INCORPORATING ASSESSED STYLE, LENGTH, AND STRENGTH INTO BREEDING OBJECTIVES FOR FINE AND SUPERFINE MERINO FLOCKS

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SUMMARY

In fine and superfine flocks, style, staple length and staple strength influence fleece value. Evaluation of the consequences of including these traits in breeding objectives highlights again that if traits of economic importance are ignored when formulating objectives, inappropriate selection decisions can result. For a fleece value objective that contained all traits of importance, near optimal aggregate gains were achieved with an index containing clean fleece weight, mean fibre diameter, coefficient of variation of fibre diameter and style.

Keywords: Breeding objectives, length, strength, style, fine, superfine, wool

INTRODUCTION

In fine and superfine Merino flocks, fleece value is the major contributor to variation between animals in returns to the sheep enterprise. To date, the development of formal breeding objectives and the estimation of relative economic values has been focussed on clean fleece weight and mean fibre diameter as the primary determinants of fleece value. However, breeders of fine and superfine wool flocks have traditionally exerted a significant proportion of their selection emphasis on maintaining or improving wool style. In addition, the increasing use of staple measurements for length and strength in wool marketing has focussed attention on the influence of these traits in price determination.

As recommended by James (1982) it is important to include in the formal definition of the breeding objective all traits that influence costs and returns. This is likely to be particularly important when there are antagonistic relationships between these traits and between possible selection criteria.

The aim of this study is to evaluate the consequences of including the additional wool quality traits identified above in the definition of breeding objectives for fine and superfine wool Merino flocks.

MATERIALS AND METHODS

Relative Economic Values (REV's) for assessed style grade (Style), measured staple length (SL) and staple strength (SS), have been estimated by Purvis and Swan (submitted to Wool Technology and Sheep Breeding). For each of these traits there was substantial variation in price that was associated with geographical area and with mean fibre diameter. For the purposes of this study we have assumed REV's which are those relevant to superfine flocks from the New England wool statistical area (NO3) having a mean fibre diameter of 17.5-17.9 μm.

The REV's of clean fleece weight (CFW) and mean fibre diameter (MFD) were calculated assuming a price of $9.00 per kg clean and the value of a one micron reduction being 10 % of the clean price. The REV for coefficient of variation of fibre diameter (CVFD) was calculated by assuming it is 20 % of the REV of MFD (Piper and Swan 1994). The REV's are expressed as $ per ewe lifetime and

follow the methodology and conventions developed in Ponzoni (1988). Marketing and measurement costs are assumed to be 10 % of the gross value of wool. Phenotypic and genetic (co)variances are those estimated for 4-tooth performance from the CSIRO Fine Wool Project and are detailed in Appendix 1. Derivation of selection indices and prediction of genetic gain used software adapted from SELIND (Cunningham and Mahon 1977). Mass selection was assumed with both males and females measured or assessed. The proportions selected were 6 % and 50 % and generation intervals were 2.5 and 4 years for males and females, respectively.

RESULTS

In Table 1, the effect on aggregate economic value of adding Style, SL and SS to a fleece value breeding objective is evaluated against a base objective of CFW and MFD. The table details a range of selection strategies that build up from the base strategy of selection on CFW and MFD to scenarios where the selection index contains the same traits as the breeding objective.

Base Breeding Objective and Selection Index. The base objective and index contain only CFW and MFD. Over 10 years this selection strategy is predicted to deliver an increase of 0.3 kg in CFW, 2.4 μm reduction in MFD, 6.2 mm longer staples, 3.4 N/kt reduction in SS, an improvement in style grade of 0.14 units and a 1.0 kg increase in 4-tooth liveweight.

Adding Length and Strength to the Objective. Relative to the base scenario, the inclusion of SL and SS to the breeding objective and the use of an index based only on CFW and MFD (Scenario 2 in Table 1) results in greater gains in CFW (+29 %), longer SL (+11 %), and reduced loss of SS (+18 %). These favourable changes are balanced by a slower reduction in MFD (-14 %). The addition of CVFD to the index (Scenario 3) acts to reduce that trait slightly and to substantially reduce the predicted loss of staple strength (from –3.38 to –1.27 N/kt relative to the base scenario).

Adding Style to the Breeding Objective. Including Style in the breeding objective, but selecting only on an index containing CFW and MFD (Scenario 4) is associated with a small additional improvement in Style, and a 13 % greater gain in CFW relative to the base scenario. Including Style as a selection criterion (Scenario 5) produces a significant acceleration (84 %) in the improvement in Style grade. There remains a reduction of more than 2 N/kt in SS.

Full Objective. Adding SL, SS and Style to the base objective and selecting only on an index containing CFW and MFD (Scenario 6) produces an outcome highlighted by greater improvement in CFW (+39 %) and SL (+14 %), and a slower reduction in MFD (-19 %) and SS (25 %). The addition of CVFD to the index (Scenario 7) arrests the decline in SS, whilst adding Style in addition to CVFD (Scenario 8) actually produces a slight increase in SS. When staple length is added to the index there is a large increase (64 % over Scenario 1) in the gain in SL, such that SL would increase by more than 1 mm per year.

Table 1. Changes in Aggregate Economic Value ($) and traits of interest over 10 years from adoption of alternative breeding goals and selection strategies

Scenario	Breeding objective Traits & Values					Selection Criteria	Change in Traits over 10 years								
	CFW	MFD	SL	SS	Style		Aggreg. Value ($)**	GFW kg	CFW kg	MFD μm	CVFD %	SL mm	SS /kt	Style Grade	BWT*** Kg
1. Standard CFW & MFD	56.9	17.6				CFW, MFD	59.27	0.37	0.31	-2.38	0.21	6.18	-3.38	-0.14	1.01
2. Add to 1. SL & SS REV's	56.9	17.6	0.27	1.47		CFW, MFD	56.49	0.38	0.40	-2.05	0.25	6.83	-2.78	-0.15	1.23
3. 2. plus CVFD as SC*	56.9	17.6	0.27	1.47		CFW, MFD, CVFD	57.69	0.33	0.38	-2.05	-0.56	7.49	-1.27	-0.19	1.44
4. Add to 1. REV of Style	56.9	17.6			34.2	CFW, MFD	64.07	0.32	0.35	-2.24	0.22	6.47	-3.13	-0.14	1.11
5. Add to 4. Style as SC	56.9	17.6			34.2	CFW, MFD, Style	66.32	0.30	0.34	-2.18	-0.02	5.88	-2.26	-0.257	1.23
6. Full Objective With base index	56.9	17.6	0.27	1.47	34.2	CFW, MFD	61.71	0.41	0.43	-1.92	0.26	7.04	-2.55	-0.16	1.30
7. 6. Plus CVFD as SC	56.9	17.6	0.27	1.47	34.2	CFW, MFD, CVFD	64.49	0.34	0.40	-1.89	-0.90	7.88	-0.36	-0.21	1.59
8. 7. Plus Style as SC	56.9	17.6	0.27	1.47	34.2	CFW, MFD, CVFD, Style	67.01	0.32	0.39	-1.83	-0.94	7.00	0.15	-0.32	1.65
9. Full Objective With full SC	56.9	17.6	0.27	1.47	34.2	CFW, MFD, CV, FD, Style, SL	67.79	0.32	0.40	-1.83	-0.95	10.11	-0.21	-0.31	1.77

* SC = Selection Criterion
** $ per ewe lifetime
*** BWT= Hogget Liveweight

DISCUSSION

This study confirms that if traits of economic importance are ignored when formulating the breeding objective inappropriate selection decisions can result. This is especially so where antagonistic genetic relationships exist between traits of economic importance. For example, defining an objective based only on clean fleece weight and mean fibre diameter results in a decrease in SS, even when CVFD is included in the selection index. It is only when account is made of the economic importance of the trait, and appropriate selection criteria added to the index, that SS is maintained and aggregate gain enhanced.

Near optimal gains were achieved for the objective that contained all traits of importance, with an index containing CFW, MFD, CVFD, and Style. This package of selection criteria can be obtained relatively cheaply.

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APPENDIX 1.

Phenotypic and Genetic parameters for 4-tooth fleece and liveweight traits from CSIRO Fine Wool Project. (Phenotypic standard deviations (σp), phenotypic correlations above diagonal; genetic below; heritabilities on diagonal)

	GFW	CFW	MFD	CVFD	SL	SS	Style	BWT
σp	0.5kg	0.39kg	1.2μm	2.0 %	9.4mm	9.0 N/kt	0.5 grade	3.9kg
GFW	**0.47**	0.89	0.26	0.10	0.10	0.18	0.24	-0.10
CFW	0.88	**0.46**	0.22	0.03	0.18	0.28	0.24	-0.17
MFD	0.30	0.28	**0.66**	-0.05	0.22	0.01	0.07	0.01
CVFD	0.22	0.10	0.01	**0.47**	-0.34	-0.16	-0.14	0.16
SL	-0.04	0.13	0.31	-0.51	**0.57**	0.04	0.06	-0.10
SS	0.18	0.37	-0.03	-0.17	-0.05	**0.30**	0.13	0.0
Style	0.21	0.26	0.04	-0.13	-0.04	0.17	**0.24**	-0.12
BWT	-0.15	-0.25	0.03	0.29	-0.29	0.0	-0.15	**0.5**