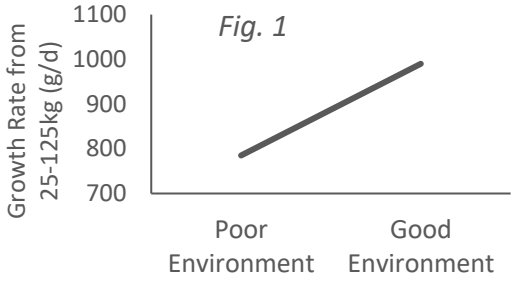
# AGC Refresher

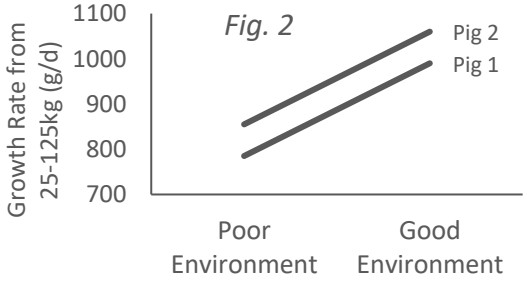
**- *G × E* Interactions -**

The last AGC Refresher article ended with a warning to consider system interactions when pursuing the "best" animal. Before we explore this further, let's first go back and make sure we understand some key concepts. *Phenotype* is a term that geneticists often use, but isn't very common in everyday language. *Trait* may be more familiar, but it doesn't mean the same thing. A trait is any categorical or measurable characteristic of an animal such as colour and conformation or litter size and growth rate. A phenotype is the actual observation or performance of that animal such as brown and deep chested or 14 born alive and 990 g/d. An animal's phenotype is influenced by its genotype (genetic makeup) and environmental effects. The simplified equation to represent this is $P = G + E$. Or in other words, performance is a combination of nature and nurture.

Consider, for example, the trait G*rowth Rate from 25-125kg*. A pig's phenotype for this trait was 785 g/d when raised in a barn with stale air, low feed quality, and high disease pressure. However, if that pig was raised under better conditions, it would have grown 990 g/d (*fig. 1*). This is entirely an environmental effect as the genotype is the same.




Let's add a 2nd pig with a different genotype, such as from a different line or time (*fig. 2*). It grows 70 g/d faster than Pig 1 regardless of environmental conditions. Pig 2 is obviously the better animal for this trait because of its better genotype.




Things get interesting when we see a genotype by environment *(G × E)* interaction. This means the difference in performance between genotypes changes from environment to environment. Different pig breeds often demonstrate a *G × E* interaction because they've genetically adapted to different environments over time. An extreme example is the the Tibetan swine breed. They thrive on pastures at high altitudes and low temperatures thanks to their well developed digestive system, high fat content, and long, black hair. On the downside, they only grow to 35kg and have five pigs/litter.

Conventional breeds wouldn't survive under these conditions, but are much more productive in controlled environments (*fig. 3*).

Though not as obvious, *G × E* interactions can occur within breeds and is often termed robustness. Some genetic lines may perform very well, but the environmental conditions must be near perfect to do so. Any disease pressure or temperature fluctuation could lead to a drastic drop in performance. A more robust genotype, on the other hand, would have a smaller drop in performance. Pig 2 in *fig. 4* has a less robust genotype compared to Pig 1 and as a result grows slower under most conditions.

Fig. 3: ***G*×*E* interaction across breeds**

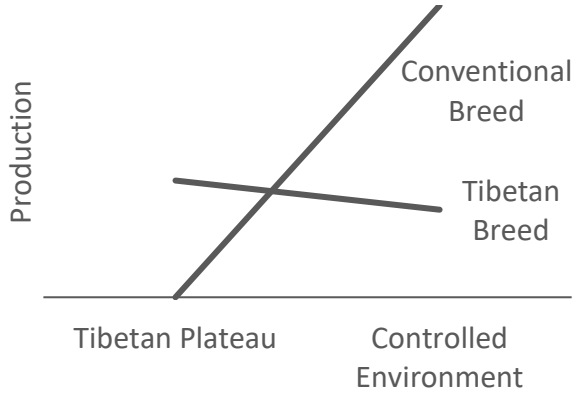
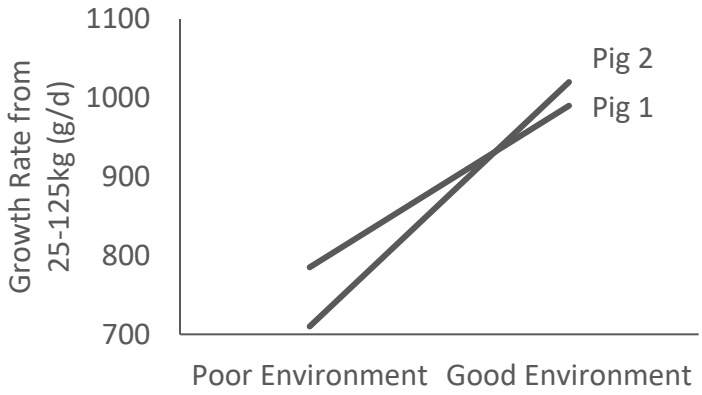



Fig. 4: ***G*×*E* interaction within breed**




Management and economics can also have interactions with genotypes and should be considered when pursuing the "best" animal. A genetic line that averages 18 pigs/litter may appear to be the best, but not when extra labour and other inputs such as milk replacer are needed to keep the piglets alive. A genetic line averaging 14 uniform pigs/litter with sufficient teat space may instead be the optimum. Just because something is the fastest or the most prolific, doesn't necessarily make it the best. Uniformity across environments and within groups of animals may not be as exciting, but it can be more profitable.

*-Brent DeVries, MSc.*

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