Swine Health and Epidemiology Report

A NIAA Publication Special Biosecurity Issue

Biosecurity becomes necessity for 21st Century pig production

The National Institute for Animal Agriculture (NIAA) is pleased to present a special issue of Swine Health and Epidemiology Report devoted to the topic of biosecurity. Plans for this special issue were made prior to the unprecedented spread of FMD across the globe in 2001 and long before the tragic events that occurred on September 11. However, both of these situations underscore the fundamental role that biosecurity measures play in pig production today. Biosecurity measures are critical not only at our nation's borders, but also at each production center. That is why we hope that this compilation of papers, authored by some of the industry's top experts, will provide an invaluable reference for producers, veterinarians and other stakeholders involved in 21st century pork production.
Joseph F. Conner, DVM

Inside this issue

Recently greater emphasis has focused on measures that manage swine population biosecurity. This increased emphasis is occurring because of our understanding of the cost of biosecurity lapses, our understanding of disease transmission, and recognition that disease challenges in lean genotypes have a greater impact on lean tissue accretion compared to low lean genotypes. Biosecurity is the special efforts, procedures, and programs implemented and maintained to reduce the risk of introducing disease organisms into a swine population. Population health may be defined in terms of crude mortality rates or production characteristics, but more typically is discussed in terms of the presence and severity of major infectious agents. Disease increases mortality, diverts nutrient resources from lean tissue deposition, decreases rate of gain, reduces feed conversion, increases growth variability and lowers reproductive performance. In a successful program, there are no health breakdowns and no cost benchmarks for comparisons. Biosecurity processes have been enhanced by new facilities and increased separation of herds providing segregation of nursery or finishing sites.

Biosecurity is both external and internal to a population or facility. External biosecurity focuses on keeping out new agents whereas internal biosecurity focuses on minimizing the challenge level of disease agents presently in the herd. The potential for disease exposure increases as pig population size age spread increases. Poor hygiene increases the pathogen challenge and overwhelms the defense mechanisms of the growing pig. Introduction of pigs and transportation of both pigs entering and exiting clearly represent the highest risk of disease introduction.

It is often convenient to draw a box around a facility or system and then make a list of all of the entries and exits into that facility or system to understand critical control points of biosecurity. (See charts on page 5).

Biosecurity risks can be prioritized to develop a practical, cost effective program. Facility level reviews are critical to understand all the entries and exits within a facility or site. The entire farm or system staff must understand the risk and preventive measures. Everyone in the production chain must accept that it is his or her responsibility to identify biosecurity lapses or risks, assimilate corrective measures and participate in the implementation. Programs can be formulated by management, but must be championed by everyone. Biosecurity programs must be sustainable and reviewed periodically. Many lapses can be corrected by the day-to-day attention to procedures. Some procedures are easy to adapt (example – showering) others are more difficult (example – slaughter truck, cleaning, disinfecting, and drying). All require discipline and

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COMMENTARY

Biosecurity: What Really Works

Sandra F. Amass, DVM, PhD, Dipl ABVP

Biosecurity and sanitation practices are implemented on many pork production units to prevent the introduction of pathogens to the herd or to groups of pigs within the herd. These protocols must take into consideration a multitude of risks for pathogen introduction. Many decisions regarding biosecurity protocols on pork production units are currently based on producer and veterinary experience and opinion, not on scientific research. Not knowing the extent to which biosecurity measures need to be implemented to prevent the transmission of porcine pathogens is an important problem, because, until that information is known, pork producers will run one of two risks:

- Expenditure of time and money on unnecessary biosecurity measures, or
- Insufficient biosecurity measures that place the pig population at risk for economically devastating disease outbreaks.

The argument often presented is that all biosecurity measures, even if not effective, are important because implementation of biosecurity protocols sensitizes personnel to biosecurity issues. The biosecurity mind-set of the personnel is thought to enable workers to pay more attention to details that, if performed sloppily, might place the herd at risk of infection. I wholeheartedly agree that we must encourage our colleagues to pay attention to these details in their work. As most biosecurity procedures have not been validated, we must do the best we can with the information that we have to date. However, I feel that a dangerous premise is set when we recommend procedures that have been scientifically shown to be ineffective, just to give the 'perception' that we are doing everything possible to prevent breaches in biosecurity. Encouraging people to perform biosecurity tasks that are known to be worthless damages our credibility. One would not ask personnel to vaccinate a herd for pseudorabies using a modified live vaccine that had been mixed and then stored for 2 weeks at 90ºF just to give the perception that by vaccinating the pigs, they were doing everything possible to prevent an outbreak of pseudorabies. Eventually, employees and clients will recognize the hoax and your future recommendations will not be heard.

The goal of our research program is to put science into biosecurity protocols. We realize that bigger issues such as siting, pig proximity, and aerosol transmission offer risks that we cannot control in many cases. Thus, our research has focused on the details within production units that we can control- specifically the role of people as mechanical vectors in transmitting porcine pathogens. These details are important because we most likely track pathogens among groups of pigs before we observe the clinical signs of an outbreak.

Boot baths

Farm personnel use boot baths with the goal of preventing mechanical transmission of pathogens among groups of pigs. However, in the authors' experience, boot bath maintenance on most facilities is poor, and frequently boot baths are grossly contaminated with organic matter. People commonly avoid stepping into boot baths or simply step through the bath without stopping to clean their boots.

Literature on boot bath use is scarce and usually limited to the authors' opinions on proper procedure. Quinn recommended phenolic detergents for use in boot baths. He suggested that effective utilization of boot baths consisted of cleaning boots in a preliminary bath filled with dilute detergent, followed by immersion of clean boots to a depth of 15 cm, for at least 1 minute, in a second bath filled with detergent. Quinn advocated that large units prepare new boot baths daily or when visibly contaminated and small units prepare new boot baths every 3 days.

We recently evaluated Cidex Formula 7*, Nolvasan®, Clorox®, Betadine Solution, 1Stroke Environ®, and Roccal-D Plus utilizing various boot bath protocols. Basic principles of proper boot bath use learned from these experiments include:

Scrubbing visible manure from boots enhances removal of significant numbers of bacteria. Simply walking

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through a boot bath will not reduce bacterial counts. Standing in a boot bath for up to 2 minutes without scrubbing off the manure did not significantly reduce bacterial counts except when a cost-prohibitive disinfectant (Cidex formula 7*) was used.

Scrubbing visible manure off in a water bath is as efficacious as scrubbing manure off in a bath of the disinfectants tested as far as reducing bacterial counts. Although not tested, detergents may make manure removal easier.

Scrubbing off manure in a clean disinfectant boot bath (1Stroke Environ®) reduces the bacterial count more than scrubbing boots in a contaminated boot bath.

Boots that have been scrubbed free of manure and then soaked in Roccal-D Plus for 5 or more minutes meet the standard for disinfection.

Time constraints make proper use of boot baths within production units difficult. However, spending time and money to implement boot bath procedures on a farm without using them correctly is a waste of resources. Although going through the motions of stepping in a boot bath has benefits of increasing employee awareness of biosecurity and maintaining a clean workplace, this insufficient biosecurity measure as tested in this study may place the pigs at risk for infection because contaminated boots are being used by personnel.

In conclusion, boot stations with hoses and brushes will facilitate manure removal. Disinfectants should be selected based on efficacy, cost, ease of use, and environmental friendliness. The intention of this research was not to have everyone stop cleaning boots, but instead, to encourage the use of effective footwear cleaning protocols.

People as vectors

People flow into and within production units comprises a large component of biosecurity; however little research is available to support common policies regarding people movement. Sellers, et al sampled people who had contacted animals infected with FMDV. More FMDV was isolated from the nose than the mouth of these people. Virus was isolated from the nose of one person at 28 hours, but was not isolated after 48 hours. Nose blowing or washing was not effective in eliminating the virus, and cloth or industrial masks were not effective in preventing inhalation of the virus. Transfer of the virus between people was documented after persons in contact with infected animals spoke to unexposed colleagues in a box for 4 minutes. One year later, Sellers, et al, reported that FMDV could be transferred by human beings, from infected pigs, to susceptible cattle. Results from Seller's work appear to be the origin for the "48 hour rule" used by many producers even though different viruses and bacteria may be harbored for longer or shorter periods by humans. Wentworth, et al., recorded transmission of SIV to human caretakers. In this study, pig-to-human transmission occurred despite the use of Animal Biosafety Level 3 containment practice (coveralls, boots, goggles, gloves, hairnets, and dust masks.).

"I feel that a dangerous premise is set when we recommend procedures that have been scientifically shown to be ineffective, just to give the 'perception' that we are doing everything possible to prevent breaches in biosecurity."

In contrast, Goodwin reported that the culture of breath and hair samples from a person exposed to pigs experimentally infected with *M. hyopneumoniae* did not result in reisolation of *M. hyopneumoniae*. Additionally, the authors could not detect pig-to-human transmission of *S. suis* using throat swab samples collected from farm personnel who were working in close daily contact with infected pigs.

Our investigations of people as mechanical vectors for PRRSV were less conclusive. Although people did not transmit PRRSV from pigs with acute PRRS to uninfected pigs under the conditions of our study, there was some evidence that people could be contaminated with PRRS viral RNA after contact with infected pigs. PRRS viral RNA was detected in saliva and fingernail rinse samples of 2 of 10 people immediately after exposure to PRRSV-inoculated pigs, on a third person (fingernail rinse) at 5 hours, and a fourth person (nasal swab) at 48 hours after exposure to infected pigs. Further studies should address these findings using virus isolation instead of nRT-PCR to determine if the PRRSV RNA found on people is infectious.

Thus, it would appear that the risk of transmitting diseases back-and-forth between human beings and swine varies with the pathogen. Quantification of the risk of transmission of common porcine pathogens and individual strains of these pathogens on an individual basis is essential.

Conclusions

Further research is needed to validate biosecurity methods used in pork production. Once effective biosecurity procedures are defined, producers and veterinarians can develop protocols for production units commensurate with the greatest risks for that farm, keeping in mind that removal of visible manure is central to all biosecurity efforts whether the contaminated surface is a boot, clothing, truck or skin.

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Editors Note: *The author's complete paper and references can be found at www.animalagriculture.org in the Swine Health issues section.*

Isolation of incoming breeding stock to prevent introduction of disease

Rick Tubbs, DVM, MS, MBA

Isolation of incoming breeding stock from the main herd for a period of observation and testing is a critical step in preventing introduction of disease-causing organisms into a herd. Before isolation occurs and in order for it to be effective, the pigs should have first been obtained from a known reliable source. The animals must be transported in cleaned and disinfected vehicles and loaded and unloaded properly using cleaned and disinfected load-out areas. Transportation routes must minimize the potential for exposing pigs to other pigs or pig trucks during transport. While in isolation the pigs can be tested for antibodies to specific diseases to determine if exposure has occurred. Vaccination for some diseases can take place if it is a part of the herd's disease prevention plan, developed by the herd veterinarian.

Location and Design of Isolation Facility

The proper distance of isolation facilities from the main farm has been debated and is not known precisely, but it must be functionally separate from the main herd. Waste management, proper nutrition, pest control and people movement should be at the same level of security as the main herd.

Potential designs for isolation facilities range from separate buildings on different sites from the main farm to separate parts of a building located on the home farm. The key point is to remember that the primary purpose of an isolation facility is to protect the main herd. Placement, air-flow and pig movements must be planned so as to prevent the spread of disease organisms from the isolated pigs to the main herd. A secondary purpose is to protect the new pigs from organisms present in the main herd in the early stages, yet allow acclimatization to occur in the latter stages. The time allowed for isolation must allow for clinical signs of any disease that may be incubating to develop. Isolation also allows time for diagnostic testing to be completed prior to introduction of animals into the herd.

An isolation facility must be large enough to house all incoming breeding animals comfortably and should be planned accordingly. Poorly planned isolation facilities are often over-stocked which increases stress and attrition of purchased animals due to injuries and lameness. The facility should allow for separate housing of boars and gilts. Depending on size and age, gilts should be allowed 12 square feet per animal. Boars should be allowed 16 square feet per animal and in most cases should be housed individually unless they were raised together. Riding or fighting may occur when boars approaching breeding age are housed together; if this occurs the animals should be separated.

Operational Biosecurity of the Isolation Facility

The isolation facility must be operated in a strict all-in, all-out fashion. Each group of animals must be moved into the main herd before the next group of incoming animals enters the isolation facility. The facility must be cleaned, disinfected and dried before a new group enters. The isolation facility must have the same level of biosecurity as the main farm. Farm workers who are caring for animals in the isolation facility should do so at the end of the work day. A separate changing area from the main farm with separate clothes and boots should be provided. Once a worker has been into the isolation unit they should not return to the main farm until the next day. Many farms require a shower into and out of the isolation unit. Equipment that is used in an isolation unit should remain there until the isolation period is ended. At that time equipment can be washed, disinfected and dried before being taken back into the main farm. Ideally, waste materials from the isolation building will be handled separately from waste materials from the main farm. Minimally, waste from the isolation unit should not be flushed into a lagoon from which water will be recycled back to the main farm for flushing of pits or gutters.

The length of time that animals are isolated before being allowed entry into the main herd will vary depending on the health status of the breeding stock supplier, the health status of the receiving herd and the diseases of concern in the local area. A minimum of 21 days is needed to allow any diseases that may be incubating to express themselves. Many states require a 30 – 60 day retest for PRV; in those states the minimum isolation period should be 30 days plus the amount of time needed to get test results back from the lab. Concern about other diseases (especially PRRS) and the time required to perform necessary testing and get results back may dictate much longer isolation periods. Many farms also use the isolation facility to acclimate incoming animals to the disease organisms present on the home farm. This should only be done after the strict isolation period has been completed.

Health Monitoring

The isolation period, in addition to protecting the main herd from diseases that may be incubating in the new pigs, allows adequate time for health monitoring both by observing clinical signs and performing serological and perhaps other tests. The new pigs should be observed daily for clinical signs of any disease, including: coughing, excessive sneezing, diarrhea, blood or mucus in the feces, loss of appetite, skin lesions,

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sustainability.

Our industry is realizing that high health status herds have value and that there is technology to maintain this status. There is a cost of disease and in preventing disease but the true cost of disease usually accrues over time and thus is frequently underestimated when determining cost effectiveness of preventive procedures. Challenging diseases such as PRRS reawaken our awareness of the value of preventive biosecurity. In the future, consumer acceptance of antibiotic interventions may also direct an increased value on high health production. Biosecurity may seem like an undaunting program, however, many practical interventions will very effectively manage this risk.

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BIOSECURITY FORCES

Chart 1 illustrates the common introductions and exits of typical Farrow-to-Wean unit.

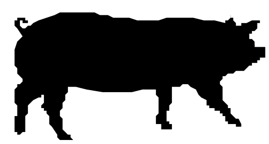
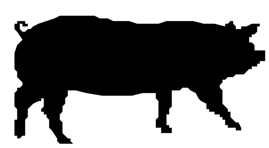
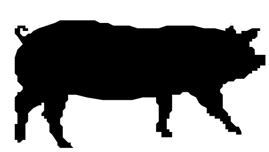
Entries	Farrow to Wean	Exits
Pigs →		→ Weaners
Semen →		→ Culls
People →		→ Deads
Feed →		→ Used Supplies
Water →		→ Waste
Air →		
Pests →		
Recycle Water →		
Supplies →		

Chart 2 illustrates the common introductions and exits of typical Wean-to-Finish facility.

Entries	Wean to Finish	Exits
Pigs →		→ Slaughter
People →		→ Culls
Feed →		→ Lites
Water →		→ Deads
Air →		→ Used Supplies
Pests →		→ Waste
Recycle Water →		
Supplies →		

Entries and exits can be grouped into classifications such as pigs, people, transportation, etc. to develop a systematic approach in reducing risk.

Chart 3 further suddivides human traffic in and out of a unit illustrating traffic volume.

Entries	People	Exits
Staff →		→ Staff
Consultants →		→ Consultants
Maintenance →		→ Maintenance
Insurance Reviews →		→ Insurance Reviews
Pest Control →		→ Pest Control
Auditors →		→ Auditors

The Potential for International Travelers to Transmit Foreign Animal Diseases to US Livestock

Editor's Note: In August 1998, the Centers for Epidemiology and Animal Health within the US Department of Agriculture published a report assessing the potential risk for international travelers to transmit foreign animal diseases (FAD) to livestock and poultry in the US. The following is a summarization of the report and focuses on diseases of interest to the swine industry. The full report can be found at www.aphis.usda.gov/vs/ceah/cei/travrisk.pdf.

Commercial airlines carry 1.4 million persons across international borders every day (CDC 1998). Forty-seven million Americans vacationed in foreign countries in 1994 and over 43 million tourists came to the US in 1995 (WTO 1997). Business travelers, including veterinarians, producers, and representatives and regulators of animal and poultry industries, add many millions to that total each year.

Numerous studies have examined the risk of foreign animal diseases (FAD) being introduced to the United States (US) via importation of live animals, germ plasm, and animal products. What has not been looked at extensively is the risk of FAD introduction via the human travelers themselves and is the issue that this paper explores. The purpose is to highlight and summarize what is currently known regarding the potential for human infection and human-to-animal transmission of FAD, focusing on the International Office of Epizootics (OIE) List A diseases. This paper also explores the ability of humans to be biological or mechanical vectors for each disease.

Human to Animal Transmission

Table 1, "Humans as Potential Biological Carriers of List A Diseases," summarizes existing literature regarding whether humans can be infected with each disease agent, what the incubation period is in humans, and possible modes of transmission from animals to humans. Table 2, "Qualitative Risk of Human to Animal Transmission," focuses on the ability for the disease causing agent to be transmitted from a human to an animal, including relative risks for such transmission to occur. Both biological and mechanical modes of transmission are included for each List A disease. The risk ratings listed in Table 2 pertain to human-to-animal transmission in general and are not specific to travelers.

For the development of risk ratings, it must be emphasized that these risk levels only pertain to risk from human-to-animal transmission. Other modes of transmission such as animal-to-animal or via contaminated animal products would result in significantly different risk ratings for some diseases. It was the purpose of this paper to focus only on human-to-animal transmission. Risk of disease transmission by travelers is addressed in subsequent sections of this paper.

Table 1: Humans as Potential Biological Carriers of relevant OIE List A Diseases

Disease	Incubation period in humans	How humans may Become infected
Foot and Mouth Disease	2-6 days	Drinking raw or pasteurized milk from an infected animal; direct contact
Swine Vesicular Disease	unknown	Direct contact; aerosol; laboratory exposure
Vesicular Stomatitis	2-6 days	Direct contact

A review of relevant literature centered around four basic questions: 1) Have there been reported cases of humans being infected with the disease causing agent? 2) Can an infected person transmit the agent back to an animal and if so, via what mode of transmission? 3) Can people act as mechanical vectors for the agent? How long can the agent survive outside the host, and under what conditions? 4) For vector borne diseases, is there a competent vector in the US and could that vector become infected from a person?

Synopsis of Results: Biological Transmission

The first factor to consider when determining the level of risk for biological transmission from humans to animals is whether or not a human can become infected with the disease agent. Cases of human infection have been reported for foot and mouth disease, swine vesicular disease, and vesicular stomatitis. The ability of transmission to take place from humans to animals and the mode of that transmission must also be considered. If there are no documented cases of human-to-animal transmission, one can assess human-to-human modes of transmission for possible extrapolation to human-to-animal transmission.

Synopsis of Results: Mechanical Transmission

There are many factors to consider in order to arrive at a risk rating for mechanical transmission. Whether or not a particular agent is infectious is of importance. Agents requiring a vector for transmission are not at risk for mechanical transmission under this study's focus. The amount of the agent shed in secretions and excretions is also important. If a disease-causing agent is shed in doses too low to cause disease in another host, the risk level is much lower then if high amounts of the agent are shed. Many of the viruses causing List A diseases can survive in the environment at room temperature for extended periods of time. This prolonged survivability increases the risk of disease transmission by allowing more time for contact with a susceptible animal to occur. Another factor to consider in mechanical transmission is the type of contact with the infected animal that is required. If an agent can be transmitted via environmental contact, the level of risk is much higher than if direct contact with lesions is required. An example of environmental contact is a person walking onto an infected premises, never touching an animal yet becoming contaminated with the disease agent. The person then walks onto another premises, again never touches an animal and yet spreads the agent to the new location. For this project, only the person and their clothing were taken into account when assessing the risk of mechanical transmission from a human to an animal. Any animal products or equipment they might be carrying were not considered.

Disease Transmission by International Travelers

When considering the risk that international travelers play in disease transmission, several factors must be considered. First, the traveler must have contact with the disease agent in the country of origin. The traveler must then either become infected with the agent or become mechanically contaminated with it. After arriving in the US, the traveler must come in contact with a susceptible host or vector so the agent can be transmitted to an animal, resulting in disease. For mechanical transmission to occur, the agent must further be able to survive outside the host for a sufficient length of time for the person to travel to the US.

The likelihood of contact with the disease agent varies greatly depending on the traveler's country of origin and the prevalence of disease in that country. It also depends on the traveler's activities. Did the traveler spend their time only in metropolitan areas with little to no opportunity for contact with livestock? Or did the traveler spend time in rural areas allowing opportunity for contact with livestock? With the increasing amount of ecotourism by US tourists, more people are spending time in rural areas of other countries, thus increasing their opportunity to come into contact with livestock and disease agents of livestock.

In order for mechanical transmission to occur, a traveler must have contact with feces or other animal excretions containing the disease agent, wear or pack the contaminated items to travel internationally, then wear these same contaminated items to a location where they have contact with animals. While this scenario is entirely possible, for the majority of travelers it is not highly plausible. Travelers originating their travel in another country are unlikely to bring fecal contaminated clothing with them for an international trip. However, for the US originating tourist who spent time in another country and is now returning to the US, and who packed a limited amount of clothing, it is a more probable scenario. And unfortunately, many of the List A diseases can survive outside the host for extended periods of time making it entirely possible for the agent to be carried back to the US on dirty clothing or foot wear and still be viable.

Once in the US, the traveler must come in contact with a susceptible host. It is unknown how many travelers are likely to do so. Those who routinely have direct contact with animals in the US, such as veterinarians, farmers, ranchers, consultants, farm workers, etc., are obviously at greater risk for transmission of diseases then the general traveler.

When considering the risk of humans biologically transmitting diseases, the duration of the travel comes into play. The length of most international air flights is less than the incubation period of many infectious diseases. People incubating diseases can leave the location they became infected, travel to the US, and transmit the disease, before showing any symptoms of infection. A disease can truly move around the globe before the person incubating it has any indication that they are infected.

Conclusion

It is possible for humans to transmit OIE List A diseases to animals in the US. However, for most of the List A diseases, the risk of either biological or mechanical transmission is negligible to none. At high risk for mechanical transmission is swine vesicular disease. Foot and mouth disease and African swine fever are at moderate risk for mechanical transmission while vesicular stomatitis is at low risk for mechanical transmission. Mitigating factors brought into account by international travel further reduces the risk of effective human-to-animal transmission of List A diseases.

Table 2: Qualitative Risk of Human-to-Animal Transmission

Disease	Possible modes of transmission from humans to animals: Biological	Possible modes of transmission from humans to animals: Mechanical[3]	Qualitative risk of human-to-animal transmission[2]
Foot and Mouth Disease	- respiratory - direct contact	- virus on shoes, clothing, etc. - stable in the environment for months	biological: negligible mechanical: moderate
Swine Vesicular Disease	- unknown, possibly fecal oral route	- via contaminated clothing, shoes, etc. - survives 4 months or more in feces and infected tissues - resistant to high temperatures	biological: negligible mechanical: high
Vesicular Stomatitis	- via insect vector	- survives several weeks depending on environmental conditions - inactivated at 58 degrees C in 30 minutes	biological: negligible mechanical: low
Classical Swine Fever	- none	- possible but rare via fecal contamination on clothing, shoes, etc. - survives several days in manure	biological: none mechanical: negligible
African Swine Fever	- none	- via clothing, shoes, etc. contaminated with manure - survives 11 days in feces at room temperature - possibly via human carrying infected tick to US	biological: none mechanical: moderate

An Overview of Rodent Control for Commercial Pork Production Operations

Robert M. Corrigan, Ph.D.

Swine operations are particularly vulnerable to rodent infestations because they provide nearly unlimited amounts of harborage, food, and water to rodents. It is uncommon to find a confined swine operation, which does not contain at least a minor level of a mouse infestation.

When rodent infestations are not diligently managed they quickly become severe, which in turn can pose significant economic problems to a swine producer. Rodents consume and contaminate feed, gnaw on structural, mechanical, electrical and various utility components, and weaken concrete slabs and walkways via their burrowing activities. Norway rats and large populations of mice are particularly destructive to building insulation.

Rodents can also play a significant role in the maintenance and transmission of swine diseases such as leptospirosis, trichinosis, toxoplasmosis, erysipelas, swine dysentery, and others. Mice and rats can spread or accelerate the spread of established diseases from contaminated areas to uncontaminated areas via their droppings, feet, fur, urine, saliva, or blood, As an example, mice may travel through infected manure and then contaminate the food and water of healthy animals several hundred feet away, or introduce a disease to nearby uninfected barns, Consequently biosecurity cannot be assured if rodents are tolerated in or around swine facilities.

Key Rodent Reproduction and Behavior: Rodents have impressive capacities for reproduction - especially in swine facilities. Thus it is important to control them early, before they reach populations that cause significant damage. For example, in a single year a female mouse produces about 6-8 litters, each litter averaging 5-6 pups. The pups reach reproductive maturity in 6-10 weeks. The Norway rat produces about 4-7 litters, averaging 8-12 pups per litter. Rats reach reproductive maturity between 8-12 weeks. Both rats and mice have natural life spans ranging from 5 to 12 months. The house mouse has a typical home range of 6-30 feet, while rats have home ranges of 15-100 feet, and sometimes more.

Pro-active Rodent Inspections: Conducting monthly rodent inspections of a swine facility is one of the most important good production practices a swine manager can perform. Such inspections should be done on a pro-active basis, regardless of whether or not a facility has a current infestation. Because rodents tend to be secretive and are active at night, infestations can build very quickly and can catch a producer off guard. Thus, by performing monthly inspections, minor infestations or new incoming rodents can be prevented from becoming severe.

Rodents living in farm buildings are most active just after dusk and again shortly before dawn. If rodents are seen repeatedly during the day, it indicates an established infestation. To get an accurate assessment of the rodents at a facility, the interior and exterior premises should be inspected using a good flashlight, with the lights out at either dusk or within an hour or two of dawn. If rodents are present, the inspection will reveal the location, distribution, and severity of the infestation. The results of the inspection will also prove valuable in determining control procedures such as the most important areas to bait or place traps.

When inspecting for rat burrows, all areas around the building's foundations and around bin slabs should be carefully checked. Inspections should also be conducted into any thick overgrown vegetation within up to a 100-ft. radius of the swine facility. To confirm whether or not a rat burrow is active, the burrows can be caved in and inspected the following day.

Practical Rodent Control Programs: Controlling rats and mice around swine facilities must be a well-organized effort. Tossing a few bait packets out on a regular basis, or stuffing baits down rat burrows usually results in only harvesting rodents from the facility. Unfortunately, surviving rodents quickly replace those harvested off as a result of incomplete control programs. These types of efforts have led to a misperception in the swine industry that "you never can get rid of rodents around swine operations". But this is not entirely true. It is very possible to completely eliminate rat infestations from swine operations (and in fact, this should be the goal). For mice—especially inside confined facilities—achieving *zero mice* may not be practical, or even possible. But it is totally realistic and possible to keep mouse populations to very low numbers (e.g. less than a dozen mice) even in a large complex facility.

Facility sanitation plays a critical role in controlling rodent populations. It is obviously impractical to eliminate all food sources for rodents in and around swine facilities. Still, feed spills, or equipment malfunctions that provide rodents with unlimited amounts of food should be removed or repaired as soon as possible.

Easily accessible harborage is also one of the key elements that allows for rodent explosions. Any exterior debris such as old equipment, junk piles, old boards, and the like should be eliminated.

Controlling weeds is also important. Weeds provide rodents with food, water, nesting material, and cover from predators. By maintaining an uncluttered three-foot, weed-free, graveled perimeter around buildings, rodents cannot use these areas. Gravel should be at least one inch in diameter and be laid in a band at least three foot wide and one-half foot deep.

Eliminating Existing Infestations: Rats and mice can be eliminated or severely reduced in numbers by using poison baits (rodenticides) and/or rodent traps. In the majority of cases involving established infestations, rodenticide baits strategically placed based on the results of the rodent inspections will provide the most cost-effective control.

Using Poison Baits: There are many different types of poison baits on the market, and selecting the right bait for the right job can be confusing to the swine producer.

The majority of the baits used today in livestock programs are the single feed anticoagulants. Multiple feed rodenticides require more feedings to kill but can be used for economy purposes and for minor infestations. For established infestations, the single feed anticoagulant baits are recommended. Assuming the baits are fresh, are well placed, and the other aspects of rodent control programs are implemented (i. e. sanitation, clutter control, weed control, etc), from a practical level, the different single dose anticoagulants will perform similarly.

The three keys to effective control using rodent baits are: 1) installing fresh baits in the rodent's high activity areas as determined from the inspections and/or rodent signs (droppings, gnaw marks, etc); 2) placing out enough bait points to ensure the rodents readily encounter the baits during their nightly travels to gather food; and 3) matching the right bait formulation (e.g., pellets, vs. blocks, vs. packets, etc) to the specific area needing to be baited. A casual approach of putting out baits in corners of barns and buildings, or simply stuffing rodent bait packets down rat burrows will have little long term effect on rodent population reduction, regardless of the bait brand used.

For example, for effectively controlling mice inside confined swine operations, research has shown baits have to be placed directly in the pathways of feeding areas for the mice both on-floor areas as well as along the various off-floor areas (e.g., along wall ledges, pen dividers, off-floor utility lines, etc.). Such strategic baiting efforts are crucial to success because a significant number of mice never travel along the floors, and thus will not be subject to programs that utilize floor baiting programs only.

For small infestations, and or maintenance baiting, rodenticides need not be purchased in large quantities. For severe infestations however, or for large swine operations, the best economy with baits is to buy rodenticides in bulk quantities (25-40 lbs.). The best economy with formulations is with bulk pellets and bulk block baits. The new block baits as they are formulated today, are very effective in all situations - not just damp or wet areas, and offer the swine producer excellent baiting versatility.

Baiting Rat Burrows: To bait burrows correctly, 6-8 ounces of pellet baits should be installed deep into active burrow holes using long-handled spoons. The burrows should not be caved in until one week later. Burrows, which are then reopened the next day, should be re-baited in the same manner. Only one active burrow hole need be treated every 15 feet or thereabouts, Remember burrow systems located further away (100-ft. radius) from the buildings must also be treated.

Finally, for all programs involving rodenticides, it can't be emphasized enough that the use of rodenticide baits will rarely be cost-effective on a long term basis if the conditions allowing rodents to enter the premises, hide, and feed at will, are not addressed via comprehensive programs involving sanitation, and harborage / vegetation control.

Rodent Traps: For minor infestations of rats and mice, or to stem off an infestation from new incoming rats or mice, the use of traps, placed strategically where rodents have been noticed is very effective, and inexpensive. But traps are too labor intensive for anything beyond a minor infestation.

When using mouse snap traps, the trick is to set many traps for just a few mice. For example, 6-8 snap traps are recommended to capture 2-3 mice. Several dozen traps would be needed for a moderate infestation. To catch rats with traps, it is most effective if the traps are left unset but baited with a highly attractive bait (e.g., hot dogs, bacon, meat) for a couple of days until the rat takes the bait. Otherwise, rats can become very wary of the traps and avoid them altogether.

Electronic Machines: Despite on-going advertisements claiming "new technological breakthroughs", there are currently no electronic machines utilizing ultrasonic or electromagnetic means which have any scientific data to prove they work. Buyer beware.

Dogs and Cats: Although dogs and cats will periodically kill a few rats and mice, they cannot control an already established infestation. At best, rodent-aggressive dogs and cats can be effective in preventing infestations from developing if they happen to quickly kill any new rodent immigrants that venture into an uninfested premises.

But, cats and dogs pose an additional potential for disease transmission around swine facilities, and thus these animals are not encouraged.

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A guide to the use of the rodenticides and formulation is available from the National Pork Board. To order the Guide Chart for the Use of Rodenticide Baits for Swine Facilities contact the NPB Ordering Department at 515-223-2621.

Editors Note: *The information presented here was excerpted from a comprehensive paper by Robert Corrigan, which can be found on the Internet at www.porkscience.org.*

Transportation Cleaning and Disinfection

Dr. Robert Thompson
PIC USA

Proper cleaning and disinfection of transportation equipment is one of the key methods to prevent disease introduction into a swine farm. Management needs to emphasize the importance of this area to the biosecurity of the operation. Staying focused on transportation cleaning and disinfection can be challenging. It is important to continually monitor the cleaning and disinfection process.

Pathogen Survival

Numerous references document the ability of viruses and bacteria to survive in the environment. (Beran, 1991; Benfield et. al., 1999; Taylor, 1999; Saif, 1999; Schwartz, 1999; Harris, 1999) PRRS and TGE viruses are both able to survive for long periods at low temperatures. Salmonella is very hardy and able to multiply at 7-45°C. PRV reached 99.9% inactivation within 40 minutes under ultraviolet light in a thin liquid suspension. PRV could not be recovered on dried glass or gelatin. This points out the need for allowing time for drying of the equipment following cleaning and disinfection, Exposure to sunlight may also help eliminate pathogens.

Disinfectants and Detergents

Most of the common disinfectants are effective with the proper cleaning, environmental temperature, and disinfectant contact times. Inactivation of the microorganisms is a function of exposure time, type of organism, concentration of organism on the surface (contamination level), concentration of disinfectant, temperature, and pH. Empirical rules suggest inactivation time decreases by a factor of 2 to 3 for each 1O°C rise in temperature, which makes it important to use hot water. Because of the differences in disinfectants available, it is important to evaluate their effectiveness in the specific environment - trailer type, ambient temperature, possible safety issues, and interactions with other compounds used.

Cleaning compounds like soap or detergents are surface-active chemicals that can modify the solubility of water. Cleaning compounds should have the following properties: wetting or penetrating, rinsing properties to lower the surface tension of the water, emulsifying properties (degreasing) to break up fats and oils into smaller particles, foaming to increase the contact time, sequestering to remove or inactivate water hardness, and water conditioning to soften the water by sequestering mineral ions. Alkyl detergents meet most of these requirements (Jeon, 1998). Use of a soap or detergent is an important first step in the cleaning process. An example of the benefits of this is demonstrated in Table 1.

Table 1. Effects of Various Washing Steps

State of house	Viable bacteria / sq. cm.
Immediately after pigs out	50,000,000
After plain washing	20,000,000
Hot water wash and detergent	100,000
Target before disinfection	1,000

Gadd, 1999

Summary of Properties of Disinfectants

(see Table 2. Quinn, 1991)

- Halogens (chlorine and iodine), phenolics, and quaternary ammonium compounds (QAC) are effective against Gram positive and negative bacteria, Mycoplasmas, and common viruses.
- Chlorine is inactivated by organic material, ammonia (urine), and has some user safety issues.
- Iodine compounds are more effective in organic material and have a good spectrum of activity but can stain equipment.
- Phenolic disinfectants have a broad spectrum of activity, are tolerant of organic material and hard water, have residual activity, and are biodegradable. Anionic detergents work better with phenols.
- QACs have similar activity as the phenols but are cationic surface agents which act as surfactants. They form a bacteriostatic film and are effective on aluminum.

For any disinfectant thorough rinsing after the cleaning step is necessary to prevent any adverse reaction with the detergent.

Facilities

Providing an enclosed, well lit, and heated building for shelter will greatly improve the quality of the washing.

Federal regulations require that all the wastewater be captured in an approved holding facility. If bedding is used, it must be held until it can be disposed of properly or applied to agriculture land. Proper slope for washing out the trailer is necessary. A minimum of 2% to 3% slope to get the wash water to run out is recommended, A pressure washer with high pressure and hot water is needed. Recommendations are to use a minimum of 2,000 psi with 4 gallon per minute of water. An accurate metering device is important in the application of the soap and disinfectant.

Procedures

1 . Bedding and large debris should be scraped out of the trailer before entering the wash area. If no

bedding is used, soaking the trailer before washing will reduce wash time.

2. Use of soap is highly recommended to reduce washing time by loosening debris. Normally it is applied on low pressure. Apply soap and water to the outside of the trailer first. Next move inside to the front of the top deck and start the soap application at the junction of the floor and side, Work up the sides from bottom to top to reduce streaking and give more surface contact time. Soak the roof and floor while working to the back of the trailer. Soaking the whole trailer will give plenty of time to loosen debris. However, don't allow the soap to dry or it will be harder to rinse.

3. After soap has been applied to the whole trailer move back outside and start rinsing and cleaning the trailer from the top down. After rinsing the trailer, soap and wash the cab to give additional soaking time inside the trailer.

4. Rinse and clean each deck from front to back and ceiling down starting with the top deck. Pay special attention when washing to spray the flooring support members on the ceiling of the bottom deck in a multi-deck trailer, behind all the gates, in all the corners, and the inside of the roll-up door. Unloading ramps should also be washed. During the winter it is essential to wash all the winter panels as well as the storage box after every trip. Any time of the year wash and disinfect the cutting boards, paddles, boots, and coveralls after every load.

5. After the trailer has been rinsed inside and out, apply the disinfectant at the appropriate dilution rate. Start on the inside of the trailer and finish on the outside, Disinfectant should be applied at low pressure because many of the metering devices will not dilute properly on high pressure.

6. Clean out the inside of the cab, wash, and disinfect the floor mats.

7. After disinfection, park the truck on a slope so all the remaining water can drain out. During the winter leave the truck in the washout bay, or park it in a protected area to ensure no pooled frozen water.

Monitoring the quality of the cleaning and disinfection is possible through the use of environmental culture media or ATP tests. For more information on monitoring see Fact Sheet Vol. 1 No. 2, "An Overview of Methods for Measuring the Impact of Sanitation Procedures for Swine Transport Vehicles by Dr. Scott Dee.

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Table 2. The Antimicrobial Spectrum of Disinfectants, Classified According to Their Chemical Composition

	Chemical Disinfectants[a]			
Microorganisms Listed in Order of Increasing Resistance to Disinfectants	Chlorines	Iodines	Phenolics	QACs
Micoplasmas	++	++	++	++
Gram-positive bacteria	++	++	++	++
Gram-negative bacteria	++	+	++	+
Enveloped viruses (TGE, PRRSV, PRV)	++	+	+/-	+/-[b]
Nonenveloped viruses	+	+/-	-	-
Acid-fast bacteria	+	+	+/-	-
Bacterial spores	+	+	-	-

++, highly effective; +, effective; +/-, limited activity; -, no activity; a, individual members may vary from the activity listed for that category; b, varies with the composition of disinfectant;
Quinn 1991

Isolation of incoming breeding stock

Continued from page 4

excessive scratching or lameness. Rectal temperatures should be taken and recorded from pigs that show any of the above signs. If signs are severe or linger more that a couple of days, or if normal transitory appetite loss following shipment lasts more than a few days, a veterinarian should be consulted. Diagnostics may be indicated and in especially severe cases it may be necessary to sacrifice an animal or two in order to reach a diagnosis and determine if the new animals will ever be allowed to enter the main herd.

In addition to observation of clinical signs with appropriate diagnostics if indicated, routine serological monitoring should be established as part of an isolation program. Many states require PRV testing 30 to 60 days after the arrival of new animals. Even if your state does not require it, this is a good management practice and serves to protect the farm from animals that may have been incubating the disease when they arrived. Tests for other diseases may be incorporated into the monitoring program. Test accuracy and presence or absence of specific diseases in the main herd should be considered when developing the monitoring program.

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New Biosecurity Center advises on disease prevention

International animal disease crises and increased awareness of the potential for bioterrorism have placed added significance on disease prevention as a way to protect American livestock. Purdue University has established the National Biosecurity Resource Center for Animal Health Emergencies to help avert such catastrophes.

The center offers information via a website designed to help handle the challenges of animal health emergencies. The center is a resource for government officials, producers, veterinarians, commodity groups and others interested in learning about good biosecurity measures based on scientific research.

One of the center's first activities will be this fall when center members help evaluate biosecurity measures at the Plum Island research facilities in New York to guard against any accidental outbreak of foot and mouth disease. The government center is the only place in this country where the live FMD virus can be studied.

"Disease prevention is a big key in maintaining a secure livestock industry," said Sandy Amass, assistant professor of veterinary clinical sciences and center director. "There's a lot of dogma out there. Producers follow procedures they've done for years without knowing whether or not they really work."

In addition to information on disease prevention, cleaning and disinfecting, the site includes state-by-state resources and regulations regarding nutrient management, reportable diseases and carcass disposal. "In the event of a real animal health emergency, the website will act as a readily available resource for providing producers and decision makers with information on proper handling measures," Amass said.

The center's website address is www.biosecuritycenter.org.

Other websites offering biosecurity and swine health-related information:

National Pork Board
www.porkscience.org

National Institute for Animal Agriculture
www.animalagriculture.org

American Association of Swine Veterinarians
www.aasv.org

USDA, APHIS, Veterinary Services
www.aphis.usda.gov/vs

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