Breech Flystrike Prevention Genetic RD&E Review

Independent review of Australian Wool Innovation's Breech Flystrike Prevention Genetic Research, Development and Extension Program, June 2024

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Executive Summary

The 2024 review of the genetic components of AWI's Breech Strike Research Development and Extension program was conducted by reference to research papers and reports, extension materials and information provided at an on-line meeting with Australian Veterinary Association and AWI representatives on the 31st of May 2024. The focus of the AWI's funded work in the sheep genetic improvement area has transitioned to:

- facilitating the creation of breeding tools, including breeding values and selection indexes that for the first time include traits related to improving resistance to flystrike
- the establishment of a genomic reference population for calculating genomically enhanced breeding values for flystrike
- increasing extension and communication activities on controlling flystrike, including by breeding for more resistant sheep and changing management to a production system without mulesing.

Reports on studies funded by AWI during the 2024 reporting period (July 2023 to June 2024) have been reviewed, including:

ON-00775 – AWI – Animal Genetics and Breeding Unit (AGBU) Genetic Analysis
ON-00820 – Planning for a virtual genomic reference flock – BSC Agribusiness
ON-00866 – Merino Genomic Reference Flock – BCS Agribusiness
ON-00860 – Immune Resilience in Merino sheep, including Flystrike – CSIRO
ON-00765 – Flystrike Extension Package (Its Fly Time and Simplifly development)
ON-00815 – Breeding for Flystrike Resistance Workshop (ClassiFly development)
ON-00818 – Moving to a Non Mulesed Enteprise (StrateFly and AmpliFly development)
ON-00849 – Flystrike Extension Delivery (for the period 2022 to 2026)
ON-00790 - ParaBoss Phase III

ON-00775 – AWI – AGBU Genetic Analysis 2022-2027 (AGBU)
This project has 3 key topics:
• Merino Lifetime Productivity (MLP) Analysis
• Genetic Evaluation Improvement (Wether Trials, Sire Evaluation, MERINOSELECT)
• Genomic Reference Flock with a focus on Flystrike.

New MERINOSELECT Indexes
In June 2023, Sheep Genetics released 5 research selection indexes, as part of the MERINOSELECT service. Following a period of collecting and reviewing industry feedback, these research indexes have been replaced by 4 official industry indexes, as of May 2024. These 4 industry indexes are similar overall to the research indexes released earlier, with most change in the fine wool index. From the point of view of breeding for reduced breech strike, the industry indexes are likely to achieve a genetic reduction in breech wrinkle scores, whilst improving productivity traits. One of the 4 new industry

indexes (Sustainable Merino) also includes the ability to achieve a reduction in dag scores, which provides significant management benefits in addition to reductions in breech strike susceptibility.

We welcome this long-needed initiative by Sheep Genetics, which will help achieve greater genetic gains in improving resistance to breech strike. It would be helpful if these new indexes could be accompanied with predictions of likely genetic gains over a period of 10 years.

Recent analysis of AWI breech strike selection flocks
Recent analysis work on data from the AWI breech strike selection flocks (DPIRD flocks at Mt Barker, WA and a CSIRO flock at Chiswick, Armidale, NSW) has been conducted by AGBU, as a prelude to including this information in larger studies on flystrike using several data sources. This will assist in the creation of a genomic reference flock with a focus on flystrike and in the further development and refinement of flystrike traits (see discussion below) and breeding tools to assist in breeding for reduced breech strike.

Results indicate that breech strike is heritable (as previously reported by Greeff *et al* 2014; 2016 and Smith *et al.* 2009; 2016) in the AWI breech dataset from two flocks in western Australia and in the flock at the CSIRO Chiswick site in NSW. The heritability estimates are all in the range observed in other studies (0.14 for hoggets in the WA DPIRD flocks and 0.21 for yearlings and 0.27 for adult ewes in the CSIRO flock near Armidale, NSW). Further, the addition of genomic information can help the analytical modelling to capture more genetic variance from the raw phenotypic data. The results also suggest that the data from the AWI breech flocks' datasets will continue to make a valuable contribution to further combined studies of flystrike.

We strongly support this work, which again leverages the results from significant past investment by AWI.

Development of breeding values for Fly Strike

As noted in our 2023 report, AGBU already has Research Breeding Values (RBV) for flystrike under development. There are two being developed, a Breech Strike RBV and a Body Strike RBV. This work is being carried out in tandem with creating genomic-enhanced breeding values, via the establishment of a genomic reference flock.

This work involves drawing data from historic as well as contemporary flocks, including the Sheep CRC Information Nucleus flock, the AWI Breech strike flocks (as discussed above), the Merino Lifetime Productivity site at Chiswick near Armidale, NSW, the Connemara flock and other ram breeding flocks participating in the AWI pilot project – see Project ON-00866 (discussed below).

One of the key findings to date is the large contribution that can potentially be made by including genomic data to improve breeding value accuracy and thus the rate of genetic gain. At this stage, there is more data available to aid the development of a breech strike RBV than there is for a body strike RBV and we look forward to further progress on these important developments. Once sufficient data is available to release these flystrike RBVs, it would be appropriate to revise the predictions of the rates of genetic gain for flystrike and what gains can potentially be achieved over 10 years, as reported by Brien *et al.* (2021).

Merino genomic reference flock

Direct selection to improve resistance to breech strike has long been viewed as problematic, as to evaluate sheep directly for susceptibility to flystrike, they need to be exposed to risk of strikes during the fly season. This raises ethical and animal welfare concerns, along with production and economic

risks to the sheep breeder. These issues have been among the main drivers behind AWI's R, D and E past investments on researching and developing indirect selection methods using the main indicator traits of breech wrinkle, breech cover and dag scores. Unlike direct selection, indirect selection does not require sheep to be exposed to significant flystrike risk.

The same advantage of not needing to expose sheep to flystrike risk is also the case for genomic selection.

Genomic selection using genomically-enhanced breeding values requires, as a first step, the creation of a genomic reference flock, where sheep are phenotyped for susceptibility to flystrike, with these results then being associated statistically with genotypes of the animals. This statistical association is then used to predict breeding values for flystrike on genotyped sheep outside of the reference flock. Currently, this genomic data is blended with more conventional phenotypic data for records of breech wrinkle, breech cover and dag score to generate genomic-enhanced breeding values.

Ultimately, if the accuracy of genomic breeding values is high enough, the need for phenotyping of flystrike indicator traits is reduced, if not eliminated. Current AWI projects in this area are reviewed below.

ON-00820 – Planning for a virtual genomic reference flock. This project, conducted by BSC Agribusiness, has largely been completed. It drafted a plan for the creation of a virtual Merino Flystrike genomic reference flock, including on-farm protocols for phenotypic and genomic data collection, transfer, storage and reporting. It included gathering up all the flystrike genotypes and phenotypes available from old R&D flocks (Sheep CRC Information Nucleus Flock, MLA Genomic Flocks, AWI Breech Flystrike Flocks, and AMSEA sites. It also facilitated some additional genotyping of stored samples from the AWI breech strike selection flocks.

The project also drafted a business case to support the long-term sustainability of a virtual Merino Genomic Reference flock. Elements of this business plan are now being implemented under project ON-00866 (see below).

We strongly support this work, which leverages past investments by AWI.

ON-00866 – Merino Genomic Reference Flock. This project, which is also conducted by BCS Agribusiness, set out to establish a Merino Genomic Reference flock as a pilot project. It is doing this via:
- providing a 50% subsidy for genotyping of all Merino sire evaluation progeny at AMSEA sites
- engaging willing ram breeders (via an EOI) in late 2023 to collect flystrike data and genotypes. 18 EOIs have been received.

We strongly support this work.

Breeding for Resilience

Project ON-00860, Immune Resilience in Merino Sheep - including flystrike
Immune resilience has been defined as a proxy trait for general disease resistance or the ability for an animal to remain productive in the face of disease or diverse environmental challenge (Hine *et al.* 2022).

This project is an extension of work commenced under Project 0N-00511 'Improving resilience by breeding for immunity' (reviewed in our 2023 report), to allow for the expansion of the dataset via further data collection on F2 Progeny of the Merino Lifetime Productivity project. This will enable the more precise estimation of genetic parameters on resilience traits (immune competence) and correlations with health and welfare traits, including resistance to flystrike.

Verbal advice received at the briefing meeting on May 31st suggests that with the additional data collected to date in phase 2, the promising preliminary results reported in the Hine *et al.* (2022) paper are largely being confirmed. We note that data from animals born in 2023 will be added later this year to complete the dataset.

A favourable outcome from this research would provide an additional tool for breeders to select sheep that are more resistant to flystrike, as part of a balanced breeding program.

Extension Program
ON-00765 ON-00815, ON-00818 and ON-00849

AWI has developed a comprehensive suite of webinars, face to face training module extension publications and online modules to assist wool producers design optimal flystrike control programs while maximising profitability and lifetime welfare of their sheep. This is arguably one of the most extensive and comprehensive extension packages ever developed for flystrike control. It addresses all elements of a well-planned program and provides the facility for one-on-one coaching support delivered by accredited advisers to aid in the development of property-specific on-farm control programs.

At the centre of the AWI approach are 6 training modules for advisers and sheep owners. **'Its flytime** provides an introduction to flystrike, focusing on the actions that can be taken in the face of a fly wave or impending high-risk period and includes monitoring and detection and an overview of prevention of practices for the prevention and treatment of strike. **Simplifly** is a one-day face to face workshop assisting wool producers to develop a strategic property-specific plan to reduce the incidence and impact of strike in their flocks. **Demystify** addresses the development of chemical resistance in sheep blowfly populations to the most widely used flystrike control products. It provides practical information about factors and practices leading to the development of resistance and prevention and management of resistance on-farm. Demistify was finalised in late 2021 and subsequently included delivery of a webinar to resellers and advisers, introducing them to the resources and information available in the program and how to access it. Six train the train the trainer workshops and 19 woolgrower workshops have been completed. **Classifly** is also a one-day workshop designed to increase understanding of what is involved in breeding for flystrike resistance and covers selection strategies and classing skills for use with both mulesed and unmulesed flocks. Three train the trainer workshops have been completed. Further workshops are planned but were delayed by the extreme weather conditions experienced in late 2022. **Stratefly** aids in the development of a property specific strategy for moving to a non-mulesed enterprise. This includes the determination of optimal approaches for incorporating breech strike resistance tailored to individual enterprise breeding programs. Four pilot workshops were held (Young NSW February 2024, Karoonda SA Feb 2004, Hamilton Vic 2024, and Cumnock NSW April 2024). Attendees included woolgrowers with a range of experience from those who have already moved to a non-mulesed flock to those contemplating a change and wanting to clarify what was involved. **Amplifly** focusses on provision of 'train the trainer' programs to facilitate one-on one coaching in the development and conduct of an optimal on-farm flystrike control program for individual enterprises. It is anticipated individual consultation will be provided on a fee for service basis.

In addition, the AWI website continues to provide a comprehensive body of well-coordinated material, cross linked to and harmonised with other information sources such as ParaBoss and the Sheep Genetics websites and focussed towards practical on-farm issues. Notable amongst these is the section on 'Breeding and selection for flystrike resistance' that answers practical questions such as 'How long will breeding for breech strike resistance take and links to tools such as the AWI/MLA Visual Sheep Score Guide for selection programs (recently updated) and the FlyBoss flystrike risk simulator. Beyond the Bale also continues to be important in providing timely articles alerting wool growers and other stakeholders to the occurrence of high-risk periods and the availability of upcoming flystrike-related workshops and training courses. It also provides timely updates on current research programs with delivery tailored to a woolgrower audience.

ON-00849 Flystrike Extension Delivery (for the period 2022 – 2026)

Continued funding for ongoing flystrike extension delivery, recently approved by the AWI board, is an important step forward and will enable ongoing extension of outcomes resulting from AWI's substantial research investment in this area. It will also assist wool growers to address the demands of quality assurance schemes increasingly sought by wool markets, in particular the need to reduce reliance on surgical and chemical control methods, and to make full use of emerging new tools such as flystrike breeding values and genomics-assisted methods of selection for flystrike resistance.

ON-00790 ParaBoss Phase III – Animal Health Australia (AHA) and The University of New England (UNE), with funding from MLA

Phase III of the ParaBoss website (currently managed by Animal Health Australia) was launched in mid-2022 with two main components, firstly the upgrading of the website and tools and the on-going management of parasite-related newsletters, media releases, regional parasite reports, and monthly webinars. The ParaBoss website has also been substantially remodelled to facilitate accessibility during this phase. ParaBoss hosts several important flystrike decision support tools, including the Flystrike Risk Simulator, Optimise Flystrike Treatment and Compare Flystrike Management Options. In addition, ParaBoss provides an important industry function in providing timely regular seasonal updates of regional parasite risk conditions and newsletters, monthly webinars, and web-based newsletters covering topical parasite related topics, including many focussing on flystrike control topics such as regional seasonal risk and resistance updates. Importantly, it is also available in cell phone format enabling rapid access by woolgrowers and other industry stakeholders to aid pen-side or other on-site decision making.

A second major component of ParaBoss, managed by UNE, focuses on the training and accreditation of advisers and consultants through the delivery of the ParaBoss Certificate in Sheep Management. Ninety-seven participants have completed the course in the last 12 months and 306 in total, providing critical training capacity for industry in this area.

The existence of a continuing, familiar, practically focussed and adaptive resource that maintains and promotes the most up to date information for growers on flystrike issues and control methods is critically important, particularly as market requirements for accredited production systems become more stringent and new technologies for control emerge. This is of growing importance in the context of ongoing erosion of State government advisory resources.

Industry Uptake of Technology

A Beyond the Bale article (September 2023 'Merino and Dohne Genetic Trends') reiterates our 2023 report of a large increase in sheep recorded by ram breeders for breech traits since 2010 that have

Australian Sheep Breeding Values (ASBVs) available from the MERINOSELECT genetic evaluation. We have updated the table on the proportion of total animals recorded that have ASBVs for breech traits since 2009 - see below). Note that the values shown only count Merino sheep breed in commercial breeding programs and do not include sheep in research flocks nor in sire evaluation sites. This again demonstrates that ram breeders and their clients are increasingly valuing the inclusion of the breech flystrike indicator traits in their breeding programs.

Year of Birth	Animals with ASBVs as a percentage of animals recorded		
	Early Breech Wrinkle	Early Breech Cover	Late Dag Score
2009	22%	15%	9.0%
2010	18%	12%	6%
2011	20%	14%	6%
2012	17%	12%	8%
2013	15%	14%	11%
2014	14%	10%	9%
2015	12%	10%	9%
2016	16%	14%	8%
2017	19%	14%	8%
2018	16%	14%	7%
2019	22%	16%	14%
2020	33%	21%	11%
2021	46%	34%	13%
2022	51%	37%	22%

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