Improving On-Farm Performance: Management vs Genetics?

Advances in research and technology give us a deeper understanding of the complex biological processes and environmental factors behind the production of dairy products. We continue to develop genetic evaluations for traits that have the largest impact on the animal's productive life – including health, fertility, longevity, functional conformation, and production. With the introduction of genomics, we have propelled the genetic improvement of traditional traits and driven gains in novel traits with low heritability. But how are these genetic improvements showing on your farm? Are you working for your cows, or are your cows working for you?

While functional traits help to decrease on-farm expenses, production is still the primary revenue source for dairy farmers, which should be sustained for multiple lactations. To reflect this, production yields and Herd Life are the biggest contributors to the Pro$ index and the LPI formula in Holsteins has relative weights of 40% on both the Production and Durability components. Milk, fat, and protein yields are some of the most reliable and heritable traits, having average proven sire reliabilities of 90%. Even for genomic young bulls, with no daughters having performance data, production traits have genomic reliabilities upwards of 70%!

Production Improvements Over Time

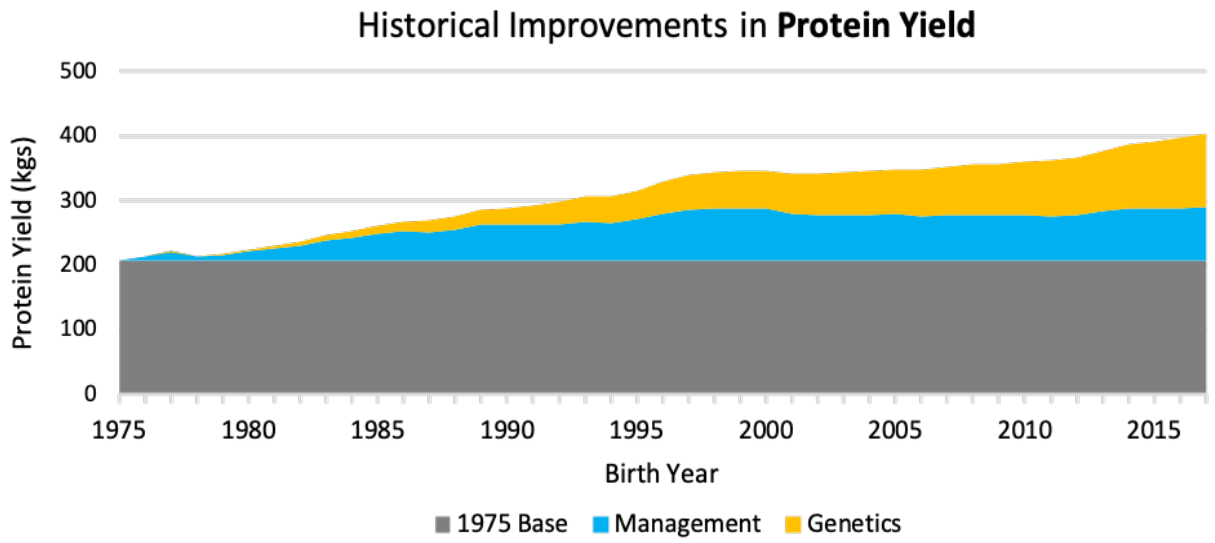
The average Canadian Holstein cow born in 1975 produced 6,907 kg of milk with 256 kg fat and 207 kg protein, in terms of mature equivalent (ME) yields. Since then, we have seen improvements to almost double those levels. For Holsteins born in 2017, the average ME yields were 12,468 kg milk, 495 kg fat and 403 kg protein. This increase is due to two factors – the introduction of improved management techniques and the selection for genetically superior animals.

Dairy herds in Canada are among the top managed herds globally. Improvements at the herd level for on-farm performance were historically due to changes in management techniques. Nationally, we have a high adoption rate of new technologies and use these to get the most out of our cows. Whether that be the introduction of new milking systems, early detection methods for sub-clinical infections, better cow comfort, optimization of rations or the widespread use of herd management software. However, if a herd's average genetic potential is low, greater management efforts are needed to achieve the desired high performance. That is time, and revenue, being wasted.

Genetics indicates the potential an animal has. Management decides whether the cow meets that potential or performs below expectations. Over time, and with the introduction of new genetic technologies that allow us to make incredible genetic progress, the proportion of on-farm performance due to genetics is getting larger. We can genetically improve our animals at a much faster rate, which means that less management interventions are required to have a high producing cow in the average herd.

Figures 1, 2 and 3 show the increases in on-farm production performance over time for protein, milk, and fat yields, respectively, separated into a management component (blue) and a genetic component (yellow), while the grey area represents the base level of ME production yields for Holsteins born in 1975. The proportion of on-farm production performance due to genetics has been steadily increasing over time and now represents a significant proportion of on-farm performance progress – in some cases, the majority.

Figure 1: Historical national averages for Protein production in mature equivalents, where grey represents the base level for cows born in 1975, blue is the proportion of on-farm performance improvement due to management and yellow is the proportion due to genetics.



For protein yield, we see an increase in the rate of genetic gain (the slope of the graph) around the same time as the implementation of genetic evaluations for cows and the LPI index in Canada (late 1980s and early 1990s). This is also true for the introduction of genomics in 2009, which increased genetic gain by improving accuracies and shortening the generation interval. Gains due to genetics are cumulative from generation to generation and have long term benefits. Each time we select for increased protein, we build on the progress that was previously made. In fact, for Holsteins born in 2017, 57% of the cumulative production improvement for protein yield since 1975 has been due to genetics and the remaining 43% has been due to better herd management practices.

For milk yield, a similar trend exists whereby the relative improvement of on-farm performance has gradually shifted from management to genetics (Figure 2). Again, for cows born in 2017, 61% of the gains accumulated since 1975 have been due to genetics and 39% due to management.

Figure 2: Historical national averages for Milk production in mature equivalents, where grey represents the base level for cows born in 1975, blue is the proportion of on-farm performance improvement due to management and yellow is the proportion due to genetics.

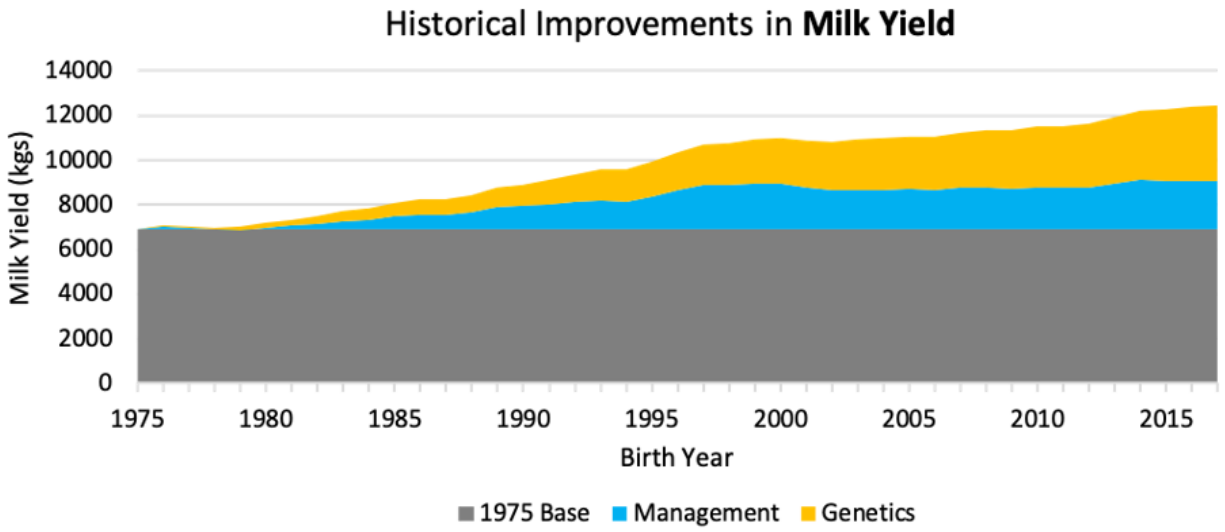
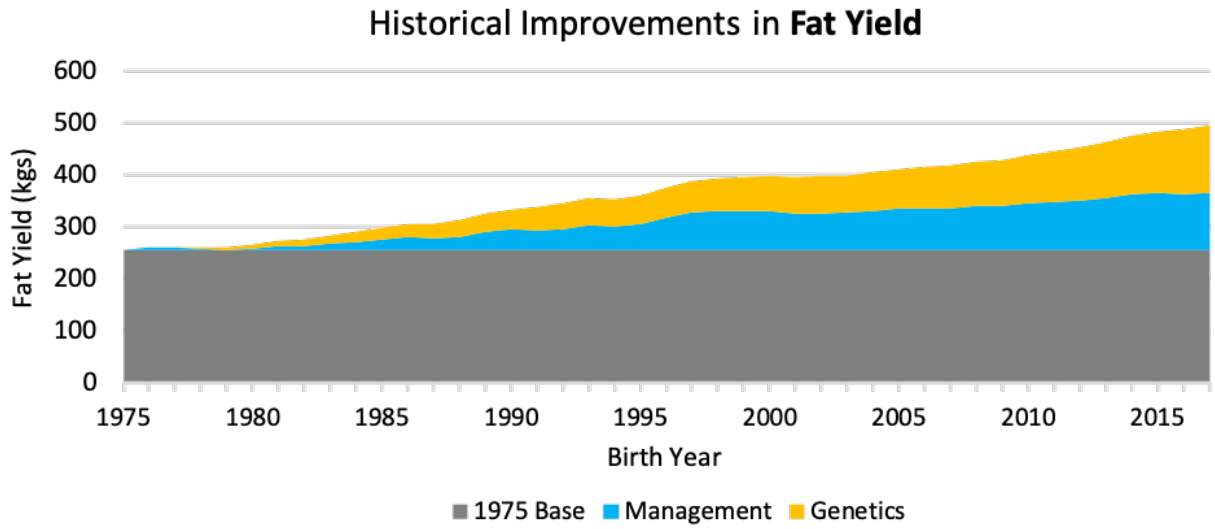


Figure 3 shows that the switch in progress from management to genetics has been relatively slower for fat yield, with each area roughly contributing equally (46%:54% in 2017) to the accumulative improvement realized since 1975. This is most likely due to the ease of improving fat performance through adjusting feeding rations. While there are quite a few management practises that can be used to increase fat production, altering protein yield through dietary manipulation is much more challenging – and costly. The longer-term solution is to increase the importance of fat production in your genetic selection goals and decisions.

Figure 3: Historical national averages for Fat production in mature equivalents, where grey represents the base level for cows born in 1975, blue is the proportion of on-farm performance improvement due to management and yellow is the proportion due to genetics.



What are the Long Run Trends?

In our milk payment system, fat is becoming more valuable. Historically, selection emphasis within the production component of LPI strongly favoured protein compared to fat. This emphasis has been continually updated to better reflect the most current economic climate and payment system for farmers. These changes in the milk payment system are annually reflected in the update of the Pro$ formula applied in each breed. For LPI, the most recent update in 2019 resulted in 60% of our production emphasis being focused on increasing fat yield with the remaining 40% on protein production. In more recent years, we are beginning to see the same proportional performance trend in fat as protein, but it is just not as prominent yet. As selection continues, we expect that fat will follow the same genetic trend.

We may even start to see a similar trend in functional traits as we continue to select for more robust animals. Functional traits allow us to have more profitable cows – both by allowing cows to reach their full productive potential, but also by saving costs associated with poor health and fertility. Management still plays an important role, especially for traits with lower heritability. The goal, genetically, is to create a future herd that is easy to manage – so that your cows are putting in the overtime, not you.

Use Compass to check out where your herd stands in terms of management versus genetic potential and see where you can improve. It's a free online tool with so much to offer – including what your future herd may look like based on your selection decisions.

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