

CSIRO



Fine wool Newsletter



Issue 5

May 1993

A Description of CSIRO's Fine Wool Project¹

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WOOLMARK

1. Project Details

Name of Flock: CSIRO Fine Wool Flock.
 Organisation: CSIRO Division of Animal Production (DAP), Armidale, NSW.
 Principal Investigators: Dr Laurie Piper (DAP)
 Dr John Lax (DAP)
 Collaborating Organisation: CSIRO Division of Wool Technology (DWT), Ryde, NSW.
 Collaborators: Mr Rob Rottenbury (DWT)
 Dr Kerry Hansford (DYM)
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 Location of Flock: "Longford" Field Station, 40 km North West of Armidale, NSW.

WRDC Details:

Phase 1 of the project has been funded by the WRDC from 1990/91 to 1992/93. Phase II has been granted funding from 1993/94 to 1995/96.

PHASE 1

Project Number: CPB88
 Project Title: Breeding, fleece and wool metrology, processing performance and fabric quality studies in fine apparel wool Merino genotypes.

Funding History:

	1990/91	1991/92	1992/93
Salary	\$101,248	\$111,616	\$115,107
Operating	\$35,000	\$37,500	\$65,500
Capital	\$89,500	\$72,000	\$72,000
Total	\$225,7481	\$221,1161	\$252,6071

Contributions made by the host organisation were approximately \$300,000 p.a.

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¹This is an edited version of a paper prepared for the "Workshop on Merino Research Resource Flocks", Gawler, South Australia, 27-28 May 1993.

Objectives:

1. To establish 10 Merino breeding flocks representative of current industry genotypes within the 17-22 micron range of average fibre diameter.
2. To collaborate with CSIRO Division of Wool Technology in their research programs aimed at developing methodology for objective specification of fibre diameter (mean diameter), staple length, staple strength, colour, resistance to compression (bulk), and style.

3. Begin measurements required to estimate genetic and phenotypic parameters as well as economic values for production and wool quality traits in fine wool genotypes.
4. To initiate collaborative research with CSIRO Division of Wool Technology on the processing performance of fine wools and on the quality of the resulting fabrics.

PHASE II

Project Number: CPB287

Project Title: Breeding, fleece and wool metrology, processing performance and fabric quality studies in fine apparel wool Merino genotypes. Phase II.

Funds Requested:

	1993/94	1994/95	1995/96
Salary	\$103,413	\$103,413	\$103,413
Operating	\$112,088	\$122,762	\$126,942
Capital	\$35,400	\$39,400	\$35,400
Total	\$250,9011	\$265,5751	\$265,755

Projected contributions from the host organisation are \$200,000 p.a.

Objectives:

1. To complete the measurement schedule on objectively and subjectively specified fleece structure and wool quality traits in hoggets, and to begin the measurement schedule in all age classes of adult ewes. This will provide precise estimates of genetic parameters in fine wool bloodlines for hogget traits, and preliminary estimates of genetic parameters in adult age classes.
2. To apply CSIRO Division of Wool Technology's new developments in wool metrology to sheep breeding research as they become available. Objective measurement of style and handle are of major interest in this respect.
3. To investigate interactions among fleece structure/wool quality traits, processing performance, and product quality in order to design superior breeding programs for improving wool and product quality in fine wool genotypes.

In addition, the Fine Wool Project will be included in the genetic technologies program of the Premium Wool Quality Co-operative Research Centre (CRC), as discussed later in this paper.

2. Flock Details

Contributing Bloodlines:

The breeding flock established at CSIRO DAP's Longford Field Station comprises 9 fine wool bloodlines and 2 medium wool bloodlines (Table 1). The medium wools were included as a link to previous (and current) research which has concentrated on those genotypes. Selection of bloodlines was based on factors such as industry influence, geographical location, and willingness to participate.

Table 1: Bloodlines within the Fine Wool Project flock.

<i>Bloodline</i>	<i>Description</i>
Europambela	New England Finewool
Mirani	New England Finewool
Emu Creek	New England Finewool
Grathlyn	NSW Central Tablelands Finewool
Ledgerton	NSW Southern Tablelands Finewool
Hillcreston	NSW Southern Tablelands Finewool
Merryville	NSW Southern Tablelands Finewool
Wurrook	Victorian Finewool
Mount Morriston	Tasmanian Finewool
Hazeldean	NSW Medium Peppin
Woodside	NSW Medium non-Peppin

Flock Establishment and Ewe Replacement:

Selection of the foundation animals was left to the contributors, with the proviso that the animal should be a representative sample of the bloodline. Rams were from the stud level and were similar to those generally available to the commercial industry, while ewes were "flock" standard. Some contributors drafted off a random line of flock ewes, while in other cases, CSIRO bid at auctions to purchase mainly aged ewes. In some cases, the contributors could not spare the numbers of sheep required. When this occurred, they nominated client studs or flocks which they felt were representative of the bloodline. The studs or flocks which have contributed to the Fine Wool Project are shown in Table 2.

Table 2: Ram and ewe sources of each bloodline in the Fine Wool Project flock.

Bloodline	Ram source	Ewe Source
Europambela	Europambela	Europambela
Mirani	Mirani	Mirani
Emu Creek	Emu Creek	Emu Creek
Grathlyn	Grathlyn	Grathlyn
Ledgerton	Ledgerton	Ledgerton
Hillcreston	Moorooloolen	Kelvin Grove
Merryville	Grathlyn (1990), Emu Hill (1991), Merryville (1992 on)	Lyndhurst
Wurrook	Wurrook	Wurrook
Mount Morriston	Mount Morriston	Mount Morriston
Hazeldean	Hazeldean	Coolringden (1990), Hazeldean (1991)
Woodside	Woodside	Woodside

From this point on, the bloodlines will be referred to by number (1 to 11, as in Tables 3 and 4). **It should be noted that these numbers do not correspond to the listed order of bloodlines in Tables 1 and 2. This is done to maintain the confidentiality of the contributors when reporting results.**

The breeding flock was established in early 1990 with the purchase of 100 ewes each from bloodlines 1 to 6. Within each bloodline the ewes were mated to 4 sires, and lambed in November 1990 (Table 3). In 1991, there were further purchases of sheep, with 60 per bloodline in the original 6 bloodlines, 160 from bloodlines 7,8,9, and 11, and 72 from bloodline 10. Each group of ewes was mated to 6 sires from their respective bloodlines, excepting bloodline 10, where only 2 sires were used.

Ewes born at Longford were mated for the first time in 1992. These were the 1990 drop females, approximate numbers of which are shown in Table 4. A further 100 ewes from bloodline 10 were also purchased and mated in that year. With the entry of the 1991-drop ewes into the breeding flock in 1993, most bloodlines will be at full strength in 1993 ie., 200 ewes mated. From this mating onwards, 7 sires per bloodline will be used.

Currently the flock is in an establishment phase, and all available ewe hoggets enter the breeding flock. However, once the flock is fully established, it will comprise approximately 5 age classes, with the oldest class being culled each year. Consequently, between one half to two thirds of the ewe hoggets available will enter the breeding flock each year. Each year prior to mating, the contributors are invited to visually class the ewe hoggets. Their comments on each sheep are recorded using NSW Agriculture's "RECALL" computer software package (Casey et al., 1992). Consequently, selections are based on the recommendations of the contributors.

Table 3: Numbers of rams and ewes mated per bloodline in 1990, 1991 and 1992.

Bloodline	1990		1991		1992	
	Rams	Ewes	Rams	Ewes	Rams	Ewes
1	4	100	6	155	6	163
2	4	97	6	155	6	183
3	4	100	6	155	6	174
4	4	100	6	155	6	187
5	4	99	6	158	6	176
6	4	100	5	159	6	201
7	-	-	6	159	6	155
8	-	-	6	159	6	151
9	-	-	5	146	6	145
10	-	-	2	72	6	162
11	-	-	6	158	6	155
Total	24	596	60	1631	66	1852

Table 4: Numbers of ewes and wethers sampled as hoggets from 1990- and 1991-drops, and numbers of ewes and wethers weaned from the 1992-drop.

Bloodline	1990		1991		1992	
	Ewes	Wethers	Ewes	Wethers	Ewes	Wethers
1	28	29	51	32	43	55
2	32	35	58	61	73	59
3	23	19	45	50	69	88
4	35	27	69	64	84	60
5	23	23	52	64	59	58
6	46	23	38	43	57	66
7	-	-	40	40	52	49
8	-	-	58	43	55	63
9	-	-	49	39	60	55
10	-	-	20	25	57	51
11	-	-	66	64	75	65
Total	187	156	546	525	684	669

Ram Replacement:

In order to maintain the flocks as close as possible to industry standards, it was initially planned to replace all rams each year with new batches purchased from the sources shown in Table 2. Unfortunately, this strategy is not optimal for genetic analyses. Hence, some sires are used across years to provide links. The linking strategy adopted is a balance between practical and statistical considerations. Linkages with the 1990 and 1991 drop were created by using rams from those years in the 1992 mating. Then, one link sire per bloodline was chosen from the sires used in 1992. Semen from these sires was collected and stored. These sires will be used in natural matings until they are unsound for breeding, following which, new link sires will be chosen, to be used until they are unsound for breeding, and so on. In the final mating, the "current" link sires will be used along with the semen stored from the original link sires. Depending on the life of the project, these may be the same sires, so that use of semen would not be necessary.

Starting from the 1993 mating, 7 sires will be mated to 200 ewes in each bloodline. Six of these sires will be new rams purchased from the contributors, while the 7th will be the link sire chosen from the 1992 team of rams.

The ram suppliers have been asked to supply performance details on the rams, and in most cases the information has been available. The type of information ranges from raw data to WOOLPLAN EBVs for traits such as greasy and clean fleece weight, mean fibre diameter, and hogget body weight. As yet little thought has been given as to how this information can be used, but one possibility is to use it to assign rams to genetic groups.

3. Management Details

The breeding ewes are run in four management flocks, with all bloodlines and age classes equally represented in each flock. Ewes are re-assigned at random to these flocks each year following shearing. Lambs are randomly assigned to three management flocks at weaning (again with all bloodlines equally represented). They are run in these flocks until their first shearing. At this time, a proportion of the wethers (80%)

is sent to NSW Agriculture's Condobolin field station (this will be described in more detail in section 5). The ewes and the remaining wethers are then run in one management flock. Maiden ewes enter the breeding flock as 2-tooths (approximately 18 months old), having been randomly allocated to the four management flocks. The calendar of events will now be described in detail.

Mating:

Mating begins in May, and proceeds for 5 weeks. Within each bloodline, ewes are randomly allocated to rams, and are then mated in single sire groups. It should be noted that ewes are not mated within their management flocks. Consequently, each sire is represented in all management flocks. On completion of mating, ewes are re-drafted into these flocks.

Sampling and Shearing:

Shearing takes place in August for the breeding ewes, and in September for the hogget ewes and wethers. At the pre-shearing sampling, a variety of traits relating to style are subjectively scored. These include greasy colour, crimp definition, dust penetration, staple size, and handle. Skin sections and midside and backline samples are taken at this time and used for a variety of measurements described in section 4.

At shearing time, greasy fleece weights (unskirted and skirted) are recorded, and each fleece is assigned an AWC wool type. The sheep are drafted into their bloodlines before shearing, and the wool from each bloodline is kept separate for use by CSIRO Division of Wool Technology in other WRDC funded research programs.

Following shearing, the sheep are weighed and wrinkle scored. Also, ewes are re-randomised to management flocks as described above. It should be noted that none of the above measurements are recorded for the foundation ewes.

Lambing:

Lambing begins in mid-October and proceeds for 5 weeks. The ewes lamb in small plots of 1ha. or less, with approximately 25 to a plot. The ewes in a particular plot are of the same

management flock and bloodline, but have not all been mated to the same sire. This prevents statistical confounding between sires and lambing plots, but may lead to increased errors in determining sire pedigrees.

Each morning, the newborn lambs are tagged and a variety of information is recorded, including: dam identity (from sidebrands which can be matched to eartag numbers and to the sire identity), lambing plot, bloodline, sex, birth type, birth coat score, and birth weight. Ewes and lambs are "drifted off" and returned to larger paddocks when the lambs are several days old.

Marking takes place in December at approximately 2 months of age. Males are castrated, and all sheep are mulesed at this time.

Weaning:

Lambs are weaned at approximately 3 months of age in mid-to late-January. The only measurement taken at this time is weaning weight. Following weaning, the lambs are randomly allocated to 3 management flocks balanced for bloodlines, sires, and age of dam.

General:

Flock management generally reflects commercial practices, given the restraints imposed by the experimental regime. The sheep graze on improved pasture, with no supplementary feeding (except in 1991 where the weaners were fed a protein supplement during a nutrition trial). Sheep are drenched according to WORMKILL (the drenching program recommended for the Northern Tablelands of NSW) and are

vaccinated with "5 in 1" annually. They are also given annual supplements of selenium which is deficient on Longford. Following shearing, all sheep are dipped, and jetting is carried out when flystrike is prevalent.

4. Characters Recorded

Characters recorded by research staff are shown in Table 5. Note that all wool and skin characters are measured (or samples are taken) either at the pre-shearing sampling, or at shearing. All measurements are made by CSIRO DAP, except for yield, average fibre diameter (airflow), staple length, staple strength, resistance to compression, colour (AWTA), and the components of style (CSIRO DWT). The latter is measured using new technology under development at DWT, and includes information on crimp definition, crimps per cm, colour, brightness, tip shape, and dust penetration.

The sheep are first shorn at approximately 10 months of age, and annually thereafter. For the 2-6yr measurements of wethers, 80% are sampled at Condobolin, while 20% are sampled at Longford, as described in section 5. All measurements on ewes are made at Longford.

Table 6 shows the wool and body characters scored by the contributors at the annual hogget ewe classing. These characters are recorded using NSW Agriculture's RECALL software package. The scoring system employed for all characters is 0=inferior, 1=good, 2=very good, and blank=average. The sheep are given an overall score: 0=cull, 1=average (flock), or 2=above average (stud). Provision is also made for comments on individual sheep.

Table 5: Characters recorded in the Fine Wool Project flock.

	Wethers				Ewes			
	Birth	Weaning	10mo	2-6yr	Birth	Weaning	10mo	2-6 yr
Objectively measured wool characters								
Greasy fleece weight (kg)			✓	✓			✓	✓
Yield (%)			✓	✓			✓	✓
Clean fleece weight (kg)			✓	✓			✓	✓
Mean fibre diameter µm			✓	✓			✓	✓
Standard deviation of fibre diameter			✓	✓			✓	✓
CV of fibre diameter (%)			✓	✓			✓	✓
Fibre diameter histogram			✓	✓			✓	✓
Staple length (cm)			✓	✓			✓	✓
Staple strength (Nkt)			✓	✓			✓	✓
Resistance to compression (kPa)			✓	✓			✓	✓
Colour			✓	✓			✓	✓
Components of style (midside and back)			✓	✓			✓	✓
Subjectively assessed wool characters								
Birth coat	✓				✓			
Handle			✓	✓			✓	✓
Dust penetration			✓	✓			✓	✓
Crimp definition			✓	✓			✓	✓
Staple size			✓	✓			✓	✓
Greasy colour			✓	✓			✓	✓
AWC wool type			✓	✓			✓	✓
Flystrike			✓	✓			✓	✓
Fleece rot			✓	✓			✓	✓
Bacterial stain			✓	✓			✓	✓
Mycotic dermatitis			✓	✓			✓	✓
Site of flystrike			✓	✓			✓	✓
Skin and wool follicle characters								
No. primary follicles			✓	✓			✓	✓
No. primary fibres			✓	✓			✓	✓

Mean diameter of primaries			✓	✓			✓	✓
Standard deviation of primaries			✓	✓			✓	✓
% primaries > 30 µm			✓	✓			✓	✓
No. secondary follicles			✓	✓			✓	✓
No. secondary fibres			✓	✓			✓	✓
Mean diameter of secondaries			✓	✓			✓	✓
Standard deviation of secondaries			✓	✓			✓	✓
% secondaries > 30 µm			✓	✓			✓	✓
S/P ratio			✓	✓			✓	✓
Dp/Ds ratio			✓	✓			✓	✓
Body characters								
Body weight (kg)	✓	✓	✓	✓	✓	✓	✓	✓
Neck wrinkle score			✓	✓			✓	✓
Body wrinkle score			✓	✓			✓	✓
Ewe reproduction characters								
Number of lambs born								✓
Number of lambs weaned								✓

Table 6: Wool and body characters subjectively scored by contributors or their nominated sheep classers using RECALL.

Body characters	Wool characters
Size	Face cover
Body length	Points
Markings	Belly
Jaw	Count
Head/horns	Style
Face	Evenness
Shoulder	Handle
Back	Lock
Hocks	Tip
Feet	Hairy breech
Body wrinkle	Skin
Neck wrinkle	

5. Other Conunents

Footrot: In January 1993, footrot was discovered in the Fine Wool Project flock. Longford had previously been free of footrot since it was purchased by CSIRO in 1965. The sheep affected include the mature ewes, and the 1992-drop weaners. To date, the 1991-drop hoggets and the rams appear to be unaffected. All sheep have been scored using a system developed by NSW Agriculture (Walker, 1988). Approximately 36% showed clinical signs of footrot, with a relatively low average score of 3.8 in affected animals (the range in the scoring system is 0 to 20). The bacteria causing footrot (*Bacteroides nodosus*) has been cultured and includes at least two serotypes with intermediate virulence (B and E). Preliminary analyses show all bloodlines to be affected, precluding any judgement about the source of the infection. An eradication program has been implemented, involving foot paring, foot bathing, and the use of antibiotics. Animals not responding to treatment have been slaughtered. This outbreak has serious implications for existing and potential linkages with other research flocks, as the flock is under quarantine until the disease is eradicated.

Linkages with other flocks: Two offshoots of the Fine Wool Project flock have been established in traditional medium wool growing environments in order to evaluate the performance

of fine wool sheep in these environments. From 1992, the surplus wethers from Longford are to be sent to NSW Agriculture's Condobolin Research Station. The 1991-drop wethers were sent to Condobolin following hogget shearing in September 1992. However, until the footrot quarantine has been lifted from Longford, there will be no further shipments of wethers to Condobolin.

The second offshoot involves the establishment of breeding flocks in Western Australia. These flocks include two bloodlines: Mirani and Hazeldean. One hundred and sixty ewes of each bloodline were purchased from the contributors in 1992, and transported to WA. They are run at two locations: the Western Australian Department of Agriculture's Great Southern Research Institute at Katanning, and CSIRO's Yalanbee Field Station at Baker's Hill. Six rams per bloodline are joined each year, with exLongford rams used to create genetic links between the Longford and WA flocks. However, due to the footrot outbreak on Longford, no rams will be sent to WA in 1993. For mating in 1993, rams will be purchased from the contributors, with one link ram from the 1992 mating per bloodline per location.

In addition, a ram from the Fine Wool Project has been entered in the 1993 rounds of the New England Sire Evaluation Scheme and the Hamilton Fine Wool Merino Ram Progeny Test. This will create genetic links between the respective flocks which will be useful in several respects: firstly, it will allow closer monitoring of the Fine Wool Project flock against industry standards, and secondly, it will allow incorporation of Fine Wool Project data in the central database for Merino sire evaluation schemes (Swan et al, 1992). Because artificial insemination is used in both these schemes, the footrot outbreak on Longford does not prevent entry of a Fine Wool Project ram.

Impact of the Premium Wool Quality CRC on the Fine Wool Project:

Program 1 of the CRC is focussed on genetic technologies to improve wool and fabric quality. Its objective is to develop genetic technologies for manipulation of important determinants of textile fibre quality, especially fibre diameter, while at the same time, maintaining or enhancing other economically important aspects of productivity. There will be

two Projects, one based on quantitative genetics (Project 1) and the other on genetic engineering (Project 2).

The Fine Wool Project will be included in Project 1 and CRC funds will be used to support and expand the activities at all sites (Armidale, Ryde, Geelong, Condobolin, Bakers Hill, and Katanning). Options under consideration include the establishment of breeding ewe flocks at Condobolin to expand the scope of the G by E studies and expansion of the wool processing and fabric quality studies at CSIRO DWT.

Other WRDC funded research involving the Fine Wool Project: There are several WRDC research projects which benefit from the resources established in the Fine Wool Project. These include:

1. CSIRO Division of Wool Technology research projects. DWT's metrology and processing performance research programs aim to effect changes in clip preparation, marketing, and early stage processing. To date, this research has concentrated on medium wool types which constitute the bulk of the clip, while research at the fine wool end has had lower priority. DWT has taken the opportunity to use wool from the Fine Wool Project flock in established research projects investigating metrology and processing aspects of fine and superfine wools. These projects are funded by WRDC's Postfarm Committee, and include the "Woolgrower Ramifications Project" (CWR37), the "Style Project" (CWR3), the "Processing Prediction Project" (CWR6), and the "Contamination Project" (CWR5).

Collaboration has been beneficial for both CSIRO Divisions: the Division of Wool Technology benefits from access to wool from a wide cross-section of fine and superfine genotypes which are run in a single environment, and have a variety of breeding and production data available. The Division of Animal Production benefits from improved wool metrology procedures for use in its research and from information

on the processing performance and resulting fabric quality of wool from the Fine Wool Project flock. The collaborative approach established will lead to improved integration of the breeding, production, marketing, and processing sectors for fine apparel wool.

2. The Fine Wool Project flock has been used in a WRDC funded project examining between-flock genetic variation in resistance to internal parasites (CPB132). The 1991 drop was artificially challenged with *Haemonchus contortus* following weaning in February 1992, and the 1992 drop were similarly infected with *Trichostrongylus colubriformis* in 1993.
3. The 1991-drop weaners were also used in a nutrition trial by a WRDC funded postgraduate student from the University of New England. The three management flocks were fed different levels of protein supplement in a trial designed to examine genotype by nutrition interactions for a variety of wool production and quality traits. Further collaboration with this student is planned.
4. A collaborative project with NSW Agriculture using the wether progeny to examine genetic variation in pasture intake and digestibility (DAN174) has been funded by the WRDC for three years from 1993/94.

6. References

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