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Relative performance of three strains of fine-woolled Merino sheep farmed on Waikato hill country

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Abstract

Flocks of Saxon (ex Tokanui Research Station), Merryville (ex Tara Hills Research Station) and Fine Peppin (ex Tokanui Research Station) Merino sheep were established at the Whatawhata Research Centre to investigate their relative productivity under North Island hill country conditions. Production data were collected for five years. The Fine Peppin ewes had a higher reproductive rate (0.1 ± 0.05 (standard error of difference) lambs weaned/ewe joined) with a higher lamb birth weight (0.37 ± 0.08 kg), lamb weaning weight (1.9 ± 0.4 kg) and yearling weight (3.5 ± 0.6 kg), a higher ewe greasy fleece weight (1.2 ± 0.1 kg) that was longer (7 ± 2 mm) and coarser (3.0 ± 0.2 μ m) with a greater coefficient of variation of fibre diameter (2.2 ± 0.4 %), lower brightness (-1.3 ± 0.4 CIE Y units) and more yellow (1.1 ± 0.2 CIE (Y-Z) units) than the Saxon. The Merryville was intermediate between the other two strains for most characteristics. The yearling fleece of each strain exhibited similar trends to the adult fleece. On the basis of the measured performance, and applying wool and lamb price trends between 2007/08 and 2011/12, the differential returns per ewe of the Fine Peppin would be expected to exceed that of the Saxon by \$8.80 with the Merryville being intermediate.

Keywords: live weight; fleece weight; reproductive rate; Merino sheep; Saxon; Merryville; Fine Peppin

Introduction

During the early 1800s there were several small importations of Merino or Merino cross sheep, mostly from Australia. The Merinos were small framed sheep of the fine woolled Saxon type with the infusion of other breeds being undertaken to improve meat production. During the late 1800s Australian graziers began to develop different strains of Merino to suit their diverse range of environments. Fine wool types were better suited to high rainfall areas and coarse wool types were better suited to dry inland areas. Groups of the newly developed strains, particularly the finer wool types, were subsequently imported into New Zealand during the late nineteenth and twentieth centuries to improve the productivity of the original importations. Two strains that were used to develop merino sheep in New Zealand were the Fine Peppin and Merryville with the Merryville type being finer than the Fine Peppin type.

The following paper is a summary of the relative productivity of these samples of Saxon, Merryville and Fine Peppin strains while grazing together at Whatawhata Research Centre between 1990 and 1993.

Materials and methods

In 1969, in response to depressed prices for coarse wools generally a trial was initiated at Ruakura Agricultural Research Centre where six rams and 44 ewes were purchased from leading Saxon Merino studs in Australia and imported into New Zealand. The group was grazed at the Tokanui Research Station, near Te Awamutu in association with a group of New Zealand Merino ewes, predominantly of Peppin origin, sourced from properties in the South Island of New Zealand (New Zealand Department of Agriculture 1978).

The comparative productivity of the two flocks, a Romney Control and Romney x Merino flocks generated within the trial were reported by Dobbie et al. (1985). In 1990 the two Merino flocks were transferred to Whatawhata Research Centre, near Hamilton and grazed with a sample of Merino ewes with a Merryville background that were sourced from the Tara Hills High Country Research Station, near Omarama.

Flock management

Each flock was managed as a closed flock once rams suitable for breeding were available. While an adequate number of yearling Fine Peppin rams were available for transfer from Tokanui in 1990, two Saxon rams were sourced from private flocks for use in 1990 and 1991. Rams for use in the Merryville flock were supplied by Tara Hills each year with the rams being relocated close to joining. All ewes transferred into the trial had a recorded pedigree. The ewes in each flock were single sire mated to one of five unrelated rams each year. A new group of rams, one per sire line, were used each year following re-randomisation of the ewes allocated to be joined to each sire line.

The three Merino groups were combined with approximately 1,500 experimental ewes of diverse British breeds involved in several separate trials and managed as a single mob. The large flock was separated into its component sub-flocks over joining and lambing to facilitate recording of an accurate pedigree of all progeny.

All the Merino ewes were weighed and their live weight recorded post-joining (April/May). While the young ewes were shorn pre-lambing the older ewes were balanced for strain, age, live weight and mean fibre diameter, and shorn once-yearly in March (pre-mating), May (post-mating) July (pre-lambing),

Table 1 Number of records of lambs born, individuals weighed as a yearling the following year and ewes joined each year within each of the three Merino strain groups.

Strain	Year born/ Year of record	Age group and sex				
		Lamb		Yearling		Adult
		Ewes	Rams	Ewes	Rams	Ewes
Saxon	1990	9	12	4	6	48
	1991	18	16	8	12	41
	1992	16	20	11	14	37
	1993	13	11	7	4	41
	Total	56	59	30	36	167
Merryville	1990	32	25	19	15	92
	1991	11	13	9	10	61
	1992	17	16	13	10	62
	1993	25	23	15	14	53
	Total	85	77	56	49	268
Fine Peppin	1990	36	28	22	19	110
	1991	31	31	23	21	79
	1992	28	31	21	20	87
	1993	28	39	11	16	94
	Total	123	129	77	76	370

Table 2 Proportional distribution (%) of ewes in each age group joined between 1990 and 1993 inclusive within each of the three Merino strain groups.

Ewe age (years)	Strain		
	Saxon	Merryville	Fine Peppin
2	23	20	29
3	28	28	27
4	24	22	20
5	20	20	17
6	5	10	7
Total	100	100	100
Number of ewes	167	268	370

October (lambs-at-foot) or December/January (weaning) as part of a separate investigation published elsewhere (Sumner 2005). Before each shearing a fleece sample was clipped from the mid-side region of the body and identified for subsequent measurement. At shearing the fleece was weighed and the greasy fleece weight recorded. The amount of wool carried by each ewe post-joining live was estimated by proportioning the subsequently recorded fleece weight according to the interval between the dates of the previous shearing and live weighing, relative to the date the ewes were shorn. A fleece-free post-join live weight was calculated for each ewe by subtracting the estimate of the amount of wool carried by each ewe at post-joining live weighing from the recorded live weight.

Lambs were individually identified at birth when their dam, sex and live weight were recorded. All ram lambs were left entire. They were subsequently weaned in December when their live weight was recorded, and shorn as a precaution against flystrike. Thereafter the lambs were managed as single sex groups until they were weighed and their live weight recorded as yearlings in September/October. At the same time a fleece sample was clipped from the mid-side region of the body and identified for subsequent measurement. The yearlings were then shorn and their greasy fleece weight recorded. Potential sires for each flock were selected on the basis of their performance as a yearling and the remainder of the rams culled after yearling shearing.

Wool measurements

Staple length, washing yield at 16% regain, mean fibre diameter and fibre diameter standard deviation were measured with the latter two parameters measured by an OFDA100 instrument (BSC, Ardross, Western Australia, Australia). The coefficient of variation of fibre diameter (%) (CV) within the fleece sample was calculated as fibre diameter standard deviation x 100 / mean fibre diameter. Wool colour was described using the Commission International de l'Eclairage (CIE) system with the samples measured by a Hunterlab D25M reflectance colourmeter (Hunterlab, Reston, Virginia, USA). CIE Y (brightness) and CIE Z of each fleece sample were recorded and CIE (Y-Z) (yellowness) was calculated as the difference between the CIE Y and CIE Z measurements.

Statistical analysis

A linear mixed model was fitted using residual maximum likelihood (REML) in GenStat (Payne et al. 2009), with ewe and year of record as random effects for all continuous variables. Fixed effects associated with strain, ewe age, and where appropriate, the number of lambs born and number of lambs weaned, were included for the ewe analyses. The interval between the previous shearing and the date of shearing were added for the ewe greasy fleece weight and wool characteristic analyses. Sex, birth date, birth rank, rearing rank, dam age and age at weaning were included as fixed effects for the lamb analyses. Additional terms of age at yearling live weight were added to the lamb model for analysing the yearling live weight data and interval between lamb shearing and yearling shearing were added to the lamb model for analysing the yearling wool data.

Table 3 Predicted mean and standard error of difference (SED) of ewe fleece-free post-join live weight, ewe fleece weight and ewe fleece characteristics recorded between 1990 and 1993 inclusive, adjusted for interval since previous shearing, for each of the three Merino strain groups. Bold text indicates significance at $P < 0.05$.

Strain	Ewe fleece-free post-join live weight (kg)	Ewe greasy fleece weight (kg)	Ewe live weight/ewe greasy fleece weight	Ewe staple length (mm)	Ewe washing yield (%)	Ewe mean fibre diameter (μm)	Coefficient of variation of ewe fibre diameter (%)	Ewe CIE Y	Ewe CIE (Y-Z)	
Saxon (S)	35.5	3.26	11.4	93	73.4	19.1	20.7	59.4	2.0	
Merryville (M)	37.7	3.89	9.9	93	74.6	19.7	20.7	60.5	1.8	
Fine Peppin (FP)	38.9	4.40	9.3	100	73.7	22.1	22.9	58.1	3.1	
S vs M	SED	0.6	0.09	0.2	2	0.5	0.2	0.4	0.2	
	P value	<0.001	<0.001	<0.001	0.88	0.02	0.006	1.00	0.01	0.41
S vs FP	SED	0.6	0.09	0.2	2	0.5	0.2	0.4	0.2	
	P value	<0.001	<0.001	<0.001	<0.001	0.55	<0.001	<0.001	<0.001	<0.001
M vs FP	SED	0.5	0.07	0.2	1	0.4	0.2	0.4	0.2	
	P value	0.01	<0.001	0.008	<0.001	0.04	<0.001	<0.001	<0.001	<0.001

Assuming live weight to be an indicator of winter feed requirements, the less live weight that needs to be over-wintered to produce a kilogram of wool, the more efficient the animal with respect to its wool production capacity. This measure of efficiency was calculated for ewes as the fleece-free post-join live weight of each ewe divided by their greasy fleece weight and for yearlings as the live weight at yearling shearing divided by the yearling greasy fleece weight.

Ewe reproductive performance was quantified as 'ewe reproductive rate' or the number of lambs weaned (LW) per ewe joined (EJ), comprising four measured components (Turner 1969). Namely:

$$\text{Reproductive rate} = \frac{\text{Ewe survival}}{\text{Ewe survival}} \times \frac{\text{Ewe fertility}}{\text{Ewe fertility}} \times \frac{\text{Litter size}}{\text{Litter size}} \times \frac{\text{Lamb survival}}{\text{Lamb survival}}$$

Each of these components can be measured individually as

$$\frac{\text{LW}}{\text{EJ}} = \frac{\text{EPL}}{\text{EJ}} \times \frac{\text{EL}}{\text{EPL}} \times \frac{\text{LB}}{\text{EL}} \times \frac{\text{LW}}{\text{LB}}$$

where EPL = Number of ewes present at lambing, EL = Number of ewes lambing and LB = Number of lambs born. Fixed effects associated with strain and ewe age were included.

A Merino industry measure of ewe reproductive performance is the total weight of lamb weaned across the flock, per kilogram of live weight at joining. On a flock basis this may be calculated as $\text{LW/EJ} \times \text{mean lamb wean weight} / \text{mean ewe live weight at joining}$. In this analysis, where all individuals were identified and productivity recorded, ewe reproductive performance was calculated for each ewe as the total weight of lamb weaned divided by the fleece-free post-joining live weight.

Results

Strains are listed in the text and tables in order of increasing mean fibre diameter, namely Saxon, Merryville and Fine Peppin (Tables 3 and 5).

Number of observations

The number of records of lambs born, yearlings weighed and shorn, and ewes joined each year within each of the three strain groups, are shown in Table 1. The proportional distributions of ewes in each age group within each strain are shown in Table 2.

Ewe live weight and wool production

Predicted means for ewe fleece-free post-join live weight, ewe greasy fleece weight and the measured ewe wool characteristics are shown in Table 3. Fine Peppin ewes were heavier and grew more wool than Merryville ewes which in turn were heavier and grew more wool than Saxon ewes. Fine Peppin ewes were more efficient in producing wool than the Merryville ewes, which were in turn more efficient than the Saxon ewes, in terms of live weight farmed to produce a kilogram of wool. While there was a significant strain effect for washing yield, the magnitude of the difference was small and insufficient to change the between strain ranking for clean fleece weight from that for greasy fleece weight.

Allied with the strain trend for fleece weight, wool from the Fine Peppin ewes was longer and coarser, with a higher within sample variation in fibre diameter, and had a lower brightness and was more yellow than wool grown by the Saxon ewes. Wool grown by the Merryville strain was intermediate in its measured characteristics between the Fine Peppin and Saxon strains for mean fibre diameter and brightness, and not significantly different to wool grown by the Saxon ewes for staple length, fibre diameter variability and yellowness.

Ewe reproductive performance

Predicted means for ewe reproductive rate (LW/EJ), ewe survival (EPL/EJ), ewe fertility (EL/EPL), litter size (LB/EL) and lamb survival (LW/LB) within each strain are shown in Table 4.

Table 4 Predicted means and standard error of difference (SED) of ewe reproductive performance recorded between 1990 and 1993 inclusive, for each of the three Merino strain groups. LW = Number of lambs weaned, EJ = Number of ewes joined, EPL = Number of ewes present at lambing, EL = Number of ewes that lambed, LB = Number of lambs born. Bold text indicates significance at $P < 0.05$. Italic text indicates significance between $P = 0.05$ and $P = 0.10$.

Strain		Ewe reproductive rate (LW/EJ)	Ewe survival (EPL/EJ)	Ewe fertility (EL/EPL)	Litter size (LB/EL)	Lamb survival (LW/LB)
Saxon (S)		0.40	0.96	0.59	1.03	0.69
Merryville (M)		0.39	0.96	0.48	1.07	0.80
Fine Peppin (FP)		0.50	0.94	0.63	1.08	0.77
S vs M	SED	0.05	0.02	0.05	0.03	0.06
	P value	0.90	0.88	0.03	0.29	0.04
S vs FP	SED	0.05	0.02	0.05	0.03	0.05
	P value	0.04	0.38	0.40	<i>0.08</i>	<i>0.09</i>
M vs FP	SED	0.04	0.01	0.04	0.03	0.05
	P value	0.01	0.40	<0.001	0.53	0.59

Fine Peppin ewes had a significantly higher reproductive rate than the Merryville and Saxon ewes with the performance of the Merryville ewes potentially being affected by a 'long-distance' relocation from the South Island immediately prior to joining reducing the number of lambs that were born. Fine Peppin ewes had a tendency to have both a larger litter size and a higher lamb survival than Saxon ewes. The Merryville lambs that were born had a higher lamb survival than the Saxon lambs. Ewe survival rate was not significantly different between the three strains. The overall effect of these trends was that there was no significant difference in the industry measure of reproductive performance.

Lamb performance

Predicted means for lamb birth weight, total weight of lambs born per ewe, weaning weight and total weight of lambs weaned per ewe are shown in Table 5. There was a significant strain effect for each of the measured live weight characteristics with Fine Peppin lambs being heavier at birth and weaning than Merryville lambs, that were in turn heavier than Saxon lambs. Similarly Fine Peppin ewes gave birth to and weaned a heavier total weight of lambs than Merryville ewes that in turn gave birth to and weaned a heavier total weight of lambs than Saxon ewes.

Yearling live weight and wool production

Predicted means for yearling live weight, yearling greasy fleece weight and the measured yearling wool characteristics are shown in Table 6. As with the ewes, Fine Peppin yearlings were heavier than Merryville yearlings that were heavier than Saxon yearlings. While Fine Peppin yearlings grew more wool than Merryville yearlings, there was no significant

difference between the greasy fleece weight of Merryville and Saxon yearlings. The combined effect of these two parameters was that Merryville and Saxon yearlings had a similar live weight per unit of greasy wool, while the Fine Peppin yearlings were more efficient in producing wool in terms of live weight farmed to produce a kilogram of wool. The significant strain effect for washing yield was insufficient to change the between strain ranking for clean fleece weight from that for greasy fleece weight.

The strain effect for yearling fleece weight, was associated with the fleece of the Fine Peppin yearlings being longer and coarser, with a higher within sample variation in fibre diameter and more yellow than the Merryville and Saxon yearlings that were not significantly different. There was no significant difference in wool brightness of the yearling fleece between the three strains.

Discussion

Some of the presented data relating to the Merryville strain, particularly that related to reproductive performance associated with semen quality, has a potential bias. The study was not of sufficient duration for all the studied Merryville ewes and rams to acclimatise to North Island conditions through being born and raised in the Waikato under similar management conditions to the other two strains. All the studied Saxon and Fine Peppin sheep were born and raised together in the Waikato.

Comparison of this data with that reported by Dobbie et al. (1985) indicates that grazing Merino sheep, in conjunction with a larger group of British breed type sheep, in this case the ratio of British breed type sheep to Merinos was approximately 5:1, may have compromised individual Merino sheep productivity, through differences in the degree of cohesion exhibited by different breeds while grazing (Fisher & Matthews 2001). While the tight flocking characteristic of the Merino may have limited their pasture intake, the effect would have applied equally to each of the three strains of Merino. The ranking in production traits between the Fine Peppin and Saxon strains in this study were similar to those reported by Dobbie et al. (1985) where the Merino sheep were run as a separate mob. There were no Merryville strain sheep in the trial reported by Dobbie et al. (1985).

There was a similar ewe age distribution within each strain in this study with a decreasing proportion of ewes with increasing age, as occurs under commercial conditions, except for the two-year-old ewes. This was due to a distortion in the age balance at the start of the trial, in combination with the short time

Table 5 Predicted means and standard error of difference (SED) of lamb birth weight, total weight of lambs born per ewe, weaning weight and total weight of lambs weaned per ewe recorded between 1990 and 1993 inclusive, for each of the three Merino strain groups. Bold text indicates significance at $P < 0.05$. Italic text indicates significance between $P = 0.05$ and $P = 0.10$.

Strain	Lamb birth weight (kg)	Total weight of lambs born/ewe (kg)	Lamb wean weight (kg)	Total weight of lambs weaned/Ewes weaning lambs (kg)	Total weight of lambs weaned/Ewe fleece-free post-join live weight (kg/kg)
Saxon (S)	3.70	3.96	16.5	17.8	0.22
Merryville (M)	3.91	4.31	18.0	19.6	0.19
Fine Peppin (FP)	4.07	4.54	18.4	20.6	0.24
S vs M	SED 0.09	0.16	0.4	0.7	0.03
	P value 0.02	0.03	0.001	0.01	0.39
S vs FP	SED 0.08	0.15	0.4	0.7	0.03
	P value <0.001	<0.001	<0.001	<0.001	0.48
M vs FP	SED 0.07	0.14	0.4	0.6	0.03
	P value 0.03	0.10	0.24	0.10	0.07

Table 6 Predicted mean and standard error of difference (SED) of yearling live weight, yearling wool production, yearling live weight/yearling greasy fleece weight and yearling fleece characteristics recorded between 1990 and 1993 inclusive, for each of the three Merino strain groups. Bold text indicates significance at $P < 0.05$.

Strain	Yearling live weight (kg)	Yearling greasy fleece weight (kg)	Yearling live weight/yearling greasy fleece weight	Yearling staple length (mm)	Yearling washing yield (%)	Yearling mean fibre diameter (μm)	Coefficient of variation of yearling fibre diameter (%)	Yearling CIE Y	Yearling CIE (Y-Z)
Saxon (S)	29.8	2.61	11.8	72	68.5	18.0	21.5	62.5	1.1
Merryville (M)	31.4	2.64	12.3	69	70.4	18.2	21.7	63.1	1.2
Fine Peppin (FP)	33.3	3.14	11.0	82	67.6	20.3	24.4	63.2	1.8
S vs M	SED 0.7	0.09	0.3	4	0.9	0.2	0.5	0.5	0.2
	P value 0.02	0.80	0.13	0.50	0.03	0.30	0.69	0.18	0.67
S vs FP	SED 0.6	0.08	0.3	4	0.8	0.2	0.5	0.4	0.2
	P value <0.001	<0.001	0.002	0.007	0.28	<0.001	<0.001	0.10	<0.001
M vs FP	SED 0.6	0.07	0.3	3	0.7	0.2	0.4	0.4	0.1
	P value <0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.80	<0.001

span over which the data were collected. Ewe age was considered as a fixed effect in all the ewe analyses.

Post-joining live weight was analysed as a measure of 'ewe size' as it was equidistant in time between weaning of the previous litter and effects associated with the forthcoming pregnancy. Trends in between strain differences in birth weight, weaning weight and yearling weight, as well as ewe fertility and ewe reproductive rate if the Merryville ram relocation effect is ignored, were all positively related to adult ewe live weight. However, while the industry measure of reproductive performance was low and effectively unsustainable for a breeding enterprise in a Waikato hill country environment, it was similar across the three strains.

Overall between strain trends in fleece weight, and associated wool characteristics, were essentially similar for both yearling and adult ewe fleeces with the attributes of the Merryville strain tending to be closer to the Saxon than to the Fine Peppin. Anecdotally this would be expected as selection within the Merryville

strain has traditionally been focussed more on the production of fine, bright wool than was the case within the Fine Peppin strain, where the emphasis tended to be focussed more on fleece weight. The result of this selection has been that the Fine Peppin ewes were more efficient in growing wool than the Merryville ewes, which were more efficient than the Saxon ewes in requiring less feed, as related to their live weight, to produce a kilogram of wool. The Merryville yearlings grew relatively less wool, in comparison with the other two strains, than the Merryville ewes, and were therefore not more efficient in growing wool than the Saxon yearlings.

The relatively high CIE (Y-Z) (yellowness) value of the ewe fleece wool was a result of treatments imposed as part of an associated "time of shearing" trial (Sumner 2005). While the relative difference between the strains was a genuine effect, the mean yellowness of ewe fleeces would be expected to be similar to that of yearling fleeces if they had all been shorn in the early spring before lambing, as is the

normal management practice for farming Merino sheep in New Zealand. Yearling fleeces in this study in the Waikato were approximately two CIE (Y-Z) units higher (more yellow) than Merino yearling fleeces grown in the Manawatu under less humid conditions (Newman et al. 1996).

While there was a similar increase in mean fibre diameter between yearlings and ewes, the coefficient of variation in fibre diameter was greater in yearlings than in ewes for each of the three strains. Coefficient of variation for fibre diameter in a fleece sample is a combined measure of differences in fibre diameter between fibres as well as variation in fibre diameter along the fibre due to seasonal and management effects. While it is possible that the greater coefficient of variation for fibre diameter in the Fine Peppin fleeces may be a result of historical wool selection policies, the higher values in the yearling fleeces of all three strains suggest a greater along fibre variation in the yearling than in the adult ewe fleeces in this study. The mean fibre diameter of the yearlings in this study was potentially slightly coarser than yearling fleeces in commercial flocks of the same stain type as the yearlings in this study were shorn as lambs in contrast to the standard industry practice of not shearing Merino lambs (Newman et al. 1996). Notwithstanding, lamb shearing would not change the relativity between the three strains.

During the period between 1 July 2007 and 30 June 2012 there was a mean price differential between 19 μm and 22 μm fleece wool of approximately 300 c/kg clean for Merino wool offered at auction in Australia that comprised a mixture of Australian and New Zealand wool (K. Ovens, New Zealand Merino Company Ltd., Personal communication). This differential aligns closely with a relative economic value of 293 c/kg clean per unit change in fibre diameter for 20 μm fleece wool based on historical New Zealand auction data during the 1984/85 to 1989/90 wool selling seasons (Maddever et al. 1991). Maddever et al. (1991) also published a relative economic value of -6.5 c/kg clean per unit change in CIE (Y-Z) value (increasing yellowness) across the New Zealand clip. No Australian data on the economic value of changes in objectively measured yellowness is available. Bearing in mind that the price of fine wools are curvilinearly related to mean fibre diameter, the depression in price of Merino wool associated with increased yellowing is likely to be greater than the average effect reported by Maddever et al. (1991). While it cannot be objectively substantiated an average price differential of +350c/kg clean between Saxon and Fine Peppin fleece wool and +250c/kg clean between Merryville and Fine Peppin fleece wool would be realistic.

Merino lambs are slower growing, with a smaller adult size than lambs of a New Zealand "crossbred or composite" breed type. In practical terms this means that Merino lambs are not suitable for slaughter until 12 to 14 months of age. In this study they would have had an average carcass weight of approximately 13 kg

if slaughtered as a yearling. The average price for lambs of this weight slaughtered between July 2007 and June 2012 was \$60 (Beef + Lamb New Zealand 2013).

Assuming equivalent costs, the differential return between farming Fine Peppin and Saxon strain ewes, calculated as (difference in mean clean fleece weight x average difference in wool return) + (difference in reproductive rate x average price of a lamb suitable for slaughter), was \$8.80 per ewe joined in favour of the Fine Peppin over the Saxon for the five year period between 2007/08 and 2011/12 inclusive. If the reproductive rate of the Merryville ewes in this study was compromised through ram management, it would be reasonable to expect that the differential for the Fine Peppin over the Merryville would be \$4.00 or less per ewe. During this period approximately three quarters of the differential return was associated with a difference in lamb production and a quarter associated with a difference in wool returns.

Thus, while the Saxon Merino sheep is generally considered to be a specialty strain providing high value wool, the presented results indicate that the total economic returns for the larger, more prolific Fine Peppin Merino, which produced a heavier and coarser fleece, exceed that of the Saxon Merino on Waikato hill country, with the Merryville strain being intermediate. Dobbie et al. (1985) also reported a greater return from Fine Peppin than from Saxon sheep on North Island lowland country under a different wool/lamb price structure. The magnitude of the differential may differ in other regions of New Zealand experiencing different climatic conditions and different levels of performance.

It would be expected that the relative production traits expressed by the respective Merino strains would also occur, if rams of each of the Merino strains were crossed with Strong wool or Composite breed ewes in an attempt to produce finer wool to achieve a higher price than that received for wool produced by the dam breed (Everett-Hincks, 1997). Using Fine Peppin type Merino rams for crossing should therefore result in more productive Merino cross progeny, although it may be finer, than using Saxon type Merino rams.

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