Connecting with Paul VanRaden

This month, Paul VanRaden of USDA's Animal Genomics Improvement Laboratory, discusses the value of genetic indexes, new national health traits and future new traits. VanRaden has been a Research Geneticist at USDA since 1988 and has earn distinction with the USDA-ARS Young Scientist Award, the Jay Lush Award in Animal Breeding and the Research Award from the National Association of Animal Breeders.

Paul VanRaden (right) accepts the 2016 Journal of Dairy Science Most-Cited Award in Genetics and Breeding.

Why is Net Merit $ an important tool to improve the dairy herd?

VanRaden: Breeders can select for any combination of traits, but total genetic progress will be fastest using an index. The goal of the NM$ index is to maximize profit over the cow's lifetime by summing the incomes and costs associated with all available traits. Most producers have too little time to consider the importance of each trait in the index. When new traits are evaluated and economic conditions change, producers can improve traits according to the estimated value of each – simply by using the index instead of examining every trait of every animal and doing the math themselves.

Breed associations also publish indexes that often are the consensus of leading breeders rather than expected future profit under commercial conditions. Both approaches have advantages, but the consensus approach may not adopt the new traits or reflect market forces as quickly as the mathematical approach. As the number of traits has grown, indexes such as NM$ have become more valuable in condensing the available information on each animal into one number for selection. NM$ is an excellent ranking tool, but breeders must still then decide how much extra to invest in the best semen, embryos or animals, versus the average.

For dairy producers, what are benefits of disease resistance traits and their incorporation into Net Merit?

VanRaden: Producers may believe that genetic progress should be fastest if selection focuses on one or few traits. However, because many traits affect profitability, total profit usually increases when more traits are included in the selection index if the evaluations are accurate and correct economic values are used. The economic values obtained by AGIL from university research are only about $1/10^{th}$ as large as those claimed by Zoetis, and the actual benefits from adding health traits are not so large because previous traits such as productive life, SCS, fertility, livability and calving ease had already directly or indirectly accounted for much of the benefit. In any case, publishing the evaluations and showing the math helps producers give attention to individual health traits as needed, or select for all traits automatically using the recommended values in Net Merit. Consumers desire to purchase dairy products from healthy cows and should be pleased dairy breeders are closely monitoring so many traits. Finally, traits such as fertility can steadily decline over many years if ignored. Such traits with low heritability were very difficult to improve with progeny testing, but genomic selection based on sufficient data now allows us to improve many more traits.

What new traits are important to develop next?

VanRaden: Dairy leaders and researchers choose which traits to make available by comparing the information gain to the data collection cost. (Economic calculations rarely assume unlimited resources because controlling cost is one of the main goals.) Most of the traits currently in NM$ were already collected by producers for use in herd management, and later used for genetic evaluations. In previous decades USDA did not pay for the data or charge for the service, and that worked well for traits already recorded. CDCB also recently added "free" traits like livability and gestation length, based on accurate data recorded by DHI herds for decades. Other "free" traits, such as age at first calving and persistency of production, can also be added soon using existing data. But, new traits often require investment to organize and collect uniform records; consider hoof heath, milking speed and

new characteristics from milk samples. A few traits such as feed intake are very expensive to collect but also very valuable.

What is the process here in the U.S to research and develop new traits?

Most traits were initially developed by university researchers or breed associations and then launched nationally by USDA* or CDCB. Examples are milk production testing at Michigan State, early SCS research at Wisconsin and Minnesota, genetic evaluations for calving ease at Iowa State, stayability at Cornell leading to productive life, bull fertility at North Carolina State and health trait research at Wisconsin, North Carolina State and Zoetis. Recently, multiple universities joined together using USDA funding to collect feed intake data for about 5,000 cows. Fertility, livability and gestation length were available because the DHI system collected more variables to help producers manage their herds. Ideas for new traits also come from foreign researchers and evaluation systems, and more recently from AI companies with their own large datasets. Usually AGIL* develops evaluation methods and proposes economic values based on recent price surveys, research studies and management costs associated with each trait. Then CDCB determines how traits will be presented, consults on methods, automates the evaluation and schedules implementation. AGIL and CDCB cooperate closely during all phases.

**USDA AGIL = United States Department of Agriculture, Animal Genomics and Improvement Laboratory*