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RATE OF GENETIC GAIN IN REDUCING BREECH FLYSTRIKE

AUTHORS

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SUMMARY

Genetic gains were predicted for reducing breech flystrike incidence (FSI) based on selection using modified MERINOSELECT indexes. Predicted genetic reductions in flystrike incidence after 10 years of selection were larger when the heritability of the trait was moderate (as in a summer rainfall environment) than when a low heritability was assumed (as in a winter rainfall environment). The relative gains between flystrike incidence and fleece weight, fibre diameter and reproductive rate and their implications for Merino breeding programs are discussed.

INTRODUCTION

General consensus within the Australian wool industry is that breeding more resistant sheep will play a critical role in controlling breech and tail strike in non-mulesed flocks as well as reducing the risk of strike in mulesed sheep. Since 2005, a major research program has been funded to identify optimal breeding strategies for reducing breech strike resistance. Selection lines for breech flystrike were established at Mt Barker in WA, in a winter rainfall environment (Greeff and Karlsson 2009) and near Armidale, NSW, in a summer rainfall environment (Smith *et al.* 2009). Results have confirmed the presence of significant genetic variability amongst sheep in susceptibility to breech strike and also identified key indirect selection criteria for improving resistance, in particular scores of breech wrinkle, dag, breech cover and urine stain (Smith *et al.* 2009; Greeff *et al.* 2014). Earlier studies (Brown *et al.* 2010; Richards and Atkins 2010) predicted genetic gains from index selection with breech wrinkle score included in the breeding objective, as a proxy for breech flystrike incidence. This project extends earlier findings, by predicting genetic gains in breech flystrike incidence from selection using all available indicator traits of breech wrinkle, dag and breech cover scores for three different breech objectives within three different environments.

METHODOLOGY

Predictions of genetic gain from within flock selection were undertaken based on software written by members of AGBU staff. Three breeding objectives were examined, by modifying the Dual Purpose (DP+), Fibre Production (FP+) and Merino Production (MP+) indexes available from MERINOSELECT (Sheep Genetics 2018). The modifications consisted of adding Flystrike incidence (FSI, strikes/ewe/year) as a formal trait to the breeding objective associated with each index. The modified indexes, DP+FSI, FP+FSI and MP+FSI target, respectively, medium wool/dual purpose, superfine/fine wool and fine/medium wool production systems, along with reduction in flystrike incidence. The effects of using a range of flystrike incidence economic values were examined, from $0 to -$240/strike/ewe/year, to include the likely large range in the associated costs of flystrike

incidence across Australia. Genetic parameters used in predictions were from Sheep Genetics, supplemented by values from Hatcher and Preston (2017, 2018) and AWI project reports (Greeff *et al.* 2016; Smith 2016). Full records of productivity traits and pedigrees were assumed as selection criteria, as well as records of breech wrinkle, dag and breech cover scores. Predictions were conducted for 3 different scenarios (i) moderate heritability (0.20) for (ii) low heritability for flystrike incidence (0.10) and (iii) low heritability for flystrike incidence (0.10) but high heritability (0.30) for Dag Score.

RESULTS AND DISCUSSION

Genetic gains in flystrike incidence (Figure 1). After 10 years of index selection, with moderate heritability (scenario i), predicted gains for flystrike incidence range from a low of -0.02 to -0.03 (2% to 3%) to -0.19 to -0.21 (19% to 21%) strikes/ewe/year, when the economic value is increased from 0 to -$240. These predicted gains are 3 to 5 times as large as those where heritability for flystrike incidence is low (scenario ii). Gains are slightly less for the FP+FSI index and slightly more for the MP+FSI index compared to gains from using the DP+FSI index. At the highest economic value, most (80%+) selection emphasis is placed on reducing flystrike incidence (not shown). Predicted gains for scenario iii are no different to scenario ii, so are not discussed further.

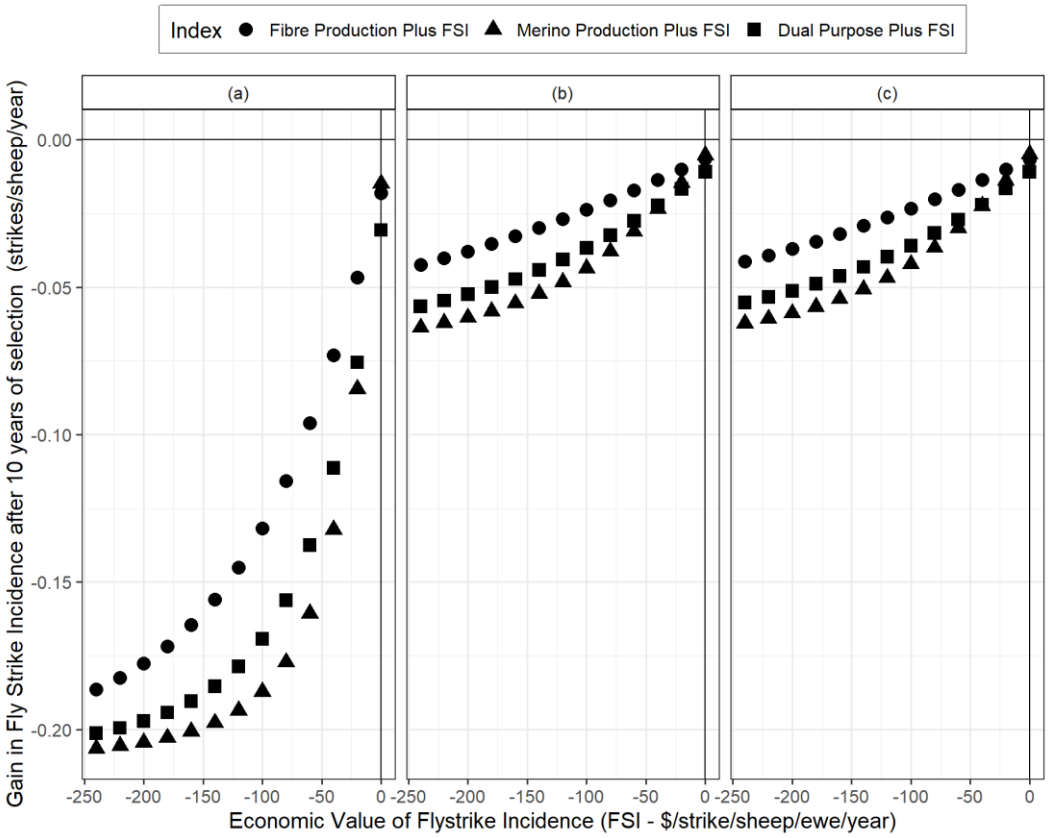

Figure 1. Predicted 10-year genetic gains in Flystrike Incidence (FSI, strikes/ewe/year) assuming (a) moderate FSI heritability (b) low FSI heritability and (c) low FSI heritability and high Dag Score heritability, with economic values from 0 to -$240 for FSI.

When compared to breech flystrike incidence in unmulesed, crutched young sheep in a winter rainfall environment in WA (see Greeff *et al.* 2016) and in a summer rainfall environment near Armidale, NSW (Smith 2016), our predicted genetic gains suggest that once a flock was fully pedigreed and all important breech and productivity records were being collected, after 10-15 years of index selection, flystrike incidence could be reduced in unmulesed sheep to low levels (<0.02 or 2%) in average years. It is however important to balance potential gains with the predicted impact on genetic gains for other important traits, shown below.

Genetic gains in key production traits. Predicted genetic gains for Clean Fleece Weight (CFW), Fibre Diameter (FD) and the Number of Lambs Weaned/Ewe Joined (NLW) are listed in Tables 1 to 3, respectively, listed by economic value for flystrike incidence. With increasing economic value for flystrike incidence, gains in Clean Fleece Weight decrease gradually when the heritability of flystrike incidence is low, but decrease more rapidly when the heritability of flystrike incidence is moderate, particularly for the DP+FSI and MP+FSI indexes. However, even for the largest economic value for flystrike incidence examined (-$240), genetic gains for fleece weight remain positive.

Table 1. Predicted genetic gain in Clean Fleece Weight (%) after 10 years of index selection, by economic value for Flystrike Incidence (FSI).

h^2 FSI/Index	Economic Value for FSI ($/strike/ewe/year)						
	0	**-40**	**-80**	**-120**	**-160**	**-200**	**-240**
Low h^2							
DP+FSI	2.69	2.50	2.27	2.03	1.80	1.59	1.39
FP+FSI	2.69	2.59	2.48	2.30	2.20	2.06	1.92
MP+FSI	6.04	5.58	4.92	4.22	3.59	3.06	2.63
Moderate h^2							
DP+FSI	2.69	2.07	1.46	1.01	0.70	0.48	0.32
FP+FSI	2.69	2.37	1.97	1.59	1.26	1.00	0.80
MP+FSI	6.04	4.34	2.77	1.84	1.29	0.92	0.67

Table 2. Predicted genetic gain in Fibre Diameter (μ) after 10 years of index selection, by economic value for Flystrike Incidence (FSI).

h^2 FSI/Index	Economic Value for FSI ($/strike/ewe/year)						
	0	**-40**	**-80**	**-120**	**-160**	**-200**	**-240**
Low h^2							
DP+FSI	0.01	-0.03	-0.07	-0.11	-0.14	-0.16	-0.18
FP+FSI	-0.78	-0.80	-0.81	-0.81	-0.81	-0.80	-0.79
MP+FSI	-0.36	-0.42	-0.44	-0.45	-0.44	-0.44	-0.43
Moderate h^2							
DP+FSI	0.01	-0.10	-0.17	-0.21	-0.23	-0.25	-0.26
FP+FSI	-0.78	-0.81	-0.79	-0.75	-0.70	-0.66	-0.62
MP+FSI	-0.36	-0.45	-0.43	-0.40	-0.38	-0.37	-0.36

When the heritability of flystrike incidence is moderate, there are small genetic reductions predicted in Fibre Diameter with increasing flystrike incidence economic value using the DP+FSI index of up to 0.26μ after 10 years of selection. There are also slightly lower genetic gains in Fibre Diameter with increasing flystrike incidence economic value using the FP+FSI index of up to 0.16μ. However, in general there is little impact predicted on genetic gains for Fibre Diameter when also selecting for reduced flystrike incidence as part of index selection. Predicted genetic gains for the Number of Lambs Weaned when also selecting for reduced flystrike incidence are impacted much less than those for fleece weight. Relative to gains when flystrike incidence has no economic value, there are modest declines of up to a maximum of 31% in the Number of Lambs Weaned gains using the MP+FSI index and up to 45% using the DP+FSI, at the largest economic value for flystrike incidence examined (when h^2 for FSI is moderate).

Table 3. Predicted genetic gain in the Number of Lambs Weaned/ewe after 10 years of index selection, listed by economic value for Flystrike Incidence (FSI).

h^2 FSI/Index	Economic Value for FSI ($/strike/ewe/year)						
	0	**-40**	**-80**	**-120**	**-160**	**-200**	**-240**
Low h^2							
DP+FSI	0.08	0.08	0.08	0.07	0.07	0.07	0.06
FP+FSI	0.02	0.02	0.02	0.02	0.03	0.03	0.03
MP+FSI	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Moderate h^2							
DP+FSI	0.08	0.07	0.07	0.06	0.05	0.05	0.04
FP+FSI	0.02	0.02	0.03	0.03	0.03	0.03	0.03
MP+FSI	0.04	0.04	0.04	0.03	0.03	0.03	0.03

CONCLUSIONS / KEY MESSAGES

Useful and meaningful reductions in breech flystrike from 0.05 to 0.08 strikes/ewe/year up to 0.19 to 0.21 strikes/ewe/year in a summer rainfall low dag environment were predicted after 10 years of index selection for breeding objectives relevant to the Australian wool industry (once full pedigree and data recording has commenced). For a winter rainfall environment in WA, with a lower heritability for flystrike incidence, smaller gains were predicted after 10 years of index selection, from 0.01 to 0.02 up to 0.04 to 0.06 strikes/ewe/year.

The length of time required to breed sheep that no longer require mulesing not only depends on the rate of genetic gain that can be achieved, but also on how susceptible the sheep are to breech flystrike at the start of the breeding program and the site's relative risk of flystrike. For example, sheep types with high wrinkle scores and / or high dag scores will take considerably longer to reduce susceptibility to breech flystrike to a point where mulesing could be stopped.

It is unnecessary to use very high economic values for flystrike incidence to achieve significant reductions in the trait. For example, when the heritability for flystrike incidence is moderate and the trait is given an economic value of -$80, 62% of the highest genetic gain for flystrike incidence predicted (when the economic value is -$240) is obtained with the FP+FSI index, with higher gains of 78% and 86% being obtained with the DP+FSI and MP+FSI indexes, respectively. At that economic value for flystrike incidence (-$80), between 46% to 73% of the genetic gains for fleece weight and between 84% and 125% of the genetic gain for the Number of Lambs Weaned are being retained, with no significant impact on gains in Fibre Diameter. In the absence of formally-derived economic values, -$80 for flystrike incidence appears to be a reasonable upper limit to use in Merino breeding programs to achieve a balance between genetically lowering flystrike incidence whilst obtaining competitive genetic gains in productivity traits as outlined above.

The take home messages are:

- Meaningful reductions in flystrike incidence are possible in ram breeding flocks over a 10 to 15-year period after full data recording has commenced, whilst retaining competitive levels of genetic gains for other important traits, by using appropriately constructed selection indexes. This amount of genetic gain could reduce breech flystrike incidence sufficiently to reduce reliance on mulesing, or to cease it.
- With the aid of appropriately weighted selection indexes, breeders do not actually have to accept going backwards in genetic merit for any important trait when incorporating reducing flystrike incidence in their breeding objectives, but there will be a reduction of rates of genetic gain that can be made for some traits, in particular fleece weight, with gains reducing by 27% up to 50%.

RECOMMENDATIONS

- Estimate economic values for flystrike incidence for different wool-growing regions for establishing formal breeding objectives that include reducing flystrike incidence along with productivity and quality traits.
- Develop new selection indexes that incorporate animal welfare / resilience traits, including flystrike incidence as part of index options by the MERINOSELECT service, plus inclusion of flystrike incidence as a reportable trait.
- Active encouragement (extension and promotion) to industry to increase the number of sheep that are recorded for breech traits and for neck and body wrinkle if they have already been mulesed or are already very low for breech wrinkle.
- Explore the merit of direct progeny testing of leading industry sires for flystrike incidence, particularly for areas of high dag incidence. This should be done in conjunction with establishing a reference population for the development of genomic enhanced breeding values.
- If ram buyers are having difficulty accessing suitable flock ram genetics to more rapidly reduce breech flystrike incidence and keep improving flock productivity, establishing their own ram breeding nucleus and purchasing semen from elite sires may be more economically feasible for their particular breeding objectives, management regime and locality.
- Set target ASBVs to go non-mulesing.

FURTHER INFORMATION

An article communicating project outcomes to woolgrowers was published in the June 2019 edition of *Beyond the Bale*. The article and the final project report are both available at www.wool.com/flystrikelatest**,** or at the links below.

- Project Report – Rate of Genetic Gain in Reducing Breech Flystrike - Update June 2019
- Genetically Reducing Breech Flystrike – June 2019 *Beyond the Bale* article

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