Selecting for Disease Resistance

by ***Shauna Rose Hermel***

As antibiotic treatment of livestock comes under greater scrutiny by the consuming public, more attention is being turned toward genetic selection for disease resistance. Gary Snowder, research geneticist at the Roman L. Hruska U.S. Meat Animal Research Center (MARC), near Clay Center, Neb., presented a status report during the Genetic Predictions Committee meeting at the 2006 Beef Improvement Federation (BIF) Annual Meeting and Research Symposium.

Snowder differentiated genetic disease from genetic resistance. A genetic disease, he explained, is an inherited disorder. There are 125 known genetic disorders in cattle. Most are caused by a simple recessive gene. Examples include dwarfism and syndactyly.

Genetic resistance, on the other hand, is a genetic predisposition to resist pathogen infection, he explained.

Interest in finding genetic resistance is being encouraged by several factors, Snowder said. Microbial diseases are developing resistance to antibiotics, and no new class of antibiotics has been introduced in 30 years. New diseases, such as avian influenza and chronic wasting disease (CWD) are emerging, and disease transmission is increasing. Therapeutic costs are increasing, and consumers' expectations for meat free of drug residue and for animal care are increasing.

Breed differences in resistance to pinkeye, ticks and bovine respiratory disease (BRD) are visible examples that genetic variation for disease resistance does exist, Snowder said. However, several factors complicate the selection process.

Complications

"The success of selection for disease resistance is dependent on correctly identifying the phenotype," Snowder said. "If it can't be accurately measured, it's not a useful trait."

Complicating identification of the phenotype, or how the disease is physically expressed, Snowder explained, is that not all healthy animals are resistant to the disease. Whether an animal gets sick after being exposed is affected by a myriad of factors, including nutrition, stress, age, management system, pathogen(s), season, immune system, immunological background, epidemiology and the preventive measures that were taken by the producer.

Also, disease expression can be confounded by other diseases. For example, pneumonia can be caused by several different pathogens. This can be especially troublesome if the disease of interest is a secondary disease. Diagnosis of the pathogen at fault can be timely and costly, Snowder explained.

Searching for genetic solutions to disease is justified, he said, when:

- the cost or potential cost of the disease is high;
- there is no available vaccine or antibiotic;
- the microbes are resistant to antibiotics;
- a variety of pathogens affect the host in a similar manner or pathway;
- consumers shun the product because of health-related fears;
- "organic-labeled" product;
- animals rarely show clinical symptoms;
- cattle breeds differ in resistance; and
- disease liability can be traced back to the owner.

Resistance or tolerance

Snowder posed the question, "Is the goal genetic resistance or genetic tolerance?" While resistance is the ability to prevent an infection from entering the biological system, he explained, tolerance is the ability of an infected animal not to express clinical symptoms.

Genetic resistance would be best, he said, but tolerance may be more practical when resistance is not possible. Such would be the case when it would not be ethical or practical to challenge animals with a pathogen. Tolerance may also be preferred when selection for resistance to one disease may disrupt the homeostasis of the immune system, or when selection for resistance to a particular pathogen may result in indirect selection for a more virulent pathogen.

PHOTO BY SHAUNA ROSE HERMEL

►Gary Snowder, MARC, discussed opportunities to select for disease resistance during BIF's Genetic Predictions Committee meeting.

"Microbes can change their genetic makeup much faster than we can change the host's genetic ability to resist them," Snowder explained. He also noted that genetic resistance is often antagonistic with production traits, using the example that selecting turkeys for growth rate increased their susceptibility to Newcastle disease.

When looking at genetic approaches to reducing microbial disease, Snowder said, we must consider genetic components affecting the animal's response to the pathogens and the pathogen's response to the animal. Selection can be based on treatment records (natural resistance to disease), host immune responses (titer), host biological responses (somatic cell count) and pathogen responses (fecal egg count).

Snowder shared the pros, cons and success stories of each selection option and suggested that marker-assisted selection may offer promise in the future.

Editor's note: *To view the PowerPoint® presentation and the proceedings that accompanied this talk, visit the newsroom at* www.bifconference.com.