

### BREEDPLAN Guide to Genetic Improvement

- Success in stud breeding is measured by genetic improvement.
- Genetic improvement boosts herd performance and profitability.
- It is achieved when offspring have better genetics than their parents.
- The amount of improvement depends on how superior the offspring are compared to the parents.

#### Factors influencing genetic improvement (R)

- The Response to selection equation applies to the genetic improvement that is made for a trait, selection index or overall breeding objectives.

$$R = (i \times r \times \sigma_g) / L$$

- Where:
  - R = Response to Selection
  - i = Selection Intensity
  - r = Accuracy of Selection
  - $\sigma_g$  = Genetic Variation
  - L = Generation Length

### Accuracy of Selection (r)

- Influenced by heritability of a trait, the quantity and quality of information available, the availability and accuracy of selection tools.
- The higher the accuracy, the more informed and correct selection decisions will be, and the more genetic improvement can be achieved.
- Accuracy of selection can be maximised by:
  - Performance recording and measuring all animals within the breeding program.
  - Measuring as many traits as possible.
  - Utilising genetic tools such as BREEDPLAN EBVs and selection indexes when making selection decisions.
  - Using proven sires as opposed to younger bulls.

### Generation Length (L)

- Is the average age of the parents in a population at the time that their progeny are born, with a shorter generation length resulting in greater genetic improvement being achieved.
- Cattle are constrained by contrast to other livestock species (e.g. poultry) due to an older age of puberty and longer length of gestation.
- This includes strategies such as retaining a higher proportion of replacement heifers, ensuring heifers have their first calf at two years of age and the use of yearling sires.

### Selection Intensity (i)

- The difference in the average genetic value of the animals selected for breeding vs the average genetic value of all animals in the population from which they were selected.
- The higher the selection intensity, the higher the rate of genetic improvement that can be achieved.
- When a large proportion of animals are selected as parents, the resulting selection intensity will be small. Conversely, when a smaller proportion of animals are selected as parents, the resulting selection intensity will potentially be large.
- Reproductive technologies, such as artificial insemination (AI) and embryo transfer (ET), are tools that can increase the selection intensity of bulls and dams, respectively.
- By increasing selection intensity, these reproductive technologies can be used to increase the overall level of genetic improvement within the herd.

### Genetic Variation ( $\sigma_g$ )

- The amount of genetic variation that exists within the population of animals that are available for selection within the breeding program influences the amount of genetic improvement that is possible, with greater genetic variation providing a greater potential to make genetic improvement.
- The degree of genetic variation can be increased by expanding the gene pool from which animals are selected, such as through sourcing genetics from herds or bloodlines not previously utilised or from overseas countries.
- Strategies such as crossbreeding can also be used to increase genetic variation, particularly in commercial operations.

### More Information

- Scan the QR code alongside or click [here](#) for the BREEDPLAN Help Centre

