RIRDC Completed Projects in 2009 - 2010
and Research in Progress as at June 2010

RIRDC Publication No. 10/086

RARE NATURAL ANIMAL FIBRES

RIRDC Innovation for rural Australia
RARE NATURAL ANIMAL FIBRES

August 2010
RIRDC Publication No 10/086
Foreword

RIRDC produces Research in Progress summaries of continuing projects and those completed during 2009-2010. Our intention is to:

- Provide stakeholders early access to the results of ongoing and completed work to inform their decisions, and
- Inform researchers of results to shape research directions

The complete report on all programs is on our website at http://www.rirdc.gov.au

Rare Natural Animal Fibres Research in Progress, June 2010, contains short summaries of continuing projects as well as those that were completed during 2009-2010. This program aims to facilitate the development of new and established industries based on rare natural fibres.

The complete report on all RIRDC programs is available at our website http://www.rirdc.gov.au

The research objectives for the Rare Natural Animal Fibres Program are:

- industry development
- commercial viability
- communication and research capacity

This report is an addition to RIRDC’s diverse range of over 2000 research publications, which are available for viewing, downloading or purchasing online through our website: www.rirdc.gov.au. Purchases can also be made by phoning 1300 634 313.

Craig Burns
Acting Managing Director
Rural Industries Research and Development Corporation
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RARE NATURAL ANIMAL FIBRES
COMPLETED PROJECTS

Commercial viability

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Objectives

Our key strategy is to identify superior sires by central progeny evaluation and provide estimated breeding values (EBVs) for industry to enable them to produce more quality cashmere. It will also foster a national approach for Australian production of more quality cashmere by communicating the outcomes to industry.

Background

Australian Cashmere production has remained stagnant in recent times. Its sheep counterpart, the superfine/fine wool sector of the market, has enjoyed some success with increased production, increased yields and increased earnings over the last decade. Much of this can be attributed to the adoption of new breeding technologies such as estimated progeny differences (EPD). EPDs provide an objective measure of an animals' genetic worth and this quantitative system can provide rapid genetic gain and, as a consequence, can improve production and economic returns.

In addition to the original aims, we compared AI methods so we could identify the least stressful method. This was considered important for UWA-84A and also to the wider cashmere industry because stress causes sub-fertility and because adopting more animal-friendly practices will be seen in a positive light by community. Therefore, during the execution of UWA-84A, stress was evaluated using a comprehensive set of welfare indicators.

Research

We used about 300 cashmere does retained at Allandale since 1998 from RIRDC project UWA-27A, Increasing the production of mohair and cashmere sought by processors. This relatively homogenous herd provided an ideal breeding flock for genetic comparison of cashmere sires from all over Australia. After consultation with the ACGA, economically important traits were selected, weighted and placed in an equation (McGregor Index) that allows the ranking of the sires. Semen from 18 bucks from Queensland, NSW, Victoria and WA herds was used in artificial insemination (AI) programmes. One buck was used in both years to act as a link sire to allow valid comparisons among the progeny from each year. The primary data source was the total number of kids born and the number alive at different ages, with up to 300 records per year for the critical variables. A heritability estimate of 0.25 was assumed for birth weight (based on sheep information as no goat information was available). A heritability estimate of 0.30 was assumed for body weight and a heritability of 0.2 was assumed for temperament tests and for WEC to estimate the breeding values of the sires. BLUP (Best linear Unbiased Prediction) breeding values of the traits were calculated for the different sires.
Supplementary Project 1: transcervical and laparoscopic AI were performed on experienced adult and maiden Cashmere does. Stress was evaluated by analyzing physiological (heart rate and core temperature), hormonal (cortisol) and behavioural (vocalizations and struggles) responses during the course of the AI procedure.

Supplementary Project 2: semen was collected by artificial vagina or by electro-ejaculation, and both processes were also compared to natural mating. Stress was evaluated by analyzing sexual behaviour, vocalisation, struggling, plasma cortisol and beta-endorphin in the three groups of males.

Outcomes

A web page was created and published with a list of sires ranked on the basis of performance traits using an objective measure. This enables producers to make informed choices to meet their individual breeding objectives.

For artificial mating, the least stressful practices were semen collection by artificial vagina and transcervical AI.

Implications

Industry use of superior sires for economically import traits will improve production and economic returns for Australian cashmere growers.

Transcervical AI greatly reduces stress in the does and appears to greatly improve reproductive efficiency as reflected in pregnancy rates. This practice should be adopted by industry.

Publications

The outputs below concern the above project and also supplementary projects on stress and artificial insemination.

University of Western Australia. Faculty of Natural & Agricultural Sciences. School of Animal Biology. Cashmere group. Sire Reference Scheme. [7 June] [cited; Available from: http://www.cashmere.animals.uwa.edu.au/.


The main aims of this project are to identify the sources and constituents of the viscous seminal plasma; and investigate ways of reducing the viscosity of camelid seminal plasma. The project also aims to continue the work of RIRDC project US-138A and AAA-1A. Considerable progress was made during RIRDC project US-138A and we have clearly demonstrated:

1. Addition of a diluent to the container during semen collection increases semen quality
2. Ejaculated sperm can remain viable for up to 96 hours during liquid storage
3. Epididymal sperm tolerate liquid storage, freezing and thawing procedures and retain their function better than ejaculated sperm
4. Enzyme addition to semen reduces seminal plasma viscosity but alters membrane properties of sperm
5. Mechanical separation of sperm from the viscous seminal plasma is effective, but recovery rates are low (40-60 %)

Nevertheless, the key problem for storage of semen from all camelids remains the viscous seminal plasma. If the industry is to achieve the practical application of liquid and frozen sperm storage, and a viable system of artificial insemination (AI) in camelids, particularly llamas and alpacas, the following basic questions must be answered: (1) What are the sources and constituents of the viscous seminal plasma? and (2) What is the basic protein content, structure and function of camelid seminal plasma?

Analysing the source and constituents responsible for semen viscosity is critical to developing methods to overcome or circumvent the deleterious effects of the seminal plasma. This has been achieved in other species with problematic seminal plasma, for example the goat, but has either been ignored or considered too difficult in camelids.

The proposed project aims to answer the two questions using modern proteomic analysis techniques, further determine the effects of seminal plasma on the viability and integrity of ejaculated and epididymal sperm, and investigate several methods (both surgical and non-surgical) to overcome/circumvent the deleterious effects of seminal plasma on the integrity and longevity of sperm. In addition, the project will also further refine the techniques for liquid and frozen storage of alpaca sperm (established during RIRDC project US-138A) so that rapid progress in the development of AI technology can occur after the characterisation of the viscous seminal plasma.
Objectives

- Characterise effect of seminal plasma on sperm function and integrity
- Identify cause and source of viscous seminal plasma
- Investigate use of enzymes to reduce viscosity

Current Progress

The effect of seminal plasma on epididymal and ejaculated sperm has been determined. In the absence of seminal plasma, sperm rapidly lose motility and undergo the acrosome reaction. In the presence of 100% seminal plasma, sperm also become non-motile although their acrosomes remain intact. Sperm remain functional in the presence of 10% seminal plasma. These results suggest that 10% seminal plasma is beneficial to alpaca sperm but that a high concentration is toxic. It may be necessary to add seminal plasma proteins to alpaca sperm following cryopreservation.

We determined that glycosaminoglycans (GAGs), although abundant in alpaca seminal plasma, are not the cause of its viscosity. Using mass spectrometry and iTRAQ analysis we have identified a gel-forming protein that is 5-8 times more abundant in viscous compared to non-viscous semen. Investigations are in progress to confirm this finding and to identify the source of this protein.

Although GAG enzymes reduced seminal plasma viscosity, the protease papain was more effective. We have determined the optimal method for papain treatment of alpaca semen to eliminate viscosity whilst maintaining sperm function and are currently investigating methods to inhibit or remove the papain following treatment. Investigations are in progress to identify enzymes that specifically degrade the identified viscosity-causing protein whilst maintaining sperm function and integrity.
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<td><strong>Researcher:</strong></td>
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**Objectives**

This project aims to develop feeding strategies to improve wool production and reproductive performance of alpacas. Alpacas produce glucose from degradation of amino acids and this may limit the use of strategies developed for others ruminants but, enables the design of specific and low-cost feeding strategies.

**Current Progress**

Expt 4 “Libido”: After discussion with producers, we have added an experiment investigating the effect of canola feeding on puberty onset (40 alpacas) in complement to the effect of castration on bodyweight (60 alpacas - Mr Daud, PhD Student). Both experiments have been approved by the UWA Animal Ethics Committee and have been running for 6 months. No differences have been noticed between the treatment groups.

Expt 5 "Gestation length": We are waiting for the third and final set of data from Canchones Alpaca Stud. The 2 initial data sets indicate that the final dataset should have enough variability in gestation length for multivariate analysis. The full analysis will be started as soon as we have received the last set.

Expt 6: This experiment has not been started because we have moved the 2 components of Expt 4 to Banksia Park.

Publications: The publication of manuscript and fact sheets has been delayed because some further analysis were required and we want to obtain some data from Ms Kirrin Lund’s PhD work to confirm the interpretation of the results obtained in Expt 1 and 2. Ms Kelsie Moore has started to write a manuscript from Expt 3 (60% completed).
### Project Title

Inheritance of white colour in alpacas: identifying the genes involved

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### Objectives

This project is designed to collate and analyse information that will lead to an understanding of the genetics and genetic mechanisms that produce white fibre in alpacas. The project aims are to (1) determine the mendelian inheritance of white (and as a side product, other colours) in alpacas, and then (2) apply this information to molecular studies of the genes involved in determining fibre colour.

### Current Progress

Over 80 samples have been analysed using the optimized melanin analysis method. All brown/fawn/white alpacas tested so far contain pheomelanic pigment. This supports our hypothesis that the agouti alleles are one of the key regulators of colour in alpacas. Two of the mutations we found in the MC1R gene have been tested in functional assays and found to independently cause massive reduction in signalling capacity in the receptor. In combination, these mutations will almost certainly lead to an inability to produce black, so are desired mutations in the white alpaca herd. Sequence analysis of the coding region of ASIP is complete and three mutations have been found that probably lead to black fibre production. These mutations are recessive, so there is the potential to test white animals for these mutations to prevent black cria. These mutations, however, do not explain all black animals, nor do they explain the difference between white and fawn and brown. Due to massive improvements in technology (RNA-seq), it is now possible to sequence the entire transcriptome for the same price as testing 15 genes. We are in the process of preparing samples for RNA-Seq to examine the expression profiles of white versus fawn etc alpacas.
**Project Title**
ACGA Merrrit - Cashmere Estimated Breeding Vale Program - phase 2

**RIRDC Project No.:**
PRJ-002498

**Start Date:**
1/9/2008

**Finish Date:**
1/8/2011

**Researcher:**
Andrew James

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**Objectives**
- To expand the participation in ACGA Merrrit – the Cashmere Industry's low-cost across-herd performance recording and estimated breeding value (EBV) system.
- To bring into ACGA Merrrit additional genetic linking data from the WA Sire reference scheme and the UNE worm project as it becomes available.
- To perform analysis of performance data at least quarterly, report results to participating cashmere growers and to assist with data interpretation and understanding.
- To communicate results to the wider Cashmere producing industry and to the Agriculture sector more broadly.

**Current Progress**
Fresh data has been imported into the analysis from three flocks and estimated breeding values calculated. The results of this latest round of analysis will be presented to growers on the 5th June 2010. Very large genetic gains have been demonstrated over the life of this project and its predecessor.

Briefly, the trait leader for down weight has an EBV of +403 grams, albeit at a fibre diameter EBV of +0.2 um. The trait leader for a selection index in which reduction in fibre diameter is given equal weight to increase in down weight has EBVs of +349 grams for down weight and -0.43 um for fibre diameter. By way of comparison, the benchmarking study of McGregor showed average down weight was 134 grams. The top animals therefore demonstrated a four-fold increase in down weight c/- the average [(403/134)/134 = 4 fold]. This difference in performance is absolutely enormous!
Objectives

This project has three main objectives:

• to assist the local rare animal fibre industries in the key areas of efficient fibre production, improved fibre quality, cost-effective fibre processing and new product development; and to
• retain and further grow the pool of expertise in the rare animal fibre area for the long term benefit of the rare animal fibre industries; by
• funding Dr. Bruce McGregor’s continued R&D for the Australian Speciality Fibre industries.

Specifically, this project will help maintain and significantly enhance the R&D capacity in Australian rare natural fibre industries, through strategic support for the Centre for Material and Fibre Innovation at Deakin University, including funding for the Centre to appoint Dr Bruce McGregor as a Senior Research Fellow to continue and grow his research into rare natural fibres, in collaboration with Professor Xungai Wang.

Successful completion of this project would see increased knowledge and development of technology to improve efficient fibre production, improved fibre quality, cost-effective fibre processing and new product development with Australian rare natural fibres.

Current Progress

The review of organic pathways was completed. Revision of the review ‘Improving the quality and processing of Australian rare natural fibres’ was substantially completed. Research on a method to identify the origin of fibres and authenticate animal source, on fibre length and structural aspects of fibres are in progress.

Three scientific papers were prepared and published on the influence of stocking rate and mixed grazing of Angora goats and Merino sheep on: pasture, animal and fibre production and quality.

Scientific papers were prepared and published on:
Affect of nutrition and origin on amino acid, grease and suint composition and colour of cashmere;
Associations of mature live weight of Australian cashmere goats with farm and age;
Phenotypic factors associated with fibre curvature standard deviation in cashmere.

Four scientific papers were prepared and accepted on: gross margins in Australian mohair enterprises; influence of grain supplements on weaner Angora goats; weaning weight in Australian cashmere goats; fibre contamination potential from cattle fibre.

Five other manuscripts were prepared and submitted to journals.
Six mohair research updates were published by Mohair Australia. A report on cashmere knitwear was published by Cashmere Australia.

Two formal presentations were made to TAFE agriculture students on rare natural fibres.
Rare Natural Animal Fibres Research in Progress, June 2010, contains short summaries of continuing projects as well as those that were completed during 2009-2010. This program aims to facilitate the development of new and established industries based on rare natural fibres.

There are three program objectives. These are:

• industry development
• commercial viability
• communication and research capacity.

RIRDC is a partnership between government and industry to invest in R&D for more productive and sustainable rural industries. We invest in new and emerging rural industries, a suite of established rural industries and national rural issues.

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