Cost-Effective Counterpart to Vaccination

Breeding For Disease Resistance

U.S. livestock producers lose billions of dollars annually as a result of animal diseases. In 1980, losses from cattle diseases alone amounted to an estimated $5 billion. This means that feed production from millions of acres of land is wasted; costs of production to farmers and ranchers rise needlessly; and consumers pay higher prices for meat, milk and eggs at the marketplace.

Reservoirs of disease resistance exist in livestock, just as in plants, awaiting exploitation by animal scientists, according to Terry B. Kinney Jr., Agricultural Research Service Administrator. As an example, a single cow in a herd in France survived an outbreak of foot-and-mouth disease in 1938. Fourteen years later, six descendants of the original resistant cow survived another outbreak that occurred in the same herd.

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Such acute diseases as foot-and-mouth disease most reasonably may be countered with a growing arsenal of vaccines. But selective breeding may become an ideal way to protect animals from a chronic disease. Kinney's outlook is that radically new technology emerging from biomedical sciences may provide the means for identifying resistance without exposing the animals to the disease.

Breeding for disease resistance may prove to be a cost-effective counterpart to vaccination for maintaining herd health, says Robert R. Oltgen, director of the Roman L. Hruska U.S. Meat Animal Research Center (MARC), Clay Center, Neb. The cost of preventing disease by veterinary means alone is rising and is limiting animal production in many areas of the world today.

Oltgen cites research results and trends leading to improved ways to capture disease resistance traits in cattle, swine, sheep and poultry. He says the rapidly developing field of immunogenics that paved the way for successful organ transplants now offers hope for identifying particular disease resistance in farm animals. This prospect alone could greatly enhance the progress of conventional breeding. But combined with embryo cloning, embryo transplanting and genetic engineering technologies, the possibilities are even more extensive.

These new technologies will help animal scientists employ principles used by plant scientists who are quite successful in developing disease-resistant plant varieties. Until now, breeding disease resistance in farm animals has been slowed by generation intervals of up to five years.

Here, in digest form, are some salient points Oltgen makes on trends and opportunities in breeding animals for disease resistance.

- Progress is being made with small animals such as poultry. Through breeding and selection, it has been shown that strains of chickens can be developed having genetic resistance to Marek's disease. Genetic resistance to Newcastle disease and pullorum disease also have been demonstrated in poultry.
- Notable achievements, although slow in coming, have been made in large animals also: Resistance to mastitis is being used in animal production today, and resistance to tuberculosis is known to be genetically controlled. Studies have confirmed that Zebu cattle are more resistant to tick-borne protozoan infections and high temperatures than are European breeds, and that genetic resistance is present in cattle against leukosis, intestinal worms, and pinkeye, and in sheep against scrapie and brucellosis.
- Scientists are aware of some inherited traits that are associated with resistance to diseases. Other genetic markers may be found. One example: A dark ring around a cow's eye is an indicator of resistance to cancer eye. And several body functions serve as markers or indicators; fever, digestive system enzymes and tears are genetically controlled and related to susceptibility.
- The likelihood of an animal's succumbing to certain diseases when stressed may be genetically regulated. Scientists at MARC and at several cooperating universities are studying stress in hogs; this and other research on stressed animals may help scientists understand the mechanisms of immunity and devise improved measures for preventing or treating diseases.
- Scientists at MARC and Oregon State University are evaluating the heritability of immunoglobulin concentrations in bovine colostrum and blood serum. They are studying the relationships of these fluids to other characteristics including calf survival and incidence of disease and growth rates in beef cattle.
- Basic research in immunogenetics is opening frontiers to identifying the genetic complex that regulates the ability of lymphocytes to detect an invasion of bacteria or viruses and launch a counterattack. A further understanding of this phenomenon is an important area of research.
- A modern technique for defining single antibodies directed to single sites on antigens—monoclonal antibody technique—has enabled scientists to study this area with more authority than previously. Some of the antibodies are cross-reactive among species, so technology that is perfected for cattle may transfer to other livestock such as swine, goats or sheep.

In the decades ahead, Kinney says, we may be able to select progeny the day they are born by "interrogating" their cells, in a biological sense, and deciphering their potential for growth, disease resistance, metabolic efficiency, nutritional capacity, and physiological and reproductive ability. AJ