PROGENY TESTING MATERNAL SIRES IN THE AUSTRALIAN LAMB INDUSTRY

N.M. Fogarty1, L. Cummins2, G. Gaunt3, J.E. Hocking-Edwards4 and N.J. Edwards4

1 NSW Agriculture, Orange Agricultural Institute, Orange, NSW 2800 Australia
2 DNRE, Pastoral and Veterinary Institute, Hamilton, Vic. 3300 Australia
3 DNRE, Rutherglen Research Institute, Rutherglen, Vic. 3685 Australia
4 SARDI, Struan Research Centre, Naracoorte, SA 5271 Australia

INTRODUCTION

The Australian lamb industry uses crossbreeding from a predominantly Merino breed based flock. Over 5 million F1 Merino crossbred ewes are mated annually to terminal sires with their 3-way-cross lamb progeny slaughtered for meat consumption. Two-way-cross lambs are also slaughtered for meat, which are the progeny of terminal sires and Merino ewes, as well as the male progeny of maternal sires whose female F1 progeny are retained for breeding. Considerable genetic improvement in growth and carcass traits has been achieved by breeders of terminal sires over the past decade through widespread adoption of LAMBPLAN, the Australian genetic evaluation program for meat sheep (Banks, 1994). However improvement of the maternal breeding sector has lagged behind and to address this a national maternal sire progeny testing program (MCPT) was initiated in 1997. The program aims to evaluate the variation in progeny performance of maternal and dual purpose (meat and wool) sires and increase the improvement and uptake of genetic technology by the maternal breeding sector. Productivity of the crossbred ewe flock has a major impact on the profitability of lamb enterprises, with lamb carcasses (number produced, weight and fat level) and wool (weight and fibre diameter) being major contributors.

Sires from several maternal breeds including Border Leicester (BL), Booroola Leicester (BoL), Corriedale (Cr), Coopworth (Cp), East Friesian (EF), Finnsheep (Fi) and White Suffolk (WS) are being tested at 4 genetically linked sites: Cowra, Hamilton, Struan and Rutherglen. Early results have demonstrated considerable variation among sires in the performance of their crossbred progeny (Fogarty et al., 2001a). The MCPT is also assessing the feasibility of developing across-breed estimated breeding values (EBVs) for maternal breeds in LAMBPLAN. Results from the MCPT are presented and opportunities for the industry to exploit superior maternal genetics are discussed.

MATERIALS AND METHODS

MCPT design. Top maternal sires were entered by breeders and mated to Merino ewes. Generally the sires had high LAMBPLAN indexes, but were not sampled to provide specific breed comparisons. The F1 ewe progeny were mated to terminal sires to produce 3-way-cross slaughter lambs over 3 years. Their lamb performance (lambing rate, lamb growth and carcass) and wool production (fleece weight and fibre diameter) were measured as well as the growth and carcass performance of F1 wether progeny. A total of 91 maternal sires, including 3 link sires, have been mated at 3 sites over 3 years (Cowra and Hamilton, Feb/Mar 1997-1999 ; Struan, Jan 1998-2000), with F1 ewes born at Struan evaluated at Rutherglen. The matings
aimed to produce > 25 F1 ewes per sire.

**Management.** F1 progeny were weaned and weighed at 3 months and post weaning (7 - 9 months). F1 wethers were slaughtered and hot carcass weight, fat depth (GR), eye muscle depth and width at the 12th rib were recorded.

At Cowra the F1 ewes are evaluated in either an autumn or spring joining system, with first joining occurring at 7 or 14 months of age respectively. The F1 ewes born in 1997 (average 16 F1 progeny of 12 sires per season) have completed their evaluation over 3 lambings. The autumn group was mated naturally to Poll Dorset rams in Feb/March 1998, 1999 and 2000 to lamb at 1, 2 and 3 years of age, with the spring joined group mated in Oct/Nov of the same years. In each year and season the 3-way-cross lambs were slaughtered as a group (about 7 months of age) when they reached a target average carcass weight of 22 kg. The F1 ewes were shorn in October of 1998, 1999 and 2000, with greasy fleece weight and classing bin line recorded. In 1998 individual mid-side samples were taken for measurement of yield and fibre diameter.

**Statistical analysis.** Sire breeding values were estimated (EBVs) from F1 progeny performance using BLUP procedures in OVIS (Brown *et al.*, 2000) as used in LAMBPLAN. EBVs for weight (post-weaning) used weaning and post-weaning weights of ewes and wethers, with adjustments for age, type of birth and rearing status. EBVs for fat (carcass GR) used carcass fat depths at the GR site, adjusted for carcass weight. EBVs for eye muscle depth used the carcass measurement, adjusted for carcass weight.

**RESULTS**
There was considerable variation in EBVs for the 91 sires for their meat and wool traits and particularly for weight and fat (table 1). The range in values represent very large differences in growth rates and fat levels in the F1 progeny of these sires. The number of F1 progeny per sire ranged from 460 to 560 for the 3 link sires and averaged 51 for all other sires for weight. The other traits were measured in only one sex and the numbers of progeny were approximately half those for weight. Several sires and breeds were represented among the trait leaders and there was considerable variation between individual sires within the breeds.

**Table 1. Range of estimated breeding values (EBVs) for 91 sires based on F1 progeny**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Weight (kg)</th>
<th>Fat (mmGR)</th>
<th>Muscle (mm)</th>
<th>Wool wt (kg)</th>
<th>Fibre diam (um)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>+ 9.7</td>
<td>+ 6.7</td>
<td>+ 3.9</td>
<td>+ 1.6</td>
<td>+ 5.8</td>
</tr>
<tr>
<td>Min</td>
<td>- 13.1</td>
<td>- 6.3</td>
<td>- 4.5</td>
<td>- 2.3</td>
<td>- 10.3</td>
</tr>
</tbody>
</table>

The percentage of lambs weaned per ewe joined for the Cowra 1997 drop F1 ewes over 3 lambings varied considerably for both the autumn and spring joined groups (figure 1). For example, at their third lambing the groups ranged from 81 to 167 % (autumn joined) and 112 to 169 % (spring joined) lambs weaned per ewe joined. While some other groups had higher percentages of lambs born, due to high average litter size, lower lamb survival rates reduced their lamb weaning percentages. Lambing rates were low in 1998 (autumn joined) when the ewes were joined at 7 months of age, although one group achieved 100 % lambs weaned (Fi3) and others
were over 90%. There was reasonable consistency of performance of the ewe groups over the 3 years.

Figure 1. Lambing rate for F1 1stX ewe progeny of 12 individual sires from several breeds born in 1997 and joined in a) autumn or b) spring of 1998, 1999 and 2000 at Cowra

DISCUSSION

The MCPT involves two phases of progeny testing maternal sires that correspond with the breeding sectors in the lamb industry. These are the production of F1 progeny (males for slaughter as lamb and females for breeding) and the mating of the F1 ewes for production of 3-way-cross lambs for slaughter. The first phase involves the growth and carcass performance of F1 lambs. The second phase involves the lambing performance and wool production of the F1 ewes, including growth and carcass performance of their 3-way-cross lambs and the F1 influence on the maternal environment (reproduction, maternal ability and milk production). The first phase of the MCPT was completed in mid-2001 when the final group of F1 wethers was slaughtered. The second phase involves evaluation of F1 ewes over 3 lambings and will be completed in 2004.

The large ranges in F1 EBVs for the maternal sires, especially for weight and fat, are greater than previously found among Australian terminal sires (Banks et al., 1995) and provide considerable scope for selection and genetic improvement within the maternal breeds. Choosing sires from the extremes would result in F1 lambs differing by 10 kg post-weaning and their carcass fat by 8 mm GR or 1.5 fat scores at the same carcass weight. Subsequent results have shown the differences in growth and fat levels persist in 3-way-cross lambs. Ranges of up to 6 kg post-weaning and 5 mm carcass GR or 1.0 fat score have been found between the 3-way-cross lambs from the various F1 ewe groups. These differences are a combination of direct genetic effects from the maternal grandsire and maternal effects (genetic and environmental) from the F1 dam.

The lambing results presented for the F1 ewes that have completed their evaluation over 3 lambings at Cowra (figure 1) illustrate the large range in performance between maternal sire groups. The top groups of F1 ewes weaned 32% more total lambs than the average for the autumn joined and 23% more for the spring joined F1 ewes. The number of lambs weaned per ewe joined is the combined outcome of several component traits, such as conception rate, litter size and lamb
survival. The first autumn joining was at 7 months of age which is influenced by age at puberty. There was reasonable consistency in relative performance of the F1 ewe groups over the 3 years. Although the different ranking of some sires between seasons may indicate a significant genotype x environment interaction. Contributing factors may include poorer spring joining ability among some sire groups (Fogarty et al., 2001b) and lower lamb survival among groups with higher litter size when they lamb in the harsher climatic conditions following autumn than spring joining.

The number of lambs slaughtered is a major determinant of profitability for a lamb enterprise. Meeting carcass specifications for weight and fat levels affect price in some markets and wool production of the F1 ewes also contributes to income. Previous results have shown the top group of F1 ewes to have 23 % higher total returns per ewe than average, with lamb carcasses contributing 62 %, lamb skins 12 % and wool 26 % of returns (Fogarty et al., 2001a). Lamb value was a higher proportion of returns for those groups with higher lamb production.

MCPT results to date show the considerable variation that exists for all lamb production traits. It is also apparent that the leading sires for each of the various traits are different. This highlights the need for breeders at all levels to carefully consider the traits that contribute to their enterprise and select sires accordingly. Breeders of F1 animals, 3-way-cross lambs and maternal seedstock all have different objectives. The majority of the increased returns from genetic improvement of maternal sires are reaped by the 3-way-cross producers, yet they are the farthest removed from the selection decisions because of the tiered crossbreeding structure that exists in the industry. F1 producers can make considerable improvement by using sires with high EBVs for growth and leanness. In contrast, 3-way-cross lamb producers make the greatest gains from improvement in the lambing rate with significant contributions from growth, leanness to match specifications, muscling and wool. Lamb producers using crossbred ewes need to exert greater control over the selection and genetic merit of the sires (and dams) of their ewe flock. Contracting the supply of crossbred ewe replacements is one way to achieve this goal.

ACKNOWLEDGEMENTS
The MCPT is conducted at Cowra, Hamilton, Rutherglen and Struan by NSW Agriculture, DNRE and SARDI, with support from Meat and Livestock Australia. The support of breeders who entered sires and provided semen is appreciated.

REFERENCES