Pig Genetics Info

ANIMAL GENETICS AND BREEDING UNIT

A joint unit of NSW DPI and UNE

Demonstrating Estimated Breeding Values – A Case Study

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What is an Estimated Breeding Value?

Estimated Breeding Values (EBVs) are predictions of the genetic merit of a boar or sow for a particular trait and are reported in terms of the traits recorded (millimetres for back fat and grams per day for average daily gain). The way animals perform (eg. how fast they grow or how much fat they lay down) is influenced by both, the animals' genes and the environment the animals are subjected to. The effects of the animals' genes and the effects of the environment they experience are separated using Best Linear Unbiased Predictors (BLUP) programs, like the Australian PIGBLUP program. EBVs are relative values and only EBVs from the same genetic evaluation can be compared. However within evaluations animals from different years or herds can be compared fairly using EBVs. EBVs are used as selection tools for all livestock industries and there are numerous papers that show how effective they are at predicting progeny performance (see further reading at the end of this document).

How do EBVs help?

EBVs allow producers to select genetically superior parents. By choosing parents with superior EBVs for the traits that producers wish to change they can alter performance in grower pigs. Using superior boars with higher EBVs for average daily gain or lower EBVs for back fat will, for instance, increase the growth rate or decrease the back fat of progeny of these boars in comparison to the growth rate and back fat achieved by progeny from average boars. This does not mean that all pigs from a particular sire will express better growth rates or lower backfat levels in comparison to progeny from an inferior sire. There will still be variation between all the offspring but on average the progeny from sires of high genetic merit will have higher growth rates and lower backfat depths than pigs from sires with inferior EBVs. This allows producers to target specific processor requirements and will increase financial returns.

Demonstrating EBVs

We can demonstrate that EBVs are effective predictors of genetic merit by comparing the performance of offspring from sires with different EBVs. This information sheet documents a case study conducted in 2004 by the NSW DPI to demonstrate the use of EBVs in predicting differences in progeny performance.

Outline of trial

The trial involved inseminating 24 sows with semen from four boars (six sows per boar). The offspring of these matings were then grown to approximately 22 weeks of age and measured for both back fat and growth rate. This trial was conducted on two farms (12 sows per farm) from the Grenfell Rural Producers Co-Operative in South Western NSW. The two farms involved were 'Khartourum' at Bimbi and 'Springfield' at Grenfell.

Boars for this demonstration were chosen primarily for the wide range of EBVs for both back fat and average daily gain. The EBVs for each sire were generated from the National Pig Improvement Program (NPIP; http://npip.une.edu.au) in which neither Khartourum nor Springfield were involved.

Six sows were inseminated with semen from each boar during December 2003. The mid-summer matings produced poor results and only 17 of the 24 sows farrowed. Unfortunately one of the sires was very poorly represented with only five progeny attaining daily growth and back fat measurements. Consequently this sire and his progeny have been excluded from this data set and are not presented in this report.

The offspring of the three remaining boars were slaughtered and measured for back fat depth when the pigs were approximately 22 weeks old with an average carcase weight of 70 kg. This was done at Burrangong in Young and at Mulligans in Corrowa and coincided with the Grenfell Pig Field Days held during September 2004 (Brewster, 2004). EBVs of sires and the average performance of their progeny are shown for growth rate and backfat in Table 1.

Table 1 Sire EBVs and performance of their progeny

	EBVs		Performance of progeny		
Boar	Growth rate	Back Fat	N	Growth rate	Back Fat
Playboy	+ 96	- 1.3	21	638 (+64)	12.34 (-0.64)
Courtland	+ 35	- 5.5	22	594 (+20)	9.10 (-3.88)
Powerful	+ 8	-0.9	22	574 (ref)	12.98 (ref)

** The bracketed number is how progeny have performed when compared to the poorest performing progeny (ref) from each category*

Growth Rate

The top ranking sire for growth rate (Playboy) produced the fastest growing progeny. This sire's EBV for growth rate was 61 g higher than the EBV for the second ranking sire (Courtland) and 88 g higher than the lowest ranked sire (Powerful). Progeny from Playboy (ranked 1st) grew on average 44 g/day faster than progeny from Courtland and 64 g/day faster than progeny from Powerful (ranked 3rd).

Theoretically ***half*** of the sire's superiority for each trait is passed to his offspring, because half of an animals genes come from his sire and the other half come from his dam. Therefore, we would expect that on average the offspring from Playboy would be 44 g better than offspring from Powerful. This expectation is half of the difference between EBVs for growth rate of Playboy and Powerful. In this case we observe a 64 g per day difference in mean progeny performance which is 20 g better than the expectation. However, it should be noted that only small numbers of progeny were available for each sire and the observed differences were not significantly different to the expectations.

Back Fat

The best ranking sire for back fat (Courtland) produced the progeny that had the lowest mean back fat level. This sire's EBV for back fat was 4.2 mm lower than the EBV for the second ranking sire (Playboy) and 4.6 mm lower than the bottom ranked sire (Powerful). Progeny from Courtland (ranked 1st) had a mean back fat depth of 3.88 mm less than the average back fat depth than the progeny from Powerful (ranked 3rd). Similar to growth rate, the 3.88 mm difference between the progeny from the best and worst sires also exceeded the theoretical or expected difference of 2.3 mm between these two sires based on their EBVs (half of the difference in EBVs).

Figure 1 Progeny performance for growth rate (ADG) and back fat (BF)

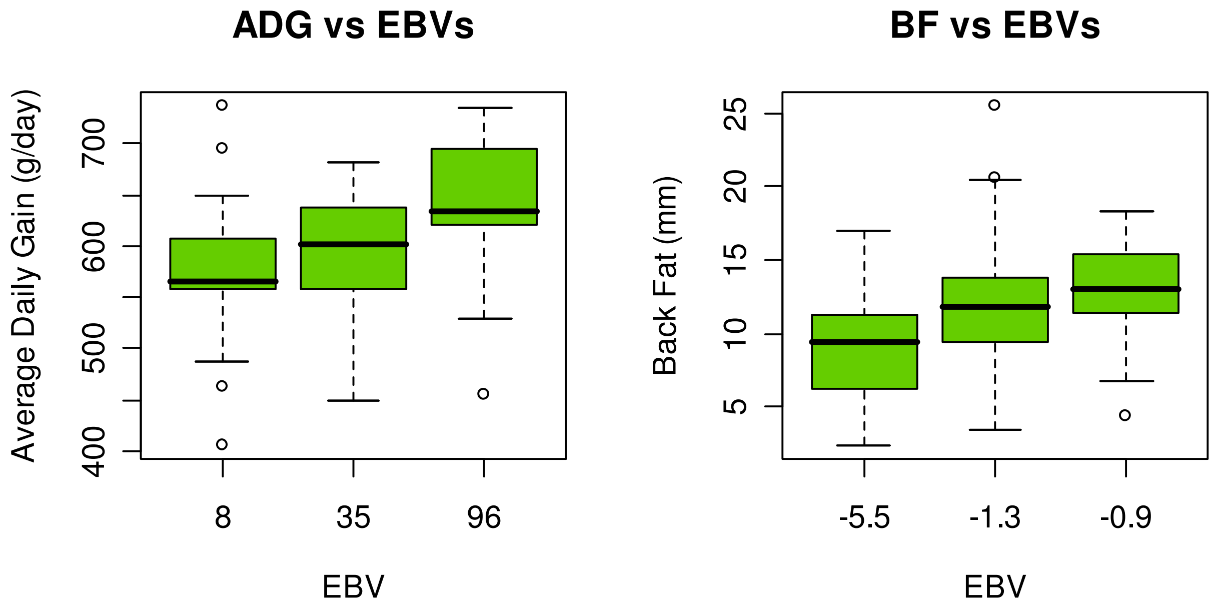


Figure 1 shows both the mean progeny results (represented by the black bar) and the "spread" or variation in average daily gain and back fat for progeny from each sire. The upper and lower whiskers show the upper and lower non outlier observations respectively and the box represents the upper and lower quartiles. The performances of the progeny are consistent with their sire's EBV ranking (progeny from playboy grew faster than progeny from Courtland who grew faster than progeny from Powerful, while Courtland's progeny had the least back fat followed by the progeny of Playboy then Powerful). The spread (indicated by the dashed lines and circles) shows that individual animals from each sire can attain values well below or above the average progeny result for each trait. Therefore, individual pigs of the top ranking boar may perform worse than the best individual pigs of the lower ranking boars.

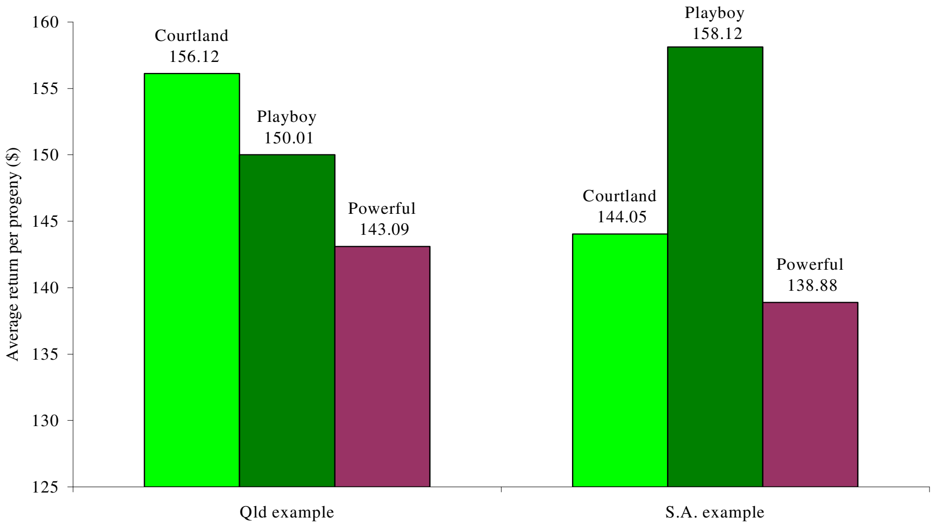
So which boar is best?

Maximising returns per progeny depend upon both the animals carcass weight and its fat depth. When it comes to individual traits Playboy's EBV (and progeny) are the best (highest) for daily gain and Courtland's are the best (lowest) for back fat. Which boar will deliver the highest return per progeny is however, not so obvious. This depends upon processors premiums and penalties and on how the herd now performs for the traits of interest.

Using the carcass weight and back fat depth of each slaughter pig we calculated the return for the progeny of each sire based upon two different payment schemes. The payment schemes were actual payment grids used by one processor in Queensland and another from South Australia. The two payment grids differed mainly in that the South Australian payment scheme penalised animal carcasses with less than 7 mm back fat depth.

For the South Australian grid example, the sire that produced the most valuable progeny was Playboy ($158 per pig), due to the higher growth rate of its progeny followed by Courtland ($144 per pig) and Powerful ($139 per pig) as is displayed in Figure 2. In Queensland, where animals were not penalised for too low a level of backfat, the best performing boar was Courtland ($156 per pig), the sire with the lowest EBV for back fat. Courtland's progeny returned an average of $6.11 per pig above the second ranked sire Playboy. Under both payment scales the progeny from Powerful showed the poorest returns.

Figure 2 Average returns per progeny ($/pig) for two example payment grids



EBVs were demonstrated

- EBVs allow producers to select genetically superior parents for traits of interest.
- EBVs can be used to predict how the progeny from different matings will rank and perform relative to each other.
- EBVs allow producers to tailor their production systems to suite different processor requirements and to maximise their returns.
- EBVs are easy to use and allow producers to specifically alter production characteristics in their grower pigs.

Further reading

Hansson. A, and Hermesch. S, 2005, '*Estimated Breeding Values of sires predict average progeny performance*', Australasian Pig Science Association Conference, Christchurch, New Zealand, November 27-30, P.100

Hermesch. S, 2005, '*Producer 1 - EBV's are a better predictor of genetic differences between pigs than performance records*' available online at http://agbu.une.edu.au/pigs/pigblup/pgi/pdf/producer1.pdf

Brewster. C, 2004, '*Demonstration of EBV's at the Grenfell Pig Field days*', Australian Pork Limited Group Demonstration Report, NSW DPI

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