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Responses to modern technology within the New Zealand sheep breeding industry

T.G. HARVEY, R. HAYDON¹, H.T. BLAIR, D. DANIELL² AND R. HILSON³

Sheep and Beef Cattle Unit, Massey University, Palmerston North

ABSTRACT

The use of modern technology is having a major effect on the structure of ram-breeding in NZ. The uptake of sire referencing schemes (SRS) and artificial insemination (AI) is having an impact on the whole structure of breeding groups and the industry. The role of traditional group breeding schemes is being questioned by the industry.

The structure of New Zealand dairy breeding underwent a period of change with the introduction of AI and sire proving in the 1950's. Some aspects of these changes are relevant to the sheep industry. The decrease in the size of the national flock, increasing ram ratios and the use of AI will all impact on the industry over the next 5-10 years.

The industry is responding to the new environment with groups like the NZ Romney Development Group and the Perendale Genetic Development Group re-evaluating their objectives and making major changes to their structures. This paper looks at these changes and the likely effect on the sheep breeding industry.

Keyword Sheep; sire referencing; recording; breeding structures; artificial insemination; BLUP.

INTRODUCTION

The future of the New Zealand ram breeding industry lies in its ability:

- To strike a balance between practicable farming and the demands of new technology.
- To set market focused breeding objectives.
- To market sires.
- To maximise return on the investment in breeding.
- To form group structures/organisations that have the size and strength to implement new technology.
- To obtain scientific information and techniques in a form that can be successfully implemented cost effectively.

It is over 30 years since artificial insemination (AI) and across herd ranking of bulls by progeny testing was established in the New Zealand dairy industry. AI and sire referencing are only now establishing themselves in the New Zealand ram breeding industry, and one can only ponder what the next 30 years will bring. The ram breeding industry is in a state of flux at present and the

objective of this paper is to look at the developments in modern breeding programmes and examine some of the emerging structures and their likely impact. Six breeding structures are evaluated for their ability to influence genetic advancement.

Although this paper does not focus on the problems or requirements for breeders to set breeding objectives. The importance of establishing clear breeding objectives based on sound market information can not be overstressed. Atkins and Barlow (1990) stated that "It is an underlying assumption that animal breeders have clearly identified objectives". This may be a bold assumption with some breeders lacking sound market information, the expertise or the necessary assistance to set clear objectives. The success of group breeding structures will depend as much on them setting sound breeding objectives as on the genetic technology that they use.

DEVELOPMENT OF MODERN BREEDING STRUCTURES

Modern breeding structures started with the introduction of the National Flock Recording Scheme in 1967 and the subsequent development of Sheeplan (Clarke

¹ Private Bag, Wairoa.

² Wairere Station, Masterton.

³ R.D. 2, Takapau.

and Rae, 1977). Flock recording for performance traits gave ram breeders the opportunity to increase selection accuracy through the use of breeding values and selection indexes.

With the introduction of Animalplan in 1989 New Zealand has a soundly based, flexible recording system on which to develop (Johnson *et al.* 1989). However, in the development of Animalplan the designers may have lost some balance between technological perfection and the reality of on-farm data capture. The New Zealand sheep industry no longer has a "national" recording system or a national database. Breeders can now record on Personal Computer (PC) packages, Animalplan bureau service and the Lincoln University's "FlockLink" recording programmes. The development of a two tier recording system should be considered, where breeders operate smaller farm data capture PC packages which carry out preliminary analyses to produce breeding values. The second tier being a national database on to which data is electronically transferred, before analysis and calculations are undertaken to produce new BLUP breeding values. The BLUP breeding values can be used to update the preliminary analyses, calculate sire reference ranking and for future research.

Group breeding schemes (GBS) were developed in the late 1960's through the guidance of Professor Rae and others. The GBS's were either two or three tier structures with "members" contributing their best ewes into an open nucleus. Genetic material flowed back to "members" in the form of elite rams from the nucleus. New Zealand led the world in the development of sheep group breeding with the popularity of this structure meeting its peak in the 1970's. The GBS structure served ram breeders well with some of the more efficient groups increasing the genetic mean of such traits as NLB by 1-2%/year, as illustrated by the strain comparison trial at the Rotomahana Research Station (Baker *et al.*, 1987). Over the last 10 years many of the GBS's have disbanded or moved into other types of breeding structures. The decline in the use of GBS's can be contributed to a number of factors:

1. The breeding objectives of the members have changed over time.
2. Many of the groups covered a wide range of environmental conditions which have influenced the

type of objectives required.

3. The problem of disease from stock transfer between flocks.
4. The costs involved in operating a G.B.S.
5. The decline in farming returns in real terms.

GBS structures fulfilled a greater role than just genetic improvement. Breeders learnt from each other, set common objectives, marketed and promoted their products and ideas, and also utilised and developed new technology.

ARTIFICIAL INSEMINATION

Although the basic technique for sheep AI has been available for a number of years, the introduction of AI into breeding groups was only undertaken in the early 1980's. The development of improved AI techniques and synchronisation (Harvey *et al.*, 1988) at Rotomahana Research Station helped stimulate its development. AI is unlikely to have a role in commercial flocks in the foreseeable future, other than for breed introductions. Its major impact will be in ram breeding. The number of recorded ewes in New Zealand serviced via AI is increasing and reached approximately 15,000 in 1989.

The first use of AI within a group breeding scheme was in 1983 by the Perendale Genetic Development Limited. This group used AI to reduce the genetic lag between the nucleus flock and contributing flocks. AI is still in a developmental phase with techniques being improved. An industry structure is only just developing through veterinary practices and agriculture firms. AI will have a marked effect on future breeding structures, opening up a new range of possibilities.

SIRE REFERENCING SCHEMES (SRS)

SRS was introduced into the New Zealand sheep breeding scene in 1985. A small group of 9 Coopworth breeders saw the opportunity to combine the AI techniques developed at Rotomahana Research Station with across-flock ranking of sires. The group formed the basis for the New Zealand Ovine Sire Referencing group.

In 1987 Best Linear Unbiased Prediction (BLUP) (Henderson, 1963) methodology was introduced to sheep breeding in New Zealand with the MAFTech

National Sire Referencing programme. Twenty four flocks were involved in 1987. Three breeds were represented; Romney, Coopworth and Perendale. BLUP analysis is now being used for both within flock and across flock calculations of breeding values.

AI played an important role in the development of the MAF Technology SRS allowing link sires to be represented in a large number of flocks. Although 85 flocks are now involved many questions still remain over its final structure. Questions such as access to genetic material, the setting of breeding objectives and semen royalty all need addressing.

The introduction of BLUP also saw the Eastern Romney Group introduce a sire referencing scheme based on the "ram circle approach" in 1988. Rams are exchanged and naturally mated to develop genetic links.

COMMERCIAL BREEDING VENTURES

New breeding groups are developing with the reformation of the New Zealand Romney Development Group, the Apex Coopworth Group and other breeding structures.

The MAF/farmer joint venture company (NZ Sheepac Limited) was formed in 1987 involving three exotic sheep breeds. Although Sheepac is a commercial structure and is totally different to any previous group, it is still based on genetic improvement of the national flock. Shareholders contributed elite ewes to be involved in a centralized breeding programme. Genetic material flows back to shareholders through female crossbred stock, returning after a set period. Although Sheepac's immediate aim is the release and sale of the new breeds, its potential to continue as a commercial breeding venture is obvious. This type of collective commercial venture is also influencing the Australian Merino industry in the form of the MerinoTech organisation (Carrick and England, 1990).

In the immediate future the ram breeding industry is unlikely to follow the extremes of the dairy industry where the number of breeders decreased dramatically between 1950-1970. However with recently developed breeding technologies available there is opportunity to increase the rate of genetic improvement through group breeding. The cost of such programmes are daunting for individual breeders and therefore their

future may lie in collaborative ventures.

EVALUATION OF STRUCTURES

New Zealand does not have sheep breeding evaluation computer models which allow breeders or their genetic advisers to examine all the ramifications of new types of breeding structures. Without these computer models it is difficult to simulate and compare the rates of genetic gain possible. Every breeder or breeding group will have different genetic parameters. The genetic progress will be affected by such factors as the number of flocks, breeding objectives, selection criteria, within flock heritabilities, and the genetic ranking of the flocks within a group at the start of a programme.

This paper looks at six different breeding structures and compares them. It is necessary to standardize as many factors as possible but the evaluation is not an attempt to compare different breeding programmes; it is a comparison of the different concepts. Hopefully in the future full economic sheep breeding computer models will be available for farmers.

The different breeding structures compared are:

- (a) A single closed flock of 500 ewes using 5 two tooth rams.
- (b) Open nucleus flock of 500 ewes with 9 contributing flocks of 500 ewes using one two tooth ram per 100 ewes.
- (c) Open nucleus flock and 9 contributing flocks (as above) but using 2 top nucleus rams via AI in contributing flocks.
- (d) Decentralized open nucleus flock situated in 10 flocks of 500 ewes. Rams bred from the top 500 2 tooth ewes. Top 500 two tooth ewes mated to top 2 rams. The top 42 rams used to mate all other ewes.
- (e) Ram circle breeding programme with two progeny tested six tooth rams chosen out of 40 rams and mated to 50 ewes each in each flock.
- (f) Sire referencing using AI with 50 flocks of 500 ewes using 5 six tooth progeny tested rams as link sires.

The summary of results in Table 1 shows a 13-18% increase in genetic gain/year for a single trait such as hogget fleece weight through co-operative breeding

TABLE 1 Predicted results of single trait selection on hogget fleece weight in different breeding structures.

Type of structure	Genetic Gain /yr	% Increase	Genetic Lag	Genetic Gain 10 yrs	Genetic Gain 20 yrs
A: Single flock	67.7	-	0	686	1372
B: Open nucleus	77.8	+15%	152	626	1404
C: Open nucleus + AI	80.1	+18%	131	670	1471
D: Decentralised nucleus	79.4	+17%	54 ¹	740	1534
E: Ram circle SRS	76.4	+13%	0	764	1528
F: SRS using AI	79.7	+16%	0	797	1594
	gram/yr		(grams)	(grams)	(grams)

¹ Lag between males and females

programmes. The summary helps to highlight the long term nature of ram breeding and the need to try and set long term breeding objectives, rather than follow short term trends. The gains to be made are significant. However all avenues of improvement should be considered such as embryo transfer and crossbreeding programmes.

The breeding structures that have been outlined and compared indicate that significant genetic gain can be achieved. With the advent of new technologies and new crossbreeding possibilities it is likely that breeding structures will continue to develop and alter. This paper highlights the need for further research into sheep breeding structures and demonstrates the advantages of a co-operative approach.

Given the assumptions made, it is not possible to differentiate amongst the schemes but all give significant long term gains. The rate of genetic gain will be modified and altered by the practical decisions made by farmers and the use of multi-trait selection.

CONCLUSION

The introduction of SRS, AI and BLUP estimation of breeding values into the New Zealand ram breeding industry has been a catalyst for many breeders and

breeding groups to re-evaluate their structures. There are many new dimensions available to the industry. Sire referencing, ram circles, decentralized group breeding and commercial breeding ventures are all operating.

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