

LRIC Horizon Series Highlights: Genomics

Highlights with Dr. Stephen Miller, Animal Genetics and Breeding Unit, Australia

As part of its Horizon Series, the Livestock Research Innovation Corporation (LRIC) has written five new white papers on issues impacting the livestock sector and the entire livestock value chain. In this issue, Dr. Stephen Miller highlights advances made in livestock breeding through genomics. Miller completed his undergraduate and graduate degrees at the University of Guelph, was the director of genetic research with Angus Genetics Incorporated and is currently the deputy director of the Animal Genetics and Breeding Unit in Australia. He co-authored LRIC's white paper Genomics.



“The snip chip changed the game for the genetic improvement of livestock.”

Dr. Stephen Miller

In 2005, the SNP (single nucleotide polymorphisms) chip came out. It represented the differences in traits of interest that could be used for genetic selection. The chip consisted of 50,000 individual “snips” or differences in DNA across the entire animal genome, called the whole genome selection. The chip signalled the first time it was possible to genotype large numbers of animals for that large density volume. Before 2005, Miller says the industry was doing just a handful of snips, but when the technology enabled the identification of 50,000 snips, it really transformed livestock breeding.

“The dairy industry implemented the process with great success after 2005.”

Dr. Stephen Miller

Shortly after the chip came out, University of Guelph’s Dr. Larry Schaeffer—and one of Miller’s former teachers—asserted that applying genomic selection in dairy cattle with the use of the chip could double the rate of genetic change. Schaeffer’s predication played out. Lactanet Canada data shows the annual rate of gain on the dairy genetic evaluation index was about 46 points per year, before genomic selection was implemented. After genomic selection was implemented, the rate of improvement is more than 100 points per year—more than doubling the rate of genetic gain.



“Genomics basically accelerates rate of gain and makes selection go better and faster for the desired traits.” Dr. Stephen Miller

The technology provides a way to come up with an accurate genetic prediction based on genotype. In practical terms, Miller explains how genomics means young bulls can be genotyped without waiting until that bull has 90 daughters in milk and is much older, before his performance is known. Genomics is really shortening the generation intervals and increasing the accuracy of selecting young animals.

“On the beef side, the question started coming up in 2010 about whether we could implement the same technology in beef as we did in dairy for genetic selection with genomics. The answer was yes.” Dr. Stephen Miller

Miller explains the process took a little longer in beef cattle, than with dairy. When he started working with American Angus in 2016, they had just over 250,000 genotypes for this single beef breed. In 2021, they will hit one million genotypes. Genotyping is becoming a routine part of business for farmers because the accuracy is there.

“It is now more accurate to have genetic evaluations on animals that we create from a genomic sample than if we went out and measure the actual traits in animals that we were interested in.” Dr. Stephen Miller

Weaning weight is a good example. Miller explained that genomics means we can more accurately predict weaning weight with just a DNA sample at the animal's birth, compared to waiting to weigh the calf at weaning.

“We can apply genomics to any species.” Dr. Stephen Miller

The technology is transforming the way breeders are breeding their cattle, but Miller reiterated the technology is not limited to cattle. At the Animal Genetics and Breeding Unit, they are doing work on honeybees, prawn, plants and other species. They've developed a software tool for the sheep industry for a number of traits including growth, wool, carcass quality, reproduction and health.

“Genomics is not magic. It is still a lot of hard work.” Dr. Stephen Miller

There is no magic bullet when it comes to genomics. Miller outlined how the process requires animals that have the measurement or trait you want to change as a reference set—thousands of animals that are measured for that trait and genotyped—and related to the candidates we need to select to make the genetic improvement.



"If you can dream it, you can change it with genomics." Dr. Stephen Miller

Looking ahead to what's next with genomics, Stephen says the livestock industry faces a number of challenges and genomics offers a key solution. The method and the recipe are there—measure the trait, genotype it, select for it, and repeat. It's up to the industry to determine where they want to take genomics.

Watch the full webinar or review the white paper at livestockresearch.ca/white_papers. For more information, contact LRIC at info@livestockresearch.ca or 519-766-5464.

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