Réseau laitier canadien

Canadian Dairy Network

Impact of Sire Selection on Genetic Improvement

The statistics in Canada are clear! Significant rates of genetic progress have been achieved for both production and conformation traits. According to the most recent data available, the average genetic gain over the past five years in the Canadian Holstein cow population has been 4.5 kg per year for EBV protein and 0.7 EBV points for overall conformation.

Genetic progress is affected by four factors; (1) increasing the genetic variation in the population, for which we have relatively little control, (2) decreasing the generation interval by selecting younger animals as parents of the next generation, (3) increasing the accuracy of selection which is reflected by the Reliability of each animal's genetic evaluation as well as the accuracy of the underlying genetic evaluation system such as the Canadian test Day Model, and (4) increasing the intensity of selection. This article will focus on the impact of the intensity of selection on genetic improvement.

The intensity of selection refers to the degree to which the very best animals are used as parents. In fact, there are four different pathways to selection and each has a varying level of relative impact on genetic progress in the population (Figure 1). The first of these pathways is the selection of dams of replacement heifers in each herd which represents only 3% of the genetic progress in a population since essentially all cows in most herds are bred and most heifer calves born are raised and eventually enter the milking herd. The second pathway is the selection of dams of young bulls for A.I. testing programs which accounts for 29% of the genetic progress since their sons end up with about 100 daughters in the population and possibly thousands if the son is selected as an elite proven sire for wide usage. Of essentially equal importance, with a relative impact of 27%, is the selection of proven and young sires, used by breeders in their herd. The selection

pathway with the most significant impact on genetic progress (41%) is the selection of sires of young bulls as carried out by A.I. organizations for their respective testing programs. These percentages clearly show the importance of selecting the most elite sires and dams for young bull testing programs, representing a total influence of 70% on the national rate of genetic gain.

To take a closer look at the impact of the selection of sires of future young bulls, Figure 2 shows the November 1999 genetic evaluation for protein yield for the famous Hanoverhill Starbuck, all of his proven sons including the best one, Madawaska Aerostar, all of Aerostar's proven sons including his best one, Startmore Rudolph, and all of Rudolph's sons tested in Canada to date. In other words, this graph represents the result of three generations of selection of elite sires of sons. Each circle represents at least one bull with Starbuck, Aerostar and Rudolph specifically labelled.

Starbuck, born twenty years ago, has a current EBV for protein yield of +10 kg, expressed on today's genetic base. He received his first official proof in 1984, was immediately used as a sire of sons in Canada and his wave of A.I. sons were born from 1985 to 1990. Today, these 200 sons are all officially proven with an average value of -4 kg Protein and -29 LPI. It may seem strange that a bull as great as Starbuck has sons which average below zero today. This phenomenon is due to two main factors; (1) the sons reflect the genetic potential of Starbuck and their respective dams, and (2) the total genetic gain for protein yield in Canada since the mid-1980's has been close to 40 kg.

More importantly however, from a breed improvement perspective, is the superiority of Starbuck's top sons, especially Aerostar at +57 kg Protein, which is 47 kg better than his sire. By coincidence, Aerostar was one of Starbuck's first sons tested while his second best son for protein yield today is Hanoverhill Lieutenant at 54 kg, who was born in 1989 and was one of Starbuck's latest sons to be tested in Canada. Other than these two bulls, the remaining Starbuck sons are at +31 kg Protein or lower in November 1999.

Once proven in early 1990, Aerostar was heavily used as a sire of sons around the world with 160 sons currently proven in Canada, born between 1990 and 1994. These sons average +30 kg Protein and 686 LPI. The range in proofs for protein yield is from -7 to Rudolph at +72 kg. Today, Rudolph has a 15 kg superiority for protein and 579 points for LPI over his world renowned sire, Aerostar. As with using Starbuck to produce Aerostar, the importance of using the most elite sires to

produce the next generation of young A.I. bulls is demonstrated through the combination of Aerostar and his son Rudolph.

In November 1999, Rudolph added several hundred daughters to his production and conformation proofs, maintaining his elite status for these important traits as well as being desirable for all of the auxiliary traits. This is an important event which will ensure continued strength in the rate of genetic progress in Canada. Currently, Rudolph has close to 200 sons tested in Canada born between 1996 and 1998 with more on the way. Although these young bulls are not yet proven, they have parent averages for protein yield which currently range from +33 to +92 kg, averaging +63. Obviously, the highest indexing of these young bulls are sons from the most elite dams in Canada and the United States. Based on our past experience, we can predict that as these bulls become officially proven from the year 2001 onwards, the top sons will be at least 15 to 20 kg Protein better than Rudolph and up to 600 LPI points higher. Recall also, that as the Canadian cow population continues to make genetic improvement, the genetic base for expression of bull proofs and cow indexes increases each year so the magnitude of proofs for top Holstein bulls will likely be close to 100 kg protein and 2300 LPI.

Genetic evaluations are a powerful tool as demonstrated by the use of Starbuck, Aerostar and Rudolph in this article. When used wisely to make selection decisions, both in A.I. programs and at the farm level, significant rates of genetic gains can be achieved for all traits of economic importance. Although genetic progress can be affected by increasing genetic variation, reducing generation intervals and improving the accuracy of selection, the most important factor is ***high selection intensity***. A.I. organizations must continually strive to maximize the genetic potential of the sires they offer while maintaining diversification of pedigree. At the same time, breeders must strive to use the most elite proven and young sires in their herd to realize strong gains towards their breeding goals.