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A national sire evaluation programme.

EM Roberts* KD Atkins† DJ Cottle‡

J Eppleston** JW James†† M Lollback‡‡

W Schuman§ P Reed¶

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A National Sire Evaluation Program

Roberts, E.M.,* Atkins, K.D., Cottle, D.J.,* Eppleston, J.,* James, J.W.,* Lollback, M.,** Schuman, W.,** Reed, P.***

*** University of New South Wales, Dept. of Wool & Animal Science**
**** N.S.W. Agriculture & Fisheries**

SUMMARY

INTEGRATING SIRE EVALUATION PROGRAMMES

Merino sire evaluation in Australia has taken place on-farm (Lewer, 1987) and on central test stations (Roberts et al, 1988). Both approaches are required and complementary. The question should be not one of central test versus on-farm evaluation but one of combining the information from both sources in an optimal way.

This document describes an approach to sire evaluation that will efficiently identify superior Merino rams at a national level using common methods by:

1) On-Farm screening of rams

A relatively large number of rams can be screened or pre-evaluated 'On-Farm' using home bred rams and where possible, sires that have previously been centrally tested. The use of central test rams will allow the comparison of a large number of potential sires across flocks and will identify those worthy of central testing. Additionally, the breeder will also be able to identify any outside rams from central tests that may be beneficial to his breeding program.

2) Central Testing of Selected Rams

Rams identified by 'On-Farm' testing will be evaluated at a Central Test Station. This will provide several benefits including:

- *Independence of results*
- *Measurement of additional traits*
- *Measurement at later ages*
- *Correction for environmental effects*

3) Identification of Reference Sires

The identification of reference sires based on the results of sire evaluation is critical in linking together evaluation schemes (both 'on-farm' and central tests in various regions) and different years of the same scheme.

The selection of reference sires based on the results of sire evaluation is critical due to the potential widespread use of reference sires in ram breeding flocks and hence on the direction of the industry as a whole.

INTRODUCTION

One of the most important economic decisions facing sheep breeders is where to buy their rams. For the ram breeder, Sire Evaluation Schemes (SES) can provide objective genetic information on which to answer this question.

1) AIM OF SIRE EVALUATION SCHEMES

The aim of SES is to identify genetic differences between sires by:

- 'Screening' on-farm progeny tests using reference sires to identify rams to be tested on central test stations.
- Central Test Station evaluations which will identify 'trait leader' sires for use by industry and as reference sires.
- Use of these outstanding sires as Link sires for use in both on-farm and central test station SES's.

2) THE ROLE OF SIRE EVALUATION SCHEMES IN GENETIC IMPROVEMENT:

2.1 Within-flock improvement

The primary use of sire evaluation for within-flock improvement is to identify superior sires through a direct estimate of breeding value. How well a sire performs may determine whether that ram is culled from the breeding flock, used as a sire for a further mating or matings, or perhaps, used extensively through artificial insemination (AI) as a proven sire. The benefits to the genetic progress of the flock will be determined by what potential exists to apply effective selection among adult rams.

When selection of young rams is based on intense and accurate recording of objective performance records then recording progeny performance adds only a small level of accuracy while increasing the generation interval since there is a long wait before progeny information becomes available. Under these conditions, progeny testing has little to offer in increasing rates of genetic progress; increases in accuracy are largely matched by increases in generation interval (Morley 1952). Turning ram generations over quickly is a legitimate method of not allowing an individual sire to have too much influence on the flock. The average breeding value of the selected rams is relied on to improve the performance of the flock.

However, for a number of reasons, such an approach to ram selection has often not been acceptable to stud breeders.

- The influence of shows and individual ram sales (more recently extending to semen sales) has always highlighted the inherent value of an individual ram so that identifying a group of sires and treating all members of this group equally is unacceptable to most breeders.
- Accurate selection of young rams before first mating has rarely been attempted. Even in breeding programs relying heavily on objectively measured characters, selection emphasis on these objective traits has usually not exceeded 80% among young sires. With greater reliance by most breeders on visually assessed information, there has been an implied acceptance that selection before 18 months of age will only identify a group of rams that should be further evaluated before a final selection is made.
- It follows from the above point that sires are continually selected to remain in the flock, or be downgraded or culled. Contrast this with early recommendations on keeping all selected sires (without any culling) for two mating seasons and then replacing them all (Turner, Brown and Ford 1968). Hopkins and James, (1977) subsequently showed that the best sires should be kept for a longer period than lesser sires. Ram selection in industry has always been a complex, multi-stage process (Casey, 1990).

In practice, then, potential to apply effective selection among adult rams exists in most flocks because selection accuracy is usually not optimal at young ages and because a distinct age structure among sires is in place. It also follows that the selection program is more complicated because of the need to consider individual sires in terms of their continuing performance and the need to exercise caution over the build-up of inbreeding. However, it is also true that, if the breeding plan is well designed, using progeny testing in combination with individual performance testing need be no less efficient than relying on performance testing alone for within-flock improvement.

2.2 Across-flock improvement

Sire evaluation for across-flock improvement can be used to identify superior sires regardless of where the animals were reared or their source. The identification of sires to be introduced into a flock was probably based in the past more on the source stud of the ram rather than the individual ram. Having purchased a ram at high cost, there was little incentive to conduct an evaluation of the purchased sire against other sires since the only realistic strategy would be to cull the high-priced ram and his progeny if they did not perform as well as or better than the progeny of home-bred sires.

The availability of frozen semen combined with the use of laparoscopic AI has the potential to radically alter the way in which stud breeders operate. By conducting an evaluation of one or more outside sires, at relatively low cost compared with the purchase of the rams themselves, a breeder has the option of purchasing further semen of individual sires based on the outcome of the evaluation. Furthermore, if at least one of his own sires or an outside sire he has used had been evaluated in a central test comparison, he has access to information on the relative performance of a larger number of potential sires. Under these circumstances, the source flock of a sire is secondary to identifying a particular sire for use.

2.3 Other

There are some other benefits that arise from evaluating sires.

Firstly, for within-flock improvement, a sire's breeding value can be included in the estimation of breeding value for his progeny. For example, if two rams had equal performance of 120% greasy wool percentage, the ram from a high fleece weight sire group would be a better candidate for selection than the other from a low fleece weight sire group. This will occur by including the sire's performance in breeding value estimates.

Secondly, where sires are used in more than one year, the performance of a sire in different years can be used to link sires and years together. The advantages of such an approach include:

- all information on a sire is used when estimating breeding value so that the estimates are more accurate.
- reliable comparisons can be made between sires used in different years
- an estimate of genetic trend in the flock can be obtained that arises from the differential use over time of (hopefully) better sires.

The third additional benefit of sire evaluation is the potential for better marketing of semen sales from different flocks where relative progeny information is available. One only has to look at commercial semen catalogues to realise how little objective information is commonly available on rams for marketing purposes. In the short term centralised progeny tests will provide some information which is likely to be heavily utilised by buyers.

3) DESIGN AND ORGANISATION OF SIRE EVALUATION

There are a number of aspects of design and organisation of sire evaluations that need to be considered, including:

- conduct of progeny tests
- identification and use of reference sires
- measurement recording
- data analysis
- presentation of results

These considerations apply to both on-farm' and central test schemes, although the relative importance of each may vary between the two types of evaluation. Any differences are noted in the text.

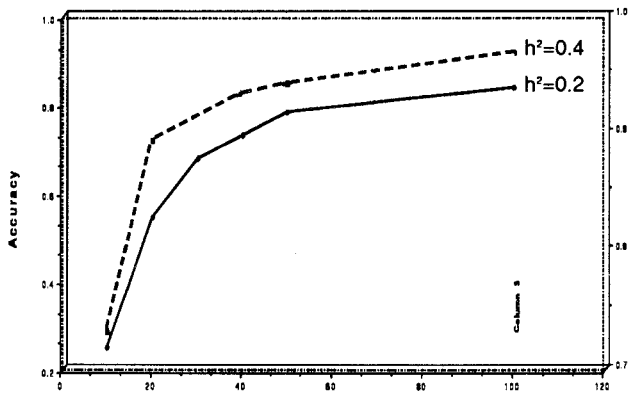
3.1 Conduct of Progeny Tests

Unbiased and accurate estimates of breeding values for sires based on progeny records require an adequate number of progeny, equal allocation of ewes and equal management of ewes and progeny. The requirement for equal ewe allocation can be relaxed for BLUP analysis only when full performance records on all ewes and the identification of lambs to individual ewes is undertaken. These conditions are unlikely to be met in most Merino breeding programmes so that we must rely on appropriately designed progeny tests. Detailed guidelines for the conduct of progeny tests have been supplied by Maxwell and Rogan (1989), Roberts and Eppleston (1989), Schuman (1990) and Lollback (1990).

3.1.1 Sufficient Number of Progeny

The accuracy of information is governed by the number of progeny per sire and the heritability of the characters that are being assessed. This degree of accuracy can be called reliability (Figure 1).

Accuracy with Differing Number of Progeny



After Cunningham (1969)

A useful grouping of reliability may be LOW (reliability of less than 0.8 at $h^2 = 0.4$ i.e. fewer than 15 progeny), MODERATE and HIGH (reliability of greater than 0.9 at $h^2 = 0.4$ i.e. more than 40 progeny).

For central test schemes, the aim would be to achieve a HIGH reliability. To achieve approximately 40 progeny per sire for hogget assessment, sufficient ewes must be mated to account for conception rate to AI, litter size of ewes conceiving and survival rate of progeny from birth to time of assessment. (See Table I)

TABLE 1. NUMBERS OF EXPECTED PROGENY

NUMBER OF EWES	CONCEPTION RATE	AVERAGE LITTER	SURVIVAL RATE	NUMBER OF PROGENY
50	0.65	1.6	0.70	36
			0.75	39
			0.80	42
55	0.65	1.6	0.70	40
			0.75	43
			0.80	46

The conception rate and litter size listed in Table 1 are thought to be acceptable for a laparoscopic AI program using frozen semen. Of the 3 survival rates, 0.7 is probably the most realistic. The recommendation for central test schemes is to have 55 ewes per sire group.

3.1.2. Equal Allocation of Ewes

Allocation of ewes to sire groups should then be done at random. This is essential as each group of ewes joined to sires in the comparison must be of equal genetic merit. If for some reason the ewe flock comprises either different ages or different breeding backgrounds, then a system should be used to ensure that each sire has an equal proportion of the different ewe types.

3.1.3. Equal Management of Ewes and Progeny

It is essential that equal management be applied to all ewes and progeny to allow accurate comparison of sires. It is also important that management ensures high reproductive and survival rates to maximise progeny numbers.

Ewes should be run as one mob if possible during pregnancy. Where this is difficult to achieve, the ewes should be divided to ensure that equal numbers from each ram are in each management group. This allows the differences in treatments to apply to all sire groups.

Ewes should be pregnancy scanned 90 to 100 days after insemination. This will identify litter size and allow greater control in management, and also allow for corrections in data analysis according to litter size.

Ewes should be divided into sire groups prior to lambing and allocated their lambing paddocks. Where possible they should also be lambed in single and multiple litter groups.

All progeny should be identified into their sire groups by using double eartags at lambing or marking.

A record should also be taken to identify which group the progeny were born into (e.g. multiples/singles or maidens/adults). This will provide further information in data analysis.

As soon as possible after lamb marking all ewes and lambs should be run as one mob to reduce effects of nutritional differences.

Lamb shearing can occur at weaning or later. An even-up shearing is necessary to remove wool grown during the

period markedly effected by maternal influence.

Progeny should be run in as few management groups as possible. Every care should be taken to ensure that equal management is imposed on all progeny at all times.

No culling of progeny should occur unless required on humane grounds. These culls should be recorded.

3.2 Identification and Use of Reference Sires

The question of allocating particular sires to a sire evaluation program is only of importance in establishing links with other sires. For a central test sire evaluation scheme, links will be required between years of the same scheme (by using some common rams across years) and between different schemes (by using some common rams across locations). In an on-farm sire evaluation program, links may be required between years (again using some common rams across years) and between the on-farm and central test schemes. Provided that all central test schemes are linked, an individual breeder only has to link himself to a single centralised scheme in order to be linked to all central test schemes. Such a link might be achieved by having one of his own rams in the central test scheme and/or by using semen from rams that are being or have been evaluated in the central test scheme.

For all schemes, a minimum of only one common ram is required to establish a link. However, that single link relies on adequate numbers of progeny at both ends of the link to provide an accurate connection. Also if a link ram performs very well in a particular environment it is risky to use only one. For this reason, it is always preferable to link years within a scheme or different schemes together with at least two common sires e.g. linking Australia, New Zealand and South Africa (Cottle & MacDonald, 1990). Reference sires for 1990/1991 are listed in Roberts (1991).

3.3 Scoring and Measuring

As wide a range of production and description traits as possible should be recorded on progeny groups. For objectively measured characters, standard methods of recording and measuring are relatively simple to formulate, although there would be some debate over some additional wool measurements or indicator traits. For visually assessed traits, there is a clear need to develop standardised scoring systems so that average scores can be easily interpreted. Steps have been taken by Kearins and Moxham (1990) to generate some agreement among breeders on this issue. Recording a wide range of traits is another argument in favour of central testing of sires in that on-farm recording of complete progeny groups will probably only be achieved for a bare minimum of traits and often at too early an age to provide a truly accurate assessment of a sire's breeding value for lifetime productivity.

The following is a list of traits that are proposed for measurement in sire evaluation schemes, both 'onfarm' and central test. Clearly cost of measurement in relation to importance of the trait will influence the decision to measure traits in the list.

Primary Economic Traits

Recorded on hoggets. Important in both 'on-farm' and central test evaluation.

- Greasy fleece weight
- Clean fleece weight
- Yield
- Mean fibre diameter
- Body weight

To be recorded in central test evaluations only. Four-tooth production traits.

Secondary Wool Traits

On hoggets and/or four-tooths

- Staple length
- Staple strength
- Predictive colour/greasy colour
- Fleece rot/body strike

Visual ('Type') Traits

To be recorded in central test evaluations and encouraged (perhaps in an abbreviated way) in "on-farm" evaluations.

- Visual cull rate
- Conformation faults e.g. legs/feet/back/mouth/face cover/wrinkle
- Fleece component faults e.g. density, staple structure
- 'Quality' faults e.g. handle, style, tip
- Black/pigmented wool

Indicator Traits

Little encouragement should be given to measure indicator traits or those with negligible direct economic value such as crimp frequency, fibre diameter variability, resistance to compression, wax and suint levels etc. If research and/or marketing changes result in these traits assuming greater economic importance then they will be included as additional wool traits.

PRESENTATION OF RESULTS

The goal of the Sire Evaluation Program is to present results as estimated breeding values in conformity with world wide animal breeding practice.

Biggins 1991 (personal communication) in discussing the improvement of the Sire Evaluation Program said that Breeders wished to become familiar with the results of central test programs before combining values into single estimates.

He suggested that the report leave separate results from;

1. Different stations
2. The same rams in different years
3. Hogget & 4 tooth results
4. Percentage deviations & Estimated Breeding Values
5. Trait leaders for all important traits
6. Home progeny tests although Link rams have been used, are to be private figures at the discretion of the owners.

ANALYSIS OF RESULTS

It is suggested that the following estimates be provided so that simultaneously breeders may become familiar with breeding value estimates combining results for the same rams from all sources of information.

Initially the combined results would be single-trait BLUP estimates of breeding values for each ram over all years and test locations. During this phase, multi-trait BLUP estimates will also be computed, but not routinely provided. Multi trait BLUP is not quite so robust against false assumptions as single-trait BLUP, and while comparisons made so far (Mian 1991 unpublished results) show that the two methods agree well, further experience is desirable before the more complex estimates replace the single-trait BLUP.

When estimated breeding values are available they can easily be combined into a single overall index by assigning appropriate economic weights to each trait. The weights used in WOOLPLAN would be a sound basis for conversion of estimated breeding values for several traits into an aggregate dollar value. Individual breeders should have the option of obtaining an index calculated using economic weights different from those of WOOLPLAN if they wish to provide the weights themselves. These index values would not form part of the general publication of results.

USING THE RESULTS

The preceding technical considerations are of little value unless breeders make use of the results. In an endeavour to make the results of the N.S.W sire evaluation program more acceptable to users, a working party was established in December 1990. Its goal was to review the results of hogget classing and measurement which had been obtained from the 1989 drops at Hay and Deniliquin (Kinross and Cook, 1990).

The recommendations of this working party have been included in an associated paper by Roberts, (1991).

PRESENTATION OF RESULTS

TABLE 2

HAY SIRE EVALUATION 1989 DROP.
ESTIMATED BREEDING VALUES (BLUP)

Sire Code	No. of progeny	GFW (Kg)	CFW (Kg)	FD (μ)	YLD (%)	HWt (Kg)
Hazeldean.4.139*	33	.38	.38	.20	2.85	-.82
Pooginook 4.2	35	-.16	-.11	.34	.49	-.02
Old Cobram Snow.	38	.03	.10	1.02	2.83	-2.47
AMS 4268	39	-.16	-.19	.70	-2.20	6.44
AMS 5414	46	-.28	-.42	-1.96	-7.93	-1.28
AMS GT 118	33	-.23	-.20	-1.27	-.91	-1.30
Old Ashrose 61	30	.08	.08	.05	.97	3.15
Dunedin Park Reg.	24	.12	.16	.12	2.10	-1.72
Coonong 6.28	33	.31	.13	-.43	-3.18	.88
Lowanna 7.1	38	.21	.23	.15	2.34	-.49
One Oak 00.400*	38	.10	.06	.35	-.51	.20
Willandra Wes	52	-.22	-.15	-.54	.84	-1.21
ABRI Darajohn Red*	43	-.15	-.08	1.63	1.61	-2.64
Nat.Ref.Flock6.066*	33	-.02	.01	-.05	.68	1.27

TABLE 3

HAY SIRE EVALUATION 1989 DROP
PROGENY DEVIATIONS DERIVED FROM LEAST SQUARES MEANS

Sire Code	No. of progeny	GFW (%)	YLD (Dev)	CFW (%)	FD (Dev)	HWt (%)
Hazeldean.4.139*	33	108.5	+1.8	110.9	-0.13	98.5
Pooginook 4.2	35	96.3	+0.3	96.7	+0.21	99.9
Old Cobram Snow.	38	100.5	+1.7	102.7	+0.63	95.7
AMS 4268	39	96.4	-1.4	94.6	+0.42	111.0
AMS 5414	46	94.1	-5.4	88.3	-1.18	97.9
AMS GT 118	33	94.7	-0.6	93.9	-0.81	97.7
Old Ashrose 61	30	101.8	+0.6	102.3	+0.03	105.7
Dunedin Park Reg.	24	102.8	+1.4	104.8	+0.08	96.7
Coonong 6.28	33	106.7	-2.0	103.7	-0.28	101.5
Lowanna 7.1	38	104.4	+1.4	106.4	+0.15	99.1
One Oak 00.400*	38	102.0	-0.3	101.7	+0.21	100.3
Willandra Wes	52	95.3	+0.5	95.9	-0.32	98.0
ABRI Darajohn Red*	43	96.7	+1.0	97.7	+0.98	95.5
Nat.Ref.Flock 6.066*	33	99.6	+0.4	100.2	-0.03	102.2

Note: Link sires *

	Year used
Hazeldean 4.139	1987, 1989, 1990, 1991
One Oak 00.400	1991
Nat.Ref.Flock 6.066	1988, 1989, 1990, 1991
ABRI Dara Red	1989

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Preliminary Notice

FUTURE DIRECTIONS FOR THE WOOL INDUSTRY

"May School" to be held October 1-3, 1991 at the University of New South Wales

Topics covered will include:

- Future directions for the new AWC bodies
- Future directions for research
- Advances in production and processing techniques
- Advances in clip preparation and marketing
- Future directions in markets

Speakers will be drawn from a wide range of the industry

Colleagues who may wish to attend and receive fuller details when they become available should write to:

May School Director or
Dr D Cottle
Department of Wool and Animal Science
University of New South Wales
PO Box 1, KENSINGTON NSW 2033