MAINE TRIALS
COMPOSTING ANIMAL CARCASSES – 2001 – 2004

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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.

As a result of these findings, the Maine State Soil Scientist, David Rocque 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).

* Note: The Maine Compost Team includes: Mark King, Maine Department of Environmental Protection; Bill Seekins, Maine Department of Agriculture and Mark Hutchinson, University of Maine Cooperative Extension. Neal Hallee, formerly of the University of Maine Cooperative Extension was also a member of the team at the time the trials began.

Literature on FMD virus survival suggested that the FMD virus did not survive beyond about 8 days in either liquid or solid manure 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 PROJECTS

The Compost Team set up a demonstration/research project at Highmoor Farm, a research farm owned by the University of Maine. Several sets of trials were conducted at Highmoor and at other farm locations in the state. 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.

Summer Trials 2001

Four different approaches were tried during the Summer Trials. The initial trials began on June 5, 2001. Four dairy cows and two calves were used in the initial 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 and if placing the piles in a trench offered any benefits. The trials were set up as follows:

Two were done in trenches, one with compost under and over the carcass and the second on the soil with compost as a cover. Two others were done above ground. One using farm compost materials above and below the carcass, while the other used the municipal sludge compost above and below the carcass.

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.

On September 6, 2001, 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.

General Results of 2001 Trials

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. 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. Vector activity at the site was minimal. None of the sludge compost piles were dug into at any time during the project.

Temperatures in 2001 Trials

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.

Figure1 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.

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. Pile 1, which was the carcass laid directly on the soil, 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 of 2001 Trials

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.

Other Trials – 2001 – 2003

Following the summer trials at Highmoor Farm, the Maine Compost Team conducted a winter trial using the approach that proved to be the most successful during the summer trials. One cow carcass was composted on a bed of hot municipal sludge compost with a hot compost cover. The trial ran from December 2001 to February 2002. After exactly 10 weeks the carcass was exhumed. Almost 100% of the soft tissue was eliminated and significant deterioration of the bones was observed.

Three additional trials were conducted on other farms in Maine between 2002 and 2003. The first of these occurred on a game bird farm that had an outbreak of avian influenza. Hot sludge compost was used to break down the birds and to create an environment that would kill the AI virus. A trial was conducted on a working dairy farm as a demonstration for Farm Days. This trial showed that it was possible by using dry calf bedding to achieve temperatures over 130° F for several weeks. A third trial was conducted the following winter at a small diversified farm. In this trial, the pile was started with a frozen carcass in February. It demonstrated that even under these adverse conditions, the soft tissues could be eliminated in as little as 13 weeks.

Media Comparison Trials – 2004 - 2005

The most recent trials in Maine were again at Highmoor Farm. This was a much more ambitious project that used 8 different compost media and two types of animal carcasses. This set of trials was established to serve as a basis for developing best management practices (BMPs) for Maine farmers to use in composting mortalities on their farms. Observations were made about the environmental and nuisance impacts associated with each media material as well as the performance in terms of temperatures and rate of decomposition.

The original design called for 22 individual trials. Seven different media were to be used for composting cow carcasses and four were to be used for horse carcasses. Each combination of media and carcass type was to be done twice. As the trials progressed, the design changed slightly in response to early findings and the availability of additional media materials. These changes resulted in dropping three of the original piles and adding four others. The table below indicates the combinations of media and types of carcass used.

Table 1. Combinations of Compost Media and Carcass Type Used in 2004 Trials

Media	Cow	Horse	Foal	Comment
Horse bedding	X (2)	X(2)		
Heifer manure/ bedding	X(1)			Only 1 trial due to lack of material
Sawdust/ shavings	X(2)	X(2)		
Woodchips	X(2)			Second trial included horse bedding around carcass
Municipal sludge compost	X(2)	X(4)		1st cow used fresh compost, 2nd used older compost
Leaf/ manure mix	X(2)			1st cow used fresh compost, 2nd used older compost
Silage/ bedding mix	X(2)			1st cow had 2/3 wet grass silage & 1/3 horse bedding; 2nd had 1/3 corn silage & 2/3 heifer bedding
Nviro Soil			X(2)	one used a woodchip base
Nviro Soil/ Sludge Compost mix	X(1)			

Each trial was set up using the same methodology that proved most successful in the earlier trials. Each carcass was laid on an 18" bed of material and covered with 2 ft of material. (See photos #1 through 4.) All carcasses were vented prior to covering and had a 4 ft thermometer inserted into the abdomen to track internal temperatures. Thermometers were also placed in the compost media to read temperatures at the one foot and three foot depths. Temperatures were taken approximately 5 days per week throughout the summer, fall and early winter. Observations were also made of odors, animal activity, insect activity, leachate, pile structure changes and management activities. (A separate report details the findings associated with these observations.)

Temperature Observations 2004 Trials

Temperature observations were made regarding peak temperatures achieved on all three thermometers in each pile, overall temperature profiles and number of days the internal carcass temperatures exceeded 130 °F. Compost media temperatures were also tracked for 1 and 3 ft depths in the piles.

Internal temperatures over 130° F.

The most critical observation was felt to be the internal temperatures achieved in the carcasses themselves. Only seven of the 24 trials failed to achieve at least 130° F inside the carcass. For four of the seven, insufficient porosity in the media, either due to moisture or fine texture, was

most likely responsible for not achieving 130° F. The other 3 all lacked energy due to a high C:N ratio or the compost mixture being too old. All of the trials that had sufficient porosity and relatively fresh materials, heated up sufficiently to achieve pathogen reduction, even in the core of the carcass. See Figure 2 for a break down of peak temperatures by media type. Seven of the trials actually achieved peak internal temperatures of over 140°F.

The duration of the high internal temperatures was also noted. Twelve of the trials maintained temperatures over 130° F for 10 days or more and eight sustained those temperatures for more than 20 days. These eight 'top performers' were:

Cow in fresh municipal sludge compost – 42 days
Cow in fresh leaf/chicken manure compost – 25 days
Cow in horse bedding – 34 days
Horse in fresh municipal sludge compost – 20 days
Cow in horse bedding – 40 days
Horse in fresh municipal sludge compost – 25 days
Foal in Nviro soil w/ woodchip base – 32 days
Cow in 1/3 silage, 2/3 horse bedding mix – 53 days

Figure 3. displays the results for all the trials.

Evaluation of 2004 Trials

In general , it appeared that the conditions achieved in the compost media made a bigger difference than the actual media itself. Some examples:

Municipal sludge compost performed very well in terms of both peak temperatures and duration of temperatures when it was relatively fresh, ie had only been composting/curing for about 3 to 4 weeks. Older municipal sludge compost (over four months old) from the same facility did not have as much energy and so did not result in internal temperatures as high or for as long.

A spoiled silage/ bedding mix proved to be the best overall performer in all the trials while another spoiled silage/ bedding mix turned out to be one of the most disappointing performers. The one with the poor performance was mostly grass silage which was very wet and dense with very poor structure. Consequently, the air space collapsed out of the pile within a day or two, causing the pile to cool down and resulting in a number of other nuisance problems.

Two 400 lb. foals were buried in two piles of Nviro soil. (Nviro soil is a soil amendment made from municipal sludge, wood ash and lime.) One of these was the worst performer in terms of peak temperature achieved, only reaching about 102° F. The other was among the top eight performers, achieving temperatures of over 140° F and maintaining temperatures over 130° F for over a month. The difference was that the second carcass had a bed of woodchips underneath for better aeration.

One leaf/ chicken manure compost mix was among the poorest performers while another was among the top eight. The difference was that the first was a relatively new mix with a low C:N

ratio that still had a lot of energy, while the second was several months old with a higher C:N ratio and no longer able to sustain the higher temperatures.

Conclusion

Animal carcasses can be successfully composted in a variety of media. The ability to achieve temperatures proven to kill most pathogens will depend more on the conditions in the media than on the source of the media. Those conditions that appear to be most conducive to rapid and sustained heating are:

Porosity – Piles with very fine textures or very wet materials fail to heat due to lack of oxygen. Piles with a very high porosity, such as wood chips, heat rapidly but are unable to sustain the high temperatures a long as materials with a little less air space. Textures with particles between ¼ inch and ½ inch appear to give the optimum results.

C:N ratio – As with all composting, piles with C:N ratios too high (over 40:1) tend to heat slower, in general than those with a lower C:N. One exception to this is the woodchip piles in which there is very little available carbon due to the coarse texture.

Age – Piles with materials that have been mixed and composting for several months do not have the amount of energy or activity needed to sustain the temperatures within the carcasses when compared to relatively fresh active compost piles.

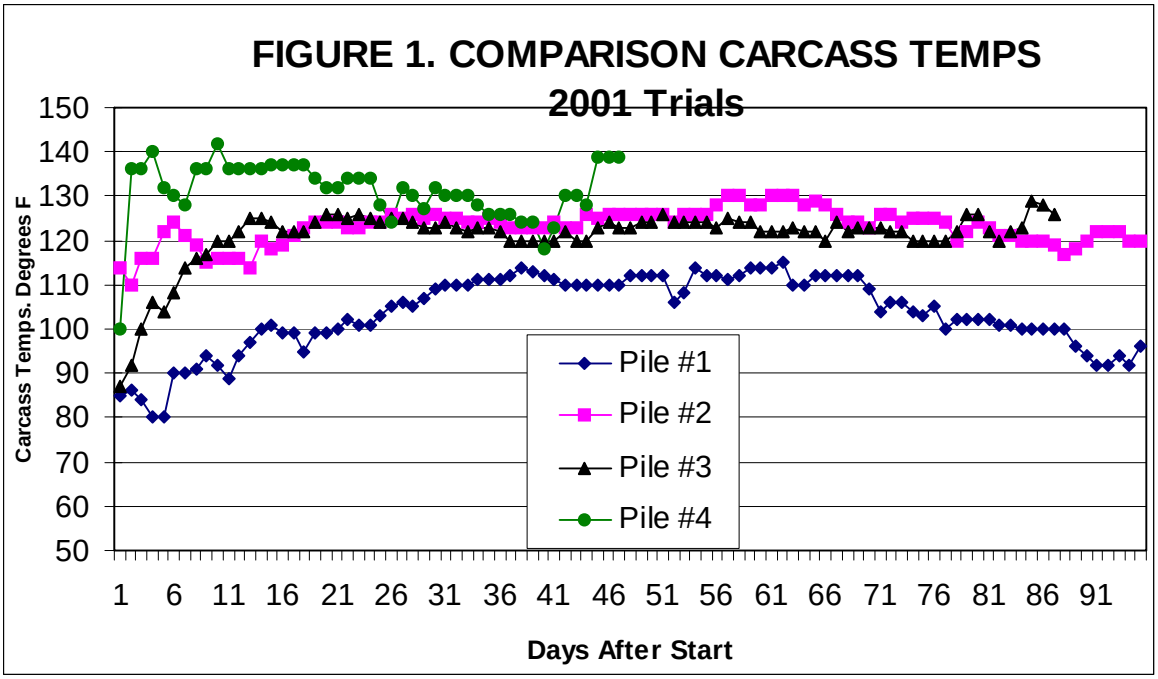
BIBLIOGRAPHY

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

Photos: 2001 Carcass Compost Trials – Highmoor Farm

Photo #1. Placing Cow Carcass on Bed of Hot Municipal sludge Compost

Photo#2 Covering Cow Carcass in a Trench with Hot Municipal sludge Compost



Pile #1- Carcass placed in trench on soil
Pile #2- Carcass placed in trench on bed of hot compost
Pile #3 -Carcass placed on bed of farm compost (no trench)
Pile #4 -Carcass placed on bed of hot compost (no trench)

Figure 2. PEAK TEMPERATURES FOR COW & HORSE CARCASSES IN DIFFERENT MEDIA 2004 Trials

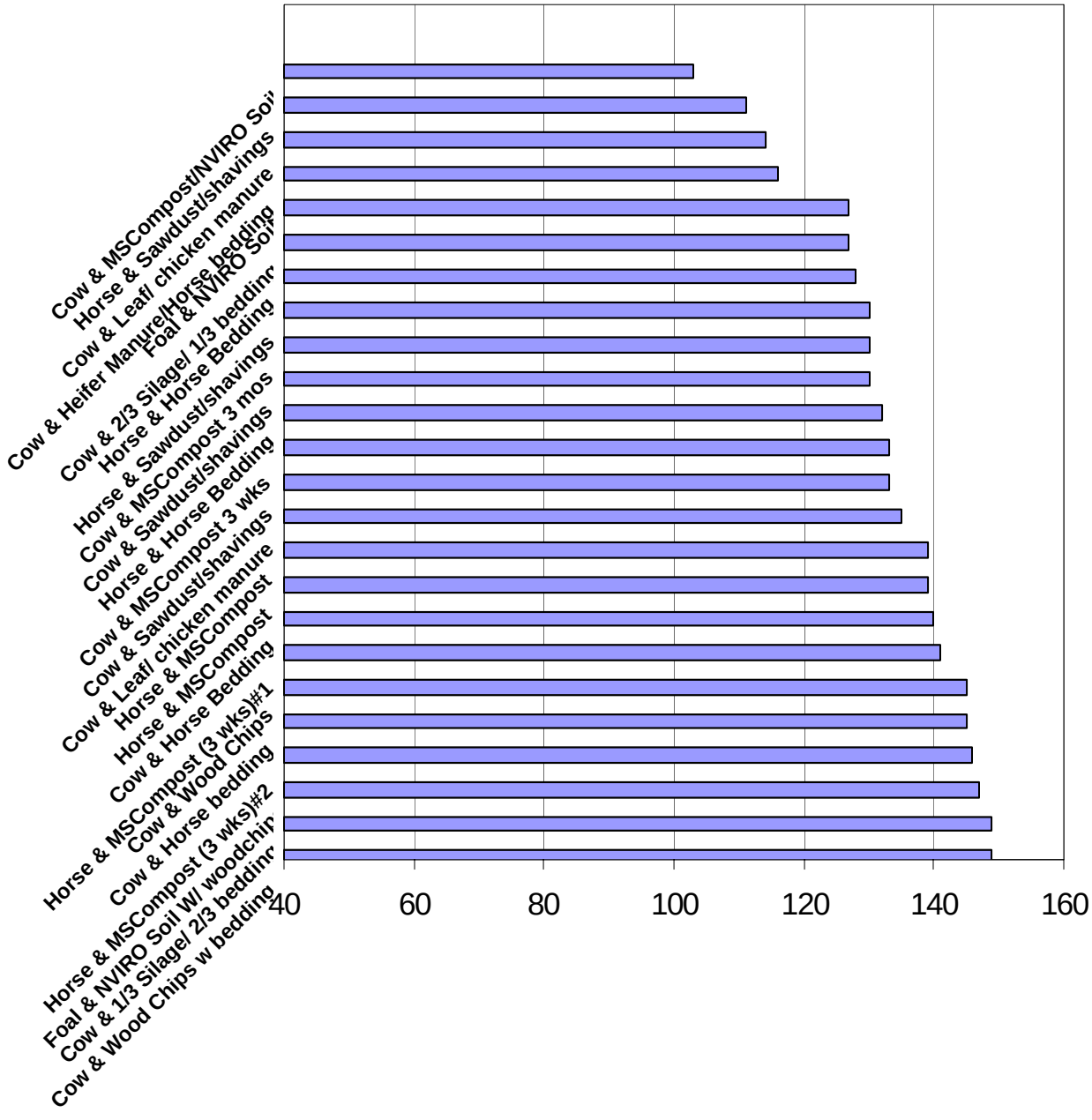
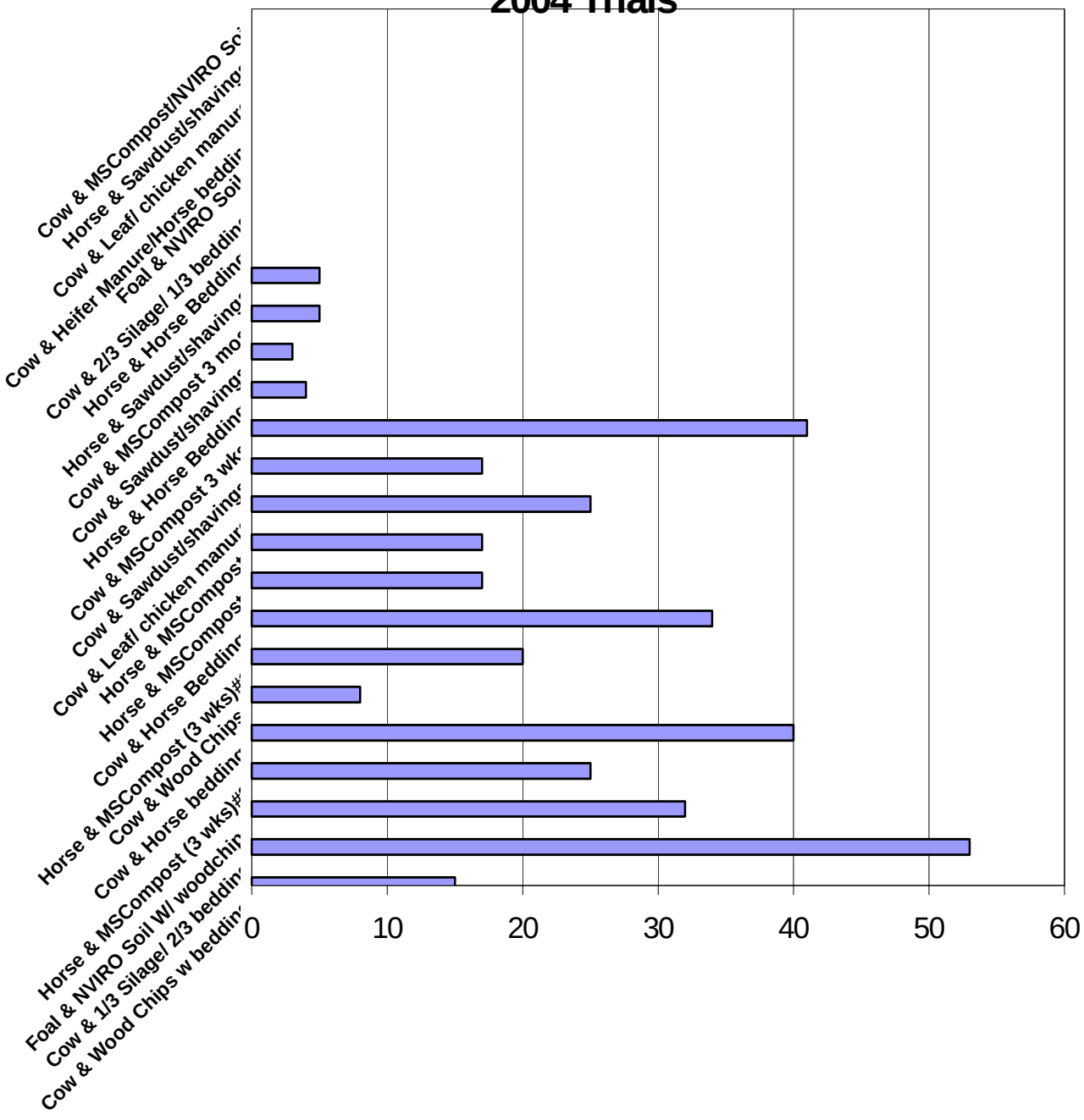


Figure 3. NUMBER OF DAYS OVER 130° F in COW & HORSE CARCASSES IN DIFFERENT MEDIA 2004 Trials



Photos: 2004 Carcass Compost Trials – Highmoor Farm

Photo #3. Ventilation of Cow Carcass on Horse Bedding Base

Photo #4. Covering Cow Carcass with Silage/ bedding Mix.