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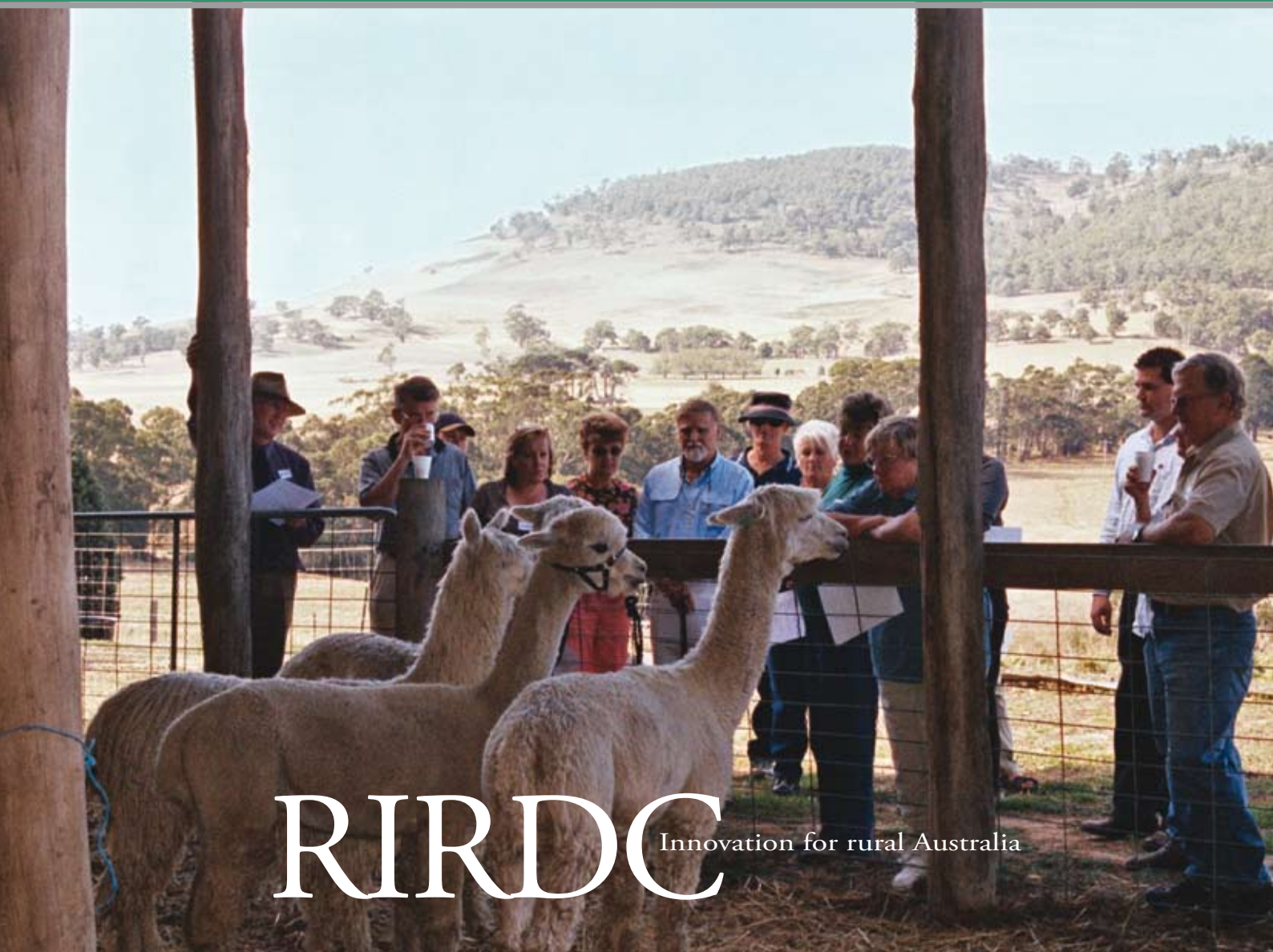
Producing Better Alpaca Fleece

The benefits of using the Alpaca Across-herd Genetic Evaluation System

RIRDC Publication No. 08/190



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The benefits of using the Alpaca Across-herd Genetic Evaluation System

by C.M. Langford and A.E. Casey

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Foreword

The Alpaca Across-herd Genetic Evaluation (AGE) project has successfully established a most important genetic improvement tool for a commercial livestock industry. This report describes this achievement and its importance to rapid genetic improvement in the alpaca industry.

This research is of benefit primarily to Australian and New Zealand alpaca breeders to show them the progress achieved with the establishment of an Alpaca Across-herd Genetic Evaluation system and to encourage them to enter their alpacas into the AGE system.

An AGE commercial service has been established for the Australian alpaca industry. This service is a world first for the alpaca industry. In the analysis of March 2008 there were 100 herds, 1879 progeny and 3872 alpacas.

This project was funded by RIRDC Core funds with some voluntary funding provided by the AAA plus funds through NSW Department of Primary Industries.

This report is an addition to RIRDC's diverse range of over 1800 research publications. It forms part of our Rare Natural (Animal) Fibres Program which aims to foster the development of rare fibre industries.

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/fullreports/index.html
- purchases at www.rirdc.gov.au/eshop

Peter O'Brien
Managing Director
Rural Industries Research and Development Corporation

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Secretaries and Presidents and the organising committees for the Regional AGE days are also acknowledged for their help and assistance in organising the Hands-On workshops and for promoting AGE within their Region.

Dr Kevin Atkins is acknowledged for providing the leadership in the production of the genetic parameters and the development of the Breeding Objective Values (BOVs). The genetic data analysis at Advanced Breeding Services (ABS) was performed by Johanne Taylor, Jennie Staples and Leigh Florance.

Staff at ABRI and in particular Christopher de Crespigny is acknowledged for their assistance in accessing the International Alpaca Register (IAR) for the data and the provision of the reports to breeders through the IAR database.

Abbreviations

AAA	Australian Alpaca Association Ltd
AAFL	Australian Alpaca Fleece Ltd
ABV	Alpaca Breeding Value
ABS	Advanced Breeding Services
AGE	Across-herd Genetic Evaluation
AI	Artificial Insemination
BLUP	Best Linear Unbiased Prediction genetic software
BOV	Breeding Objective Values
ET	Embryo Transfer
DPI	NSW Department of Primary Industries
GIP	Genetic Improvement Project
IAR	International Alpaca Register

PHENOTYPIC VALUES – performance as measured by breeders

FW (kg):	Fleece Weight
FD (µm):	Fibre Diameter
CV (%):	Coefficient of Variation of Fibre Diameter
BW (kg):	Body Weight
SL (mm):	Staple Length

ALPACA BREEDING VALUES – trait genetic performance

FW (%):	Fleece Weight percentage deviation
FD (µm):	Fibre Diameter deviation
CV (%):	Coefficient of Variation of FD percentage deviation
BW (kg):	Body weight percentage deviation
SL (mm):	Staple length deviation

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What the report is about
The Alpaca Across-herd Genetic Evaluation (AGE) project has successfully established a most important genetic improvement tool for a commercial livestock industry. This report describes this achievement and its importance to rapid genetic improvement in the alpaca industry.

Who is the report targeted at?
This report is primarily for Australian and New Zealand alpaca breeders to show them the progress achieved with the establishment of AGE and to encourage them to enter their alpacas in AGE.

Background
An independent Consultant Report prepared for the Australian Alpaca Association (AAA) in 2000 concluded that alpaca farming for commercial fleece production could be profitable by 2008 provided certain genetic improvements were achieved in that time. The AAA established a Genetic Improvement Project (GIP) to assist industry achieve the required genetic improvement. The GIP established that the progress being achieved by industry was not fast enough. Additional genetic advice to the AAA has indicated that an across-herd genetic improvement service could achieve the rate of genetic improvement required to obtain profitable fleece production. A paper presented to the Australian Alpaca Conference (Casey 2002) allowed AAA members to debate the genetic improvement options and proposed an Across-herd Genetic Evaluation (AGE) service as the way forward. The conference strongly supported the AGE model.

Following consultation between Advanced Breeding Services (ABS) and AAA a proposal to establish AGE was submitted to RIRDC and this project was the resulting product. ABS is a commercial unit with the NSW Department of Primary Industries (DPI) based at Orange NSW and is a specialist breeding service provider to sheep and alpaca breeders.

Objectives
1. Establish an Across-herd Genetic Evaluation (AGE) system and commercial service that will allow effective use of all genetic resources and the emerging artificial breeding technology so that industry genetic progress is maximised
2. Establish and conduct an industry driven, on-farm performance recording system and AGE training program
3. Utilise the AGE database to establish and maintain genetic parameters for commercial production traits.

Methods used
The AAA established an AGE Working party who have been the driving force behind this project and have provided guidance and supervision of the project.

The AGE Working Party established a list of 26 traits which breeders may submit data to AGE. A promotional campaign was conducted in each state. A workshop was developed to train breeders in the benefits of AGE, how to enter data and how to interpret the reports they receive. There were 12 workshops run across all states with over 300 breeders being trained. Eight sets of combined Australian and New Zealand herd data were analysed and reports sent to breeders. The use of the International Alpaca Register allows pedigree information from herds to be used which improves the accuracy of the Alpaca Breeding Values provided to breeders. The working party continually reviewed the operation of AGE and enhancements to the program with regular updating of the process and system of operation.

Results/key findings

An AGE commercial service has been established for the Australian alpaca industry. This service is a world first for the alpaca industry. There were 100 herds, 1879 progeny and 3872 alpacas in the last analysis in March 2008.

In the initial stages of the project it became obvious that alpaca breeders had limited knowledge or experience in the principles of genetic improvement and how to collect and submit data for analysis. In addition the majority of breeders are employed in occupations which limit the amount of time they can spend working with their alpacas. Allied with a wide general dependence on the alpaca show circuit to identify superior alpacas these factors provided some challenges for the project officers and the AGE Working Party.

The Hands-On workshop to explain the benefits of AGE, how to collect and organise data for submission and how to interpret an AGE report were consequently developed to address these issues. Following the rollout of these workshops across all States the amount and quality of submitted AGE data has increased.

Implications for relevant stakeholders

The successful establishment of AGE provides the alpaca industry and individual breeders with the genetic information on which to base their breeding decisions to accelerate genetic gain within the Australian alpaca industry.

Decisions prior to AGE were based on the appearance of the alpaca and some production data, primarily FD but this was not adjusted for management or environment and alpacas did not breed consistently based on these measurements. The reports supplied to breeders by AGE show the genetic value of an individual alpaca for a variety of traits which have been adjusted for environmental and other affects and represent the true genetic value of the alpaca. Alpaca breeders can be confident of the breeding potential of alpaca in the AGE based on their ABVs and be more confident in the consistency of their progeny in relation to the genetic merit of their parents.

The original research proposal to RIRDC in 2003 stated *"However there is currently too much variation of quality in terms of skirted yield of quality fleece, coefficient of variation in fibre characteristics, and in the ratio of secondary to primary fibres."*

AAFL, as the major buyer of alpaca fleece throughout Australia, states on its website that it has seen a dramatic improvement in fleece quality and this can be seen by the decrease in FD in fleece being received from the Australian bred alpacas as compared to the older alpacas imported from Peru which have a higher FD. AAFL also states: *'further uptake of AGE by growers will hopefully see this rapid improvement continue'* which will see Australian alpaca fleece become a world leader in fine alpaca fleece.

Recommendations

The two recommendations are firstly for the AAA to continue to promote and support AGE by appointing an AGE promotion person in each of their regions, and secondly for RIRDC to provide some additional funding for technical advice and support to AGE and to protect RIRDC's original investment.

1. Introduction

An independent ACIL Consultant Report prepared for the Australian Alpaca Association (AAA) in 2000 concluded that alpaca farming for commercial fleece production could be profitable by 2008 provided certain genetic improvements were achieved in that time. The AAA established a Genetic Improvement Project (GIP) to assist industry achieve the required genetic improvement. The GIP established that the progress being achieved by industry was not fast enough. Expert genetic advice to the ACIL report had recommended a nucleus approach to achieve this progress, however after extensive investigation by the GIP it was found that practical obstacles to the formation of the nucleus herd meant this option was not feasible. Additional genetic advice to the AAA indicated that an Across-herd Genetic Evaluation (AGE) could achieve the rate of genetic improvement required to obtain profitable fleece production.

A paper presented to the Australian Alpaca Conference (Casey 2003) allowed AAA members to debate the genetic improvement options. The conference strongly supported an AGE system following discussion that identified AGE as the practical cost effective approach to achieving continuous genetic improvement.

Following consultation between Advanced Breeding Services (ABS) and AAA a proposal to establish AGE was submitted to RIRDC and this project was the resulting product. ABS is a commercial unit with the NSW Department of Primary Industries (DPI) based at Orange NSW and is a specialist breeding service provider to sheep and alpaca breeders.

The AGE approach is practical to implement across a wide range of herds and responds most effectively to the present industry situation and available resources, for example:

- With the IAR database providing full pedigree and strong genetic linkage between herds, all of the industry's breeding alpacas can be utilised to maximise genetic improvement
- The AAA pedigree database can be easily modified to accommodate the additional production trait records and report them for analysis
- Core genetic parameters are available that will allow an AGE to provide significant industry benefits in Year 1
- BLUP software suitable for the AGE is available at no cost to the project
- AI and ET technology is nearing commercial adoption and is very complementary to the AGE program and
- AAA members' highest development priority is to make genetic improvement and they strongly endorsed the AGE approach to achieve this improvement.

Alpaca fleece production is rising as the number of alpacas in Australia increases. This fleece is sold in a number of ways; (i) to the company Australian Alpaca Fleece Limited who then market the clip to commercial processors in Australia and overseas, (ii) alternatively by breeders in smaller quantities to other processors or for home spinning, and (iii) some breeders value-add their fleeces by making garments or yarn and selling these.

At 20 January 2003 there were 2048 full voting members of the Australian Alpaca Association Inc, including 1,611 with a registered alpaca stud prefix. There were 44,402 alpacas registered in the Australian 'International Alpaca Register' (IAR) over 36,000 of which are owned by AAA financial members. The AAA is the primary 'voice' and organisation representing alpaca owners and breeders, and there are 13 active affiliated AAA Regions spread across all Australian States.

Including unregistered alpacas there were believed to be around 45,000 alpacas in Australia in January 2003. Registered breeding females owned by AAA members currently total 23,000, and there are 2,087 males certified and DNA registered as breeding stock under current AAA standards. Capital invested in the Australian alpaca industry is estimated at over $100 million.

Annual alpaca fleece production in 2003 was small at around 60 tonnes, a little under half of which was currently processed by the Alpaca Co-operative. However, fleece production is progressively increasing and was expected to reach more than 200 tonnes by 2008.

The alpaca is currently very under-developed genetically compared to, for example, the Australian Merino. On the other hand, this South American member of the camel family is extremely well suited to the Australian climate and soils. Its soft padded feet, efficient digestive system, high resistance to internal and external parasites, together with its fleece which is highly regarded as a luxury natural apparel fibre, gives the alpaca high potential as a commercial farm animal for fleece production.

However there is currently too much variation of quality in terms of skirted yield of quality fleece, coefficient of variation in fibre characteristics, and in the ratio of secondary to primary fibres. Annual testing conducted by the AAA indicates that mean fleece quality is being progressively improved, but professional geneticist advice was that faster improvement is both practicable and highly desirable. That was the reason for developing the GIP Project, the prime aim of which was to develop more commercially valuable breeding stock suitable as foundation alpacas for broad-hectare alpaca fleece production.

There have been two project officers coordinating this project with Mr Allan Casey coordinating from the beginning of the project in 2003 to February when Mr Col Langford became the Project Officer.

2. Objectives

The objectives for the project were:

1. Establish an Across-herd Genetic Evaluation (AGE) system and commercial service that will allow effective use of all genetic resources and the emerging artificial breeding technology so that industry genetic progress is maximised.
2. Establish and conduct an industry driven, on-farm performance recording system and AGE training program.
3. Utilise the AGE database to establish and maintain genetic parameters for commercial production traits.

Participants at a Hands-On workshop in Victoria

3. Methodology

AAA established an AGE Working Party comprising experienced alpaca breeders from NSW, Victoria, SA, WA and one NZ breeder. The purpose of the working party was to review the progress of the project and provide feedback on the relevance of the project and also as a contact person to promote AGE and coordinate activities in their state. The NZ breeder was added when it became obvious that NZ alpaca breeders also wanted to be able to enter their alpacas into the AGE project.

The project was broken into seven steps to allow the project to be completed.

3.1 Establish BLUP software so that alpaca AGE can be performed and analyses/reporting of the available AAA data

To enable the alpaca genetic parameters to be analysed it was necessary to modify the existing genetic parameters used in the BLUP software in the Merino sheep industry to cater for the differences in the alpaca industry. A literature search was conducted to identify genetic parameters for alpacas.

3.2 Evaluation traits finalised, database upgraded and promotional seminars completed

The Working Party consulted with alpaca breeders and arrived at a comprehensive list of traits for inclusion in the AGE project.

The traits were a combination of visual and measured traits important to the alpaca industry. The traits that could be efficiently and cost effective measured were evaluated this way to maximise the accuracy of assessment. A visual trait scoring system that allowed for the full range of expression of performance was developed for the remaining traits.

The full list of traits and whether they are a visual or measured trait are shown in Appendix A. The definition of the traits and the method of evaluation are defined in the Across-herd Genetic Evaluation Service Booklets.

The decision was made to only report on the traits with established genetic parameters. In addition these would only be reported when sufficient data had been received for an accurate assessment to be made of the alpaca's genetic merit.

When sufficient data was received and genetic parameters could be derived other traits would be reported to breeders.

It was decided that a number of promotional seminars would be completed across Australia and NZ to promote AGE to breeders.

3.3 Develop, pilot and establish a Stud Breeders AGE workshop

The majority of alpacas are run as stud alpacas and are registered with the AAA though the IAR. The decision was made to initially target these breeders as they breed the seed stock alpacas for the remainder of the industry.

Very few alpaca breeders have been involved in a performance recording scheme and it was thought that a workshop was needed to explain the recording procedures to ensure management effects were accurately recorded the Stud Breeders Workshops would explain the procedures and provide breeders with the confidence to report their alpaca to the AGE.

3.4 Conduct Stud Breeder AGE workshops – at least one in each state

To ensure as many breeders as possible were introduced to AGE and the procedure to be followed when collecting and submitting data to AGE a decision was made that at least one Stud Breeder Workshop should be held in each state.

3.5 Develop, pilot and establish a commercial producers AGE workshop

In the proposal to RIRDC it was anticipated that commercial alpaca fibre production would be possible by 2008 and to cater for commercial producers and how they should select particularly sires on their genetic merit it was decided to develop a commercial producers AGE workshop.

3.6 Conduct Commercial Producers AGE Workshops in all States

Once it had been piloted it was proposed that the workshop would be run in all states.

3.7 Documentation of the outcomes of the project and publication of genetic parameters from AGE.

The outcomes of the project would need to be published in a RIRDC publication but updates to the alpaca industry to keep them abreast of developments and project outcomes were necessary.

It was planned that the genetic parameters arising from the AGE Project would be published in a refereed scientific journal.

4. Establishment of an AGE Service

For an AGE service to be established there were a number of components to ensure the success of the service. These components and their success will now be discussed.

4.1 Genetic Parameters developed for use in BLUP software

ABS was already using a BLUP software package (BVEST) for analysing genetic parameters in the sheep industry. Genetic parameters and a suitable analysis model were developed to allow the AGE analysis to be routinely conducted. The initial genetic parameters for the traits which were identified as being important (Appendix A) were established after a review of relevant publications. Once this work was finished the data analysis was able to proceed.

4.2 Promotion of AGE

One of the tasks of the members of the AAA AGE Working Party was to promote AGE in their state through the Regional Committees.

The main avenue for the AAA to promote AGE was through the AAA website which has a separate section on AGE which is regularly updated and the Chairman of the AAA AGE Working Party posts updates on AGE on the Forum part of the AAA website

The Project Officer promoted AGE through:

- AGE Breeder's Workshops undertaken in 2003/2004
- A paper presentation on AGE at the 2004 AAA National Conference in Hobart
- Paper presentation and stand on AGE at the 2006 AAA National Conference in Adelaide
- Paper presentation on AGE at the 2007 National Alpaca Fibre Seminar 'Alpaca Fleece – the future' Ballarat July 2007
- AGE Hands On workshops in 2005-2006
- Talks to Regional Committees as requested
- Stand to promote AGE at the World Alpaca Conference held in Sydney in March 2008
- The President of AAA Dr Ian Davison who is also a member of the AAA AGE Working Party presented a paper on AGE at the 2008 World Alpaca Conference where there were over 400 delegates from over 10 countries.
- Members of the AAA AGE Working Party sought out and spoke to the Presidents of the overseas Alpaca Associations with a view to their Associations using the AGE service for genetic evaluation in their respective countries

The other promotion of AGE occurred through breeders who had entered data into AGE promoting and talking to their fellow breeders about AGE.

In addition to this the NZ Member on the AAA AGE Working party also ran promotional events and training workshops across NZ. The Project Officer and WP Chairman also promoted AGE in NZ in 2004, including a paper presented to 350 delegates at the NZ Alpaca Conference and an inaugural Train the Trainer Workshop.

4.3 AGE Service Booklet

The AAA AGE Working Party developed a breeders' performance recording system and published a user's guide to assist breeders to submit data. The first edition of this guide titled the *Across-herd Genetic Evaluation Service* was published in August 2003 and six additional versions have since been published to reflect the enhancements and changes in the service since AGE was commenced.

The Booklet was published to promote the AGE to breeders but also for use as a resource for breeders to understand the concepts behind the AGE and to give them the information needed to complete the AGE Recording Sheet for the submission of data.

The topics covered in the booklet were;

- Introduction
- Maximising your breeding and marketing outcomes
    - The role of genetics
    - AGE service
    - Cost
    - Large benefits
    - Improved Accuracy of Breeding Decisions
    - Using Breeding Objective Values
    - AGE Reports
    - Training and support
- "5 Star" AGE service – promoting your commitment
- How to record performance information
    - Important principles
    - Recording and reporting steps
    - AGE Reports
    - Evaluation age
    - How to Complete an AGE Recording Form
    - Information recorded
    - How and when to send your Recording Form
    - Payment
- How to assess traits
    - Measured traits
    - Scored traits
- Trait options and description
- AGE Alpaca Breeding Value (ABV) Report
    - Description of information reported
    - Example Report pages – Page 1: ABV Report and Page 2: Phenotype
- AGE Questions & Answers
- Contacts AGE Database and AGE Technical Advice
- AGE Trait Recording Form

The above topics illustrate the comprehensive nature of the booklet which showed breeders the benefits of the system in relation to their breeding decisions in their own herd, how and what to record, how to assess the traits and how to read and interpret the reports which would be received on alpacas entered into the AGE program. There were also examples of completed and a blank recording forms and sample reports.

There was a list of contacts for breeders to refer to if they needed assistance both of a general nature to the more technical questions. Copies of the AGE Service booklet may be obtained from the Researcher whose contact details are listed on page ii of this report.

4.4 Submission of Data

Difficulty was experienced by breeders in reporting data collected from the 2003-2004 performance evaluations. After the breeder's alpaca performance data were sent for inclusion in the AGE database and was reviewed by NSW DPI it became apparent that breeders were having difficulty in completing their alpaca's performance recording forms.

The primary reasons for the difficulty were:

- breeders were not familiar with maintaining and reporting formal performance records and the complexity of recording was stopping some breeders becoming involved.
- breeders did not evaluate (eg fleece weigh) all the alpacas in a contemporary age group at the same date – some alpacas in the group may be evaluated several weeks after others. This reduced the size of many groups in the genetic analysis to a level that would not allow meaningful results to be provided.
- weaning and paddock management (that normally results in a management effect on performance in other livestock) were not being applied equally to all alpacas in a contemporary age group. In the majority of cases this was not resulting in a management effect although breeders were being directed by AGE recording procedures to split a group based on these management events. This reduced the size of many groups in the genetic analysis further limiting the amount of meaningful results.

When these issues were identified the Working Party decided that to resolve these issues:

- recording procedures needed to be redeveloped to ensure management effects were accurately recorded,
- the AGE system had to be made simpler and as straightforward as possible, and
- planned Stud Breeders Workshops would be used to explain and train breeders in these procedures and provide breeders with the confidence to report their alpaca.

New procedures were successfully developed; however the redevelopment required more time then expected. The fully committed Working Party members were not able to provide the additional time needed to finalise the Stud Breeders Workshop material and deliver a pilot workshop before the 2004 spring shearing and evaluation period. Once shearing and evaluation began it was impossible to get good attendance of potential trainers from across Australia to attend pilot workshops. The result was that in Australia the planned pilot workshops had to be postponed until early autumn 2005 when breeders would have more time to attend workshops.

New Zealand (NZ) Breeders Workshops were able to proceed because of their later shearing and evaluation season. The NZ workshops were very successful and indicated that the new procedures provided a practical method of recording while at the same time maintaining larger contemporary alpaca groups.

The AGE Recording Form was simplified and has enabled breeders to enter data for submission for analysis. In October 2007 the AGE Recording Form was again simplified to remove the need for breeders to place alpacas into management groups, with this now being done by ABS on receipt of the data. To reduce administration costs it was also decided in October 2007 that data would only be received which was in an electronic format.

4.5 AGE Breeder workshops

Given the difficulty breeders were encountering with collecting trait data and submitting this for analysis the decision was made by the Working Party for the Project Officer to develop a Hands-On Breeders workshop which would not only discuss the theory of the AGE service, but also show breeders how to collect trait information and how to fill in the data recording sheet. The aim of the workshop was that at its conclusion the attendees would be able to collect and submit data.

A meeting with RIRDC was held in January 2005 to allow the original concept of the breeders workshop to be changed to the Hands-On Workshop from the original concept which was for the Breeder workshop to be a Train the Trainer workshop so that one breeder from each Region would train breeders in the use of AGE. RIRDC agreed for the workshop format to be changed to a Hands-On Workshop conducted by the Project Officer across all states in Australia which were designed to be of about 4 hours duration and were to be organised with regional office bearers.

These workshops were conducted on farm with the following program;

- Introduction and benefits of AGE
- Assessing measured and scored traits
- How to record and submit data
- Using your AGE reports
- Discussion
- Evaluation

The participants enjoyed the format of the day and especially the segments where it was demonstrated how to collect alpaca and fleece data.

After the development of the Hands-On Workshop the pilot was successfully conducted in March 2005 and delivery then commenced with the aim of at least one in each state.

A total of 12 workshops were conducted; NSW = 6 (including the pilot workshop), VIC = 2, SA=1, TAS = 2, Qld = 1 and WA = 1. Over 300 breeders attending the workshops.

The workshops were considered to be successful, as from the evaluation sheets participants had a greater understanding of AGE through having their questions and myths answered, and most participants said that they would be entering data into AGE.

To assist breeders who had attended a Hands-On workshop regular email contact was maintained with breeders who had enrolled in AGE and the AAA Website was regularly updated to keep other breeders abreast of AGE developments

The amount and quality of the data improved following the AGE workshops.

Participants at a Hands-On Workshop assessing alpacas for visual traits

4.6 Data analysis

There have been a total of 8 AGE analyses conducted and reported to breeders with the first analysis of data being in February 2005. This was later than planned but the problem with having enough data for a meaningful analysis delayed the first analysis. It can be seen that once the Hands-On workshops commenced the amount of data increased dramatically.

Since then analyses have been conducted in November 2005, February, July and November 2006, May 2007 and March 2008.

At the first analysis there were 485 alpacas from 28 studs, and in 2008 this number has grown to 3872 alpacas from 100 studs in the March 2008 analysis. The total number includes the sire and dam of the alpacas that had performance data submitted.

After each analysis AGE Alpaca Breeding Values (ABVs) are reported to owners who have registered with the AGE by submitting data.

Reports were initially sent by email to each breeder but the reports are now accessed through the on-line IAR register. Each report contains, (i) a record of the data sent by the breeder, (ii) ABVs for the traits submitted for the alpaca, and (iii) the ABVs for relevant sires and dams in the herd. Only alpacas owned by the breeder are reported.

Breeders receive individual ABVs on the following fleece traits: FW (%), FD (µm), CV (%), BW (kg) and SL (mm). The absence of genetic parameters and the small amount of data for the other traits means that has not been possible for an analysis of the other traits or ABVs to be reported to breeders.

Appendix B shows the March 2008 AGE Report Summary which was the last data analysis and illustrates the genetic variability which has been found within the Australian and New Zealand alpaca population entered into the AGE. For example, the spread of ABVs for FD (µm) is from -3.5 to +4.5 which illustrates that it is possible to use this variation to make rapid progress to reduce fibre diameter by selecting alpacas which have ABVs at the finer end of this range.

The variation in ABV for the five traits which have been reported show a similar spread to FD and indicate that rapid genetic progress can be made for each of the traits.

It can be seen that the most common traits are FD and FW. BW has the smallest amount of data as the emphasis on this trait is generally low and only a small number of breeders have the capability to measure BW accurately.

In the first to analyses there was a considerable change in the ABVs reported, however as the number of alpacas in the analysis increased the range in the ABVs reported remained relatively stable.

4.7 Breeding Objective Values (BOV)

Breeding Objective (Index) Values (BOVs) enable breeders to combine a number of traits into one value to assist them to select alpacas which closest match the breeding objective for their alpaca herd. BOV have been introduced into AGE reports as breeders understanding of AGE matured.

Three industry standard breeding objectives (Selection Indexes) have been developed with input from the Working Party as a starting point in the use of BOVs. As a result standard BOVs were reported to breeders following the 2008 March analysis.

The three industry standard breeding objectives are:

1. ***Fibre Plus:*****.....** Majority of emphasis is on increasing fleece weight, while fibre diameter is maintained at its current level.
2. ***Fibre Value:*** ..... Moderate and equal emphasis on increasing fleece weight and reducing fibre diameter.
3. ***Fibre Quality:*****.....** Majority of emphasis is on reducing fibre diameter, while fleece weight is maintained at its current level.

The default BOV for reporting to breeders is the Fibre Value BOV but breeders are able to request their data with one of the other BOVs.

It is planned that in the future breeders will specify when they enter the IAR database the BOV they wish to use in their report.

4.8 Enhancements to the AGE Service

Improvements and changes to AGE have occurred due to feedback from breeders and attempts by the AAA Working Party to assist breeders to enter data onto AGE.

The major change has been the simplification of the data entry form which was posted on the AAA website in October 2006. The original data entry form confused breeders and was a barrier to participation in AGE. The need for breeders to allocate alpacas to management groups is now eliminated and this is now done by ABS when the data is submitted, and based on the comments provided by breeders.

A second major change has been the requirement for breeders to submit data in an electronic file. Originally breeders were able to submit data either electronically or in a paper format. However due to the costs and transcription errors the decision was made in October 2007 that data would only be accepted in an electronic format. Another enhancement has been the ability of ABS to enter data into an electronic format for breeders who are unable to do this themselves. AGE Working Party members are also assisting breeders to enter data electronically for submission to AGE.

Another major change has been the timing of AGE analysis. Originally an AGE analysis was conducted when sufficient data was available but now with the size of the data set being analysed the outputs are very stable and consequently an analysis can be conducted when they are required. At present three analyses are planned each year in February, August and November. In addition if sufficient data has been submitted an analysis could be conducted at other times.

Confidentiality of breeders participation in AGE and the performance of their alpacas was a corner stone in the AGE service to ensure breeders did not feel they were exposing their industry status by joining AGE. However breeders who are involved in AGE feel there is marketing advantage by being publicly reported as being involved in AGE and they are currently being surveyed to determine whether they are prepared to allow their name to be displayed on the AAA website as an AGE member. The AGE working party is also considering voluntary publishing of trait leaders on the AAA website.

The AGE Service booklet has continually been updated as new issues arise and is now up to its 7th Edition.

The Project Officer has had discussions with the OPTIMATE Computer Systems to develop OPTIMATE ALPAFARM (alpaca herd management software) so that the software will allow a breeder to export an AGE data file at the push of a button. This will save breeders who use ALPAFARM from either extracting the data manually or entering the data onto the AGE Recording Form. This development will encourage breeders who use the ALPAFARM software to enter data into AGE.

5. Discussion

The project has met the objectives for which it was established. The objectives are examined separately below.

The first objective was to '*Establish an Across-herd Genetic Evaluation (AGE) system and commercial service that will allow effective use of all genetic resources and the emerging artificial breeding technology so that industry genetic progress is maximised'.*

This project developed a system which allows breeders to submit trait performance records, store them in a central database for ongoing use in AGE and report ABV and BOV to the breeder to assist their breeding and marketing decisions.

This project has allowed all of the elements which make up the AGE system to be amalgamated into a commercial service with breeders paying a fee for each alpaca they enter onto the AGE service. The data analysis is conducted by ABS which is a commercial unit with the NSW Department of Primary Industries (DPI) based at Orange NSW and is a specialist breeding service provider to sheep and alpaca breeders. Breeders receive their report from the IAR database which is managed by ABRI for the AAA.

AGE enables the alpaca industry to fully utilise all of the genetic improvement technology that is available to them including the artificial insemination and embryo transfer. In fact it could be argued that AGE will enhance the artificial breeding techniques because it identifies the genetically superior alpacas which should only be used more by the industry.

One of the hurdles confronted by the project was breeders lack of understanding and skills in on-farm performance recording. This was perhaps understandable given the majority of alpaca breeders do not come from a livestock background and in fact the alpaca is often their first venture into agriculture. In addition the majority of alpaca breeders own less than 10 alpacas and therefore have had difficulty in seeing the relevance of AGE to their herd. Another hurdle is that most alpaca breeders are employed in occupations outside the alpaca industry; thus their alpaca herd is only a part-time occupation. This limits the time they are able to spend on performance recording. In addition the preoccupation of many alpaca breeders with the show circuit and not the commercial production of fibre reduces the benefit they see in AGE. Many breeders have expressed genuine interest in becoming involved in AGE but say for example "when time permits" or "when I have my data organised".

When the uptake of genetic on-farm performance recording systems is compared across industries the number of alpaca breeders is comparable with Australian sheep and beef breeders' uptake of similar schemes in their industries.

Therefore while there have been challenges it can be seen that the AGE project has achieved its first objective.

The second objective of the project was to *'Establish and conduct an industry driven, on-farm performance recording system and AGE training program'.*

The project was supported by the AAA and the establishment of the AAA AGE Working Party shows the support of the peak industry body for the project. The members of the AAA AGE Working Party spent a great deal of time in the development of AGE, discussing issues as they have arisen and ways in which the AGE can be enhanced. During the development phase of AGE the AAA subsidised the cost of AGE to their members to encourage them to submit data. In NZ the NZAA were successful in obtaining funding from the NZ Government to support the promotion and other activities of AGE in NZ.

The data which is entered for AGE is all collected on-farm either by, or under the direction of, the breeders. This is essential for the project because for the project to be successful these measurements will only be able to be taken on-farm.

The project through its training program and especially the Hands-On Workshops which were conducted in all States has trained over 300 breeders in the benefits of AGE, how to collect data, how to fill in the recording form and how to interpret their AGE reports to enhance their breeding and marketing.

All changes to AGE whether the system, the Service Booklet, the Recording Form and other enhancements to the project were driven by the breeder members of the AAA AGE Working Party which demonstrates the project being an industry driven project leading to the establishment and maintenance of genetic parameters for commercial production traits.

The project has therefore successfully achieved its second objective.

The third objective of the project was to *'Utilise the AGE database to establish and maintain genetic parameters for commercial production traits'*.

The AGE project has allowed data which have never before been collected on alpacas in Australia to be entered into the AGE database and used to establish and maintain genetic parameters for the commercial production traits of alpacas. Prior to this project any comparison of the production merit of alpacas was conducted within a herd and almost exclusively based on phenotype. AGE however utilising the pedigree information within the IAR database has broadened this narrow and limiting perspective of genetic performance so that alpacas entered into the AGE could be compared across the Australian and NZ alpaca population and potentially to herds across the world. As the great majority of alpaca herds are recorded in the IAR database breeders are easily able to obtain the genetic improvement that AGE offers.

The AGE project has established genetic parameters for the following commercial traits; fibre diameter, coefficient of variation of fibre diameter, clean fleece weight, body weight and staple length. Based on the price schedule for Australian Alpaca Fleece Ltd the major determinants of price for alpaca fleece are fibre diameter, fleece weight, staple length, colour and absence of guard hair. The only one of these factors not measured by AGE is colour which demonstrates that AGE is focussing on the commercial production fibre traits.

Australian Alpaca Fleece Ltd is a company which collects fleece, classes these fleeces and has strategic partnerships with companies who market their products. AAFL states on its website that it has seen a *'dramatic improvement of fleece being received over the past few years'* and *'Continued efforts and further uptake of AGE by growers will hopefully see this rapid improvement continue'*.

Since its establishment in 2003 AAFL has seen the total amount of fleece it has received increase in the last 3 years by 49% to 65 tonnes. When the project commenced it was anticipated that total Australian fleece production would increase to 100 tonnes by 2006, however seasonal and other conditions meant that this total was under-achieved by about 10%. The project was predicated on there being a commercial alpaca fleece industry by 2008, and a milestone within the project was to develop a commercial breeder's workshop. Most alpaca fleece in Australia is produced within the industry stud herds and the remainder being alpaca wethers which are normally run as guard alpacas in sheep flocks. Because of the absence of a commercial fleece industry this workshop was developed for stud breeders on how to select alpacas based on their AGE reports but there was little demand for these workshops as breeders who had attended a Hands-On Workshop did not require the second workshop. This was the only milestone within the project which has not been completed largely due to the success of earlier project activities.

Those AGE traits which are being reported to breeders have a direct affect on the value of the fibre produced, and the size of the alpaca which has value for future meat production. The reporting of

these traits to breeders in AGE will allow them to determine whether they wish to select alpacas for fibre characteristics or for meat production for the newly developing ‘La Viande’ alpaca meat for human consumption.

The project has successfully achieved its third objective and thus has successfully completed all of the objectives for the project.

6. Implications

In brief a commercial AGE service has been established for the Australian alpaca industry. This service is a world first for the alpaca industry. Other livestock industries have clearly demonstrated the importance of their across-herd/flock genetic evaluation services in making well defined and rapid genetic improvement.

The successful establishment of AGE provides the alpaca industry and individual breeders with the genetic information on which to base their breeding decisions to accelerate genetic gain within the Australian alpaca industry.

Decisions prior to AGE were based on the appearance of the alpaca and some production data, primarily raw fibre diameter measures that were not adjusted for management or environment and therefore did not breed consistently based on these measurements. AGE reports describe the genetic value of an individual alpaca for a variety of traits which have been adjusted for environmental and other affects and represent the true genetic value of the alpaca. Alpaca breeders can be confident of the breeding potential of alpaca in the AGE and as a result be more confident in the performance of their progeny which is of course is essential if rapid genetic is to be achieved.

The original research proposal to RIRDC in 2003 stated *"However there is currently too much variation of quality in terms of skirted yield of quality fleece, coefficient of variation in fibre characteristics, and in the ratio of secondary to primary fibres."*

AAFL states on its website that it has seen a dramatic improvement in fleece quality and this can be seen in Table 1 by the decrease in fibre diameter in fleece being received from the Australian bred alpacas as compared to the older alpacas imported from Peru which have a higher fibre diameter. AAFL also states *'further uptake of AGE by growers will hopefully see this rapid improvement continue'* which will see Australian alpaca fleece become a world leader in fine alpaca fleece.

Table 1. Alpaca fleece grade as a percentage of total alpaca fleece received by AAFL (Source: AAFL Matthew McAninly)

Fleece Grade	2005/06	2006/07	2007/08
H1	4	6	7
H2	21	25	26
H3	39	37	36
H4	24	22	21
H5	12	10	10

A comparison of current prices being paid by AAFL for alpaca fibre (Table 2) obtained from their website shows a price advantage for finer micron fleeces with a soft handle (low medullated fibres). Using the prices for White/Light fawn alpaca fibre as an example:

Table 2. Prices for different micron categories of White/Light fawn alpaca fibre for A length fibre in each category (Source: AAFL Website – http://aafl.com.au)

Grade and micron	Price ($A) per kg
H1 - Under 20µ	27.50
H2 - 20-23µ	12.10
H3 - 23-26µ	5.95
H4 - 26-30µ	4.40
H5 - 0-34µ	2.80

It can be seen in Table 2 that the market demand is for fibre under 20 microns, 80-120mm in length, not tender, very soft handle and with minimum guard hair. The price discounts for increasing micron are substantial with the price of 23-26 micron fibre being only 21.6% of the price for H1 fibre.

South American countries, particularly Peru, which produce the majority of the world's alpaca fibre do not have a performance recording system comparable with AGE. As a result the Australian industry will enjoy a competitive advantage over other alpaca fibre producers as the quality and quantity of the Australian alpaca fibre increases due to faster genetic improvement resulting from AGE.

Alpaca breeders wishing to make high genetic gains will increasingly recognise the benefit of using AGE ABVs in their breeding program. Failure of individual breeders and the Australian alpaca industry to recognize and utilize the advantages of AGE will adversely affect genetic progress within their own herd and the industry development as a whole.

7. Recommendations

1. The AAA should continue to support and promote AGE to its members. The AAA should establish an AGE promotion officer within each of the AAA regions to assist other breeders to become involved in and effectively utilise AGE. The appointee should demonstrate a commitment to AGE by being enrolled and enthusiastic about how using AGE has assisted their herd's breeding objectives.

2. That RIRDC provide funding to assist technical advice to the AAA and breeders to consolidate the present RIRDC and industry investment in AGE.

3. NSW DPI should maintain its research and development commitment to AGE to ensure the potential of the alpaca industry to have a commercial base is achieved.

8. References

Paper pivotal to the development of the AGE Project

Casey A.E (2003)
Proceedings of National Conference of Australian Alpaca Association, Noosa. August 2003

Papers arising from AGE Project

Casey A.E (2004)
Proceedings of National Conference of Australian Alpaca Association, Hobart August 2004

Davidson, I. (2004)
Proceedings of National Conference of Australian Alpaca Association, Hobart August 2004

Casey A.E. (2004)
NZ Alpaca Conference 2004

Langford, C.M (2006) Breeding Programs – Review of approaches in Australia. *Proceedings of National Conference of Australian Alpaca Association, Adelaide August 2006*

Langford, C.M. (2007) Understanding Genetics – a practical introduction. *Proceedings of 2007 National Alpaca Fibre Seminar 'Alpaca Fleece – the future'* Ballarat July 2007

Langford, C.M. (2007) Developing a Breeding Program to accelerate Genetic gain *Proceedings of 2007 National Alpaca Fibre Seminar 'Alpaca Fleece – the future'* Ballarat July 2007

Langford, C.M. & Casey, A. (2006) Alpaca Across-herd Genetic Evaluation (AGE) to achieve commercially viable fleece production. *Proceedings of sheep & wool conference* NSW Department of Primary Industries Orange August 2006

Across-herd Genetic Evaluation Service Booklets – Editions 1-7 August 2003 to March 2008 NSW Department of Primary Industries, Orange 35pp

Appendendices

Appendix A: List of alpaca traits

List of alpaca traits which can be reported to AGE by breeders and whether they are a visual (V) or a measured (M) trait. Some of the measured traits are a Yes/No assessment of whether the alpaca has been affected.

Trait	**V/M**	**Trait**	**V/M**
Fibre Diameter	M	Testicular Size	M
Coefficient of Variation	M	Lustre	V
Comfort Factor	M	Guard Hair	V
Spinning Fineness	M	Bite	V
Curvature	M	Frame	V
Medullation %	M	Face Cover	V
Staple Strength	M	Skin fold thickness	M
Staple Length	M	Skin follicle density	M
Fleece Weight	M	Secondary:Primary Ratio	M
Skirted Fleece Weight	M	Internal Worms	Y/N
Mating age	M	Staggers	Y/N
Cria Weight	M	Facial Eczema	Y/N
Body Weight	M	Heat Stress	Y/N

Appendix B: Alpaca Age Report Summary - March 2008

DATA IN ANALYSIS

Number of Herds in analysis: 100

Number of progeny in analysis: 1879

Total number of alpacas in analysis: ... 3872

GLOSSARY OF TERMS

PHENOTYPIC VALUES – performance as measured by breeders

FW (kg): ..... Fleece Weight

FD (µm): ..... Fibre Diameter

CV (%): ..... Coefficient of Variation of Fibre Diameter

BW (kg): ..... Body Weight

SL (mm): ..... Staple Length

ALPACA BREEDING VALUES – trait genetic performance

FW (%): ..... Fleece Weight percentage deviation

FD (µm): ..... Fibre Diameter deviation

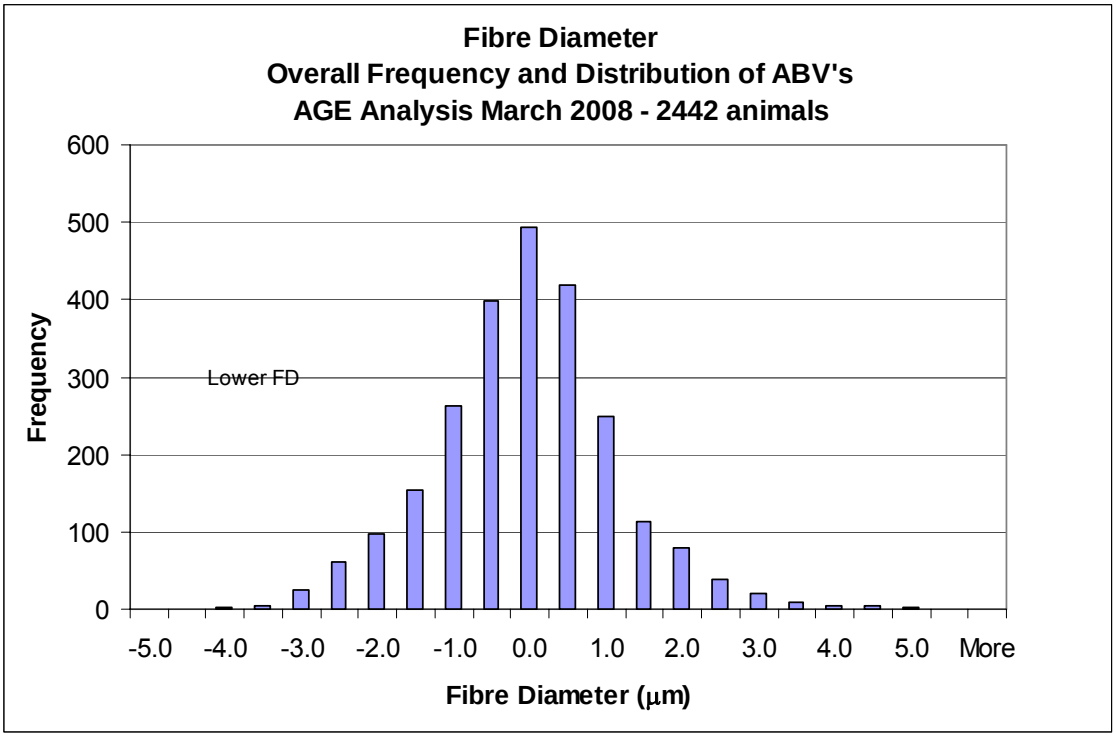
CV (%): ..... Coefficient of Variation of FD percentage deviation

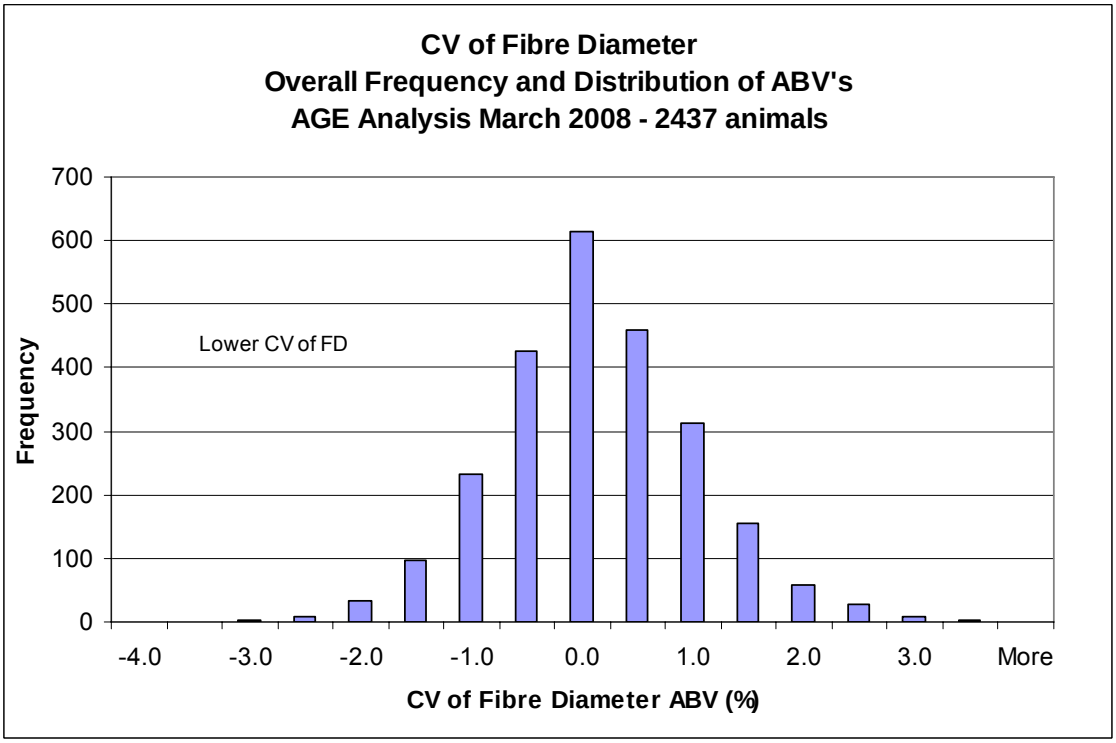
BW (kg): ..... Body weight percentage deviation

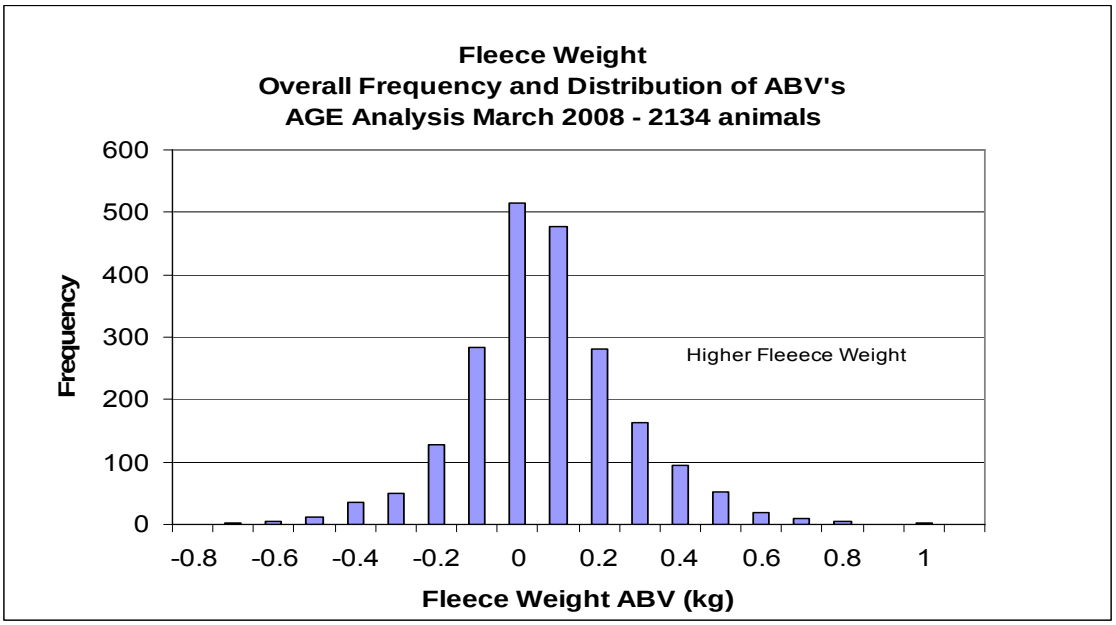
SL (mm): ..... Staple length deviation

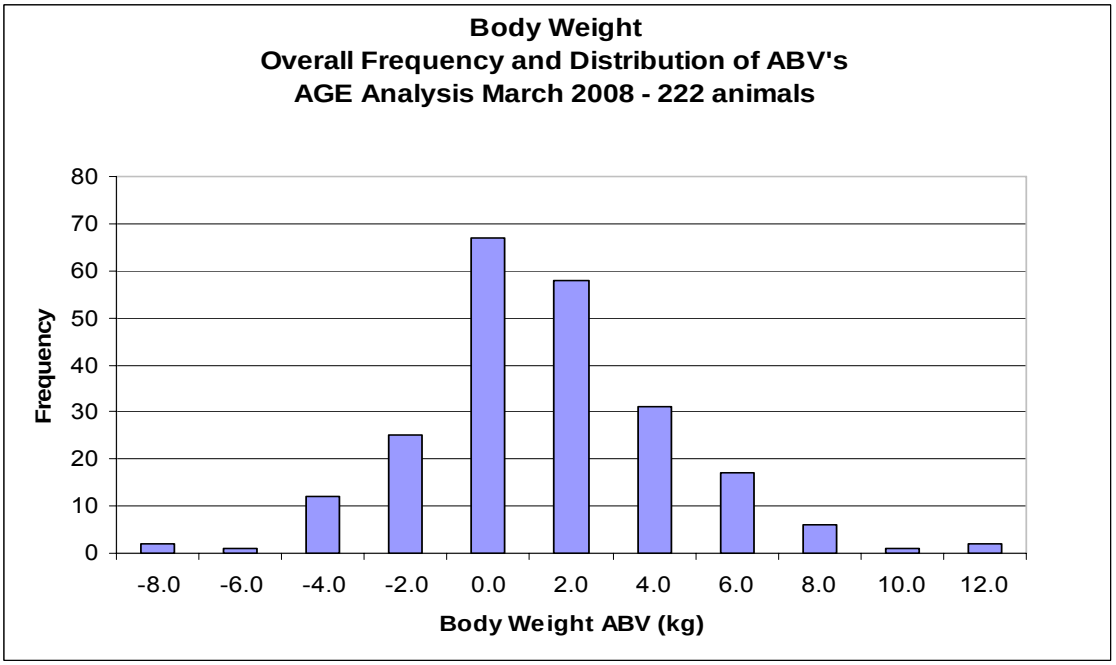
SUMMARY OF AVERAGE PHENOTYPIC VALUES

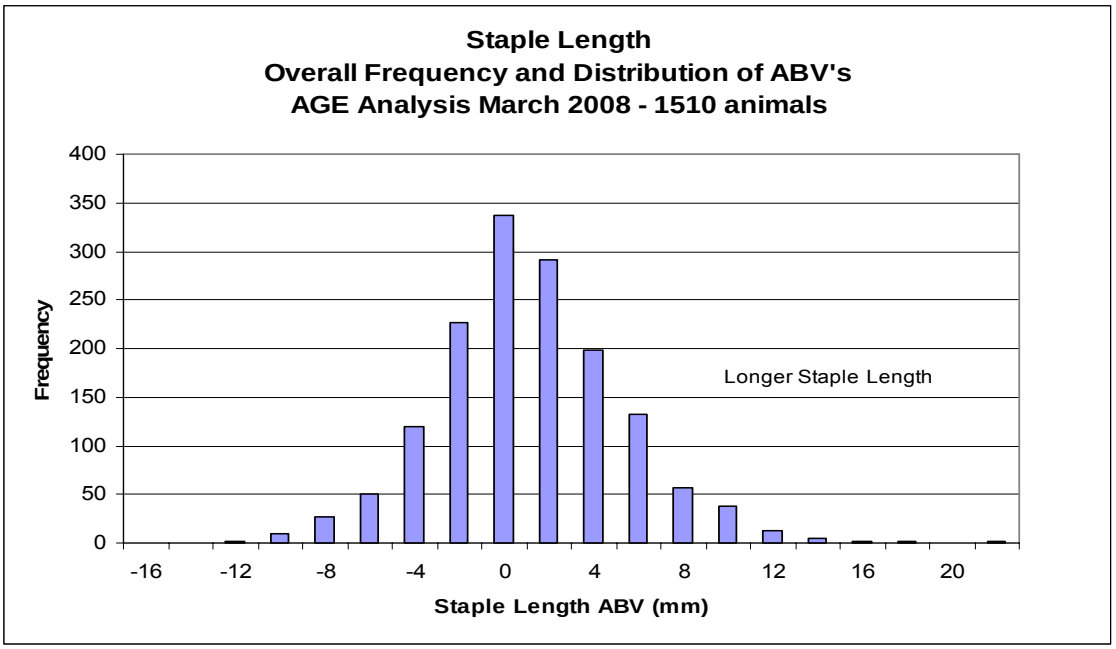
	Yearling	Tui	Adult
Average FW (kg):	2.0	2.6	2.8
Average FD (µm):	20.4	22.1	25.3
Average CV (%):	23.5	21.4	21.2
Average BW (kg):	43.9	53.6	65.8
Average SL (mm):	110	111	96


Fibre Diameter
Overall Frequency and Distribution of ABV's
AGE Analysis March 2008 - 2442 animals
Frequency
600
500
400
300
200
100
0
Lower FD
-5.0
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
More
Fibre Diameter (µm)


CV of Fibre Diameter
Overall Frequency and Distribution of ABV's
AGE Analysis March 2008 - 2437 animals
Frequency
700
600
500
400
300
200
100
0
Lower CV of FD
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
More
CV of Fibre Diameter ABV (%)


Fleece Weight
Overall Frequency and Distribution of ABV's
AGE Analysis March 2008 - 2134 animals
Frequency
600
500
400
300
200
100
0
Higher Fleeece Weight
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
Fleece Weight ABV (kg)


Body Weight
Overall Frequency and Distribution of ABV's
AGE Analysis March 2008 - 222 animals
Frequency
80
70
60
50
40
30
20
10
0
-8.0
-6.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
Body Weight ABV (kg)


Staple Length
Overall Frequency and Distribution of ABV's
AGE Analysis March 2008 - 1510 animals
Frequency
400
350
300
250
200
150
100
50
0
-16
-12
-8
-4
0
4
8
12
16
20
Staple Length ABV (mm)
Longer Staple Length

Producing Better Alpaca Fleece

The benefits of using the Alpaca Across-herd Genetic Evaluation system

by C.M. Langford and A.E. Casey
RIRDC Publication No. 08/190

The Alpaca Across-herd Genetic Evaluation (AGE) project has successfully established a most important genetic improvement tool for a commercial livestock industry. This report describes this achievement and its importance to rapid genetic improvement in the alpaca industry.

This research is of benefit primarily to Australian and New Zealand alpaca breeders to show them the progress achieved with the establishment of an Alpaca Across-herd Genetic Evaluation system and to encourage them to enter their alpacas into the AGE system.

An AGE commercial service has been established for the Australian alpaca industry. This service is a world first for the alpaca industry. In the analysis of March 2008 there were 100 herds, 1879 progeny and 3872 alpacas.

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