CSIRO

Finewool Newsletter

Issue 6

May 1994

CSIRO

PREMIUM QUALITY WOOL COOPERATIVE RESEARCH CENTRE

WOOLMARK

In this Issue:

Editorial

I must first apologise for the rather lengthy gap between the last Fine Wool Project Newsletter and this one. As the new boy on the block I can shoulder a large part of the blame. However, now that Laurie Piper has been elevated to the title of Professor Piper, as a result of his appointment as Director of the Cooperative Research Centre for Premium Quality Wool, he now has the necessary baggage to also wear some of the blame. Suffice to say that we will try to be more regular in getting our FWP Newsletter to the post. We should, however, take the opportunity to congratulate Laurie on his achievements in getting the CRC up and running and wish him all the best for the future.

The period between the Newsletters has not been without good news. The continued steady improvement in wool prices, and in fine wool prices in particular, is welcomed by all sectors of the industry. There are many in the non-production parts of the industry who acknowledge that a healthy wool growing sector is vital to achieving long term stability in the wool textile industry. We will continue to hope that there is a slow and steady increase in wool prices in the future.

There are some exciting results coming out of work being conducted in the Wool Quality Project and we have included a report on this subject by Andrew Swan which has been adapted from a talk given by Andrew at the Wool Quality Seminar at Walcha in January. One of the important pieces of information comes from an analysis of historical data of the genetic relationship between clean fleece weight (CFW) and average fibre diameter (AFD) in sheep from fine-wool flocks. It is only recently that robust techniques have been developed to examine such data. These results support the view held by many that the relationship between AFD and CFW in fine wool flocks may be stronger than in medium and strong wool genotypes, and hence it will be more difficult to simultaneously improve these two traits. If these findings are confirmed by the more precise and industry relevant results that will come out of the Fine Wool Project, then this knowledge will allow us to design much better selection indices for fine wool breeders.

We have also included in this newsletter an update of the current FWP flock structure and also the latest results from the 1992 drop hoggets. These results reinforce, once again, the very important role that the environment plays in bringing together the wool production and quality attributes of fleeces from what might have been thought to be genetically diverse groups.

Kerry Hansford and Michael Bow, part of the FWP team from CSIRO Division of Wool Technology have contributed an article on the precision of measurements used in flock testing programs. I am sure this will prove valuable information for the many of our readers who routinely use these procedures.

The advent of the Cooperative Research Centre for Premium Quality Wool has been an exciting development, and particularly for those who breed fine-wool sheep or, indeed, aspire to so do. The focus of the Genetic Technologies Program, which is the one in which the Fine Wool Project sits, is on fibre diameter and the other measures of wool quality. The primary objective of the research in this program is to give breeders the tools that will enable them to better manipulate average fibre diameter, while maintaining control of fleece weight and the other determinants of wool quality, such as style, handle and absence of faults. We will have a full report on Program 1 of the CRC in the next Newsletter.

Dr. Ian Purvis
Leader of the Wool Quality Project
Sheep Breeding Program
CSIRO Division of Animal Production

Flock Report

Because of the problems with footrot in 1993, the composition of the management flocks at Longford was changed in order to accommodate control measures. Four management flocks were created: Flocks AA and B comprise all the foundation ewes plus the 1990 drop ewes from lines 1 to 6 that were born at Longford; Flock C is made up of the 107 ewes purchased from Kelvin Grove in January 1993 for the Hillcreston bloodline; and Flock D consists of the 1991 drop ewes from all the bloodlines

The feed at Longford during winter was of quite good quality and quantity, and with minimal supplementary feeding of wheat the sheep maintained excellent condition. At lambing the conditions were also good and lambs and ewes did particularly well.

The comparative performance of the management groups at lambing was:

Management Group	Ewes Mated	Lambs Weaned	Weaning Percentage
Flock A	568	447	78.7
Flock B	568	452	79.6
Flock C	107	67	62.6
Flock D	524	284	54.2

The results are only average, overall, and in flocks C and D are disappointing. However, the conditions for mating this year look promising so we will hope to have a better performance .The 1993 weaners have grown well during the summer and early autumn and should be in good condition for classing in July.

Dick Farrell
Senior Technical Officer

Wool Quality Research in CSIRO Division of Animal Production

Dr Andrew Swan
Research Scientist, Sheep Breeding Program
CSIRO Division of Animal Production,
Private Mail Bag
Armidale NSW 2350

The Wool Quality research effort of CSIRO is part of a broad genetics program aimed at increasing wool quality, production efficiency and profitability in the Australian sheep industry through superior breeding strategies. This aim is addressed through the development of breeding objectives for ram breeders and their clients the wool growers.

Obviously, all ram breeders have some sort of breeding objective, whether based on performance figures, or simply a picture in the mind of "the type of sheep I would like to breed". However, with ever increasing financial pressures facing wool growers, it is essential that ram breeders adopt more formalised breeding objectives which focus on improvement of the traits which influence profitability.

The breeding objectives currently recommended by researchers (eg. WOOLPLAN) aim to increase fleece weight and reduce fibre diameter with lesser emphasis on higher reproductive rate and body weight. These have been developed mainly for medium wool flocks.

There is a need to re-work this set of traits for fine wool types, and to consider the inclusion of additional fleece structure and wool quality traits which influence wool prices, particularly at the fine end of the clip. These traits include length, strength, and style.

Development of breeding objectives requires the following knowlege:

- Identification of the traits which influence profit (this group of traits is termed the "breeding objective").
- By how much these traits influence profit (the "economic value" of each trait).
- Identification of the traits on which to select. These traits are referred to as the "selection criteria", and may or may not be the same as the traits in the breeding objective.
- The size of the differences between animals for all traits ("variation").
- The degree to which these differences are passed from parents to offspring ("heritability"). Heritability is often expressed as a percentage, with higher values enabling more rapid genetic gain.
- The level of association between traits ("correlation"). Correlation is a measure that ranges between -1 and +1. Correlations which are close to +1 or -1 indicate strongly associated traits, whereas correlations close to 0 indicate weakly associated traits.
- Estimated breeding values, which reflect the value of an animal's genes for breeding. These are never known with perfect accuracy.

- Selection index. The above information is combined into the selection index. There will be an index value for each animal, and selecting the animals with the highest values achieves the most rapid genetic gain towards the breeding objective.

The AWRAP-funded research projects discussed below have been designed to obtain this information, with particular reference to fine wool flocks.

The Fine Wool Project

The Fine Wool Project is based on a flock of 2200 breeding ewes from 11 industry bloodlines, including 9 fine/superfine and 2 medium wool bloodlines. In establishing the flock, CSIRO was fortunate to obtain support from AWRAP and from ram breeders, the former providing funding, and the latter contributing sheep and allowing their names to be associated with the project.

Progeny born in the flock are subjected to a comprehensive measurement schedule, which includes objectively measured and subjectively assessed wool traits, skin and wool follicle traits, reproduction and body traits, and parasite resistance and feed efficiency traits. These assessments and measurements will be used to derive the heritabilities and correlations required for the development of breeding objectives, and will also improve our knowlege of the biology of wool growth, particularly in fine and superfine wooled sheep.

In addition, wool from the project is used by CSIRO Division of Wool Technology in their research programs aimed at improvement of wool metrology procedures, processing techniques, and garment quality assessment. This collaboration will allow better integration of production, marketing and processing research.

The Fine Wool Project recently began its second 3-year term of funding from AWRAP. By the end of this term, relatively accurate estimates of heritabilities and correlations in hoggets will be available.

A third term of funding will be required to obtain accurate estimates for older animals. Preliminary results show there are significant differences between bloodlines for a variety of economically important traits, indicating there may be differences in profitability. Table 1 shows the results to date for several traits: greasy and clean fleece weights, yield, average fibre diameter, and body weight.

Historical Analysis of Fine Wool Data

In this project, data from past experiments involving fine wool types were re-analysed to obtain heritabilities and correlations for the core objectively measured traits, including fleece weight, fibre diameter, and body weight. When compared to heritabilities and correlations derived from medium wool types:

- The variability within traits was lower for fine wools.
- The heritability of fibre diameter was higher in fine wools (60% *v* 50% in medium wools).
- The heritability of fleece weight for fine wools was similar, in the range of 35 - 40%. [This is much more reasonable than the estimate of 1% for clean fleece weight from the Fine Wool Project flock which appeared recently in the "Farm Journal". That figure was based on a very small data-set.]
- The association between fleece weight and average fibre diameter was stronger in fine wools. The correlation between clean fleece weight and fibre diameter was 0.39, compared to 0.25 which is commonly assumed for medium wools. This result implies that it is harder for fine wool breeders to increase fleece weight and reduce diameter simultaneously, giving some evidence to beliefs held by breeders of fine wool sheep.

This study was intended to give some idea of what to ultimately expect from the Fine Wool Project, and the results should be viewed as preliminary only. Historical analyses can be an efficient way to spend research funds, as CSIRO, the state Departments of Agriculture, and universities all maintain databases of old breeding experiments.

However, there can be limitations. For example, the design of old experiments is not always entirely appropriate, and there will obviously be no data from newly developed measurement techniques such as those used to measure diameter distribution. A library of biological samples has been established from the Fine Wool Project flock to provide for future research needs. This library includes wool, skin, and DNA samples.

Development of Breeding Objectives Using Sale-by-Description Data

The aim of this study is to calculate economic values for wool quality and fleece structure traits such as style and its components, length, and strength, to determine whether there is benefit in including them in breeding objectives. The SIROSYS database developed by CSIRO Division of Wool Technology is being used to carry out the price analyses involved.

This database has 5 years data on individual lots, with up to 80 items of information per lot. Preliminary results show that growers are paid premiums for additionally measured wool, except in the case of Spinners types. This result was somewhat questionable since very little Spinners type wool had additional measurement.

The results also showed that in many cases lot size can be increased by combining shed lines, since the measurements show them to be within the allowable tolerances for interlotting. Larger lot size reduces the cost of additional measurement.

Sample Survey of NSW Medium Wool Studs

Over the past two years, a sample survey to determine the incidence of wool quality faults in the NSW medium wool stud population has been conducted. Thirty studs were chosen at random, with either 100 or 200 unclassed ewe hoggets sampled from each. A stratification procedure was used to ensure adequate regional representation, and a balance of studs of varying importance to the industry.

Traits measured on the ewes were diameter distribution, and a variety of wool quality and fleece structure traits, including handle, crimp definition, colour, staple formation, tip shape, dust penetration, protruding fibres, and skin and fleece conditions such as dermatitis.

Results show moderate associations between fibre diameter variability (FDV) and wool quality traits. For example, ewes with low FDV tended to have softer handle, better crimp definition, and good staple formation.

By contrast, ewes with high FDV tended to be harsher handling, have poorer crimp definition, poorer staple formation, and an increased tendancy for fibres protruding from the fleece.

Reduction of fibre diameter variability has been promoted in certain industry circles recently, and the results of this survey might be construed as support for such arguments. However, it should be pointed out that since the breeding of these sheep was unknown, the associations could not be calculated at the genetic level.

In addition FDV currently attracts no price premium. Therefore, there is currently no basis for including FDV in a breeding program, as there is no economic value, and the underlying genetic effects are still unknown. In any case, the currently accepted breeding strategy of reducing average diameter will also have the effect of reducing FDV.

Other Projects

Other projects of the group include:

- A database to assemble the data from on-farm and central-test sire evaluation schemes run throughout Australia. This database is currently used for research purposes, in the development of techniques for breeding value estimation. This project is funded by AWRAP.
- A flock of medium-wool Merinos which have been selected solely on clean fleece weight. This project is funded from within CSIRO.
- Two trials to evaluate the performance of fine wool Merinos in traditional medium wool growing regions. The first of these involves surplus wethers from the Fine Wool Project flock being run at NSW Agriculture's Condobolin field station. The second involves the establishment of breeding flocks with two Fine Wool Project bloodlines in Western Australia. These are run by CSIRO and WA Department of Agriculture, and use ex-Armidale rams to create genetic links. This project is also funded from within CSIRO, and by the Cooperative Research Centre for Premium Quality Wool.

Conclusion

The research carried out by the Wool Quality group is aimed at increasing fleece value by genetically improving both wool quality and production, with special reference to fine wool Merinos. Each research project is designed to provide information on different components of such breeding objectives: the analysis of sale-by-description data will provide information on which wool quality traits to include in the breeding objective, and the economic importance of each; the Fine Wool Project, historical analyses, and to a certain extent the sample survey of medium wool studs will provide information on heritabilities and correlations; and technology for estimation of breeding values will be developed from the sire reference database. Together, the information provided by this research should allow breeders to produce rams and ewes that will improve the quality of wool production in clients' flocks.

Further Information

Further information can be obtained from Dr Ian Purvis, Wool Quality Project Leader (ph. 02 6776 1373, fax 02 6776 1371).

Table 1: Bloodline mean values for hogget fleece and liveweight traits.

Bloodline	Greasy Fleece Wt.			Yield		Clean Fleece Wt.		Average Fibre Diameter			Body Wt.		
	1990	1991	1992	1990	1991	1990	1991	1990	1991	1992	1990	1991	1992
1	2.1	2.2	1.6	72.9	71.4	1.5	1.5	16.6	17.0	15.8	24.7	22.2	22.7
2	2.6	2.6	2.0	74.7	73.7	1.9	1.9	17.2	17.0	16.4	28.1	24.1	23.7
3	2.5	2.6	2.0	76.6	74.9	1.9	1.9	16.8	16.9	16.0	27.2	22.2	24.7
4	1.9	2.5	1.8	76.1	73.6	1.5	1.8	16.3	16.9	15.9	24.2	22.8	23.8
5	2.5	2.3	1.8	70.9	71.0	1.8	1.6	16.9	16.7	15.6	26.7	21.9	23.1
6	3.2	3.1	2.5	76.9	75.4	2.5	2.3	18.2	17.9	17.7	28.1	26.0	26.3
7	-	2.0	1.6	-	71.0	-	1.4	-	16.5	16.4	-	20.7	22.6
8	-	2.9	2.4	-	72.7	-	2.1	-	18.5	18.3	-	25.4	25.4
9	-	2.2	1.7	-	70.6	-	1.5	-	17.3	16.2	-	21.5	22.2
10	-	2.1	1.6	-	73.1	-	1.5	-	16.9	16.1	-	20.9	23.2
11	-	2.1	1.5	-	71.0	-	1.5	-	17.0	15.9	-	21.1	22.3
Average	2.5	2.4	1.9	74.7	72.6	1.8	1.7	17.0	17.1	16.4	26.5	22.6	23.6

Precision and Flock Testing

Dr Kerry Hansford & Mr Michael Bow
(both formerly of) CSIRO Division of Wool Technology
Sydney Laboratory, Ryde NSW 2112

An aspect of measurement which is often discussed is the level of accuracy and precision attached to flock testing. Here, these issues will be considered in terms of the measurement of mean fibre diameter (MFD).

Accuracy is the ability of a measurement system to give a true or unbiased result wherever and whenever it is done. Accuracy is a function of the instrument used and its calibration. For fibre diameter measurement accuracy is defined by the correct calibration of an instrument such as Airflow or Laserscan using the current eight Interwoollabs standard wools. The calibration process is described more fully in Reference 1.

Precision in flock testing refers to the random variation of a test result due to variation in the selection of a sampling site, the amount of material taken, and the replication (number of repeats) of the measurement. Since precision can be changed by increasing or decreasing the amount of sampling and measurement, it can be controlled by growers.

The most precise measurement of MFD is that of the whole fleece but obviously this is not practical and so a sample is used. There is a pattern of diameter variation over a fleece: the shoulder is finer than the breech. The midside site is, therefore, commonly used as it is reasonably close to the fleece mean. However, there are small differences in this fleece pattern between sheep. For example, on two sheep with a whole fleece MFD of 20.0µm, if a sample is taken from the same position on each sheep (e.g. midside) one sheep may measure 20.2µm the other 19.9µm.

Similarly, if a midside sample was taken from a sheep and diameter measurements were performed on only part (halves or quarters) of this sample, there would be small differences between the measurements.

As an example, Table 1 shows results of MFD measurements made on midside samples (approx. 100g in weight) for two sheep from three different FWP flocks run at Armidale. Each sample was split into quarters and, using Laserscan, MFD was measured on 2000 fibre snippets. The four values within each midside sample differ by between 0.3µm (Flock 2, Sheep B) and 0.8µm (Flock 3, Sheep B).

Table 1. MFD (µm) measurements on split midsides.

Flock	Sheep A		Sheep B	
1	21.6	22.2	19.5	18.9
	22.1	22.3	19.3	19.0
Mean	22.1		19.2	
2	17.8	17.6	19.7	19.7
	18.0	17.8	19.7	20.0
Mean	17.8		19.8	
3	19.2	19.0	19.5	20.0
	18.6	18.7	20.3	19.6
Mean	18.9		19.9	

Even if repeat measurements are made using the same part of a sample, i.e. two or more plugs are measured using Airflow or several sets of snippets are measured using Laserscan, random variation will result in small differences of the order of 0.1 to 0.3µm between measurements. (See Reference 2.) As shown in Table 2, by increasing the number of samples tested (i.e. test specimens), and taking the average of these, the confidence limits (the variation in a measurement) are reduced.

Table 2. Effect of increasing test specimens on confidence limits for MFD measurements.

Test Specimens	1	2	3	4	8
Confident Limits (µm)	±0.4	±0.3	±0.2*	±0.2*	±0.1

* Confidence limits are the same for 3 & 4 test specimens due to rounding of decimal places.

The overall precision with which a sample measurement reflects the whole fleece value is a function of the differences or variability described above. The choice of the precision of diameter measurement is governed by a balance between the cost of sampling and testing, and the purpose of the measurement.

In flock testing, diameter measurements may be used for breeding purposes or the evaluation of rams for sale. It is the ranking of these animals within the flock that is important, not the actual mean diameter value which may change from year to year due to seasonal conditions. Breeding goals are achieved by culling animals, usually at one end of the ranking.

In the measurement of rams for sale, the important considerations are the ranking of the ram within its own flock, as well as how rams from the stud and their progeny may perform in the purchaser's environment.

A small data set of 35 sheep drawn from a commercial superfine flock can be used to demonstrate the effects of sampling and measurement precision on ranking. Using both Airflow and Laserscan, MFD was measured on eight sites (left and right shoulder, midside and breech, withers and mid-back) over each fleece. Table 3 shows the Laserscan results for five sites on six sheep covering the range in MFD for this flock. The fleece mean is the average of the eight sites.

Table 3. MFD (µm) for five sites over six sheep from a group of 35.

Sheep	Left Shoulder	Left Midside	Left Breech	Withers	Mid-back	Fleece Mean
1	15.7	14.3	16.0	14.6	15.0	15.3
2	16.5	16.3	17.2	16.1	16.6	16.6
3	17.0	17.0	18.0	17.2	17.2	17.3
4	17.4	17.6	18.5	17.3	18.2	17.9
5	18.5	18.7	20.3	18.5	18.2	18.9
6	19.7	19.0	21.5	19.8	20.1	20.3

Using these data, the sheep were ranked on each site and the fleece mean, and a rank correlation test was applied. For both Airflow and Laserscan the test showed that, when compared with the fleece mean, no site was better or worse for ranking the animals. When all sites were compared with the fleece mean the correlation coefficients were all greater than 0.9.

Another way to examine the effect of ranking using a site sample compared with the fleece mean is to plot the value of the site sample against the value of the fleece mean. For these 35 sheep, the left midside (Figure 1a) and the right breech (Figure 1b) are plotted against the fleece mean. The lines on these graphs represent a decision to cull the coarsest 25% (or 9 sheep) from the group based on the site measurement (horizontal line) or the fleece mean (vertical line).

In Figure 1a, the animals which would be culled as a result of the left midside measurement are the same as those which would be culled based on the fleece mean. In Figure 1b, there is a small difference between the animals culled by the right breech measurement and the fleece mean. The letters (a-i) on the data points in Figures 1a and 1b represent the same sheep ranked using the left midside/fleece mean values compared with the right breech values. The relative position of the sheep in each ranking is very similar. That is, two sheep out of nine are not the same if the ranking is based on the right breech values compared with the fleece mean values.

Figure 1a & 1b. The ranking of 35 sheep for MFD comparing the fleece mean value with that measured on sites 1a. left midside & 1b. right breech.

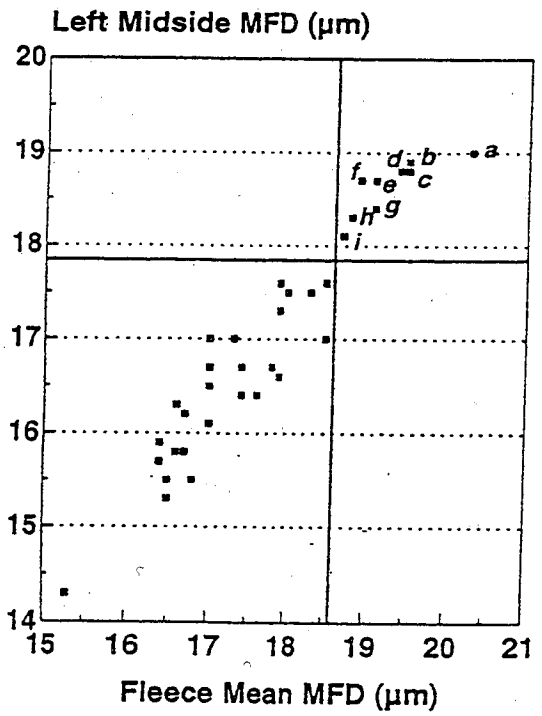

Figure 1a.

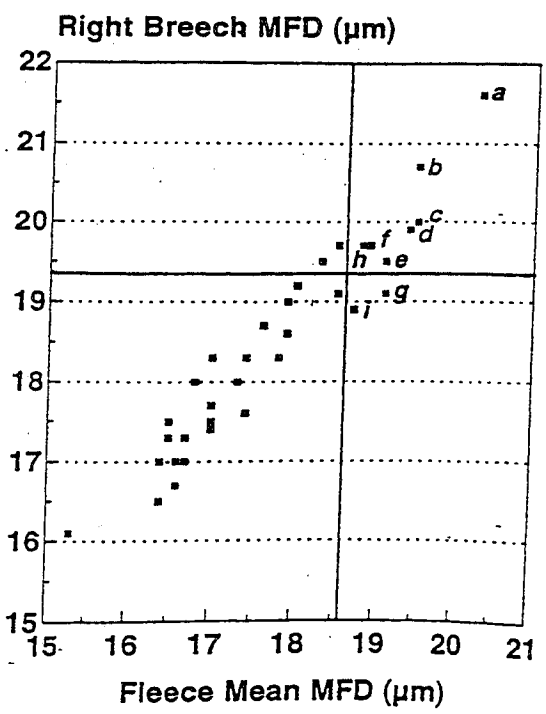

Figure 1b.

Further discussion of the ranking of sheep for diameter and diameter distribution can be found in Reference No 3.

In summary, each site ranks sheep in a similar order compared with the whole fleece value. The precision in a flock testing measurement program may be improved by:

* careful identification of the sampling site,
* taking a reasonable amount of sample (i.e. 50-100g, not 1-2 staples), and
* making more than one measurement.

It is intended that further estimates of these sampling and precision effects will be undertaken as part of the FWP.

Further Reading:

(1) K.A. Hansford (1993) Objective specification and fine wool production, Australian Superfine Wool Growers' Association Newsletter, August 1993.

(2) K.A. Hansford (1993) Wool metrology, CSIRO Fine Wool Project Newsletter No. 4, January 1993.

(3) K.A. Hansford (1992) Fibre diameter distribution: implications for wool production, Wool Technology and Sheep Breeding, Vol. 40, No. 3, March/April 1992.