Across-herd Genetic Evaluation of Australian Alpacas

By Dr Ian Davison

How genetic performance evaluation will help to maximise Australian alpaca herd breeding and marketing

Like all livestock breeders, alpaca breeders are constantly striving to improve their breed. Improvement is generally seen as a better "product", and in the alpaca industry, a better "product" may be seen by different people as being different things. For most it will be larger quantities of more valuable fibre, incorporating such things as fineness, softness, lustre, and evenness of colour. For others the emphasis may be on better conformation, higher fertility, bigger body weights, or resistance to disease and illness. A market is rapidly developing for alpacas as herd guardians, whilst others are exploring the demand for alpaca skins and meat. For each such market, there are likely to be markers identified to distinguish "improved" alpacas from average ones, and for which above average prices will be available for a "better" product.

Wheresoever improvement is sought, genetic factors are likely to play an important part in determining that improvement, and different alpacas vary in their ability to deliver that genetic improvement to their offspring.

It is the job of geneticists to measure that ability across a range of qualities ("traits"), and advise breeders on which animals are most likely to pass on their genetic improvement in any given trait to their progeny. They do so by gathering, collating and applying genetic performance data. Whilst improvement may still occur without this process, the rate of genetic gain is likely to be much slower, and much less certain.

A program for Genetic Improvement

The Australian Alpaca Association (AAA) is implementing just such a program to be applied Australia-wide from 2003. It is called an **Across-Herd Genetic Evaluation (AGE)** program, and invites members to measure and collect performance data for some or all of their alpacas across a broad range of traits considered to be important to genetic improvement of the breed. The data collected will be used to calculate the genetic performance values for both individual alpacas and their relatives over a wide range of traits, and will permit comparisons between individual alpacas, with allowances made for such variables as climate, sex and age, or between individual alpacas and accepted industry standards. In fact, they can be used to benchmark the industry on a yearly basis, thereby indicating the rate of genetic improvement annually for each of the measured traits.

This exciting development is a reflection of the strong commitment of the Australian alpaca industry towards establishing a viable and productive rural industry based on the alpaca breed. The traditional method of making genetic improvement through breeding decisions has been based purely on show results, on-farm appraisal, and the comprehensive pedigree and colour records included in the Australian-owned International Alpaca Registry (IAR). The IAR is a database owned by the AAA, but independently managed and administered by a professional organisation on their behalf. The AGE, which will similarly be owned by the AAA but administered and managed by a professional breeding service (Advanced Breeding Services), will be linked to the IAR, combining two powerful databases with a high level of connectivity. The result will be an extremely powerful genetic selection tool, which will revolutionise the way in which genetic improvement is progressed in the industry.

AAA members will be invited to enrol any number of their alpacas on the AGE, for which they will pay about $5 annually, with further subsidy from the AAA and government to cover the full costs. For each enrolled alpaca, owners will then be invited to measure and record any of up to about 30 selected traits according to strict protocols. Those traits and protocols are presently being defined with input from breeders, geneticists and other scientists, but it is likely that only fleece measurement data will be compulsory.

Estimated Breeding Values and Breeding Objective Values

When the performance data is gathered at the end of each year, the AGE will provide reports to breeders for each of their enrolled alpacas, based on their performance and that of their progeny, in each of the assessed traits, and comparing them to the industry average. By measuring performance in relatives and progeny, geneticists can define what they call an **Estimated Breeding Value (EBV)** for each trait in each alpaca, which is a measure of that alpaca's ability to pass on improvement in that trait to its progeny. The value may be positive or negative, depending on whether it represents an improvement or a regression compared to the national herd average.

Breeders will also be invited to define their own breeding objectives by nominating those traits most important to their selection, and according them a weighting that reflects their relative importance to each other. These objectives can be written as a mathematical formula called a **Breeding Objective Value (BOV),** which will be different for each breeder, and will reflect each breeder's different goals. A range of standard BOV options will be made available as part of the AGE service. Breeders may choose from these BOV's or develop their own. Any alpaca can be measured against such a Breeding Objective by simply inserting their data for the various traits into the equation that defines the BOV in question, and alpacas measured and ranked according to their suitability for such a breeding objective.

The Advantages of Genetic Performance Evaluation

The annual rate of genetic improvement in alpacas is likely to be slow if only traditional criteria asre used in stud selection. Experience in other livestock industries suggests that, if alpaca breeders apply the principles of an AGE, genetic improvement in the Australian alpaca will be significantly accelerated.

Furthermore, the sale prospects for stud males and females described by genetic performance values are likely to be greatly improved because buyers can select the most suitable animals for their purpose more accurately and easily. With technologies emerging to extend Artificial Insemination and Embryo Transfer to alpacas, genetic performance data will become increasingly important in optimal sire and dam selection, thus maximising the advantages to be had through use of advanced reproductive technology.

Improved Accuracy of Breeding Decisions

An alpaca's EBV for any given trait is a more accurate selection tool than its own measured performance for that trait, as it accommodates factors such as variation in age, climate, nutrition, and pedigree that a simple performance record cannot possibly account for. Increased genetic connectivity between herds, established through the widespread use of some stud sires, can help to account for environmental influences, thereby rendering the measurement of genetic influences more accurate.

For example, it is a recognised fact in other breeds that an animal with relatives that exhibit well above average performance for a given trait will breed progeny that exhibit above average performance for that trait, notwithstanding that the animal itself may demonstrate only average performance. That animal will have a higher EBV than another animal with the same, or perhaps even better, performance for that trait, but whose relatives lack the same level of performance.

The AGE will also provide data from which the heritability (how much of an animal's measured superiority is passed on to offspring) for any given trait can be deduced, thereby establishing which traits are easily improved by genetic selection, and which traits are not. It will furthermore establish correlations between traits, whereby variations in one trait (for example, fibre diameter) may be expected to have a positive or negative effect on another (for example, fleece weight).

Multiple observations of any given trait in one alpaca, made over time, will improve the accuracy of EBV's, and identify trends in performance (for example, in fleece weight and fineness) with increasing age of the alpaca.

AGE Reports

The AGE will issue annual reports to each participating breeder, beginning with a **Genetic Performance Report** indicating the recorded performance and the EBV's for each of his enrolled alpacas, and for every recorded trait. Additionally, there will be a **Breeding Objective Value Report,** assigning a BOV to every enrolled alpaca for each of his defined breeding objectives, and ranking the alpacas in order of merit for each breeding objective. A **Genetic Trend Report** will summarise the genetic progress that has been achieved each year in the traits recorded for that herd. Recommendations on mating allocations can be made on the basis of the recorded data and pedigree records that will maximise genetic progress whilst minimising inbreeding.

National herd averages can be given for each of the traits recorded, against which breeders can compare their own, and assess their own and national genetic progress.

AGE training and support

Training workshops will be set up throughout Australia by the AAA for those members interested in participating in the AGE program. It will be important for participants in the program to have a sound appreciation and understanding of the standardised protocols for measuring and recording data, as well as the interpretation and application of the data to their own breeding operations. Key personnel will be trained from every region so that trainers will be available on a regional basis for individual breeders to learn about the practice and implementation of the AGE.

Implementation of the AGE is destined to see the Australian alpaca industry firmly established in the fabric of Australian agriculture, and the Australian Alpaca recognised worldwide as the ultimate refinement of the breed.

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