PHASE I: DEMONSTRATION

TRIAL SITES

During Phase I of this project, seven trial sites were established in five counties between October, 2006 and April, 2007. Four of the sites were dairies, two were beef operations, and one was at the Washington State University compost facility. Four producers willing to host field trials were located by contacting the local conservation districts in Yakima, Grant, Adams, and Skagit counties, and two additional producers were located through word-of-mouth. These four counties were chosen because of their large dairy populations and support from the local Conservation District for the project. Four additional dairies already composting farm mortalities were located through local Conservation Districts, Extension Agents, and announcements at the Washington Dairy Federation annual meetings.

Due to the nature of farm trials, much of the data collection and observation, especially for the trials located in counties on the Eastern side of the state, was dependent on the time and effort of the producers hosting the trials. Specific temperature data were available from the trials at the WSU compost facility as part of their management protocol, and from the trials in Skagit County because of the proximity of the project coordinator.

Washington State University Compost Facility

The WSU compost facility handles organic wastes generated from a variety of sources on campus including the animal centers and the vet school, dining halls, landscaping, and most recently the animal slaughter facility and meat lab. The finished compost is used on campus or sold to local plant nurseries.

Methods and Materials

The first trial at the WSU compost facility began on November 1, 2006 with a full-sized dairy cow (Figure 1). The base of the pile was constructed with a layer of wood chips covered with a layer of straw. The carcass was placed on this base and covered with a mixture of straw and cattle manure from the beef barn on campus.

Figure 1. Pile construction at the WSU compost facility – November 1, 2006

The entire pile was then covered with a layer of separated dairy manure solids. During the first phase of composting, internal temperatures of the pile were measured at two different points at a depth of 36 inches below the surface. Temperatures (^{o}F) were as follows:

December 5 – 141, 131
December 11 – 148, 150
December 18 – 147, 152
December 28 – 135, 151
January 4 – 117, 142 [very cold weather]
January 8 – 118, 132 [very cold weather]
January 12 – 140, 140

On January 12, ten weeks after the pile was constructed, it was turned for the first time (Figure 2). Most of the large bones (skull, pelvis, shoulders, etc.) were still intact but very clean and a few very small pieces of hide and tissue remained. There was a slight unpleasant odor, but it was not overpowering and quickly dissipated.

After the pile was turned, it was reconstructed and left to continue composting. During the following month, the windrow turner was used to regularly aerate and mix the pile. Internal pile temperatures (^{o}F) at two different points at a depth of 36 inches below the surface were as follows:

January 23 – 131, 145
January 25 – 158, 166
February 2 – 166, 170
February 12 – 158, 161

Figure 2. Turning the pile at the WSU compost facility – January 12, 2007

The second trial at the WSU compost facility began March 21, 2007. A full-sized beef cow was composted using similar co-composting materials as the first trial. The base consisted of a layer of woodchips and a layer of straw. The carcass was placed on this base and then covered with a mixture of straw and cattle manure from the beef barn on campus. Instead of a layer of separated dairy solids over the top, a layer of active compost was used. There was less straw used in this trial than the first one, and the materials were more uniformly mixed. Three weeks after the pile was constructed for the cow, offal and processing waste from ten pigs and five beef cows was added to both ends of the pile and covered with the same co-composting materials. During the first phase of composting, internal temperatures (^{o}F) of the pile at two different points at a depth of 36 inches below the surface were as follows:

March 23 – 136, 138
March 30 – 142, 148
April 4 – 145, 160
April 16 – 138, 148 [offal added]
April 19 – 147, 155
April 25 – 143, 146
May 2 – 141, 142
May 9 – 136, 142

This pile was turned on May 9, 2007 after only 7 weeks of active composting. Most of the bones were still intact and were not as clean as the bones from the previous trial. Many of the bones still had small pieces of tissue and hair left on them, and there were a few places where noticeable chunks of partially decomposed tissue remained (Figure 3). The structure of the carcass was thoroughly broken down however, and the pile was easy to turn. After turning, the pile was reconstructed and internal pile temperatures (^{o}F) at two different points at a depth of 36 inches below the surface were as follows:

May 10 – 138, 144
May 16 – 142, 146
May 22 – 149, 150
May 30 – 146, 152
June 11 – 154, 160

Figure 3. Turning the pile at the WSU compost facility – May 1, 2007

Results and Conclusions

Both of these trials were very successful. There were no problems with odor or signs of disturbance in either trial, and temperatures remained well above what is required for PFRP. In both trials, the straw that was used as a co-composting material was very dry when the pile was constructed, and was not well mixed with other materials. As a result, there were large clumps of dry uncomposted straw when the piles were turned for the first time (Figures 2 and 3).

Straw can be an excellent addition to a compost mixture when combined with other materials because it is a good source of highly degradable carbon and the large particle size can help reduce the bulk density of the pile and improve aeration. However, it can also be a very hydrophobic material with a large particle size, unless chopped, that does not readily absorb moisture. In both of these trials, thoroughly wetting the straw 1 to 2 days before it was added to the compost pile would have softened it and made it into a more available carbon source that could be quickly degraded.

Turning the pile to introduce oxygen and mix the materials before the carcass is completely decomposed has the potential to accelerate the composting process by increasing oxygen availability and redistributing the materials. In the first trial most of the tissue was gone and the bones were clean at 10 weeks. In the second trial (7 weeks) the tissues and hide were reduced to small pieces but the bones were not as clean as in first trial. In both cases, high pile temperatures were sustained after turning due to an increase in microbial activity. The finished compost was comparable from both piles so the biggest advantage to turning the compost sooner would be the potential to shorten the total amount of time from start to finish.

In this and other field trials, the large bones required much longer to decompose than other parts of the carcass, especially when exposed to the air and allowed to dry and harden. Bones that were never exposed to the dry air outside a compost pile decomposed much faster than bones of an equivalent size that came from the meat processing facility and were exposed to air for several days prior to composting.

Yakima County Dairy

The dairyman who hosted this field trial owns and manages two dairies in the area. He is milking 3600 cows between both dairies and composts 5-8 cows and 10-20 calves per month. Before the start of the trial, rendering was his primary method of mortality disposal. By the end of the trial, he was composting all mortalities from both farms. His primary motivation for composting mortalities was reducing disposal costs. The dry climate of this area is an advantage for an uncovered compost system like the one used at this dairy, as it allows for more flexibility in compost materials.

Methods and Materials

This trial began at the end of October, 2006 with two windrows comparing different combinations of co-composting materials. The primary materials used for the first windrow were a combination of feed refusals and silage with a small amount of straw. This mixture was used to form the base of the windrow and also to cover the carcasses. The entire windrow was then covered with a thin layer of dried separated dairy solids (Figure 4). The second windrow was constructed with wet manure along with the feed and silage mixture used in the first windrow. It was also built using more material and was both wider and taller.

Figure 4. Yakima County dairy compost site – June 1, 2007

The location and date of each carcass as it was added to the windrow were marked with small flags. Internal temperatures were measured once a week near the location of each carcass.

The rumen on each cow was punctured as it was added to the windrow. Cow carcasses were placed in the windrow side by side, calves were layered with cows.

After some trial and error, the farm employee responsible for the management of the compost settled on a system that allowed him to manage all of the farm mortalities with a minimal amount of labor. The first stage of active composting lasts 90 to 120 days, at which time the windrows are turned and combined with other windrows. These new rows are left to continue composting for approximately another 90 days. At this point the compost is moved to the curing pile where it stays until land application. The average internal temperatures in the first phase of active composting peak between 135^{o}F and 145^{o}F.

Results and Conclusions:

The first windrow (lower moisture) was turned January 9, 2007 after 8 to 10 weeks of composting. There was no unpleasant odor, the bones were clean, and only very small bits of tissue or hide were left. After this first phase of composting the large bones were still quite hard, but by the time the compost had undergone a second phase of composting and been moved to the curing pile they had decomposed further and were easily broken by hand.

In the second windrow, the wetter material and larger pile size slowed the compost process considerably. The leachate that had collected around the edges of the windrow gave off an unpleasant odor and when this one was turned there was a much stronger odor than from the first one. The carcasses were also not as thoroughly decomposed and there were more bones and some larger pieces of tissue. This problem was most likely caused by a lack of available oxygen in the pile due to the wetter, denser materials and the larger pile size. The wet manure on top of the pile formed a crust as it dried which further reduced air flow through the compost.

The combination of feed refusals and silage with a small amount of straw worked very well as the primary co-composting material for this system due to the porosity from a variety of particle sizes, adequate available nutrients, and low moisture content. The base was dry enough to absorb fluids from the carcass, and the surrounding materials provided sufficient nutrients for the microbes. The layer of dry manure over the top seemed to work as a dust mulch would to keep some of the moisture in and help reduce odors. Adding another 6 inches of the compost mixture to the pile instead of dry manure might also work well to insulate and maintain moisture, while at the same time increase airflow. Straw worked well as a co-composting material in this system because it was added in small amounts and evenly distributed throughout the pile.

A brief trial was done by this dairyman at a separate site on the farm using only separated dairy manure solids as the co-composting material. The compost rate was very slow and more odorous than the other trial and so it was quickly abandoned. The manure solids were still quite wet when the compost piles were built and seemed to form a crust as they dried that greatly reduced oxygen availability within the pile. Although separated dairy manure solids generally have a higher C:N ratio than liquid manure, part of the problem in this case may also have been a lack of available carbon for microbial metabolism.

Grant County Feedlot

The feedlot where this trial was conducted has a capacity of 40,000 animals among three locations. The mortality rate depends on the time of year and number of animals on-site but can average as high as eighty animals per month. Because of the number of mortalities, materials and space available, and lack of use for the finished product, it was not feasible to do a large scale trial or use composting as the primary method of mortality disposal.

Methods and Materials

The trial began on November 13, 2006 with twelve steers that were around 875 pounds each. The primary composting material was a mixture of manure (75 – 80%) and straw (20 – 25%) on an 18 inch base of woodchips. The partially composted manure was 6 to 12 months old and had formed a dense, blocky structure. The carcasses were placed in the windrow nose to tail with about 2 to 4 feet between each one. The windrow was between 7 and 8 feet wide and about 130 feet long (Figure 5).

This site was not monitored regularly. On January 8, about 7 weeks after the start of the trial, internal temperatures ranged from 118^{o}F to 142^{o}F. This wide range was most likely due to the inconsistency in the mix of materials when the pile was built, and the large spaces between carcasses in the windrow. There was very little sign of disturbance (only a few small bones had been exposed) and no odor.

Figure 5. Grant County feedlot compost windrow – January 8, 2007

Results and Conclusions

On February 6, 2007 after almost 3 months of composting, the pile was turned. There was very little odor and most of the bones were clean. Of the twelve carcasses composted, there were only a few visible places where pieces of tissue and hide remained, although there may have been more that were not exposed. The large bones were still intact as well as the very small ones.

The carcasses in the parts of the windrow with more manure and less straw appeared to be more completely decomposed. This is not what was expected because the manure was both low in available carbon and very dense with the potential to severely limit oxygen availability. The very porous base of woodchips helped facilitate airflow through the pile, and the clumped, inconsistent structure of the manure may have helped as well. The area where this trial was conducted has a very low annual precipitation (less than 10 inches/year) and it turned out that moisture rather than oxygen was the limiting factor in this trial. This same combination of materials would not have worked well in a region with high rainfall because the manure would have quickly absorbed too much moisture and become saturated.

Considering the climate and materials that were available, this trial was successful. In order for a feedlot of this size to effectively compost all mortalities, there would need to be a source of suitable co-composting materials in sufficient quantities, as well as either a market for the finished product or land for application of the compost.

Adams County Dairy

The owners of this dairy had been composting all farm mortalities for several years with limited success and were ready to improve their system and change compost sites. Previous to this trial, they had been using only separated manure solids as a co-compost material. They have about 3000 milking cows between two locations, and average 12 to 20 mortalities per month. The new compost site is on hard packed ground with a gentle slope and is a sufficient distance from the road, buildings, and livestock. The primary materials available for composting are separated manure solids and feed refusals (grain, silage, and hay). The climate in the Columbia Basin is ideal for this type of composting because of the low annual precipitation.

Figure 6. Adams County dairy compost site – April 7, 2007

Methods and Materials

Due to problems with equipment and labor on the farm, this trial got off to a slow start. The first batch of materials were mixed and a base was laid for the compost windrows by November 13, 2006, but it took until mid-January for them to consistently bury the carcasses correctly and move the rest of the co-composting materials to the site. On April 7, 2007 temperatures throughout the pile ranged from 95°F to 120°F (Figure 6). There was a strong unpleasant odor coming from parts of the pile, especially where leachate had collected around the edges.

Results and Conclusions

This dairy had the ideal site, materials, and climate for a successful mortality composting operation but the limiting factors were system management and labor availability. At the time of this report, the owners of this dairy were still composting some of their mortalities and estimate that it takes 8-12 months to complete the entire process.

Skagit County Dairy #1

Previous to the start of this trial, the owners of this dairy had been burying all mortalities and were looking for a better alternative. They are currently composting all of their farm mortalities, and are very pleased with the time and labor they have saved.

Methods and Materials

This trial began on December 26, 2006 with one cow. The compost site was located on a concrete slab at the edge of the silage pit, and all leachate and run-off was pumped into the lagoon. The primary co-composting material was sawdust bedding from the maternity pens at the dairy. The sawdust is relatively dry when removed from the pens (estimated 30 to 40% moisture) and contains a small amount of manure. Spoiled silage and hay were also used as co-composting materials when available. This trial was not consistently managed, and at times it was difficult to determine where new mortalities had been added to the pile (Figure 7).

Figure 7. Skagit County dairy # 1 compost site – April 12, 2007

Internal temperatures of the pile were measured every 5 to 8 days at 36 inches below the surface for the first 4 months of the trial. Temperatures ranged from 60 to 156°F, depending on the location and time of measurement. Because the locations of carcasses in the pile were not marked and new ones were added in an unorganized manner, it was not always possible to measure temperatures at the same location each time nor determine the location of the carcass in relation to the temperature probe. The most accurate temperature data was from the first carcass. Internal pile temperature ranges (°F) at a depth of 36 inches below the surface were as follows:

December 26 – pile built
December 28 – 60 to 70
January 2 – 128 to 156
January 5 – 126 to 135 [top settled and cracked, cold spots near cracks]
January 14 – 116 to 118 [second carcass added, and more sawdust]
January 17 – 122 to 124
January 25 – 135 to 145
January 30 – 133 to 138
February 3 – 127 to 136 [third carcass added]
February 12 – 103 to 120 [pile opened]

Internal temperatures remained between 110 and 140^{o}F for the rest of the trial, unless the carcass was insufficiently covered, or had been recently buried. When there was not enough material covering a carcass (< 1 foot) the temperatures remained low (< 100^{o}F). For several months during the winter there was standing water on the concrete pad around the compost piles. In this situation, the deep layer of sawdust (3+ feet) forming the base of the pile was essential for providing enough material to absorb fluids from the carcass and keep the rest of the pile from getting saturated due to the standing water.

Results and Conclusions

On February 12, 2007, after 7 weeks of composting, the oldest part of the compost pile was opened (Figure 8a). More sawdust and silage had been added to the top of the pile and the first carcass buried was about 6 feet below the surface of the pile. Most of the bones were still intact, and there were a few small pieces of hide and tissue. The rumen contents looked unaffected by the composting process (Figure 8b). This may have been because the material left in the rumen had already been digested and so was resistant to further microbial decay, as well as the fact that the microbial population already present in the rumen may have slowed the composting process.

Figure 8. Excavation of pile at Skagit County dairy #1 – February 12, 2007

The sawdust was well composted, dark in color, and maintained a good moisture content (~50%). However, it had compacted considerably from of the amount of material added to the top. This, along with the carcass being so far from the surface, may have limited the amount of oxygen available for the composting process. Sawdust is not as easily degradable as feed refusals or silage and is generally slower to decompose. However, this trial illustrated the fact that sawdust works very well in wet climates because of its ability to absorb large amounts of moisture without getting oversaturated. It can also provide enough structure to facilitate airflow through the pile, even when very wet. When the weather was drier, a thin crust formed over the top of the pile and may have sealed some of the moisture inside.

In areas with dry climates like Yakima or Adams counties, sawdust like this would be too dry and would inhibit microbial activity to an extent that the carcass would not compost, and would instead attract pests. The addition of a material like wet manure or silage would work well to provide additional moisture as well as other nutrients.

Skagit County Dairy #2

At the start of this trial, the owner of this dairy was already composting all of his used bedding, old feed, and manure, along with leeks from a local farmer. He gives away some of the finished compost, and applies the rest of it to his fields. There was already a building on the site ideal for a covered compost trial with two large bays with doors and a third bay open in the front used for curing the compost.

Methods and Materials

This trial began on April 19, 2007 with one cow. A base of straw, silage, sawdust, manure about 3 feet deep was built in one of the bays. The carcass was then placed on this base and the abdomen was punctured before it was covered with more co-composting material. The cover material had a higher moisture content than the base and was a mixture of manure, silage, sawdust, and leeks (Figure 9). Two days later a second animal was added on top of the first pile and covered with additional sawdust and silage.

Figure 9. First compost pile at Skagit County dairy #2 – April 20, 2007

Over the next four weeks internal pile temperatures were measured at several points at depths of 12, 24, or 36 inches below the surface. Temperatures (^{o}F) were as follows:

April 20 – 89 to 93 (36″)
April 23 – 111 to 127 (36″) [strong ammonia smell, leachate from pile]
April 25 – 126 to 141 (12″)
109 to 128 (36″)
April 29 – 137 to 149 (24″) [temp probe reached bone, more leachate from pile]
122 to 124 (36″)
May 2 – 122 to 143 (24″) [minimal odor, faint ammonia smell]
114 to 136 (36″)
May 14 – 107 to 133 (24″) [minimal odor, no ammonia smell]
95 to 122 (36″)
May 15 – 119 to 135 (24″)
113 to 130 (36″)

Initially there was a strong smell of volatilized ammonia, and the leachate that collected around the edges of the pile had an unpleasant odor as well. The strong ammonia odor was gone after around 10 days, but unpleasant odors from the leachate and composting materials continued for several weeks.

On May 15, 2007 the first pile was partially turned and moved and a second compost pile was started next to it with one cow carcass (Figure 10). The co-composting material was a uniform mixture of silage, old feed, sawdust and manure and appeared to be an excellent combination of materials for composting with the correct moisture content. The co-composting materials had been sitting for a few days before the mortality compost pile was built and so were already beginning to compost. The internal temperature of this pile was 95^{o}F.

Figure 10. Second compost pile at Skagit County dairy #2 – May 15, 2007

On May 16, 2007 both compost piles were steaming and there was a very strong ammonia smell. By May 18, the top of the second pile had settled considerably and was starting to crack. By May 24, the ammonia had mostly dissipated, and there was very little odor. Internal pile temperatures (^{o}F) for the second pile measured at several points in the pile and depths of 12, 24, or 36 inches were as follows:

May 16 – 129 to 142 (12″) [temp probe touching carcass]
112 to 119 (24″)
May 18 – 158 (12″)
125 to 136 (22″) [temp probe touching carcass]
108 to 120 (36″)
May 21 – 131 to 141 (24″)
106 to 130 (36″)
May 24 – 149 to 161 (12″) [temp probe touching clean bone]
143 to 147 (24″)
110 to 134 (36″)
May 30 – 109 to 144 (24″) [pile was moved]
107 to 154 (36″)

Results and Conclusions

On May 15, 2007 after four weeks of composting, the first pile was partially turned and moved. There was a very strong unpleasant odor from the carcass, but no chunks of tissue or bone large enough to impede turning. The bones were mostly clean with only small pieces of tissue still attached. The compost was piled up again and then covered with several inches of sawdust mixed with manure and old feed.

An enclosed building was the ideal situation for this trial because it allowed the use of materials that would not have composted well when exposed to rain. It also kept odors contained. The mixture of co-composting materials used would have worked very well for a regular compost pile, but was too high in nitrogen and too wet for mortality compost. This was apparent from the strong odor of volatilized ammonia and the amount of leachate that collected around the edges of the piles. The fact that the piles were in an enclosed building may also have contributed to the strong odors because they did not dissipate as quickly.

In this trial, oxygen was the limiting factor, as shown by the significant difference between the temperatures at 12, 24, and 36 inches below the surface of the pile. There was more available oxygen closer to the edges of the pile, especially when the materials were wet and the carcass had not yet started to lose its structure. In a non-aerated compost pile, air is moved through pile by the chimney effect as cool air comes in along the edges of the pile, and warm air rises through the center. In the case of a mortality compost pile, there is a very dense mass in the center of the pile that impedes airflow and limits oxygen availability.

Mixing or turning the compost pile will increase available oxygen and improve the homogeneity of the materials. Early and frequent turning will expedite the composting process but may create more odors (initially) and make the compost more attractive to pests if bones are left exposed. In this case, having the trial enclosed allowed for earlier turning because any odors could be contained, and pests kept out.

Skagit County Farm

This small farm raises beef steers and cow-calf pairs on pasture and at the time of the trial had approximately twenty-five animals. The compost pile was built directly in one of the pastures.

Methods and Materials

This trial began on December 8, 2006 with one steer that weighed about 800 pounds. The materials used were partially composted horse manure and sawdust, with a small amount of very wet cow manure. The pile was built using the bucket loader on a tractor and it was difficult to get a uniform mixture of materials. The compost pile was built in a corner of the pasture on a slight slope to minimize any standing water around the pile.

On December 15, one week after the pile was built, internal temperatures ranged from 85 to 131^{o}F. There were some signs of animal activity and digging, but no odor (Figure 11). Two days later, several additional loads of the sawdust/horse manure mixture were added to discourage pests and help insulate the pile.

Figure 11. Compost pile at Skagit County farm – December 15, 2006

On December 21, internal temperatures were between 104 and 120^{o}F, and on December 28 temperatures were between 116 and 118^{o}F. It had been raining hard for several days, and below freezing at night. Internal temperatures stayed between 110 and 126^{o}F for the next week, and the rain continued. There was still no odor and no more signs of disturbance. By the second week of January, after about 5 weeks of composting, internal temperatures were between 84 and 97^{o}F, and the pile was still very wet. Over the next 2 weeks, the internal temperatures dropped down to the mid 70s, still with no odor or signs of disturbance

Results and Conclusions

On February 11, 2007 two months after the compost pile was built, it was turned and moved. When the pile was opened it was clear that the inside was too wet and dense and the conditions had become anaerobic. There was a strong odor of rotting tissue and anaerobic uncomposted manure. Most of the bones were still intact and there were a few pieces of tissue and hide, although these were small.

The partially composted materials were re-mixed and then covered with a thin layer of sawdust and woodchips. Over the next 4 weeks internal temperatures peaked between 99 and 109^{o}F, and then dropped down to between 85 and 95^{o}F. At this point, the compost was moved and used to build another compost pile and no further data was collected.

Even after turning, microbial activity did not increase noticeably. The material was too dense to allow adequate airflow through the pile and the microbes quickly used up what oxygen was available. In this case, adding a material like straw or woodchips to the pile when it was constructed would have improved the structure to facilitate airflow.

The materials used in this trial absorbed too much moisture in the wet weather and the pile quickly became saturated and anaerobic. In a drier climate this mixture may have worked well. This pile did not meet the time and temperature parameters required for pathogen reduction under the EPA's Processes to Further Reduce Pathogens (PFRP) and so should be mixed with fresh materials and re-composted before it is used. The location worked well for an on-farm compost pile because it was in a well-drained area and the finished compost could be easily spread on the pasture.

Other Sites

In addition to the trial sites, four other dairies were located that were already composting farm mortalities. All were using different methods and combinations of materials with varying degrees of success.

Whatcom County Dairy

The owner of this 500 cow dairy also owns and manages a commercial compost yard where he composts all of the organic waste produced on their dairy, as well as some from neighboring farms. He had been composting mortalities for about a year and a half in a three-sided shed with a concrete floor that measures 22 feet by 30 feet (Figure 12). Since building the shed, over sixty cows have been composted and none of the finished compost has been removed.

Figure 12. Whatcom County dairy compost shed

Primary co-composting materials used were straw and sawdust from the maternity pens, and feed refusals which included grain and silage. Because he did not have a use for the finished compost, he was burying new mortalities in the old compost and having difficulty decomposing bones and reaching thermophilic temperatures. After a suggestion to add fresh co-composting material and remove some of the old compost, some improvement was made, but at the time of this report there was still no system for using the finished compost.

A three-sided building like this works very well if it is large enough to handle the volume of mortalities required and can be emptied regularly. A covered compost site is especially helpful in wet climates because managing the moisture of the compost pile is much easier, and there is less water runoff and leaching.

Snohomish County Dairy #1

The owner of this 600 cow dairy has been composting all of his farm mortalities for over 5 years and loses about two cows per month. The primary composting material is straw bedding (75-80%) mixed with separated manure solids.

New mortalities are added to the pile in the front, while the pile in the back is the finished compost that will be spread on the fields in the spring (Figure 13). From start to finish the process takes 1 ½ to 2 years. The site gets very muddy in the winter with areas of standing water and the owner reported that there is often a very strong odor in the summer.

Figure 13. Snohomish County dairy #1 compost site

This is a good example of a system that uses primarily straw as a co-composting material. The straw is removed from the dairy maternity pens mixed with manure and urine and is then stored in a large pile. By the time it goes into the mortality compost pile it is already hot and starting to decompose. Like sawdust, straw is a great material for an uncovered compost pile in a wet climate. It provides adequate structure, sheds water well, and is not easily saturated. However, because of the large particle size (and relatively low surface area), it is important to use plenty of material and ensure the carcass is well covered. This system does not work as well in the summer (odors reported by farmer) because the straw is too dry and “fluffy.” There is not enough available moisture for the microbes and too much pore space between the carcass and the co-composting materials. If the straw does not get wet enough to soften and begin the decomposition process, it is not as easily degraded by the microbes in the compost pile. Dry straw also does not make an effective bio-filter for odors.

Snohomish County Dairy #2

The owners of this dairy have been composting all of their mortalities for several years. They initially started as a way to reduce disposal costs but have found that the finished compost is valuable for improving soil quality in some of the fields where they grow corn. They are milking around 900 cows with a mortality rate of about 10 cows per month.

The compost site is about a half mile from their barns and at the edge of a cornfield. The primary co-composting materials are spoiled silage and feed refusals, with some manure and used bedding. These materials are piled at the compost site and mortalities are added to one large pile as they occur. In the spring, after 6 months to 1 year of composting, the finished product is spread on the corn fields. The pile is not turned regularly and temperatures are not measured. Some large bones are left, but these are spread on the field with the compost and are not a concern on this dairy.

This is a good example of a very low input and low cost method of composting. It works well in this case because the site is far enough away from the rest of the operation and the owner is not concerned with how long the process takes or with the presence of bones in the finished product.

King County Dairy

This owner of this dairy has been composting all of his farm mortalities for several years, and recently started composting some of his neighbors mortalities as well. He uses only separated manure solids as a co-composting material and the compost site is on a concrete pad next to the manure separator. The owner reports that in about 5 months, after turning at least once, the compost is ready for land application. He does not measure the temperatures of the compost piles, and says that sometimes the smell can be very unpleasant.

Separated dairy manure has a very small uniform particle size that can severely limit oxygen availability when wet. In this case, adding a bulking agent such as old feed or bedding materials would work well to increase porosity as well as available nutrients.

General Observations and Conclusions

Each one of the trial sites provided valuable information and experience throughout the course of this project. One of the challenges of farm trials is that there is often less control and more variables to account for than in a laboratory trial. The advantage, however, is that the innovation of the farmer or field manager can contribute to the success of the project in unexpected ways.

Compost trial sites in Skagit, Snohomish, King, and Whatcom Counties received considerably more precipitation than sites in Yakima, Whitman, Grant, and Adams Counties. The sawdust that worked well for Skagit County dairy #1, or the straw used by Snohomish County dairy #1, is not as effective in an area with a much drier climate like Grant or Adams County. Compost mixtures high in manure like the ones used by Skagit County farm or Skagit County dairy #2 do not work well when exposed to heavy rainfall. The piles become oversaturated which causes anaerobic conditions and slow the compost process.

Oxygen is a limiting factor for any compost operation, but can be even more of a challenge for mortality compost. Placing a large, dense carcass in the center of the compost pile severely limits airflow through the pile, especially before the structure begins to break down.

The trials at Yakima County dairy and Skagit County dairy #2 both demonstrated the effect that a thick layer of compost material can have on limiting oxygen availability.

Perhaps most interesting was the example provided by Skagit County dairy #2 and the WSU compost facility on how short the initial phase of the compost process can be. At the WSU compost facility, the second trial was turned after only 7 weeks and showed very little remaining tissue. At Skagit County dairy #2, the pile was turned and moved after only 4 weeks. There was a very strong unpleasant odor but not enough remaining structure to impede turning. If the compost site is well managed, and there are adequate co-composting materials available for a bio-filter over a freshly turned pile, the compost can be reasonably turned for the first time in as little as 4 to 5 weeks.

PHASE I: DEMONSTRATION

FIELD DAYS

Field days were held at the WSU and Yakima County trial sites to demonstrate compost methods and promote on-farm mortality composting. Announcements for both field days were published in the Capital Press, Ag Equipment Power, the Washington Tilth Calendar, the WSU BIOAg news page, and the WSU extension calendar. Email announcements were sent out to all WSU extension offices, WSU College of Agricultural, Human, and Natural Resource Sciences (CAHNRS) faculty and student list-serve, WSU Crop and Soil Sciences list serve, and the WSU Announcements list-serve. The field day information was also posted on the project website, and announcements were sent out to all producers, state agencies, industry representatives, and individuals who had contributed to, or shown interest in, this project.

Field Day at WSU Compost Facility – May 9, 2007

The field day began with a brief presentation about the project, field trials, and general methods for composting mortalities. The presentation was followed by time for questions and answers. Participants then had the opportunity to look at the second WSU compost trial after 7 weeks of active composting as well as the curing pile from the first WSU trial. The compost facility manager and the two yard employees were also present and spoke briefly about the WSU compost yard and the butcher waste composting they are doing. Eighteen people attended the event with representatives from WSU, a variety of state agencies, and two trade associations:

WSU Health and Environmental Safety (5)
WSU graduate students, Crop and Soil Sciences department (4)
WSU Crop and Soil Sciences faculty (2)
USDA Natural Resource Conservation Service, Spokane office (3)
King County Conservation District (1)
President of the Northwest Meat Processors Association
President of the Washington Cattle Feeders Association
WSDA Livestock Nutrient Management Specialist, Ephrata

Field Day at Yakima County Dairy – June 1, 2007

The field day began with a brief explanation of the WSU BIOAg program and the WSU On-Farm Mortality Composting project, as well as the general methods for composting mortalities. The owner of the dairy, and the employee in charge of the composting operation then explained their methods and co-composting materials used. At the time of the field day, there were two active windrows with about fifteen mortalities in each, and one curing pile. The oldest windrow, which had been composting for about two months, was turned to demonstrate the effectiveness of their compost system. Ten people attended this field day, and the event lasted 2 ½ hours:

Washington State Department of Agriculture (3)
King County Conservation District
Washington State Department of Ecology, solid waste specialist
WSU Knott Dairy Center, herdsman
Representatives from two local dairies and one poultry farm

Field Day Evaluations

At each field day, attendants were given the opportunity to rate their knowledge of mortality composting before and after the event, and how likely they were to use the new information. Results varied between participants but the general response was positive. The following format was used:

Rate your knowledge of mortality composting *before* today's event:
1 2 3 4 5
Minimal Very knowledgeable

Rate your knowledge of mortality composting *after* today's event:
1 2 3 4 5
Minimal Very knowledgeable

How likely are you to use the information you gained today?
1 2 3 4 5
Unlikely Very likely

Given the opportunity, how likely are you to practice mortality composting in the future?
1 2 3 4 5
Unlikely Very likely

There were sixteen evaluations from the WSU field day on May 9 and out of those, six rated their knowledge before the event as a 4 or 5. Of the remaining ten evaluations, seven rated their knowledge as improving by at least two points on the scale, two rated their knowledge as improving by one point, and one stated no change. Eleven out of the sixteen participants rated the likelihood of using the information or practicing mortality composting in the future as a 4 or 5. Comments on the evaluation forms included: "Great info for dairymen on the West side" and "Very interesting, I look forward to updates and more information".

At the Yakima County field day on June 1, seven participants filled out evaluations. Three were already very knowledgeable about the topic. The remaining four rated their knowledge as improving by two to four points on the scale. Six out of the seven participants rated the likelihood of using the information or practicing mortality composting in the future as a 4 or 5.