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Transmission of porcine reproductive and respiratory syndrome virus (PRRSV) by non-porcine vectors and fomites: Soil, insects, avians, and aerosols

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Introduction

Over the last 1.5 years, tremendous progress has been made in identification of routes of transmission of porcine reproductive and respiratory syndrome virus (PRRSV) by non-porcine vectors and fomites. Otake and others have led the way, identifying such routes as needles, coveralls, boots, and mosquitoes.\(^1\)\(^2\)\(^3\) Dee and others have established field models that demonstrate how easy it is to spread PRRSV mechanically in cold weather, through a coordinated sequence of events.\(^4\) Yet, questions exist that are still unanswered, unknown routes remain a mystery, and biosecure farms continue to become infected through means other than pigs and semen. The purpose of this paper is to review new data from experiments designed to assess transmission of PRRSV by avians, aerosols, houseflies, and a coordinated sequence of events during warm weather.

Avians

This work is currently in progress and final results will be reported at the Leman Conference. Basically, the current study is a modification of the experiment published by Zimmerman and others, that described replication and transmission of PRRSV by Mallard ducks.\(^5\) In this study, Zimmerman clearly demonstrated that PRRSV-contaminated drinking water could infect mallard ducks, resulting in shedding of infectious virus to other mallards. The recovered PRRSV from Mallard feces was also determined to be infectious to pigs following IM injection. Our current study in progress is looking at the ability of experimentally infected pigs to infect Mallards housed in the same facility, allowing for "snout to bill" contact. Furthermore, as positive controls, we are repeating the Zimmerman study. We are allowing ducks to consume PRRSV-contaminated water, along with orally drenching ducks with PRRSV, and monitoring viral excretion in feces. We are also assessing the potential of infected ducks to spread PRRSV to pigs, by housing PRRSV-naive sentinel pigs directly below the cage that holds the experimentally infected Mallards, and allowing contact of pigs with fecal material on a continuous basis for 14 days. On a regular basis, over a 21-day period, fecal and cloacal samples will be collected from Mallards and will be tested for PRRSV by PCR, virus isolation, and swine bioassay. Pigs will be blood tested and assessed for evidence of PRRSV infection.

Aerosols

This work, currently in progress, is a modification of the study by Otake and others that assessed aerosol transmission of PRRSV under field conditions and utilized an experimentally infecting finishing pig population and sentinel pigs housed in trailers.\(^6\) The current study will evaluate whether PRRSV can be transmitted through an opaque tube of 30 meters in length, serving as a connector between an exhaust fan from an experimentally infecting finishing pig population of 150 animals and a trailer of 10 naïve sentinel pigs. The side wall openings of the trailer have been wrapped with plastic sheeting to concentrate exhaust in the animal airspace and to reduce the insect population in the trailer itself. Sentinel pigs will remain in the trailer and be exposed to exhaust from the tube for 24 hours over a 7-day period. Through the use of an all glass impinger, air samples will be collected from the infected animal airspace and the end of the tube at various times during the day, and will be assessed for PRRSV by PCR, virus isolation, and swine bioassay.

Houseflies

Otake and others have conclusively demonstrated that hemaphotogenous insects (mosquitoes) and non-biting flies (houseflies) can mechanically transmit virus from experimentally infected pigs to naïve recipients.\(^7\) This current study is evaluating the ability of PRRSV to remain viable in houseflies for specific periods post-feeding and to determine if the virus is present on the exterior or interior of the body of the fly. This information is important to assess whether contaminant PRRSV would be exposed to ultraviolet light and/or drying it on the exterior, or potentially protected it internalized. Following feeding to repletion on an experimentally infected nursery pig (day 7 post-infection), flies were housed at 28.3°C and 2 subsets (A and B, 30 flies/subset) were collected at 0, 6, and 12 hours post-feeding. Subset A was used to evaluate if PRRSV was present on the exterior of the fly. Flies were washed in minimal essential medium (MEM),
and MEM was tested for PRRSV by PCR, VI, and swine bioassay. Flies in subset B were used to determine whether the virus was located within internal viscera. Following feeding to repletion on an experimentally infected pig, flies were again allowed to incubate at 28.3°C for 0, 6, or 12 hours. At each of the respective sampling times, 30 fly subsets were again selected were washed in MEM, immersed in 70% ethanol, washed again, and dissected. The intestinal tracts (mid-gut and diverticulum) of the 30 flies were removed, pooled, and tested for PRRSV as described. As of this writing, only exterior wash samples at 0 hours post-infection were positive by PCR and bioassay. In contrast, intestinal tract samples were positive by PCR and bioassay at 0 and 12 hours post-infection. These results demonstrate the ability of PRRSV to reside within the intestinal tract of poikilothermic insects housed at 28.3°C for longer periods that on the exterior surface, and may enhance survival of the virus outside the host due to protection from environmental factors such as exposure to UV light or drying.

Soil

This study was a modification of the experiment conducted by Dee and others that assessed mechanical transmission of PRRSV throughout a coordinated sequence of events during cold weather. The basic design of this study remained the same, except that it was conducted at 10°C to 16°C (instead of -9°C to -2°C) weather and used soil as a carrier instead of snow. While viable PRRSV was detected on the surfaces of containers, in 8/10 replicates collected during cold weather, the warmer weather study resulted in detection of PRRSV on containers in 1/10 replicates. This supported laboratory investigations describing the impact of heat and drying on the viability of PRRSV. However, it did demonstrate that infectious virus can be tracked on a farm premise and into a facility during springtime conditions, therefore stressing the importance of implementation of biosecurity programs throughout the year.

Conclusions

While it is certain that routes of PRRSV transmission remain unidentified, much information has been generated, removing a lot of the “mystery” surrounding area spread. The importance of insects and fomites cannot be overlooked. In contrast, the significance of avians and aerosols as vectors of the virus appear to be insignificant. While more work is necessary, swine producers and practitioners can now implement biosecurity interventions to reduce the risk of PRRSV introduction to susceptible farms. Promising solutions include insect screens on sidewall openings of facilities, the use of disposable boots at truck wash sites, disinfecting of vehicle floor mats and personnel boots, and a plan to safely introduce shipping parcels into a farm.

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