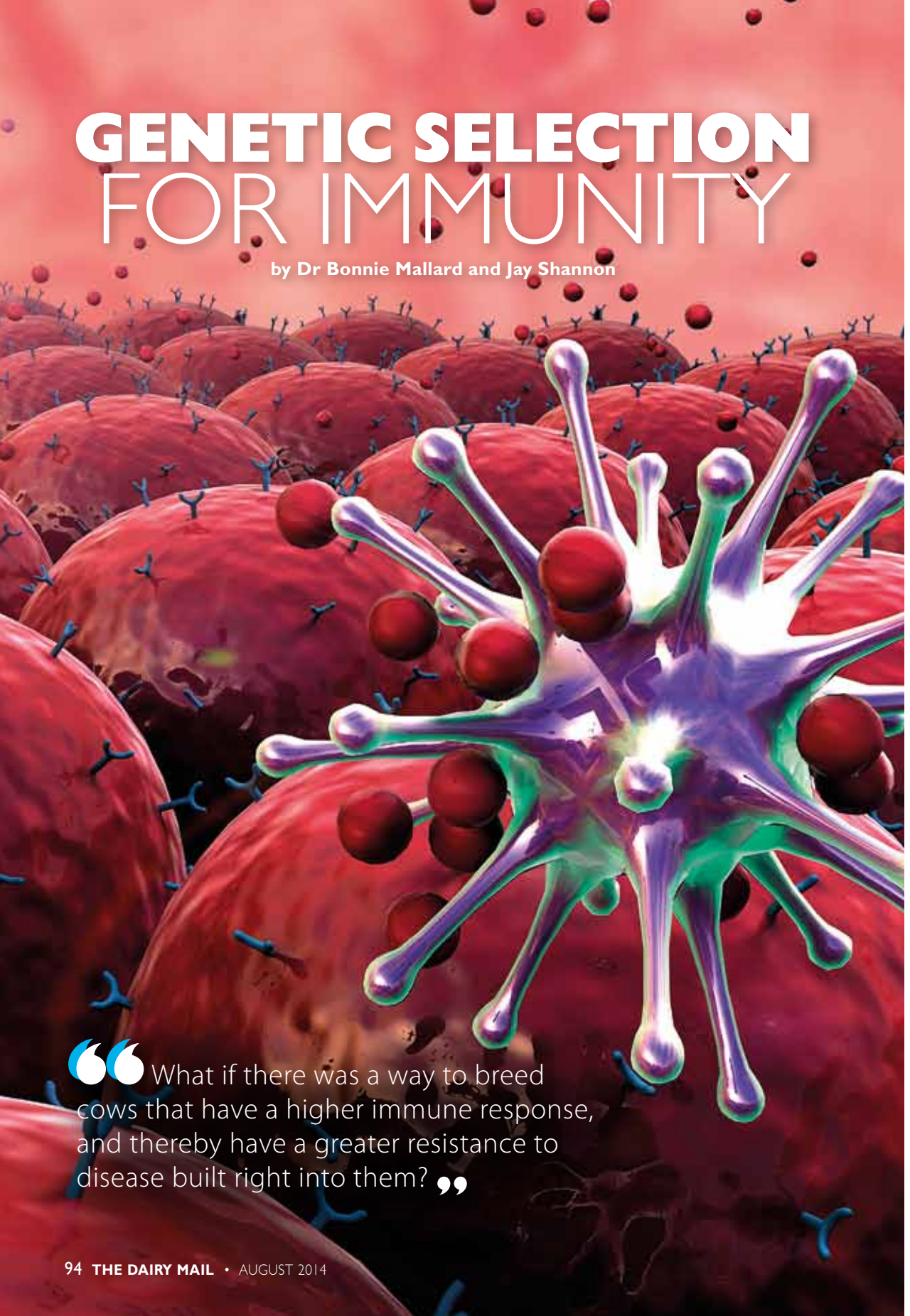
GENETIC SELECTION FOR IMMUNITY

by Dr Bonnie Mallard and Jay Shannon



> What if there was a way to breed cows that have a higher immune response, and thereby have a greater resistance to disease built right into them?

No matter whether you manage your cows on pasture or in commercial housing, it's a challenge to maintain a healthy herd of profitable and efficient cows. If a cow becomes sick, modern management and medicine are used to remedy the situation. If that's not possible, the unfortunate decision to cull the animal may have to be made. Either way, both result in added costs. But, what if it didn't have to be that way?

What if there was a way to breed cows that have a higher immune response, and thereby have a greater resistance to disease built right into them? The immune system is designed to provide protection from a wide range of pathogenic microorganisms. Therefore, being able to identify individual dairy cows with a natural ability to make superior immune responses reduces disease occurrence, will increase farm profit and improve milk quality as well as safety.

The research

The high immune response (HIR) technology developed by Dr Bonnie Mallard and her colleagues at the University of Guelph has been researched more than most technologies brought to the farm. This research tells us that HIR cows have a 19 to 30% lower incidence of disease compared to the herd average. In addition, these cows respond better to commercial vaccines and produce higher-quality colostrum for their calves. As a result, they're more profitable, by bringing in more revenue, lowering costs and wasting less of the dairyman's time. The discovery of HIR was a game changer, as it revealed that high immunity is passed from parent to progeny at rates much like production and some conformation traits. Compared to most health traits

TAKE-HOME MESSAGE

- The immune system is the body's defence system that provides disease resistance.
- The immune system is genetically regulated and can be modified by genetic selection.
- The University of Guelph award-winning patented high immune response (HIR) technology is designed to identify cattle with optimised immune responsiveness and is associated with enhanced resistance to a broad range of diseases.
- The Semex Alliance has an exclusive licence to apply this technology to identify high-immune responder sires, marketed under the Immunity+ trademark, which can be used to breed for improved bovine immune responses.
- The HIR technology offers both a novel management and genetic selection tool to improve herd health.

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with low heritabilities of <10%, immune response is considered moderately to highly heritable at 25%. This means it can be selected for and improved upon with each generation.

In December 2012, the University of Guelph granted Semex an exclusive licence to use the HIR procedure to identify sires with the high immune response classification. These sires are given the designation of Immunity+, marking their enhanced capacity to make protective immune responses.

Breeding for resistance

The immune system is the body's natural defence against infectious disease and cancer. This system has the ability to customise a protective response against a set of diverse pathogens. These defensive mechanisms are delivered via a collection of genetically regulated cells and molecules that control invading microorganisms, including those that cause bovine mastitis, metritis, pneumonia, Johne's disease, BLV and so on.

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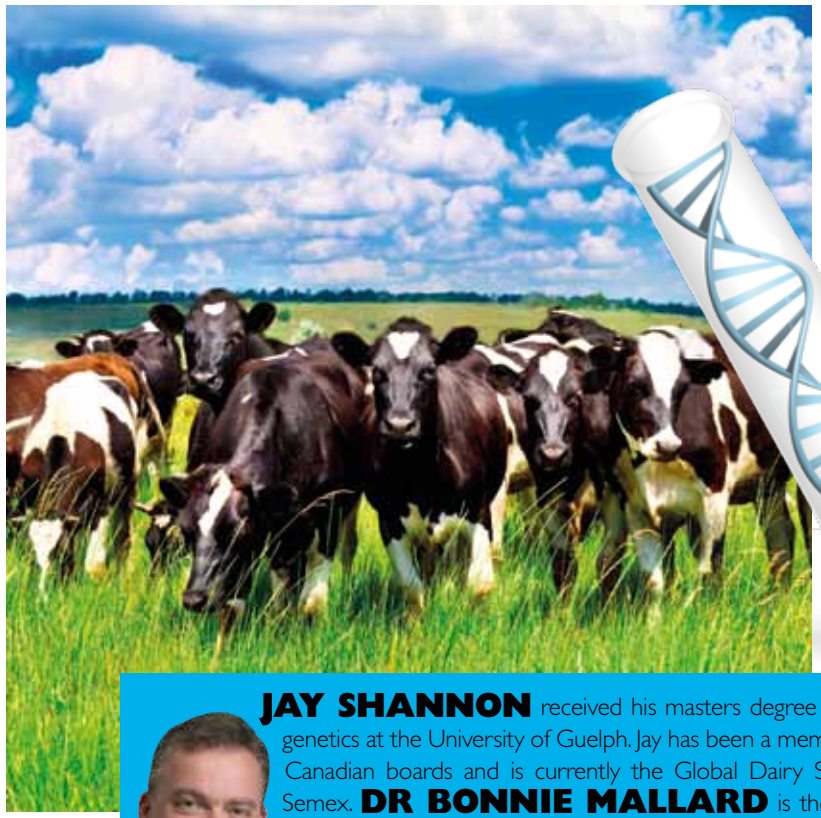
Using well-established quantitative genetic principles, it is possible to identify individuals with enhanced immune response phenotypes. Phenotypic characteristics (measureable traits) are composed of two parts – genetic plus environmental components. By comparing the phenotypic responses of interest in related individuals, the genetic component of the phenotypic values can be determined. Knowledge of the genetic component allows computation of the heritability and the estimated breeding value (EBV) for each individual

Table 1 Disease occurrence of Immunity+ daughters in a large US dairy herd in 2013.

Disease	Cattle	Immunity+ daughters	All other daughters	Disease reduction*
Mastitis	1st lactation	8,8%	15,8%	44,3%
All recorded disease	1st lactation	16,7%	18,2%	8,5%
Pneumonia	Heifers	6,8%	9,1%	25,3%

* Disease reduction = (Disease incidence in all daughters - disease incidence Immunity+ daughters) / Disease incidence in all daughters x 100%

for the trait of interest. This approach has been used for decades to improve livestock traits, including milk production. The HIR technology uses a similar approach to identify cattle with the highest EBVs for immune response. The heritability of immune response is sufficiently high to allow for improvement via genetic selection. In general, high responders have about half the disease occurrence of low responders. Similarly, daughters of Immunity+ sires are now seen to have lower disease incidence and generally higher genetic values for most health-related traits and total merit so it can be selected for without sacrificing genetic advancement for other traits (Table 1).



CONCLUSIONS

HIR/Immunity+ is an award-winning patented technology that allows dairy producers to safely and effectively improve herd health. High immune responders have about half the disease occurrence of low responders, along with improved colostrum quality and response to commercial vaccination. HIR is both a management and breeding tool. Semex has an exclusive license to use the HIR technology to identify sires with the elite high immune response classification. Immune response traits are heritable and using Immunity+ bulls allows improved disease resistance genes to be passed on to offspring.

JAY SHANNON received his masters degree in animal breeding and genetics at the University of Guelph. Jay has been a member of many national Canadian boards and is currently the Global Dairy Solutions Manager at Semex. **DR BONNIE MALLARD** is the professor of immunogenetics in the Department of Pathobiology at the University of Guelph and the lead research director of the high immune response technology. Contact the authors at bmallard@ovc.uoguelph.ca or jshannon@semex.com. TDM