Detection & Control of Swine Viral Diseases

NC-229 (2009-2014)

Devastating Respiratory Syndrome Difficult to Control

Porcine reproductive and respiratory syndrome (PRRS) is the most devastating swine disease in the U.S. PRRS jeopardizes foreign trade in breeding pigs, semen, and pork products , and upheaves the industry and farmers' livelihoods. Losses due to increased production costs, animal losses, and delayed marketability related to PRRS virus infection total around $600 million each year.

PRRS virus is highly infectious and persistent, spreading every way possible (intrauterine, milk, feces, urine, saliva, semen, blood, and aerosol) and surviving a long time in cold, wet conditions. The virus mutates easily, making vaccine effectiveness inconsistent. It is also difficult to differentiate between field and vaccine strains. Photo by Scott Bauer/USDA-ARS.

Relatively few tools are available to producers and veterinarians for managing the disease. The virus can move efficiently between farms, even those that utilize rigorous biosecurity practices. The only currently available vaccine provides sub-optimal protection and, because the vaccine uses a live virus, it causes animals to shed the vaccine virus into the environment. It is also difficult for tests to distinguish vaccinated pigs from infected pigs. Because of limited vaccine efficacy, producers have tried to acclimate pigs to PRRS by intentionally infecting pigs with a live wild-type PRRS virus. This can result in continuous spread of PRRS and inadvertently spread other diseases.

Multistate Project Coordinates Research to Improve PRRS Control & Prevention

Formed in 2009, Multistate Research Project NC-229 brings together experts on swine production and viruses from 14 land-grant universities as well as international groups in China, Mexico, and Spain. As a multistate research project, NC-229's diverse group of scientists has the capacity to share resources, coordinate cutting edge research projects, divide and conquer specific problems, and respond quickly to new information and technology.

Iowa State University photo.

During the past five years, NC-229 researchers conducted studies to understand the epidemiology of PRRS and other emerging viral diseases of swine. Through these studies, they elucidated the mechanisms of host-pathogen interactions and identified virus reservoirs in the wild. Additionally, researchers studied the effect of virus strain variability on virulence and herd immunity. With this information, group members developed effective and efficient ways to detect, prevent, and control PRRS at all levels of swine production systems. These methods include vaccines, novel therapeutics, and selective breeding and host genome control, in addition to management and biosecurity strategies. The group also worked with producers to create a comprehensive swine health surveillance system. Scientists developed diagnostics capable of determining animal infection status, rapidly identifying virus strains, and differentiating animals exposed to field viruses versus vaccine viruses. In addition, they identified factors involved in farm-to-farm transmission, including the role of geography, the environment, and viral genetics. In collaboration with the National Pork Board and the American Association of Swine Veterinarians, the group developed outreach and educational materials and real-time delivery methods that provide essential biosecurity and compliance information.

Impacts

Swine producers and veterinarians have been able to rapidly apply NC-229's recommendations and guidelines in the field, improving animal health and reducing losses. For example, in University of Minnesota trials, farms significantly improved productivity after implementation of recommended air filtration technologies. In most cases, the pay-back period to cover initial investment in the system was between two and three years. Reduced disease incidence and stronger breeding herds and genetic stocks have improved and secured the supply of safe, affordable pork for consumers. By producing PRRS virus-free pigs and lowering the costs of PRRS, NC-229 has increased the competitiveness of U.S. swine industry. Swine disease surveillance and information provided by NC-229 has also been critical for maintaining and expanding markets.

Highlighted Research Findings & Impacts

PRRSV Pathology

- Clear definitions of the negative effects of PRRS virus on the pig immune system can be used to design better cross-protective vaccines.
- Better understanding of the factors at play during severe infections versus less severe infections helps scientists develop more suitable vaccines and vaccination strategies.
- Kansas State University researchers identified effects of PRRS virus infection on digestibility. This information was used to formulate diets that optimize growth during PRRS infection.

Transmission

- NC-229 provided producers and veterinarians with knowledge and tools to improve air filtration and reduce airborne transmission of PRRS virus between farms.
- University of Minnesota researchers identified aerosols and hand contact surfaces as possible routes of influenza virus exposure to people on commercial farms, live animal markets, and agricultural fairs.
- University of Illinois researchers revealed multiple PRRS virus introductions from Canada to the U.S., which are causing a major shift in virus genetic composition in the Midwest. These insights into virus evolution will facilitate targeted programs for control and prevention.

Diagnostics & Monitoring

- Iowa State University led development of a new method using saliva to detect PRRS virus and antibodies. Saliva samples are an economical and rapid alternative to invasive blood samples for disease surveillance.
- NC-229 developed the Luminex testing system, which has higher sensitivity and specificity. Luminex is becoming popular because it is available at a low cost and can be used on a single small-volume sample, including non-serum samples, such as oral fluids and meat juice.
- South Dakota State University developed a less time-consuming, more affordable method for assessing the presence of Porcine Epidemic Diarrhea Virus.
- New, cost-effective methods helped track infection and determined whether eradication programs should be implemented on individual farms or entire regions.

Treatments

- Researchers found that PPMOs inhibited PRRS virus replication, protected against cell death, and resulted in lower presence of the virus in the bloodstream and fewer lung lesions in infected piglets.
- Newly discovered genes that possess potent anti-PRRS virus properties can be incorporated into vaccines and other antiviral therapies.
- Better understanding of genetic variation in PRRS viruses is guiding development of new vaccines with broad efficacy.
- University of Minnesota researchers found that electromagnetic particle ionization reduced airborne PRRS and influenza viruses.
- Ohio State University researchers discovered that intranasal delivery of an inactivated PRRS virus vaccine may elicit anti-PRRS virus immune response and clear the virus from the bloodstream.
- NC-229 scientists informed stakeholders of age-dependent differences in the ability of pigs to resist PRRS virus infection, encouraging farmers to apply vaccines at the right time.

Genetics & Breeding

- NC-229 helped verify important genotypes and phenotypes that predict resistance/susceptibility to PRRS virus infection.
- NC-229 researchers at Kansas State University identified genomic markers for improved response to PRRS virus, creating the opportunity to conduct marker-assisted selective breeding.
- Researchers identified DNA markers associated with Porcine Circovirus Associated Disease. Breeding selection based on DNA markers can be an alternative to vaccination for disease control.

Want to know more?

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- Hong Kong University, China
- University of Illinois, Urbana-Champaign
- Iowa State University
- Kansas State University
- University of Maryland
- University of Minnesota
- University of Missouri, Columbia
- University of Nebraska, Lincoln
- North Dakota State University
- Ohio State University
- Purdue University
- South Dakota State University
- Virginia Polytechnic Institute and State University
- University of Wisconsin

- USDA-APHIS
- USDA-ARS Beltsville Agricultural Research Center
- USDA-ARS National Animal Disease Center
- Center for Food Research and Development (El Centro de Investigación en Alimentación y Desarrollo), Mexico
- National Institute of Agricultural Research (El Instituto Nacional de Investigaciones Agronómicas), Spain
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Impact Statement compiled by Sara Delheimer.