Accuracy of Genomic Evaluations from 6K Genotypes

A previous article published in January 2012 showed the accuracy of imputing genotypes derived from the 6K panel into 50K genotypes used for the estimation of genomic evaluations. While imputation accuracy is very important for breeders to take advantage of the lower cost genotyping option provided by the 6K panel, the key question, however, is "How accurate are genomic evaluations resulting from 6K genotypes compared to 50K genotypes?". Geneticists at Canadian Dairy Network (CDN) recently addressed this question and presented results at the most recent meetings associated with the Genetic Evaluation Board (GEB) of CDN.

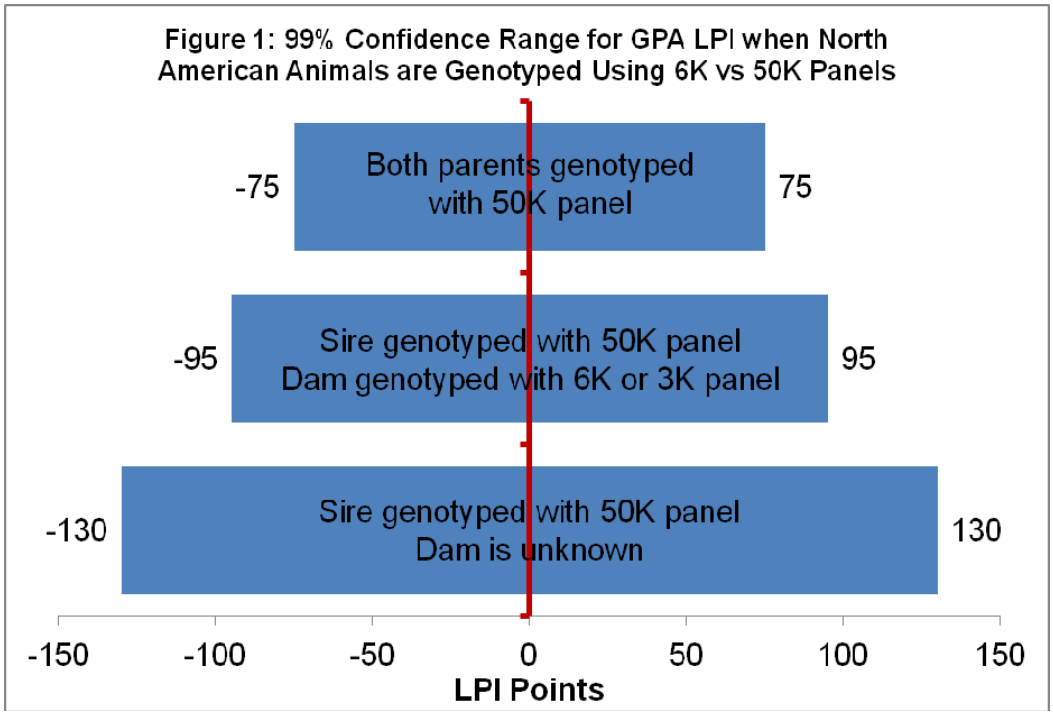
Strategy of Analysis

There are basically two ways to examine the impact of genotyping animals using a lower density panel such as the 6K one versus the standard 50K panel. One approach is to genotype a proportion of the population with the 6K panel, compute the associated genomic evaluations and then redo the same calculations after re-genotyping the same animals again with the 50K panel. This approach is expensive since it requires that each animal be genotyped twice. A more logical approach is to start with a large group of young animals genotyped with the 50K panel and then reduce their actual genotypes to include only the 6K subset of the markers on the 50K panel. The CDN analysis was based on over 9,000 young bulls born in 2011 that were genotyped with the 50K panel. Given that young bull candidates genotyped by A.I. companies tend to have extensive pedigree information and often several ancestors genotyped, the CDN analysis also removed some of the parental genotypes to mimic various scenarios routinely found within the Canadian dairy breeds. Similar to the previous analysis of imputation accuracy, this study of genomic evaluation accuracy was conducted within groups based on whether the animal's dam was genotyped with the 50K panel, a low density (6K or 3K) panel or the dam was not known at all.

99% Confidence Range for LPI

Figure 1 shows the degree of change in an animal's genomic evaluation for LPI if it had been genotyped with the 50K panel instead of the 6K panel. This degree of change is expressed as a 99% confidence range, which means that only 1 animal out of every 100 could experience a change in genomic LPI outside of the given range. In addition, the confidence range values in Figure 1 vary depending on the amount of known pedigree and the level of genotyping of the dam. In all scenarios shown, the sire is assumed to have been genotyped with the 50K panel since this is the reality for approximately 90% of all registered heifers born in Canada.

When a heifer from Canada or the United States is genotyped with the 6K panel and both parents have been genotyped with the 50K panel, it is expected that 99% of the time the resulting genomic evaluation for LPI will be within ±75 LPI points from what it would have been if she too had been genotyped with the 50K panel. If the heifer's dam was genotyped with a low density panel (6K or 3K), then 99% of the time the change compared to having a 50K genotype is expected to be within ±95 LPI points. In the worst case scenario, when the dam is not even known and has no pedigree information, then 99% of animals genotyped with the 6K panel would have an estimated genomic evaluation that is within ±130 LPI points from what it would have been if the higher priced 50K panel was used for genotyping the animal. The 99% confidence ranges in Figure 1 based on 6K versus 50K genotyping serve as valuable information about what panel to use. In most situations, the accuracy achieved with the 6K panel is so high, and the 99% confidence range is so narrow, that it makes no sense to spend the extra money to use the 50K panel to genotype heifers. If, on the other hand, it is critical to have the most accurate results possible, then 50K genotyping is recommended.



Accuracy for Key Traits

Table 1 provides a summary of the 99% confidence ranges for various traits of importance, which have been rounded to facilitate understanding in terms of proof expression. As before, the animal's sire has a 50K genotype and its dam has either a 50K or low density (6K or 3K) genotype or is not known. In brief, the 99% confidence ranges for each trait clearly show that genotyping with the 6K panel is very accurate compared to using the 50K panel, and the optimal situation exists when animals have both parents with a 50K genotype. As for LPI, however, there are some scenarios when the maximum accuracy is desired and the 50K panel is recommended. CDN requires all bulls entering A.I. to be genotyped with the 50K panel since the highest accuracy of their genomic evaluation is important and these bulls, once progeny proven, will become part of the reference population used at CDN. Accurate genomic evaluations are also important for bull dams being considered by A.I. companies as well as any donor dam in the herd to increase the accuracy of genomic evaluations for resulting daughters.

Table 1: Approximate 99% Confidence Ranges by Trait for North American Animals Genotyped Using 6K versus 50K Panels

Known Parents and Genotypes	Milk Yield	Fat Yield	Protein Yield	Somatic Cell	CONF	Herd Life	Daughter Fertility
Both parents with a 50K genotype	±80	±3	±2	±0.03	±0.55	±0.55	±0.55
Sire with 50K genotype Dam with 6K or 3K genotype	±100	±4	±3	±0.04	±0.70	±0.75	±0.75
Sire with 50K genotype Dam is unknown	±130	±5	±4	±0.05	±0.85	±0.95	±0.95

Summary

The availability of the 6K panel for genotyping animals since October 2011 has significantly improved the accuracy of genomic evaluations derived from low density genotypes compared to paying the higher cost for a 50K genotype. This advancement will undoubtedly contribute to an expanded use of genotyping in a broader group of herds across Canada. The accuracy of genomic evaluations using the 6K panel is influenced by the level of genotyping of parents and the pedigree information available, especially on the maternal side. While the 6K panel can be widely used to genotype most heifers and cows, the 50K panel is recommended when the maximum accuracy of genomic evaluations is desired, which includes young bulls, bull dams and donor cows for embryo transfer.

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