

SA Merino Sire Evaluation Site: 2018 drop carcass outcomes
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Summary

The SA Merino Sire Evaluation Site received support from the SA Sheep Industry Fund to collect carcass information on hard to measure traits associated with feedlot performance, carcass value and eating quality for the 2018 drop wethers. Feedlot exit weight, carcass weight, fat depth, eye muscle area (function of width and depth), intramuscular fat percentage (IMF%), shear force and carcass pH were all recorded. Overall, carcass outcomes for the cohort were excellent for eating quality, with only 7% carcasses having IMF% below lower level for consumer acceptance of 4%. There were only minor differences between sire differences in IMF% but larger differences in shear force (measure of tenderness). All data has been submitted to AMSEA for inclusion in Sheep Genetics evaluation.

Introduction

The high price of lamb coupled with high consumer expectation has driven the urgency for the Australian lamb supply to ensure it is able to consistently supply high eating quality product. Good meat-eating quality is driven by multiple traits which are influenced by genetic and environmental effects. Two key traits are intramuscular fat % and shear force. For good eating quality a benchmark of 4% intramuscular fat and a shear force of 49 Newtons or less has been proposed (Hopkins *et al.* 2006).

Project purpose and outcomes

- Collect individual animal data, including carcass traits and eating quality traits (intramuscular fat % (IMF%) and shear force (SF5)) for progeny of 16 rams.
- Contribute to the provision of an independent ram benchmarking service for merino sires within South Australia to inform on sire selection, increase breeding value accuracy of relatives and augment the reference population for these traits through completion of the following activities:
 - 2018 Keyneton drop wether lambs to be processed
 - Individual animal information to be recorded for average gain in feedlot, carcass weight, dressing percentage, C-fat, eye muscle depth and predicted lean meat yield collected and analysed
 - Individual animal IMF% and SF5 samples to be collected and analysed.

Methods

208 wether lambs from 16 sires were transported from Keyneton Station to Thornby feedlot on June 19th 2019. Lambs were finished as a single group at Thornby feedlot prior to being transported to Thomas Foods International sheep processing facility at Lobethal on August 21st 2019. Feedlot exit weight were recorded for each lamb. Lambs were processed on August 22nd 2019 at Thomas Foods International Lobethal facility. All lamb carcasses were manually tagged to link with electronic identification.

Abattoir measurements

Hot standard carcass weight (HSCW) was measured and recorded upon entering the chiller. Measurements of pH and temperature were recorded upon entrance, again 3 hours post slaughter and 24 hours post slaughter. The pH and temperature of the lamb carcasses were measured by probe insertion in the left dorsal of the *M. longissimus lumborum* (LL). GR fat depth (mm) was recorded by using a GR knife that is inserted into the carcass at the 12th rib at approximately 110mm from the backline. The carcasses were kept in the chiller overnight at 0-4 °C.

At 24 hours post-slaughter all lamb carcasses had the ultimate pH of the LL recorded. The carcasses then entered the boning room where the mid-loin was removed from the carcass at the 1st -6th thoracic vertebrae. Each mid-loin cut had a label that was linked to a specific carcass. The eye muscle depth and width was measured on the cut edge, caudal end of the *M. longissimus lumborum* as well as the fat depth (CFAT) at the C-site. The eye muscle area (EMA) was calculated by multiplying the depth and width of the *M. longissimus lumborum*, then multiplied by 0.8 (Plant and Maden 1996). Two samples of each mid-loin were taken, approximately 30g minced for IMF% analysis and approximately 65g sample for shear force analysis. The two sample types were stored in vacuum sealed bags and aged for 5 days at 4°C. After the 5 days the samples were frozen and stored in -20°C (Sheep CRC 2009). Lean meat yield (LMY) percentage was calculated with consideration to both HSCW and GR fat (Smith, 2018).

Intramuscular fat and shear force analysis

Intramuscular fat percentage of *M. longissimus lumborum* as determined using the procedure of near infrared (NIR) of samples that are freeze-dried. IMF% was only recorded on 99 progeny. The frozen shear force samples were cooked in a water bath at 71 °C for 35 minutes. To stop the cooking process the samples were placed in an ice bath for 15 minutes. A pre and post cook weight was recorded and the shear force measurements (Newtons) were taken by using a Lloyd LRX texture analyser fitted with a Warner-Bratzler head, with a crosshead speed of 100.00ml/min. The shear force value was recorded by the mean of six samples from the 65g *M. longissimus lumborum* sample. If the coefficient of variation was 24% or greater the median value is reported for the shear force (SF5) value (Sheep CRC 2009).

Statistical analysis

Data was analysed using R software, version 3.5.2 with the ASREML package. Linear mixed models were fitted as described below:

- a) Model A for feedlot exit weight with gestation type (single vs. twin pregnancy) fitted as a fixed effect and sire as a random effect
- b) Model B for all other traits with gestation type fitted as a fixed effect and sire as a random effect
- c) Model C, same as model B but with a cold carcass weight covariate

A sire model was fitted to the data with sire variance, residual variance and heritability's estimated by using the univariate model. Carcasses that were trimmed were removed from the dataset where carcass weight was fitted as a covariate. For eye muscle width and depth, eye muscle area, CFAT, LMY, IMF, shear force and ultimate pH, the covariate cold carcass weight was fitted. For IMF, an additional model was fitted with sire as a fixed effect. In addition Model D was fitted specific to IMF. This model comprised fixed effects for gestation status, \pm weight covariate, and sire.

Results and discussion

Traits reported on in Table 1 are animal live weight, carcass weight, GR fat, C fat, EMD, EMW, lean meat yield, IMF% and shear force (SF, newtons). For each trait average, minimum, maximum and standard deviation are reported. No adjustments have been made for type of birth (single vs. twin). As expected in a progeny test, there was large variation across the cohort. This is important and demonstrates differences in performance between individuals within the same lifetime management group. Importantly, on average the wethers were finished to a heavy carcass specification (28kg, Table 1) on a grain ration. This has enabled significant expression of genetic merit for growth, carcass composition (muscle and fat) and traits linked with eating quality (IMF% and SF). On average, the wethers had very good IMF% and SF relative to cut offs at which consumers typically downgrade lamb. Only 7% lambs were below 4% IMF, which is considered a lower threshold before consumers typically downgrade lamb.

Table 1. Unadjusted weight, carcass weight, composition and eating quality measurements.

Trait	Mean	Min	Max	SD	CV (%)
Feedlot Exit Liveweight (kg)	62.65	44.4	88.5	8.92	14.24
Hot Carcass Weight (kg)	28.4	19.1	43.6	4.73	16.36
Cold Carcass Weight (kg)	27.5	18.5	42.3	4.59	16.36
GR Fat (mm)	25.97	10	40	6.54	25.2
EMD (mm)	29.79	20	42	4.16	13.98
EMW (mm)	64.5	52	80	5.08	7.88
EMA (cm ²)	15.41	8.8	23.38	2.7	17.53
C Fat (mm)	4.81	1	12	2.14	44.5
LMY (%)	53.19	49.24	62.14	1.97	3.7
IMF (%)	5.84	3.48	10.47	1.51	25.8
Shear Force (Newtons)	29.38	16.87	49.2	5.89	20.05
Ultimate pH	5.46	4.96	5.8	0.11	2.1

Results for feedlot exit weight are presented below (Table 2). Single born lambs (as per gestation status) were on average 4.05kg heavier at feedlot exit than twin born lambs. Estimated heritability aligns with prior publication for sheep live weight. Sire effects were significant.

Table 2. output for feedlot exit weight including tests of significance, variance components, gestation status effects and sire predicted means (model A)

Feedlot Exit Wt	
Test of Significance	
P-value	0.001
Variance Components	
Sire Variance	7.05 ± 4.76
Residual Variance	66.13 ± 7.15
Heritability	0.38 ± 2.57
Gestation Status Predicted Means	
Single	64.32 ± 1.05
Twin	60.27 ± 1.15
Sire Predicted Means	
Challara Poll_140394	62.72 ± 1.65
Collinsville_160608	60.30 ± 2.15
Flairdale_150078	59.20 ± 1.86
Gunallo Poll_G473	59.58 ± 1.68
Hazeldean_15_3368"	65.11 ± 1.59
Hilton_Heath_150817	65.65 ± 1.70
Kelvale_160088	64.46 ± 1.77
Leahcim_1322624	62.49 ± 1.90
Lucernbrae_160010	63.58 ± 2.32
Malleetech_166048	62.18 ± 1.86
Mumblebone_160418	61.01 ± 1.81
Nyowee_L7.70	62.72 ± 2.32
Radnor_Prince_Harrison_604	59.76 ± 1.90
Roemahkita_160256	62.28 ± 1.65
Tuckwood_161069	62.23 ± 1.90
Wallaloo Park_161514	63.39 ± 1.66

Variance components, gestation status effects and sire predicted means are presented in Table 3 and Table 4 with (model B) and without (model C) a carcass weight covariate. Carcass weight, eye muscle traits and shear force estimated heritability aligned with prior work. However, heritability estimates were lower than expected for carcass fatness and IMF. Single born lambs had lighter carcasses but with no significant differences in eating quality traits (SF and IMF). There were significant differences between sires for carcass weight, eye muscle traits and Shear Force.

Between sire differences for IMF were not significant. Given the high mean IMF value this is somewhat unexpected as typically higher mean IMF is also associated with greater variance. However, given the small sample size (16 sires) it is not atypical to not observe between sire differences in a sire model, e.g. this also occurred for a recent study in another breed for shear force. For interest, sire predicted means for IMF are also presented with and without a carcass weight covariate for IMF where sire is fitted as a fixed effect (Table 5), noting sire P-values are a long way from significant at 0.05.

Table 3. Variance components, gestation status effects and sire predicted means for carcass traits (model B)

		Hot Carcass Wt	Cold Carcass Wt	GR fat	EMD	EMW	EMA	C fat	LMY	IMF	Shear Force	Ultimate pH
Test of Significance	P-value	0.001	0.001	0.18	0.0458	0.571	0.058	0.924	0.186	0.395	0.006	0.292
Variance Components	Sire Variance	2.41 ± 1.50	2.26 ± 1.40	1.54008E-05	0.40 ± 0.66	2.96 ± 2.12	0.21 ± 0.30	4.75053E-07	1.54623E-06	2.26459E-07	5.24 ± 3.00	1.35834E-09
	Residual Variance	18.24 ± 1.98	17.15 ± 1.86	4.425470e+01	16.77 ± 1.88	23.35 ± 2.66	6.85 ± 0.77	4.694529e+00	3.153781e+00	2.237890e+00	28.00 ± 3.11	1.342331e-02
	Heritability	0.47 ± 0.62	0.47 v 0.88	1.392016e-06	0.09 ± 0.26	0.45 ± 1.19	0.12 ± 0.21	4.047715e-07	1.961108e-06	4.047715e-07	0.63 ± 1.77	4.047715e-07
Gestation Status Predicted Means	Sinlge	29.91 ± 0.58	29.01 ± 0.56	26.66 ± 0.69	30.42 ± 0.45	64.82 ± 0.66	15.78 ± 0.29	4.85 ± 0.24	52.91 ± 0.18	6.03 ± 0.19	28.59 ± 0.79	5.47 ± 0.01
	Twin	27.71 ± 0.63	26.88 ± 0.61	25.21 ± 0.82	29.14 ± 0.51	64.39 ± 0.72	14.99 ± 0.33	4.81 ± 0.28	53.29 ± 0.22	5.77 ± 0.24	30.90 ± 0.85	5.45 ± 0.01
Sire Predicted Means	Challara Poll_140394	29.37 ± 0.90	28.49 ± 0.87	25.93 ± 0.54	29.95 ± 0.60	64.8 ± 1.01	15.54 ± 0.41	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	27.42 ± 1.16	5.46 ± 0.01
	Collinsville_160608	27.65 ± 1.20	26.82 ± 1.16	25.93 ± 0.54	29.73 ± 0.67	64.33 ± 1.34	15.34 ± 0.46	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	33.55 ± 1.61	5.46 ± 0.01
	Flairdale_150078	26.94 ± 1.02	26.13 ± 0.99	25.93 ± 0.54	29.60 ± 0.65	64.87 ± 1.22	15.32 ± 0.453	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	31.47 ± 1.39	5.46 ± 0.01
	Gunallo Poll_G473	27.07 ± 0.92	26.27 ± 0.89	25.93 ± 0.54	29.44 ± 0.61	63.92 ± 1.05	15.12 ± 0.42	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	29.10 ± 1.19	5.46 ± 0.01
	Hazeldean_15_3368"	30.45 ± 0.86	29.54 ± 0.83	25.93 ± 0.54	29.93 ± 0.60	62.64 ± 1.03	15.24 ± 0.41	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	30.58 ± 1.13	5.46 ± 0.01
	Hilton_Heath_150817	30.30 ± 0.93	29.38 ± 0.90	25.93 ± 0.54	29.83 ± 0.61	65.42 ± 1.07	15.52 ± 0.42	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	26.38 ± 1.20	5.46 ± 0.01
	Kelvale_160088	30.39 ± 0.97	29.47 ± 0.94	25.93 ± 0.54	29.77 ± 0.63	63.52 ± 1.12	15.26 ± 0.43	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	29.90 ± 1.30	5.46 ± 0.01
	Leahcim_1322624	29.30 ± 1.04	28.43 ± 1.01	25.93 ± 0.54	29.78 ± 0.64	62.95 ± 1.17	15.21 ± 0.44	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	28.13 ± 1.38	5.46 ± 0.01
	Lucernbrae_160010	29.47 ± 1.30	28.59 ± 1.26	25.93 ± 0.54	29.92 ± 0.69	66.30 ± 1.46	15.62 ± 0.48	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	32.06 ± 1.69	5.46 ± 0.01
	Malleetech_166048	28.41 ± 1.02	27.57 ± 0.99	25.93 ± 0.54	29.79 ± 0.64	65.00 ± 1.18	15.47 ± 0.44	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	28.81 ± 1.38	5.46 ± 0.01
	Mumblebone_160418	28.08 ± 0.99	27.25 ± 0.96	25.93 ± 0.54	29.66 ± 0.64	65.49 ± 1.17	15.40 ± 0.44	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	31.49 ± 1.38	5.46 ± 0.01
	Nyowee_L7.70	29.14 ± 1.30	28.26 ± 1.26	25.93 ± 0.54	29.75 ± 0.69	67.40 ± 1.46	15.58 ± 0.48	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	29.34 ± 1.78	5.46 ± 0.01
	Radnor_Prince_Harrison	27.16 ± 1.04	26.35 ± 1.01	25.93 ± 0.54	29.65 ± 0.64	62.70 ± 1.17	15.12 ± 0.44	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	30.84 ± 1.37	5.46 ± 0.01
	Roemahkita_160256	28.80 ± 0.90	27.93 ± 0.87	25.93 ± 0.54	29.45 ± 0.60	65.00 ± 1.01	15.24 ± 0.1	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	28.41 ± 1.16	5.46 ± 0.01
	Tuckwood_161069	28.54 ± 1.04	27.68 ± 1.01	25.93 ± 0.54	29.54 ± 0.66	64.40 ± 1.29	15.22 ± 0.46	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	28.82 ± 1.48	5.46 ± 0.01
	Wallaloo Park_161514	29.86 ± 0.92	28.97 ± 0.89	25.93 ± 0.54	30.65 ± 0.60	64.86 ± 1.01	15.96 ± 0.41	4.83 ± 0.19	53.10 0.14	5.90 ± 0.15	29.56 ± 1.17	5.46 ± 0.01

Table 4. Variance components, gestation status effects and sire predicted means for carcass traits with carcass weight fixed effect (model C)

		Hot Carcass Wt	Cold Carcass Wt	GR fat	EMD	EMW	EMA	C fat	LMY	IMF	Shear Force	Ultimate pH
Test of Significance												
	P-value											
	Gestation Status	0.001	0	0.148	0.022	0.58	0.033	0.923	0.145	0.379	0.002	0.267
	Exit or Carcass	0	0	0.0001	0	0.0001	0	0.029	0	0.006	0.001	0.001
Variance Components												
	Sire Variance	0.09 ± 0.07	0.08 ± 0.07	0.01 ± 1.43	0.21 ± 0.47	3.79 ± 2.32	0.28 ± 0.28	1.8457E-06	0.03 ± 0.10	2.11E-07	3.63 ± 2.29	1.28E-09
	Residual Variance	1.34 ± 0.14	1.25 ± 0.14	37.95 ± 4.50	13.02 ± 1.46	21.00 ± 2.40	4.96 ± 0.56	4.56 ± 0.58	2.48 ± 0.29	2.089701e-	25.36 ± 2.8	1.267445e-
	Heritability	0.24 ± 0.21	0.24 ± 0.21	0.002 ± 0.15	0.06 ± 0.18	0.61 ± 1.38	0.22 ± 0.26	0.0000016177	0.05 ± 0.17	4.047715e-	0.50 ± 1.5	4.047715e-
Gestation Status Predicted Means												
	Single	29.13 ± 0.14	28.26 ± 0.13	26.26 ± 0.64	30.02 ± 0.39	64.63 ± 0.69	15.52 ± 0.27	4.78 ± 0.24	53.03 ± 0.15	9.97 ± 0.19	28.62 ± 0.7	5.46 ± 0.01
	Twin	28.97 ± 0.15	28.11 ± 0.15	25.76 ± 0.77	29.73 ± 0.44	64.89 ± 0.75	15.42 ± 0.30	4.89 ± 0.28	53.11 ± 0.25	8.87 ± 0.24	30.37 ± 0.7	5.46 ± 0.01
Sire Predicted Means												
	Challara Poll_140394	29.30 ± 0.21	28.42 ± 0.21	26.00 ± 0.51	29.92 ± 0.47	64.80 ± 1.00	15.57 ± 0.40	4.84 ± 0.19	53.20 ± 0.25	9.92 ± 0.15	27.68 ± 1.0	5.46 ± 0.01
	Collinsville_160608	29.04 ± 0.26	28.17 ± 0.26	26.01 ± 0.51	29.95 ± 0.51	64.88 ± 1.39	15.61 ± 0.49	4.84 ± 0.19	53.08 ± 0.25	9.92 ± 0.15	32.39 ± 1.4	5.46 ± 0.01
	Flairdale_150078	28.94 ± 0.24	28.08 ± 0.23	26.02 ± 0.51	29.91 ± 0.50	65.63 ± 1.24	15.67 ± 0.46	4.84 ± 0.19	53.04 ± 0.25	9.92 ± 0.15	30.50 ± 1.2	5.46 ± 0.01
	Gunallo Poll_G473	28.86 ± 0.22	28.00 ± 0.21	26.02 ± 0.51	29.83 ± 0.48	64.52 ± 1.06	15.40 ± 0.42	4.84 ± 0.19	53.04 ± 0.25	9.92 ± 0.15	28.33 ± 1.1	5.46 ± 0.01
	Hazeldean_15_3368"	29.13 ± 0.21	28.27 ± 0.20	26.01 ± 0.51	29.79 ± 0.48	61.93 ± 1.03	14.91 ± 0.41	4.84 ± 0.19	53.09 ± 0.25	9.92 ± 0.15	31.07 ± 1.0	5.46 ± 0.01
	Hilton_Heath_150817	28.78 ± 0.22	27.91 ± 0.21	26.01 ± 0.51	29.69 ± 0.48	64.93 ± 1.07	15.29 ± 0.42	4.84 ± 0.19	53.05 ± 0.25	9.92 ± 0.15	27.16 ± 1.1	5.46 ± 0.01
	Kelvale_160088	29.33 ± 0.23	28.44 ± 0.22	26.01 ± 0.51	29.69 ± 0.49	62.87 ± 1.13	14.95 ± 0.43	4.84 ± 0.19	53.10 ± 0.25	9.92 ± 0.15	30.41 ± 1.1	5.46 ± 0.01
	Leahcim_1322624	29.31 ± 0.24	28.44 ± 0.23	26.03 ± 0.51	29.82 ± 0.50	62.61 ± 1.19	15.08 ± 0.45	4.84 ± 0.19	52.99 ± 0.25	9.92 ± 0.15	28.36 ± 1.2	5.46 ± 0.01
	Lucernbrae_160010	28.99 ± 0.28	28.13 ± 0.27	26.01 ± 0.51	29.92 ± 0.53	66.55 ± 1.53	15.75 ± 0.51	4.84 ± 0.19	53.13 ± 0.25	9.92 ± 0.15	30.85 ± 1.5	5.46 ± 0.01
	Malleetech_166048	28.81 ± 0.24	27.95 ± 0.23	26.01 ± 0.51	29.93 ± 0.50	65.34 ± 1.19	15.68 ± 0.45	4.84 ± 0.19	53.12 ± 0.25	9.92 ± 0.15	28.61 ± 1.2	5.46 ± 0.01
	Mumblebone_160418	29.04 ± 0.23	28.17 ± 0.22	26.03 ± 0.51	29.87 ± 0.50	66.04 ± 1.19	15.65 ± 0.45	4.84 ± 0.19	52.98 ± 0.25	9.92 ± 0.15	30.85 ± 1.2	5.46 ± 0.01
	Nyowee_L7.70	29.10 ± 0.28	28.22 ± 0.27	26.02 ± 0.51	29.83 ± 0.53	68.06 ± 1.53	15.75 ± 0.51	4.84 ± 0.19	53.05 ± 0.25	9.92 ± 0.15	29.38 ± 1.5	5.46 ± 0.01
	Radnor_Prince_Harrisc	28.89 ± 0.24	28.02 ± 0.23	26.02 ± 0.51	29.96 ± 0.50	63.16 ± 1.20	15.38 ± 0.45	4.84 ± 0.19	53.01 ± 0.25	9.92 ± 0.15	29.93 ± 1.2	5.46 ± 0.01
	Roemahkita_160256	29.04 ± 0.21	28.17 ± 0.21	26.00 ± 0.51	29.63 ± 0.47	65.13 ± 1.00	15.25 ± 0.40	4.84 ± 0.19	53.15 ± 0.25	9.92 ± 0.15	28.41 ± 1.0	5.46 ± 0.01
	Tuckwood_161069	28.88 ± 0.24	28.02 ± 0.23	26.01 ± 0.51	29.84 ± 0.51	65.07 ± 1.33	15.48 ± 0.48	4.84 ± 0.19	53.08 ± 0.25	9.92 ± 0.15	28.19 ± 1.3	5.46 ± 0.01
	Wallaloo Park_161514	29.35 ± 0.22	28.48 ± 0.21	26.02 ± 0.51	30.40 ± 0.47	64.63 ± 1.01	16.11 ± 0.40	4.84 ± 0.19	53.04 ± 0.25	9.92 ± 0.15	29.85 ± 1.0	5.46 ± 0.01

Table 5. Predicted sire means for IMF with sire fitted as a fixed effect (model D)

	IMF with weight	IMF without weight
Test of Significance		
P-value		
Gestation Status	0.337	0.407
Carcass Wt	0.015	
Sire	0.793	0.778
Variance Components		
Residual Variance	2.21 ± 0.35	2.35 ± 0.37
Gestation Status Predicted Means		
Single	6.13 ± 0.21	6.13 ± 0.22
Twin	5.86 ± 0.28	5.75 ± 0.28
Sire Predicted Means		
Challara Poll_140394	6.12 ± 0.47	6.10 ± 0.49
Collinsville_160608	7.19 ± 1.07	6.64 ± 1.08
Flairdale_150078	6.02 ± 0.89	5.68 ± 0.9
Gunallo Poll_G473	6.01 ± 0.50	5.85 ± 0.51
Hazeldean_15_3368"	6.26 ± 0.68	6.59 ± 0.69
Hilton_Heath_150817	5.66 ± 0.48	5.79 ± 0.50
Kelvale_160088	5.76 ± 0.58	5.98 ± 0.59
Leahcim_1322624	6.66 ± 0.61	6.84 ± 0.63
Lucernbrae_160010	5.93 ± 0.87	6.29 ± 0.89
Malleetech_166048	6.52 ± 0.69	6.42 ± 0.71
Mumblebone_160418	6.07 ± 0.75	5.92 ± 0.77
Nyowee_L7.70	4.71 ± 0.75	4.72 ± 0.77
Radnor_Prince_Harrison_604	5.54 ± 0.58	5.18 ± 0.58
Roemahkita_160256	5.93 ± 0.48	5.91 ± 0.49
Tuckwood_161069	6.32 ± 0.77	5.88 ± 0.77
Wallaloo Park_161514	5.20 ± 0.54	5.20 ± 0.52

Conclusion

The data collected in this project will inform Australian Sheep Breeding Values for key carcass and eating quality traits. Importantly, average performance for eating quality traits (IMF% and Shear force) was very good across the cohort.

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Appendix

Lean meat yield equation

By using a quadratic formula, the lean meat yield was calculated with consideration to both GR fat and HSCW (see equation below) (Smith, 2018).

$$\begin{aligned} LMY = & 55.4263 + 0.496295303 \times HSCW (kg) + -0.450324456 \times GR \text{ fat} (mm) \\ & + -0.009002935 \times HSCW (kg) \times HSCW (kg) + 0.0037530912 \\ & \times GR \text{ fat} (mm) \times GR \text{ fat} (mm) \end{aligned}$$

Heritability

In this trial only had observations on sires were obtained, due to the sire making up ¼ of additive genetic variance the following equation was used.

$$h^2 = \frac{(4 \times \textit{sire variance})}{(\textit{sire variance} + \textit{residual variance})}$$