AGC Refresher

- Breeding Values –

Breeding value: The value of an individual as a (genetic) parent. Also – can't be measured directly, elusive, relative, and an abstract mathematical concept. That sure doesn't sound very reassuring to base a genetic program on. And yet, through measuring performance, building pedigrees, and using statistical procedures it can be done! Though true breeding values can't be measured directly, they can be predicted. We call these *Estimated Breeding Values (EBVs).*

EBVs are used for traits that are controlled by many genes and for when the actual genotype can't be identified. This is the case for virtually all economically important traits in swine production. Only the breeding value of an animal is transferred to the next generation; not its performance. Thus, it's important to select animals for breeding based on good EBVs rather than solely on performance.

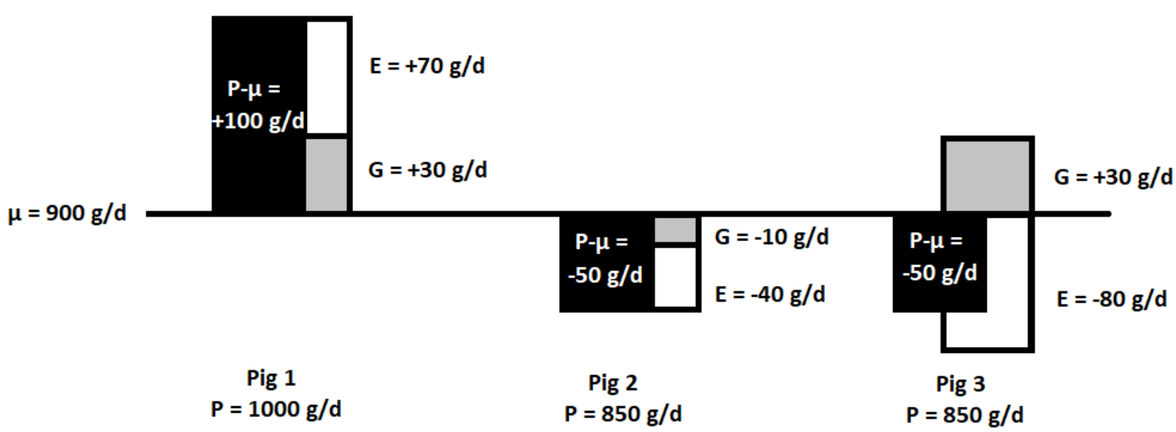
How an animal performs essentially comes down to its genetics (nature) and its environment (nurture). The basic genetic model uses the following equation to represent this:

$$\mathbf{P = \mu + G + E}$$

where **P** = the phenotype or performance of an animal for a trait
μ = (the Greek letter *mu*) the trait mean or average for all animals in the population
G = the genotypic value of the animal for the trait (includes breeding value)
E = the environmental effect on the animal's performance for the trait

Only P and μ are measurable, so G and E must be predicted. The combination of G and E determines how much an animal's performance (P) for a particular trait deviates from the population or herd average.

Consider the following diagram:



The average growth rate for pigs in this population was 900 g/d. Pig 1 grew 100 g/d faster partly because it had a good genotypic value at +30 g/d. Pig 1 was also in a better than average environment which helped it to grow another 70 g/d faster. Pigs 2 and 3 had the same performance at 850 g/d but for different underlying reasons. Pig 3 actually had the same genotypic value as Pig 1, but underperformed due to the environment that it was raised in.

Notice how G and E are relative to μ and are expressed as deviations, either positive or negative. Negative doesn't necessarily mean worse. For traits where a higher number is better (such as growth rate) you want a positive G and E. For traits where a lower number is desirable (such as days to 100kg) you want a negative G and E.

Genotypic value includes Breeding Value (BV) but also Gene Combination Value (GCV). BV accounts for all the gene effects that can be transmitted to the next generation. GCV accounts for the positive (or negative) effects from having a particular combination of genes. GCV can't be transferred to the next generation. Hybrid vigour is beneficial GCV.

EBVs can be thought of as the estimated value of an individual's genes to its progeny's performance. On average, progeny will have ½ of their sire's EBVs and ½ of their dam's EBVs. Each individual can have their own EBV for each trait so long as there is performance data from themselves or relatives to base it on. EBVs cannot be compared across breeds or unrelated populations. EBVs change over time because they are a relative number and depend on the EBVs and performance of other animals in the population. As more performance data is collected from the individual or relatives, EBVs will change and become more accurate – they approach the true breeding values.

Name	Age at 100kg (days)	Number Born	Number Weaned	Litter Wean Weight (kg)
AGC 6106G	**-11.1**	**+1.58**	**+1.20**	**+3.41**
AGC 30817G	**-14.8**	**+1.48**	**+1.05**	**+5.87**

The table above provides an example of EBVs for two AGC Yorkshire AI boars. Both are estimated to have excellent breeding values for the economically important traits listed relative to others in the very large population. For example, if AGC 6106G were mated to a sow with an EBV of 0 for Number Born (average), we'd expect their progeny to have (+1.58+0) ÷ 2 = +0.79 more piglets born compared to others in the population. We can be confident in the boar EBVs because a large amount of performance data has been collected from their relatives across several herds and environments. These values are also more accurate thanks to genotyping. This is particularly beneficial for traits on boars that can't be measured directly such as number born and weaned.

Any pork producer with internal gilt replacement (IGR) that includes purebred matings should be referring to accurate EBVs when making selection, culling, and mating decisions. Knowing which sows to breed pure based on their EBVs will lead to better performing progeny and faster genetic gains. AGC offers a full IGR package which includes EBV evaluations and other tools through the Canadian Centre for Swine Improvement (CCSI). Breeding values are the backbone of genetic programs including IGR. A proper IGR program is more complex and costly than purchasing F1 gilts, but when connected to AGC and with the right tools, genetic progress is certain.

-Brent DeVries, MSc.

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