Genetic Selection for Improved Hoof Health is Now Possible!

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Over the past few years, we have heard from many producers, “genetic selection for increased resistance to hoof lesions cannot come soon enough”. This December, the time has come; a genetic evaluation for Hoof Health will be available for the Holstein breed.

Selection for Hoof Health was made possible through a research project that spanned from 2014 to 2017, targeted at improving hoof health in Canadian dairy herds. Only one year after this project’s completion, Canadian Dairy Network (CDN) is able to move the research to the field in the form of genetic evaluations for Hoof Health – an index that promotes increased resistance to eight key foot lesions.

In addition to genetic evaluations for Hoof Health, there are two other key outcomes from this project. The first is the development of a data collection pipeline from hoof trimmers, to Canadian DHI, and then on to CDN, where it is stored in a national database. The second outcome

includes the development of an interactive DHI hoof health management report, which will be available to producers in coming months.

From Genetic Evaluations for Digital Dermatitis to an Overall Hoof Health Index

Genetic selection for increased resistance to Digital Dermatitis has been possible since December 2017. The new Hoof Health (HH) evaluation will replace Digital Dermatitis as the primary selection tool – a logical transition since Digital Dermatitis is one of the eight lesions that make up the HH index. The full list of lesions contributing to the Hoof Health index are included in Table 1. The frequency of Digital Dermatitis is the highest among the eight lesions of interest, at approximately 17%. Of cows presented to the hoof trimmer, 46% experience at least one hoof lesion in their lifetime.

Table 1: Frequencies, Heritabilities, Correlations and RBV Translation for the Eight Hoof Lesions Included in the Hoof Health index

Lesion	Frequency (%)	Heritability (%)	Correlation with Hoof Health index (%)	Expected % increase in Healthy Daughters for each 5 point increase in HH
Digital Dermatitis	16.9	8	85	4.6
Interdigital Dermatitis	2.6	5	70	0.9
Heel Horn Erosion	2.9	8	76	0.1
Sole Ulcer	8.5	5	74	3.0
Toe Ulcer	1.3	4	3	0.5
White Line Lesion	4.7	4	9	1.4
Sole Hemorrhage	7.4	3	63	0.9
Interdigital Hyperplasia	2.2	7	40	1.1

Genomic evaluations for Hoof Health are calculated using a new methodology called “Single-Step”, which calculates genomic evaluations by simultaneously using all pedigree, performance and genotype information. Lesion frequency and economic importance to producers dictated the weights of the eight lesions within the HH index. Like all functional traits, Hoof Health will be expressed as a Relative Breeding

Value (RBV) with an average of 100 and general range from 85 to 115 with higher values indicating better resistance to Hoof Health problems. The average reliability for bulls reaching official proof status for Hoof Health will be roughly 75%.

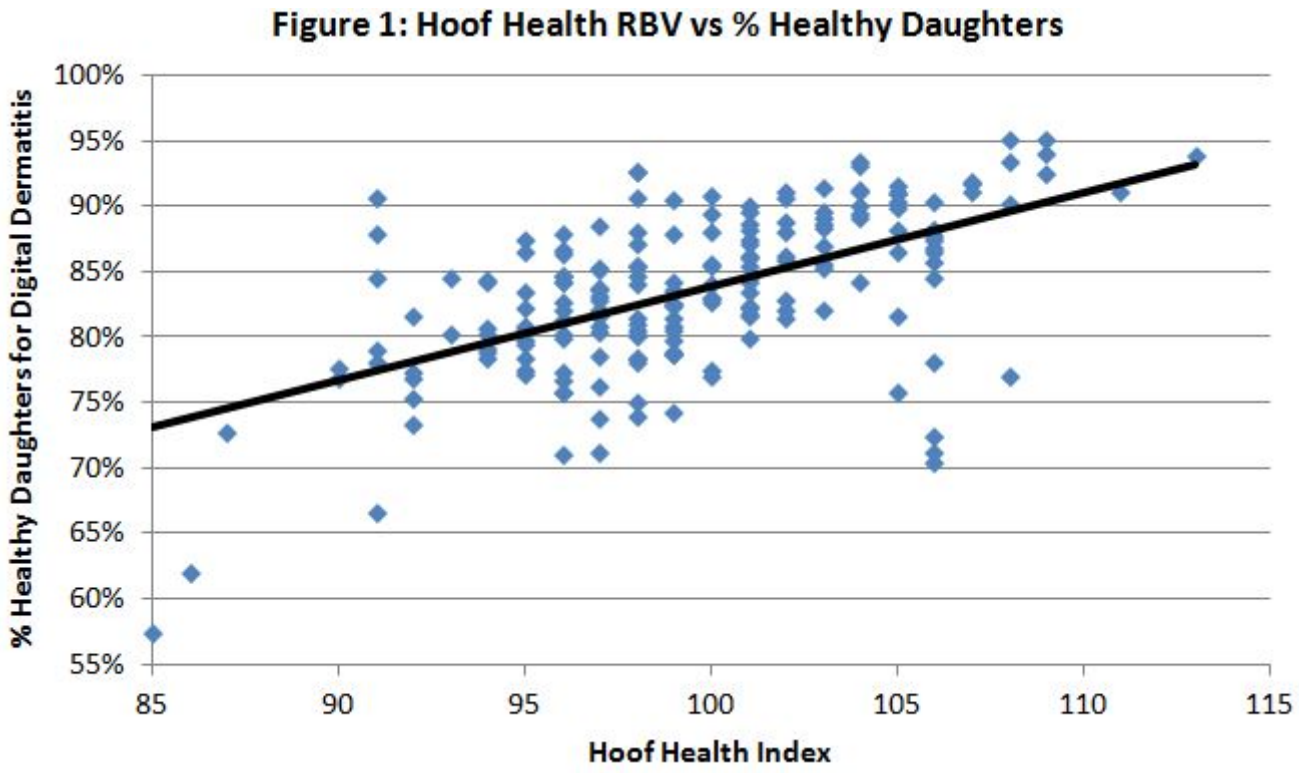
The heritability of each individual lesion is included in Table 1, ranging from 3% to 8%. The heritability of the overall Hoof Health index is 9%, meaning 9% of the variation for hoof lesions seen in Holsteins can be attributed to genetics. Correlations of the individual lesions with the overall Hoof Health index are also presented in Table 1. Infectious lesions like Digital Dermatitis, Interdigital Dermatitis and Heel Horn Erosion have high correlations with Hoof Health. The correlations between Hoof Health and the non-infectious lesions like Sole Ulcer, Toe Ulcer, White Line Lesion, Sole Hemorrhage and Interdigital Hyperplasia are more variable. Toe Ulcer and White Line Lesion have the lowest correlations with Hoof Health since they each have a small negative genetic correlation with the three infectious hoof lesions. Overall, the correlation between HH and both LPI and Pro$ is 58%, meaning selection for either national index will result in improvement for Hoof Health.

Since the focus of classification has been on animal mobility based on structural soundness of feet and legs as opposed to foot health, correlations of the Hoof Health index with feet and legs traits are moderate to low. The highest of these correlations are presented in Table 2. Other interesting correlations with the Hoof Health index include Herd Life at 49% and the Production component of LPI at 42%.

Table 2: Correlations of Hoof Health with Feet and Legs Traits	
Feet and Legs Trait	Correlation with Hoof Health
Heel Depth	47%
Feet & Legs	35%
Rear Legs Rear View	21%

Selection for Hoof Health

Selection for Hoof Health will lead to improved resistance to the eight key lesions. This is illustrated in Figure 1, which shows the relationship between a sire's Hoof Health proof and the percentage of healthy daughters for Digital Dermatitis. An average Hoof Health bull with an RBV of 100 will have ≈84% healthy daughters. In other words, approximately 16% of daughters presented to a trimmer will have a Digital Dermatitis lesion.



Selection for Hoof Health will have varying impacts on the frequencies of the eight lesions in your herd. The last column in Table 1 translates the expected percentage increase in healthy daughters for each five-point increase in a sire's Hoof Health index. As an example, consider two bulls with Hoof Health ratings of 100 and 110. Based on Table 1, you could expect a bull rated 110 for Hoof Health to have around 9%, 6% and 2% more healthy daughters for Digital Dermatitis, Sole Ulcer and Sole Hemorrhage, respectively, compared to daughters of the bull rated 100 for Hoof Health.

Due to the large impact of foot problems on production, animal health and welfare, Hoof Health is a tool producers are eager to adopt. As of December 2018, Hoof Health will be available as a new "Functional" trait. In coming months, separate RBV for each of the eight lesions will appear on the CDN website when selecting the "Health" tab for any Holstein sire.

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