Best Management Practices
Guidelines for Pathogen Control at Organic Material Processing Facilities

December 2007

Abstract
Environmental pathogens can affect plants and animals, workers, a local environment, and organic material markets. Keeping potentially pathogenic material segregated and contained at processing sites requires management of dust, water and the feedstocks. Proper site layout and appropriate processing technology are other features that maintain control and treatment of pathogens. The unique ability for organic materials to self-heat in large piles, along with reasonable handling techniques can be used to provide excellent control over even some of the most difficult of the plant and animal pathogens that might be delivered to organic material processors. This Best Management Practices document strives to identify the details that make this a predictable outcome.

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Guidelines for Pathogen Control i

December 2007
1.0 Introduction

Over the past two decades, the organic material processing industry (composting, digestion, wood grinding) in Washington State has become key to managing residential, agricultural and commercial wastes; producing useful products from otherwise wasted organic materials. The industry continues to grow as ever-larger volumes and a wider diversity of organic feedstocks are processed into products. Naturally occurring plant and animal pathogens exist in the environment and can be delivered in these feedstocks. Ensuring the hygienic safety of workers, consumers, and plants and animals is a priority for every facility.

Conscious facility design and process management can provide continuous protection to destroy pathogens and to prevent pathogens from being released. The great benefit of organic material management is that it is quite difficult to keep large piles cool. Heat is the great killer of most pathogens and it is usually a question of how long to heat, how high a temperature to obtain, and whether there is enough moisture to generate the heat. Since pathogens can come in from any source, they all should be treated appropriately.

Subsequent to time and temperature treatment, management of treated materials is also critical. Pathways that may result in recontamination of treated materials need to be eliminated. A primary approach to this is preventing contaminated sources from coming into contact with processed materials. The main tool for this at any facility is site segregation.

The Washington Organic Recycling Council has prepared these guidelines as a tool for managers processing organic materials. Information is provided here to assist managers in meeting existing regulatory requirements and ensure control of pathogens. This publication includes the most pertinent and generally required information necessary for a facility manager to understand the challenges of pathogen control when handling organic materials. However, it does not include all laws, regulations, permit requirements, or practices for managing organic materials.

This report provides background information on pathogens, describes the regulatory framework for pathogen management, outlines basic facility design criteria that meet pathogen reduction requirements, and recommends planning and operation practices for well-run facilities. The resources section provides a list of the important documents and web pages used in developing the BMP for Pathogens. These provide invaluable information to those who need a deeper understanding of the issues and methods put forth in the BMP.

This publication cannot be used as a substitute for legal advice. Ignorance of any law that may apply to a facility’s activities is not a defensible position. Frequently, regulatory agencies have overlapping jurisdiction over some activities. Therefore, we recommend contacting the representatives from the jurisdictional health department, Washington State Department of Ecology, National Resource Conservation Service, U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS), or at the Washington State Department of Agriculture (WSDA) for specific guidance or interpretation of a law, regulation, or permit requirement.

If the reader has comments or questions regarding this document please submit them in writing to the WORC mailing address or to WORC’s email address info@compostwashington.org
2.0 Pathogens in Organic Materials

Pathogens are agents which cause disease and include a wide variety of organisms, mostly microscopic, including for example, bacteria, viruses, nematodes, fungus, spirochetes, amoeba, and other parasitic organisms. Pathogens exist almost anywhere in the environment where life exists, but generally they need a pathway to get from the pathogen source to a susceptible plant or animal, to directly cause an infection. The resultant effect of a particular pathogen depends on the dose received, the susceptibility of the host, the virulence of the strain, and the type of action performed on the living cells or organism.

Almost any pathogen from a local population or plant community could be transported to an organic materials processing facility. And in some cases, the populations of pathogens might even increase under the conditions that result during collection and transportation to a facility. In general however, pathogenic organisms die rapidly after they leave their host, or if their environmental conditions change.

It is difficult to detect the sources and pathways of a pathogens spread until it is discovered that someone or something shows symptoms of a disease. Once a disease symptom shows, then the tests are run on the infection to clarify what it may be. Tests are also run on any possible sources until the pathogen is traced back to where the infection may have originated. The likelihood of certain pathogens varies with the organic material class and how it may be handled prior to entering the facility.

Washington State solid waste rules use a classification for organic materials to identify feedstocks that are more likely to have higher pathogen content, and to identify differences in what parameters should be tested for and what processing methods are required to be used.

2.1 Type 1 Feedstocks

Type 1 feedstocks include wood wastes, wax coated cardboard, source separated yard and garden wastes; agricultural crop residues; Pre-consumer vegetative food wastes; and other similar source-separated materials that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances, human pathogens, and physical contaminants.

Pre-consumer food waste varies in the level of pathogens. Some pre-consumer food waste is highly contaminated with food pests, such as fungi.

Generally, yard debris is considered to not contain the high levels of pathogens common to other feedstocks. However, contamination by animal feces and other sources often results in high levels of certain human pathogens and often levels of plant pathogens are high in this feedstock. If a feedstock is of plant origin or had been amended with plant material, the product may contain plant pathogens including viruses, fungi, bacteria, or other parasites.

2.2 Type 2 Feedstocks

Type 2 feedstocks include manure and bedding from herbivorous animals that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances and physical contaminants when compared to a Type 1 feedstock. Animal pathogen populations are routinely found in raw animal manure. Processed organics based on manure feedstocks are commonly applied to agricultural fields and pastures which are used for stock production. Thus, eliminating animal pathogens is critical for Type 2 feedstocks.
2.3 Type 3 Feedstocks

Type 3 feedstocks include, meat and post-consumer source-separated food wastes, other similar source-separated materials that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances and physical contaminants, but are likely to have high levels of human pathogens.

Post-consumer food waste generally has a high level of human and animal pathogens. Since post-consumer food waste is often collected from all kinds of generators on an infrequent basis -- sometimes as little as once every 2 weeks-- pathogen growth can be facilitated. Among pathogens, *Salmonella* species are specifically problematic since they can infect or contaminate nearly all living vectors ranging from insects to mammals.

2.4 Type 4 Feedstocks

Type 4 feedstocks contain organic material likely to be high in pathogens as well as containing a high level of physical and chemical contaminants. These include mixed municipal solid wastes, post collection separated or processed solid wastes, Industrial solid wastes, Industrial biological treatment (also known as wastewater or sewage) sludge, or other similar organic wastes that the jurisdictional health department determines to have a comparable high level of risk in hazardous substances, human pathogens and/or physical contaminants.

2.5 Municipal Wastewater Treatment Solids

The human pathogens in wastewater sludge have been studied extensively. The process at the sewage treatment plant concentrates any infectious solids from wastewater into a sludge and the wastewater generally then goes through extensive treatment to meet sanitation requirements before discharge. The sludge may or may not receive further sanitation at the treatment plant prior to transferring to an organic materials processing facility. A secondary process of anaerobic digestion is generally used to significantly reduce pathogens. However, further pathogen treatment is required before distribution for public uses. These feedstocks are not normally managed under the State solid waste permit system and differ in their requirements. The Washington State Department of Ecology biosolids web site provides the sanitation requirements for the management of sewage sludge. [http://www.ecy.wa.gov/programs/swfa/biosolids/downloads.html](http://www.ecy.wa.gov/programs/swfa/biosolids/downloads.html)

2.6 Wood Debris

There are different issues and protocols for organics processors such as wood grinders and screeners who sell raw mulch, as opposed to those that are intentionally using and verifying a heating method. Currently, many types of wood debris are processed without going through a heating cycle, including bark, woody mulch, wood chips. There are no cold biological processing techniques known that will control pathogens. With the advent of the plant pathogen *Phytophthora Ramorum* in West Coast wet temperate forests, this lack of control for mulch and soil markets is becoming a concern.

We recommend that wood byproduct processors purposely heat treat any product by implementing moisture and nutrient control and other handling procedures that encourage self-heating. Stockpiling in an appropriate manner for woody material can result in heating, and would serve to provide sanitation if time and temperature targets were reached. The process may not as dependable as other heating methods since moisture, nutrients and oxygen are generally not controlled. If the wood is going to fuel markets the risk is lower since combustion kills most all pathogens, however cross contamination pathways with mulch use materials are still likely.

3.0 Pathways of Contamination

Pathogens can move through air in aerosols or with dust particles, with water and leachate movement, and with the movement of untreated contaminated materials. Movements of pathogens are not easy to track or predict so prevention and sanitation procedures must be in place and monitored regularly to reduce the risk of spread. Facility personnel or visitors can spread diseases by handling or stepping through pathogen rich...
materials. The pathogen may be transmitted to vehicles and vehicle tires, carried on clothes, gloves, and shoes, and thus spread beyond the facility.

A few examples of potential pathways from contaminated feedstocks to humans, animals, and the environment are presented in Table 1.

Table 1: Pathways of contamination (adapted from Böhm 2002).

<table>
<thead>
<tr>
<th>Transmission Type</th>
<th>Pathway</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Direct Transmission to Animals</td>
<td>Airborne or waterborne transmission of pathogens from storage and processing areas located close to susceptible animals.</td>
</tr>
<tr>
<td></td>
<td>Contamination of pastures by untreated materials followed by grazing</td>
</tr>
<tr>
<td></td>
<td>Airborne transmission to pastures through dust created when spreading contaminated materials followed by inhalation or grazing.</td>
</tr>
<tr>
<td>b. Direct Transmission to Humans</td>
<td>Occupational exposure to contaminated products resulting in inhalation or ingestion.</td>
</tr>
<tr>
<td></td>
<td>Domestic (household) handling of contaminated clothing products followed by ingestion or inhalation.</td>
</tr>
<tr>
<td></td>
<td>Unknowingly contaminated organic materials handled as if they were clean resulting in inhalation and ingestion of pathogens.</td>
</tr>
<tr>
<td></td>
<td>Through open wounds.</td>
</tr>
<tr>
<td>c. Indirect Transmission to Animals</td>
<td>By living vectors such as rat or bird feces in feed.</td>
</tr>
<tr>
<td></td>
<td>By introduction of disease-causing agents into the food chain.</td>
</tr>
<tr>
<td>d. Indirect Transmission to Humans</td>
<td>Food becomes contaminated by living vectors.</td>
</tr>
<tr>
<td>e. Introduction into the Environment</td>
<td>Generation of vectors/carriers in the local fauna.</td>
</tr>
<tr>
<td></td>
<td>Spread by wind, water and animals from facility</td>
</tr>
</tbody>
</table>

3.1 Issues generated by the plant pathogen *Phytophthora ramorum*

Of prime concern to processors in the northwest is a plant pathogen known to cause sudden oak death, ramorum blight, and other plant disease. This pathogen is a microbe called *Phytophthora ramorum* (*P. ramorum*) that was first observed in 1995 and not identified until 2000. Since approximately 1997, this extremely virulent organism of unknown origin has spread to forests in coastal California counties as well as Oregon’s Curry County. It has also been found in numerous European nurseries and gardens, and recently in nurseries in California, Washington, Oregon, and British Columbia, Canada. In 2006, the pathogen was identified from streams in Kitsap County, Washington, where leaves were intentionally placed specifically to monitor for this pathogen. This indicates that the pathogen is present in the local surroundings of a nursery, but no plant outbreaks have been recorded for Kitsap County to date.

In Washington, risks to both landscape plants and plants in natural settings from this pathogen are extreme because the pathogen has been shown to have a broad host range, which includes many northwest native trees and shrubs, including Douglas-fir, as well as many common landscape plants. These host plants can carry the disease in their leaves, bark, and even in roots if soil is attached. *Phytophthora ramorum* has already killed tens of thousands of coast live oak, tanoak, and California black oak trees, and causes branch and twig dieback in conifers and several shrubs, as well as leaf blight in mountain laurel, camellia, and other species (U.S. Department of Agriculture, 2005). Currently, the majority of control efforts have been directed to limiting the spread through infected plant nursery stock. Current information on this plant pathogen with information on...
quarantine areas, nursery protocols, regulations, and a list of hosts and associate plants is provided on the USDA, APHIS web site (http://www.aphis.usda.gov/ppq/ispm/pramorum/overview.html).

While *P. ramorum* is a potential major disease of native and landscape plants, it has been shown that infected plant material can be managed through composting. Controlled laboratory and field experiments have indicated that the temperature and time parameters federally stipulated for commercial composting are sufficient to sanitize plant material infected by *P. ramorum* (Garbeletto 2003, Swain et. al. 2005). However, composting is not currently accepted by APHIS as an outright approved treatment for treatment of quarantined plant materials, except on a case-by-case basis, such as provided to Sonoma Compost for windrow composting in Marin County, California. There are no quarantined areas in Washington State at the time of this writing.

In additional research, Garboletto (2003) found that immature compost facilitated regrowth, while mature compost did not readily regrow the pathogen. However, resting *P. ramorum* propagules may survive if placed in mature compost. Thus, contamination by fresh, contaminated feedstocks of finished treated compost can result in contamination by the infectious agent. *Phytophthora ramorum* in small-size woody substrates will lose viability if air-dried, even without going through the composting process (Garbeletto 2003).
4.0 Best Practices

4.1 Fundamental Concept 1: Use the appropriate time and temperature for processing materials to ensure that all materials are treated.

High temperatures for a specific duration are key to inactivate or kill plant pathogenic organisms in organic materials (Ryckeboer, 2001). Research has shown that maintaining composting materials at greater than 55 degrees Celsius (°C) (equal to 131 degrees Fahrenheit) for 15 to 21 days is effective at destroying most pathogens. Temperatures greater than 65 °C for over 21 days are recommended for treatment of more resistant virus and fungi, such as tobacco mosaic virus and club root.

It is now understood that the synergistic effects of temperature, other microbes, enzymes and moisture created during the composting process, facilitate better pathogen destruction than just inactivation temperatures would predict. The self-insulation of a large (greater than 6 feet deep) pile of fresh, moist (45 to 60 percent moisture) organic matter retains tremendous amounts of heat and potential energy that is initially generated by the microbial biomass feasting on the available carbon and nutrients. Upwards of 50 percent of the heat value that would be released instantly by incineration is released slowly by microbial oxidation over 15 to 30 days (or longer) at temperatures exceeding 55°C (131°F). The process, if it gets too hot for most microbes (greater than 75°C or 167°F), can also progress into chemical oxidation processes that have the potential to spontaneously combust if not managed properly.

This method of bio-oxidative heat treatment is easy to initiate. However, making it work predictably and with assurance of pathogen control is a real management challenge for the organics processing industry. There are several basic systems of organic processing systems commonly in use which are designed to control the heating process. The basic types of systems generally recognized include:

- turned windrows or turned extended windrows,
- aerated static piles
- enclosed/in vessel systems.

Two other methods in use for organics processing are static (not turned) piles and material stockpiling. In these two systems, the material is not mixed and temperatures are generally not monitored, thus they are not recommended for control of pathogens.

Regulations for organics processing in Washington State requires that facilities that process feedstocks Type 2, Type 3 and Type 4 meet the requirements of the “Process to Further Reduce Pathogens” (PFRP). Rules for Type 1 feedstocks do not require meeting PFRP. However, we recommend that all Type 1 materials be processed by the PFRP in order to control pathogens.

4.1.1 Turned windrow systems

Studies have shown that pathogens are eliminated if the windrow is inverted (turned) and allowed to reheat for 3 days at 55 °C between each of 5 turns. Piles that are smaller than 6 feet deep are less likely to be able to buffer environmental changes and still consistently meet temperature requirements within the pile. The extended windrow and extended aerated windrow systems are modifications of the basic turned windrow systems that allow piles with less porosity to be processed. The advantage of extended turned windrows is they significantly reduce the overall exposed outer surfaces that may be below treatment temperatures. However, turning regime should still mimic the turned windrow to provide similar assurance of outer edges getting heat treatment.
4.1.2 Aerated static pile systems

Control over aeration and temperature is extremely important in aerated static pile systems (ASP). Temperature monitoring is used to control the volume of air through the piles. Aerated static piles need to have a layer of treated material placed for insulation of 1 to 2 feet deep around the processing materials to enable heating to reach all portions of the material. Often processed wood chips, wood shavings, or previously treated woody overs are used. If temperatures are too cool adjustments of the aeration system is needed, check oxygen levels, if they are too low this can reduce biological activity and temperature. On the other extreme, too much air can over cool a pile. After the time and temperature treatment is completed, the material is usually moved to a curing area to allow reheating as further assurance of pathogen destruction. Process times of 21 days or longer are usually recommended for this system.

4.1.3 In vessel systems

Compost covers have been able to reach PFRP temperatures on the compost pile surface consistently and this is one of the locations that should be monitored. Other wise turning and reheating is recommended.

4.2 Fundamental Concept 2. Avoid re-contamination of materials that have been processed.

To control the spread of pathogens, untreated contaminated materials must be kept segregated from processed materials.

4.2.1 Use a segregated site layout to control the flow pattern of material during processing

Proper site layout is the foundation for ensuring segregation of contaminated and treated materials. Effective segregation of unprocessed materials and containment of emissions from processing areas avoids contamination of processed materials. Keeping pathogenic material segregated and contained at processing sites requires management of dust, water, and the products themselves. Other best practices for segregation more easily follow when a site has a segregated layout.

An idealized facility layout (Figure 1) demonstrates several facets of a segregated layout:

1) A clearly-defined processing flow pattern, beginning at receiving and flowing all the way through to output, without a major flow of materials doubling-back or crossing-over. Another way to say this is the youngest, least processed material moves up slope through the process with the oldest, most processed material upstream. The oldest, most processed material never is exposed to younger material by runoff.

2) A receiving area is defined. The receiving area layout should enable materials to be easily processed on a first in/first out pattern.

3) Vehicle traffic is segregated. Vehicles delivering and working on incoming, contaminated feedstock are not the same vehicles handling outgoing processed materials.

4) Work areas are segregated to the greatest extent possible and workers and equipment are dedicated to either un-processed or processed materials, and these do not overlap.

5) When materials have completed the appropriate time and temperature processing, they then cross from unprocessed to processed portion of the facility.
This conceptual diagram is provided to convey an idealized layout. In reality, most processing facilities are not divided physically, nor is the location of the "dividing line" between processed and unprocessed material a feature of the site, but rather the location changes as materials complete the appropriate time and temperature requirements.

We acknowledge that for some facilities, facility segregation does not occur in the recommended manner. As we stated earlier, static pile systems are the least likely to meet the requirement of segregation because materials are not managed beyond the initial pile building. However, maintaining site segregation to the maximum extent possible in these systems will reduce the risk of producing contaminated products. Some protection is afforded when materials that have completed the first phase of heat treatment are transferred to a second area and are allowed to reheat again. This second heating cycle provides for an extra measure of safety. However, complete segregation within a facility is always recommended as the best practice. In no case should unprocessed material be combined with processed material without ensuring a sanitation process follows.

When a single facility supports multiple activities, clear segregation becomes more difficult to enforce. Again, any steps taken toward segregation will reduce the risk of producing contaminated products.

4.2.2 Plan the site layout with prevailing wind direction as a consideration
- Finished products should be upwind of strongest wind direction in relation to fresh material handling areas.
• Normal wind direction should have finished compost up wind

• Finished product storage piles should remain up wind from any receiving areas. If this not easily done, consider transporting to an offsite location.

4.2.3 Plan site layout with slope and water movement in mind

• Since water flows down hill, material under treatment should be located up slope of untreated materials.

• Locate finish materials upstream of stormwater flow.

• Finished product storage piles should remain up wind from any receiving areas. If this not easily done, consider transporting to an offsite location.

4.2.4 Keep the site clean

• Cleanup spills quickly to avoid tracking pathogens.

• Always move any spilled material towards fresher, untreated materials. This includes materials spilled from edges of piles. Never move spilled materials towards treated materials. Stated again, any materials that is of questionable treatment must be moved to untreated areas.

• Sealed asphalt or concrete is recommended as a pad for receiving and processing areas (at a minimum) to enable more complete cleanup, reduce the amount of embedded fines, and avoid tracking of pathogens from the receiving area.

• Incorporate vehicle wash down and wheel wash facilities with sediment traps in site layout.

• Wheel washing and foot dips should be flushed of all water and sediment. This is recommended as a daily practice, but may require more frequent up keep if there are high traffic loads.

• A solution containing 5 percent household strength bleach by volume can be used in wheel wash and foot dips for quick re-sanitation when passing from an un-treated area to a treated area. However, once this solution is particle laden it is no longer effective and must be replaced. Lactic acid is a new technique being investigated for sanitation by WSU and may be able to be used in stead of bleach.

• Heavy equipment from un-treated areas should be pressure washed with hot water and a biodegradable soap solution before entering treated material areas.

• Keep sediment traps clean.

4.2.5 Manage leachate appropriately

Leachate from untreated materials and processing material can contain high numbers of pathogens. Leachate must be managed appropriately so that it does not contaminate processed materials directly or lead to contamination indirectly.

• Collect and transport leachate to a collection area for treatment or reuse on untreated materials.

• Drain leachate released during tipping and grinding to a treatment area.

• Do not let leachate accumulate or be tracked to other areas.

• Use clean material as absorbent for leachate. Compost socks and berms work well for this. Absorbent material should be replaced when saturated. Saturated materials are now contaminated and should be handled as such. They can be processed with untreated materials.

• Incorporate sediment removal weirs and settling ponds in the leachate handling system. This will reduce pathogen loading to leachate holding areas since many pathogens move with particles.

• Align and shape piles so that rain and wash down water does not accumulate above the piles increasing leachate production through the bottom of the pile.
• Use collected leachate for wetting only at the grinder discharge conveyor, or when turning unprocessed materials. Never use leachate to wet finished products, wash equipment, or for dust control.
• Leachate ponds should be staged in series to encourage treatment and limit bypass of pathogens.
• All wash down water, leachate, and runoff that comes in contact with unprocessed materials must be directed to leachate collection areas.

4.2.6 Actively manage dust
Dust reduction is a priority to limiting airborne distribution of pathogens. For many materials, dust is generated during processing when moisture contents are less than about 42-45 percent.
• Use water foggers or misters at each point of material transition to increase moisture and knock dust back.
• Place windbreaks downwind of discharge conveyors, tippers, grinders, and screeners to reduce the distance dust travels by creating a dust dropout area on the lee side of the windbreak.
• Use conveyor covers, especially at conveyor transitions. This is also a good location to place to add water by misting or fogging.
• Use clean water during sweeping to reduce dust.
• Scrape and sweep often to reduce dust load in all traffic areas.
• Use clean water to wet high traffic areas during dry weather reducing dust generation between sweeping and scraping activities. Water trucks or timed sprayers can be used for this.

4.2.7 Use clean water
Water is an important amendment in organic materials processing. Use only clean water; using contaminated water would facilitate the spread of pathogens.
• Use clean, uncontaminated water for road wash down, other dust suppression, and equipment cleanup.
• Use a solution of 5 percent household bleach in clean water washes for all hand equipment, boots, and gloves after contact with unprocessed materials. Always rinse with clean water after using a chlorine solution. Lactic acid is a new technique being investigated for sanitation by WSU and may be able to be used in stead of bleach.

4.2.8 Manage vehicles and equipment
• Separate entrance/exit and traffic circulation pattern for receiving feedstock area and finished product load out area. Separate entrance or traffic pattern for feedstocks versus finished product exit.
• Use sanitizing wheel wash for all vehicles entering finished product areas.
• Use sanitizing wheel wash for all vehicles leaving any unprocessed materials areas.
• If turners and loaders are used on both processed and unprocessed materials, they must be cleaned before handling materials that have achieved sanitation. Steam and pressure washing are recommended, removing solids from all exposed surfaces. Use of a biodegradable soap is recommended.
• When turning windrows, always move from oldest to newest materials.
• Blenders should only be used for one age of material or must be cleaned out and sanitized between handling of materials of different stages.
• Clean all processing and handling equipment completely, including steam or pressure washing.
• Assure all that material put into the screener has completed time and temperature requirements.
• Keep a loader on treated side of facility at all times during screen filling and product removal especially when moving overs towards the untreated side for reuse. Do not use same loader to enter receiving area, or other areas that contain unprocessed materials. Consider the use of conveyors to send overs back to the front of the process.
• Do not allow foot traffic between unprocessed materials areas and processed materials areas without sanitation procedures taken.

4.2.9 Actively manage stockpiles
Many facilities stockpile finished materials and amendments. These need to be managed to prevent their contamination or contamination of other finished materials.

• Use physically separate stockpiling areas for materials that have already completed a treatment process and those which have not. Do not manage unprocessed amendments as treated materials. Rather always treat these as if they do contain pathogens.
• Stockpiles should be turned regularly. Before turning scrape off the outer layers of stockpile to a depth of at least 2 feet and pile for retreatment.

4.2.10 Segregate tools and containers
Tools and containers may carry pathogens from one location to another. All tools and containers should be managed. This includes for example, shovels, brooms, wheelbarrows, garbage containers, footgear, and work gloves.

• Designate and label tools and containers exclusively for use in specific areas. For example tools should be dedicated for use where materials have not yet been processed and other tools for handling finished materials.
• Wash and sanitize tools and containers prior to removing from an unprocessed materials handling area.
• Wash and sanitize tools and containers again prior using or entering finished product areas.
• If any tool or container must be used for finished materials after coming into contact with unprocessed materials it must be sanitized first.
• A 5 percent solution of common household bleach is the most common chemical disinfectant for use on tools and containers. Chlorine is a very powerful oxidant and must be used with caution as it can cause severe burns to mucous membranes and eyes, and ruin clothes and other surfaces. In all cases, surfaces must be free of particulate matter and soap residue, before rinsing with chlorine solution. Organic material and sunlight inactivate the solution. Always rinse with clean water after using a chlorine solution. Lactic acid is a new technique being investigated for sanitation by WSU and may be able to be used instead of bleach.

4.2.11 Eliminate pathogen vectors
Pathogen vectors include rats, mice, flies, seagulls, pigeons, crows or any thing that can carry disease from one place to another. Vectors must be eliminated from processing facilities.

• Reduce exposure by covering or enclosing unprocessed materials that is attractive to vectors, such as food waste, fall season yard debris, or other organic materials.
• Bait or trap all vectors known to be living on site.
• Track and report efficacy of systems used to control vectors, don’t assume they are working.
• Block bird nesting areas and landing areas.
• Use pin strips on buildings and other flat surfaces to eliminate roosting.
• Installing thin guy wires, firing artillery cap guns, and an occasional dead seagull left in view are often effective against seagulls.
• Remove standing water.
• Cool or saturated edges of fresh processing and receiving piles should be scraped up and placed on the top of the piles or back to the front of the process at least every 3 days to break the egg to larval cycle for flies.
• Bug zappers should be used at all entries of areas used as eating areas or break rooms.

4.2.12 Inform personnel on methods to avoid contamination and to protect their own health.
• Use signs to communicate and enforce rules regarding site segregation.
• Develop and follow a facility health and safety plan.
• Train personnel on site segregation and personal health and safety.
• Coveralls, gloves, hats, and boots should be provided to all personnel. These should remain and be laundered at the job site.
• Used personal equipment must be bagged before leaving site.
• Employees should wash and change clothes prior to entering any living or eating area outside the facility.
• Wash hands and face prior to eating, drinking, or smoking. Also washing hands prior and after using the toilet.
• Require dust masks for all personnel and visitors at operations where unprocessed or dusty material is handled.
• All cuts or wounds must be immediately cleaned and bandaged and protected from exposure until healed.
• Deep wounds require immediate medical attention with disclosure of potentially infectious working conditions. If possible, wash and change clothing prior to receiving medical attention.

4.2.13 Test to verify that facility management is resulting in clean products.
• Employ good sampling procedures. Refer to Test Methods for Examination of Composting and Compost published by the U.S. Composting Council (http://tmecc.org/tmecc/) for detailed sampling procedures.
• Use laboratories approved for analysis of organic materials.
• Keep data records. Especially keep records on recorded temperatures, times of treatment, names of piles, locations, and laboratory testing data.
• Review laboratory and process data frequently and update processes as needed to improve effectiveness.

4.2.14 Stay current
• New treatment methods and process approaches are being developed.
• Regulations change.
• New threats from pathogens can be identified at any time.
• Membership in the Washington Organic Recycling Council can help keep you informed.
4.3 Special considerations for handling materials known to be contaminated with *P. ramorum*.

- Do not knowingly receive unprocessed materials from areas quarantined by APHIS, Washington State Department of Agriculture, or other jurisdictions without prior approval from USDA APHIS.

- Currently, the only composting method officially approved by the USDA APHIS for treatment of known *P. ramorum* contaminated materials is turned windrows (15 days minimum and 5 turns).

- Do not receive known or likely infected material in the same location as other feedstocks.

- Place known contaminated material in area that minimizes crossing traffic patterns.

- Contain runoff and leachate from this area. Direct drainage to leachate treatment area.

- Use equipment dedicated to the material and receiving area, especially loader and excavator.

- If separate processing streams for *P. ramorum* infected and non-infected materials is required, and the same equipment will be used for both streams, then a transition plan must be developed which include equipment sanitation procedures.

- Minimize/prevent precipitation run off from “raw” untreated/uncomposted piles of organic waste to nearby host plants in the surrounding landscape, local waterway and to composting or composted materials. All waste that is brought into an organic waste treatment site potentially carries soil and waterborne plant pathogens. One way to accomplish this is to cover piles of organic waste so precipitation does not run through the debris and then off site before the waste begins the composting process.

- Avoid or minimize accumulation of standing surface water (puddles) and promote good water drainage onsite. *P. ramorum* and other soil and waterborne plant pathogens thrive under wet conditions, standing puddles increase the likelihood of *Phytophthora* populations persisting onsite.

- Promote good site sanitation by avoiding the accumulation of organic debris such as leaves and wood material between raw wastes and composting piles. Such organic debris harbor up to 86% of *Phytophthora* populations in the soil profile (Dart and Chastagner, 2007). By practicing good sanitation you are potentially reducing inoculum levels greatly.

- Do not let finished composted products come into contact with bare soil, store composted products on concrete, asphalt or well drained gravel. Bare soil often contains populations of *Phytophthora* and compost stored on soil has potential to spread exotic and endemic populations of *Phytophthoras* as has been demonstrated with contaminated pots in nursery systems (Dart and Chastagner, 2007).

- Nursery personnel should be educated to recognize and report pest or disease problems resembling those of *P. ramorum* on host plants established on organic processing sites and adjacent properties. Information on training opportunities and free online resources in Washington are available at the following link. [http://www.puyallup.wsu.edu/ppo/resources.html](http://www.puyallup.wsu.edu/ppo/resources.html)
Resources


Burtscher, Carola and Wuertz, Stefan Evaluation of the Use of PCR and Reverse Transcriptase PCR for Detection of Pathogenic Bacteria in Biosolids from Anaerobic Digestors and Aerobic Composters. Applied And Environmental Microbiology, Aug. 2003, p. 4618–4627 Vol. 69, No. 8


CIWMB Regulations: Title 14, Natural Resources Division 7, Chapter 3.1 Composting Operations Regulatory Requirements http://www.ciwmb.ca.gov/Regulations/Title14/ch31a5.html#article7


Environmental Protection Agency, Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge, EPA/625/R-92/013 Revised 2003

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