Useful accuracy

GENE TALK

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What level of accuracy is useful when we use estimated breeding values (EBVs) and indexes to buy bulls or rams?

Accuracy is related to the heritability of a trait, so let's first look at heritability.

Genetic evaluation systems like Sheep Improvement Limited (SIL) or Breedplan adjust performance data for known non-genetic effects such as date of birth, age of dam or, in sheep, birth rank.

Such effects are known to influence animal performance for quite some time. After adjustment we are left with variation in performance for different animals. Heritability is simply the proportion (or percentage) of that remaining variation which is genetic.

If we didn't make the adjustments, our estimates of heritability would be lower and we would predict genetic merit less accurately.

The shorthand for heritability is "h^2". The "power" or "square" term is important. Simple accuracy when predicting genetic merit is the square root of heritability or "h".

Table 1 shows the relationship between heritability and this simple accuracy. Accuracy defined this way relates to estimates of genetic merit for individual animals when we know nothing more than their own performance, and assumes we have made adjustments for simple non-genetic effects we commonly see – **see table 1.**

Table 1: Accuracies when predicting genetic merit for an individual using only its own performance data

Heritability, h^2	Accuracy, h	Examples of traits with heritability near the specified level
5%	22%	Lamb survival
10%	32%	Number of lambs born, cow fertility
20%	45%	Weaning liveweight
30%	55%	Post weaning liveweights, some carcase traits
40%	63%	Carcase traits, some wool traits
50%	71%	Some wool traits
70%	84%	Skeletal (frame) dimensions

In practice we know more than this in typical breeding herds and flocks. Using performance information from family members increases accuracy further to give even more reliable estimates of genetic merit.

Family information is a valuable guide that good performance is genetic. You can think of this as – if two animals have similar performance, you are better to select the one from a good family than the one from an average family.

Table 2 illustrates how accuracy varies with amount and type of family information – **see table 2.**

Table 2: Accuracies of EBVs depending on heritability of trait and source of information

Heritabilities of…	10%	30%
Performance information for…	Accuracies for given heritability	
Parents only	22%	39%
Parents + individual of interest	38%	61%
Parents + individual + 10 half-siblings	42%	64%
Parents + individual + 50 half-sibs	49%	67%
Parents + individual + 10 half-sibs + 10 progeny	57%	78%
Parents + individual + 10 half-sibs + 50 progeny	77%	91%
Parents + individual + 10 half-sibs + 500 progeny	96%	99%

So what level of accuracy is useful? The answer is simple – any accuracy that confers a significant advantage over not using that information. We must not get hung up on differences in accuracy for different traits. Some traits just have lower accuracies than others due to lower heritabilities or because fewer relatives have performance information to help lift accuracy.

Using raw performance data is less accurate than using "adjusted" data – adjustment is for known non-genetic effects – which in turn is less accurate than using EBVs which make use of information from relatives and performance in other traits. And then there is DNA test information which can lift accuracy further.

Increasing accuracy increases genetic gain per generation. Some genetic evaluation systems have sought high accuracy but this only came after waiting some time to get progeny information – the dairy cattle breeding system was an example of this. High accuracy per generation was achieved but only with long generation intervals after waiting some years to get progeny proofs that gave high accuracy (reliability).

Rate of genetic gain is a function of accuracy divided by generation interval (gain per generation divided by years per generation = gain per year). Breeders must balance these effects to maximize gain per year.

For some traits, like lamb survival or reproduction, we live with lower accuracy than for traits like growth and carcase merit.

This is partly because they are very valuable traits, so even low accuracy can deliver useful value in terms of genetic gain. We know we can make genetic gain even when accuracy is low.

Accuracy is most useful as a measure of "risk". When looking at genetic information, EBVs or indexes with higher accuracy are less likely to change if we collected more information, such as progeny performance, to increase accuracy.

We should not get hung up about accuracy for two reasons.

Firstly, it is built into EBVs already. Less accurate EBVs do not show much spread about the average for a group of animals, while more accurate EBVs show more spread. The lower the accuracy, the less the system will shift the estimate for an animal away from the average.

Secondly, we make multiple selection decisions within years and across years. Having accuracies that are not high simply means some of the animals we select are better than we predict while others are less so.

This is a case of "swings and roundabouts" which evens out across a team of rams or bulls.

Accuracy can be a bit of a red herring for ram or bull buyers. You can minimise risk by selecting animals that have higher accuracies for EBVs but these will be the sons of older bulls or rams.

We expect that the sons of younger bulls or rams will be better on average but we are less certain about their actual level of genetic merit. Genetic gain is inevitable when we use genetic information to select rams and bulls.

You can give Beef + Lamb New Zealand or SIL your thoughts on this topic by email to silhelp@sil.co.nz or by leaving a phone message on 0800 SILHELP (0800 745 435).

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