

What Drives Genetic Progress?

What is Genetic Progress?

Genetic progress can be defined as progress that is made when the average genetic value of the offspring (e.g your current calves) is higher than the average genetic value of the previous generation from which the parents were selected.

What Factors Influence the Rate of Genetic Progress?

There are a number of factors influencing the rate of change in genetic progress in a beef breeding herd. As a seedstock breeder you need to appreciate how these factors interact in the dynamics of a breeding herd to ensure that long term sustainable genetic progress is achieved.

The rate of genetic progress (i.e response to selection) in any one trait or Selection Index is expressed by the following equation.

$$R = \frac{S \times h^2}{L}$$

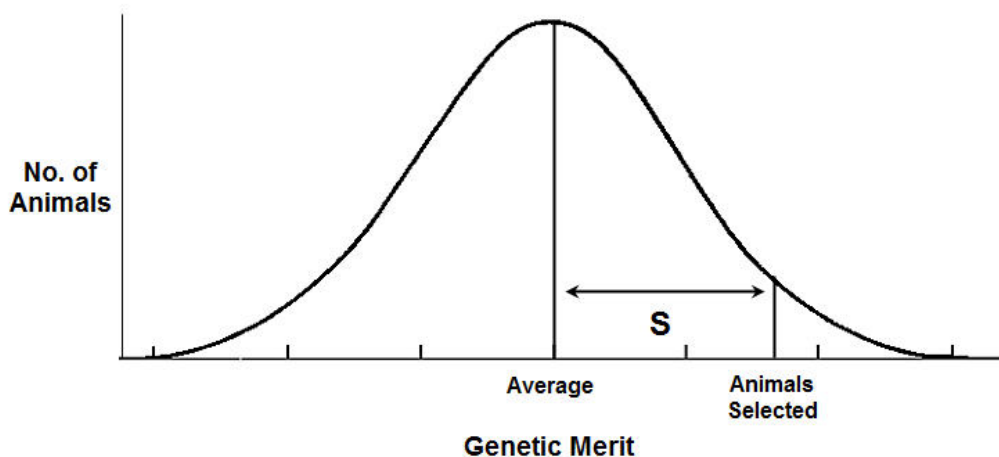
This equation gives you an insight into the factors that drive genetic progress and can be split into three main components. Where:

- R = Response to Selection
- S = Selection Differential
- h^2 = Heritability
- L = Generation Length

The factors that determine the rate of genetic progress (i.e. R) are explained in further detail below.

Selection Differential (S)

The selection differential is the difference in the average genetic value of the animals selected for breeding and the average genetic value of all animals in the population from which they were selected.



When a large proportion of animals are selected as parents, as is normal for selecting replacement heifers, the resulting selection differential will be small. When selecting bulls, it is common to select far fewer animals. In general, the smaller the proportion of animals selected, the higher will be their average genetic value, therefore the higher the selection differential. Higher selection differentials for either male or female parents will increase the rate of genetic progress for the desired trait or Selection Index.

Heritability (h^2)

The heritability of a trait is defined as the proportion of the measured variation between animals, which is due to genetic differences between individuals and will be passed on to progeny. Another definition is the efficiency of transmission of parental superiority (or inferiority) from one generation to the next.

The higher the heritability of a trait, the greater the proportion of the superiority of that trait which will be passed on to the offspring from both parents, and therefore, the greater the genetic progress that will be achieved.

The heritability values vary between traits. For example the growth traits (200, 400, 600 day weight) have higher heritability values than the fertility traits, such as Days to Calving. This alone indicates that faster genetic progress can be made for the growth traits. Selection Indexes do not have individual heritability's calculated, however the heritability values of the individual traits that are incorporated in the selection index indirectly effect the genetic progress that can be made if selecting with the aid of a Selection Index.

Generation Length (L)

Generation length is defined as the average age of the parents in a population at the time that their progeny are born. A short generation length means that animals selected for breeding are mated in the herd at a younger average age. Reducing the generation length will generally increase the rate of genetic progress.

The Trade Off

As with many of our economically important traits, an antagonistic relationship also exists between Selection Differential and Generation Length. By reducing generation length a higher proportion of replacements will be needed, resulting in a decrease in selection pressure and selection differential. The rate of genetic progress may decrease if older, "proven", high performing sires and dams are culled to make way for younger, unproven, lower performing replacement animals. Ideally, a balance between generation length and selection differential must be reached.

Influence of Your Recording Practices in Genetic Progress

The more accurately an animal's performance for a trait is measured, the better we can describe and segment the role of the genetic and environmental sources of variation using genetic evaluation schemes like BREEDPLAN. Increased accuracy of measurement means that estimation of an animal's 'true genetic value' will be enhanced. Therefore, the response achieved in a breeding program will be increased.

Another function of more accurate trait recording is a greater spread in Estimated Breeding Values (EBVs). Herds that have high levels of recording for a range of traits will have, on average, greater spread in their individual EBVs which result in a greater spread in Selection Index values. This provides a greater opportunity to identify animals for breeding with higher Selection Differential to increase the rate of genetic progress.

Summary

Knowledge of the factors that influence the rate of genetic progress and how they interact is important for cattle breeders, particularly the seedstock producer. They can be applied to genetic progress made for selection on individual traits or, as recommended, selection with Indexes

By increasing Selection Differential, reducing Generation Length and accurately recording a range of traits, a greater rate of genetic progress can be achieved. In general, you can not influence the heritability of a trait (or traits incorporated in an Index) and so, are better off focusing on the other three factors.

References

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R Thompson, Department of Primary Industries and Fisheries. *Understanding genetics Factors that affect the rate of genetic improvement* DPI&F Note, www2.dpi.qld.gov.au/beef/3131.html

For more information regarding the factors influencing the rate of genetic progress, please contact staff at BREEDPLAN