11. How a group of Merino breeders increased the rate of genetic gain by 134% in five years!

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Abstract

The DNA Stimulation Project was a major genetics adoption program in Merino sheep breeding enterprises running from January 2018 to June 2022. Historically, the Australian Merino population have had low rates of genetic gain. This project used a collaborative approach between Meat and Livestock Australia's Donor Company, University of New England, MerinoLink Limited, Merino breeders, scientists, and genetic service providers. A bold project target was set to double the rate of genetic gain by 2022 for the group of 30 breeders who collectively invested over AUD$1.7 million in total and was co-matched by Meat and Livestock Donor Company. The project focussed on working with the project participants to strategically use the genetic and genomic tools currently available. With the ambitious goal being reached a year early (increase of 134% in lifetime of project), the key component to this success was the willingness of project participants to engage and the coaching approach by the project team.

Introduction

On average genetic gain in Australian Merinos has been historically low with very large variations across the industry (Granleese *et al.* 2018). Underlying influences have been caused by a multitude of factors including inaccurate breeding values (Stephen *et al.* 2018) and/or a lack of understanding of selection theory.

The DNA Stimulation Project aimed to build understanding and implementation of genetic selection tools with the project participants. The project focussed on capacity building and working collaboratively at all levels (scientists, genetic service providers, and breeders) across the industry to communicate how to use software tools more effectively for assisting in the design of breeding programs to increase the rate of genetic gain for participants.

During the DNA Stimulation Project, project participants have been faced with significant challenges including unprecedented drought in many parts of Australia and restrictions due to COVID-19. The project team were able to adapt to the challenges and continued to deliver the project requirements.

The aim of the DNA Stimulation Project was to double the annual rate of genetic gain by 2022 (starting 2018) in line with Meat and Livestock Australia's National Livestock Genetic Consortiums aims. This paper outlines methods the project used to almost reach the target of doubling the rate of genetic gain.

Materials & methods

Merino breeders were notified of a project call that would subsidise genomic testing for their seedstock flocks. Given Merino breeders have historically low pedigree recording, this was a vehicle to fast track pedigree collection. The project expectations agreed that in exchange for subsidised genotyping (funding is 58% from the project participants and 42% from the Meat and Livestock Donor Company) that they would form a network to upskill via a series of intense coaching and workshops. Scientists were funded to link to private consulting genetic service providers, the national sheep genetic evaluation group – Sheep Genetics

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and the Merino breeders. The aim was to create links between all levels of data collection, Australian Sheep Breeding Values (ASBVs) delivery and research and development.

The Project had 30 ram breeders (accounting for 40% of the annual Merino Sheep Genetics database intake of animals) and 15 participating commercial breeders who breed their own rams, 43 commercial breeders who purchased rams and seven private consulting genetic service providers. The project participants were located across New South Wales, Western Australia and Victoria. In total this group represented over 10,000 rams sold annually (contributing to >2.5 million sheep born annually), 15,000 doses of semen sold annually to seedstock and commercial breeders, as well as over one million sheep bred directly by the project participants.

The extension and adoption process include a combination of face-to-face workshops, intensive one-on-one meetings, webinars, phone calls, personal emails, e-newsletters and group email updates. Input into these processes include key personnel within the DNA Project Team, University of New England, Sheep Genetics, Meat and Livestock Australia and participants in the project, including breeders and genetics service providers.

Key tools used with project participants include DNA parentage to capture pedigree, low density genomic tests for pedigree collection and/or genomic selection, ASBVs for selection, MateSel (Kinghorn, 2011) to optimise mating decisions in large breeding programs, Sheep Genetics Ramping Up Genetic Gain report (RUGG) to identify data collection problems, Flock Profile – a genomic only estimation of flock average (Swan *et al.* 2018) for commercial breeders, Ram Team Manager (RamSelect.com.au) for commercial ram buyers to improve their ram teams each year for their breeding objective, Rampower within flock indexes for commercial breeder collecting phenotypes but not pedigree and percentile band tables for context of breeding values.

Each project participant worked through the process of setting and documenting an achievable breeding objective which is revisited each workshop or meeting with the DNA project team. Key questions covered were: – are they on track, what is working well (or not), what can be improved, and how are project participants measuring progress?

To benchmark progress the DNA Stimulation Project used rates of genetic gain were ASBVs generated by Sheep Genetics. The project also used direct workshop feedback to track the effectiveness of the project.

Genetic improvement was benchmarked using a standard breeding objective using Sheep Genetic's Merino Production Plus (MP+) economic index. 'Doubling the rate of genetic gain' was measured by comparing the five-year genetic gain average (2012-2017) compared to the project four-year genetic gain average (2017-2021).

Results

Genetic gain increased by 134% in ram breeders comparing the four-year period of the project to the previous five years prior to the project. Another of the key outcomes of the project with the strategic use of DNA testing technologies was the increased number of ram breeder participants submitting data to Sheep Genetics with full pedigree information. There was an increase in the number of project participants submitting full pedigree from 25 to 70% between January 2018 and January 2022.

At the beginning of the project there were large differences in average genetic merit between the ram breeder participants in the DNA Project, with the lowest average MP+ index 110 (90th percentile) and the highest 167 MP+ index points (1st percentile) at the commencement of the project in 2017. The current MP+ index range between the ram breeders is 138 (70th percentile) to 188 (1st percentile) index points. The diversity in the group facilitated sharing and swapping experiences to allow informal mentoring within the group.

Discussion

The key component to the success of this educational project was providing links between breeders, private genetic service providers and scientists. The interaction between all parties allowed flow of information benefiting all parties and breaking down communication and trust barriers. Furthermore, engaging private genetic service providers who had clients within the project gave extra incentive for them to up-skill. The up skilling of these professionals' results in the multiplier effect with more educated messages and advice being passed on to many of their clients.

Trust within the project was initially built on 'across-the-kitchen table' meetings with ram breeders where they expressed their frustrations with genetic evaluation and barriers that stopped them collecting crucial data for higher quality ASBVs. With this knowledge the team scientist and service provider were able to provide direct feedback as to why not collecting data points was affecting their ASBVs and practical solutions to their problems. Once participants were listened to in a 'safe' and private space, their willingness to change and adopt occurred quickly.

Access to the same genetic service provider as well as scientist at any time in any medium (i.e. email, phone call, text message, Zoom meetings) was another key step in helping breeders upskill and adopt better practice. Further group educational activities held were annual ram breeder workshops where a range of scientific developments, direct feedback, setting S.M.A.R.T. breeding objectives and peer-to-peer learning through social networking and project case studies. Before and after each workshop the project team would get breeders to fill in questionnaires rating their understanding of how ASBVs are calculated and how much they use ASBVs in selection decisions. Prior to the project starting the group average responses and post project average responses are summarised in Table 1. Further into the project as breeders built a depth a pedigree in their flocks they were in a position to use Matesel (Kinghorn 2011) where matings are optimised to maximise genetic and limit future co-ancestry. A series of Matesel workshops were run in the last three years of the project. Either breeders ran their own Matesel at joining or employed their genetics service provider to do this for them which helped accelerate rates of genetic gain given Matesel uses index selection.

The project observed a direct relationship between attending educational activities and rates of genetic gain. Figure 1 demonstrates that the more engaged ram breeder project participants were with the project the higher the rates of genetic gain. This trend validates the intense relationship the breeders have with the

Table 1. Ongoing mean scores at set times throughout project of breeders' knowledge and use of ASBVs throughout the project.

	Understanding of ASBVs	Use of ASBVs in selection decisions
1-Jan-2018	3.6	6.4
1-Jan-2019	6.8	7.5
1-Jan-2020	7.4	8.4
1-Jan-2021	8.3	8.7
1-Jan-2022	8.5	8.9

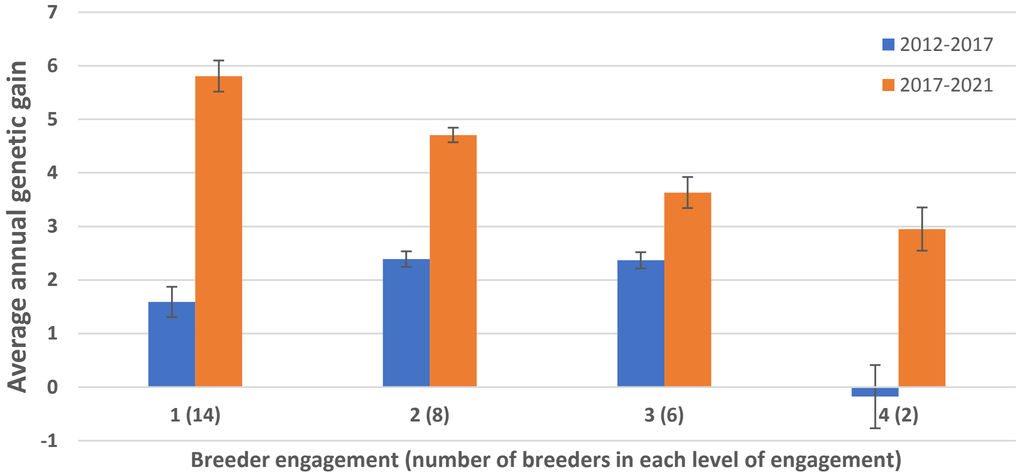

Figure 1. Blue bars represent five-year average annual genetic gain (2012-2017) pre-project and orange bars represent three-year average annual genetic gain (2017-2021) during project for studs grouped by project engagement. 1 – Fully engaged: attends all workshops, calls project leaders, asks for one-on-one meetings; 2 – Engaged: Attends most workshops and/or some extra meetings; 3 – Sometimes engaged: Sporadic attendance to workshops, rarely uses extra opportunities; 4 – Never engaged: Do not turn up to any workshops or extra activities.

project team. A key to keeping breeders engaged was using a co-investment model. Initially the project used the motivation of subsidised genomic testing to 'lure' breeders into the project. With Meat and Livestock Australia offering dollar-for-dollar investment with project partners, the project lead was able to 'skim' small amounts of money off each subsidised test to help fund a genetics service provider's and scientist's time for the life of the project. Furthermore, breeders agreed to pay an annual fee of $2,000 AUD/yr to: (1) help fund workshops and time of staff on the project; and (2) maintain interest and investment in the project after the initial benefit of subsidised genotyping.

Summing up, the DNA Stimulation project was a success in increasing the rate of genetic gain in Merinos. Furthermore, the project had long-lasting implications with the up skilling of genetic service providers and breeders to continue the pursuit of improving breeding objectives and better facilitating clients.

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