FeetFirst Update

May 2017

Just over four years ago NZM embarked on an ambitious project to develop an estimated breeding value (or EBV) for footrot. This work has moved through several phases to determine the best way to achieve the ultimate goal – a new way to find the animals that are least likely to succumb to footrot. Through the project we have forged extremely valuable collaborations across New Zealand and Australia.

What have we learnt?

- There are no silver bullets.
- That exposing rams to footrot and selecting the rams that stay footrot-free, when others in the mob do not, is an effective method for finding resistant rams.
- While footrot is predominantly a disease of the weather, 20% of the variation we see in incidences of footrot is due to genes. That is, the heritability of footrot is 20%.
- There are many genes that control footrot. In fact, 21 of the 27 pairs of chromosomes in the sheep genome contain genes that impact on footrot resistance.
- Progeny testing in a central location is by far the most effective way of determining a sire's genetic resistance to footrot.
- Footrot resistance is present in all types of fine-wool sheep, whatever your sheep type there will be sires that are genetically resistant to footrot.
- Sheep that are resistant to footrot tend to have better carcass attributes, cut less wool and grow slower. However, these correlations are weak and can be easily overcome by a balanced breeding approach.

What has been done?

We have collected a lot of DNA and have scored a lot of feet. This information is in several forms:

- **Case: Control** – The original commercial farm data, where we collected DNA from animals that either did or did not get footrot under challenging conditions.
- **Ram Challenge** – We have progeny-tested several of the rams that did not contract footrot under a year-long challenge. These rams consistently demonstrate that they pass on genes that are above average for footrot resistance.
- **CPT** – The central progeny test data, where we have scored the feet of the wether progeny each year in conditions **where footrot was present. We have also collected DNA from these animals and their sires.**
- **Nucleus flock / stud flocks** – The Southern Cross nucleus flock and a small number of studs have footrot present in their stud sheep. We have scored the feet of their ram hoggets during footrot outbreaks. These flocks have also been able to supply pedigree information.
- **Stud sires** – For four years, we have been collecting DNA from rams that are being used in the industry. For the majority of these animals, we do not know about their physical resistance to footrot, but we are using their DNA to predict this.

Where are we up to?

Delivering the best information possible

We are making sure that the data is analysed appropriately to give the most effective breeding value that we can. We can approach the transformation and analysis of the data in many ways. Each of the potential methods have been explored and compared to ensure that the industry has the best available information to make ram selection decisions going forward. The breeding value that is released to the industry will use the best combination of information.

Creating a level playing field

We are also developing methods to standardise data across various footrot challenges. Unlike many other traits, the footrot data you collect is dependent on when you collect it. Because the disease progresses with time (if conditions remain conducive), the average footrot score in the population can rapidly change. We have developed protocols to adjust data to the same disease state, helping to reduce variability and improve the accuracy of breeding value prediction.

Predicting footrot breeding values using DNA

Over the past few years, AGBU, our collaborating partners in Australia, have been working on a world-class system to analyse genomic information. Known as 'single-step', this analytical technique combines genomic (DNA) information with pedigree information and measurements or scores of traits to predict estimated breeding values. This technique is now ready and is being used to combine and analyse our footrot data.

As this update is being written, single-step is being used to predict the footrot breeding value for sires where we have collected DNA information only, based on the information we have for sires that have had their progeny tested for footrot as well as DNA information collected. This is a major milestone in the life of this project and is the outcome that we have been striving for since the inception of the project.

Where to next?

The hard work to date has built a great platform from which the industry can create a footrot-resistant future. Because of the nature of genomic relationships, the database of DNA information and footrot information will need to be maintained on an ongoing basis. The plan is to maintain the database by continuing to progeny-test sires at a central site. The 2017 mating at the CPT is now underway. The Australian industry is keen to collaborate on this work and is likely to contribute funding to enable its continuation.

Four years is a relatively short time in the world of science, particularly in the world of genetics. The foundation that has been laid by this project, if used appropriately and extended, will serve the industry for decades to come.

Acknowledgment