Genetically Speaking...

Do you know the ABC's of Selection and Breeding?

by Dr. Debra K. Aaron, Professor

Have you ever read an article on sheep breeding and genetics and wondered what in the world the author was talking about? If so, you'll want to read this edition of Genetically Speaking. Starting with A for Adjustment Factors and ending with Z for Zygote, we'll go through the alphabet one letter at a time to provide you with what you need to know to be a well-informed sheep breeder.

The ABC's of Selection and Breeding

Adjustment Factors

Known environmental or management effects that are part of every performance record. They can be accounted for in a genetic evaluation process (e.g., NSIP). Examples include sex of lamb, type of birth and rearing, and age of dam. To be used properly in selection, all records should be adjusted to a common basis.

Breed Complementarity

An improvement in the overall performance of crossbred offspring resulting from crossing breeds of different but complementary types. Breed complementarity occurs when the characteristics of different breeds complement each other in crossbreeding systems. For example, the mating of large, fast-growing, black-faced rams (Hampshires) to prolific, maternal ewes (Polypays) would be complementary in the production of market lambs.

Crossbreeding

A mating plan involving two or more breeds. Sires of one breed or breed combination are mated to dams of another breed or breed combination. Crossbreeding offers two primary advantages: Breed complementarity and heterosis (hybrid vigor).

Dominance

The ability of one allele (or gene) to express its phenotype at the expense of the alternate allele. It can be thought of as an interaction between genes at a single locus such that in heterozygotes one allele has more of an effect than the other. The allele with the greater effect is dominant over its recessive counterpart. For example, the allele for white wool color is said to be dominate over the allele for black wool color.

Estimated Breeding Value (EBV)

A prediction of genetic value derived from the application of genetic theory and statistics to performance records (e.g., NSIP). It is an estimate of the worth of an individual as a (genetic) parent. An EBV is twice the Expected Progeny Difference (EPD) for an animal. An EPD is a prediction of how much better or poorer an individual's progeny will perform compared to the average of all individuals in the breed. For example, if a ram has an EBV of 12 lb for weaning weight, on the average he should transmit 6 lb of that to his progeny. In other words, if this ram is mated to an average set of ewes, the resulting lambs are expected to be 6 lb above average for weaning weight. This value (one-half the EBV) is referred to as the Expected Progeny Difference (EPD).

Full Sibs

Animals that have the same sire and dam. In contrast, half sibs are animals that have either the same sire or the same dam (half-brothers or half-sisters).

Grading Up

A mating system designed to convert a flock from one breed to another by using purebred rams of one breed on females of any other breed and keeping the female offspring from successive generations as replacements, eventually resulting in "purebred" animals. For example, a Polypay flock can be graded-up to the White Dorper breed if White Dorper rams are repeatedly used on Polypay ewes and the resulting ewe lambs of increasing White Dorper genetics.

Heritability

The portion of total variability for a trait (such as weaning weight or slaughter weight) that is caused by genetic differences among animals. The higher the heritability, the more likely an individual's actual performance will be passed to offspring and response due to selection for that trait will be faster. Heritability estimates of 20% are considered low, 20 to 40% moderate, and greater than 40% high.

Inbreeding

The mating of animals more closely related to each other than the average of the breed. Inbreeding increases the number of homozygous gene pairs and decreases the number of heterozygous gene pairs. Inbreeding increases prepotency as well as the expression of undesirable recessive genes.

Julian Date Calendar

In the commercial world, the number of the day in a particular year, so January 1 = Day 1, February 28 = Day 59, and so on. A Julian calendar is useful for calculating lamb age at weaning. It is more correctly referred to as a "day of year" calendar.

Known Carrier

An animal that has produced an offspring that express a recessive phenotype, such as a genetic defect. The animal is outwardly normal. For example, a ram may carry the recessive gene responsible for spider lamb syndrome but he would look normal. Carrier ewes and rams should be removed from the breeding flock.

Linebreeding

A generally mild form of inbreeding designed to maintain a substantial degree of relationship to a highly regarded ancestor, generally a ram, without causing high levels of inbreeding.

Maternal Breed

A breed that excels in maternal traits (e.g., traits especially important in breeding females, such as fertility, milk production, mothering ability and maintenance). Most maternal breeds are white-faced. Maternal breeds are often referred to as ewe or dam breeds. The Polypay is an example of a maternal breed.

National Sheep Improvement Program (NSIP)

A performance-based program for genetic selection of sheep with data evaluation by Meat and Livestock Australia's LambPlan Program. Producers submit on-farm performance data and NSIP returns genetic evaluations in the form of EBVs. NSIP generates EBVs for weight traits, wool traits, reproductive traits and, for some breeds, parasite resistance. See www.NSIP.org.

Out-of-Season Lambing

Ability of certain ewes to lamb out of the normal (spring) lambing season. Most sheep are seasonal (short-day) breeders and are most fertile in the fall. Some breeds are less seasonal or have extended breading seasons. Genetic selection offers the best tool for permanent improvement of out-of-season lambing.

Paternal Breed

A breed that excels in paternal traits (e.g., traits important in market offspring, such as rate and efficiency of gain, meat quality and carcass yield). Most paternal breeds are black-faced. Paternal breeds are often referred to as ram or sire breeds. The Hampshire is an example of a paternal breed.

Qualitative and Quantitative Traits

Qualitative traits (for example, wool color and presence or absence of horns) show sharp distinction between phenotypes and are controlled by only one or a few pairs of genes. Qualitative traits are influenced little or none by the environment. Quantitative traits (for example, weaning weight and postweaning ADG) are quantitative in nature and are influenced by many pairs of genes. Quantitative traits can be affected greatly by the environment.

Records

A critical part of a genetic evaluation and selection program. Records fall into six categories: reproduction, maternal ability, growth, wool, carcass and lactation. Records must 1) include the sire and dam of the animal, 2) be accurate and 3) include date on which the measurement (e.g., birth weight, weaning weight) is recorded.

Selection

The practice of determining which animals will be parents of the next generation. Selection is the process sheep breeders use to produce genetic change. Selection should be part of all sheep production enterprises.

Terminal Sire Crossbreeding System

A crossbreeding system in which maternal-breed females are mated to paternal-breed rams to efficiently produce lambs that are especially desirable from a market standpoint. Terminally-sired females are not kept as replacements but are sold as slaughter lambs. Most terminal cross programs involve crossing blackface rams with whiteface ewes.

Utilization of Heterosis

This is an advantage of a systematic crossbreeding program. Effects of heterosis tend to be large for lowly heritable traits (reproduction) and small for highly heritable traits (growth, carcass, wool). Heterosis is maximized by mating crossbred ewes to a ram of another breed to produce crossbred offspring.

Visual Appraisal

A method of selection based solely on phenotype (appearance). It is most important from a structural soundness or conformation standpoint. The most effective selection is based on a combination of visual appraisal and performance records.

Weaning

Separating lambs and ewes from each other to prevent nursing. It is typically done when lambs are approximately 60 days of age in intensively-managed sheep operations. A lamb's weaning weight is a good indicator of a ewe's milk producing ability, as well as an early indication of growth potential.

X Chromosome

The sex chromosome that occurs paired in each female zygote and single in each male zygote in species, such as sheep, where males have two unlike sex chromosomes.
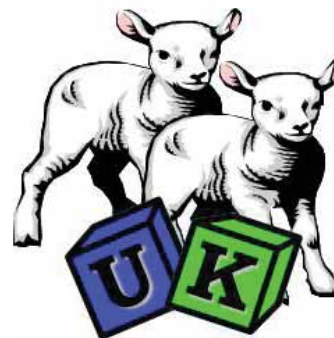
Y Chromosome

The sex chromosome that is characteristic of male zygotes in species, such as sheep, where males have two unlike sex chromosomes.

Zygote

A cell formed from the union of male (sperm) and female (oocyte, egg) gametes. A zygote has a full complement of genes—half from the sperm (sire) and half from the egg (dam).

And, there you have selection and breeding from **A** to **Z**.

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