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**A STUDY OF THE INHERITANCE OF FOLLICLE AND
FLEECE CHARACTERISTICS IN MERINOS, NEW ZEALAND ROMNEYS,
AND THEIR CROSSBRED PROGENY**

**A thesis in partial fulfilment of the requirements
for the degree of Doctor of Philosophy in
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ABSTRACT

A study was carried out to investigate the inheritance of follicle and fleece characteristics in Merinos, New Zealand Romneys and their crossbred progeny under North Island conditions. A total of 637 animals were sampled from the Ministry of Agriculture and Fisheries's flocks at Tokanui. It should be noted that the Romneys studied, were not the parents of the crossbred animals. Six flocks were sampled.

Least squares means of the Romneys, Superfine Merinos, Local Merinos, Superfine Merino x Romneys, Local Merino x Romneys and Backcross (3/4 Superfine Merinos) were respectively as follows: secondary to primary follicle ratio (S/P), 6.68, 18.06, 18.66, 10.92, 10.32 and 15.81; follicle density $n(P+S)$, 35.73, 69.69, 82.07, 49.57, 45.92 and 73.60; primary follicle density (nP), 4.72, 3.70, 4.23, 4.12, 4.23 and 4.40 and mean fibre diameter (MFD) 37.26, 20.71, 22.56, 26.24, 28.23 and 21.21.

Of the fixed effects tested (age, birth/rearing rank and year of sampling) only age exerted a significant effect on most fleece and follicle characteristics. The repeatabilities for all follicle characteristics were greater than 0.4. Most objectively measured fleece characteristics also showed moderate levels of repeatability. Heritability estimates for follicle characteristics, calculated from small numbers of daughter/dam pairs, were moderate to high.

Phenotypic and genetic correlations for 21 fleece and 7 follicle parameters are reported on data corrected and uncorrected for fixed effects. An attempt was made to predict S/P using stepwise multiple regression techniques, but the resultant equations had low accuracy. There was negative heterosis in both crossbred genotypes for most follicle characteristics. LWT showed the highest level of positive heterosis.

Methods of main gene detection were used to investigate the underlying genetic factors controlling follicle inheritance. Although follicle data had skewed distributions there was little evidence for genetic segregation for $n(P+S)$. Multifactorial inheritance of $n(P+S)$ was indicated. Two or more loci are possibly involved in the inheritance of S/P. The S/P genes appeared to behave in a recessive fashion. In contrast, the current results suggest the presence of a main gene for primary follicle density in both types of Merino x Romney flocks.

INTRODUCTION

In animals to be farmed for the production of textile fibres it is necessary to combine maximum rates of fibre formation with the best possible value per kilogram.

Fibre fineness is very important in determining the suitability of fibres for clothing since, with garments of the same weight and shape, those made from finer fibres will have greater warmth, softness and bending flexibility.

With sheep, the combination of high fleeceweight and fine fibre diameter is only attained in sheep of high follicle density. This is best illustrated by comparing the fleece and follicle populations of the Merino and other breeds of sheep. Although the diameter and weight of each fibre produced is very low, Merino sheep rank highly in weight of wool produced because they have far more follicles than other breeds of sheep.

Carter and Clarke (1957a) showed that this high follicle density in the Merino was due to the fact that they develop far more secondary follicles and Carter (1955) developed the technique of using the S/P ratio as the criterion of secondary follicle development.

Traditionally animal breeders have utilized techniques that bring about genetic improvement, even though individual genes are not recognized. More recently, there has been increasing interest in searching for main genes, since this knowledge has potential advantages:

1. It is not too difficult to utilize crossbreeding, followed by backcrossing and selection to transfer a gene from one breed to another. In this way the poll gene from Corriedale and Ryeland sheep was transferred into Dorset Horns to establish a polled strain.
2. With modern techniques of DNA manipulation and injection into the pronucleus of embryos it may soon be possible to take a gene from one individual and transfer it into a newly developing young animal with a very different genotype, at other loci.

The identification of a high follicle density gene may thus allow the gene to be transferred by either of the above means.

The present topic was chosen because of the suspicion that follicle traits, particularly S/P ratio, might be inherited fairly simply. Merinos and Romneys are so different in these traits that it was decided to investigate the inheritance of S/P ratio in Merino x Romneys. A flock, including straightbred Merinos and various classes of crossbreds, was available on the Tokanui research farm. Although these flocks had been established some time earlier and samples had not been taken at the time of establishment of the crossbreds, they provided a reasonable, if not ideal source of data.

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TABLE OF CONTENTS

Abstract	i
Introduction	ii
Acknowledgements	iv
List of Tables	vii
List of Figures	xii
CHAPTER 1 REVIEW OF LITERATURE	1
1.1 Fleece-follicle relations	1
1.2 Follicle Initiation and Development	5
1.3 Adult Follicle Populations	6
1.4 Follicle Studies in Merino Crossbreds	12
1.5 Environmental Effects on Follicle Populations	28
1.6 Genetic Effects on Follicle Populations	36
1.7 Major Gene Detection	37
1.8 Applications of Main Genes to Livestock Breeding	46
1.9 Selection for Main Genes	49
1.10 Conclusion	49
CHAPTER 2 MATERIALS AND METHODS	
2.1 Terms	51
2.2 Data Sources and Collection	54
2.3 Data Analysis	62
CHAPTER 3 ANALYSIS OF THE EFFECTS AGE, YEAR OF SAMPLING AND BIRTH/REARING RANK ON FOLLICLE AND FLEECE CHARACTERISTICS	
3.1 Method of Analysis	63
3.2 Results	63
3.3 Discussion	94

CHAPTER 4 GENETIC AND PHENOTYPIC PARAMETERS

4.1	Repeatabilities	97
4.2	Phenotypic Correlations	100
4.3	Genetic Correlations	158
4.4	Heritabilities	173
4.5	Stepwise Multiple Regression	178
4.6	Heterosis	183

CHAPTER 5 METHODS OF GENE DETECTION

5.1	Frequency Distributions	208
5.2	Bartlett's Test of Homogeneity of Variance	238
5.3	Skewness and Kurtosis	254
5.4	Comparison of Means of Parental Strains, F_1 , F_2 , and Backcrosses	274
5.5	Simple Sibship Variance Tests for the Detection of Major Loci	277
5.6	General Discussion of Methods of Major Gene Detection	284

CHAPTER 6 GENERAL DISCUSSION AND CONCLUSIONS

6.1	Analysis of Fixed Effects	287
6.2	Genetic and Phenotypic Parameters	287
6.3	Major Gene Detection	289

REFERENCES	292
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LIST OF TABLES

Table 1.1	The range of individual follicle and fibre parameters observed by Carter and Clarke (1957a)	6
Table 1.2	Follicle and fibre parameters of several non-Merino breeds [from Carter and Clarke (1957b)]	9
Table 1.3	Follicle and fibre parameters for several breeds. (from Daly and Carter (1955))	10
Table 1.4	Follicle and fibre characteristics for several breeds. (from Arbiza et al, (1966))	11
Table 1.5	Summary of follicle population figures in Adult British sheep. (from Ryder (1957))	13
Table 1.6	Fleece and Follicle Characteristics of Merino Crossbreds	15
Table 1.7	Total follicle density and fibre weight for F ₁ and F ₂ - Border Leicester-Merino sheep. (from Schinckel and Hayman, 1960)	18
Table 1.8	Means and variances of wool characteristics of F ₁ and F ₂ ewes (from Pattie and Smith, 1964)	18
Table 1.9	Breed class means for hogget fleece records and skin characteristics (from McGuirk et al, 1978)	20
Table 1.10	Least squares means classified by breed type for 3 year 1971-1973 (Woolaston and Roberts, 1976)	21
Table 1.11	Fleece and follicle characteristics of Finnish Landrace, Merino and F x M sheep (Ryder and Wilson, 1972)	23
Table 1.12	Wool fibre measurement of ewes and hoggets (from Gjedrem et al, 1966)	23
Table 1.13	Follicle parameters in some British breeds (from Woolliams and Wiener, 1980)	25
Table 1.14	Fleece and follicle characteristics for Merinos, Rambouillets, and their crossbred progeny (from Ghanekar and Soman, 1971)	25
Table 1.15	A summary of skin data on Merino-Nigerian hair sheep crossbreds (from Burns, 1967a)	27
Table 1.16	New Zealand feral sheep studies (from Bigham, M., personal communication)	27

Table 1.17	Methods used in major gene identification	39
Table 1.18	Phenotypic means and variances of a quantitative character in parental and hybrid populations (from Lande, 1981)	47
Table 1.19	Responses expected to different methods of selection (from Smith, 1967)	47
Table 2.1	Number of sheep in each main group of the fixed effects study	57
Table 3.1	Least squares estimates of the effects of age, birth/rearing rank and year sampled on S/P	64
Table 3.2	Least squares estimates of the effects of age, birth/rearing rank and year sampled on ln S/P	65
Table 3.3	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Total Follicle Density [n(P+S)]	66
Table 3.4	Least squares estimates of the effects of age, birth/rearing rank and year sampled on corrected total follicle density [n(P+S)]corr	67
Table 3.5	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Primary Follicle Density (nP)	68
Table 3.6	Least squares estimates of the effects of age, birth/rearing rank and year sampled on primary follicle density np(corr)	69
Table 3.7	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Skin Shrinkage Correction Factor (CF)	70
Table 3.8	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Liveweight (LWT) (kg)	71
Table 3.9	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Fleeceweight (GFW) (kg)	72
Table 3.10	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Clean Fleeceweight (CFW) (kg)	73
Table 3.11	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Yield (YLD) (%)	74
Table 3.12	Least squares estimates of the effects of age, birth/rearing rank and year sampled on fibre diameter (MFD) (μm)	75
Table 3.13	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Quality Number (QN _p)	76
Table 3.14	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Quality Number (QN _m)	77

Table 3.15	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Staple Length (SL_r)	78
Table 3.16	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Quality Number (SL_m)	79
Table 3.17	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Total Crimp Number (TCN)	80
Table 3.18	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Crimps per Centimetre (CPC)	81
Table 3.19	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Character Grade (CHR_r)	82
Table 3.20	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Character Grade (CHR_m)	83
Table 3.21	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Lustre (LUS)	84
Table 3.22	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Tip Grade (TIP)	85
Table 3.23	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Cotting Grade (COT)	86
Table 3.24	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Soundness Grade (SOU)	87
Table 3.25	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Handle (HND)	88
Table 3.26	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Greasy Colour (GC _r)	89
Table 3.27	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Greasy Colour (GC _m)	90
Table 3.28	Least squares estimates of the effects of age, birth/rearing rank and year sampled on Scoured Colour (SC _m)	91
Table 4.1	Repeatability estimates for fleece and follicle characteristics	98
Table 4.2	Phenotypic correlations for fleece and follicle traits using data corrected for age, year sampled and birth/rearing rank	101
Table 4.3	Phenotypic correlations for fleece and follicle traits using data uncorrected for fixed effects	124

Table 4.4	Genetic correlations calculated for fleece and follicle traits using daughter/dam pairs corrected for age, year sampled and birth/rearing rank	159
Table 4.5	Genetic correlations for fleece and follicle traits calculated with daughter/dam pairs uncorrected for fixed effects	163
Table 4.6	Estimates of heritability based on daughter/dam regression using data corrected for age, year sampled and birth/rearing rank	174
Table 4.7	Estimates of heritability based on daughter/dam regressions using uncorrected data	175
Table 4.8	Effect of including additional independent variables in the multiple regression model to predict S/P and ln S/P	180
Table 4.9	Effect of including additional independent variables in the equation to predict S/P or ln S/P	180
Table 4.10	Means of fleece and follicle traits using data corrected for age, year sampled and birth/rearing rank	186
Table 4.11	Means of fleece and follicle traits using data uncorrected for age, year sampled and birth/rearing rank	191
Table 4.12	Means of fleece and follicle traits using data corrected for age, year sampled and birth/rearing rank	196
Table 4.13	Means of fleece and follicle traits using data uncorrected for fixed effects	198
Table 4.14	Estimates of heterosis by various methods using data corrected for age, year sampled and birth/rearing rank	200
Table 4.15	Estimates of heterosis by various methods using data uncorrected for age, year sampled and birth/rearing rank	202
Table 5.1	Variances of fleece and follicle traits, and significance of differences between generations by Bartlett's test of homogeneity of variances using data corrected for age, year sampled and birth/rearing rank	240
Table 5.2	Variances of fleece and follicle traits, and significances of differences between generations by Bartlett's test of homogeneity of variances using data uncorrected for fixed effects	245
Table 5.3	Variances of fleece and follicle traits, and significances of differences between generations by Bartlett's test of homogeneity of variances using data corrected for age, year sampled and birth/rearing rank	250

Table 5.4	Variances of fleece and follicle traits, and significances of differences between generations by Bartlett's test of homogeneity of variances using data uncorrected for age, year sampled and birth/rearing rank	252
Table 5.5	Skewness coefficients and their significance for various fleece and follicle traits calculated using data corrected for age, year sampled and birth/rearing rank	256
Table 5.6	Skewness coefficients and their significance for various fleece and follicle traits calculated using data uncorrected for age, year sampled and birth/rearing rank	258
Table 5.7	Kurtosis coefficients and their significance calculated using data corrected for age, year sampled and birth/rearing rank	260
Table 5.8	Kurtosis coefficients and their significance using data uncorrected for fixed effects	262
Table 5.9	Skewness and Kurtosis coefficients and their significance for various fleece and follicle traits calculated using data corrected for age, year sampled and birth/rearing rank	264
Table 5.10	Skewness and Kurtosis coefficients and their significance for various fleece and follicle characteristics calculated using data uncorrected for fixed effects	268
Table 5.11	Minimum Number of Genetic Factors	276

LIST OF FIGURES

Figure 1.1	The spatial follicle patterns of various breeds of sheep.	1
Figure 1.2	A follicle group in transverse section from Hardy and Lyne (1956a).	2
Figure 1.3	Between Breed Variation in S/P ratio (from Carter, 1965)	12
Figure 1.4	Shows the effects of a major gene on heritability estimates (from Smith and Webb, 1981)	49a
Figure 2.1	Merino x Romney sheep at the Tokanui Research Station	55
Figure 2.2	The midside skin sampling position	58
Figure 2.3	Skin sample collection	58
Figure 2.4	A Merino follicle group	59
Figure 2.5	A Romney follicle group	59
Figure 2.6	A Merino x Romney follicle group	60
Figure 5.1	Frequency distributions of S/P for all genotypes	209
Figure 5.2	Frequency distributions of S/P for parental groups and their respective crossbreds	210
Figure 5.3	Frequency distributions of S/P for parental groups and their respective crossbreds	211
Figure 5.4	Frequency distributions of S/P within crossbred genotypes	212
Figure 5.5	Frequency distributions of S/P within crossbred genotypes	213
Figure 5.6	Frequency distributions of S/P within crossbred genotypes	214
Figure 5.7	Frequency distributions of S/P within crossbred genotypes	215
Figure 5.8	Frequency distributions of ln S/P for all genotypes	216
Figure 5.9	Frequency distributions of ln S/P for parental groups and their respective crossbreds	217
Figure 5.10	Frequency distributions of ln S/P for parental groups and their respective crossbreds	218
Figure 5.11	Frequency distributions of ln S/P within crossbred genotypes	219
Figure 5.12	Frequency distributions of ln S/P within crossbred genotypes	220

Figure 5.13	Frequency distributions of $\ln S/P$ within crossbred genotypes	221
Figure 5.14	Frequency distributions of $\ln S/P$ within crossbred genotypes	222
Figure 5.15	Frequency distributions of nP for all genotypes	223
Figure 5.16	Frequency distributions of nP for parental groups and their respective crossbreds	224
Figure 5.17	Frequency distributions of nP for parental groups and their respective crossbreds	225
Figure 5.18	Frequency distributions of nP within crossbred genotypes	226
Figure 5.19	Frequency distributions of nP within crossbred genotypes	227
Figure 5.20	Frequency distributions of nP within crossbred genotypes	228
Figure 5.21	Frequency distributions of nP within crossbred genotypes	229
Figure 5.22	Frequency distributions of $nP(\text{corr})$ for all genotypes	230
Figure 5.23	Frequency distributions of $nP(\text{corr})$ for parental groups and their respective crossbreds	231
Figure 5.24	Frequency distributions of nP for parental groups and their respective crossbreds	232
Figure 5.25	Frequency distributions of $nP(\text{corr})$ within crossbred genotypes	233
Figure 5.26	Frequency distributions of $nP(\text{corr})$ within crossbred genotypes	234
Figure 5.27	Frequency distributions of $nP(\text{corr})$ within crossbred genotypes	235
Figure 5.28	Frequency distributions of $nP(\text{corr})$ within crossbred genotypes	236
Figure 5.29	Polynomial regression of the natural log (\ln) variance of $\ln S/P$ on the mean of $\ln S/P$ in $LM \times R$	278
Figure 5.30	Polynomial regression of the natural log (\ln) variance of $\ln S/P$ on the mean of $\ln S/P$ in $SFM \times R$	279
Figure 5.31	Polynomial regression of the natural log (\ln) variance of nP on the mean of nP for $LM \times R$	280

Figure 5.32	Polynomial regression of the natural log (ln) variance of nP on the mean of nP for SFMxR	281
Figure 5.33	Polynomial regression of the natural log (ln) variance of n(P+S) on the mean of n(P+S) for LMxR	282
Figure 5.34	Polynomial regression of the natural log (ln) variance of n(P+S) on the mean of n(P+S) for SFM xR	283