Proc. Assoc. Advmt. Anim. Breed. Genet: 24: 337-340

ECONOMIC ANALYSIS OF MERINO EWE PERFORMANCE FROM DIVERSE INDUSTRY SIRES USING GRASSGRO™

J.S. Wallace[1], K.L. Egerton-Warburton[1], and A.A. Swan[2]

[1] NSW Department of Primary Industries, Orange, NSW, 2800, Australia
[2] Animal Genetics and Breeding Unit*, University of New England, NSW, 2351 Australia

SUMMARY

Differences in profitability between genetically different sire groups at the Macquarie site of the Merino Lifetime Productivity Project (MLP) were compared using GrassGro™ to simulate animal performance based on the interactions between animal production and pasture growth determined by historical climate data. Mean gross margin (GM) differences of $13/Dry Sheep Equivalent (DSE) and $42/head (hd) were found between sire groups for wool and meat median prices. In median to high markets wool income had a higher influence on GM/DSE than meat income, with fibre diameter being the trait of most influence. In low markets meat income had a greater influence on GM/DSE with weaning rate the most influential single trait. Utilising a combination of traits, through either of three different selection indexes, showed the strongest correlations with GM/DSE.

INTRODUCTION

Previous studies (Clarke *et al.* 2019) have reported large (over $50) differences in production value of wether progeny on a per head basis between sire groups. Analysis of combined wether trial data using GrassGro™ (Merino Bloodline Performance, www.merinobloodlines.com.au) also reveals differences among bloodlines of up to $13/hd. However, one limitation of using wether data is an inability to account for differences in reproductive performance in the financial analysis.

GrassGro™ (Moore *et al.* 1997) is a decision support tool that enables the economic performance of livestock enterprises to be simulated using animal production data and their interactions with seasonal variation in pasture, historical weather data and specified market scenarios.

The MLP project was designed to evaluate 134 diverse industry sires based on the lifetime performance of their ewe progeny for a wide range of wool, growth, carcase, reproduction and disease resistance traits. This paper presents a preliminary analysis using GrassGro™ to investigate differences in economic performance between sire groups using a production dataset generated from the first one and two reproductive opportunities of the 2018 and 2017 drop ewes, respectively, at the Macquarie site of the MLP project.

MATERIALS AND METHODS

The design of the MLP project has been described by Ramsay *et al*. (2019). The specific design of the Macquarie site has been described by Egerton-Warburton *et al.* (2019). Data from ewes born at the Macquarie site in 2017 (n=425) and 2018 (n=536) were available for analysis. Ewes were joined by artificial insemination in December to lamb the following May, with shearing occurring in October after the weaning of progeny in August. Traits evaluated included greasy fleece weight (GFW, kg), clean wool yield (YLD, %), mean fibre diameter (FD, µm), bodyweight (WT, kg) and reproduction (conception and number of lambs weaned per ewe joined, LW/EJ) in adult ewes.

A representative model farm was set up in GrassGro™ for the Macquarie site. Historical climate and rainfall data for Trangie Agricultural Research Centre (TARC, Lat -31.99, Long 147.95) was

* A joint venture of NSW Department of Primary Industries and the University of New England

sourced from SILO (Jeffrey *et al.* 2001) for the period 1970 to 2019, commencing when the required data set became available. The base parameters of the model were set to reflect the annual calendar of operations, and livestock management policies (feeding, selling) at TARC. A conservative fixed stocking rate (1.5 animals/ha) was used to ensure heavier sire groups were not unreasonably restricted in average seasons and was based on the regional estimate of 3-7 DSE/ha (Hassall and Associates 2006).

An across-year analysis was undertaken using the MERINOSELECT OVIS software (Brown *et al.* 2007) to estimate sire breeding values (BVs), accounting for fixed effects such as birth and rear type, dam age, dam source and management group. Predicted sire progeny group means were then calculated as mean flock production level + 0.5 × sire group BV, with assumed production level means shown in Table 1. Body weight sire group means were then adjusted to reflect animals in condition score 3 (standard reference weight). These predicted sire group means were used as inputs to the GrassGro™ simulation, and the range between sire group means are shown in Table 1. Sire differences in survival rate cannot be expressed (in combination with conception rates) in GrassGro™. Therefore, adjustments to conception rates were used to achieve desired weaning rate differences. The proportion of empty ewes was entered and then conception rates for singles and twins were adjusted in GrassGro™ to reflect desired weaning rate outcomes in alignment with weaning rate BVs for each sire group.

Table 1. Mean, minimum and maximum predicted sire group means for production inputs to the GrassGro™ decision support tool

	FD (μm)	GFW (kg)	YLD (%)	Standard reference WT (kg)	LW/EJ
Mean	19.5	7.0	71.4	60.0	0.98
Minimum	18.4	6.5	69.8	57.9	0.86
maximum	20.6	7.3	72.7	62.3	1.11

Three wool and meat price scenarios (30, 50 and 70th percentile, denoted as low, median and high) were used from weekly Australian Wool Exchange (AWEX) and Meat and Livestock Australia (MLA) market reports between January 2015 to December 2019 and supplementary feed costs (barley) were averaged over the same timeframe (ABARES 2020). Husbandry costs were calculated from NSW DPI Farm Enterprise budgets (18μm Merino) in 2019 (https://www.dpi.nsw.gov.au/agriculture/budgets/livestock).

Mean GM/DSE was simulated for each sire group in response to historic seasonal conditions over the period from 1970 to 2019 using median prices for 2015 to 2019. GM/DSE was plotted against four adult production traits (GFW, FD, WT and LW/EJ) as a deviation from the mean of all sire groups. Three selection indexes based on the Dual Purpose Plus (DPP), Merino Production Plus (MPP) and Fibre Production Plus (FPP) MERINOSELECT standard indexes (Brown and Swan 2016), were used to combine the production traits into index values, which were then correlated with GM/DSE under the 3 wool and meat price scenarios. Each of these indexes were modified to only include yearling and adult sire BVs for the traits in Table 1 and excluded any additional traits.

RESULTS AND DISCUSSION

On average, GM/DSE ranged $13 between the top and bottom sire groups under median and high market scenarios and $10 per DSE with low prices. Mean GM/DSE may undervalue higher weaning rates and mean GM/hd provides an alternative comparison for properties that are understocked and can accommodate additional lambs without increasing supplementary feed or reducing ewe numbers. There was a difference in GM/hd of $35, $42 and $45 in low, median and

high price scenarios respectively between the highest and lowest sire groups. There was a range of 3.8 to 4.5 mean DSE/ha between the highest and lowest sire groups in the scenario examined. Mean GM/DSE will be used for all other comparisons in this paper to account for changes in resource requirements, such as increases in feed.

Figure 1 shows the resulting distributions of mean GM/DSE at median prices against FD, CFW, WT and LW/EJ for each sire group as a deviation from the mean of all sire groups. The correlations between GM/DSE and these traits were -0.65, 0.32, -0.06 and 0.42, respectively. Wool income had a larger effect on GM/DSE (r = 0.62) than meat (r = 0.42) with FD the main trait of influence, followed by LW/EJ. Higher wool and meat prices resulted in similar trends in the relationship between traits of influence and the GM/DSE as those of median prices. Interestingly, when wool and meat prices were lower, meat income had a greater influence (r = 0.69) than wool (r = 0.17) on GM/DSE and the trait of largest influence was LW/EJ (r = 0.68) then CFW (r = 0.47).

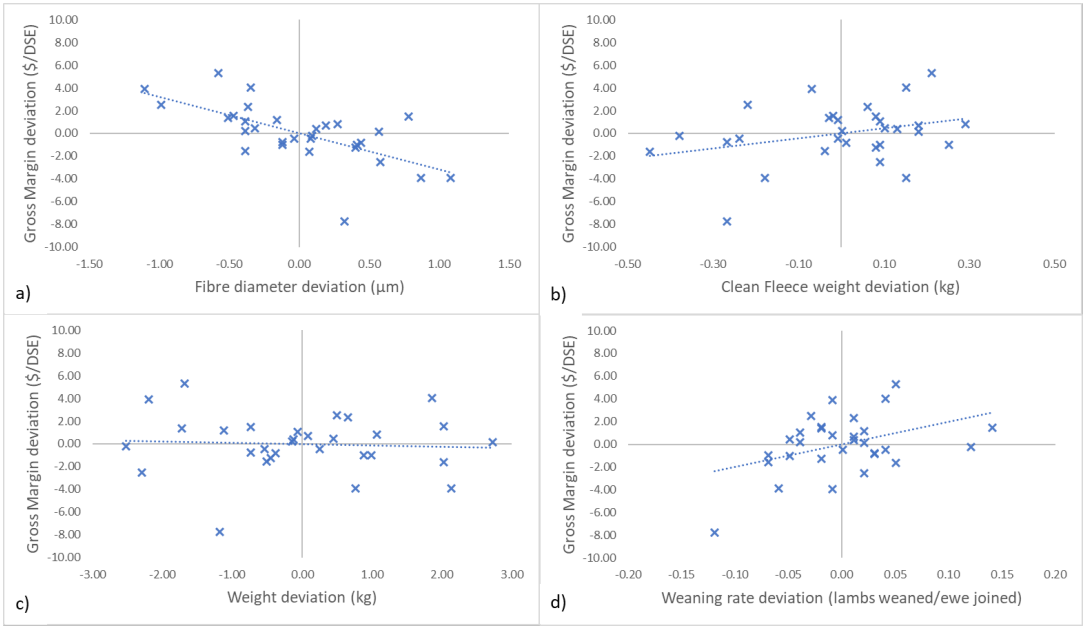

Figure 1. Gross margin per DSE for each sire group against adult ewe a) FD, b) CFW, c) WT and d) LW/EJ as deviations from the mean of all sire groups at Macquarie (median prices)

Correlations of GM/DSE for high and low prices with median prices were 0.99 and 0.84 respectively. This suggests that ranking of sires on GM/DSE will be similar in median and high markets. However, due to a higher emphasis on meat prices when wool and meat markets decline, a stronger influence of LW/EJ and CFW may lead to a re-ranking of sires during these periods.

Table 2. Correlations between DPP, MPP and FPP MERINOSELECT indexes and GM/DSE in low, median and high market prices

	DPP	MPP	FPP
Low	0.93	0.92	0.79
Median	0.72	0.82	0.92
High	0.76	0.87	0.95

Combining traits, using a selection index, resulted in higher correlations with GM/DSE than single traits, as shown in Table 2. These results show stronger correlations for the DPP and MPP indexes when markets were low and the FPP index when markets were high. This reflects the earlier findings where wool income had a stronger influence on GM/DSE in higher markets and meat income in lower markets.

The various seasonal conditions between 1970 and 2019 resulted in simulated mean production values that differed from the predicted sire means that were entered as breed references in GrassGro™, but these inputs and outputs were highly correlated (r>0.98). Variation between sire progeny group weaning rates had a large influence on GM/DSE, highlighting the importance of accounting for differences in reproductive performance between genotypes. However, it was difficult to model these directly in GrassGro™, and more accurate results may be achieved if genetic differences in survival rates could be included as inputs. Different resources (eg. nutrition) are required for similar weaning rates depending on variations in conception and survival rates.

CONCLUSIONS

This study shows large differences of up to $13/DSE and $42/hd mean GMs between sire groups under a median price scenario when based on simulated environmental impacts across multiple seasons. It would be valuable to extend these results for these sire groups in different environments and across a larger range of sire groups within the MLP project. The value in including weaning rate differences between sire groups when comparing GM/DSE is evident especially when experiencing low wool and meat markets.

ACKNOWLEDGEMENTS

The MLP Project is being undertaken in partnership between the Australian Merino Sire Evaluation Association Incorporated (AMSEA) and Australian Wool Innovation (AWI). AMSEA and AWI would like to acknowledge those entities who also contribute funding: woolgrowers through sire evaluation entry fees, site hosts, site committee in-kind contributions, and sponsors of AMSEA. The MLP Macquarie site gratefully acknowledge the generous financial support provided by the site host NSW Department of Primary Industries.

REFERENCES

ABARES 2020, Australian crop report, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, December. CC BY 4.0. https://doi.org/10.25814/5e3a014fa7e2d

Brown D.J., Huisman A.E., Swan A.A., Graser H-U., Banks R.B., Ball A.J., Atkins K.D. and Woolaston R.R. (2007) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **17**: 187.

Brown D.J and Swan A.A. (2016) *Anim. Prod. Sci.***56:** 690

Clarke B.E., Young J.M., Hancock S. and Thompson A.N. (2019) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **23**: 516.

Egerton-Warburton K.L., Mortimer S.I. and Swan A.A. (2019) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **23**: 520.

Hassall and Associates Pty Ltd (2006) The Structure and Dynamics of Australia's sheep population - Report prepared for Australian Government. Available at https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/animal-plant/animal-health/livestock-movement/sheep-movement-ead.pdf.

Jeffrey S.J., Carter J.O., Moodie K.B. and Beswick A.R. (2001) *Environ. Model. Softw.* **16:** 309.

Moore A.D., Donnelly J.R. and Freer M. (1997) *Agric. Syst.* **55**: 535.

Ramsay A.M.M., Swan A.A. and Swain B.C. (2019) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **23**: 512.