Selecting replacement heifers based on genomic results versus birthdate

Technote 28

Dairy farmers with excess replacement heifers have several options for selecting which ones to keep and those to sell. For example, in seasonal and split calving herds, keeping the earliest born calves helps heifers reach target liveweight by mating start date and calve early in the herd, which contributes to improved herd reproductive performance and a tight calving pattern.

Another option is to genomic test the calves and select those with the highest results for priority traits such as daughter fertility or protein production.

This Tech Note reports on findings from a simulation study* that estimated the effects of selecting replacement heifers based on genomic results compared with selecting on birthdate or random selection. The analysis was for seasonal and split-calving herds only. The results are not applicable to year-round calving systems.

* Refer over page for more details on the simulation.

Range within a calving group

Genetically, calves within a group are not all the same. In fact, there is a wide range between best and worst within a group. This creates the opportunity to select those calves in a group with the highest Australian Breeding Value (ABV) for priority traits.

In this study, there was typically 380 units difference in Balanced Performance Index (BPI) between the highest and lowest calves within each group. For Protein ABV, the range was typically 30 units, and 20 units difference for Daughter Fertility ABV.

Impact on birthdates within cohort

Compared to selecting purely on birthdates, selecting heifers on genomic ABVs will result in keeping more late-born heifers. In herds where calving periods extend beyond 6 weeks, younger heifers will likely need some preferential treatment to catch up to their older mates in the group and achieve target weight by mating start date.

Selecting on Protein ABV

In this study, selecting on Protein ABV (compared to random selection, or selecting early-born calves) produced a cohort with about 4.3 to 4.7 units higher than average for Protein (Figure 1).

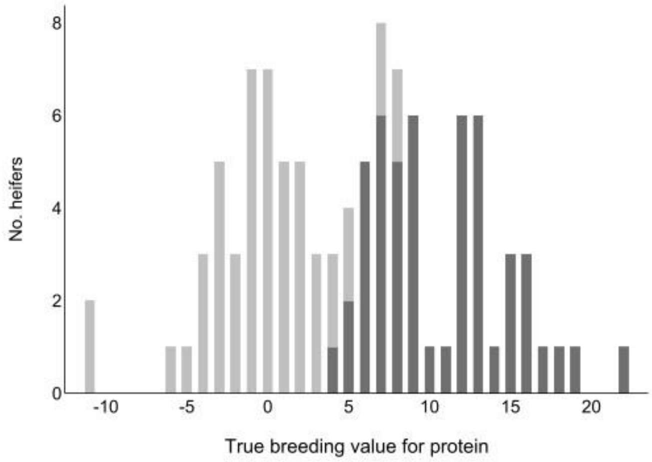

Figure 1: Example of selecting 50 from 100 Holstein heifers based on **Protein ABV**. The distribution of true breeding values for protein for the 100 heifers is shown. Dark bar sections indicate heifers that would be selected if the 50 heifers with highest ABVs for protein and light bar sections indicate heifers that would be sold under that selection strategy

Selecting on Fertility ABV

Selecting on Fertility ABV (compared to random selection or selecting early-born calves) produces a cohort with about 2.8-3.2 units higher than average for fertility. The downside was that the selected group contained more animals born after day 42 of calving.

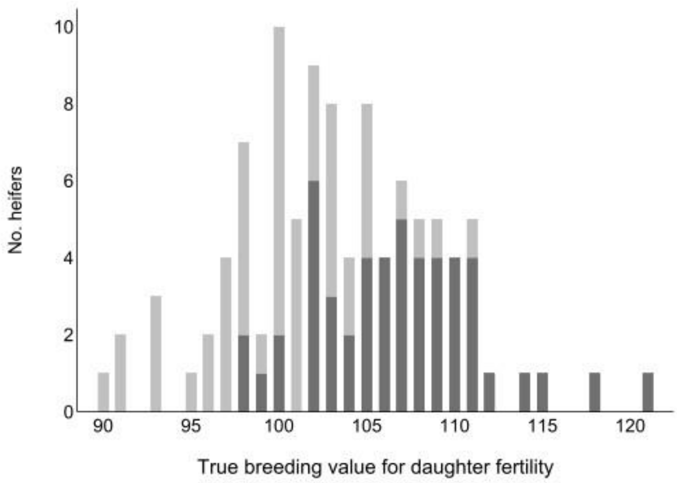

Figure 2:. Example of selecting 50 from 100 Holstein heifers based on Daughter Fertility ABV. The distribution of true breeding values for daughter fertility for the 100 heifers is shown. Dark bar sections indicate heifers that would be selected if the 50 heifers with highest ABVs for daughter fertility were selected, and light bar sections indicate heifers that would be sold under that selection strategy.

Selecting on BPI

Indexes help to select for more than one trait at the same time. By selecting on BPI in this study, modest increases in both Protein ABV and Fertility ABV were observed which is better than selecting to just one trait and seeing a decline in another important trait.

Selection pressure matters

The advantages in average Protein ABV, Fertility ABV or BPI are significant when 50% of the group is selected replacements. If 80% of the group is kept and 20% sold, there is still an advantage to using genomic results, but it is smaller.

Reliability matters

As the reliability of the genomics results increases, so does the benefit. This is because higher reliability genomic results are a better prediction of future performance. Improvements in Protein ABV are larger compared to Fertility ABV partly because Protein ABV reliabilities are higher.

DairyBio research has produced considerable increases in ABV reliability over the past decade and this work is continuing.

Works with limited ancestry, data

Surprisingly, the results hold up reasonably well for lower versus higher reliability groups. For example, the reliability of a group can be lower with limited pedigree information. However modest increases in ABV are expected by selecting on ABV or BPI even if only the heifers' sires were known (or identified by genomic testing).

Lag time to see impact

These results demonstrate the lag time between genomic testing heifers and seeing the benefits in herd performance. This is because of the time it takes for tested heifers to become a substantial proportion of the milking herd.

Figure 3 shows that selecting heifers to keep based on Daughter Fertility ABV had minimal impact on herd average Daughter Fertility ABV before about year 4. The benefits peaked at about year 8 and continued from then as long as heifers continued to be tested.

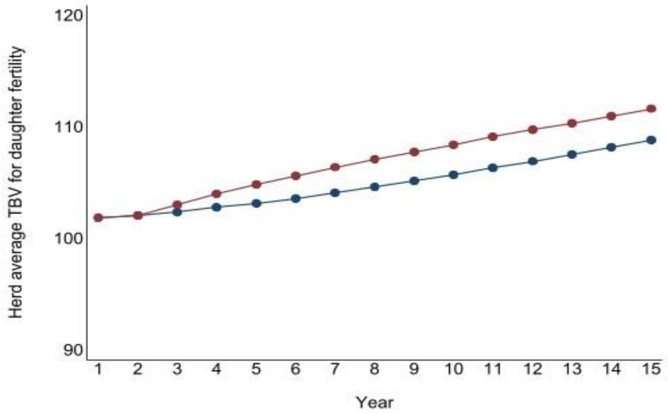

Figure 3: Expected effects of selection of 50 from 100 heifers based on Daughter Fertility ABV (maroon line) relative to selection of earliest-born heifers (blue line) on herd average true breeding value (TBV) for daughter fertility (average for all cows that calved in the year) where genomic selection of heifers commences in year 1 and is used each year thereafter.

Take home messages

The benefits of genomic testing heifers to decide which to keep and which to sell are greater when there is more genetic spread within the heifer group and when selection pressure is higher.

Good records of sires and dams is important. However, if you are starting with heifers with unknown sires and dams, genomic testing for a few years will help you catch up.

If selecting heifers with best BPIs/ABVs in seasonal or split calving herds, you will need to grow late-born heifers faster. Even better, ensure a tight calving pattern to avoid late-born heifers through working to increase herd reproductive performance, inseminating yearlings and using sexed semen appropriately.

If you select heifers with best BPIs/ABVs, use an inbreeding report to avoid mating close relatives

Acknowledgement

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More information

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Simulation study

A simulation study involves using a computer model to imitate a real-world scenario. The model is run numerous times, allowing exploration of the average effects and variation in effects.

In this study each simulation involved randomly generating a group of 100 heifers from a source population based on analyses of more than 14,000 genomically-tested heifers.

The variables (conditions which varied between simulations) were selection strategy, selection pressure, low/high genetic variation and low/high reliability.

For each heifer, true breeding values and ABVs for protein and daughter fertility were generated, along with a BPI value and birth date.

A heifer's true breeding value is its true genetic merit for the trait. The ABV estimates the true breeding value as it is impossible to ever know an animal's true breeding value. When reliability is high, the heifer's ABV is generally closer to her true breeding value.

Further insights were gained through additional simulations, including with four different source populations, each with a combination of lower and higher genetic spread within groups and lower and higher reliabilities of ABV estimates.

About DataGene

DataGene is an independent and industry-owned organisation responsible for driving genetic gain and herd improvement in the Australian dairy industry. DataGene performs pre-competitive herd improvement functions such as genetic evaluation, herd testing and herd improvement software development and data systems. DataGene is a Dairy Australia and industry collaboration.

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