*Progressive Dairyman* Editor **Dave Natzke**

**AT A GLANCE**

As a predictor of disease resistance, using health traits in genetic selection can be viewed as a preventative measure. Balance use of health traits in breeding strategies to avoid losing ground on productivity and fertility.

Through technology and other tools, the amount of information available to make dairy management decisions continues to grow. That includes reproduction and genetics, where official evaluations will feature six new health traits beginning in April 2018.

The new health traits predict resistance for six common dairy cattle diseases (see page 50). To help interpret and use the additional information, John Cole, head of the USDA Agricultural Research Service Animal Genomics and Improvement Laboratory (AGIL) at Beltsville, Maryland, addressed the Council for Dairy Cattle Breeding (CDCB) annual meeting, held Oct. 3 in conjunction with World Dairy Expo.

## Genetics versus environment

Gains in animal performance are a product of both genetic and environmental factors, working individually and in unison.

"As we improve the genetic potential of animals, that potential cannot be realized unless the environment the cow is in also improves so those genes can be expressed," he explained.

"All improvements result from deliberate decisions people make: the bulls you choose to mate with your cows, the way you manipulate the environment so cows can perform at their genetic level and even things like the decision to collect additional information," Cole said. "These decisions aren't free – there's an investment in time, new equipment or whatever. In the modern, competitive climate everyone operates in, decisions must be based on data. It's easy to undervalue data because we're drowning in it, but data contributes to gains in genetic and management decisions."

Performance gains are not guaranteed. Environmental factors can be controlled but are subject to changes in management, climate, facilities or labor. A mistake in one of those areas could erase previous improvements.

Genetic factors can provide steady improvement, especially related to production traits. However, when genetic selection leaned too heavily toward productivity in the past, fertility suffered, Cole said.

Unlike environmental factors, one attribute of using genetics to improve performance is: The gains are cumulative and set a base for the next step.

"Even if you put only a small amount of emphasis on a trait, but let it go for a long time, you can accumulate a lot of improvement," Cole said. "If you stop doing genetic selection, you stop where you are; it doesn't become unraveled."

"In contrast, when you stop doing a management intervention (for example, eliminating feed supplements), as soon as you stop doing it, you lose all the benefits," Cole said.

The balance between environmental factors and genetic factors varies by trait. Fat yield has a heritability of 20 percent, meaning 20 percent of variation is due to genetics and 80 percent is due to the environment. That's in contrast to selecting for mastitis resistance, with a heritability of just 3 percent, meaning 97 percent of variation is related to the environment.

## How does genetic selection work?

It's important to understand the basics of genetic selection when using the new health trait information, Cole said. The amount of the genetic change we see over time is based on four factors: the reliability of the trait, the selection intensity, the genetic variability in the population and generational intervals.

Unlike bygone eras, when traditional progeny testing took generations of new daughters to evaluate genetic progress, genomics has sped up the process. So while little can be done regarding genetic variance within the dairy cattle population, generational intervals have shortened substantially with the use of genomics to identify bulls.

"Genomics helps us by getting better reliabilities earlier in life," Cole said. "We can be more selective using management and tools such as sexed semen, so we have more females in the herd and can be more selective in the ones we keep and the ones we cull."

Butterfat and milk production were essentially the only genetic selection traits from 1926 to 1978. Over time, the speed of adding traits has increased as the biology of animals and economics changes (see timeline on page 46).

Multiple traits have been incorporated into indexes. The use of indexes is common worldwide and depends on how dairy profitability is defined in each market. Today, the CDCB provides the indexes Net Merit, Cheese Merit, Fluid Merit and Grazing Merit, depending on desired markets and goals.

"If we do a good job of constructing the index, we're going to improve our traits in proportion to their economic value," Cole said. "Always look beyond an index, but it's a good tool."

"Selecting for multiple traits improves your bottom line, but you're not always making selection to improve every trait in an index," he said. "Some traits need to be maintained, while others need to be improved. Sometimes you want to protect a trait from a decrease while you're increasing in another area."

"If you're already selecting bulls for good livability, Productive Life, good calving ability, you're already indirectly selecting for improved health," Cole said. "There is new information in the health traits, but not all the information in health traits is new. There's value in putting health traits in the index and allowing improvement over time."

## Keeping it in balance

Most genetic selection traits have economic value, Cole said. However, there is a high level of heritability variation among genetic traits, and some desirable traits have very low heritability.

Cole said his early years in genetic research were driven by the theme "you select for traits with high heritability and manage around traits with low heritability." That's changed.

Cole recognizes low health trait heritabilities and dairy farming economics come into play when making genetic selections. If you put too much emphasis on a low-heritability trait, you're going to lose money.

"Improved cow health is important," he said. "There isn't anyone who likes the idea of going out to the barn and seeing a sick cow. Everybody wants healthy animals that are efficient and profitable. That's how you feel like you're doing your best job managing your cows and producing safe and healthful food for people."

"But it has to be balanced against other things," Cole continued. "If you put all your emphasis on health and give up too much in terms of efficiency, yield or fertility, you're not in business in five years to have healthy cows because you didn't attend to the bottom line. That's always the challenge."

"There's no magic number for everyone to use in making selection decisions," he said.

A second test to measure balance involves disease-prevention costs versus treatment costs. In most cases, the cost to prevent a disease is lower than the cost of treatment, especially when discarded milk and meat and culling and mortality are considered.

As a predictor of disease resistance, using health traits in genetic selection can be viewed as a preventative measure, and those traits have been assigned relative values in existing indexes.

Cole has heard the questions: Why do we need new traits? Don't we already know enough?

Economics and the way dairy farmers are paid change over time, so the indexes which dairy farmers use to make genetic selection decisions must also change, said Cole, citing selection for kappa casein as an example. In addition, potential sources of new information continue to grow, spurred on by technological advances and research into feeding biology.

## Animal welfare issues

Finally, selection for health traits might have an impact all the way to the consumer.

"We're operating in an environment today where our production practices are more transparent to consumers," Cole said. "We can't make every decision based on a knee-jerk reaction from someone who doesn't understand the nuances of our production system, but we have to be aware consumers want assurances the food they're feeding their families comes from animals that were humanely treated and healthy. In the end, both consumers and dairy producers have the same goal. We want good food produced from healthy animals."

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—John Cole, head of the USDA Agricultural Research Service Animal Genomics and Improvement Laboratory