COMPOSTING LARGE ANIMAL CARCASSES

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INTRODUCTION

The Maine Department of Agriculture became aware of the outbreak of Foot and Mouth Disease (FMD) in Great Britain during the winter of 2001. The two Maine State Veterinarians and the Federal Veterinarian in Maine all spent time in England assisting with managing the crisis. Upon their returns to Maine, they reported on the devastation caused by the disease and the problems that resulted from trying to dispose of the thousands of carcasses. Their experience heightened the concerns already felt by the Department and by the Maine livestock industry about what would be done here if an outbreak occurred. A task force was established by the Commissioner of Agriculture to develop a plan of action to deal with such an emergency. One of the efforts of the task force was to evaluate the disposal options available and to develop a plan for implementing those best suited to the conditions in Maine.

The methods of disposal that were considered were:

- burial
- burning
- rendering
- composting

When these options were evaluated, each was found to have a weakness, or concern.

Burial was a possibility in some circumstances, but in many situations, it would not be possible to bury a large number of carcasses using the guidelines offered by the USDA. Maine's soils are shallow and except for sand and gravel deposits, have very shallow water tables. Burial in these conditions would pose a serious threat to Maine's ground and surface waters. In addition, the burial of a large number of animals would require the disruption of many acres of farmland making them unusable for years.

Burning was found to be unacceptable due to the difficulty of setting up large burn operations and finding enough fuel to burn the carcasses. It was also noted that the FMD virus could be carried by the particles of soot from large open fires. In addition, there were significant concerns about the resulting release of pollutants to the air from all the open burning. The large trash incinerators were considered, but it was learned that they are not equipped to handle large, dense items like carcasses. There was also concern

about the threat of spreading the disease by hauling the carcasses from many locations to one central location for burning.

Rendering was not considered to be a viable solution for two reasons. First, transportation of the infected carcasses would be discouraged due to the threat of further spreading the disease. An on farm solution would be preferred so that it could be quarantined and so limit the avenues for spreading the disease. Second was that the only large renderer serving Maine (Baker Commodities in Billerica, Ma.) did not have the capacity to handle whole carcasses and could only handle a limited number of carcasses even if they were quartered. This practice (cutting the carcasses into pieces) was highly discouraged by the State and Federal Veterinarians because of the release of the FMD virus in any body fluids that may escape.

Traditional composting techniques using sawdust and/or shavings as a compost substrate were attractive due to the ability to implement them without having to remove the carcasses from the farm and without having to dig deep into the soils. Questions were raised, however, about whether this approach would be able to contain the disease and about the length of time needed to decompose the carcasses. Reports of earlier work suggested that it took up to a year to decompose a large animal carcass. This method would be considered if the process could be modified to ensure that the disease could be contained and to shorten the breakdown time.

As a result of these findings, the Maine State Soil Scientist, David Rocque, who was assigned to evaluate burial options for FMD carcass disposal, suggested that the compost process should be tried using a hot, active compost instead of sawdust or shavings as the compost media. The reasoning behind this suggestion was that a hot compost would already have an active microbial population that was breaking down organic material. The heat and active microbes would create an environment that should be very hostile to pathogenic organisms such as the FMD virus.

The task force felt that this idea had merit and requested the assistance of the Maine Compost Team* (Compost Team) in evaluating this approach. The Compost Team was already planning to conduct animal carcass compost trials using farm based compost and so gladly accepted the charge. They determined that the most readily available source of active compost would be the large compost facililties that composted municipal waste water treatment sludges (biosolids). Although farm based compost would be practical for the disposal of the routine mortality on a farm, it would probably not be available in large enough quantities to handle a large disease outbreak. In contacting the largest municipal sludge composters in the state, the Compost Team learned that between 25,000 and 80,000 cubic yards of compost could be accessed quickly from just two facilities and that a trucking network was already moving this material on a daily basis. This allayed concerns that it might be difficult to obtain enough compost in the event of a disease outbreak.

* Note: The Maine Compost Team includes: Mark King, Maine Department of Environmental Protection; Bill Seekins, Maine Department of Agriculture and Neal Hallee, University of Maine Cooperative Extension.

Literature on FMD virus survival was searched for information on survival in compost. No information was found for virus survival in compost piles. There was information on studies performed on the survival of FMD virus in manure piles and fermenting manure. The data suggested that the FMD virus did not survive beyond about 8 days in either setting if the manure was at or above 32°C (90°F). It also indicated that survival time was shortened significantly with every 2°C rise in temperature above this level. It was hypothesized that survival in a compost environment would be similar if it could be shown that the internal temperature in the carcass could be raised to this level and maintained for at least eight days.

DESCRIPTION OF PROJECT

The Compost Team set up a demonstration/research project at Highmoor Farm, a research farm owned by the University of Maine. The farm provided a site for conducting the trials and supplied the equipment and operator. Two separate sets of trials were conducted. The first was done in the Summer of 2001, trying different approaches for composting. A second trial was conducted in the Winter of 2001-2002. This second trial focused on using the most successful of the approaches tried in the Summer Trials. The results of the Winter Trial were not available at the time of this report.

Summer Trials

Four different approaches were tried during the Summer Trials. The initial trials began on June 5, 2001. Two holstein dairy cows and two calves were used in two trials. These trials were set up to determine if there was any difference between just covering the carcass with active compost and completely surrounding it with compost. The trials were set up as follows:

Trial 1 - a trench was dug eight feet wide, ten feet long and about one foot deep. The carcasses of one cow and one calf were placed on the soil in the bottom of the trench and covered with two feet of the active municipal sludge compost. Prior to covering, each carcass was vented by cutting a small slit in the abdomen. A length (3'8") of 1/2 inch PVC pipe was inserted into the abdomen of the cow to be used as an access port into the carcass to allow the internal temperatures in the carcass ton be taken. A bolt was inserted, two days later, into the end of the pipe to act as a plug.

Trial 2 - a trench was dug eight feet wide, ten feet long and about eighteen inches deep. The carcasses of one cow and one calf were placed on a bed of compost one foot thick in the bottom of the trench and covered with two feet of the active municipal sludge compost. Prior to covering, each carcass was vented by cutting a small slit in the abdomen. A length (3'8") of 1/2 inch PVC pipe was inserted into the abdomen of the cow to be used as an access port into the carcass to allow the internal temperatures in the

carcass to be taken. A bolt was inserted, two days later, into the end of the pipe to act as a plug.

A third trial was set up on June 11, 2001. This trial was intended to show the use of farm based compost as an approach to managing routine mortality on the farm and so was set up using materials and methods that would be likely to be used on a working farm. The trial set up was as follows:

Trial 3 – Prior to starting this trial, a compost mixture was made using manure from a heifer barn, spoiled silage and wood shavings. Due to the texture of these materials and the difficulty of achieving a thorough mix using a front loader, this batch of compost did not heat up as well as the more uniform sludge compost material. This mixture was allowed to heat for 5 days before being used in the trial. A one foot thick bed (about 8'x8') of this pre-made compost mixture was then placed on the turf. The carcass of a holstein dairy cow was placed on this bed and covered with two feet of the farm based compost. Prior to covering, the carcass was vented by cutting a small slit in the abdomen. A length (3'8") of 1/2 inch PVC pipe was inserted into the abdomen of the cow to be used as an access port into the carcass to allow the internal temperatures in the carcass to be taken. A bolt was immediately inserted into the end of the pipe to act as a plug.

A fourth trial was set up after the original trials had been under way for 6 or 7 weeks. This trial was set up because of the promise shown by the approach in trial 3. The Team wanted to determine if equally good results could be obtained using the same methodology but with the municipal sludge compost instead of farm based compost. The trial set up was as follows:

Trial 4 - a one foot thick bed (about8'x8') of the active sludge compost was placed on the turf. The carcass of a holstein dairy cow was placed on this bed and covered with two feet of the active sludge compost. . Prior to covering, the carcass was vented by cutting a small slit in the abdomen. A length (3'8") of 1/2 inch PVC pipe was inserted into the abdomen of the cow to be used as an access port into the carcass to allow the internal temperatures in the carcass to be taken. A bolt was immediately inserted into the end of the pipe to act as a plug.

MONITORING AND DATA COLLECTION

The monitoring consisted of daily visits to the site by a Compost Team member, who took and recorded temperature readings and made observations about odors, vector activity, moisture conditions and general pile appearance.

Temperature Monitoring

Temperatures were taken and recorded at three locations for each cow carcass each day. A three foot long thermometer was used to take temperatures in the compost materials at depths of one foot and three feet from the surface. A four foot long

thermometer was used to take the internal carcass temperatures using the PVC pipes as sampling ports.

Temperature data was entered into an Excel spreadsheet and used to create graphs. These graphs were used to compare the temperature response within the carcasses to the surrounding compost materials (see Figure 1.) and to compare the internal carcass temperatures between the different trials (see Figure 2).

EXHUMATION

On September 6, the Compost Team dug into each of the trial piles to examine the condition of the carcasses. The amount and condition of the soft tissue was determined and the bones were examined for indications of decomposition.

RESULTS

Moisture and Leachate

Through out the project, the piles were watched for signs of leachate escaping from the piles. No moisture was observed leaving the piles at any time. When the piles were dug up in September, the compost materials were very dry except in the areas immediately surrounding the location of the carcasses. The area below the carcass location in the piles was moist to a depth of about 8 or 9 inches, while the zones just above and to the sides of the carcass were moist for about 4 to 5 inches indicating that the moisture from the decomposing carcass had wicked up and out from the carcass in addition to moving down.

It should be noted that the summer of 2001 was unusually dry for Maine and this raised the question about the potential for leachate during a wetter time period. A winter trial was initiated, in part, to answer this question. Although the winter trials were still under way at the time of this report, initial results indicate that even after considerable rain and snowfall events, the material was still dry below the top 7 inches of compost and no leachate was observed.

Odors

Odors at the compost site were minimal throughout the project. The odor that was detectable on site most of the time, was the relatively mild odor associated with the compost materials themselves, not the carcasses. At no time was there any of the odor associated with rotting carcasses. The only source of odor of this type in the trials were the sampling pipes that had been inserted into the abdomens to allow temperatures to be taken. These were plugged to prevent the odor from escaping. When the plugs were removed, strong odors were detected in the immediate vicinity of the pipes. The odors that were emmited from the pipe in Trial 1 (cow on the soil in a trench) were noticably stonger and persisted longer in the project than those from any of the other trials. In addition, only pile 1 had any significant odor when the carcasses were exhumed. The other three piles had surprisingly little odor when opened up.

Vectors

Vector activity at the site was minimal. In the first two days of the project, before the sampling pipes were plugged, animal tracks were observed around the first two piles and there was some digging but the carcasses were not exposed. At about 8 or 9 weeks into the project, digging was observed at one point in pile 3 (farm based compost). An animal had dug in to expose the spine of the carcass and had tried to feed but had abandoned the attempt. It was speculated that the high temperatures in the pile discouraged the animal from continuing. None of the sludge compost piles were dug into at that time nor were any of the piles bothered again during the rest of the project.

Volume Reduction

General observation of the piles showed that within two to three weeks, the piles had sunk down a foot or more in the center of the area above the carcasses. This shrinkage continued at a slower pace into the project. The piles were all approximately two feet lower at the end of the project than at the start.

Temperatures

The temperature response within the carcasses was an important indicator, both of the suitability of each method for achieving the pathogen reduction and of the relative performance of each of the trials. The temperature graphs were also useful for comparing the temperature response within the carcasses to the temperatures in the surrounding compost. (Note that the sludge based compost used in Trials 1, 2 and 4 were all from the same sludge compost stock pile on site that had the same composition and same initial temperature. Any differences in compost temperatures, then, should be attributable to the approach used in the trial.)

Looking at Figure 1, it can be seen that the internal carcass temperatures lagged behind those of the compost initially, but eventually caught up to and on some occasions surpassed the temperature in the compost material. It is likely that once the carcass had achieved a certain level of decomposition and the moisture from the decomposition had wicked into the compost sufficiently, that the composting conditions in the former locations of the carcasses were better than the surrounding compost, which had become too dry. This allowed the temperatures in the compost in and immediately around the former location of the carcass to heat up more.

Figure 2 shows a comparison between the internal carcass temperatures for all four trials. Note that Trial 4 (carcass on a sludge compost bed laid on the turf) had the most rapid and highest temperature response of any of the trials. It quickly reached temperatures of over 140°F(65°C) and sustained temperatures over 130°F (55°C) for several weeks. Trials 2 (carcass laid on a bed of sludge compost in a trench) and 3 (carcass laid on a bed of farm based compost on the turf) had similar temperature responses, with both exceeding 120°F (52°C) for several weeks. Trial 1 (carcass laid directly on the soil in a trench) had the lowest temperature response of all the trials. The temperatures rose slower, but eventually exceeded 110°F (47°C) and maintained that temperature for several weeks. All four trials exceeded 90°F (32°C) for at least 8 days.

Figure 2 also shows that the internal carcass temperature had exceeded 110°F (47°C) in Pile 2 and Pile 4 by day 2 and in Pile 3 by day 8. The internal carcass temperature did not reach 110°F (47°C) until day 31 in Pile 1 (the carcass laid directly on the soil in a trench). The additional compost under the carcasses in Trials 2, 3 and 4, increased the heat exchanged to the carcass and prevented contact with the soil which apparently absorbed some of the heat in Trial 1, keeping the carcass cooler throughout the process.

Decomposition

On September 6, Piles 1 and 2 had been in place for 13 weeks; Pile 3 had been in place 12 weeks and Pile 4 had been in place 6 weeks. At that point in time, Pile 3 had achieved the greatest degree of decomposition. Most of the soft tissue was gone and the larger bones showed signs of advanced decay. The large bones were pitted on the surface and were easily broken or sliced with a knife. Piles 1 and 2 still had a small amount of relatively dry soft tissue associated with some of the large bones and the bones themselves were still solid and not pitted. Pile 1 also had a layer of gooey odorous material at the bottom of the pile next to the soil. Pile 4 had a similar level of decomposition to Pile 2, even though it had been in place for only 6 weeks. (Note: Pile 3, the farm based compost, was moister than the other piles and so had better conditions for composting, even though it did not have the uniform mix and higher temperature of the sludge compost.)

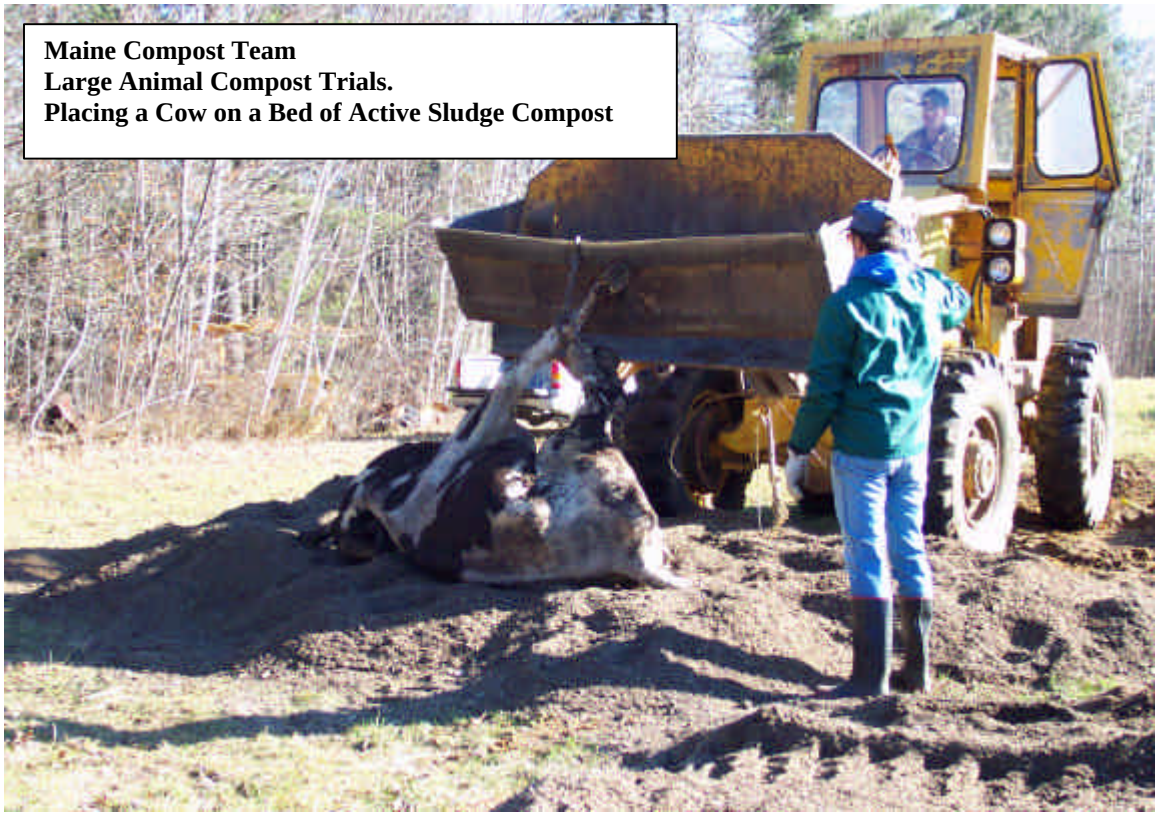
EVALUATION

All of the trials were successful at achieving the goal of 32°c for 8 days. Given this, any of the methods tried should be suitable for containing and reducing the survival time of the FMD virus. The trials using the bed of compost (either type) placed on the turf rather than in a trench worked better than the trials in trenches from both the point of view of temperatures achieved and rate of decomposition. In addition, odors associated with the above ground piles was less than those in the trenches. This was probably due to the greater amount of air that could infiltrate the piles.

The farm based compost laid out as a bed on the soil surface and a cover of farm based compost over the carcass would be the preferred approach for managing normal mortality. The preferred approach for managing a large number of carcasses from a disease outbreak, however, would be the use of sludge based compost as in Trial 4, where the compost is laid out as a bed on the ground surface and is used as a cover over the carcass.

BIBLIOGRAPHY

Parker, J. 1971. The Veterinary Record. Presence and Inactivation or Foot and Mouth Disease Virus in Animal Feces. June. 659-662.



Maine Compost Team
Large Animal Compost Trials.
Placing a Cow on a Bed of Active Sludge Compost

Maine Compost Team
Large Animal Compost Trials.
Covering a Carcass with Active Sludge Compost.
(Note Tube in Abdomen used for Taking Temperatures.)

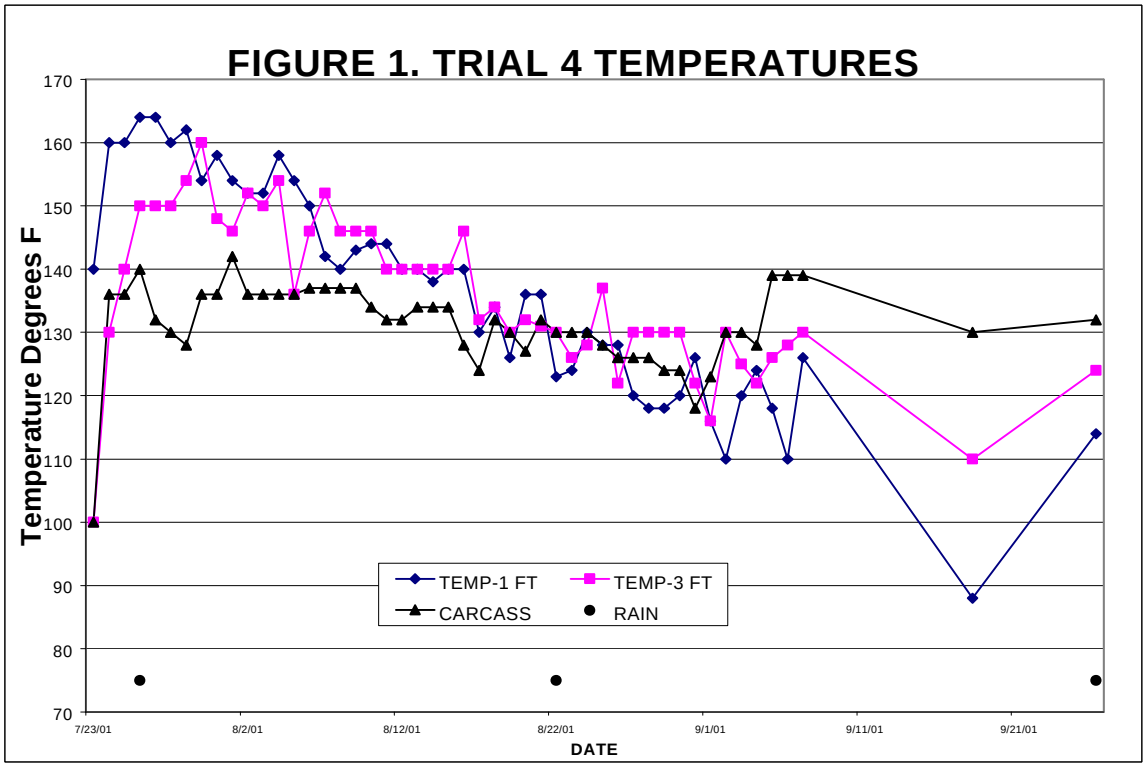


FIGURE 1. TRIAL 4 TEMPERATURES
Temperature Degrees F
170
160
150
140
130
120
110
100
90
80
70
7/23/01
8/2/01
8/12/01
8/22/01
9/1/01
9/11/01
9/21/01
DATE
TEMP-1 FT
TEMP-3 FT
CARCASS
RAIN

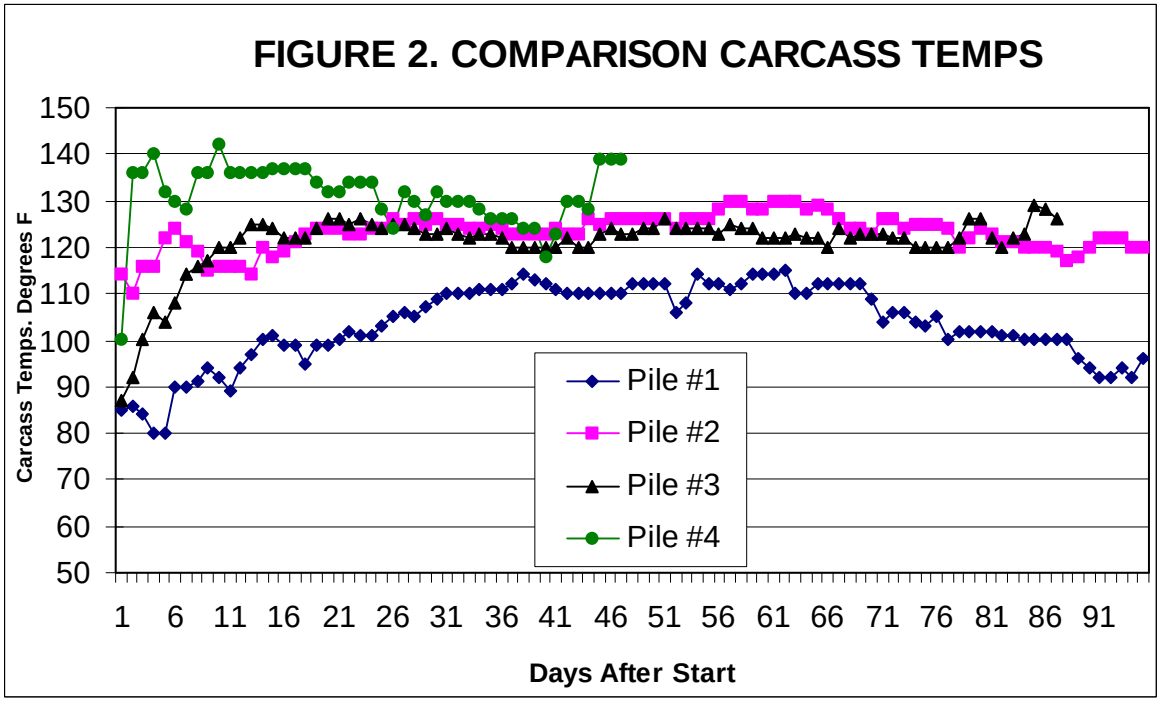


FIGURE 2. COMPARISON CARCASS TEMPS
Carcass Temps. Degrees F
150
140
130
120
110
100
90
80
70
60
50
1
6
11
16
21
26
31
36
41
46
51
56
61
66
71
76
81
86
91
Days After Start
Pile #1
Pile #2
Pile #3
Pile #4