Mortality Composting Resources for Extension and Conservation Educators: Teaching the Benefits and Opportunities to Producers

Thomas M. Bass

Montana State University Extension

Montana State University, Bozeman, MT 59715

Introduction

Many livestock producers, whether range and pasture-based or confinement-based, are concerned with proper mortality disposal and management. Management of animal mortalities on the farm/ranch/feedlot has important implications for nutrient management, herd and flock health, as well as farm/ranch family and public health. The purpose of proper mortality disposal is to prevent the spread of infectious, contagious, and communicable diseases and to protect air, water, and soil quality. To best ensure human health and safety, reduce regulatory risks, and protect environmental resources, livestock producers should become familiar with best management practices (BMPs) for dealing with dead animals. Producers and advisors should also be aware of state or local laws related to proper disposal or processing of mortalities.

For many species, carcass composting (i.e., the biological process of converting organic matter into fine-particle humus-like material) is an environmentally preferable method for managing mortalities. When performed correctly, the end-product may be reused in future mortality composting, and under certain conditions, applied to forage and non-human food crops and forest crops. Poultry composting is a common practice and much information is available that describes how to dispose of birds in this way. Composting is also practical for larger carcasses.

Many operations, even in cold climates, successfully compost larger stock including sheep and goats, sows and pigs, cattle, and horses. Composting large carcasses can save labor and space. This practice allows a dedicated area to be used and reused for carcass management; it is done above ground, thereby reducing the number of labor-intensive burial pits created as well as minimizing the number of buried carcasses on the property. Additionally, composting is recognized as a sound biosecurity protocol for routine and catastrophic mortality events, including many disease scenarios. Research observations at demonstration sites and producer anecdotes also support the belief that composting reduces predator and nuisance animal attraction to livestock operations.

In 2011, extension specialists and educators in Montana, Wyoming, Colorado, and New Mexico developed a suite of resources to be used by outreach professionals to engage producers on the issue of mortality composting. The Western SARE funded project resulted in a graphical full color manual, companion PowerPoint, video overview, and simple enterprise budget tool. The project had two goals; 1) provide outreach professionals with materials to educate themselves, and 2) build capacity for such educators and consultants to coach producers on developing mortality composting practices, if appropriate. This paper and presentation

is intended to promote the use of these resources, and to offer additional practical tips for engaging producers on the benefits and technical details of mortality composting.

Mortality Composting Basics Steps

Greater details are provided in referenced resources. The following represent best case scenarios and the best management practices of a successful composting operation for mortalities. Individual site trial and error is always part of implementation. Likewise, not all details are required for eventual success. Consideration of producer time and enthusiasm should be gauged by the extension educator or technical service provider. Cost-shared practices of federal dollars or pass-through dollars to conservation districts will likely require adherence to USDA-NRCS standards.

Planning

Does it make sense for your operation? Composting is a good alternative for any operation that has appropriate space and equipment for moving mortalities and compost materials. Check with county and state agriculture and environmental offices. Minimum tools will include a tractor with frontend loader and a 36- to 48-inch compost thermometer.

Carbon materials

The base of a successful pile should be course material such as 3- to 6-inch wood chips or coarse crop residue such as chopped corn stalks. Core may be existing compost, spoiled silage, stockpiled manure, or crop and food processing residues. The cap materials should be drier and without odor; chopped straw and sawdust work well. If a region or operation is carbon waste limited, chopped straw will suffice. Finally, sawdust can also be used for all carbon layers, though it is not optimum.

Site selection

Size requirements can be described different ways, and will vary with different carbon materials, and whether or not a bin is used. Size may be about 200 cubic feet per 1000 lbs. of livestock mortality, or 10 x 10 x 6 feet for a single large animal pile, or 6 x 6 x 6 feet for a bin. Windrows are best for airflow and ease of management, but bins made from wood or large hay bales allow tighter piling and a smaller footprint. Choose an area with enough space to build and turn compost, deliver and move mortalities, and base, core, and cover materials.

The pile or windrow should be away and downwind from neighboring properties, and where scavenger activity can be monitored and discouraged. Also, choose clay soils at least 3 feet above ground water and 200 to 300 feet from streams, ponds, wells, other water resources. An ideal site would have a gentle slope for drainage. In some areas, an underlayment of compacted sand or gravel, or sometimes clay or concrete may be advisable. Construct berms to divert run-on if necessary, and divert potential leachate to a grassed buffer. Compost piles in the semiarid west generally do not need to be covered, but should be monitored for runoff or seepage during unusually wet periods events. In more humid environments, roofs could be recommended; however, with the significant amount of carbon material recommended much absorption can take place before leaching will occur.

Building the pile

Lay a base of 12 to 24 inches of wood chips or shreds that allow air flow and are not compactable or excessively wet. Spread to allow 18- to 24-inch margin. Breaking up large mortalities will speed the process, though it is not required. The body cavity should be opened and the rumen punctured for cattle, sheep, and goats to prevent excessive bloating and displacement of cover material.

Place large mortalities on one side in the center of the base material. Smaller mortalities can be stacked with 8 to 12 inches of core material between layers. The core ideally should be 12 to 18 inches of fine, actively

composting material with 50 to 60% moisture content, such as manure, silage, or recycled compost is ideal (squeeze test: at 50 to 60% moisture a few drops can be squeezed from a handful of material). Adding water is often necessary to start at this moisture level.

The cap should be 6 to 12 inches of fine, moist, low-odor material such as sawdust with 50 to 60 moisture content to achieve 18- to 24-inch final margin around mortalities. Form flat or troughed top to collect moisture in dry regions. Peak the top to shed moisture in wetter areas.

Composting stage (3 to 6 months)

Monitor temperature, especially as you are learning. For the thermophilic phase, interior temperature should rise to 130 to 160°F (54 to 71°C) within 2 weeks; if it doesn't, check moisture, start over. Watch for odors, flies, and exposed mortalities from scavenger activity or movement by wind or water and cover with more material as needed. Turn the pile when temperature declines to <80°F (27°C) for 7 days. Check the moisture content right after turning and add water if necessary. If the temperature spikes again after turning, turn again when it declines.

Curing stage (4 to 8 months)

This is a mesophilic phase; warm, not hot temperatures. Bones break down during this stage in a slower decomposition process. The process is complete when the temperature stabilizes near ambient air temperatures. If initial temperature in this phase drops, the pile may need to be turned or mixed and moisture adjusted again. A small temperature increase after mixing indicates that the mesophilic curing process is underway. It may then be left alone.

Storage and possible land application

Screen to remove remaining bones to reincorporate in the composting process. Store until land application or for reuse in the core of a new compost stage. Apply on the premises, or on fields where owner/manager is aware of the source of the material. Bone fragments can cause alarm if unexpected. Have the material tested for nutrient content and apply to non-food crop fields according to soil test based recommendations.

Helpful Tips and Special Considerations

Ranchers and grazing operations

Many benefits can be realized by pasture-and range-based producers with mortality composting. Though historical practice may have been to allow nature to take its course on the soil surface in the "back-forty" and it was certainly low labor, composting offers a compromise in labor with added biosecurity, reduction in predator attraction, and reduction in other pests that could be detrimental to animal health. Pastured animals that are discovered dead can be hauled to a central composting location, or composted in place. Composting in place requires that some carbon source be brought to the location of the dead animal. Though the pile may not be constructed to the highest standard of recommended practice, simply covering the carcass in 18 to 24 inches of carbon material can still result in satisfactory composting.

Insects and rodents, that can be vectors for disease, will have much less attraction to the carcass, when compared to abandonment. The compost pile will provide fewer breeding sites, or poorer habitat for flies, and as discussed below will also mitigate predator attraction (commonly domestic and feral dogs, and coyotes). On smaller acreages or on range and pasture visible from the road, composting in place is preferable from a neighbor relations and public perception standpoint. Finally, composting can reduce and destroy many pathogens, some of which could pose risk to healthy stock that would encounter an otherwise exposed carcass. As always, cause of death should be considered, and a veterinary consult may be recommended.

Scavenger pressure

Proper coverage and capping of mortality compost piles is vital to discouraging scavengers. Also, fencing around mortality compost may be advisable for the same reason. At two sites in rural Montana with known dog and coyote populations, little to no scavenger activity has been noted. In some areas, the practice of composting, in general, should be carefully considered and protected in order prevent attraction of dangerous scavengers such as grizzly bears or wolves (primarily Wyoming, Idaho, and Montana, and Western Canada).

Goats and sheep

Though composting of medium to large carcasses and land applying the material is proving to be feasible, careful consideration must be given for goats and sheep due to the prevalence of scrapie, a prion disease, in flocks across the U.S. This disease is a transmissible spongiform encephalopathy (TSE) similar to BSE (i.e., mad cow disease) and the human Creutzfeldt-Jakob disease. If compost from diseased animals were used as fertilizer, it would create a serious biosecurity threat. Fate of compost from sheep and goats should be carefully considered. Be sure to seek expert advice prior to disposal of these species. If a producer has a certified scrapie-free flock, then they could proceed with composting in relative safety.

Technical procedures on composting cattle carcasses are available and continue to be studied and refined; this appears to be a viable option which will is described further in the manual. Most composting requires storm water protection, and possibly roof-type covering. Additional management and monitoring is required to refine the process, maintain temperatures, attain proper decomposition, and prevent scavengers. Nutrients and organic matter in finished carcass compost can benefit forest and crop land; however, nutrient management guidelines should be followed. This publication focuses on aerobic composting in piles or windrows on the soil surface. Other methods do exist and are also continue to be studied.

Prion diseases and composting

The science on this issue is still inconclusive; composting suspect animals should be avoided. Prion diseases, such as scrapie (sheep), chronic wasting disease (CDW; deer and elk) and bovine spongiform encephalopathy (BSE; cattle), are diseases that cause a degeneration of the central nervous system. Prion diseases appear to be extremely durable in the environment, likely because of their ability to bind with soil minerals. In one experiment, scrapie remained infectious after burial in garden soil for 3 years and anecdotal evidence suggests that the disease persisted for 16 years in an abandoned sheep barn.

One recent study suggests that composting may have the potential to degrade the part of the protein responsible for causing infection, called PrP^{Sc}. In this study, the PrP^{Sc} in samples of scrapie-infected sheep tissues (i.e., central-nervous-system, lymphoid system, and various organs) experimentally composted in a static-pile, passive-aeration system were demonstrated to have degraded after 108 days; however, this study did not specifically measure infectiousness of composted tissues.

Another study, which simulated a natural scenario in which an infected animal dies and remains at ordinary physiological and ambient temperatures, indicated that the N-terminus of brain-derived PrP^{Sc}, a section of the protein vulnerable to cleavage, was lost after 7 to 35 days[3]. While this study demonstrated that PrP^{Sc} can be degraded in certain environmental conditions, it did not determine the infectivity of the resulting, damaged protein.

Based on this recent work, it appears that composting conditions that include high heat and bacteria may degrade PrP^{Sc}, but that these conditions are not typical of natural environments. The risk of disease transmission appears to be most heavily influenced by the degree of bypass, which is the compost that does not reach critical temperature because of its location in the pile. A United Kingdom investigation of BSE concluded that composting and compost spread on pasture were safe when a 2-tier (primary and secondary) composting system was used together with a 2-month grazing ban for the treated pasture.

Because prion diseases are transmissible between mammalian species, are incurable, and are highly infectious, extreme caution should still be used when disposing of infected carcasses. Incineration and burial in landfills, practices often used to dispose of infected carcasses, may create air and water contamination risks and may be publically unpalatable. Certification of flocks for scrapie-free status can be done and may open up composting as safe mortality management tool.

Winter tip

Surrounding the carcasses in warm or active compost will give them a quicker start, especially for winter or early spring mortalities. In Montana, producers have been successful with attaining necessary temperatures by placing non-frozen carcasses in the pile and building the core with silage, warm compost or manure solids. The pile should always be capped with a "clean" material such as sawdust or chopped straw. Likewise, getting carcasses started in compost before they freeze in the field helps the pile attain and maintain desirable temperatures.

Rotary drum composting

Several manufacturers in the U.S. and Canada are now manufacturing rotary drum, or in-vessel composters suitable for mortality management. These are mechanically driven horizontal drums that are loaded with carbon material and mortalities. Sizes vary from 200 gallons (suitable for poultry) on up to units the size of a standard semi-tanker trailer. The insulated drums slowly, and continuously, turn. For small and medium carcasses, time to finished compost can be as short as 3 to 7 days. This technology requires the purchase of a unit, or hired services of a contractor with a trailer-mounted mobile drum system.

Regulations

State, local, county, or city regulations need to be researched before composting because they can place additional constraints on a composting operation. Likewise, consult the regulatory agency directly, or an extension specialist knowledgeable on the subject.

Accessing the Educational Materials

Colorado State University – Institute for Livestock and the Environment

http://www.ext.colostate.edu/pubs/ag/animal-compost.html.

- Manual in English and Spanish
- Video in English and Spanish
- Companion PowerPoint (open source, please provide credit)
- Excel enterprise Budget Tool

MSU Extension Publications - http://msuextension.org/publications/AgandNaturalResources/EB0205.pdf

Source Material

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Editors: Sara Lupis, Colorado State University; and Thomas Bass, Montana State University.

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Additional Resources

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