# FACT SHEET

## INCREASING SELECTION INTENSITY DRIVES PROFITABILITY

**Increasing Selection Intensity for Profitability**

One of the key measures of the success of any beef breeding enterprise is the genetic improvement that is made within their breeding program from one year to another. In its simplest form, genetic improvement describes the improvement from genetics in desirable performance provides. Therefore it is an important tool that can be used to facilitate an improvement in the phenotype, performance and ultimately profitability of animals in both seedstock and commercial beef herds. Critically, this allows producers to offset rising costs, you can't pay tomorrows bills with today's production.

Genetic gain is often used to describe genetic improvement, however genetic gain can be in either a positive or negative direction. Genetic improvement is achieved when the average genetic value of the progeny is higher than the average genetic value of the parents from which they were selected. A key to achieving genetic improvement is that the genetic gain must also be driven towards the breeders chosen markets. The ability of each generation to improve profitability, is not just a function of genetic gain, but also a function of increased genetic performance. This can only occur when the needs of all end users are defined.

**Selection Intensity**

Selection intensity is the difference in the average genetic value of the animals selected for breeding, compared to the average genetic value of all animals in the population from which they were selected. The higher the selection intensity (or degree of superiority), the higher the rate of genetic gain that will be achieved.

Within every population, there is always a distribution of poorer performers, average performers and elite performers. Given a normal pattern of distribution, there will always be smaller numbers of poorer and elite performers compared to average performers, relative to each population.

Consider the distribution within the 2016 drop Shorthorn Beef population, relative to the Export Maternal Index. The difference between the top value (+63), and the lowest value (-8), is known as genetic variation. The more genetic variation that exists within a population, the greater the ability to achieve genetic gain, within that population.

Using this distribution, there are two key ways for breeders to apply selection intensity in order to accelerate genetic gain within their herds. First is the removal of poorer performers from within the original population, or culling, and secondly the introduction of superior (elite) genetics, usually through sire selection.

**Culling poor performers.**

Removing poorer performers from the population and replacing them with females of higher genetic performance is a standard procedure for most breeding herds. Culling for key traits of economic importance such as fertility, soundness, temperament and culling on phenotype is a critical process and allows the population to make some degree of genetic gain.

However, there are two limitations to the amount of genetic gain that can be achieved through culling alone. First is that cows will usually only have one calf per year (except ET donors). Because of this, the population requires a large number of females to produce the desired number of progeny, and this reduces the ability to apply higher levels of selection intensity to the breeding herd and therefore cull more poor performers each breeding season.

The second limitation is the difficulty, particularly within commercial herds, to achieve accuracy of selection. Accuracy of selection is critical, and refers to the ability to identify, not only elite performers, but also poorer performers to remove from the population. Where a producer is unable to measure all traits of economic importance within the population, it can be extremely difficult to know which cows represent the poorer performers within the population for a number of important and economically relevant traits. For example, commercial breeders seeking to improve IMF% may not be able to identify the poorer IMF % performers from within their population of females.
Because of this, improvement of key traits in any population, also requires careful selection of genetics that are introduced into the herd.

**Introducing Elite Sires**
Sire selection can provide a relatively high impact on selection intensity, largely because each sire is capable of joining multiple numbers of females. The effect of this is to reduce the number of overall sires required, relevant to the population size, and therefore increase the amount of selection intensity that can be applied to the male portion. The more "elite" the sires imported, and the more progeny born to "elite" sires, the more the average performance of the progeny can be increased, particularly where higher levels of genetic variation exist.

**The role of AI in Selection Intensity**
***Increasing Selection Intensity***
Given the shape of a normal distribution curve, there can only be a very limited number of elite sires within each population. If each elite sire has only a limited number of progeny, such as with natural service, then the impact of the elite sires on genetic gain, relevant to the overall population, is reduced.
The role of Artificial Insemination is to allow those elite sires to be used more widely throughout the population, and therefore further increase selection intensity, to the effect of moving the progeny average faster than natural service alone can often achieve, and so accelerating genetic gain.

***Genetic Description***
Another key to selection intensity is also genetic description and its impact on accuracy of selection. For selection intensity to work correctly, elite sires must be truly elite. The ability to use high accuracy, proven elite sires through AI, further increases the opportunity for producers to accelerate genetic gain.

***Accuracy of Selection***
An increased use of elite, high accuracy sires, within herds, also increases the accuracy of genetic description of progeny, whilst use of elite sires across herds also increases pedigree linkages, which further increases the accuracy of genetic description within the overall population, increasing selection accuracy for future matings.

***Genetic Variation***
Correct sire selection from outside a breeders population, may also have the effect of increasing genetic variation within each breeders population. An elite sire may represent a performance level that exceeds the level of performance present in the breeders own population. In this instance, the use of AI may provide increased genetic variation, and an even greater opportunity to accelerate genetic gain, by expanding the available gene pool for selection, further increasing selection intensity. Use of AI can provide access to proven elite sires, that may represent an overall breeds gene pool, worldwide.

***Genetic Intervals***
Increasing the number of heifers born by proven elite sires, also increases selection pressure as producers are able to choose a greater proportion of genetically superior replacement females and apply even more selection pressure to the original population. This also has the effect of shortening generation intervals, or the length of time from one population being replaced by a superior population, which further accelerates genetic gain.
Achieving genetic gain is a measure of the herds increasing ability to offset rising costs through improved performance and phenotype, and therefore productivity. However, it is also a critical function for breeds to be able develop new markets, increase premiums and increase compliance to key markets.
Applying selection intensity correctly to each population is certainly the key to creating genetic gain for producers. AI though, when used correctly, becomes a very powerful tool, one that can cost effectively assist producers to turn the key, and accelerate genetic gain, improving phenotypes and increasing productivity, and therefore profitability, within their breeding enterprise.