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PERFORMANCE RECORDING FOR MERINO SHEEP IN AUSTRALIA (WOOLPLAN)

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INTRODUCTION

Merinos are the predominant sheep breed in Australia, accounting for about 76% of a total of 150m. Approximately 197,000 Merino rams are sold annually, of which 157,000 are horned and 40,000 are polled.

The Australian Merino is above all a producer of premium quality white wool. The major determinant of wool income is weight, but the price per kilogram is influenced mainly by fibre diameter.

Recording in Merino stud flocks is minimal. Sires are sometimes identified but dam identities are not routinely recorded. Neither are required for registration purposes. Subjective grading of breeding stock is still the main selection criterion, but there is an increasing emphasis on wool testing data.

Several past attempts to design and establish recording services aimed at flocks with some pedigree information have been largely ignored by Merino breeders. However, successful testing services based on fibre diameter measurement and either greasy or clean fleece weights have been set up by some of the State Departments of Agriculture, the Australian Wool Testing Authority, the School of Wool and Pastoral Sciences (Univ. of N.S.W.) and by private consultants and are well supported. WOOLPLAN is an attempt to rationalise and integrate testing services and extend them to incorporate the recording requirements of studs producing rams for commercial flocks in which wool is an important, though not the sole, source of income.

SELECTION OBJECTIVE

For a breeder to enjoy success from a genetic improvement programme, his selection objective must be clearly stated and single mindedly pursued. All income sources which pertain to the commercial enterprise must be included (Gjedrem, 1972).

The primary objective must ultimately be increased profit for the commercial producer. However, it is necessary to further refine the breeding objective to include the components of productivity. Ponzoni (1979) defined the traits which affect Merino breeders incomes and later (Ponzoni, 1982) he attributed relative economic values to these traits for a broad range of situations. His net prices take account of the additional feed cost associated with genetic improvement in liveweight and reproductive rate. Ponzoni's work was used as a basis for the definition of the WOOLPLAN selection objective which appears in table 1. Although discussed here in relation to Merino sheep, the breeding objective is also appropriate for other Australian breeds, where wool is the predominant product.

Table 1 Traits in the WOOLPLAN selection objective with their relative economic values.

Trait	Abbreviation	Relative economic value
Clean fleece weight	CFW	14.5
Fibre diameter	FD	-2.1
Reproduction rate	RR	31.0
Sale weight of surplus progeny	SW	0.5
Weight of culled-for-age ewes	MW	0.1

Prices need to be regularly monitored to ensure that trends in relationships do not disadvantage the breeder, but it is important to maintain a conservative approach to variation in the relative economic values. This is particularly the case in a national improvement scheme where the confidence of a large number of users is to be considered. A moving average could be a convenient mechanism which would reflect long term trends, but be little affected by transient fashions or other short term market fluctuations which might otherwise distort underlying relativities.

SELECTION CRITERIA

To qualifiy for inclusion as predictors, selection criteria should be easily measured and correlated with the traits in the objective. These variates may be the same or different to the traits in the selection objective.

As WOOLPLAN has been designed for Merino sheep with fleece testing information, minimum and mandatory selection criteria are clean fleece weight (CFW) or greasy fleece weight (GFW) and average fibre diameter (FD). To these can be added bodyweight at about 12-15 months of age (hogget body weight, HBW) and dam's number of lambs born or weaned (dNLW). HBW is a particularly important source of information on traits in the objective, providing predictions of weight at various ages as well as indirect indications of potential production in the other traits. Table 2 shows the effect on the various indices of adding HBW.

Table 2 The correlation between the index and selection criteria with and without HBW included with fleece weight and FD as selection criteria.

Variates in index	Objective: All traits+, no restrictions.	Objective: All traits, FD restricted*
CFW,FD	0.43	0.40
CFW,FD,HBW	0.49	0.46
GFW,FD	0.34	0.27
GFW,FD,HBW	0.43	0.39

* Restricted to zero genetic change

\+ CFW,FD,NHP,SW,EW (see text)

Adding HBW to an index which comprises fleece weight plus fibre diameter increases the correlation between the index and the selection objective by between 14 and 44 percent. The effect is greater with greasy than with clean fleece weight, and when genetic change in FD is restricted.

Either greasy or clean fleece weight can be used as a selection criterion. Although CFW is more efficient as a predictor of the breeding objective than greasy fleece weight, the latter is far more cheaply obtained. For example, the New South Wales Department of Agriculture's fleece testing service provides FD measurement at one dollar per sample, but does not include yield testing. Fleece testing houses which measure both clean yield and FD commonly charge about two dollars and fifty cents for the service. GFWs combined with FD are promoted as preliminary selection criteria, with final stud sire selection being based on full testing.

MEASUREMENT AND SAMPLING

Fleece sampling is the responsibility of the WOOLPLAN user. A sample is collected from the mid-side of each sheep and submitted with other production data, such as GFW, HBW and dNLW. The testing laboratory either scours the samples to produce a clean yield and CFW figure as well as FD, or will process the sample only for FD.

BREEDING VALUES

The phenotypic values for the selection criteria are used to estimate breeding values for the traits in the selection objective. The index method described by Henderson (1963) is used to estimate individual trait breeding values using direct and indirect information from all of the variates. This has two advantages. Firstly, economic values can be added later or easily updated without re-calculation of the index coefficients. Secondly, the estimated breeding values can be used for single trait selection.

An index is provided which combines the estimated breeding values by weighting each by its relative economic value. The index is then an estimate of the breeding value for aggregate economic merit.

There are several identifiable environmental effects which influence production. For example, progeny of young dams, twins and late born animals are, on average, penalised in terms of fleece production and bodyweight. If these factors are ignored, selection will be biased against sheep affected. This information is seldom collected by Merino breeders, therefore selection responses will be below their potential and less than predicted using parameter estimates from research flocks which are more intensively recorded. Breeders are encouraged to increase the level of observation in their flocks, but the cost is seen as a disincentive.

Provision has been made in WOOLPLAN to account for variation in CFW and HBW caused by differences in date of birth, maternal handicap (type of birth and age of dam) and management group.

Date of birth. The variates are adjusted to the contemporary average date of birth using standard regressions.

Maternal handicap. Where there are sufficient animals in a type-of-birth by age-of-dam subclass, records are transformed to standardised deviations from the mean (i.e. (X-X)/), otherwise fixed additive adjustments are employed.

Management group. All other adjustments are carried out within management groups before transforming as above.

Because pedigree records are not normally maintained, it is not necessary to make provision for updating of ewe records in WOOLPLAN, nor is it of great benefit to employ more sophisticated statistical techniques such as best linear unbiassed predictions. With further developments in industry attitudes this may change.

FLEXIBILITY

The developers of WOOLPLAN have always been mindful of providing sufficient flexibility to cater for the wide range of requirements of the Australian wool industry. This is reflected in the range of options in the selection objective and in the selection criteria.

Selection objective. Flexibility in the selection objective is achieved in two ways:

(i) by allowing nomination of sets of traits with different combinations of restrictions on RR and FD;

(ii) by incorporating user-specified sets of relative economic values.

There are four selection objectives (Table 3) with the standard set of relative economic values and an infinite variety with user-nominated economic values. Although breeders will have to exercise their own judgement to take advantage of the flexibility provided, it is emphasised that changes to economic weightings should be approached cautiously if selection efforts are to be rewarded with improvement in the aggregate genotype.

Selection criteria. Flexibility in the selection criteria is achieved by providing a choice of three sets of traits for the breeder's use as described earlier.

Combined selection criteria/objective options appear in table 3, totalling 22 when account is taken of both CFW and GFW. On average, greasy fleece weight is about 80% as efficient at predicting the objective as clean fleece weight.

The efficiency of GFW indices relative to CFW indices is greatest when there are no restrictions on the selection objective traits. The most profitable combinations also occur where no restricions apply. Adding HBW to indices which contain FW and FD increases the value of the response, but further addition of dNLW has only a small or zero effect.

Where no objective is nominated, the default will be to assume objective 2, as most breeders aim to maintain their present long term fibre diameter average. The index default will be a function of the data submitted. If no HBW data is included in the index, breeding value estimates for RR and the bodyweights are subject to large errors and will not be printed on the selection lists.

Table 3. Options available in WOOLPLAN, the relative efficiency (%) of greasy fleece weight as an index variate compared with clean fleece weight, and the dollar value of response to one standard deviation of selection on the clean (greasy) fleece weight index.

Breeding objective options	Index options		
	FW, FD	FW, FD, HBW	FW, FD, HBW, dNLW
1. All traits (no restrictions)	79	88	88
Value ($)	3.14 (2.48)	3.58 (3.15)	3.63 (3.20)
2. All traits (FD restricted)	68	85	84
Value ($)	2.75 (1.91)	3.20 (2.67)	3.25 (2.73)
3. All traits (RR restricted)	79	77	79
Value ($)	3.13 (2.47)	3.28 (2.55)	3.28 (2.58)
4. All traits (RR+FD restricted)	*	76	76
Value ($)		3.07 (2.32)	3.07 (2.33)

*Index provides insufficient information on the selection objective.

CONCLUDING REMARKS

WOOLPLAN represents a co-ordinated attempt to implement scientific selection procedures at a national level. Durings its development an effort was made to arrive at proposals that were acceptable to stud breeders, wool testing organisations, extension and research staff, and were of potential value to commercial breeders as a whole. Although there is, of course, room for improvement in the selection objectives and indices currently available in WOOLPLAN, they constitute an important step in the direction of achieving a greater rate of genetic gain in Australian Merino flocks.

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