated based on very little information. These EBVs could change substantially as more direct performance information becomes available on the animal.

50% - 74%: The EBVs are of medium accuracy. EBVs in this range will usually have been calculated based on the animals own performance and some limited pedigree information.

75% - 90%: The EBVs are of medium-high accuracy. EBVs in this range will usually have been calculated based on the animal's own performance coupled with the performance for a small number of the animal's progeny.

More than 90%: The EBVs are a high accuracy estimate of the animal's true breeding value. It is unlikely that EBVs will change considerably with addition of more progeny data.

Although the accuracy of an EBV should be considered, animals should be compared on EBVs regardless of accuracy.

Where two animals have the same EBV however, the animal with the higher accuracy would normally be used more heavily than the bull with the lower accuracy because the results can be predicted with more confidence.

Please note:

In North America a different formula is used for reporting accuracy and so the above table does not apply to the accuracies reported in North American evaluations.

What are Within-herd EBVs?

The calculation of within-herd EBVs is an option available to those breeders who wish to see their data analysed separately. Within-herd EBVs may also be generated from breed association databases if good genetic linkage does not exist between herds. The genetic base for within-herd EBVs is calculated separately for each herd based on 1000 performance records. The performance of related cattle outside the individual herd is ignored.

Within-herd EBVs are only comparable within the herd for which they are calculated. They are not comparable with GROUP BREEDPLAN or Interim EBVs. They should be confined to within-herd use.

Within-herd EBVs are calculated from performance data in your herd only

How BREEDPLAN Works

Does BREEDPLAN separate genetics from environment?

Yes! This is a very important feature of BREEDPLAN. When you look at an animal's weight, 70% of what you see is the contribution of the environment (eg. feed quality, disease, management etc) - only 30% is due to genetics. However it is only the genetic component that is transmitted from one generation to the next. It is the genetics that makes an animal valuable for breeding - but unfortunately we can't "see" these genetics separately from the environmental influence. However, BREEDPLAN can separate out genetics from the environment and this allows you to select for real genetic differences.

Here's how it is done. Assume that the calves from a particular drop (ie. Spring 2009) are drafted two ways. Group 1 is run on good feed and Group 2 on poor feed. Calf A in Group 1 has a 400-day weight of 430kg and calf
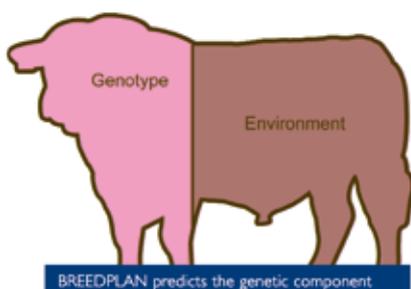
GROUP	1	2
Calf Id	A	B
Feed	good	poor
Calf Wt (kg)	430	390
Average Wt of Group (kg)	420	360
Difference from Av.	+10	+30
Heritability of Trait	30%	30%
Difference from Group due to Genetics	+3	+9

B in Group 2 has a 400-day weight of 390kg (see Table below). Is calf A genetically better than calf B because it is heavier at the same age? Not necessarily. The average weight of Group 1 is 420kg, so calf A is just 10kg above average. Calf B is 30kg above the average of Group 2. Calf B is correctly assessed as being better in its own group. If the two groups are genetically similar, you would find that calf B will have a better EBV than calf A. The higher absolute weight of calf A is due to the better environment.

What is a genetic trend?

Because environment is separated out from genetics in the BREEDPLAN evaluation, and the data is analysed over a number of years, it is possible to calculate the genetic trend for each trait. This trend can be calculated for an individual herd or the breed as a whole. As a breeder you will be able to see the progress you are making in the traits included in your selection program. As a buyer of genetics, you can zero in on purchasing genetics from those herds whose genetic trends are above the breed average. By checking the EBV profiles you can select a sire best suited to your individual breeding program.

Genotype / Environment

BREEDPLAN predicts the genetic component

200 Day - Growth (kg)
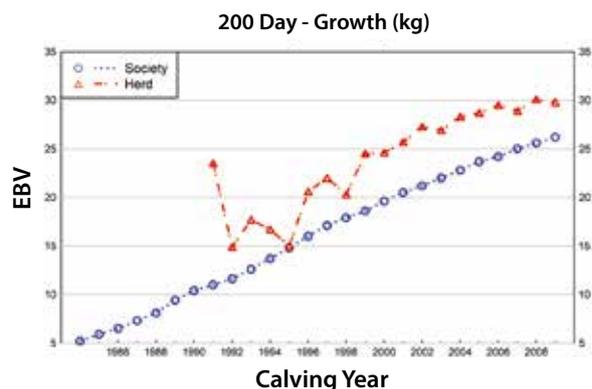
Can animals be compared across herds?

Yes, BREEDPLAN is able to compare animals across herds provided there are genetic links between the herds. These links are provided by the use of AI sires and the sale of cattle from one herd to another. These links are reinforced by the detailed pedigrees available in BREEDPLAN and breed association databases.

Let's look at the example where cattle on 3 properties A, B and C are compared. They all use a link sire by AI, and compare his progeny with those of a different home sire on each property. Property A is having a bad season, B average and C very good.

From the differences in the average weight of progeny from home sires and the link sire in each herd, we can see that herd sire X tested in herd A is superior to sire Y from herd B, which is superior to sire Z from herd C. (This assumes reasonable numbers of progeny measured and cows of equal performance. Adjustments are made if the cows are known to differ in performance on BREEDPLAN figures.) EBVs are then calculated from these progeny differences.

In this example, if the link sire is a base animal, EBVs would approximate - X +40, Y 0, Z -40, ie. double the progeny differences as sires only contribute half the genes.

This example also demonstrates that breeders should not be concerned that their EBVs will be depressed if they continue their recording programs during a drought.

How often are GROUP BREEDPLAN EBVs calculated?

The computing of GROUP BREEDPLAN EBVs is very consumptive of computer resources, time (for supervision) and money (for publication of results). The number of GROUP BREEDPLAN evaluations run per year differs for each breed, with some of the larger breeds running up to four GROUP analyses per year and smaller breeds running one or two per year.

For breeds that have moved to ABRI's new generation pedigree and performance software, ILR2, GROUP analyses are run monthly. A genetic "base" for the breed is determined as part of the GROUP BREEDPLAN run and EBVs of individual animals are calculated relative to the breed base.

What are INTERIM GROUP BREEDPLAN reports?

For some breeders, the scheduling of GROUP BREEDPLAN evaluations does not always coincide with their requirements for up-to-date EBVs. The INTERIM BREEDPLAN analysis is designed to meet this need. It is run for a nominated herd each time that herd submits additional calf performance records.

The analysis uses the latest GROUP EBVs for the herd as a starting point, an updates the calf EBVs based on the extra performance information. These INTERIM EBVs can then be compared directly to the latest GROUP EBVs and INTERIM EBVs reported for other herds.

| | | Average Weight (kgs) | | |
		Herd A	Herd B	Herd C
Link Sire Progeny (Common Sire)		340	380	420
	Sire X	360	-	-
Home Sire's Progeny	Sire Y	-	380	-
	Sire Z	-	-	400
Difference between Home/Link Sires		+20kg	0	-20kg

How to use BREEDPLAN?
Use of the BREEDPLAN service is easy. The minimum requirements are:

- Record dates of birth and the sire and dam of each calf with the relevant breed society
- Record and submit performance information on your calves to BREEDPLAN

There is no minimum requirement on the amount of performance information you submit to BREEDPLAN and you are free to pick and choose which traits are of importance to your breeding program and you wish to record performance on. It should therefore become a part of your normal management program without creating hours of extra labour.

Listed below is some of the information you could record on your animals and submit to BREEDPLAN:

- **Joining details e.g. AI date, bull in and bull out date, pregnancy test results**
- **Birth weights and calving ease scores**
- **200, 400 & 600 day weights**

- **Live animal fat and muscle scans**
- **Scrotal circumference measurements**
- **Temperament and structural scores**
- **Carcase data from abattoirs**

Most breeders start with the basics (i.e. weight traits) and move into the other options if and when they see a need for such options in their selection and marketing programs. If you are:

✓ recording with a breed that has installed an integrated pedigree-performance system,

✓ using AI to create genetic linkage to other herds, or

✓ you have bought in most of your females from another BREEDPLAN recorded herd then you can successfully participate in GROUP BREEDPLAN with any number of females.

What is BreedObject?

While BREEDPLAN provides cattle producers with a comprehensive range of information regarding the genetic merit of an animal, it can result in a dilemma when trying to select animals for use in a particular breeding program. In an ideal situation, it would be desirable to select animals that excel in all traits, but rarely will an animal be superior for all the available EBVs. So which traits should producers put most emphasis on? How much emphasis should be placed on each trait?

BreedObject is a tool that can help solve this dilemma. The BreedObject technology was developed by the Animal Genetics and Breeding Unit (AGBU), with financial assistance from Meat and Livestock Australia. BreedObject combines the BREEDPLAN EBVs for an animal with an economic weighting (based on costs of production and returns on outputs), to produce a single Selection Index. A separate Selection Index can be produced for any particular production scenario and market.

Selection Indexes enable cattle producers to make "balanced" selection decisions, taking into account the relevant growth, carcase and fertility attributes of each animal to identify the animal that is most profitable for their particular commercial enterprise. Selection Indexes reflect both the short term profit generated by a sire through the sale of his progeny, and the longer term profit generated by his daughters in a self replacing cow herd.

Standard Selection Indexes are now available for most Breed Society/Associations. The standard breed specific Selection Indexes have been designed to cater for the commercial market production systems of general relevance in each particular breed. These Selection Indexes are intended for use by both seedstock & commercial producers.

As well as standard Selection Indexes, it is also possible to develop customised indexes for individual producers using herd-specific production information and marketing goals.

What is TakeStock?

TakeStock is a powerful benchmarking tool for the beef seedstock industry. TakeStock collates all available BREEDPLAN and Selection Index information to provide beef cattle breeders with a tool that enables them to assess and improve the rate of genetic progress in their herds.

Takestock enhances the ability of breeders to manage genetic change. It enables seedstock breeders to focus on the key variables affecting the rate of genetic gain being made for the particular breeding objective of their commercial clients.

What does TakeStock do?

TakeStock users the pedigree and performance information that has been recorded with each Breed Society to:

- Provide a range of statistics relating to the genetic structure of the breed and individual herds.

- Evaluate the rate of genetic progress that has been made by the breed and then individual herds within it.

- To do this, TakeStock assesses the genetic progress that a herd has made for each Selection Index and benchmarks the individual herd's progress with the genetic progress that has been made by the breed as a whole.

- Determine the key factors that explain significant differences in the rate of genetic progress between herds within a breed across a given period of years. These factors are known as Key Performance Indicators (KPI). The KPIs help breeders identify the type of factors that had the greatest impact on the rate of genetic progress made by herds within their breed. Herds are rated for their performance against each KPI to benchmark the performance of their breeding program.

BREEDPLAN has leading-edge internet facilities which ensure that its users become part of a virtual world community of cattle breeders.

The facilities include:
- Electronic animal and EBV enquiry service: all animals on a Breed Societies database are included on Internet Solutions, which allows enquirers to undertake a wide range of functions including searching for individual or groups of animals pedigrees, progeny and EBVs,
- Member enquiry system: allows an enquirer to search the membership files directly for relevant contacts

INTERNET SOLUTIONS

- Sale catalogue facility (public auction): sale catalogues can be formed for single-vendor or multi-vendor auction sales with powerful search and enquiry facilities. Photos of animals for sale can be displayed. All pedigrees and performance are picked up automatically from the database and are continuously updated as EBVs (both GROUP and INTERIM) are updated. Searches can be done across catalogues to rank animals for sale on any particular trait (e.g. a particular BreedObject Index).
- Private treaty sales: breeders that are not having an auction sale can include details of registered and commercial animals that they have for sale. The BREEDPLAN software puts the seller in contact with an interested buyer. The sale is then concluded by private treaty.
- Listing of AI sires: these can be listed for a year at a time. EBVs and accuracies are automatically updated as more information is analysed. This is a valuable service to the AI industry.
- Mating Prediction: list the male(s) and the female(s) which you are considering joining and the system will calculate the expected average progeny value and the inbreeding coefficient of each particular mating.
- Report and data downloads: individual breeders can log on with their respective passwords and they can pick up reports and/or EBV data files that have been computed for them.
- Custom Reports: breeders can customise the reports they require from the database on-line.
- Internet based registrations and performance data submission: breeders can log on via their passwords and enter their animals' registrations and performance data to submit to the relevant breed society and BREEDPLAN office. The system will do interactive checks on validity of these records and subsequently update correct entries as a batch update. This allows a breed society office to be open for business 24 hours per day, 365 days per year for a very small retainer cost.

As a breeder, Internet Solutions puts the details of your genetics onto the world market continuously.

What research and development is behind BREEDPLAN?

Around $1.5M per year is being invested in upgrading the BREEDPLAN evaluation procedures. This keeps the system on the leading edge internationally.

BREEDPLAN herds have also been closely involved in major meat quality and breeding herd efficiency research projects.

The Australian Government, the Australian beef industry and four of Australia's research organisations have collaboratively funded these projects to the tune of $70M.

These exciting projects have provided important new technologies for inclusion in the BREEDPLAN service.

Benefits of BREEDPLAN

Many BREEDPLAN herds are now producing sale progeny that are 10% heavier at the same age than before those herds began performance recording with BREEDPLAN.

To achieve that benefit for 1% of sales revenue means a high benefit cost for BREEDPLAN. Benefit costs of around 15:1 are commonly being achieved now - especially in herds which sell BREEDPLAN recorded stock at a premium for breeding purposes.

These benefits will be further accentuated as you are able to make improvements in your herds fertility and carcase traits through using BREEDPLAN.

ACT TODAY!

In summary, BREEDPLAN is an inexpensive breeding tool that helps to put more dollars in your pocket - irrespective of whether you are breeding stud or commercial livestock or both.

That's what's so good about it. That's why it's been such a success internationally.

For further information about BREEDPLAN, please contact

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