The AAA low-cost Alpaca Across-herd genetic Evaluation (AGE) Project

Introduction

Genetic factors are very important in determining breeding improvement, and different alpacas vary in their ability to deliver genetic improvement to their offspring.

Geneticists can measure that ability across a range of characteristics (traits), and report to breeders which animals are most likely to pass on their genetic merit in any given trait to their progeny. They do so by gathering performance and pedigree data, collating these records, and applying a genetic analysis program to produce Breeding Values.

While genetic improvement may occur without the use of Breeding Values, applying them in mating decisions will normally increase the rate of genetic gain very significantly.

AGE and alpaca genetic improvement

In 2003 the AAA introduced a new Across-herd Genetic Evaluation (AGE) service to assist all members to achieve their individual breeding objectives; that is, to maximise their herds' genetic improvement.

A broad range of optional traits can be recorded and analysed to ensure all members' breeding objectives can be assisted. Private (and future Public) reports allow both breeders and commercial fleece producers to take advantage of the information produced by the AGE service.

In 2004 the AGE Project was extended to members of the Alpaca Association New Zealand (AANZ) who already have the necessary pedigree linkage through their own IAR database.

While involvement of breeders in the AGE service is strictly voluntary, the success of AGE will play a major role in ensuring prosperous development of the alpaca industry in Australia and New Zealand.

Breeding improvement

Traditionally, alpaca breeding advances in Australia and New Zealand have been based on show results, on-farm appraisal, and pedigree records in the International Alpaca Register (IAR). The IAR database is owned by the AAA, but independently managed and administered by the Agricultural Business Research Institute (ABRI), University of New England, Armidale NSW.

AGE is administered by the AAA and the AGE genetic analysis is conducted by Advanced Breeding Services, Orange NSW, a commercial arm of the NSW Department of Primary Industry. It is directly linked to the IAR, the combined

databases enabling an extremely powerful selection tool that is revolutionising genetic improvement in the Australasian alpaca industry.

Those same genetic tools employed by the AGE have been and remain very effectively employed by the sheep, dairy and beef industries for many years.

AGE is suitable for all breeding objectives. Most alpaca breeders seek larger quantities of more valuable fibre, incorporating such things as fineness, softness, lustre, and colour evenness. For others the emphasis may be on better conformation, higher fertility, bigger body weights, or resistance to disease and illness. AGE offers many options for breeding goal priorities.

AGE service

The AAA and AANZ invite members to measure and collect performance data for their alpacas on characteristics important to them, selected from a broad range of optional traits considered important to breeding improvement.

The data collected and reported to AGE by breeders is used to calculate the genetic performance (breeding) values for individual alpacas and their relatives.

Most importantly, the breeding values produced by AGE take into account the effects of variables such as climate, management, sex and age and therefore enable comparisons across herds to be reported on a level playing field. Thus breeders can compare individual alpacas evaluated in the AGE, or any individual alpaca with the industry benchmark.

Alpaca Breeding Values (ABVs) can also be used to annually benchmark a herd or the whole industry, thereby allowing the rate of genetic improvement to be mapped over time.

Small cost

AAA and AANZ members are invited to enrol their alpacas in the AGE service and submit initial data. Members in Australia and New Zealand pay a small one-off fee (currently A$5.50 and NZ$5.65 for each enrolled alpaca). There have been additional subsidies from the respective Associations and Government bodies to cover development costs.

Further payments from members are only required in subsequent years if more data for that alpaca is submitted.

The genetic performance of all alpacas enrolled in AGE is automatically updated on each analysis as more data from their relatives is added to the database.

For the one-off fee breeders can report to AGE up to 30 of the optional AGE traits available (see list below.) To ensure performance is accurately reported clear and easy to use protocols are required to be used when evaluating the traits submitted

to AGE. The traits and protocols have been defined with input from breeders, geneticists and other scientists.

Large Benefits
After breeders supply their alpacas' performance records, the AGE service provides **confidential private reports** for each enrolled alpaca indicating its performance in each of the assessed traits, as well as a comparison to the industry benchmark. By measuring those same values in relatives and progeny, geneticists can define what is called an Alpaca Breeding Value (ABV) for each trait evaluated.

Reported as a positive or negative value relative to the industry benchmark, an ABV is a measure of that alpaca's ability to pass on improvement in that trait to its progeny.

Breeders can also combine several ABVs for any given alpaca into a single number called a Breeding Objective Value (BOV). This describes the animal's breeding value relative to the BOVs of all other AGE alpacas. In this way a group of alpacas can be compared and ranked against a breeding objective. A range of four industry-standard BOVs are currently available and in the future personalised BOVs will be able to be developed for a breeder and reported with their alpaca.

Overall, the rate of genetic improvement in alpacas by traditional breeding selection is likely to be about 1 - 1.5% per annum, following some 20 years of importation of outside genetics. **Experience in other livestock suggests that using AGE breeders will be able to double the rate of their herd genetic improvement as well as benchmark their herd's industry performance and their herd genetic improvement over time.**

Improved Accuracy of Breeding Decisions
An alpaca's ABV for any trait is more accurate than its measured performance alone, because ABVs account for the following effects which otherwise mask an alpaca's true breeding value:

- **Early age effects.** Age of the dam and progeny date of birth must be accounted for so that, for example, an animal born late in the season is not penalised relative to cria born earlier.
- **Pedigree.** Pedigree records allow the performance of relatives of an alpaca to be used to more accurately describe the performance that animal will pass on to its progeny. For example, an animal whose relatives all have well above average performance for a trait will breed progeny that also demonstrate above average performance - even if the animal itself shows only average performance. IAR pedigree records also provide the links that allow different mating groups, different years and different herds to be combined in the AGE so that all alpaca ABVs can be directly compared.
- **Heritability and trait correlations.** Once known, the heritability of a trait (how much of the desirable trait is passed on to offspring) and correlations between traits (the effects of one trait on another) are accounted for by the AGE analysis. Trait expression can change with age, which is why it is

important to record an alpaca's age and fleece growth at the time of assessment. Measuring the change of some traits over time (e.g. fibre diameter and fibre length) will also be valuable.

- **Multiple trait assessments.** Breeders often measure traits such as fibre diameter a number of times over years, and often the best estimate of genetic performance is a combination of all assessments for the trait.
- **Environmental variation.** Variation between and within different groups of alpacas is affected by their environment and feeding, as well as other influences such as prior selection. To obtain accurate ABVs the assessed records need to be standardised to remove the effects of unusually high or low variance in the group resulting from their environment and prior selection.

Confidential AGE Reports

The following AGE reports are provided to participants as they are progressively developed for alpaca:

- Genetic Performance Report: Traits recorded in the AGE are reported as Alpaca Breeding Values reflecting genetic performance where the available knowledge permits these to be calculated. The breeder's brief recorded comments on an alpaca can also be included.
- Breeding Objective Value Report: All alpacas can be assigned a BOV for the Breeding Objective defined by the breeder, and then can be reported in rank order for a trait or BOV for the objective, or simply listed in tag order.

Future Developments

- **Breeding Objective and Likely Genetic Progress Report:** A personalised BOV will be able to be developed, and the likely genetic progress that will result from using that BOV in the participant's herd will be able to be described.
- **Genetic Trend Report:** The genetic progress that has been achieved in each of the previous years for the traits that are evaluated and the BOV will be able to be described.
- **Mating Recommendation:** Based on the genetic performance values and pedigree records of the herd, mating allocations can be made to maximise genetic progress and minimise inbreeding.

AGE training and support

AGE training workshops are periodically organised throughout Australia and New Zealand for members interested in the AGE program. Regional AGE mentor volunteers are also available to assist breeders.

How do I Start?

Please go to the AAA website at www.alpaca.asn.au and look for the newly simplified AGE Data Instructions and the Excel data form. Then decide which traits are important to your breeding aims from the Trait List also on the web (and next page) and how and when you'll measure them. Fill in the data and email it to

Janette in the AAA Office, and she will confirm the modest payment required by return email.
Further information and help contacts are also on the AAA website.

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"Five Star" AGE Service - promoting your commitment
Breeders will be able to promote their involvement in the AGE Service by using the "Five Star" AGE Service rating system. One star indicates that you are enrolled in the AGE and each additional star indicates a higher level of involvement - as shown in the table below. The "Five Star" rating system provides you with instant recognition of your AGE involvement for use in promotional and sale material. Clients will look for your AGE "Five Star" rating. The number of stars shown in the table indicates a breeder is providing the service shown at that level as well as the service at all the preceding levels.

"Five Star" AGE Service rating levels

AGE Level	Nbr of Stars	Member's level of AGE Service required to use the rating
AGE	*	Pledge to use AGE
AGE	**	AGE is being used
AGE	***	AGE data is available to stud clients
AGE	****	Breeder is trained to use AGE
AGE	*****	Breeder provides client training in the use of the AGE

First Star AGE *
Breeders get their first star by pledging to use the AGE as soon as they have progeny eligible for AGE Stage assessment

Second Star AGE **
Breeders get their second star as soon as results of the first AGE evaluation are reported.

Third Star AGE ***
Breeders get their third star immediately they get their first results if they undertake to make all their AGE results available to their clients.

Finally, please remember that the more AGE pedigree-linked data is available, the more accurate and valuable the program will be to its participants. And **ALL** identified data is kept confidential to the alpaca owner as certified on the data form, but owners may publicise the results if they choose.

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AGE Trait List
Breeders can submit performance information for any of the following OPTIONAL list of traits - ONLY

Abbr	Trait Name *	Units	Details and assessment
FD	Fibre Diameter	micron	Mean Fibre Diameter - mid-side fleece sample
CV	Coefficient of Variation of FD	%	CV is SD divided by mean FD x 100 to provide % variability of FD - mid-side sample
SD	Standard Deviation of FD	micron	Spread of fibres above and below mean FD containing two thirds of the mid-side sample
CF	Comfort Factor	%	Percentage of fibres up to and less than 30 microns - mid-side sample
SF	Spinning Fineness	micron	Calculation of FD CV to represent spinning quality - mid-side sample
Curv	Curvature	Deg./mm	Fibre curvature (degrees/mm) related to crimp frequency - mid-side sample
Med	Medullation %	%	Tested Medullation (% of fibres tested with medullation) - mid-side sample. (Can be tested for white only)
SS	Staple Strength	N/Ktex	Tested Staple Strength (Newton/Ktex) - mid-side sample
SL	Staple Length	mm	Staple Length (mm) as measured (not adjusted) - at the mid-side (average of three measurements)
FW	Fleece Weight	kg	Total shorn Fleece Weight - as measured (not adjusted to 12 months)
SFW	Skirted Fleece Weight	kg	Skirted Fleece Weight (kg) - as measured (not adjusted to 12 months)
MA	Mating age	mth	Age (months) at mating that produces the first live cria
CW	Cria Weight	kg	Body Weight at birth (kg)
BW	Body Weight	kg	Body Weight (kg)
TestL	Testicular Length	mm	Average size (length in mm) of both testicles
Lust	Lustre	1 to 5	Lustre: The degree of fleece lustre - standard score 1 [high] to 5 [low] - midside assessment
GH	Guard Hair	1 to 5	Guard Hair: Level of guard hair across the entire fleece - standard score 1 [low] to 5 [high]
Bite	Bite	1 to 5	Bite: the alignment of teeth and pad - standard score 1 [under] to 5 [over]
Fram	Frame	1 to 5	Frame: The size and proportion of an alpaca -

			standard score 1 [large & heavy] to 5 [small & light]
FC	Face Cover	1 to 5	Face Cover: The area of the face covered with long fibre - standard score 1 [bare] to 5 [covered]
SkinT	Skin thickness	mm	Skin thickness from special lab test of mid-side 1 cm skin sample
SFD	Skin follicle density	f/sq mm	Skin follicle density (follicles/sq mm) - lab test mid-side skin sample
SP	Sec:Primary follicle ratio	ratio	Skin secondary to primary follicle ratio - lab test mid-side skin sample
Worm	Internal Worms	Yes/No	Had significant internal worms - Yes or No
Stag	Staggers	Yes/No	Had Rye Grass/Phalaris/Paspalum 'Staggers' - Yes or No
Ecze	Facial Eczema	Yes/No	Had Facial Eczema - Yes or No
Heat	Heat Stress	Yes/No	Had significant heat stress - Yes or No

* All traits in the above table are optional and the order of listing is no indication of importance. **However, traits particularly recommended for recording include: FD, CV, CF, SL and FW.** At present, Alpaca Breeding Values can only be calculated from the major traits being recorded by breeders - but as more data is recorded additional ABVs will be able to be reported.

AAA Across-herd Genetic Evaluation Service

Instructions for recording and submitting AGE data

How to record AGE data

The following information will assist you to accurately record and submit the performance of the alpacas you wish to enrol in the AGE Database. The comments refer to the simplified 2007 AGE Excel Recording Form available here (zipped to reduce download time).

AGE evaluation is based on the performance of groups of young alpaca progeny bred in a herd. An alpaca's performance is normally recorded once for each trait, however additional performance can be recorded.

Important principles

There are three major principles critical to ensuring the genetic performance values resulting from the AGE are accurate:

1. All traits must be accurately evaluated and recorded, using a method that is consistent across all alpacas in a Recording Group. Please refer to the AGE Trait List and AGE Evaluation Protocols documents on the AAA website.

2. All progeny in a group need to be included (unless their performance is affected by injury or illness) otherwise the breeding values produced can be inaccurate.
3. Maintain the same sex progeny of a recording group together and provide them with the same feed and management as much as possible, so that they all receive "a fair go" relative to others in the group.

AGE reports
After you have submitted an AGE Recording Form the performance of the progeny it contains will be added to the AGE database. All the alpacas in the AGE database, including yours, are analysed together to obtain benchmarked across-herd Alpaca Breeding Values (ABVs) that describe the alpaca's genetic performance for each trait.

You will be sent the performance of your alpacas in your AGE Private Report. Your report will only be accessible to you via your private AAA Website IAR registration login password. Email a request to the AAA Office to obtain your password.

To access your web report go to the Members Home page, select On-Line Registration (not IAR Database), insert your 3-letter herd code and password, select Sign on, then select My Folder to see your AGE Private Report in Excel format. You can then copy and print it.

Your AGE Report lists each of your alpaca's ABVs for the analysed trait you submitted. **The ABV is reported as a value + or - relative to the industry benchmark.** The important reason for presenting ABVs this way is so that in later years as you obtain reports on new groups of progeny **you will be able to compare the progeny in the new group with groups evaluated in previous years.** You may be able to compare your alpacas with those owned by other AGE breeders who are willing to share their performance data with you, provided there are across-herd linked sires. At present some traits in the AGE Trait List cannot be reported as an ABV because there are insufficient performance records for that trait to allow the trait to be correctly analysed.

AGE Public Reports list ABVs for alpacas bred by many breeders. An alpaca's owner must give permission before they are added to a Public Report.

Alpaca age at Evaluation
Breeders normally only evaluate, record and submit a group of progeny's performance ONCE to the AGE database. Depending on the trait, performance evaluation and recording is usually carried out just prior to, at or shortly after shearing.

Because the heritability of performance for a trait such as fleece weight is higher for values measured at the shearing closest to an alpaca's second birthday there is an advantage in submitting performance measurements at this older age. However if any progeny in the Recording Group are likely to be sold or castrated before this

shearing it is better to evaluate the traits at the shearing closest to their first birthday so that all progeny can be submitted.

If all progeny from a birth year are not evaluated and submitted the subsequent AGE analysis will not be accurate and the performance of alpacas in this group may be incorrectly reported. The performance of alpacas in other groups in the herd and other herds can also be affected.

Some breeders may wish to build up ageing related performance (e.g. fibre diameter blow-out) so they may send in data from one or more adult shearings. Only one adult shearing can currently be use in the AGE analysis - but additional data records will be valuable over time.

How to complete an AGE Recording Form

Step 1: Header information
In the green highlighted cells above the main trait recording table record Stud Prefix, 3-letter herd code and nominated person to receive the confidential AGE Private Report.

It is the responsibility of the nominated person to obtain the prior permission of all owners whose alpacas are recorded on the form to submit their alpaca's performance to AGE. The AGE will only communicate with the nominee regarding all AGE matters relating to the alpacas submitted. Nominees may transfer these rights to another nominee (e.g. if an alpaca is sold) by submitting a completed Nominee Transfer Form available on the AAA website.

It is an advantage in establishing the AGE performance of progeny of agisted alpacas if the progeny are included in a bigger Recording Group for analysis.

List only the total number of progeny including unregistered alpacas in a birth year progeny group that will **not included in the performance information detailed in the form**, and the reason why they were not submitted. This information is essential to ensure accuracy of the analysis.

Step 2: Individual alpaca data

Which alpacas are recorded?
It is best to submit data on all alpaca progeny born within a 12 month or less period (unless they are ill, injured or dead by misadventure) on the one Excel AGE Recording Form. However there is no need to separate alpacas into groups by age, sex or type as this will be done from IAR records during the analysis. You can also include data on older alpacas if you wish, but unless they can form a genetically linked group it may not be practicable to report ABVs for them. For additional data recorded earlier than the 12-month period covering the main progeny group, please use the additional sheets accessed at the bottom of the screen.

Include all progeny

All progeny born in an analysis year need to be submitted to AGE to ensure the AGE analysis is not biased by missing genetic data. Normally all male and female progeny should be recorded, however you can opt to submit all females only.

If for some reason a significant number of males aren't registered (it costs only $5.50!) you should not include only higher quality males as this will invalidate the genetic analysis. If you have more then one shearing in a 12-month period please ensure the different dates are shown on the form.

Only data from registered alpacas can be submitted to AGE - to enable IAR pedigree linkages to be established.

Information recorded

- **IAR number:** alpaca's IAR number without a prefix letter.
- **Name:** alpaca's name (optional, for ease of later reference).
- **Birth date:** required format - day (dd)/month (mm)/year (yy)
  e.g., 8th May 2007 = 08/05/07 and 8th May 1998 = 08/05/98.
- **Evaluation dates:** In the next 6 columns record dates of evaluation for associated traits. If a trait is not evaluated leave the column blank.
  i. Previous shearing date: the mean date of the shearing prior to the shearing when traits being submitted were evaluated.
  ii. Shearing date: the mean shearing date when the fleece weight related traits were evaluated. Visually assessed traits are considered to have been evaluated at or close to this shearing date unless otherwise recorded.
  iii. Fibre sample date: the mean date when the fleece samples were obtained. If this was at the shearing date this does not need to be recorded.
  iv. Body weight date: the date when body weight was evaluated. (Average if over several days.)
  v. Testicular measure date: the date when testicular size was evaluated.
  vi. Skin samples date: the date (if) skin samples were obtained.

  Note: Fleece weight and diameter traits evaluated before 6 months of age or with less then 6 months fleece growth cannot be submitted.

- **Traits:** The evaluation of traits should follow the protocol set out in AGE Evaluation Protocol and AGE Trait List available on the AAA web site. All traits are optional, and all allowable AGE traits are listed in the Excel Form. They should not be added to, deleted or moved; just leave blank those traits not recorded. Use the correct units, e.g., fleece weight in kg, not pounds. Only record 1 decimal place please.
- **Comments:** Briefly describe any alpaca that has been treated differently to the Recording Group in general, e.g., *'Birthed 09/06/07', 'Off-farm mating for x-weeks from 01/03/07'* or *'Vet treatment and different feed for y-weeks from 05/04/07'* or *'Castrated 05/04/07'*. Ignore minor events not affecting an

alpaca's 'fair go' such as short duration matings, minor feed changes at shows.

How and when to send your Recording Form
To reduce costs all AGE data needs to be sent by email to the AAA Office in an Excel AGE Recording Form (zipped). Data can be sent in at any time and the results will be reported after the next scheduled analysis (3-4 times each year.)

Always retain a copy of the AGE Recording Form you submit in case it is lost.

If you do not have access to Excel contact the AAA Office (details below) for advice.

Payment
Email your AGE Recording Form to AAA Office (details below). Janette will email you the payment required. Payment can be made by cheque or credit card at A$5.50 or NZ$5.65 for each registered alpaca whose data is submitted at one time, regardless of the amount of data.

All inquiries
Email or phone the AAA Office - Janette Law - janette@alpaca.asn.au Tel 03 9873 7700 Ext1

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