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IN-HOUSE COMPOSTING AS A RAPID RESPONSE TO AVIAN INFLUENZA

BioCycle May 2006, Vol. 47, No. 5, p. 38

Studies by Virginia state agencies conclude that composting is a preferred option because it reduces disease transmission from farm to farm while being cost-effective and environmentally-sound.

Eric S. Bendfeldt, Robert W. Peer and Gary A. Flory

THE CONTINUED spread of the high pathogenic H5N1 strain of bird flu from Southeast Asia to Eastern Europe and Africa has world health officials and the public justifiably concerned. Some public health experts believe that the H5N1 bird flu virus could mutate, allowing it to spread easily from human to human leading to a worldwide pandemic. The World Bank estimates that a bird flu pandemic lasting a year would cost the global economy up to $800 billion. The United States is the world's largest producer and exporter of poultry meat, with chicken, turkey and duck production valued at about $23 billion annually. An outbreak of bird flu could result in a devastating cost to U.S. and Virginia poultry producers and the industry in lost trade.

The Virginia poultry industry had been very hesitant to use composting as a carcass disposal method for dealing with avian influenza outbreaks and catastrophic poultry losses because of an unsuccessful attempt during the 2002 outbreak in Virginia and of a lack research on in-house composting or large birds. Here at the Virginia Cooperative Extension and the Virginia Department of Environmental Quality, we have examined our experiences with avian influenza outbreaks of 1984-85 and 2002, looking at what methods were used for disposal and the drawbacks of those methods. We have also specifically looked at in-house composting as a more preferred and acceptable option because it reduces the possibility of disease transmission from farm to farm, while being cost-effective for large birds like turkeys, and environmentally sound. If high pathogenic bird flu would happen to come to the U.S., all disposal methods would be evaluated, but the sentiment is that public perception and outcry may limit the transportation of carcasses of infected birds off farms to landfills or incinerators. The Virginia experience with landfills and incinerators shows that these methods are extremely costly and have many drawbacks.

The Virginia Cooperative Extension, Virginia Department of Environmental Quality and other state agencies view in-house or on-farm composting as one method that limits costs and has many positive benefits in addressing catastrophic poultry losses such as an avian influenza outbreak. Since 2002, in-house composting and on-farm composting has been used to dispose of five flocks that were catastrophically lost to heat stress. Additionally, in the winter of 2005 a demonstration was successfully conducted in Virginia on composting of large birds. As a result of these experiences, the Virginia poultry industry now considers composting the preferred and most acceptable method of disease containment and carcass disposal for all bird types and poultry house structures.

VIRGINIA'S EXPERIENCE WITH LOW PATHOGENIC AVIAN INFLUENZA

A low pathogenic avian influenza outbreak in the central Shenandoah Valley of Virginia in the spring and summer of 2002 affected 197 poultry farms, with an estimated cost of $130 million to the farmers and state economy. The low pathogenic avian influenza outbreak of 2002 was particularly challenging and problematic because of the magnitude and urgency of the epidemic and carcass disposal issues. More than 4.7 million birds were infected and disposed of from March to July 2002. Many lessons were learned about poultry carcass disposal because five different disposal methods were used during the outbreak. As a result of these lessons and experiences, Virginia regulatory officials have encouraged the poultry industry to consider in-house or on-farm composting as a rapid response tool for disposal

and disease containment, particularly with low pathogenic avian diseases. (See sidebar on "Lessons Learned.")

Landfilling has been the preferred option for disposal because the infected flock can be removed from the poultry farm relatively quickly, enabling the farmer to begin cleaning and disinfecting the poultry houses. In 2002, more than 13,000 tons of poultry carcasses were disposed in sanitary landfills (DEQ 2002). Disposal in landfills is still a valid option; however, the drawbacks include expense, transportation logistics, biosecurity risks, public perception issues, and environmental considerations. From past experience with avian influenza outbreaks, public perception and attention can quickly influence what are thought to be acceptable and prudent disposal methods. In case of highly pathogenic avian influenza, off-farm disposal may not be publicly acceptable. Therefore, contingency plans have to be developed and maintained with several on-farm disposal options.

EMERGENCE OF COMPOSTING AS CATASTROPHIC DISPOSAL METHOD

The poultry industry has been concerned about the effectiveness of composting in destroying the avian influenza virus. However, research of composting poultry carcasses has shown that the avian influenza virus can be inactivated at compost temperatures within 10 days (Senne et al., 1994) and within 10 minutes at 140°F (60°C) (Lu et al., 2003).

During an avian influenza outbreak on the Delmarva Peninsula, the successful demonstration and use of in-house composting of 5-pound broilers proved the effectiveness of composting as a method of disposal and containment in a catastrophic event and gained the attention of Virginia poultry and regulatory officials (Malone, 2004a; Malone et al., 2004b). Avian influenza was confined to three farms despite a high density of poultry farms in the area. However, the Virginia poultry industry was concerned this disposal method would not work with larger birds because of unacceptable odor, leachate production, and would cause extensive down time as the large birds composted. The industry was interested in conducting more research with large birds to overcome these obstacles because 79 percent of the farms impacted by the avian influenza outbreak of 2002 were turkey breeder and grow-out flocks. Virginia Cooperative Extension and Virginia Department of Environmental Quality offered to address this concern through a large scale on-farm composting demonstration.

APPLICATION OF IN-HOUSE COMPOSTING IN VIRGINIA

Poultry production in the Shenandoah Valley of Virginia is more diverse than on the Delmarva Peninsula. There are more bird types, different poultry house designs, and aged structures such as double-decker houses. Turkey production and breeding is particularly prominent in the Shenandoah Valley.

In the fall of 2004, Virginia Cooperative Extension, Virginia Department of Agriculture and Consumer Services, Virginia Department of Environmental Quality, Virginia Poultry Federation, Virginia Poultry Disease Task Force and the poultry industry initiated a research and demonstration project to build on the Delmarva experience and evaluate the effectiveness of in-house composting of turkeys as a means of disease containment and disposal of catastrophic losses. Dr. Lewis Carr of the University of Maryland and Dr. Bud Malone of the University of Delaware provided guidance to the research team based on their work on the Delmarva Peninsula. Eight windrows (12 feet wide by 6 feet high), each representing a treatment, were formed. Each windrow contained 2,500 to 3,000 pounds of turkey carcasses, with each turkey carcass weighing between 17 and 40 pounds.

Carbon materials compared for their effectiveness in composting turkey carcasses included: hardwood sawdust; aged, weathered woodchips with relatively high moisture; built-up poultry litter; starter litter or wood shavings from the brooder house; and a blend of starter litter and built-up litter. The turkey carcass treatments included: whole carcasses mixed and piled; shredded and tilled carcasses, mixed and piled; and crushed carcasses mixed and piled.

PROJECT RESULTS

The results of the research and demonstration are summarized as follows: After two weeks, few carcasses remained in any of the windrow treatments. All carbon materials (i.e., hardwood sawdust, woodchips, built-up litter, and starter litter) were effective in composting the turkey mortalities. Temperatures of all the windrows reached 140°F and maintained temperatures adequate for pathogen kill. The windrows with woodchips reached and maintained the highest temperatures because of good porosity, varying particle size, and relatively ideal moisture content.

The starter litter required the addition of water during the mixing process, but only enough to make the litter and mixture glisten. The carcass treatments (i.e., shredding, tilling, and crushing) helped activate the composting process by releasing and distributing the moisture throughout the compost mix; increase windrow temperatures, increasing the surface area to volume ratio; and expose the bones and marrow to further decomposition. An equally effective alternative to tilling and shredding the birds would be to crush the birds. Crushing reduces the equipment necessary for in-house composting and eliminated the difficult process of cleaning and disinfecting the tiller. Whole carcasses effectively composted, but took a little longer to process.

Tilling the poultry litter in the house after depopulation helped to break up excessively caked or crusted litter and enhance the composting process and prevents any seepage from the carcasses and windrows. Maintaining the base and cap on the windrow is essential to composting and preventing any carcasses from being exposed to the air which can prevent

decomposition.
The results from the experiment to determine the minimum carbon material needed for composting heavy toms are summarized as follows: Temperatures of 140°F were achieved within five days for the crushed treatment. It took 16 days for the whole carcass treatment to reach the same temperatures. Therefore, avian influenza virus would be deactivated faster and the compost removed from the poultry house 11 days sooner if the carcasses are initially crushed.
With a 5-inch base layer and 5-inch cap (10 inch total), no seepage occurred at a density of 12.5 pounds per square foot and composting was promoted. The whole birds tended to roll off the pile, require more labor, and take longer to begin composting. In the whole carcasses treatment, at least 0.8-inch of carbon material per pound of carcass was needed as a base and cap to adequately cover the carcass. More material, approximately 1-inch of carbon material per pound of carcass, was needed to promote composting.
To illustrate the reduction of vehicle traffic onto diseased farms, in the worst case scenario, where there is very little base poultry litter in the poultry house (i.e., < 5-inches) and heavy toms in the poultry house, two tractor trailer loads of additional carbon material may be needed per house to promote composting. In 2002, seven semi-trailer trucks were needed per house to haul carcasses off the farm to the landfill.

ECONOMICS AND LOGISTICS OF IN-HOUSE COMPOSTING

Even if cost were the only consideration, in-house composting would be preferable to landfill disposal because it reduces vehicle traffic. In-house composting after euthanasia and depopulation is less than one-third the cost of landfill disposal with its transportation expense plus the current arrangement the Virginia poultry industry has with a sanitary landfill. Research, the Delmarva Peninsula in-house composting success, and the 2002 avian flu experience demonstrate the cost-effectiveness and practicability of in-house composting.
Farmers have expressed concern about the quality of the finished product including the presence of bones. In the research with heavy toms, only the upper part of the leg bones was visible. Other bones broke down during the compost process. Application of the final compost to tillable row crops like corn, small grains, and soybeans would be the preferred method of utilization. Applications to pasture or hay land would require a simple method of screening the bones such as through a box poultry litter spreader.
In 2002, the standard practice of transferring litter off of the farm for land application was problematic because of the stigma associated with litter coming from an avian influenza positive farm. An incentive payment of $10/ton of litter was implemented to facilitate movement of 5,000 tons of litter off farms. In-house composting could resolve some of these issues because composting reduces the volume of litter 40 to 60 percent, provides sufficient heat to deactivate most pathogens, and produces a quality final product that would not likely require an incentive payment to facilitate movement of the litter from farms.
In-house composting is a cost-effective and environmentally sound method of disposal and containment of avian influenza. The Virginia poultry industry was concerned this method would not work on turkeys and large birds because of unacceptable odor, leachate production, and the extensive down time needed to compost large birds. The in-house turkey composting demonstration has shown that with a good base, cap, and proper disease monitoring, the compost could be turned and moved out of the poultry house within three to four weeks. This time would be comparable to the minimum down time experienced by farmers in the 2002 avian influenza outbreak. Each farm and type of flock would have to be evaluated, but with proper planning and training of farmers and industry personnel, in-house composting is an effective rapid response tool for managing catastrophic poultry losses.

Eric Bendfeldt is the Area Specialist, Community Viability, for the Virginia Cooperative Extension in Harrisonburg. E-mail ebendfel@vt.edu; Robert Peer is the Agricultural Program Coordinator for the Virginia Department of Environmental Quality in Harrisonburg. E-mail rwpeer@deq.virginia.gov; Gary Flory is the Agricultural and Water Quality Assessment Manager for the Virginia Department of Environmental Quality in Harrisonburg. E-mail gaflory@deq.virginia.gov.

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Sidebar:

OUTBREAKS IN VIRGINIA

EARLY developments in commercial hatchery technology, artificial incubation and brooding, marketing, diagnostic testing, and key infrastructure improvements from 1900 to 1950 contributed to the growth and present prominence of the poultry industry in the Shenandoah Valley and its importance in the agricultural economy of Virginia. In 2003, Virginia ranked fifth, ninth, and 31st in the nation for commercial turkey, broiler, and egg production, respectively, and the value of the state's turkey, broiler, and egg production was $692 million. The expansion and density of poultry production in the Shenandoah Valley has posed challenges to the industry and regulatory officials in the control of contagious diseases like avian influenza.

The low pathogenic avian influenza outbreaks of 1983 and 2002 were particularly challenging and problematic because of the magnitude and urgency of the epidemic and carcass disposal issues. Many lessons were learned from these outbreaks and the experience of trying to dispose of poultry carcasses through on-site burial, burial in sanitary landfills, incineration, rendering, and Ag-Bag composting. Each outbreak was unique and offered many environmental and economic challenges. Virginia regulatory officials, as a result of these experiences, have encouraged the poultry industry to consider sanitary landfills and in-house or on-farm composting as rapid response tools of disposal and disease containment, particularly with low pathogenic avian diseases.

COST TO INDUSTRY

In 1983 an avian influenza outbreak cost Virginia poultry farmers and industry $40 million, resulting in the disposal of 5,700 tons of poultry carcass material. Approximately 88 percent of the material was disposed of on-site in burial trenches, and the remaining 655 tons of carcasses were disposed in a local sanitary landfill. The cost of on-site burial and landfilling was $25/ton or $142,000. Concerns about contaminated groundwater from these sites and the discovery, during the excavation of a school building site in the late 1990s, of relatively intact poultry carcasses buried for more than 15 years affected future decisions and responses.

Eighteen years later, the poultry industry in the central Shenandoah Valley was affected by an even larger avian influenza outbreak, costing the industry an estimated $130 million. At the time of the outbreak in 2002, more than 56 million commercial turkeys and chickens were being grown on over 1,000 poultry farms. On March 12 low pathogenic avian influenza was confirmed in a turkey breeder flock near Penn Laird, Virginia. One month later more than 60 flocks tested positive. A total of 197 farms were infected, and 4.7 million birds were destroyed to eradicate the virus. Turkeys accounted for 78 percent of the positive farms and bird losses.

On-site burial, assumed to be an acceptable method of disposal based on its use in 1983, was used to dispose of the first flock in 2002. However, several complaints about on-site burial and possible well contamination were raised by adjoining landowners. Today there is greater public awareness of the need to protect groundwater resources. In response to these concerns, state authorities have developed stricter criteria for on-site burial, such as public disclosure of sites on deed records, use of a compacted clay liner, a narrower ratio of birds to carbon material, and on-site groundwater monitoring.

EXPERIENCE WITH DIFFERENT DISPOSAL METHODS IN 2002

As the disease progressed in 2002, many alternative disposal methods were researched, and five options were implemented: burial in sanitary landfills, controlled slaughter, incineration with air curtain destructors, in-house and Ag-Bag composting. Rendering was not used as a disposal method because of biosecurity risks associated with central collection sites and possible disease transmission.

Approximately 13,100 tons of infected poultry were landfilled. Two large landfills located more than 160 miles from Harrisonburg accepted 7,900 tons, but transportation was expensive and problematic because of distance and an insufficient number of biosecure dump trailers. Tipping fees for landfilling the carcasses ranged from $45 to $89/ton. With euthanasia, truck loading, and tipping fees, the actual disposal cost was $145/ton. In 2004 a long-term contract was negotiated with two mega landfills to accept carcasses at a cost of $75/ton.

Landfilling

Landfilling was successfully used to dispose of 65 percent of avian influenza infected birds in 2002. Large commercial sanitary landfills may continue to be an effective disposal method with proper biosecurity, supervision, and coordination with industry and state authorities. However, disposal at smaller county or regional landfills poses many logistical difficulties and is not recommended in most cases. Successful landfill disposal requires significant resources and capital: track-hoe or similar heavy equipment, adequate lighting for operating after normal working hours, cleaning and disinfecting crews and equipment, double lining of

transport vehicles to assist in the offloading of carcasses, stabilizing material for working in wet conditions, and an adequate communications system between the affected farm and the landfill. In addition, transport trucks need hydraulic "wet lines" to operate dump trailers. Disposal of a significant number of animal carcasses in a landfill can result in settling, offensive odors, and increased leachate production. Safety concerns need to be adequately addressed during the offloading of transport trailers.

Poultry litter is usually considered an asset and is used as a soil amendment. From an infected farm, however, litter and feed need to be disposed of after the carcasses are removed from the houses. In 2002, over 5,000 tons needed a $10/ton USDA incentive paid to recipients of this material because of the "stigma" of coming from an avian influenza infected farm.

CONTROLLED PROCESSING

Transporting birds with low pathogenic avian influenza to processing plants poses a biosecurity threat difficult to manage. Allowing birds to remain on the farm until processing increases the possibility of virus mutation. The potential impact on export and domestic markets needs to be addressed. Communication, biosecurity, and preplanning are critical for large-scale controlled processing.

Incineration

Although it has been used to manage large animal mortalities, prior to 2002, large-scale incineration of poultry mortality had not been attempted. Over 600,000 birds were incinerated in air curtain incinerators in the summer of 2002. Critical issues for successfully managing large-scale incineration include location and environmental impact, quality and quantity of incinerator feedstocks, scheduling, proper loading of the incinerator, and ash disposal.

On-Site Burial

Two flocks were buried during the first week of the 2002 outbreak. As mentioned earlier, the public is more aware of and concerned about environmental issues than people were in the 1983-84 outbreak. Similarly, solid waste permitting regulations have been updated, making this disposal method more environmentally sound but more costly and difficult to implement on a large scale.

Composting

During the search for alternative disposal methods in 2002, composting in Ag-Bags was attempted on two flocks and evaluated. As with incineration, this method had not been tried previously for large-scale disposal of poultry mortalities. Challenges of Ag-Bag composting include obtaining permits to transport large specialized equipment; moving and disinfecting this equipment; coordinating necessary equipment, supplies and personnel; managing moisture content; and adequately blending the feedstocks. Many poultry farms in the Shenandoah Valley do not have level ground required for Ag-Bag composting and adequate space outside of the houses to place the bags.

Centralized sites were evaluated during the 2002 outbreak, but biosecurity risks and the concerns of neighboring poultry farms prevented these sites from being used. (See "Composting Helps Avian Bird Flu Outbreak," May 2005 for details on effective use of this composting technology in British Columbia.)

In-House Composting

In-house composting was attempted on two flocks in the midst of the 2002 outbreak with limited supervision and success. Lessons learned include the need for properly constructing and managing the windrows, covering the carcasses with adequate carbon material, having adequate carbon material readily available, coordinating euthanasia protocol, conducting further research and demonstration with various bird types and poultry house designs, and training farmers and poultry company personnel.

In-house composting had not been considered a viable option by the poultry industry and farmers because of the 2002 experience, the potential loss of production space and the perception that composting would not work on larger birds. However, successful in-house composting of 5-pound broilers on the Delmarva Peninsula in 2004 proved the effectiveness of composting as a method of disposal and containment for an avian influenza outbreak. Avian influenza was confined to three farms despite the high density of poultry farms in the area.

In-house composting appears to be the most acceptable and practical method of disposal because it limits the risks of groundwater and air pollution, potential for farm-to-farm disease transmission, transportation costs, and tipping fees.

CARCASS DISPOSAL FOR FUTURE OUTBREAKS

In the 19 years between the 1983 and 2002 avian influenza outbreaks, there was a significant shift in accepted environmental practices which made the preferred disposal method used in the 1983 outbreak unacceptable in 2002. Since the 2002 outbreak, the poultry industry has worked to develop a thorough plan for prevention and rapid response to future challenges and meets regularly to ensure that the plan is current. In the fall of 2004, Virginia Cooperative Extension, Virginia Department of Agriculture and Consumer Services, Virginia Department of Environmental Quality, Virginia Poultry Federation, Virginia Poultry Disease Task Force and the poultry industry initiated a research and demonstration project to evaluate the effectiveness of in-house composting of turkeys as a means of disease containment and disposal of catastrophic losses. This research and demonstration project

showed that even large birds, such as 40-pound turkeys, can be effectively composted within three to four weeks. (See accompanying article for details.)
Presently, we are researching and demonstrating in-house composting in poultry houses that are not clear span buildings, such as breeder and double-deck houses, which have previously been considered impractical for in-house composting. The goal of this research is to demonstrate that in-house composting can be used on the majority of U.S. commercial poultry operations.
The avian influenza outbreaks of 1983 and 2002 were particularly challenging and problematic because of the magnitude and urgency of the epidemic and carcass disposal issues. Our experience indicates that off-farm carcass disposal methods introduce additional economic, environmental, and social challenges. On-farm disposal methods such as in-house composting minimize these challenges and offer the poultry industry a biosecure and cost-effective option for disease containment and carcass disposal.

- Eric S. Bendfeldt,
Robert W. Peer and Gary A. Flory