BREEDING FOR IMPROVED PRODUCTIVITY AND WOOL QUALITY IN FINE WOOL MERINOS

I.W. Purvis
Pastoral Research Laboratory, CSIRO Division of Animal Production
Private Mail Bag, Armidale, NSW 2350

SUMMARY
Goals for fine and superfine wool breeders are complex if they are to satisfy the desires of several levels of consumers. Breeders must also take into account trends that are occurring in the downstream sectors of the industry. The CSIRO Fine Wool Project was designed to provide genetic information to breeders so that they can design the best mating and selection strategies to achieve their breeding goals.

Keywords: Fine wool, Merino, breeding, wool quality

INTRODUCTION
In setting breeding goals and designing breeding programs to best meet their objectives, fine wool Merino breeders must satisfy the desires of several levels of consumers. Breeders must improve the quality of raw wool and downstream products, and hence they need information and good tools with which to make the decisions that are necessary for designing and conducting a genetic improvement program.

The future market share for wool will be determined by price relativities with other apparel fibres, both natural and synthetic, and by the ability of the wool industry to meet modern consumer preferences in relation to fabric properties such as weight, construction, colour, style, comfort (softness), easy care, appearance and appearance retention. The wool industry must therefore become proactive in developing new products and processes that build demand and enhance fibre quality.

Within the wool sector, the market share for fine and superfine wool will be influenced by the factors identified above, but also by competitive forces between different classes of wool: classes that are determined largely by mean fibre diameter and fibre (staple) length.

Recent IWS consumer research has shown that the major trends in consumer preferences for wool apparel are focused on what Ian Hilton, Director of Information Planning, IWS (Hilton 1995) calls the five “c’s”: i) contemporary and casual; ii) comfort; iii) convenience; iv) clean textiles; v) competitive value for money. His message to woolgrowers and breeders is “where you can, grow more wool which gives higher garment comfort to the consumer; that is, of finer fibre diameter, fewer coarse fibres, and improved wool style and softness. In return, textile processors will, over the longer term, pay continuing premiums for these wools.”
In addition to evidence that consumers have begun to prefer lightweight, softer fabrics, there have also been dramatic changes in textile processing. In part these have been driven by the requirement for increased efficiencies of production and have been achieved by substantial increases in the mechanisation of mills and in the speed of wool processing equipment. This combination of developments has reinforced the requirement for an increase in the availability of finer wools. The downward trend in the average fibre diameter of cotton over the past 20 years (4.5 micronaire -> 3.8 micronaire), and the advent of man-made fine micro-fibres clearly supports the thrust of this philosophy.

Ultimately, the preferences of consumers and the responses of the processors will be reflected in prices paid for raw wool in the international marketplace. Whilst any one week, season or year will show substantial distortions to any general long term trend, an examination of prices paid for wools of different mean fibre diameter in the last 20 years does reveal a strong reward (on a per kilogram basis) for growing finer diameter wools. Similarly, an analysis of the relative importance of factors affecting prices paid for Merino wools at auction in Australia, such as conducted by IWS (IWS, 1994) supports the signals coming from consumers and processors.

**BREEDING GOALS**

To develop strategies for optimising genetic improvement in Merino flocks, information on costs and returns are first required so that breeding objectives can be formulated that best address business objectives. Ponzoni (1986) has clearly defined the steps in this process for Merino flocks. The first requirement is to document the costs and returns in an enterprise that are influenced by animal performance and to then calculate Relative Economic Values (REVs) for each trait. Increasingly, individual breeders have access to historical market and cost information that is specific to their particular enterprise and client base, and such information is being used to assist in the definition of breeding goals. However, industry-wide analyses, such as those now routinely conducted by IWS (IWS, 1996), are important for those traits that are not usually measured or assessed at the enterprise level, or where there is little variation within a flock. For example, components of style may show little variation within a breeding flock, relative to that seen in a wider context. Equally, the relative importance of traits may change as other attributes change. Style accounts for only a small part of the variation in price for wools broader than 21 microns, but for wools less than 17.5 microns, it can account for more than 20% of the variation in price (K Stott, IWS, personal communication).

For several of the quality traits that influence price of Merino wools, there is a non-linear relationship. However, for most of these traits the relationship with price is essentially linear over the range of values that are relevant to the current flock performance in that trait and the goal of the breeder. A more complicated scenario is seen in the relationship between some of the staple measurements and price. For example, prices are still assigned to staple length on the basis of classes. For fine and superfine wools there is a lot of dogma about penalties for over-length wools, but very little hard data. For such cases, individualised calculation of REVs should be the preferred option. When adopted for the marketing of Merino wool in Australia, full objective specification will greatly simplify the calculation of returns.
There are traits which are currently not measured or formally assessed, but there is evidence of their effect on processing performance or product attributes. The contribution of such traits to variation in price is unknown, but there is anecdotal evidence these traits affect prices. Examples of such traits are fibre diameter distribution and crimp frequency. How do breeders deal with these situations? The answer is to acquire the knowledge of the heritability of these traits and the genetic associations between them and those that are formally incorporated in a breeding objective and which are targeted in the selection program.

To meet the demands of their downstream consumers, breeders need to be satisfied that their breeding goals and selection strategies (which are based on raw wool components and raw wool auction prices) will deliver favourable outcomes in terms of processing efficiency, quality of processed product, and naturally, returns from these products. In order to give breeders this capability, knowledge of the genetic relationships between raw wool characteristics and processing performance are required. This information is very expensive to acquire and the industry can only support a small number of resource flocks specifically designed to capture the required data.

**SELECTION CRITERIA**

It is one thing to define a breeding goal focused on improving traits that have been determined by consumers as important; it is another to actually achieve acceptable progress in changing those traits in a practical breeding program. Some properties of the finished garment that are desired by consumers have the equivalent as a property of raw wool. Softness and fabric weight are primarily affected by mean fibre diameter and this is a property that can be ascribed to the fleece of a sheep. Whether or not it can be usefully applied as a selection criterion is dependent upon whether it can be cheaply and easily measured and whether it is heritable. There are other properties of fabrics and garments that have no direct counterpart in raw wool. Fabric properties such as drape and texture cannot be measured in raw wool and therefore raw wool attributes that are associated with those fabric properties are used as indirect selection criteria. Acquiring the necessary information on the relationships between raw attributes and downstream processing and product attributes and performance is an exceedingly expensive business.

**CSIRO FINE WOOL PROJECT**

The Fine Wool Project is a large program of research that is being conducted by CSIRO Divisions of Animal Production and Wool Technology, with collaboration from the Departments of Agriculture in NSW and WA, and financial assistance from IWS and the CRC for Premium Quality Wool. This project was specifically set up in 1989 to give breeders advice on questions such as those identified above. The project was designed so that the animals from which information was obtained were representative of the major ram suppliers in the fine-wool breeding industry in Australia. In addition, the structure of the breeding flocks, the numbers of animals, and the time over which the measurements and assessments were collected, were chosen to provide breeders with precise information about the genetic control of a wide range of traits from the animal, fleece and processed products.
The Fine Wool Project is based on data and samples collected from 9 fine and superfine wool flocks, comprising 200 ewes and their progeny from each bloodline. Two medium wool bloodlines are also represented so that there are links to this part of the Merino population and to the genetic parameters that are currently in use in the industry. The first progeny were born at the Longford Field Station at Armidale in the Northern Tablelands of NSW in 1990 and since then data have been collected on a wide range of objectively measured wool quality and production characteristics, visually assessed wool and conformation traits, and skin and follicle measures. All flocks are fully pedigreed and the initial assessments and measurements are based around the first shearing at 10 months of age. The ewe portion of the flock is then measured and assessed annually until they are 6 years of age. At this stage of the project we have collected information on hogget traits (10 months of age) from more than 5,000 progeny.

The major challenge within the Fine Wool Project has been to collect the necessary information on traits for which there has been no established measurement or assessment system (e.g., handle, components of style) and for characteristics such as measures of processing performance, for which the identity of the individual animals is lost.

CONCLUSIONS
For breeders to produce the genotypes that will breed progeny and deliver products which satisfy, and even exceed, the expectations of a whole range of consumers, they must have a breeding goal that focuses primarily on their requirements. In order for this to occur, breeders must have high quality information on the requirements of these consumers. Ideally, the preferences and requirements of the consumers will be reflected by premiums and discounts in the market place. The task for the industry is to have in place a classification and measurement system for all factors that are deemed important and which influence price. Only with such signals can breeders monitor the relevance of their animals to the future requirements of their customers.

It is one achievement to have a well focused breeding objective. It is another to put in place a mating and selection strategy that will actually realise an acceptable rate of genetic progress. The challenge for the scientists is to produce a range of friendly software products that will accurately predict the consequences of any selection strategy. This objective features prominently in the programs of the major genetic research and development teams around Australia.

ACKNOWLEDGMENTS
The staff of the CSIRO Fine Wool Project have all contributed to the content of this paper.

REFERENCES

700