How to make genetic improvements

In order to make genetic improvement breeders need a clear goal or objective of what they wish to improve. The objective for most stud breeders will be to increase the profitability of the commercial herds run by their buck buying clients.

In order to increase the objective or the profit of these herds it is imperative to examine what traits will impact on the profit of these herds. These traits can be broken into three broad categories as follows:
Weight – Birth weight, weaning weight, sale weight and adult weight.
Fertility – Number of kids born, number of kids weaned and sold.
Carcase – Carcase weight, Carcase fat, proportion of muscle or carcase yield, tenderness.
An increase or decrease in a unit of each of the above traits will impact on the bottom line of the commercial goat herds.

To genetically improve any one or a combination of the above traits relies on selection decisions. Genetic improvement therefore relies on the selection of animals to be used as parents in the breeding program. The aim will therefore be to select parents that produce the best kids in terms of the above traits. To do this it is best to select on the breeding value or the genetic merit of these animals. Estimated Breeding Values (EBVs) for these traits offer the best method for selecting animals on the basis of their genetic merit as parents.

The next question is therefore – How do we estimate the animals breeding value? An estimation of an animals breeding value can be made by studying the animals own performance records, its looks (which is less reliable), the performance of its relatives, or the performance of its progeny compared to the progeny from other animals. By utilising the pedigree information, progeny performance and the performance of known relatives and analysing this information in a genetic evaluation system (BLUP) it is possible to produce EBVs for the particular traits.

The performance of the animal's progeny will be determined by a combination of genetic and environmental influences. For a trait with a heritability of 40% (which is quite high) means that 40% of the variation seen in that trait is due to genetic influences and the other 60% of variation is due to environmental influences. The environmental variation is not passed onto the next generation but it can be influenced by management. The genetic variation between individual animals is determined by the genes that the animal receives from its parents and will be passed onto the next generation.

Therefore the best measure of the animals breeding value is attained by a comparison of the progeny from other animals. As the performance of the progeny is due to the combination of genetic and environmental factors it is necessary to adjust or correct for any known environmental effects that are influencing the progeny's performance. Know environmental effects that can be adjusted for include age of dam, age of animal at measurement, birth status and rearing status. There is a degree of environmental variation due to random effects that is unable to be corrected for by systematic adjustments. The random environmental variation can be reduced by only directly comparing animals run under the same conditions and by ensuring all animals are treated equally or identified as different groups.

Given that we need to know more about an animal that we can tell by just looking at it and that the pedigree information and the performance of known relatives is useful in determining an animals EBV. How do we collect and analyse all this information? Once the traits to be included in the breeding objective and when and how these traits will be measured are decided. A system of performance recording is needed to collect and analyse this information. A central data collection centre is especially needed when analysing information from a number of different herds to ensure that animals used in more than one herd are identified correctly. The central collection centre can then run this information through a BLUP analysis to produce the required EBVs.

When analysing performance information it is necessary to ensure that fair comparisons are being made between animals. This means breeders need to identify animals that have been treated differently, as different management groups, for example animals that have been fed for show, or two different mobs with one mob on irrigated pasture and the other on native pasture. It is only valid to directly compare the performance of animals that have been managed in the same way.

When analysing the performance information from different herds or different mobs it is imperative that there are genetic links between the herds or mobs. The best method of linkage is to ensure that there are progeny in the different herds or mobs by a common sire. For across herd linkage A.I. will be the best method available to ensure that a link sire has progeny in a number of different herds.

Genetic improvements

Progeny Testing – Progeny performance is the best measure of an animals breeding value, therefore a well designed progeny testing scheme is very useful in identifying superior breeding animals. It is important that when designing progeny testing programs to eliminate as many of the environmental differences as possible, for example random allocation of females to the bucks and ensure all progeny are run under the same conditions.

Central Performance Test Stations – Central buck or performance test stations are quite common in the US. Central performance testing is not as useful as on farm recording where the whole drop is recorded and where the herd has links to other performance recording herds. The problem with central test stations is that the animals entering the test come from a number of different environmental backgrounds. Even a settling in period before the testing commences, does not eliminate all the pre-test environmental bias. The greatest contributor to pre-test bias is the fact that animals are from many different environmental and management backgrounds. Those animals from poor environments will exhibit compensatory gain when nutritional conditions are improved. Therefore the high growth rates reflect compensatory gain and not the genetic ability of the animal.

Some traits such as feed conversion efficiency (FCE) require that animals are entered into a central testing station because the tests are unable to be carried out on farm. Again there are still problems with the background environmental influences.

Most breeding programs will involve simultaneous selection for more than one trait. How then do we combine the EBVs for the different traits into a single estimation of an animals overall worth? The best methods is to weigh each trait by economic importance, in terms of margin profit. You need to ask yourself how much extra profit do I get from 1 extra unit of the trait? Once you have an economic weighting for each trait and you have determined your breeding objective it is possible to multiply each EBV by its economic weighting to produce a single index value for each animal. The index will rank all animals within the herd for that breeding objective.

For traits without EBVs, such as animal structure (conformation) or makings it is best to cull only a small percentage. If culling a high percentage it is better to develop EBVs for these traits and to cull on EBVs and not visual appearance.

To attain maximum genetic progress or improvement it is important to have accurate EBVs (which means accurate recording or performance information, management groups etc.), have intense selection pressure and to maintain short generation intervals. Short generation intervals are

achieved by maximising the use of the youngest generation of animals.

Mating schemes – Mike's recommendations were to avoid inbreeding and that corrective and complementary mating were of some use. He stated that it is more important to decide which animals are to be retained as breeders than to decide which animals should be mated to each other. He recommended that when deciding what animals to retain, that the animals breeding value should be used in the decision making process.

Grading-up – Mike recommended that breeders select across grades on the basis of the animals breeding value and not to select solely on the animal's grade. He also recommended on not grading-up too far, as this will eliminate the useful genes contributed by the local goat populations during the grading-up phase, for example the genes for mothering ability from feral or cashmere does.

In conclusion it was recommended that Boer goats breeders recorded individual animal performance information such as birth weight, weaning weight, 6-8 month weight, yearling weight, eye muscle area, fat depth (scanning information), scrotal circumference and number of kids weaned. Record pedigree information and provide as much information on the environmental influences as possible. This information can then be used to calculate EBVs for these traits, which can be combined into a single index, based on the economic weighting and breeding objective. The EBVs, index and other information should then be used to select animals that will breed kids that produce the greatest profit for the commercial producers.

A Summary of Mike Goddard's Presentation – Contribution by Andrew Mosely.

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