

# Maximum Gain by Using Molecular Markers for Selection

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Markers are parts of a chromosome where the DNA differs from one animal to the next. If the difference in DNA is associated with a trait of economic importance, such as milk production or type traits, this is called a marker. Some markers and actual genes that code for traits are known. The question is then how useful will these markers and known genes be when used as aids to selection. Just knowing the genes and markers does not increase the genetic variance that already exists for a trait in the population; however, use of genes and markers may speed up genetic gain because selection can be more accurate. Several markers are now known, so it is useful to estimate the gains that could be made when using these markers as aids to selection. It would be very expensive to conduct an experiment to test the usefulness of the markers; however, some artificial insemination (AI) organizations are now using markers to make their selection of sires more effective for specific traits, but it is too early to know what can be gained.

We are simulating the gain that can be made on a computer by using as realistic models and methods as we can. We are simulating the U.S. Holstein population taking

into account herd size, age distribution, etc. The most commonly used breeding scheme by AI organizations is two-stage selection. The first stage is selecting the parents of young sires to be progeny tested. The second stage is choosing the best sires based on their progeny test. The second scheme that is not as well known is the use of nucleus herds. We are simulating genetic gains in nucleus herds where all bull mothers come from the nucleus herds and the sires are progeny tested in the outside commercial population. Several bull mothers are mated to a sire and several sets of sires and bull mothers are used. This results in sets of full and half sisters. All bull mothers are flushed at 8, 10, and 12 months of age and the cow is bred to carry her own calf at 15 months. This is now being accomplished in the AI industry. Decisions are made to use the flushed cows based on their production at 60 to 90 days in milk and their type scores. Ashwell and Van Tassell published a list of markers in 1999 that contained no markers for milk and fat pounds, but it did have markers for protein percentage and many markers for type traits (*J. Dairy Sci.* 81:1120-1125). Also there were markers for net merit as calculated by the USDA Animal Improvement Program Laboratory. Genes for milk proteins and genes that affect the immune system are also known. So, we are in the early stages of discovering genes that may be useful to producers. This is why we undertook this study to show how useful these markers could be.