The power of genetics

Teagasc equine specialist Dr Alan Hurley explains why breeders need to focus on genetics when making their goals.

The contribution of breeding to improving animal performance has been well recognised across a range of different species. At its most fundamental level, genet-ics involves the passing of genes (both favourable and unfavourable) from parents to offspring, and unlike manage-ment (e.g., nutrition, exercise, and health protocol), genetic selection is permanent and cumulative. This implies that inher-ent characteristics are compounded each generation.

For example, in poultry, the kilograms of feed required to produce a kilogram of meat was predicted to have reduced by 50% and growth rate increased by 50% between the years 1960 and 2000. Also, using a controlled experimental study in chickens, it has been dem-onstrated that up to 90% of the gains in performance in recent decades could be attributable to genetic improvement.

Therefore, genetic selection and optim-isation of management when used together provides the best opportunity for improve-ment, yielding enormous benefits over time. For example, if a breeder introduces good genetics for traits such as soundness, performance, and ath-letism, they can be improved every generation. In direct contrast, however, any indirect consequences of breeding are also compounded with successive generations.

A well-publicised example of such indirect unfavourable consequences of selection is the documented deterioration in reproductive performance in dairy cows concurrent with aggressive genetic selection for increased milk production. It is therefore imperative that breeding schemes are optimised to where possible, achieve gains in performance where all traits affecting perform ance are accounted.

GENETIC TERMINOLOGY

The terms commonly used by animal breeders to describe the character-istics of a population are sometimes misunderstood and misinterpreted and need to be properly understood by breeders.

GENOTYPE

Genotype refers to the information contained within the animal’s DNA, or genetic material. For example, a horse is born with a fixed genotype which remains the same throughout their life.

PHENOTYPE

The phenotype is the simply the observed performance of an animal “in the field” (e.g., coat colour or height); it is the physical expression of the ani-
mal’s genotype. However, the pheno-type is influenced by many factors in the animal’s environment. For exam-ple, two horses with identical geno-types could develop quite different phenotypes if raised in contrasting environments and exposed to different nutrition and training.

Herkability

Herkability is a commonly used stat-istic in animal breeding. Herkability summarises the proportion of pheno-typic variation, or differences among a cohort of animals, attributable to genetic variation between individuals. Put simply, how much of the observed performance (phenotype) is due to genet-ics. Herkability varies from 0 (not heritable) to 1 (fully heritable).

If the herkability is high, it is expect-ed that a large proportion of the pheno-typic differences of the parents will be passed on to the progeny. Human height for example is approximately 80% heritable.

Many characteristics such as athletic ability, coat colour, height and behav-ioural tendencies are all under genetic control. Osteochondritis Disseccans, a joint disorder, is approximately 25% heritable; therefore, it is possible to make considerable genetic progress in reducing the incidence of this condi-
tion.

BREEDING PROGRAMMES

A breeding programme is a pro-
gramme with a defined breeding goal and breeding objective for the produc-
tion of the next generation of animals. It is the combination of recording se-
lected traits, the estimation of breeding values, the selection of potential parents and a mating programme for the selected parents including appro-priate (artificial) reproduction methods.

Fundamental to any breeding pro-
gramme is a clearly defined breed-
ing goal. The breeding goal is defined by the selected parents including appro-
priate values, the selection of potential traits, the estimation of breed-

ting objective for the produc-

Breeders should be mindful and note that environmental effects can mask genetic effects where possible “bad” genetics can look better than “good” genetics due to environ-
mental effects. For example, if a horse jumps a clear round, that achievement may be partly attributed to its genetic ability and partly due to its environ-
ment such as the skill of its rider and quality of its training. For breeding purposes, a horse’s genetic ability is the only factor that is important, as a rider’s talent cannot compensate for a horse’s poor genetic constitution.

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TAKE HOME MESSAGE

Unlike management (e.g., nutrition, exercise, and health protocol), genetic selection is permanent and cumulative meaning that improve-
ments achieved are compounded each generation.

Breeders need to define a clear breeding goal and breeding objec-
tive.

A successful breeding programme needs to be based on genetic selection in addition to pheno-
typic selection.

Breeders are encouraged get ani-
mal, he combines expertise gained from Massey University, New Zealand. After his PhD, he joined Teagasc as an Equine Specialist. Having worked background and equine industry expe-
riments to deliver leadership, training and support within Teagas-