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Newsletter of the European Fine Fibre Network
Aiming for Increased competitiveness of high quality European animal fibres by improving fibre quality

Editorial

The end of the three years that we have had to carry out the work of the EFFN is upon us, and it is time to look back to consider some of our achievements in that time. In 1995 at the end of the first Concerted Action on speciality fibres, a great deal had been done to establish links between research teams in the different European countries, and to develop some ideas of the strategic requirements for establishment of viable systems for speciality fibre production. The new EFFN was a response to the problem of incomparability between national research results, and was an opportunity to expand the international links to the breeding associations and textile industry. At the time, a new wool measurement technique, the Optical Fibre Diameter Analyser (OFDA) from Australia, was showing great promise as a way considerably to reduce the unit cost of objective fibre analysis, which hitherto had been a significant obstacle to progress with fibre improvement programmes.

Since that time, three fibre analysis laboratories with OFDA machines have been established as a direct result of EFFN activities, in Hohenheim, Germany, Castelo Branco, Portugal and Aberdeen, UK. The number of samples analysed has also increased to approximately 7000 samples a year from a base of about 2000 in 1997. The results from the OFDA have proved to be reliable and accurate, and the cost has fallen from 20 Euro per sample, using the OP method to 7 Euro per sample. This, coupled with carefully designed standards for data storage, will provide significant added value to genetic improvement programmes.

Such progress is inevitably closely linked with the economic environment for fibre producers. The international markets are still failing to deliver stable prices at a viable level. However, there can be no future unless we in Europe have some of the best genetic stock, and it one of the tools to acheive this that the EFFN has brought to reality these past 3 years.

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Summary guidelines for the recording of genetic parameters in speciality fibre animals

Jerry Laker

Introduction

The European Fine Fibre Network has now established a well-integrated set of interlinked systems for parameter recording in breeding programmes for speciality fibre animals in Europe. It is to be hoped that the agreements reached through the workshops and exchange programme will provide the basis on which future breed improvement programmes will be based.

In 1997, we set out with three clear objectives, to build on the advances in international collaboration that we had made during the course of the previous three-year Concerted Action EFFN project:

1/ enhance the dissemination of state-of-the-art fibre measurement technology and ensure comparability between fibre analyses in different countries, which is a key element in the future development of the European speciality fibre industry.

2/ increase European collaboration in fibre quality improvement through the establishment of common protocols for measuring fibre traits in breeding programmes for different fibre types.

3/ improve the competitiveness of European producers of speciality animal fibres by establishing clearly defined, market-led quality objectives, grading and presentation standards and the creation of new information channels between producers, industry and research.

In pursuit of the first of these objectives we have seen the number of OFDA machines dedicated extensively in the support of breeding programmes (as opposed to those used primarily in support of the textile manufacturing industry) in Europe increase from 0 in 1997 to 3 in 1999. The number of samples of fibre used for objective quality analysis has increased from an estimated 2000 (for all quality fibres in Europe) to 7000 in 1999. This has been a very positive start in co-ordinating national breeding efforts, and improving the efficiency and effectiveness of genetic improvement programmes.

The OFDA package, showing PC, OFDA 100, monitor, slide spreader and snippet cutter. *(Courtesy, BSC Electronics Pty Ltd)*

The second of these objectives has been to establish a clear set of guidelines for the measurement of key traits, and a standardised system for genetic parameter recording. It has become clear that for each of the national breeding programmes there are “core” parameters, for example fibre diameter, which are common to all programmes, but there are other, perhaps more peripheral traits, such as lustre in mohair, which have been recorded in some countries, but not in others. Such discrepancies can easily be accommodated, provided that those parameters that are recorded are assessed to common protocols.

The most common divergence of this kind has been for subjective traits, assessed on a point scale, such as fleece type classifications of angora rabbits, where different class widths have been used, or definitions of classes have differed (see EFFN Workshop Report 1, p19). Where discrepancies of this kind have occurred, breed associations have been encouraged to find ways in which the data may be harmonised in the future.

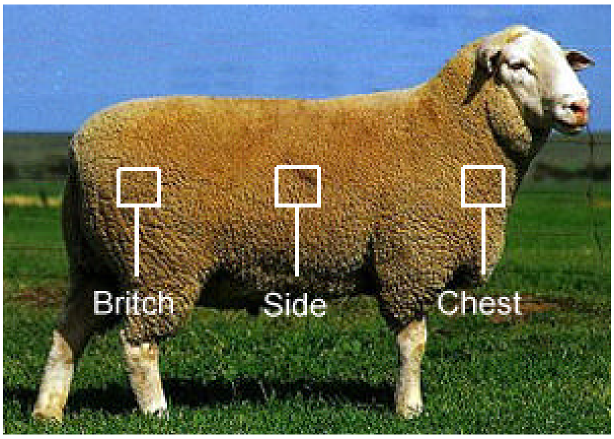
To assist in data transfer, standardised database field formats have been drawn up. MS Access files are available from the EFFN website with the agreed basic structures for each of the species and breeds involved. This article provides a brief summary of the database structures. These formats are now widely adopted, and it is strongly encouraged that new breed programmes, or those newly entering into objective fibre assessment, conform from the outset to these structures.

Collectively, enhanced progress in breed improvement by the co-ordination of national breed improvement programmes will help European producers to maintain in Europe a gene pool of quality livestock. This will be of benefit to all producers, who will benefit from a general reputation of quality. It will also enable European producers to respond quickly to future market opportunities, to develop new efficient marketing strategies, and to develop a competitive advantage over imported fibres.

Summary of agreed guidelines

Protocols for sample collection

Taking a patch sample



The sample should be cut at the base of the staple, as close to the skin as possible. It should be no smaller than a 5cm x 5cm square in size. The sample should be kept in the staple configuration, which is its natural growth state. It should not be brushed out, cleaned up, or folded. Flat bladed shears or clippers are recommended as the safest tools to use in the taking of samples.

Fine wool

1. *Fineness*
The OFDA method, with assessment of mean and SD was recommended.

- sample size:
  3 cm^2 on 3 sites (shoulder, mid-side, britch)
  or 4.5 cm^2 on 1 site (mid-side)
- time of sampling: for a first selection, samples should be taken at 150 days (male) for a second selection, samples should be taken at 16 months (male and female).

2. *Staple length*
- measured with a caliper (ruler) on the live animal
- samples taken on 3 sites (shoulder, midside and britch)

3. *Medullation*
The OFDA new methodology is used to measure the medullation of fibres.

4. *Pigmentation*
The use of visual assessment was proposed, as well as using the light reflection method.

Mohair

Fleece sampling to be carried out at 18 months of age on three locations:
- shoulder,
- britch and
- mid-side.

Shorn fleece weight to be recorded

Fibre testing: measurement by OFDA of:
- mean fibre diameter,
- fibre distribution and
- medullation.

General breeding objectives:
1. to increase the fleece weight
2. to decrease the fibre diameter and the variability of the fibre diameter all along the body.
3. to have no medullation in fibre
4. to test the fibre at 18 months
5. to assess the fleece with 1 or 3

samples (the French use only one midside sample, compared to the British who take 3 samples).
6. to record some general husbandry aspects such as the pedigree, the reproduction value and the bodyweight (conformation).
7. to have a database, in order to allow some genetic evaluation.

Angora rabbit

Fleece harvests

The desired characteristics of angora fleeces vary between the countries, and this affects the parameter recording. French angora has a "fluffy" quality, and is harvested using a natural depilatory treatment. Scandinavian angora is stronger and durable while maintaining high insulation properties. Rabbits are harvested by shearing.

The sampling method proposed to EFFNwas the following:

- taken at the first harvest, after one year
- sample taken at mid-patch
- sample cut with a razor
- area of 1 cm^2

Within the French breed, the harvested fibre is sorted and distinguished as 5 classes, according to quality:

- Class 1: clean, unfelted, long and bristly fibre, from the back, the sides and the rump of the rabbit.
- Class 2: clean, unfelted, long and woolly fibre, from the breast and the belly of the animal.
- Class 3: clean, unfelted, short (<6 cm) fibre, from the legs of the rabbit.
- Class 4: clean and felted fibre, from the neck and the tail of the animal.
- Class 5: dirty fibre, from the underbelly of the rabbit.

The Finnish Grading system is similar, but had a 7-point scale:

- Class 1: adult animal, clean, not felted, length of downs > 6 cm, from the back and sides of the animal
- Class 2: adult animal, clean, not felted, from the belly and the chest of the animal
- Class 3 adult animal, clean, not felted, length <3 cm,
- Class 4: baby, from the first harvest, not felted, clean
- Class 5: teen, from the second harvest, not felted, clean
- Class 6: felted, clean, adult or young animal
- Class 7: dirty

Figure 1 Shearing a Finnish angora rabbit

Fleece characteristics measurements

The fleece measurements made on the farm are the total fleece weight of each different grades and the length of each fibre type (bristle, downs).

Objective measurements by the OFDA method are used to measure diameter of each fibre type (bristle, awns, downs). Content of each fibre type (bristle rate) is assessed using the INRA Cross Section method, as OFDA cannot distinguish the 5 fibre types in an angora fleece.

Cashmere

The most important cashmere traits, from an industry viewpoint are colour and diameter followed by length. The traits agreed at the Castres meeting are:

1-1- Quality fibre traits:
The following parameters were chosen for recording:
- Mean Fibre Diameter
  - * fibres between 5 and 25 mm are *cashmere*
  - * fibres between 25 mm and 40 mm are to be called *intermediate fibres*
  - * fibres above 40 mm will be considered as *guard hair*
- Standard Deviation (especially the percentage of fibres above 25 mm compared to the total number of fibres)

1-2- Quantity fibre traits:
The parameters to be recorded are:
- At 5 months of age, from a 10 cm^2 patch sample from mid-size on the fleece :
  - * date of sampling
  - * weight of cashmere (each country will have to come out with factors for the Estimated Annual Production, EAP)
  - * yield of cashmere (cashmere/total fibres)
  - * liveweight of the animal
- At combing or shearing:
  - * location of the animal at recording
  - * total fleece weight (fine fibres and hair):
    - ◊ yield grade (score)
    - ◊ liveweight of the animal
    - ◊ date of measurement
    - ◊ type of collection (combing or shearing)
    - ◊ number of combing
  - * for the subsample:
    - ◊ yield
    - ◊ mean fibre diameter
    - ◊ standard deviation

1-3- Other traits:
The following information will be contained:
- Information on length
  - * drawn length (minimum, maximum and median).
  - * staple length of the fine fibre and the guard hair, taken from kid at 5 months of age and from older animals (40-45 mm is the desirable range).
- Information on lustre (brightness of fibre)
  - * lustre score which should be low
  - * measured on the whole fleece at combing
- Information concerning additional traits:
  - * crimp (measured with OFDA technique). The mean curvature should be measured from the patch and the subsample
  - * medulation (measurement of the percentage of medulated fibres with OFDA technique)
  - * colour of the fibre in the patch and of the guard hair on the animal. A classification system is to be worked out

(For further details, see EFFN Castres workshop report, p26)

Each group should undertake the first sampling of kids at a time to suit their geographical location and individual system of management but would make the necessary measurements to derive the relationship between the kid sample and the first annual harvest for their particular system.

Standard parameters
Ensuring compatibility between genetic performance recording systems has involved the precise definition of many parameters, the units in which they are expressed, and the database format in which they are stored.

The following tables summarise the conclusions from discussions between the national breed recording programmes at the second EFFN workshop in Castres. The parameters, units and level of precision represent the concensus of discussions between the relevant national breed associations. The list is "inclusive", and not all parameters will be thought essential for all breed improvement programmes. However, harmonisation of measurement protocols, and grading scales, together with the recording of as many of these parameters as is feasible will add greatly to the versatility of the databases as a research resource, and enable a wide a range as possible of breeding objectives to be evaluated.

Fine wool- Tables for ID, and wool production

ANIMAL ID

recording time	parameter	unit	size	format	symbol	limits
at birth	animal_ID	integer	C(2)+ N(14)	XX 00000000 00 0000	animal_ID **	N/A
at birth	breed	text	C(4)	XXXX	breed	N/A
at birth	sex	male, female,castrated	C(1)	M/F/C	sex	N/A
at birth	birth date	dd/mm/yr	2/2/2	00/00/00	birth_date	N/A
at birth	littersize	integer	N(1)	0	littsize_birth	1-5
at birth	sire_ID	integer	C(2)+ N(14)	XX 00000000 00 0000	sire_ID**	N/A
at birth	dam_ID	integer	C(2)+ N(14)	XX 00000000 00 0000	dam_ID**	N/A

new EU regulation ** countrycode(2)***/birth farm no(8)/year(2)/ intra-farm birth no(4)

***country code	
Portugal	PO
France	FR
Germany	DE
United Kingdom	UK
Finland	FI
Italy	IT
Denmark	DK

PRODUCTION

recording time	parameter	unit	size	format	symbol	limits
at sampling (juvenile)	animal_ID	integer	C(2)+ N(14)	XX 00000000 00 0000	animal_ID **	N/A
at sampling (juvenile)	production farm	integer	C(2) + N(8)	XX 00000000	prod_farm	N/A
at sampling (juvenile)	birth weight	kg	N(2,1)	00.0	birth_wt	1-5
at sampling (juvenile)	sampling date	dd/mm/yr	2/2/2	00/00/00	smp_date	N/A
at sampling (juvenile)	liveweight	kg	N(2,1)	00.0	live_wt	10-80
at sampling (juvenile)	age of the juvenile	months	N(2)	00	age_young	0-?
at sampling (juvenile)	mean fibre diameter	microns	N(2,1)	00.0	MFD	10-35
at sampling (juvenile)	coefficient of variation	%	N(3,1)	000.0	CV	0-100
at sampling (juvenile)	greasy fleece weight	kg	N(2,2)	00.00	greasflee_wt	0-20
at sampling (juvenile)	clean fleece weight	kg	N(2,2)	00.00	cleanflee_wt	0-10
at sampling (juvenile)	yield (clean fleece content)	%	N(2,1)	00.0	yield	0-99.9
at sampling (juvenile)	fibre length					
at sampling (juvenile)	maxi	mm	N(3,1)	000.0	maxi_lgth	0-200
at sampling (juvenile)	mini	mm	N(2,1)	00.0	mini_lgth	0-200
at sampling (juvenile)	median	mm	N(3,1)	000.0	med_lgth	0-200
at sampling (juvenile)	crimp	degrees/mm	N(3,1)	000.0	crimp	0-150
at sampling (juvenile)	medulation	%	N(3,1)	000.0	med_percent	0-10
at sampling (juvenile)	medullated fibres	objectionable fibres/10 000	N(4)	0000	med_fibres	0-9999
at sampling (juvenile)	coloured fibre	colour/white	C(1)	C or W	colour	N/A
at sampling (juvenile)	lustre	integer	C(1)	a score	lustre	1-5
at sampling (juvenile)	density	nb/mm2	C(1)	a score	density	1-5
at sampling (juvenile)	tensile strength	Newton/ktex	C(1)	a score	fibre_strgth	1-5
at harvest (adult)	animal_ID	integer	C(2)+ N(14)	XX 00000000 00 0000	animal_ID **	N/A
at harvest (adult)	production farm	integer	C(2) + N(8)	XX 00000000	prod_farm	N/A
at harvest (adult)	harvest date	dd/mm/yr	2/2/2	00/00/00	smp_date	N/A
at harvest (adult)	liveweight	kg	N(2,1)	00.0	live_wt	10-80
at harvest (adult)	mean fibre diameter	microns	N(2,1)	00.0	MFD	10-35
at harvest (adult)	coefficient of variation	%	N(3,1)	000.0	CV	0-100
at harvest (adult)	greasy fleece weight	kg	N(2,2)	00.00	greasflee_wt	0-20
at harvest (adult)	clean fleece weight	kg	N(2,2)	00.00	cleanflee_wt	0-10
at harvest (adult)	yield (clean fleece content)	%	N(2,1)	00.0	yield	0-99.9
at harvest (adult)	fibre length					
at harvest (adult)	maxi	mm	N(3,1)	000.0	maxi_lgth	0-200
at harvest (adult)	mini	mm	N(2,1)	00.0	mini_lgth	0-200
at harvest (adult)	median	mm	N(3,1)	000.0	med_lgth	0-200
at harvest (adult)	crimp	degrees/mm	N(3,1)	000.0	crimp	0-150
at harvest (adult)	medulation	%	N(3,1)	000.0	med_percent	0-10
at harvest (adult)	medullated fibres	objectionable fibres/10 000	N(4)	0000	med_fibres	0-9999
at harvest (adult)	coloured fibre	colour/white	C(1)	C or W	colour	N/A
at harvest (adult)	lustre	integer	C(1)	a score	lustre	1-5
at harvest (adult)	density	nb/mm2	C(1)	a score	density	1-5
at harvest (adult)	tensile strength	Newton/ktex	C(1)	a score	fibre_strgth	1-5

Mohair - Tables for fleece weight, Objective fibre test, subjective fleece assessment and reproduction

ANIMAL ID

recording time	parameter	unit	size	format	symbol	limits
at birth	animal_ID	integer	C(2)+ N(14)	xx 00000000 00 0000	animal_ID **	N/A
at birth	tattoo_no	integer	N(10)	00000 00000	tattoo	N/A
at birth	sire_ID	integer	C(2)+ N(14)	xx 00000000 00 0000	sire_ID **	N/A
at birth	dam_ID	integer	C(2)+ N(14)	xx 00000000 00 0000	dam_ID **	N/A
at birth	sex	M or F	C(1)	M/F	sex	N/A
at birth	birth_date	dd/mm/yr	2/2/2	00/00/00	birth_date	N/A
at birth	littersize_birth	integer	N(1)	0	littsize_birth	1-5

new EU regulation ** countrycode(2)***/birth farm no(8)/year(2)/ intra-farm birth no(4)

FLEECE WEIGHT

recording time	parameter	unit	size	format	symbol	limits
at each shearing	animal_ID	integer	C(2)+ N(14)	xx 00000000 00 0000	animal_ID **	N/A
at each shearing	production farm	integer	C(2) + N(8)	XX 00000000	prod_farm	N/A
at each shearing	shearing date	dd/mm/yr	2/2/2	00/00/00	shea_date	N/A
at each shearing	fleece weight	kg	N(2,1)	00.0	fleece_wt	0-10

FIBRE TEST

recording time	parameter	unit	size	format	symbol	limits
at 18 months of age	animal_ID	integer	C(2)+ N(14)	xx 00000000 00 0000	animal_ID **	N/A
at 18 months of age	production farm	integer	C(2) + N(8)	XX 00000000	prod_farm	N/A
at 18 months of age	fleece sampling date	dd/mm/yr	2/2/2	00/00/00	fleesmp_date	N/A
at 18 months of age	clean fleece content	%	N(2,1)	00.0	cleanflee_per	0-99.9
at 18 months of age	mean fibre diameter	microns	N(2,1)	00.0	MFD	15.0-60.0
at 18 months of age	standard deviation	microns	N(2,1)	00.0	SD	0.0-40.0
at 18 months of age	kemp	%	N(2,2)	00.00	kemp_per	0.00-30.00
at 18 months of age	total medulated fibre	%	N(2,2)	00.00	totmed_per	0.00-30.00

FLEECE ASSESSMENT

recording time	parameter	unit	size	format	symbol	limits
at 18 months of age	animal_ID	integer	C(2)+ N(14)	xx 00000000 00 0000	animal_ID **	N/A
at 18 months of age	production farm	integer	C(2) + N(8)	XX 00000000	prod_farm	N/A
at 18 months of age	fleece scoring date	dd/mm/yr	2/2/2	00/00/00	fleescor_date	N/A
at 18 months of age	staple length	mm	N(3)	000	staple_lgth	0-300
at 18 months of age	body weight	kg	N(2,1)	00.0	bodywt_18m	15-80
at 18 months of age	score values:					
at 18 months of age	kemp_back	integer	N(1)	a score	kemp_back	1-5
at 18 months of age	kemp_rump	integer	N(1)	a score	kemp_rump	1-5
at 18 months of age	kemp_chest/shoul	integer	N(1)	a score	kemp_cheshld	1-5
at 18 months of age	kemp_midside	integer	N(1)	a score	kemp_mids	1-5
at 18 months of age	kemp_britch	integer	N(1)	a score	kemp_brit	1-5
at 18 months of age	body cover	integer	N(2)	a score	body_cover	1-10
at 18 months of age	locktype_chest	integer	C(2)	a score	lockty_ches	1 to 7 combi$
at 18 months of age	locktype_midside	integer	C(2)	a score	lockty_mids	1 to 7 combi$
at 18 months of age	locktype_britch	integer	C(2)	a score	lockty_brit	1 to 7 combi$
at 18 months of age	lustre	integer	N(2)	a score	lustre	1-10

$ 7 combinations of 1 or 2 letters among F(flat), C(curly) and T(twisted):
F, FC, CF, C, CT, TC, T

REPRODUCTION

recording time	parameter	unit	size	format	symbol	limits
at each breeding season	female ID	integer	C(2)+ N(14)	xx 00000000 00 0000	female_ID **	N/A
at each breeding season	production farm	integer	C(2) + N(8)	XX 00000000	prod_farm	N/A
at each breeding season	buck ID	integer	C(2)+ N(14)	xx 00000000 00 0000	buck_ID **	N/A
at each breeding season	mating date	dd/mm/yr	2/2/2	00/00/00	mate_date	N/A
at each breeding season	kidding date	dd/mm/yr	2/2/2	00/00/00	kid_date	N/A
at each breeding season	litter size	integer	N(1)	0	litter_size	1-5

Cashmere - Animal Identification Parameters

ANIMAL ID

recording time	parameter	unit	size	format	symbol	limits
at birth	ID of animal	integer	C(2) + N(14)	XX 00000000 00 0000	animal_ID*	N/A
at birth	ID of dam	integer	C(2) + N(14)	XX 00000000 00 0000	dam_ID*	N/A
at birth	ID of sire	integer	C(2) + N(14)	XX 00000000 00 0000	sire_ID*	N/A
at birth	birth date	dd/mm/yr	2/2/2	00/00/00	birth_date	N/A
at birth	sex	M or F	C(1)	M /F	sex	N/A
at birth	colour	colour/white/offwhite	C(1)	C/W/O	colour	N/A
at birth	ID foster mother (if embryo)	integer	C(2) + N(14)	XX 00000000 00 0000	foster_ID*	N/A
at birth	uncertain sire	yes or no	C(1)	Y /N	uncert_sire	N/A
at birth	littersize at birth	integer	N(1)	0	littsize_birth	1-4
at death	date of fate	dd/mm/yr	2/2/2	00/00/00	fate_dte	N/A
at death	cause of fate	dead/sold	C(4)	XXXX	fate	N/A

*new EU regulation : countrycode(2)**/birth farm no(8)/year(2)/ intra-farm birth no(4)

** United Kingdom	UK
Norway	NO
Germany	DE
Italy	IT
Spain	SP

Cashmere parameters, recorded from juveniles.

recording time	parameter	unit	size	format	symbol	limits
at sampling time	ID of animal	integer	C(2) + N(14)	XX 00000000 00 0000	animal_ID*	N/A
(when juvenile)	current location	integer	C(2) +N(8)	XX 00000000	curr_loc	N/A
	date of sampling	dd/mm/yr	2/2/2	00/00/00	SMP_date	N/A
	liveweight	kg	N(2,1)	00.0	livewt_juvenile	5-50
	age of the animal	months	N(2)	00	juvenile_age	0-12
	QUANTITY TRAITS:					
	total patch weight	integer	N(1,4)	0.0000	P_weight	0-3
	guard hair weight in patch	integer	N(1,4)	0.0000	P_weightGH	0-3
	cashmere weight in patch	integer	N(1,4)	0.0000	P_weight_cash	0-3
	Estimated annual production	g/goat	N(4)	0000	EAP	0-1000
	QUALITY TRAITS					
	mean cashmere diameter					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_cash	4-30
	standard deviation	microns	N(2,2)	00.00	SDcash	0-10
	number of fibres	integer	N(5)	00000	no_cash	0-10000
	fine cashmere fibres					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_fcash	5-25
	standard deviation	microns	N(2,2)	00.00	SDfcash	0-10
	number of fibres	integer	N(5)	00000	no_fcash	0-10000
	intermediate fibres					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_interm	26-40
	standard deviation	microns	N(2,2)	00.00	SD_interm	0-20
	number of fibres	integer	N(4)	0000	no_interm	0-5000
	guard hair					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_ghair	41-100
	standard deviation	microns	N(2,2)	00.00	SD_ghair	0-50
	number of fibres	integer	N(4)	0000	no_guard	0-5000
	drawn length					
	minimum	mm	N(3)	000	drawn_min	0-100
	maximum	mm	N(3)	000	drawn_max	0-150
	median	mm	N(3)	000	drawn_mid	0-150
	staple length					
	down	mm	N(3)	000	kdown_lgth	0-150
	guard hair	mm	N(3)	000	kguard_lgth	0-300
	lustre score	integer	N(1)	0	lustre	1-5
	crimp					
	from_patch	degrees/mm	N(3,1)	000.0	crimp_patch	0-150

Cashmere parameters, recorded from adults at each harvest.

at each harvest	ID of animal	integer	C(2) + N(14)	XX 00000000 00 0000	animal_ID*	N/A
	current location	integer	C(2) +N(8)	XX 00000000	curr_loc	N/A
	date of harvest	dd/mm/yr	2/2/2	00/00/00	SMP_date	N/A
	harvest number	integer	N(2)	00	harvest_no	1-10
	liveweight	kg	N(2,1)	00.0	livewt_harvest	10-100
	QUALITY TRAITS					
	mean cashmere diameter					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_cash	4-30
	standard deviation	microns	N(2,2)	00.00	SDcash	0-10
	number of fibres	integer	N(5)	00000	no_cash	0-10000
	fine cashmere fibres					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_fcash	5-25
	standard deviation	microns	N(2,2)	00.00	SDfcash	0-10
	number of fibres	integer	N(5)	00000	no_fcash	0-10000
	intermediate fibres					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_interm	26-40
	standard deviation	microns	N(2,2)	00.00	SD_interm	0-20
	number of fibres	integer	N(4)	0000	no_interm	0-5000
	guard hair					
	mean fibre diameter	microns	N(2,2)	00.00	MFD_ghair	41-100
	standard deviation	microns	N(2,2)	00.00	SD_ghair	0-50
	number of fibres	integer	N(4)	0000	no_guard	0-5000
	drawn length					
	minimum	mm	N(3)	000	drawn_min	0-100
	maximum	mm	N(3)	000	drawn_max	0-150
	median	mm	N(3)	000	drawn_mid	0-150
	staple length					
	down	mm	N(3)	000	kdown_lgth	0-150
	guard hair	mm	N(3)	000	kguard_lgth	0-300
	method of collection	combing or shearing	C(1)	C or S	coll_method	N/A
	if shearing:					
	date of shearing	dd/mm/yr	2/2/2	00/00/00	date_shearing	N/A
	total fleece weight	g	N(4)	0000	fleece_wt	1000
	yield grade	integer	C(1)	a score	yield_grade	1-5
	percent yield	%	N(3)	000	yield_shearing	0-100
	weight of cashmere	g	N(3)	000	cash_weight	0-600
	crimp	degrees/mm	N(3,1)	000.0	crimp	0-150
	crimp score	integer	N(1)	0	crimp_score	1-5
	lustre	integer	N(1)	0	lustre	1-5
	colour	colour/white/offwhite	C(1)	C/W/O	colour	N/A
	H/W category	hosiery/weaving	C(1)	H/W	H/Wcateg	N/A
	if combing:					
	number of combing	integer	C(1)	0	no_combing	0-5
	at each combing:					
	fleece weight	g	N(3)	000	Cx_fleece_wt	800
	yield grade	integer	C(1)	a score	Cx_yield_grade	1-5
	percent yield	%	N(3)	000	Cx_yield_shearing	0-100
	weight of cashmere	g	N(3)	000	Cx_cash_weight	0-600
	crimp	degrees/mm	N(3,1)	000.0	Cx_crimp	0-150
	crimp score	integer	N(1)	0	Cx_crimpscore	1-5
	lustre	integer	N(1)	0	Cx_lustre	1-5
	colour	colour/white/offwhite	C(1)	C/W/O	Cx_colour	N/A
	H/W category	hosiery/weaving	C(1)	H/W	H/Wcateg	N/A
1	total fleece weight	g	N(3)	000	tot_fleece_wt	800
2	total cashmere weight	g	N(3,2)	000.00	tot_cash_weight	0-600
3	weighted crimp	degrees/mm	N(3,1)	000.0	crimp	0-150
4	weighted lustre	integer	N(1,1)	0.0	lustre	1-5

1=sum of the fleece weight of each combing

2=sum of the cashmere weight of each combing

3={(crimp at combing 1 * weight of cashmere at combing 1) + (crimp at combing 2 * weight of cashmere at combing 2)+ …etc}/total weight of cashmere after n combings

4={(score at combing 1 * weight of cashmere at combing 1) + (score at combing 2 * weight of cashmere at combing 2)+ …etc}/total weight of cashmere after n combings

Angora Rabbit - Parameters for ID, Fleece Data, and Reproduction

ANIMAL ID

recording time	parameter	unit	size	format	symbol	limits
at birth	animal birthfarm_ID	integer	C(2)+N(5)	XX00000	animal_farm_ID*	N/A
at birth	animal_ID	integer	N(5)	00000	animal_ID**	N/A
at birth	sex	integer	N(1)	0	sex***	1-2
at birth	birth date	dd/mm/yr	2/2/2	00/00/00	birth_date	N/A
at birth	sire_ID	integer	N(5)	00000	sire_ID**	N/A
at birth	sire birthfarm_ID	integer	C(2)+N(5)	XX00000	sire_farm_ID*	N/A
at birth	dam_ID	integer	N(5)	00000	dam_ID**	N/A
at birth	dam birthfarm_ID	integer	C(2)+N(5)	XX00000	dam_farm_ID*	N/A

*	2:country, 2:adminstratrive region, 3:breeder no	country:	FI	Finland
**	2:birth yr, 3: order no	code	FR	France
***	1:male, 2:female		NO	Norway

FLEECE DATA

recording time	parameter	unit	size	format	symbol	limits	
at each harvest	production farm_ID	integer	C(2)+N(5)	XX00000	prod_farm_ID*	N/A	
at each harvest	animal ID	integer	N(5)	00000	animal_ID**	N/A	
at each harvest	animal birthfarm_ID	integer	C(2)+N(5)	XX00000	animal_farm_ID*	N/A	
at each harvest	fleece harvest no	integer	N(2)	00	fleeharv_no	1-10	
at each harvest	harvest date	dd/mm/yr	2/2/2	00/00/00	harv_date	N/A	
at each harvest	liveweight	g	N(4)	0000	live_wt	200-7000	
at each harvest	angora weight, grade waF	g	N(2)	00	waF_wt	0-99	
at each harvest	angora weight, grade waD	g	N(2)	00	waD_wt	0-99	
1st harvest	angora weight, grade waB	g	N(3)	000	waB_wt	0-300	
2nd harvest	angora weight, grade waT	g	N(3)	000	waT_wt	0-400	
>2nd harvest	angora weight, grade waJ1	g	N(3)	000	waJ1_wt	0-600	
>2nd harvest	angora weight, grade waJ2	g	N(3)	000	waJ2_wt	0-600	
>2nd harvest	angora weight, grade waW1	g	N(3)	000	waW1_wt	0-600	
>2nd harvest	angora weight, grade waW2	g	N(3)	000	waW2_wt	0-600	
at each harvest	total fleece weight	g	N(3)	000	totfleece_wt	0-600	
at each harvest	bristles length	mm	N(3)	000	brist_lgth	0-200	
at each harvest	down length	mm	N(2)	00	down_lgth	0-99	
at each harvest	reproduction_info	integer	N(1)	0	repro_info	0-2	0: no gestatio
at each harvest	litter size at birth	integer	N(2)	00	littsize_birth	0-10	1:gestation wi
at each harvest	litter size at weaning	integer	N(2)	00	littsize_wean	0-10	2:gestation wi

REPRODUCTION DATA

recording time	parameter	unit	size	format	symbol	limits
at each breeding season	production farm_ID	integer	C(2)+N(5)	XX00000	prod_farm_ID*	N/A
at each breeding season	animal ID	integer	N(5)	00000	animal_ID**	N/A
at each breeding season	animal birthfarm_ID	integer	C(2)+N(5)	XX00000	animal_farm_ID*	N/A
at each breeding season	mating/insemination date	dd/mm/yr	2/2/2	00/00/00	mate_date	N/A
at each breeding season	buck_ID	integer	N(5)	00000	buck_ID**	N/A
at each breeding season	buck birthfarm_ID	integer	C(2)+N(5)	XX00000	buck_farm_ID*	N/A
at each breeding season	pregn. control after 10-12 d	integer	N(1)	0	preg_control*	1, 5 or 9
at each breeding season	birth date	dd/mm/yr	2/2/2	00/00/00	birth_date	N/A
at each breeding season	no youngsters born alive	integer	N(2)	00	bornalive_no	0-10
at each breeding season	no youngsters born dead	integer	N(2)	00	borndead_no	0-10
at each breeding season	total no youngsters born	integer	N(2)	00	totalborn_no	0-10
at each breeding season	no males born alive	integer	N(2)	00	mbornalive_no	0-10
at each breeding season	no females born alive	integer	N(2)	00	fbornalive_no	0-10
at each breeding season	no males let under dam	integer	N(2)	00	maleudam_no	0-10
at each breeding season	no females let under dam	integer	N(2)	00	femaleudam_no	0-10
at each breeding season	no males weaned	integer	N(2)	00	malewean_no	0-10
at each breeding season	no females weaned	integer	N(2)	00	femalewean_no	0-10

*1 for +, 5 for -, 9 for ?

Angora (continued). Parameters for fibre traits

FIBRE TRAITS

recording time	parameter	unit	size	format	symbol	limits
at 5th & 7th harvest	prod_farm_ID	integer	C(2)+N(5)	XX00000	prod_farm_ID*	N/A
at 5th & 7th harvest	animal ID	integer	N(5)	00000	animal_ID**	N/A
at 5th & 7th harvest	animal birthfarm_ID	integer	C(2)+N(5)	XX00000	animal_farm_ID*	N/A
at 5th & 7th harvest	mean fibre diameter	microns	N(2,1)	00.0	MFD	5-30
at 5th & 7th harvest	bristle rate	%	N(2,2)	00.00	brist_percent	0-100
at 5th & 7th harvest	fibre strength	cN/tex	N(2,1)	00.0	fibre_stgth	0-99

Database Structure and Layout

Tables and forms

Having adopted a standardised approach to data collection, the next stage is to optimise the ease of data transfer. MS Access has been chosen as a "front-end" database query software, though it may be found more appropriate foir data to be stored on a UNIX system, such as "Oracle". Data transfer is simplified if databases have the same structure.

The sample database for mohair is simply structured as shown in Figure 1. Template databases are available on the EFFN website for each of the four fibres. These may also be easily customised for other fibres, such as alpaca.

Figure 2 shows a small section from the cashmere database to illustrate the column (field) layout. Fields should always be laid out in the same order. Where possible, even if certain parameters are not recorded, it is advised to leave a blank column, so that database structure is harmonised, and future data transfers will be facilitated.

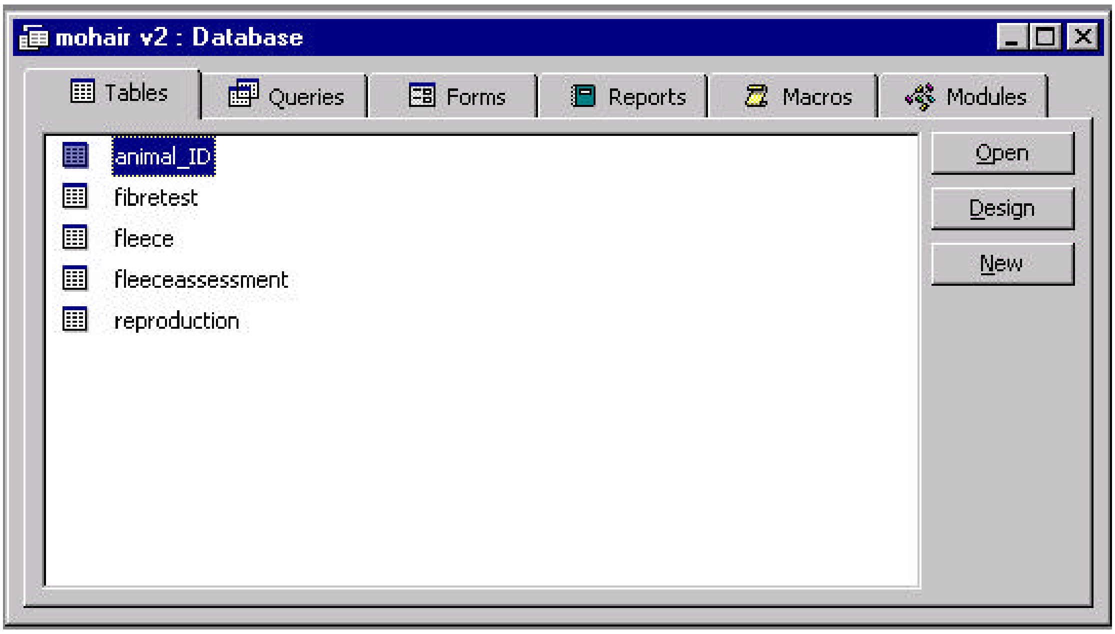


Figure1. Table structure within MS Access mohair database

Microsoft Access - [First sampling : Table]

File Edit View Insert Format Records Tools Window Help

P_weightGH	P_weight_cas	EAP	MFD_cash	SDcash	no_cash
0	0	54	15	3	8325
0	0	86	14	3	7524
0	0	46	15	3	6777
0	0	71	18	3	4532
0	0	34	14	3	7524
0	0	68	15	3	4507
0	0	42	16	3	7722
0	0	53	13	3	6989
0	0	68	16	4	7298
0	0	68	17	4	5810

Figure 2. Small section of cashmere data matrix to show orientation of fields within MS Access.

Conclusions

The EFFN has been successful in achieving a concensus view of the biologically and commercially relevant traits for quality animal fibres. The process of parameter has inevitably involved compromises involving practicality and cost of measurement, the expected heritability of traits, and the relevance of the parameters to livestock husbandry and industry requirements. We believe that this standardised recording system incorporates, best expert knowledge currently available, and will enable real benefits to be made in enhancing genetic improvement, by objectivising male selection, and enabling international comparisons and collaboration. Further details of the design of genetic parameter recording programmes can be obtained from EFFN, or directly from the appropriate breed society.

Fine fibre production with Dahlem Cashmere goats in Germany

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Introduction

A multipurpose goat breed called "Dahlem Cashmere" was developed by Prof. Horst at the end of the 1980s at the Technical University of Berlin. This synthetic breed is based on crosses between Angora goats and dairy goats, mainly from the German white dairy goat with some influence of the German Fawn and Anglo Nubian. The flock shows a good performance in meat and milk. In addition, the animals are shorn annually, and the down is separated from the fleece. The flock was transferred to the University of Bonn in 1996, when a research project was begun to describe the performance characteristics of the Dahlem Cashmere goat and define the breeding goals for further selection. First results on fibre quantity and quality are presented here.

Materials and methods

The flock of Dahlem Cashmere goats is being kept under intensive feeding conditions at the research station, Frankenforst, at the University of Bonn. In February 1997 and 1998, midside samples were taken from the year-old fleeces. The fibre diameter was measured by projection microscopy. Down fibres were defined as fibres with a diameter of £30ìm (ASTM 1986). Quality parameters considered were the down diameter and its standard deviation, as well as the ratio of down fibres to total fibres per sample.

After taking the midside samples the animals were shorn and fleece weights collected. The fleeces were sub-sampled according to the method DIN 53 811 (1970). The sub-samples were dehaired by the method of COUCHMAN (1986). Down weights of the fleeces were estimated by the yield of down in the subsample after dehairing with the Shirley Analyser at the Macaulay Institute, Aberdeen, Scotland.

The data were analysed with the SAS programme (GLM type III) with the following model:

$$Y_{ijkl} = \mu + year_i + age_j + sex_k + e_{ijkl}$$

Results and discussion

Data were collected from 105 goats, 71 female and 34 male animals. 140 samples have been taken in the two years of study from 103 females and 37 males. The age structure was as follows:

Table 1: Distribution of samples in relation to age and sex of animals

age	1 year	2 years	3 years	4 years	5 years
female	45	24	17	12	5
male	31	4	2	0	0
total	76	28	19	12	5

An overview of the performance level is given in table 2.

Table 2: Descriptive statistics of raw data

trait	n	$\overline{X}$	sd	cv
down diameter ìm	140	19.52	2.06	10.6
standard deviation of down diameter (µm)	140	3.77	0.54	14.4
down fibres / total fibres (%)	140	84.1	8.0	9.6
fleece weight (g)	135	470.8	259.5	55.1
down weight (g)	132	248.7	175.9	70.7
yield of down (%)	132	49.2	11.9	24.1

n = number of samples; 8 = mean; sd = standard deviation; cv = coefficient of variation

The results in Table 2 are comparable to the findings of by SCHEURMANN et al. (1990) in a research project with cashgora goats.

The model proved significant for all traits. The levels of significance of the main effects are demonstrated in Table 3. No interactions between the effects could be detected, so this is not shown.

Table 3: Levels of significance for the main effects

Trait effect	year	age	sex
down diameter (µm)	* * *	* * *	ns
standard deviation of down diameter (µm)	ns	***	ns
down fibres / total fibres (%) [1]	ns	**	ns
fleece weight (g) [1]	ns	**	*
down weight (g) [1]	ns	***	*
yield of down (%)	ns	**	ns

ns: p > 0.05; *: 0,01 < p≤ 0.05; ** : 0.001 < p≤ 0.01; ***: p≤ 0.001 (F-test)
[1] F-test after transformation of raw data

Table 3 shows a significant influence of the year only in the down diameter, which was 1.11ìm less in 1997 than in 1998. The age had a significant effect on all traits (Table 4). An influence by the sex of the animals was found for the standard deviation of down diameter, the fleece weight as well as the down weight (Table 5).

Contrary to these results, a research project with Australian cashmere goats showed a decreasing standard deviation of down diameter with increasing age of the animals (GIFFORD et al. 1990). Fleece weight, which decreased significantly between first and second years of age, increasing from the second year to third year and decreasing again from three year old to six year old goats, had similar tendencies to thjat found in the present research. Similarly, the down weight was smallest in the two-year-old Australian animals, and there was a difference between two, three and four-year-old year old animals. A similar fluctution was found in the present study. In contrast to our results, yield of down did not significantly decrease with age in the Australian goats.

Table 4: LSMeans of different age classes

Trait, age _	1 year	2 years	3 years	4 years	5 years
down diameter (m)	18.48 [a]	19.73 [b]	20.47 [b]	21.19 [b]	20.41 [ab]
standard deviation of down diameter (ìm)	3.62 [a]	3.96 [b]	4.10 [b]	4.25 [b]	4.22 [ab]
down fibres / total fibres (%).'	87.18 [a]	84.54 [ab]	79.13 [b]	78.30 [b]	79.07 [ab]
fleece weight (g) [1].	444 [(a)]	409 [(a)]	6.0.9 [(b)]	649 [(b)]	643 [(ab)]
down weight (g)'	232 [ab]	197 [a]	334 [b]	445 [b]	362 [ab]
yield of down (%)	49.23 [ab]	44.39 [a]	53.55 [ab]	59.63 [b]	58.33 [ab]

differences in letters indicate significant differences (tukey-test: p <0.05) in horizontal columns
differences in letters in parenthesis indicate differences (tukey-test: p ≤ 0.1) in horizontal columns
1) F-test after transformation of rawdata

Yearlings had a down diameter of 18.48µm, which was 1.25 to 2.71µm less than that of older animals. They also showed the smallest standard deviation of down diameter, which increased with age. The ratio of down fibres to total fibres was up to 8% lower in animals of three years and older in comparison with the yearlings. Fleece weights were highest in three and five year old animals (0.05 < p ≤0.10). The same pattern was observed for down weight, and for down yield. Differences in yield of down were only significant between the two and four year old goats.

Table 5: LSMeans in relation to sex

Trait, sex	female	male
fleece weight (g) [1]	519 [a]	582 [b]
down weight (g) [1]	293 [a]	336 [b]

differences in letters indicate significant differences (tukey-test: p ≤ 0.05) in horizontal columns
l) F-test after transformation of raw data

Females in the present study had a smaller standard deviation of down diameter, fleece weights and down weights were also reduced compared to males.

GIFFORD et al. (1990) found an opposite difference between sexes in the standard deviation of down diameter. However, fleece weights were also higher in males, but no sex differences were found for down weight. ROSE et al. (1992) found significantly higher fleece weights, down weights and yields of down in male goats.

Conclusion and outlook

Fibre characteristics of Dahlem Cashmere goats are comparable to Cashgora goats from Australia and New Zealand. Traits are mainly affected by the age of the animals, some also by sex.

Further insight in genetic and non-genetic effects will be gained by the evaluation of more data on fibre quantity and quality as well as milk and meat production of the Dahlem Cashmere goats.

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Cashmere production in Italy: current status and future perspectives

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In recent years there has been growing interest towards fine fibre animal production throughout the European Union countries. The development of strategies for the production of non-food commodities contributes to the diversification of the traditional goat breeding system, mainly oriented to meat and milk production.

In Italy, goat productionis rarely considered as a profitable animal breeding technology. The goat population is mainly represented by small nuclei of indigenous breeds spread exploiting niche opportunities in poor land areas. Three years ago, for the first time in Italy, three hundred cashmere goats were imported from Scotland

and distributed throughout Central and Southern Italy, in the regions of Apulia, Basilicata, Latium and Tuscany, in order to investigate the potential of cashmere production in Italy. Thus, at the beginning of the European Fine Fibre Network project, our priority objective was to study the adaptability of this "new" goat breed to the environmental conditions of the wide range of conditions found in Southern Italy.

Preliminary results showed that the reproductive function of Cashmere does, both under natural conditions as well as following hormonal treatment for oestrus induction and synchronisation, was comparable to that of local breed goats.

Cashmere bucks have been trained to use an artificial vagina for semen collection. Sexual activity and semen quantitative and qualitative characteristics and freezability will be investigated soon. The application of technologies such as Artificial Insemination with cryopreserved semen and Multiple Ovulation and Embryo Transfer (MOET) will help to enhance the reproductive potential and expansion of this genotype.

Satisfactory results were also obtained in terms of meat production from cashmere kids.

Studies on fibre production and quality have taken much of our interest in the last 3 years. We have focused our attention on the factors which may affect cashmere quantitative and qualitative production beginning with environmental factors (altitude), while the effects of nutrition and photoperiod conditioning (treatment with melatonin) will also be examined. Goats kept in the uplands showed improvements in all the quantitative parameters of cashmere production, in comparison with those kept in lowland areas, though fibre quality was unaffected and the same fibre diameter (16.6 μm) was obtained at both altitudes. Whether these results are due to the different ambient temperatures recorded at the two altitudes may be ascertained by further studies conducted with the aid of conditioned environmental chambers.

The findings so far obtained are encouraging and lead us to believe that cashmere production may be successfully achieved in our country and be a viable avenue for future livestock diversification. For this reason, we are turning our attention to the identification of native double-coated goat breeds in order to plan cross-breeding programmes. This will provide a great opportunity to add commercial value to the autochthonous goat breeds thus increasing the exploitation of the natural resources of our regions. Recently we have started to collect samples from feral goats in order to evaluate the presence and quality of the undercoat. The next step will be to plan cross-breeding between cashmere-bearing and local breed goats; this will involve the participation of farmers and their associations in the project. Quantitative (total fibre production, yield) and qualitative (colour, diameter) characteristics of fibre produced from the F1 animals will also be studied in relation to sex, season and physiological and nutritional status.

Beyond the scientific purposes of our research and the income benefits that our agricultural system and, in the long run, textile industry would gain from Cashmere goat breeding, we think that the introduction of this new breeding strategy in Italy will provide many other positive implications. Cashmere goats can play an important role on the ecological maintenance of landscape, as is already the experiencein other Mediterranean countries. They also have potential to contribute to new and exciting activities related to agri-tourism and textile handicrafts, with the aim to rediscover our lost traditions.

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OFDA 2000, the world's first portable instrument for measuring greasy wool on farm

Now being tested in Australia and New Zealand OFDA 2000 looks set to revolutionize wool testing.

The OFDA 2000 fits into a small briefcase-sized container, enabling it to be set up adjacent to a sheep classing race or in the woolshed. It uses a small video camera to measure wool characteristics along the length of greasy wool staples - in real time and on-farm. Particular measures include: staple length, profile, fibre diameter and CV of FD, finest and strongest point, percentage of fibres over 30 micron, and curvature. The test takes about 25 seconds to conduct, results are immediately available (and, via an in-built modem and communications software, can also be downloaded and used for electronic data interchange), and samples are retained by the woolgrower. Unlike previous machines where the samples had to be scoured and then chopped into 2mm lengths before testing, OFDA uses greasy wool and whole fibres.

A particular benefit of the OFDA machine has been in highlighting the seasonal variation of fibre diameter - as much as 8 microns in young sheep and 5 microns in adult sheep along the same individual fibre over a year. This reflects nutritional status, the point of break in the fibre occurring where the fibre is finest and weakest. In most Mediterranean climates (southern Australia), the weakest point occurs around the time of the autumn seasonal break, implying the desirability of shearing at that time. The point of break is important in determining the processing performance of wool. Importantly, this also reduces the prickle problem associated with coarse fibres (over 30 micron): prickle is less likely to be a problem if shearing coincides with the finest part of the fibre.

The OFDA 2000's main on-farm application appears likely to be in: selecting the most productive/profitable sheep, flock micron reduction or control, testing for coarse fibres, on farm classing, staple profiling allowing stocking rate/nutritional adjustments, preparation of lines of wool to meet customer requirements and maximise returns, formation of regional or bloodline groups, and supply contracting.

In combination with on farm testing for yield the Task Force views the advantages of this technology for labour saving, forward tendering and general flock and wool information provision to be enormous and urgent.

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Workshop IV Castelo Branco

EFFN draws to a close

With the Castelo Branco workshop, the formal activities of the EFFN drew to an official close, though there was still a lot of activity in fibre sampling and analysis, and also in the exchange programme.

The workshop report is published in full elsewhere, but it is worth examining here some of the conclusions that were drawn.

Portuguese mohair goats on the workshop field trip

The objective of the meeting was to assess the extent to which genuine collaboration between genetic improvement initiatives is emerging, and to identify some key specific research objectives that would contribute to future development of the speciality animal fibre sector.

At the start of the EFFN project, and also one of the reasons for it, the economic situation in animal fibres was poor. Competition from synthetic fibres and a prolonged state of global market oversupply is continuing to depress prices. Consumers of wool are increasingly demanding fineness, as demand trends for wool garments move away from everyday apparel to quality garments in the face of competition from synthetic fibres. The only ways forseen to weather this crisis is to aim for higher quality textile fibres, or establish niche markets. Low wool prices have contributed to a breakdown in marketing structures throughout most of Europe, and a spiral of increasing market inefficiency. Low returns have reduced the incentive on farmers to pay attention to fibre quality, both in livestock genetics and in fleece presentation, and there has resulted a general increase in mean fibre diameter.

In the case of mohair, cashmere and angora, the situation is slightly different. These systems have more focus on the fibre as a main product, but are facing a strong challenge to reach a threshold size, at which economies of scale in marketing will allow efficient marketing structures to be established, enabling stable prices to be secured.

Against this backdrop, the establishment of viable enterprises based on fibre is a stiff challenge. However, textiles are an important part of the European cultural heritage, and there is significant enthusiasm to maintain the strategic value of these systems. The initiatives networked within the EFFN are continuing efforts to maintain and improve genetic quality, as well as beginning to develop appropriate marketing structures that will put sufficient emphasis on quality traits.

There are clear market signals from EFFN-networked pilot projects all over Europe that there are good opportunities for high value niche marketing of European quality textiles. There are numerous examples of small-scale textile manufacture producing many types of products from scarves, sweaters and socks to specialised fabrics for aircraft interiors and therapeutic uses.

Common to all the niche marketing operations is that they concentrate on producing products with high end-values, and avoid sale of raw materials at commodity prices. Fibre systems tend to be low intensity in terms of their use of non-renewable natural resources, and have a low demand for agro-chemicals which may have wider environmental impacts.The syst-ems thus, environ-mentally speaking, are highly appro-

Workshop host, Luis Pinto de Andrade

priate within a context of sustainable agriculture, and can play a complementary role in mixed farming systems, especially where there is an emphasis on non-marketable farming activities, such as maintaining wildlife habitats within agri-environmental schemes, or the conservation of rare livestock breeds.

It is clear that sustained growth in fibre farming systems can be achieved through further development of networks of co-operating small enterprises, competing to exploit niche markets, but working together on generic sectoral marketing (trade fairs, catalogues of regional products etc.) and sharing appropriate technology. This can be achieved within the context of farm diversification under the Rural Development Regulation. Some of the important issues that need to be addressed at this collaborative level are:

· Continued efforts to maintain product quality, both in the genetics and presentation of raw material, and also in finished products. Measurement of quality has been well established within the EFFN and this needs to be applied within the context of an expanding sector, where there are sufficient resources to allow effective quality control to be implemented.

· Appropriate technology is needed for adding value to the raw material before it leaves the farm. This technology may range from equipment to dehair cashmere before sale, to the looms and knitting machines required for production of finished garments for on-farm retail.

· Market research is required to model consumer expectations and consumption behaviour in regard to locally identifiable goods.

Four key ideas for projects which may make significant contributions to the development of speciality fibres were discussed in Castelo Branco:

1) The setting up of a pilot project**, networking small-scale producer/ manufacturers of textiles in Scandinavia**. The project would focus on collective marketing, and the sharing of knowledge and equipment, to help establish a strong consumer image of product quality and local distinctiveness. The project would aim to stimulate rural businesses in remote areas, and help to support systems of farming appropriate to the available land resources and pastoral landscapes.

2) There is a need for **specific PC software for management of genetic performance data on-farm**. Such software would provide the appropriate forms to link data collection with dedicated databases held at centralised locations with the breed associations. The work of EFFN has provided a significantly more standardised format for data recording and protocols for parameter measurement. This now provides a good opportunity greatly to increase the efficiency by which records may be collected and analysed. The software, linked via Internet, would also be able to feed back cumulative collective results from the breeding programme, and provide useful technical information to producers.

3) The European model of the multi-functional role of agriculture has created new non-market values for livestock. The most obvious application of this is in the agri-environmental measures, which have created the possibility for livestock to be kept more for their role in maintaining pastoral habitats, as for their traditional role in meat production. **The development of systems for landscape management using breeds that produce high value fibre** is therefore a significant priority. Fibre breeds are generally highly appropriate for cost-effective control of vegetation for the maintenance and improvement of habitats and biodiversity, as well as the reduction of risk of fire. Within this context the fibre can

provide an important additional income, as well as link public impressions of well-managed and scenic landscapes with quality regional products.

4) As European sheep farming is under severe pressure, so there are increasing efforts to protect rare breeds from the danger of extinction. There are active breed preservation societies in most European countries, but there is a strong need for the establishment of an accurate and **scientific database of sheep breeds** and their phenotypic characteristics. Such a database would provide important data on wool parameters (diameter, length, lustre, strength, colour etc.) that will help in linking small producers with industrial concerns seeking innovation with different wool types. A database of sheep breeds would also provide an important resource for designing strategies to maintain genetic diversity within the European sheep population, at a time when market pressures are increasingly causing genetic losses.

The Castelo Branco meeting of the European Fine Fibre Network, was a successful end to the programme of collaborative activities. Given the serious economic pressures on the sector, there was significant optimism that there are good opportunities for expansion in certain areas, particular in local niche marketing. The standardisation of genetic recording is now well established, and beginning to pay back dividends in terms of increased international collaboration between the breeding programmes. The personal and commercial links that have been formed will form the basis for some of the R&D ideas put forward in this report, and the technical harmonisation will form the basis of future opportunities to establish European level marketing initiatives.

Genetic control of angora and cashmere fibre traits

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Angora Goats

We will describe the traits determining mohair quality and quality, and quantify the genetic control of these traits. The results will be illustrated primarily using data obtained from the French national selection scheme. Extensive on-farm recording has provided us with a large database of information. The data was analysed using the SAS GLM procedure (SAS, 1992), with genetic parameters estimated using the VCE REML package (Groeneveld, 1997), fitting an animal model.

The following traits were studied: greasy fleece weight (GFW), mean fibre diameter (MFD), coefficient of variation of fibre diameter (CVD), total kemp score (TKS), lock type score (LTS), fleece homogeneity score (FHS), staple length (SL) and body cover score (BCS). The basic statistics for these traits are shown in Table 1.

Annual greasy fleece weight is approximately 4.5kg, with the mean fibre diameter being 30.4 µm. Male goats tend to produce heavier (+0.25kg), coarser (+1.5 µm) fleeces. The autumn shearing tends to produce heavier (+0.12kg) fleeces than the spring shearing, and both fleece weight and fibre diameter increase with age.

Heritabilities, genetic and phenotypic correlations between all traits are shown in table 2. Correlations were calculate from multivariate analyses, each with five traits, using performance data on 2673 individuals from 333 sires, with a total of 4359 individuals in pedigree data. The genetic correlation matrix is not positive definite. Mean fibre diameter, CV of fibre diameter, kemp score and body cover score had medium to high heritability values (0.32, 0.30, 0.39 and 0.53, respectively), greasy fleece weight, lock type score and staple length had moderate

Table 1. *Mean and standard deviation of different traits in French Angora goats***.**

Traits	Number of animals	Number of records	Mean	Standard deviation
Greasy fleece weight (kg) [1]	2673	10628	2.27	0.85
Mean fibre diameter (µm)*	2177	2637	30.4	5.2
C.V. fibre diameter (%) *	618	693	25.3	4.3
Total kemp score * 2	1560	2778	19.1	3.6
Lock type score * 3	2359	2845	4.5	1.3
Fleece homogeneity score * 4	489	953	0.5	0.4
Staple length (cm) * 5	1401	1663	13.4	2.2
Body cover score * 6	2367	2853	8.6	0.7

* first assessment or measurement of this trait at 18 months of age.
[1] value adjusted for a 180-day shearing interval
[2] sum of individual kemp scores (from 1: kempy to 5: without kemp) on 5 different body areas
[3] score from 1 (flat lock type) to 7 (twisted)
[4] standard deviation of lock type scores observed on 4 different body areas
[5] value adjusted for a 180-day growth period
[6] score from 1 (low cover) to 10 (total cover)

values (0.19, 0.24 and 0.18, respectively) and fleece homogeneity score had a low value (0.06). Our estimates for greasy fleece weight and mean fibre diameter are similar to those obtained in Argentinean angora (Taddeo et al., 1998). Both studies were made using REML, fitting an animal model. Other literature estimates for greasy fleece weight and mean fibre diameter are variable and ranged from low (0.10-0.15: (Shelton and Snowder, 1983; Yalcin et al., 1979) to moderate and high values (0.25 - 0.50: (Gifford et al., 1991; Nicoll et al., 1989; Shelton and Basset, 1970). For other fleece traits, little information is available. However our estimates are in the range of values cited in the literature (Pattie et al., 1990; Sumner and Bigham, 1993).

A positive but unfavourable genetic correlation was obtained between greasy fleece weight and mean fibre diameter (0.37). This result is in agreement with earlier estimates (Shelton and Basset, 1970; Taddeo et al., 1998), but not with others, -0.28, 0.98 (Yalcin et al., 1979); (Nicoll et al., 1989). Medium unfavourable genetic correlations were also found between fleece homogeneity score, and mean fibre diameter (-0.59) and lock type score (0.47). Conversely, medium to strong favourable genetic correlations were found between kemp score, and greasy fleece weight (0.57), fleece homogeneity (-0.50) and body cover scores (0.72), mean fibre diameter and lock type score (-0.50).

Character and style traits, which describe the form of the lock, have been routinely recorded for a long time in a number of studies. The heritability estimate for lock type score and the favourable genetic correlation between lock type score and mean fibre diameter indicate that some genetic progress was probably achieved indirectly for mean fibre diameter before the wide use of objective fineness measurements.

Table 2. *Heritabilities (bold type on diagonal), genetic (above diagonal) and phenotypic correlations (below diagonal) between different traits in French angora goats.*

Traits	GFW	MFD	CVD	TKS	FHS	LTS	SL	BCS
Greasy fleece weight (GFW)	**0.19**	0.37	-0.33	0.57	-0.05	0.00	0.13	0.34
Mean fibre diameter (MFD)	0.64	**0.32**	0.02	-0.06	-0.59	-0.50	0.17	-0.21
C.V. fibre diameter (CVD)	0.16	0.00	**0.30**	-0.35	0.30	-0.22	-0.12	-0.26
Total kemp score (TKS)	-0.14	-0.23	-0.07	**0.39**	-0.50	0.17	0.13	0.72
Fleece homogeneity score (FHS)	-0.09	-0.03	-0.17	0.06	**0.06**	0.47	0.08	-0.24
Lock type score (LTS)	-0.12	-0.29	-0.19	0.10	0.20	**0.24**	-0.08	0.07
Staple length (SL)	0.11	0.07	0.07	0.14	0.12	0.09	**0.18**	0.08
Body cover score (BCS)	0.02	-0.12	0.02	0.37	-0.04	0.05	0.10	**0.53**

Table 3. *Mean and standard deviation of different traits in Scottish cashmere goat kids*.

Traits	Number of animals	Mean	Standard deviation
Fibre diameter (µm)	2831	15.2	1.21
Diameter standard deviation (µm)	2831	2.9	0.47
Cashmere weight in patch sample (g)	2841	0.26	0.13
Estimated cashmere weight (g)	2841	257	118
Fibre length (cm)	2097	4.69	0.97
Live Weight (kg)	2856	16.8	2.88

The presence of kemp, an undesirable fleece trait, is visually assessed. Genetic parameter estimates indicated that a genetic progress towards reducing kemp in both single and multi-trait selection could be achieved rapidly. However, there are now interesting opportunities for rapidly and accurately measuring kemp and medullated fibre content by using the OFDA method (Lupton and Pfeiffer, 1998) and it could be interesting to include these criteria in a selection programme.

French farmers attach importance to fleece homogeneity since it determines fleece grading facility at both the farm and breeder cooperative levels. To take into account the variability of fleece quality over the body, this trait is currently defined as standard deviation of lock type score in 4 different areas. A low heritability estimate (0.06), combined with medium to strong genetic correlations with other fleece traits, indicates that fleece homogeneity is probably a more complex trait involving several other fleece quality components such as staple length, mean fibre diameter, fibre diameter distribution and medullation. Further investigations of fleece characteristics on different areas over the body will have to be undertaken to improve objective evaluation of the homogeneity of the fleece.

Cashmere Goats

For the genetic control of traits describing cashmere quality and quantity we will draw primarily on our findings in the Scottish cashmere population. This population is a composite of cashmere-bearing goats originating from Siberia, New Zealand, Tasmania and Iceland, as well as feral goats. The data derives primarily from the Macaulay Land Use Research Institute's Sourhope Research Station. All reported measurements were taken on 5-month old kids. In Scotland, this is mid-September and corresponds to approximately 2.5 months of cashmere growth. At the time of measurement, all kids were weighed, a 10-cm^2 mid-side patch sample of fibre was collected and fibre colour was observed. On the patch fibre sample several measurements were made, including: total fibre weight, weight of cashmere in the sample, average fibre diameter, the standard deviation of fibre diameter and fibre length. The estimated annual cashmere production (EAP) was calculated as follows: EAP = 134 x (live weight)$^{0.703}$ x (patch cashmere weight) (Bishop and Russel, 1994).

The data was analysed using the REML procedure in GENSTAT (Lawes Agricultural Trust, 1983), with genetic parameters estimated

Table 4. *Heritabilities (bold type on diagonal), genetic (above diagonal) and phenotypic correlations (below diagonal) between different traits in Scottish cashmere goats.*

Traits	Fibre diam.	Diam s.d.	Patch cashmere	EAP	Fibre length	live weight
Fibre Diameter	**0.64**	0.68	0.81	0.79	0.60	0.03
Diameter standard deviation	0.50	**0.28**	0.37	0.29	-0.08	-0.13
Cashmere weight in patch sample	0.43	0.17	**0.61**	0.75	0.89	-0.29
Estimated cashmere weight	0.46	0.14	0.47	**0.59**	0.84	0.03
Fibre Length	0.32	-0.06	0.52	0.54	**0.57**	0.02
Live Weight	0.18	-0.01	-0.08	0.23	0.08	**0.25**

using the ASREML REML package (Gilmour et al., 1996), fitting an animal model. Mean values and phenotypic standard deviations are shown in table 3. The cashmere weight traits were highly variable, requiring log-transformation prior to genetic analyses.

Heritabilities and genetic and phenotypic correlations between all traits are shown in Table 4. Correlations were calculated from bivariate analyses using all available data, with a total of 3790 animals in the pedigree. The genetic correlation matrix is not positive definite. The traits describing the dimensions of the fibre, namely the length, diameter and weight of cashmere, are all extremely highly inherited, and strongly correlated with each other. The fibre traits are generally uncorrelated with live weight. These results are obtained after removing differences due to the different founder strains by fitting the proportional contribution of each strain to each goat's genotype as covariates in the analyses. This assumes that heterosis does not make a major contribution to these traits, as was demonstrated by Bishop and Russel (1994).

Similar high heritabilities have been previously observed for cashmere production traits. The current results are in general in close agreement with the results of Couchman and Wilkinson (1987), Pattie and Restall (1989), Gifford et al., (1990) and Bigham et al. (1993), despite the fact that these studies describe goat populations with very different genetic backgrounds and production levels. Additionally, in the Chinese Liaoning goat, believed to be the highest producing cashmere breed in the world, with annual clean down weights up to 1 kg (Ning et al., 1995a), heritabilities are also very high. For example, Ning et al. (1995b) reported heritability values of 0.69 for clean cashmere weight and 0.42 for fibre diameter. In summary it appears that cashmere production traits are amongst the most strongly inherited traits seen in domestic livestock, and this result is independent of the breed and environment.

In the Scottish cashmere research programme we are now placing greater emphasis on quality traits other than fibre diameter, in response to feedback from manufacturers, and husbandry traits, to meet the requirements of farmers. For quality traits, we are investigating fibre colour, staple structure and crimp. Staple structure, assessed as the length of cashmere in relation to the length of the guard hairs, helps to determine the processing quality of the cashmere as well as the degree of environmental protection afforded by the guard hair. Long guard hair in relation to cashmere is desirable. This subjectively measured trait is very heritable and repeatable, with the estimated heritability in adult does in our Scottish population being 0.78 (s.e. 0.02). The genetics of crimp and fibre colour are currently less well understood.

The husbandry traits under consideration include fibre moulting patterns and resistance to gastrointestinal nematode parasites. Moulting patterns are important as they influence the ease of fibre harvest by means of combing. Ideally, we wish to synchronise and/or delay the fibre shedding within the flock. The degree to which animals have shed their cashmere at various time points during the spring is a heritable trait, with heritabilities estimated from our data in the range 0.3 to 0.4. Goats are very susceptible to nematode parasites, and this can lead to severe pasture larval contamination and rapid development of anthelmintic resistance. We have demonstrated that selection for increased resistance is possible. By selecting on faecal egg count, our selected flock has, after 5 years of selection, counts which are 60% of those in contemporaneous controls. The heritability of the mean of several faecal egg count determinations is close to 0.4. We advocate selection on this trait as part of standard husbandry protocols where goats are grazing predominantly improved pasture.

Conclusions

Selection for the improvement of goat fibres, specifically cashmere and mohair, is one of the most interesting and satisfying breeding goals in goat production, or even the whole of animal production. We have demonstrated that there are many traits controlling both fibre quality and quantity, and that these traits tend to be moderately to strongly inherited. Rapid genetic progress in any individual trait is possible and indeed has been achieved. To develop selection criteria that simultaneously meet the many factors affecting the actual income received by the farmer for the product, however, is a greater challenge. This is especially the case given that some of the quality and quantity traits are

Scottish cashmere doe at MLURI

antagonistically related. Achieving this goal requires a multi-trait selection index approach.

Ultimately, the success of the breeding programmes will depend only to some extent on the genetic progress that is achievable. More important factors will be the ability of the farmers to market their product, Agricultural Policy at the national or European Union levels, and trends in world market prices. Farmers need to safeguard themselves against these factors which are often outside their own direct control. The French breeding scheme, «Le Mohair des Fermes de France», is an excellent example of a vertically integrated industry which allows the individual farmers some control of their own destiny.

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