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A Comparison of the Progeny Performance of Merino Sires Selected for Contrasting Wool and Meat Selection Indices Run in Temperate and Mediterranean Environments

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Abstract

The project evaluated in two contrasting New England and South Australian environments precision management of ewes during pregnancy for improved maternal body weights and performance of their progeny by selected Merino sires with different combinations of high or low meat and wool selection indices. Precision management resulted in increased maternal body weights of 5.7 kg and 3.6 kg respectively in the above two environments but there was little associated production improvement in progeny from either group of ewes. Lambs from HH (high wool/high meat) sires had higher lamb birth weight than those from LH and HL sires with the advantage carrying through to weaning, post weaning and carcase weight. There was little effect of lamb genotype on wool production. There were no obvious genotype by environment interactions. In conclusion precision management of ewes had little effect on lamb production in the two environments while genetic selection for high growth sires showed progeny advantages in both growth and carcase weight.

Executive summary

There is a lack of information about the performance of Merinos with different genetic merit for wool and meat production in contrasting environments. Some evidence in the literature suggests management of Merino ewes to maintain good body condition during pregnancy enhances lamb survival and subsequent wool production and growth performance.

The aims of this project were to test two hypotheses –

- that progeny of Merino sire genotypes with different wool and meat merit would perform differently in two contrasting environments
- that precision management of pregnant Merino ewes to maintain maternal body weight would enhance lamb survival and growth performance in two contrasting environments

The base Merino ewes used were 37% heavier with broader wool at Turretfield compared with Chiswick. In general the precision management of ewes during pregnancy in year one had little effect on lamb performance despite control ewes being 306 kg to 5.7 kg lighter and on average about 12% leaner. At Chiswick where precision managed ewes were 11% heavier than controls lamb birth weight was higher and lamb survival lower than in controls.

Lambs from HH sires (high wool/high meat) had higher lamb birth weight than those from LH and HL (wool/meat) sires. The weight advantage for high meat sire progeny generally carried through to weaning, post weaning and for carcase weight. There was little effect of lamb genotype on wool except that HL lambs had longer staple length than HH and HL. There was no significant difference among lamb genotypes for carcase joint weights as a proportion of carcase weight. However an interesting difference in carcase fat was that LH lambs had 20% more fat than HL.

In general there were no obvious genotype by environment interactions, even though numbers of progeny were inadequate to check this thoroughly. An exception was dressing percentage where two sires, both Merinotech, showed different rankings across the two sites. The HH sire's progeny had a much lower dressing % at Chiswick than Turretfield whereas the LH sire was the other way around.

In conclusion precision management of ewes had little effect on lamb production in the two environments while genetic selection for high growth sires showed advantages in growth and carcase weight. Selection for high wool sires had little impact on fibre diameter or fleece weight. The fact that progeny from low wool sires had greater carcase fat than high wool sires in worthy of note.

Contents

1 Background

With increasing emphasis in recent years on meat production from Merinos in the Australian sheep industry it is important to determine genetic influences on wool and meat production in different environments. This study compared six selected Merino sires over each of two years selected for various combinations of high and low genetic merit for wool and meat production. The project was run in two environments including CSIRO's Chiswick site near Armidale NSW representing a temperate environment and SARDI's Turretfield site near Roseworthy SA representing a Mediterranean environment. In year one of the project precision management was included at both sites to investigate benefits of maintaining ewe maternal body weight during pregnancy.

2 Project objectives

- To implement precision management of pregnant Merino ewes for improved production in their progeny.
- To optimise wool and meat production from Merino wethers using contrasting wool/meat genotypes and strategic management.
- To investigate genotype x environment interactions for wool and meat traits in conjunction with Project 1.2.6.

3 Methodology

3.1 Animals

Approximately 750 Merino ewes were joined at each of the two sites by AI in 2006 and 2007 using six Merino sires selected for contrasting wool and meat genetic merit based on 7% Micron Premium (mainly fleece weight and fibre diameter) and Carcase Plus (post weaning weight, fat depth, eye muscle depth) selection indices. Individual sires were selected each for high wool/low meat (HL), low wool/high meat (LH), high wool/high meat (HH) and low wool/low meat (LL) each year. With three link sires used across both years a total of nine sires were included in the project. The sires with their wool and meat indices are listed in Table 1.

Table 1: Individual sires used each year with their wool/meat indices

Sire	Stud	Wool/Meat	Year used	7%	Carcase +
6090402001011573	Merinotech	HH	2006/2007	185	137
6090402001011384	Merinotech	LH	2006	115	126
6010532001011027	Tuckwood	HH	2006	202	130
5003832000012946	Hazeldeane	HL	2006	165	101
6012502000008250	Centre+	LH	2006/2007	128	109
504358200101P077	Edale	HL	2006/2007	134	107
5034712001010156	Miramoona	HL	2007	138	83
5041662004042536	Roseville Park	HH	2007	134	113
503762200505M782	Old Ash Rose	LL	2007	109	83

3.1.1 Precision management

In the first year a precision management treatment was imposed on ewes at both sites during pregnancy. The precision managed ewes were autodrafted, using RFID tags and e-sheep equipment and an algorithm to predict maternal body weight, to maintain maternal body weight and body condition score during pregnancy.
Maternal ewe body weights were estimated as the difference between observed live weight and the sum of the predicted weights of the conceptus and greasy fleece. The decision to give each ewe in the precision-managed group access to lupin supplement was based on maternal weight or condition score relative to the target condition score.
The algorithm used for this process was written in Excel and was adapted from a generalized form developed in Program 1.5.3 of the Sheep CRC. Briefly, the algorithm is based on procedures used in GrazFeed and GrassGro (Freer et al., 1997) and consists of five steps of which the first and second need only be entered once and the remaining three are repeated for each live weight download.

A more detailed description of the precision management project is given in the appended publication by Geenty *et al.* (2007).

3.1.2 Statistical analysis

Ewe traits. Data were analysed using the statistical software packages SAS (SAS Inst., Inc, Cary, NC) and ASReml (2008). For traits of the dam there were two treatment groups of ewes in 2006 with precision managed and control groups. In 2007 all animals were precision managed. Since all ewes were precision managed in 2007 body weight during pregnancy was not recorded as frequently as in 2006. Consequently the data were analysed at three discrete time points, pre-mating, 90 days post-insemination and pre-lambing. A general linear model was fitted to both body weight and condition score data at each of these time points, with the fixed effects of age of dam (2,…,7) site (Chiswick, Turretfield), year (2006, 2007), type of birth (singles, multiples), treatment (control, precision managed) nested within year and all 2 and 3-way interactions. Starting with the highest order interaction, clearly non-statistically-significant terms ($P > 0.05$) were successively dropped, ending with the final model, in which all highest-order terms were statistically significant. Litter size and litter survival were analysed with the same model, however in the case of litter size, type of birth was excluded from the model. Ewe wool profile traits (fibre diameter, standard deviation of fibre diameter, coefficient of variation of fibre diameter, staple length and curvature) were measured in 2006. The model fitted to this data included the fixed effects of age of dam, lamb type of birth and rearing (singletons raised as singletons, multiples raised as singletons, multiples raised as multiples), site, treatment and any significant 2 and 3-way interactions.

In addition calculation of maternal body weight and simple analysis of variance of these during pregnancy is given in Geenty *et al.* (2007).

Lamb traits Lamb survival to weaning (1 = alive at weaning, 0 = died before weaning) was analysed in a number of ways. The first used a linear probability model with the probit procedure in SAS. The fixed effects included in the models for lamb survival include type of birth (singleton or multiple), age of dam (2, …,7), year (2006, 2007) sire, site (Chiswick, Turretfield), genotype (HL, HH, LH), treatment nested within year (control 2006, precision 2006, precision 2007), and any significant two and three-way interactions. These data were re-analysed using a mixed model and the logit function in ASReml. Sire was fitted as a random term, and all other terms were treated as fixed effects. Birth weight and birth weight squared were also included in a separate analysis with the above fixed effects.

Lamb body weight comparisons between sites were made at birth, weaning, early post-weaning, post-weaning and yearling. As a guide the Sheep Genetics age ranges for early post-weaning, post-weaning and yearling weights were used (

Table 1). The initial model fitted to these data included the fixed effects of treatment (nested within year), genotype, site, type of birth (birth weight data only), type of birth and rearing (all traits excluding birth weight), sex, year and site, age as a covariate and all 2 and 3-way interactions that were statistically significant after backwards elimination. Sire was included in the model as a random effect.

Table 1: Sheep Genetics age ranges and the average ages at each site for weaning and post-weaning body weight traits

Trait	SG age range	Chiswick Av. Age 2006 2007	Turretfield Av. Age 2006 2007
Weaning Weight	40 - 170	102 119	75 74
Early Post-Weaning Weight	40 - 240	141 148	140 141
Post Weaning Weight	150 - 330	220 226	222 219
Yearling Weight	290 - 450	315-373 315	376 340

Of the lamb wool traits measured only greasy fleece weight was measured in both 2006 and 2007, consequently the model for greasy fleece weight included year and treatment nested within treatment as fixed effects along with those for wool quality traits. The model for these traits included age of dam, sex, type of birth and rearing, genotype, site and age (at the time of measurement) and any significant two or three-way interactions as fixed effects. Sire was also included as a random effect.

All slaughter data were analysed using a mixed model similar to the one fitted for body weight traits, with the exception that sex was not included as only wethers were slaughtered. The model included the fixed effects of age of dam, year, treatment (nested within year), genotype, site, type of birth and rearing, age (at the time of measurement) as a covariate and any significant two or three-way interactions. Sire was also fitted as a random effect.

The genotype by environment interaction was assessed in two ways. The first included fitting the above models with sire as a random effect, and then re-running the models including site by sire as a random effect. The likelihood ratio test was then used to determine if adding the extra term (site by sire) was significant. The second method fitted a sire model, where each site was assigned a separate genetic and residual variance in ASREML estimating the genetic correlation between sites for each trait. The fixed effects fitted to the sire model were the same as those described above for the trait groups. The model was re-run fixing the genetic covariance at the boundary (0.99) and using the likelihood ratio test (LRT) statistic to determine whether the genetic correlation between sites was significantly different from unity ($r_G = 1.0$; i.e. no genotype by environment interaction). The second models required the use of a pedigree which in the case of this data set was quite weak. There were 9 sires used across the 2 years (i.e. 6 sires used each year, 3 of these were used in both years). The number of progeny per sire at each site ranged from 80 – 246 for lamb survival, 60 – 218 for body weight traits, 29 -146 for wool quantity, 52 – 75 wool quality (note this is for 2006 only therefore 3 sires have no progeny records), 10 – 15 for slaughter traits. (**Error! Reference source not found.**).

4 Results and discussion

4.1 Precision management

All pregnant ewes at each site were run together. Maternal body weight estimation was commenced after setting targets after pregnancy scanning at days 40–50 of pregnancy and continued until day 120 of pregnancy. Figure 2 shows ewe live weight changes, including weights of conceptuses and fleeces, and predicted maternal body weights for the precision-management and control groups at Chiswick and Turretfield.

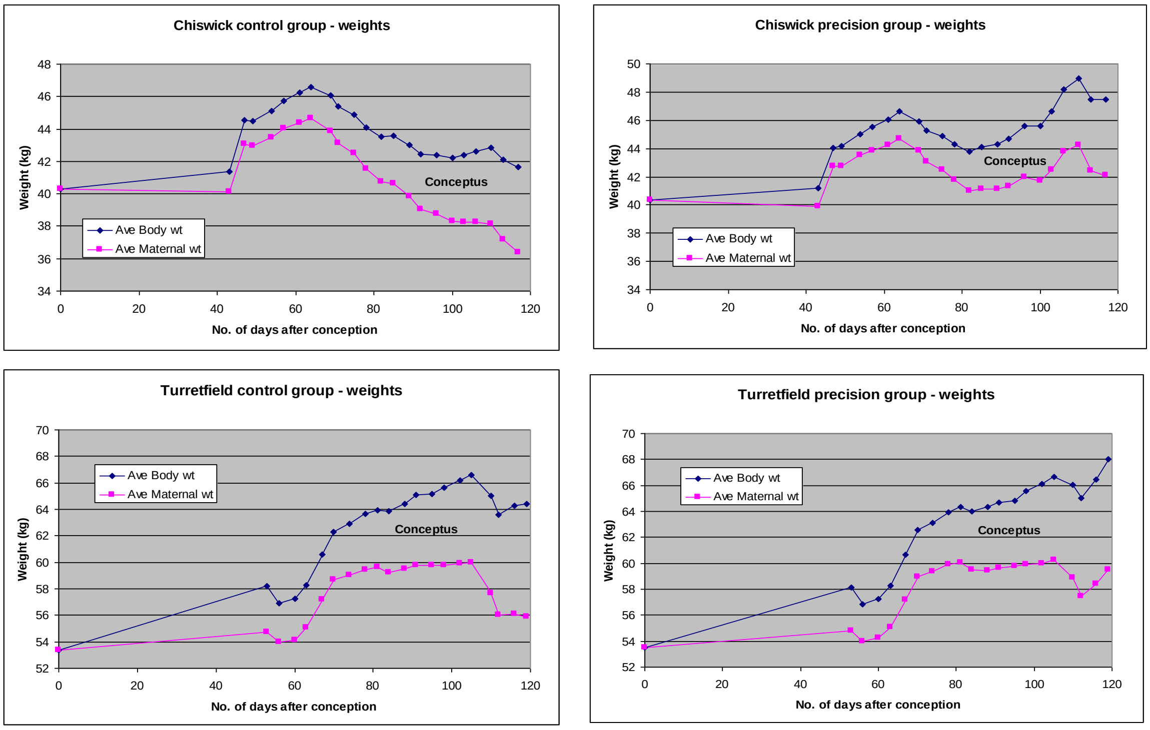


Figure 1: Ewe live weight and maternal body weight changes after conception and during the treatment period (days 40–120 of pregnancy).

The difference between ewe live weight and predicted maternal body weight at day 120 of pregnancy was similar for the precision-management and control groups (5.3 kg at Chiswick and 8.5 kg at Turretfield). Maternal body weights of ewes during pregnancy and lactation are given in Table 3.

Table 3. Maternal body weights (kg) of ewes during pregnancy (predicted) and lactation (observed) for precision-management and control groups at Chiswick and Turretfield. Standard deviations are indicated in brackets. P, pregnancy; L, lactation.

	Chiswick			**Turretfield**	
Day	Precision-management	Control	Day	Precision-management	Control
P43	40.0 (4.55)	40.1 (4.40)	P53	54.8 (8.19)	54.7 (8.43)

P82	41.0 (4.10)	40.8 (4.15)	P81	60.3 (8.50)	59.7 (8.79)
P120	42.1 (4.09)	36.4 (4.40)	P120	59.5 (8.05)	55.9 (8.02)
L38	44.8 (4.90)	42.7 (4.59)	L25	66.8 (9.40)	65.2 (9.00)
L98	47.3 (5.14)	46.6 (4.80)	L75	63.0 (8.90)	62.2 (8.40)

At both sites, the difference in maternal body weight between precision-managed and control sheep was minimal during early pregnancy but by day 120 of pregnancy, precision-managed ewes were 5.7 kg heavier than the controls at Chiswick and 3.6 kg heavier than the controls at Turretfield. After parturition, body weight differences between the precision-managed and control groups decreased at both sites to about 2 kg at lamb-marking (4–5 weeks of age) and to 0.7 kg at weaning (10–12 weeks of age) as the ewes gained weight.

Initially, the ewes were relatively light compared to industry standards, particularly at Chiswick where a high parasite burden was experienced by them prior to the trial. At both sites, there was ample pasture available. Therefore, ewes gained maternal body weight during early pregnancy on the base pasture at both sites. Consequently, the background live weights and condition scores were increased at days 78 and 106 of pregnancy at Chiswick and Turretfield, respectively, as they had been set too low, which resulted in too few of precision-management group ewes being drafted to the lupin supplement. This resulted in an absence of weight divergence between the precision-management and control groups up to this time. Alteration of the background live weights and condition scores resulted an increase in the proportion of precision-management ewes drafted to feed at Chiswick from 12% during days 40–75 of pregnancy to 80% during days 80–120 of pregnancy. The corresponding increase at Turretfield was from 23% during days 50–100 of pregnancy to 91% during days 100–120. At the same time as the background live weights and condition scores were changed, efforts were made at both sites to restrict the pasture intake of control ewes to create more weight divergence between groups. Turretfield in particular had an uncharacteristically early break to the season, which resulted in 2.1 tonnes of green DM per ha at the start of the treatment period. Paddock feed was not limiting until after the ewes were restricted to maintenance feeding at a stocking rate of 42 ewes per hectare on day 80 of pregnancy. Similarly, ewes at Chiswick had their base ration reduced to maintenance through strip grazing at day 60 of pregnancy, when feed availability was 550 kg DM/ha.

In retrospect, care is needed to ensure that ewes reach ideal background condition scores and live weights according to industry standards prior to joining in a normal season. If that is the case, condition scores and live weights during pregnancy will be closer to the targets.

The quantity of lupin supplement consumed by the precision-management group varied between sites (92 g/d at Chiswick and 380 g/d at Turretfield, where ewes were larger than at Chiswick). It was not possible to determine the cost effectiveness of the system as lamb and wool production data from the project was not available at the time of preparing this article.

If a semi- or fully-automated system is to be developed for commercial producers, remote walk-over-weighing would need to be used for data capture and drafting decisions. In the current project, observations of the Chiswick platform at both sites revealed that the proportion of ewes voluntarily going over the platform varied between sites. At Turretfield, there was little opportunity to pre-train the ewes before unseasonable pasture growth occurred, which resulted in the ewes not actively seeking supplement. Access to water and supplement was not sufficient incentive to encourage the ewes to voluntarily enter the yards and walk over the Chiswick platform. Therefore, ewes had to be forced through the Chiswick platform at Turretfield. Up to 10% of tags were not read, depending on the speed at which the ewes passed through and the amount of metal and moving parts on the platform. This resulted in a small number of Control ewes being drafted onto feed each day and a proportion of Precision-management ewes not being drafted. This probably had a minor effect on the results as this did not happen to the same ewes each day.

A similar phenomenon was observed at Chiswick but drier pasture conditions and relatively lighter conditioned ewes ensured that greater numbers of ewes voluntarily walking over the Chiswick platform (309 ewes per day over the entire treatment period from days 40–120 of pregnancy).

4.2 4.2 Litter Size and Survival

As expected dams that conceived singletons had higher (17%) litter survival than multiples. The age of the dam also influenced litter survival. In general the younger and older ewes (two, three and seven year olds) had lower litter survival than the other ewe age groups. There was no significant difference in both litter size and survival between precision managed and control ewes, or between years at each site. Furthermore when sire of the lamb was included in the model there were significant differences in 2006 for both litter size and survival between sires (Table 2). In 2007 there was no significant difference between sires in both traits. The interaction between site and sire was not significant for both traits indicating that there was no major re-ranking of sires between sites (i.e. no genotype by environment interaction) however site and the site by sire interaction were only included as fixed effects (i.e. not a genetic analysis).

Table 2: Sire differences in litter survival (standard error) and litter size (standard error) at both sites for 2006 and 2007

Sire (genotype)	Litter Survival		Litter Size	
	2006	2007	2006	2007
Centre Plus (LH)	0.78[ab] (0.04)	0.81 (0.03)	1.48[a] (0.05)	1.40 (0.04)
Edale (HL)	0.85[a] (0.04)	0.79 (0.03)	1.45[a] (0.06)	1.39 (0.04)
Hazeldean (HL)	0.74[b] (0.04)		1.46[a] (0.05)	
Merino Tech 73 (HH)	0.69[c] (0.04)	0.80 (0.03)	1.32[b] (0.05)	1.40 (0.03)
Merino Tech 84 (LH)	0.72[ab] (0.04)		1.30[b] (0.05)	
Miramoona (HL)		0.79 (0.03)		1.43 (0.04)
Old Ash Rose (LH)		0.78 (0.03)		1.41 (0.04)
Roseville Park (HH)		0.78 (0.03)		1.39 (0.04)
Tuckwood (HH)	0.75[ab] (0.04)		1.26[b] (0.05)	

Within columns, means with different superscripts denote significant differences ($P<0.05$).

Ewe Wool Quality

The main difference in wool quality in 2006 was between sites. As expected Turretfield ewes were broader (24%), had higher CVFD (5%), were 50% longer and had lower curvature (33%). Ewe management during pregnancy (i.e. treatment) had no significant impact on any of the wool quality traits (Table 3).

Table 3: Means (standard error) of each treatment at each site for wool quality traits

Trait	Chiswick		Turretfield	
	Precision	Control	Precision	Control
No. of Dams	32	39	184	183
FD	16.6 (0.2)	16.7 (0.1)	20.9 (0.2)	21.0 (0.2)
SDFD	2.73 (0.04)	2.73 (0.03)	3.66 (0.06)	3.65 (0.05)
CVFD	16.5 (0.2)	16.4 (0.2)	17.4 (0.1)	17.3 (0.1)
SL	42.6 (0.9)	43.4 (0.7)	71.7 (1.4)	71.9 (1.5)
Curve	108 (2)	110 (2)	72.0 (1)	72.8 (1)

<u>Lamb Survival</u>

With lamb survival data analysed in a number of ways (probit, logistic regression, mixed and a general linear model), all gave the same results. There was very little variation between sires (sire explained 0.2% of the phenotypic variation). The genotype by environment interaction (i.e. site by sire interaction) was not significant, indicating that lamb survival for each sires progeny was the same across sites (Table 4). As expected animals that were born as singletons had a significantly greater chance of surviving than those born as multiples, across both years at each site. Females had a 5% higher survival than males. When birth weight was fitted as a covariate there was no significant difference between singletons and multiples in lamb survival and the difference between the sexes in lamb survival increased. This indicates that the difference observed in lamb survival between singletons and multiples is largely a function of birth weight.

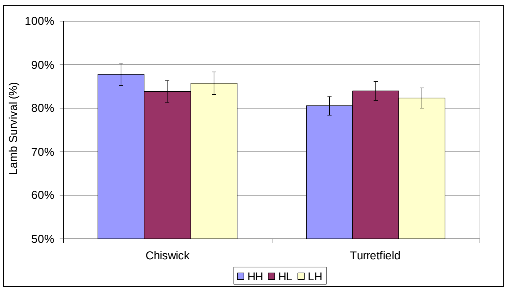
Table 4: Best linear unbiased predictions (rank) for each sire (genotype) and predicted means (standard error) for lamb survival

Sire (genotype)	**BLUP***	**2006**	**2007**
Centre Plus (LH)	0.005	0.85 (0.04)	0.87 (0.02)
Edale (HL)	0.012	0.87 (0.03)	0.89 (0.02)
Hazeldean (HL)	-0.006	0.79 (0.03)	
Merino Tech 73 (HH)	0.004	0.84 (0.03)	0.87 (0.02)
Merino Tech 84 (LH)	-0.003	0.81 (0.03)	
Miramoona (HL)	-0.005		0.83 (0.02)
Old Ash Rose (LH)	-0.002		0.85 (0.02)
Roseville Park (HH)	-0.006		0.82 (0.03)
Tuckwood (HH)	0.001	0.83 (0.03)	

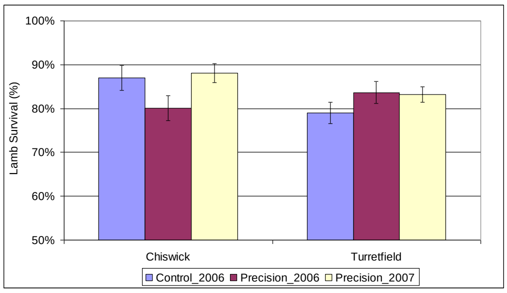
SED = 0.020

* the sire BLUPs are an EPD (expected progeny difference) representing half of the EBV in the units for the trait i.e. this is a way of ranking the random effect of sire

Furthermore, there was no difference between the sire genotypes in lamb survival (Figure 1a), regardless whether birth weight was fitted. However, there was a significant interaction between treatment and site, in 2006. Interestingly, at Chiswick the survival of lambs from the control flock was significantly higher (5%) than the precision managed flock yet at Turretfield survival was significantly higher (5%) in the precision managed flock (Figure 1b).



a)



b)

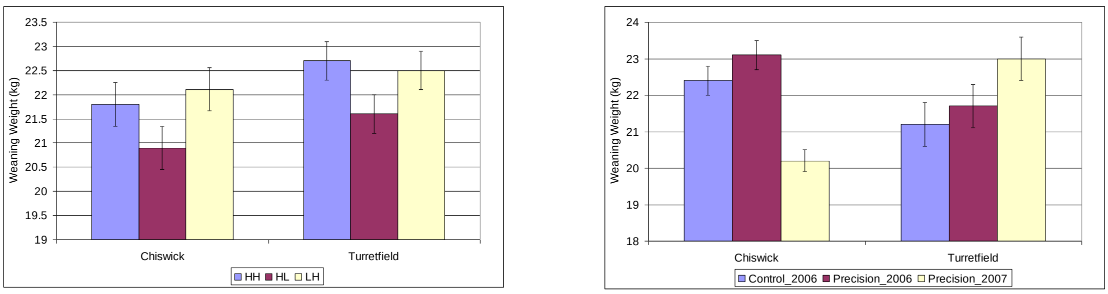
Figure 1: Differences in lamb survival between a) sites and sire genotype, and b) sites and treatment across years

<u>Pre-Weaning Body Weight and Growth</u>

As expected males were born significantly heavier than females and singletons were significantly heavier than those born as multiples (**Error! Reference source not found.**). There was a significant site by treatment interaction where lambs born to ewes that were precision managed were significantly heavier at birth than those born to control ewes in 2006 at Chiswick. In contrast at Turretfield there was no significant influence of ewe management on birth weight of the lamb. The lambs born in 2007 at Chiswick were significantly lighter at birth than those born in 2006 however at Turretfield they were significantly heavier in 2007. Interestingly those lambs whose sire was a HH (high wool, high meat) genotype were significantly heavier at birth than the other two genotypes (which were not different from one another). There was no significant genotype by environment interaction for birth weight (**Error! Reference source not found.**).

Not surprisingly males were heavier at weaning than females, and singletons were heavier than multiples raised as singletons, and multiples raised as multiples. There was no effect of ewe management during pregnancy on lamb weaning weight in 2006 at both sites (Figure 2b). The weaning weight of lambs at Chiswick in 2007 was significantly lower than for 2006 in contrast lambs were significantly heavier at Turretfield in 2007 compared with lambs weaned in 2006. Whilst age at weaning was included in the model it should be noted that the average age at weaning at Chiswick in 2006 was 97 days relative to 122 days in 2007 (

Table 1). At Turretfield animals were weaned at approximately 70 and 74 days of age in 2006 and 2007 respectively. At both sites lambs weaned from sires that had been selected for high wool and low meat were significantly lighter at both sites than those that had been selected for high meat (Figure 2a). Lambs weaned from high wool and high meat producing sires were not significantly different from those with low wool and low meat.



a) **b)**

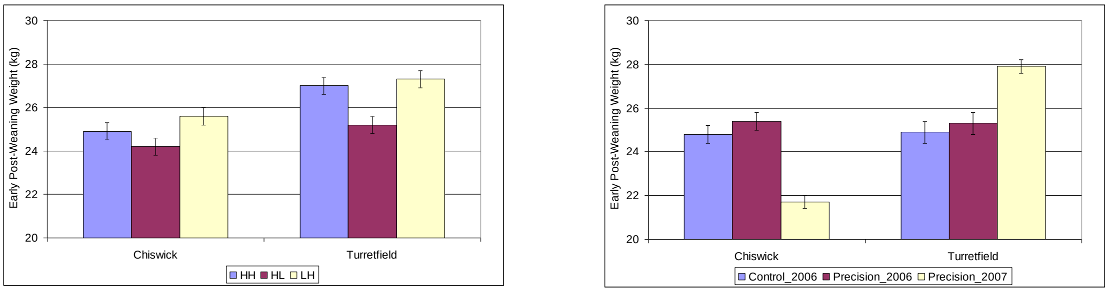
Figure 2: Differences in weaning weight between a) sites and sire genotype, and b) sites and treatment across years

The average daily gain between birth and weaning was greater in males than females. As expected singletons grew faster than multiples reared as singletons and multiples reared as multiples. Interestingly at Chiswick the genotype of the sire did not significantly influence average daily gain of lambs to weaning but at Turretfield, lambs from sires that had been selected for increased meat (irrespective of wool) grew significantly faster than those selected for superior wool traits. In general lambs from Turretfield grew faster between birth and weaning than lambs from Chiswick. As was reflected in body weight there was no difference in growth rate between lambs born to ewes that had been precision managed and those from control ewes at Chiswick, however at Turretfield those lambs from precision managed ewes grew slightly faster (3%) than lambs from control ewes. There were no significant site by sire interactions for any of the weight or growth traits, indicating that the performance of each sires progeny were similar at both sites.

Post-Weaning Body Weights and Growth

Early post-weaning weight as defined by Sheep Genetics ranges from 40 – 240 days of age (

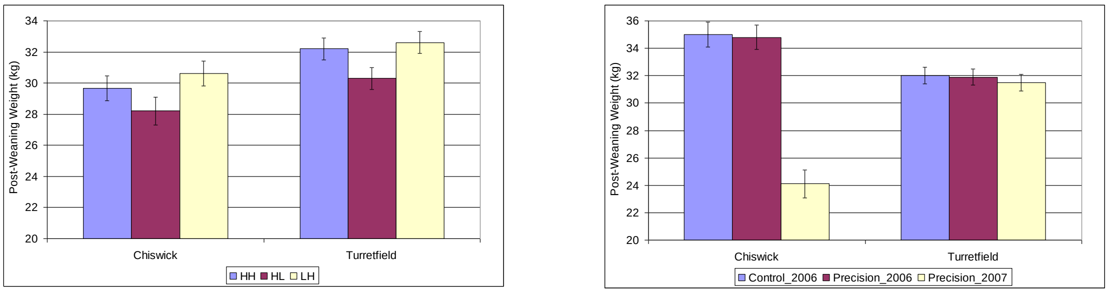
Table 1). In this study early post-weaning weight was defined as the weight at approximately 140 days of age**.** As expected males were heavier than females and singletons were heavier than multiples raised as singletons and, multiples raised as multiples. The same trends were observed in early post-weaning weight as for weaning weight where lambs from sires that had been selected for high wool and low meat were significantly lighter at both sites than those that had been selected for high meat. Lambs from high wool and high meat producing sires were not significantly different from those from low wool and low meat for early post-weaning weight. Noticeably the lambs at Chiswick in 2007 grew very little between weaning and the early post-weaning compared with 2006, however the overall trend was the same as for weaning weight (Figure 3a and b).



a) **b)**

Figure 3: Differences in early post-weaning weight between a) sites and sire genotype, and b) sites and treatment across years

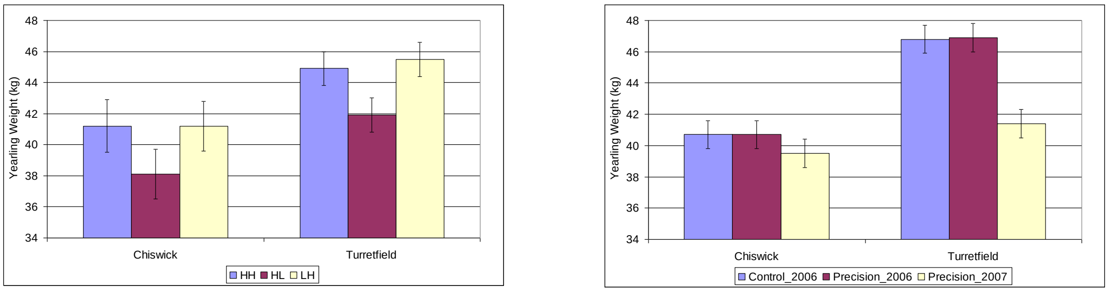
Post-weaning body weight (body weight at approximately 220 days) revealed a similar trend to the other body weight measures where males were significantly (14%) heavier than females, and singletons were significantly heavier than multiples (raised as singletons or multiples). At both sites lambs from sires with the LH (i.e. 'high meat' sires) genotype were significantly (8%) heavier than the HL (i.e. 'high wool' sires) and the HH (high wool and meat) were not significantly different from either genotype (Figure 4a). There was a significant site by treatment (nested within year) interaction driven by the large difference between years at Chiswick (Figure 4b). There was no significant difference in post-weaning body weight between lambs from ewes that were precision managed relative to the control. There was again no significant genotype by environment interaction for post-weaning weight. Interestingly weight gain between the early post-weaning and post-weaning measurement (Figure 3 and Figure 4) was significantly greater at Chiswick than at Turretfield in 2006 but not in 2007.



a) b)

Figure 4: Differences in post-weaning weight between sites and a) sire genotype and b) treatment across years

Once again, as expected yearling body weight was significantly different between males and females, and as for the other body weight traits singletons were significantly heavier than multiples raised as singletons or multiples. The influence of sire genotype was the same at each site and as for other body weight traits the HL (high wool, low meat) sires produced progeny that were significantly (8%) lighter than the high meat sires (HH and LH; Figure 5). There was no significant difference between progeny reared from ewes that had been precision managed or between years however, the yearling weight at Turretfield was approximately 10% heavier than Chiswick. In contrast to post-weaning growth, the weight gain between post-weaning and yearling measurements was greater at Turretfield in 2006 than at Chiswick. In 2007 the growth pattern was similar between the sites.

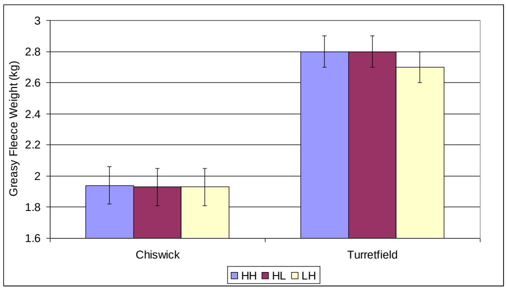


a) b)

Figure 5 Differences in yearling weight between sites and a) sire genotype and b) treatment across years

<u>Wool Growth and Quality</u>

As expected males had heavier fleeces than females, and singles had heavier fleeces than multiples raised as singles or multiples. In general the Turretfield lambs produced heavier fleeces than those from Chiswick. Interestingly there was no difference in greasy fleece weight between the progeny of sires selected for superior wool and those from sires selected for superior meat at both sites (Figure 6a). There was no significant difference between progeny from ewes that were precision managed and those that were not or between the years as Turretfield however at Chiswick fleece weights were 41% lighter in 2007 (Figure 6b). As for most of the other traits measured the addition of the site by sire interaction random term did not significantly improve the model and the genetic correlation between the sites for greasy fleece weight was not significantly different from unity indicating that there was no genotype by environment interaction.



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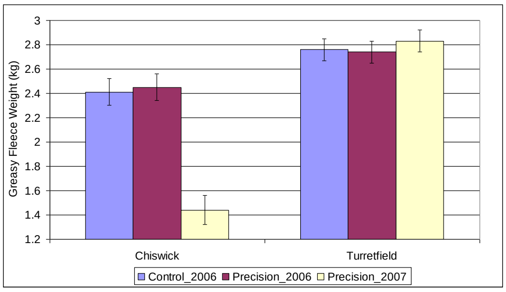


b)

Figure 6 Differences greasy fleece weight between sites and a) sire genotype, and b) treatments across years

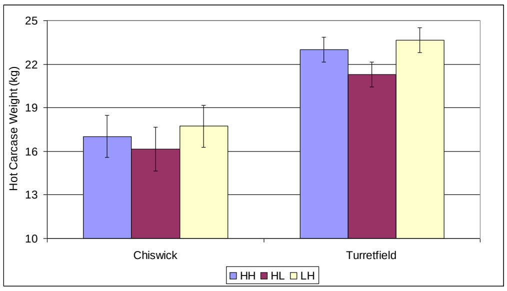
Wool quality was only measured in 2006 consequently any comparisons that are made are within this year only. Ewe management during pregnancy did not influence progeny wool quality for the five measured traits (FD, SDFD, CVFD, SL, and curvature). Surprisingly sire genotype did not influence progeny fibre diameter, coefficient of variation of fibre diameter or standard deviation of fibre diameter. However on closer inspection of the sires used Centre Plus which was chosen as a LH (low wool, high meat) sire had the lowest (i.e. most favourable) EBV for hogget fibre diameter. It is not surprising then that the progeny means for fibre diameter for Centre Plus were the lowest at each site (Table 5). There was however a significant difference between progeny from the three genotypes in staple length at both sites. Progeny from the high wool low meat (HL) sires had significantly longer staples (5%) than progeny from high wool high meat (HH) sires, and 13% longer staples than progeny from the low wool low meat sire (LH). There was no significant genotype by environment interaction for any of the wool quality traits.

Table 5 Number of progeny (n), and means (standard error) for fibre diameter (FD) and coefficient of variation of fibre diameter (CVFD) for each sire (genotype)

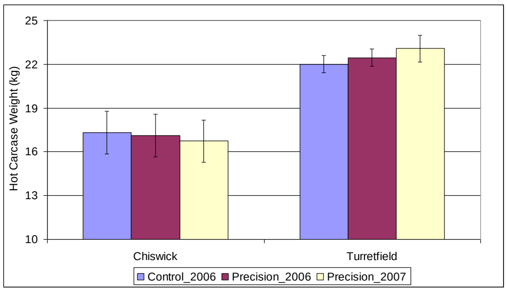
Sire	Chiswick			Turretfield		
	n	FD	CVFD	n	FD	CVFD
Centre Plus (LH)	63	16.36 (0.09)	16.46 (0.19)	71	16.09 (0.17)	19.18 (0.29)
Edale (HL)	52	17.10 (0.12)	17.39 (0.23)	64	16.57 (0.15)	20.68 (0.25)
Hazeldean (HL)	50	16.65 (0.11)	17.06 (0.20)	75	16.57 (0.15)	19.75 (0.22)
Merino Tech 73 (HH)	60	17.02 (0.11)	17.30 (0.21)	81	16.48 (0.15)	19.66 (0.22)
Merino Tech 84 (LH)	62	17.70 (0.12)	17.20 (0.21)	62	17.74 (0.19)	19.87 (0.24)
Tuckwood (HH)	55	16.83 (0.12)	16.46 (0.19)	64	16.63 (0.16)	18.82 (0.22)

Slaughter Traits

Prior to slaughter in 2006 back fat and eye muscle depth were measured. There were no differences among sire progeny means and the overall means for each site are given in Appendix Table C. The traits measured at slaughter were hot carcase weight, leg yield, loin yield, shoulder yield, carcase yield (lean meat yield), fat cover and dressing percentage. As was expected singletons had heavier carcases than multiples raised as singletons or multiples. At both sites there was a significant difference between lambs whose sires had been selected specifically for superior wool traits and not for meat traits relative to those that had been selected for superior meat, in hot carcase weight (Figure 7a). There was no significant difference between lambs reared from ewes that had been precision managed or control ewes, or between years at both sites (Figure 7b). Lambs slaughtered from Turretfield had significantly heavier carcases than those slaughtered from Chiswick.



a)



b)

Figure 7 Differences hot carcase weight between sites and a) sire genotype, and b) treatments across years

There was no significant site by sire interactions for hot carcase weight indicating that there was no re-ranking of sires between sites in progeny carcase weight. Additionally the variation between sires accounted for approximately 15% of the total variation in carcase weight. As expected the adjusted sire means and BLUPs for sires with the HL genotype were generally lower than those with the LH and HH genotype (Table 6).

Table 6 Adjusted Best linear unbiased predictions (rank) and predicted means (standard error) for hot carcase weight across both sites

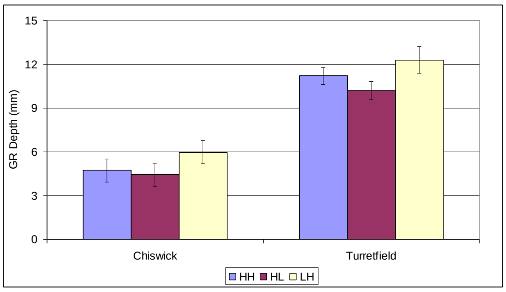
Sire (genotype)	BLUP*	2006	2007
Centre Plus (LH)	1.310	20.2 (1.2)	21.5 (0.7)
Edale (HL)	0.131	19.0 (1.3)	20.1 (0.7)
Hazeldean (HL)	-1.565	17.3 (1.3)	
Merino Tech 73 (HH)	0.917	19.8 (1.2)	20.9 (0.7)
Merino Tech 84 (LH)	-0.513	18.4 (1.2)	
Miramoona (HL)	-1.995		18.0 (0.7)
Old Ash Rose (LH)	2.215		22.2 (0.7)
Roseville Park (HH)	-0.777		19.2 (0.7)
Tuckwood (HH)	0.357	19.2 (1.2)	

Within columns, means with different superscripts denote significant differences (P<0.05). SED = 0.917

* the sire BLUPs are an EPD (expected progeny difference) representing half of the EBV in the units for the trait i.e. this is a way of ranking the random effect of sire

Despite differences between sire genotypes in carcase weight there were no significant differences in leg, loin, shoulder or overall lean meat yield (from Viascan) indicating that whilst the carcases of lambs from high meat EBV sires were heavier, the proportion or percentage of meat yield was still the same. There was however a difference between sires selected specifically for superior wool traits to those sires selected for superior meat in progeny fat depth independent of site (Figure 8a). Progeny from sires with the LH (low wool, high meat) genotype had 20 % more fat than those from the HL genotype (high wool, low meat). Ewe management had no impact on progeny fat cover (Figure 8b). As for hot carcase weight there was no significant site by sire interaction for any of the yield or fat traits.

a)



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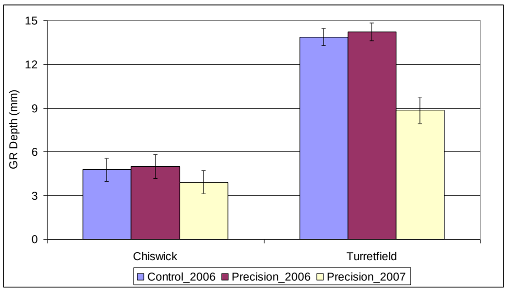

Figure 8 Differences in predicted GR fat between sites and a) sire genotype, and b) treatments across year

Dressing percentage of the lambs (D%) was the only trait measured at slaughter where there was an indication of genotype by environment interaction (Likelihood ratio test = 0.0, r_G = 0.64 between sites). This indicates there was re-ranking of sires at each site for progeny dressing percentage.

Table 7 contains the BLUPs for sires at both sites. Interestingly, Merino Tech 73 appeared to perform better at Turretfield than at Chiswick in both years (

Table 7). In contrast Merino Tech 84 appeared to be better suited to Chiswick than Turretfield. It should be highlighted that this is a very small data set to detect genotype by environment interactions, and using site as the definition of environment is not always appropriate. There was no significant impact of ewe nutrition during pregnancy on progeny dressing percentage. Although not quite significant (P=0.08) progeny from the LH genotype had higher dressing percentages (at both sites) than the progeny from the other two genotypes.

Table 7 Best linear unbiased predictions (rank) and predicted means (standard error) for dressing percentage at each site

	BLUP*		**Mean**	
Sire (genotype)	**Chiswick**	**Turretfield**	**Chiswick**	**Turretfield**
Centre Plus (LH)	0.269 (1)	0.029 (3)	41.6 (1.1)	44.1 (0.5)
Edale (HL)	0.251 (2)	-0.209 (6)	41.1 (1.1)	43.3 (0.5)
Hazeldean (HL)	-0.062 (7)	-0.170 (5)	40.3 (1.2)	42.8 (0.6)
Merino Tech 73 (HH)	**-0.516 (9)**	**0.595 (1)**	40.5 (1.1)	44.2 (0.5)
Merino Tech 84 (LH)	**0.163 (3)**	**-0.290 (8)**	40.8 (1.1)	42.9 (0.6)
Miramoona (HL)	-0.169 (8)	-0.008 (4)	40.4 (1.1)	43.1 (0.6)
Old Ash Rose (LH)	0.029 (5)	0.577 (2)	42.0 (1.1)	45.1 (0.6)
Roseville Park (HH)	-0.020 (6)	-0.306 (9)	40.2 (1.1)	42.6 (0.5)
Tuckwood (HH)	0.136 (4)	-0.230 (7)	40.8 (1.1)	43.1 (0.6)

SED = 0.875

* the sire BLUPs are an EPD (expected progeny difference) representing half of the EBV in the units for the trait i.e. this is a way of ranking the random effect of sire

5 Success in achieving objectives

5.1 Precision management

Achievement of heavier maternal body weights through precision management was successful though this had little impact on progeny performance.

5.2 Optimising wool and meat production from Merinos

Selection of high growth sires had advantages in growth rate and carcase weight of their progeny.

5.3 Genotype by environment interactions

In general there were no obvious G x E interactions though two sires showed small dressing % interactions.

6 Impact on meat and livestock industry – Now and in five years time

6.1 Precision management

Even though pregnancy precision management in this project failed to show production benefits in progeny the technology worked in achievement of differential ewe maternal body weights. It is anticipated this technology will have more beneficial impacts when used more in conjunction with specialist lamb finishing i.e. meeting predicted live weight targets.

6.2 Genetic improvement

Selection of high growth sires (carcase plus index) will result in continued genetic improvement for growth rate and carcase weight, of the order of 5-8% compared with low growth sires.

7 Conclusions and recommendations

The precision management technology worked in terms of achieving differential live weights and this will have application with other classes of stock. However the technology requires further refinement both in terms of automated walk over weighing and/or mob based walk over weighing.

Failure of increased ewe maternal body weights in this project to positively impact on productivity of progeny was surprising and it is still recommended that LifetimeWool condition score targets of 2.5-3.0 during pregnancy be adopted.

Ongoing use of selection indices such as carcase plus are recommended for continued genetic improvement in growth rate and carcase weight.

The absence of significant genotype by environment interactions for wool or meat in the two contrasting environments were surprising though numbers were not large enough to rigorously test this. Therefore caution is still recommended in using sires accross such contrasting environments without evidence there are no detrimental impacts on productivity.

8 Bibliography

Geenty, K.G., Smith, A.J., Dyall, T.R., Lee, G.J., Smith, D., Brewer, H., Uphill, G.C. (2007). Remote drafting technology for management of pregnant Merino ewes. Recent Advances in Animal Nutrition in Australia. 16:*223-228.*

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9 Appendices

9.1 Appendix 1 Geenty *et al.* (2007).

Remote drafting technology for management of pregnant Merino ewes

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Abstract

The development of a remote sheep drafting system to manage pregnant Merino ewes by selective supplementary feeding to achieve target ewe maternal body weight and condition score is described. Semi-automated data capture and an algorithm for predicting foetal weight were used to predict ewe maternal body weight and determine drafting instructions for selective feeding of individual ewes. The project was replicated at Chiswick in New South Wales and at Turretfield in South Australia. Divergence in maternal body weight between precision-managed sheep and controls at day 120 of pregnancy, when selective feeding ceased, was 5.7 kg and 3.6 kg at Chiswick and Turretfield, respectively. These differences in maternal body weights decreased at both sites to 2 kg at marking (4–5 weeks of age) and 0.7 kg at weaning (10–12 weeks of age). Determination of ewe live weight and condition score targets was problematic. Observations of voluntary walk-over-weighing of the ewes in parallel with semi-automated fixed weighing revealed that 300 ewes passed over the platform daily at Chiswick. However, at Turretfield, where more green pasture was available, very few ewes passed over the walk-over-weighing platform because they required less drinking water than those at Chiswick. The average amounts of lupin supplement consumed by precision-managed ewes from Days 45–120 of pregnancy were 92 g/d and 380 g/d at Chiswick and Turretfield, respectively.

Keywords: e-sheep management, pregnant Merino ewes, ewe maternal body weight, lupin supplementation

Introduction

Management of pregnant Merino ewes to maintain good ewe body weight and condition score during pregnancy improves lamb survival, wool staple strength and results in finer wool production by the progeny (Thompson and Oldham, 2004; Behrendt et al. 2006). These benefits are of interest to sheep producers because they affect profit. Achievement of uniform live weight and condition score within a flock of pregnant ewes is difficult because of variation in pregnancy status and variation between individuals. One means of overcoming this problem is by targeted feeding of individual ewes according to requirements and live weight performance. In this article, we describe results from a study in which a remote drafting system was used to achieve ewe live weight and condition score targets.

Materials and methods

Animals and management

At Chiswick, New South Wales, and Turretfield, South Australia, 376 and 384 mixed age Merino ewes, respectively, were used. The ewes had been artificially inseminated to the same six Merino sires in mid (Turretfield) and late March 2006 (Chiswick). At Chiswick, the flock included fine-wool ewes and at Turretfield, the flock consisted of a mixture of fine -wool ewes and larger-framed South Australian strain ewes. At each site, the ewes were examined by ultrasound scanning at 40–50 days of pregnancy to determine the number of foetuses. The average foetal number was 1.32 per ewe at Chiswick and 1.49 per ewe at Turretfield. Pregnant ewes were allocated by restricted randomization after pregnancy scanning to precision-management or control groups balanced for age, sire and foetal number. The precision-managed and control groups were managed as one flock according to local commercial practice on ryegrass–phalaris pastures at Chiswick and barley grass–subterranean clover pastures at Turretfield with the aim of meeting nutrient requirements for pregnancy. All ewes were fitted with full-duplex radio-frequency ear tags. Half-duplex tags were replaced with full-duplex tags in late July because of interference between the two weighing systems. From 45 days of pregnancy (Chiswick) or 55 days of pregnancy (Turretfield) to 120 days of pregnancy, the ewes were individually monitored during twice-weekly weighing of both groups. Precision-managed ewes were drafted to a yard where they received lupin grain supplement *ad libitum* as determined by the prediction algorithm. The precision-managed ewes offered lupin supplement had the option of voluntarily returning to pasture or re-entering the lupin feeding area via a walk-over-weighing platform that was placed in parallel with a fixed weighing platform. Between day 120 of pregnancy and parturition, both groups were offered pasture only.

At 30 day intervals, condition scores and faecal egg counts were recorded and wool samples were taken for measurement of fibre diameter and staple profile. Ewes lambed in sire groups and all lambs born were ear-tagged and weighed at birth and identified according to their dams. Greasy fleece weight was recorded at ewe shearing and a mid-side sample was taken. Growth of lambs will be monitored until slaughter of males at 48–50 kg and hogget shearing of ewe progeny. Results for ewe wool and lamb production will be reported elsewhere.

Ewe maternal weight

Maternal ewe body weights were estimated as the difference between observed live weight and the sum of the predicted weights of the conceptus and greasy fleece. The decision to give each ewe in the precision-managed group access to lupin supplement was based on maternal weight or condition score relative to the target condition score.

The algorithm used for this process was written in Excel and was adapted from a generalized form developed in Program 1.5.3 of the Sheep CRC. Briefly, the algorithm is based on procedures used in GrazFeed and GrassGro (Freer et al., 1997) and consists of five steps of which the first and second need only be entered once and the remaining three are repeated for each live weight download. The five steps were as follows:

Condition score targets

The user nominates the condition score at which they want the ewes maintained. Within this page, options are available to have one target condition score throughout pregnancy or different targets at various stages of pregnancy (until days 100, 130 and 150) and different targets for single- and multiple-bearing ewes. In this study, single targets were set on day 43 of pregnancy for a condition score of 2.5 (Chiswick) and on day 53 for a condition score of 3.5 (Turretfield). The target condition score for Chiswick was changed to 3.0 on day 78 of pregnancy according to industry recommendations.

Background data

Information specific to each ewe that is assumed not to change is required. It is also assumed that the ewes are mature. These data include: a live weight for each ewe obtained when she was not lactating and a skilled assessment of her condition score, which enables estimation of her standard reference weight (live weight at condition score 3; Freer et al., 1997), and an indication of mature frame size. At Chiswick, the initial live weights and condition scores of individual ewes were entered for day 43 of pregnancy; weight recorded on day 54 was entered for day 78 of pregnancy (Table 1).

Table 1. Mean ewe live weights and condition scores at Chiswick.

	Control ewes		Precision-management ewes	
Day	**Live weight (kg)**	**Condition score**	**Live weight (kg)**	**Condition score**
43	41.4	2.6	41.2	2.6
54	45.6	3.1	45.6	3.1

At Turretfield, the initial live weights and condition scores of individual ewes were set at day 53 and changed to the weight recorded on day 81 on day 106 of pregnancy (Table 2).

Table 2. Mean ewe live weights and condition scores at Turretfield.

	Control ewes		Precision-management ewes	
Day	**Live weight (kg)**	**Condition score**	**Live weight (kg)**	**Condition score**
53	58.2	3.6	58.2	3.6
81	63.9	3.9	64.3	3.9

Estimates of 12 month greasy fleece weight and the last shearing date are required. The nominal greasy fleece weights were 3.75 kg and 6.00 kg for Chiswick and Turretfield, respectively. Previous shearing dates were 13 February 2006 and 18 January 2006 for Chiswick and Turretfield, respectively.

Foetal number and an estimate of conception date are required. Many scanners enable the relative age of the foetus to be estimated (early, mid or late conception), which can be used to calculate an approximate conception date. For example, for a ewe classed as having an early conception over a six-week joining period, the estimated conception date would be the end of the first week of the joining period. In our study, the ages of foetuses were equal because synchronized artificial insemination was used. The foetal number of each ewe was obtained using pregnancy scanning.

Download weight

Data on live weights and the dates of each weighing for each ewe were downloaded from files stored by the scales (Trutest indicator). The incoming weights were screened to ensure validity.

Calculation of maternal weight

Initially, mean liveweight is calculated from the available valid weights to accommodate situations where multiple weights are available for individual ewes. Greasy fleece weight is estimated from the date of the latest live weight. Conceptus weight is estimated from body condition at the last weighing, foetal number, foetal age and the ewe's standard reference weight (Freer et al., 1997, equation 62 and parameters derived from equations 57–61).

Current maternal weight is derived using estimates of the weight of the greasy fleece and the conceptus. The estimated condition score (one condition score unit is equivalent to 0.15 standard reference weight) is compared to the target condition score for that parity and foetal age to determine the drafting group (1 = not pregnant; 2 = single-bearing, above target condition score; 3 = multiple-bearing, above target condition score; 4 = single-bearing, below target condition score, 5 = multiple-bearing, below target condition score). Single- and multiple-bearing ewes below target condition scores were drafted to receive the lupin supplement.

Upload draft file

Data containing the tag number, drafting group and other optional fields determined by the user are entered in an electronic file for input to the remote drafter. In our trial, a comma delimited file with drafting instructions based on the preceding two live weights was downloaded weekly to the

Trutest indicators attached to the Prattley and the Chiswick platforms. Data obtained from voluntary ewe movements across the Chiswick walk-over-weighing system were not used for calculating drafting instructions.

System configuration and equipment

The system configuration for management of ewes, data capture and auto drafting is shown in Fig. 1.

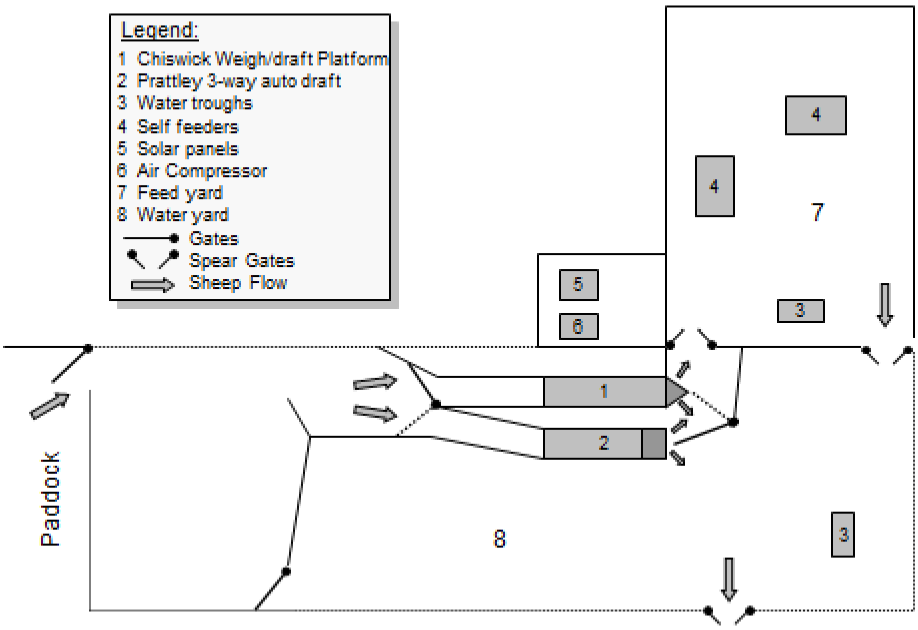

Figure 1. Configuration used for weighing, drafting, lupin feeding and paddock access.

The holding yards were large enough to hold up to 400 ewes. The two weighing systems were set up in parallel. Live weight data were obtained from twice weekly fixed weighing and the Chiswick platform was used to test the feasibility of completely automated walk-over-weighing and drafting. Weights from the fixed weighing were downloaded to a computer and after calculation of ewe maternal body weights and condition scores in relation to targets for precision-managed ewes, a new draft file was created and uploaded to the Trutest indicators on both weighing systems. The ewes were auto-drafted according to predicted maternal body weights from the previous two fixed weighings. Animals in the precision-management group that were below the maternal body weight target were drafted through non-return spear gates to allow them access to lupins *ad libitum* plus water or to water only. Animals then returned to their original feed paddock along with the control group.

As ewes entered the Chiswick platform, the rear gates closed when weight was applied to the base and the electronic tags were recorded by panels or a portal antenna as the ewes walked through the platform. The program logic controller interrogated the Trutest indicator for a draft instruction once the tag was recorded and then sent a draft instruction to the drafting gate. As ewes exited the platform, the rear gates opened for the next ewe to enter. Sheep entered the system as they required water or lupin supplement with no human intervention. The equipment in each of the two weighing-drafting platforms was as follows:

1. Fixed weighing using the Prattley three way auto drafter:
    a. Prattley weigh crate fitted with Trutest load cells,
    b. Three-way drafter linked to the front of the weighing crate,
    c. A 12 volt solar-powered compressor with three solar panels and gel batteries for pneumatic operation of drafting gates

d. Allflex portal antenna mounted inside the weighing crate, which read the electronic sheep tag information (full and half duplex),
e. Trutest indicator XR3000, which recorded electronic tag and live weight information and sent instructions to the drafting control box located on top of the framework to operate drafting gates,
f. Hand held remote control for operating the entry gate to the weighing crate.

2. Chiswick remote individual animal management platform
   a. An automated entry gate system, which operated as the sheep moved on and off the platform to separate individuals,
   b. A 2.5 m platform with a rear gate and a two-way drafter at the front,
   c. Trutest indicator XR3000 linked to the program logic controller to deliver drafting instructions to the pneumatic draft gates,
   d. Trutest load cells,
   e. Allfex flexi panels which read electronic sheep tags linked to the Trutest indicator,
   f. Solar panels, three gel batteries and a compressor to power the drafter,
   g. Capability to record walk-through weights and to draft from wireless information downloaded via a data modem connected to an office computer. However, because of restrictions on the number of ports on the Trutest indicator, it was not possible to weigh, draft and remotely download data at the same time. Consequently, data were manually downloaded from the indicator to an office computer.

Results and Discussion

All pregnant ewes at each site were run together. Maternal body weight estimation was commenced after setting targets after pregnancy scanning at days 40–50 of pregnancy and continued until day 120 of pregnancy. Figure 2 shows ewe live weight changes, including weights of conceptuses and fleeces, and predicted maternal body weights for the precision-management and control groups at Chiswick and Turretfield.

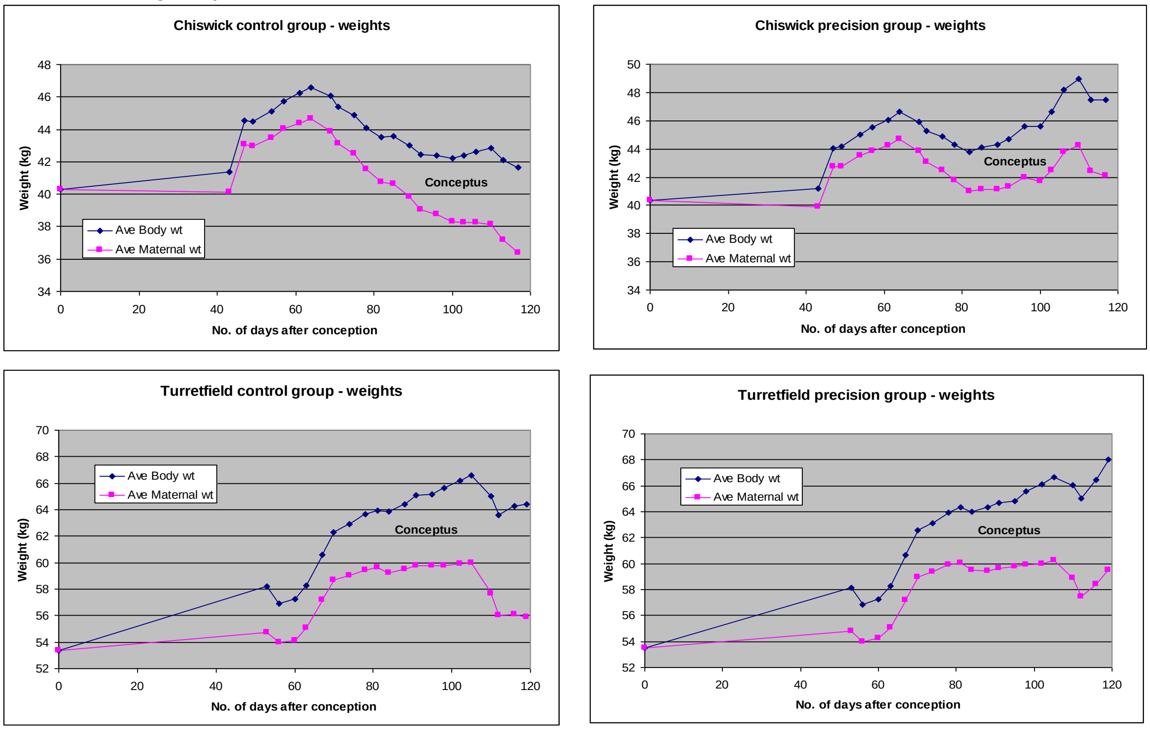

Figure 2. Ewe live weight and maternal body weight changes after conception and during the treatment period (days 40–120 of pregnancy).

The difference between ewe live weight and predicted maternal body weight at day 120 of pregnancy was similar for the precision-management and control groups (5.3 kg at Chiswick and 8.5 kg at Turretfield). Maternal body weights of ewes during pregnancy and lactation are given in Table 3.

Table 3. Maternal body weights (kg) of ewes during pregnancy (predicted) and lactation (observed) for precision-management and control groups at Chiswick and Turretfield. Standard deviations are indicated in brackets. P, pregnancy; L, lactation.

	Chiswick			**Turretfield**	
Day	Precision-management	Control	Day	Precision-management	Control
P43	40.0 (4.55)	40.1 (4.40)	P53	54.8 (8.19)	54.7 (8.43)
P82	41.0 (4.10)	40.8 (4.15)	P81	60.3 (8.50)	59.7 (8.79)
P120	42.1 (4.09)	36.4 (4.40)	P120	59.5 (8.05)	55.9 (8.02)
L38	44.8 (4.90)	42.7 (4.59)	L25	66.8 (9.40)	65.2 (9.00)
L98	47.3 (5.14)	46.6 (4.80)	L75	63.0 (8.90)	62.2 (8.40)

At both sites, the difference in maternal body weight between precision-managed and control sheep was minimal during early pregnancy but by day 120 of pregnancy, precision-managed ewes were 5.7 kg heavier than the controls at Chiswick and 3.6 kg heavier than the controls at Turretfield. After parturition, body weight differences between the precision-managed and control groups decreased at both sites to about 2 kg at lamb-marking (4–5 weeks of age) and to 0.7 kg at weaning (10–12 weeks of age) as the ewes gained weight.

Initially, the ewes were relatively light compared to industry standards, particularly at Chiswick where a high parasite burden was experienced by them prior to the trial. At both sites, there was ample pasture available. Therefore, ewes gained maternal body weight during early pregnancy on the base pasture at both sites. Consequently, the background live weights and condition scores were increased at days 78 and 106 of pregnancy at Chiswick and Turretfield, respectively, as they had been set too low, which resulted in too few of precision-management group ewes being drafted to the lupin supplement. This resulted in an absence of weight divergence between the precision-management and control groups up to this time. Alteration of the background live weights and condition scores resulted an increase in the proportion of precision-management ewes drafted to feed at Chiswick from 12% during days 40–75 of pregnancy to 80% during days 80–120 of pregnancy. The corresponding increase at Turretfield was from 23% during days 50–100 of pregnancy to 91% during days 100–120. At the same time as the background live weights and condition scores were changed, efforts were made at both sites to restrict the pasture intake of control ewes to create more weight divergence between groups. Turretfield in particular had an uncharacteristically early break to the season, which resulted in 2.1 tonnes of green DM per ha at the start of the treatment period. Paddock feed was not limiting until after the ewes were restricted to maintenance feeding at a stocking rate of 42 ewes per hectare on day 80 of pregnancy. Similarly, ewes at Chiswick had their base ration reduced to maintenance through strip grazing at day 60 of pregnancy, when feed availability was 550 kg DM/ha.

In retrospect, care is needed to ensure that ewes reach ideal background condition scores and live weights according to industry standards prior to joining in a normal season. If that is the case, condition scores and live weights during pregnancy will be closer to the targets.

The quantity of lupin supplement consumed by the precision-management group varied between sites (92 g/d at Chiswick and 380 g/d at Turretfield, where ewes were larger than at Chiswick). It was not possible to determine the cost effectiveness of the system as lamb and wool production data from the project was not available at the time of preparing this article.

If a semi- or fully-automated system is to be developed for commercial producers, remote walk-over-weighing would need to be used for data capture and drafting decisions. In the current project, observations of the Chiswick platform at both sites revealed that the proportion of ewes voluntarily going over the platform varied between sites. At Turretfield, there was little opportunity to pre-train the ewes before unseasonable pasture growth occurred, which resulted in the ewes not actively seeking supplement. Access to water and supplement was not sufficient incentive to encourage the ewes to voluntarily enter the yards and walk over the Chiswick platform. Therefore, ewes had to be forced through the Chiswick platform at Turretfield. Up to 10% of tags were not read, depending on the speed at which the ewes passed through and the amount of metal and moving parts on the platform. This resulted in a small number of Control ewes being drafted onto feed each day and a proportion of Precision-management ewes not being drafted. This probably had a minor effect on the results as this did not happen to the same ewes each day.

A similar phenomenon was observed at Chiswick but drier pasture conditions and relatively lighter conditioned ewes ensured that greater numbers of ewes voluntarily walking over the Chiswick platform (309 ewes per day over the entire treatment period from days 40–120 of pregnancy).

Conclusions

This is a report of work in progress. Minor modifications to the platform will be made to attempt to reduce the number of misdrafts caused by missed tag readings. These include increasing the length of the platform, installing more effective baffles to reduce the speed of the sheep, replacing metal parts and altering the position of the tag readers. It is anticipated that during the second year of this project, the normal seasonal conditions and use of ewes in better initial body condition will yield better results in terms of targeted feeding of a smaller proportion of ewes. It is envisaged that a greater proportion of ewes will be encouraged to take the voluntary option of walk-over-weighing, which will assist in the development of a fully automated remote system. The cost effectiveness of the system will be evaluated after a second year of operation once effects on lamb survival, lamb growth and ewe wool production have been measured and analysed.

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