

Compost Myths

TURNING THE PILE

What is one of the first things that comes to mind when one thinks about compost? Turning the pile. Early researchers who wrote seminal works in the composting field, such as King, Howard, Gotaas, and Rodale, emphasize turning compost piles. For example, Robert Rodale wrote in the February 1972 issue of *Organic Gardening*, “We recommend turning the pile at least three times in the first few months, and then once every three months thereafter for a year.”

A large industry has emerged from this philosophy, one that manufactures expensive compost turning equipment, and a lot of money, energy, and expense go into making sure compost is turned regularly. For some compost professionals, the suggestion that compost doesn't need to be turned at all is utter blasphemy. Of course, you have to turn it — it's a compost pile, for heaven's sake.

Or do you? Well, in fact, no, you don't, especially if you're a backyard composter, or even if you're a large-scale composter. The perceived need to turn compost is one of the myths of composting.

Turning compost potentially serves four basic purposes. First, turning is supposed to add oxygen to the compost pile, which is supposed to be good for the aerobic microorganisms. We are warned that if we do not turn our compost, it will become anaerobic, smell bad, and attract rats and flies. Second, turning the compost ensures that all parts of the pile are subjected to the high internal heat, thereby ensuring total pathogen death and yielding a hygienically safe, finished compost. Third, the more we turn the compost, the more it becomes chopped and mixed, and the better it looks when finished, rendering it more marketable. Fourth, frequent turning can supposedly speed up the composting process.

Since backyard composters don't actually market their compost,

usually don't care if it's finely granulated or somewhat coarse, and usually have no good reason to be in a hurry, we can eliminate the last two reasons for turning compost. Let's look at the first two.

Oxygen is necessary for aerobic compost, and there are numerous ways to aerate a compost pile. One is to force air into or suck air through the pile using fans, which is common at large-scale composting operations where air is pulled from under the compost piles and pumped out through a biofilter. The suction causes air to seep into the organic mass through the top, keeping it aerated. Such mechanical aeration is never a need of the backyard composter and is limited to large scale composting operations where the piles are so big, they can smother themselves if not subjected to forced aeration.

Aeration can also be achieved by poking holes in the compost, driving pipes into it and generally impaling it. This is popular among some backyard composters. A third way is to physically turn or dig the pile. A fourth, largely ignored way, however, is to build the pile in a constructed bin above ground allowing tiny interstitial air spaces to be trapped in the compost. This is done by using materials in the compost such as hay, straw, weeds, and the like. When a compost pile is properly constructed, no additional aeration will be needed. Even organic gardening pros such as Rodale admit that, *“good compost can be made without turning by hand if the materials are carefully layered in the heap which is well-ventilated and has the right moisture content.”*¹

Recall Sir Albert Howard and the Indore composting method in India back in the early 1900s. Many would argue that this is where composting got started both as a science and as a widespread practice. Howard's piles were open piles with exposed outer surfaces. If you ever pile up manures and food scraps in an open pile, you will soon notice two things: flies and odors, both of which are highly undesirable. What you can't see, but will soon realize, is that the interior of the pile is heating up while the outer surfaces are not. All three of these conditions can be rectified by repeatedly stirring up the organic mass, as Howard instructed. However, there is an alternative.

When I toured large-scale compost operations in Arizona as part

of a Compost Operator's Training Course, I noticed that almost all of the compost operations refused to accept food scraps or manure, only accepting yard trimmings and landscape residues. They all composted in outdoor piles or windrows and apparently none of them wanted to deal with the flies and odors from manure and rotting food.

I met a group of Brazilian agronomists in Mozambique when I was there on assignment composting blackwater from school latrines. When the agronomists found out I was making compost, we entered into a lively discussion. About three years prior, they had introduced composting to farmers in Brazil as a means of recycling manures and other organic materials. The farmers were enthusiastic to learn how to make compost. So, I asked, that was three years ago, how is it progressing today? Oh, they quit making the compost. Why?! Because turning the piles was too much work, so they just abandoned it altogether! But you don't have to turn compost piles, I told them. It's a huge amount of work and it's completely unnecessary. No wonder they quit.

My first trip to Haiti in 2010, shortly after the earthquake, was to teach people how to make and use compost toilets, since they didn't have any toilets and many thousands were living in tents. I began by working with a local group who already had a small composting operation in progress. In a walled outdoor enclosure, they were piling food scraps and organic garbage in a big pile. It was, of course, covered in flies, and it smelled really bad. Once the pile was big enough, they would attempt to turn it using shovels, but since it was laced with tree fronds, scrap fabrics, and other such materials, it was extremely difficult to turn by hand, and no machinery was available. I said, no, no, no, that's not how you make compost! Why are you doing it like this? Because a teacher from Europe came and told them this was how it was supposed to be done.

But composting is easy. Let the microbes do the work, especially if you're composting smelly things such as toilet materials, dead animals, and food scraps, all of which will stink like hell and attract flies, rats, and dogs if you don't manage your pile correctly. The trick is always to keep the compost vertically contained and keep it covered. In Haiti

we used recycled pallets standing on edge for side walls for the compost bins. We had to pay about \$5 each for the pallets. In Africa we used wire fencing looped into circular bins. These bins cost about \$15 US per household. The point is to hold the organic material vertically above ground. If it's above ground and not underwater (like Howard's pits), the organic mass will be aerobic. No forced aeration will be needed, and no poking, prodding, digging, or turning whatsoever is required. The second trick is to put a thick layer of "cover material" underneath the pile, then create a layer of cover material surrounding the composting mass. Finally, always keep a substantial layer of cover material on top of the pile, too. We used sugarcane bagasse in Haiti, a by-product of the rum industry, as cover material. At home I mostly use straw. When adding fresh material to your compost bin, pull aside the cover material, dig a hole in the underlying compost, deposit the new material in the hole, cover it with the existing compost, pull the cover material back over, then add more cover material as needed. This feeds fresh material directly into the center of the pile, leaves no exposed surface areas, and eliminates odors, flies, and any need to turn or agitate the pile. It's that simple.

I can assure you that if you're composting material from toilets, you don't want to be turning the pile if you don't have to. I turned my piles dutifully for the first decade, as we are told to do, then figured out the alternatives. It is a huge amount of work to turn compost piles (the Brazilian farmers were correct), and why do it if it's not necessary? Making compost can be like baking bread — you put it in the oven, let it cook, and don't touch it until it's completely done, then you pull it out and it's ready. When making compost, you put the organic material in the bin enveloped by cover material, like a bread dough in a bread pan, and then wait. When the temperature drops to ambient outdoor temperature, and not before, then you can take the bread out of the oven. The rule of thumb is that once the pile is completely built, wait a year before harvesting the compost (give or take a couple of months). There are various other things to take into consideration — the compost pile can't be too high, for example, but the details of bin

composting are discussed in the *Tao of Compost* chapter.

What about the oxygen content of the pile? Researchers measured oxygen levels in large-scale windrow composting operations (a windrow is a long, narrow, exposed pile of compost) reporting, “Oxygen concentration measurements taken within the windrows during the most active stage of the composting process, showed that within fifteen minutes after turning the windrow, supposedly aerating it, the oxygen content was already depleted.”² Other researchers compared the oxygen levels of large turned and unturned batch compost piles and have come to the conclusion that compost piles are largely self-aerated. “The effect of pile turning was to refresh oxygen content, on average for [only] 1.5 hours (above the 10% level), after which it dropped to less than 5% and in most cases to 2% during the active phase of composting Even with no turning, all piles eventually resolve their oxygen tension as maturity approaches, indicating that self-aeration alone can adequately furnish the composting process In other words, turning the piles has a temporal but little sustained influence on oxygen levels.” The trials compared compost that wasn’t turned, bucket turned, turned every two weeks, and turned twice a week.³

Interestingly enough, the same trials indicated that bacterial pathogens were destroyed whether the piles were turned or unturned, stating that there was no evidence that bacterial populations were influenced by turning schemes. There were no surviving *E. coli* or *Salmonella* strains, indicating that there were “no statistically significant effects attributable to turning.”

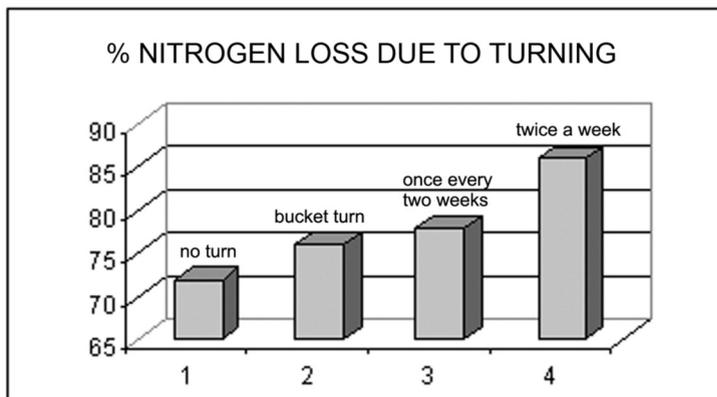
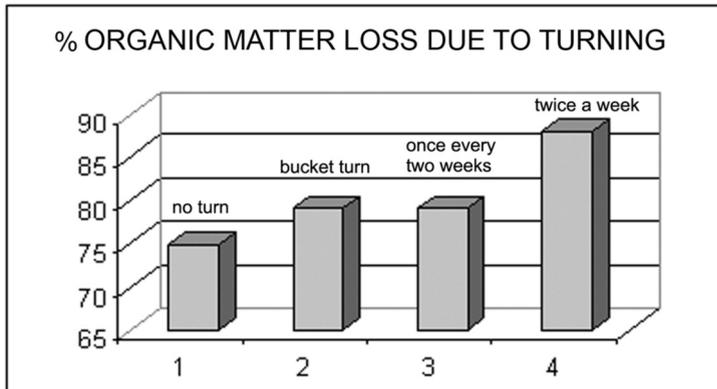
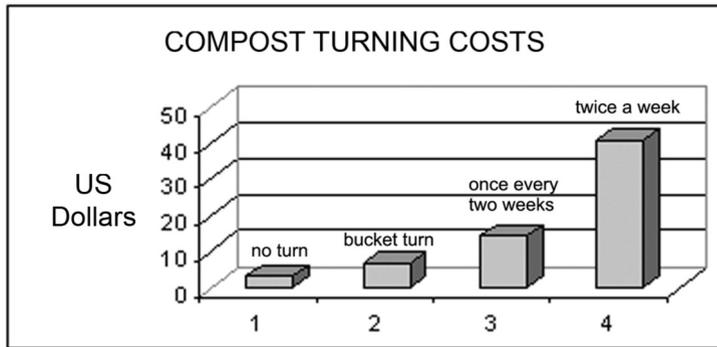
The more frequently compost piles are turned, the more agricultural nutrients they lose. When the finished compost was analyzed for organic matter and nitrogen loss, the unturned compost showed the least loss. The more frequently the compost was turned, the greater was the loss of both nitrogen and organic matter. Also, the more the compost was turned, the more it cost. The unturned compost cost \$3.05 per wet ton to produce, while the compost turned twice a week cost \$41.23 per wet ton, a 1,350 percent increase. The researchers concluded that “composting methods that require intensification [frequent turn-

ing] are a curious result of modern popularity and technological development of composting as particularly evidenced in popular trade journals. They do not appear to be scientifically supportable based on these studies. . . . By carefully managing composting to achieve proper mixes and limited turning, the ideal of a quality product at low economic burden can be achieved.”⁴ Another study concluded that the turning frequency of yard refuse windrow compost did not improve aeration, had little impact on temperatures, and increased the bulk density of the compost, which actually reduces oxygen availability.⁵

When large piles of compost are turned, they give off emissions of such things as *Aspergillus fumigatus* fungi, which can cause health problems in people. Aerosol concentrations from static (unturnd) piles are relatively small or nonexistent when compared to mechanically turned compost. Measurements thirty meters downwind from static piles showed that aerosol concentrations of *A. fumigatus* were not significantly above background levels and were “33 to 1800 times less” than those from piles that were being moved.⁶

The Cornell Waste Management Institute published a document in 2007 that summarized the issues related to compost bioaerosols released during the turning and screening of compost. Elevated levels of bioaerosols can be detected downwind from outdoor composting facilities to distances of 650 to 1,640 feet. They can contain particles of bacteria, fungi, viruses, allergens, endotoxins, antigens, various toxins, glucans, mold components, pollen, plant fibers, and so on. Compost bioaerosols can also contain sulfur and nitrogen compounds, volatile fatty acids, ketones, terpenes, aldehydes, alcohols, and ammonia compounds that are associated with compost odors.⁷

The bioaerosols can cause a wide range of adverse health effects and infection, including contagious diseases, acute toxic effects, allergies and cancer, as well as possibly pre-term births or late abortions and dermatitis. People can become sensitized to some bioaerosols from repeated exposures. Particulates and pieces of bacteria (endotoxin), spores, and fungal hyphae can produce irritation, allergy, and toxic reactions. An association was found in residents between their distance



Source: Brinton, William F. Jr. (1997). Sustainability of Modern Composting - Intensification Versus Cost and Quality. Woods End Institute, PO Box 297, Mt. Vernon, Maine 04352 USA.

to an outdoor composting facility and respiratory symptoms and general health complaints, but not allergies or infectious disease. Acute and chronic respiratory health effects, mucosal membrane irritation, skin diseases and inflammatory markers were elevated in compost workers, and several studies indicate high prevalence of respiratory

symptoms and airway inflammation. Compost workers had significantly more symptoms and diseases of the airway and skin than control subjects. Increased antibody concentrations against fungi and actinomycetes were also found in compost workers.⁸

Minimizing agitation, spraying water to control dust, and monitoring wind speed and direction to avoid stirring up the compost when winds are likely to blow toward the neighbors, can help minimize impacts. As already mentioned, frequency of turning has little impact on keeping compost piles aerated; instead, increased turning can increase bulk density and actually *reduce* air flow through the compost pile. A blanket of finished compost on top of unfinished piles can reduce odor and volatile organic compound (VOC) emissions, according to the Cornell paper.⁹ Instead, I recommend a clean cover material such as hay, straw, or something similar to cover the compost piles; it can be removed later and used to make the next batch of compost. A generous cover material and no agitation of the pile will reduce odor emissions to zero, thereby eliminating the negative health effects of inhaling compost bioaerosols. Those volatile fatty acids, ketones, terpenes, aldehydes, alcohols, ammonia, bacteria, fungi, viruses, allergens, endotoxins, antigens, various toxins, glucans, mold components, pollen, plant fibers, and so on that are inside the compost pile belong *inside* the compost pile. What's the point of releasing them into the air? If turning has no significant effect on the pile's oxygen levels, why is the compost being turned? Someday, one of these compost operators is going to build a pile correctly, cover it, then just leave it alone. After the pile has fully matured, he or she will dig it out and find beautiful compost. The microorganisms did the dirty work, and they loved it.

Turning compost piles in cold climates can also cause them to lose too much heat. It is recommended that cold climate composters turn less frequently, if at all.¹⁰ I recommend not turning. In fact, what's the point of diminishing the heat of the pile, no matter what the climate? That's what turning the pile does. That's why there are large clouds of vapor billowing off large compost piles as they're being turned by machines. It's the heat, and lots of other things, escaping into the air.

COMPOST INOCULANTS

Do you need to inoculate your compost pile? No. This is perhaps one of the most astonishing aspects of composting. In October of 1998 I took a trip to Nova Scotia, Canada, to observe the municipal composting operations there. The province had legislated that as of November 30 that year no organic materials could be disposed of in landfills. By the end of October, with the “ban date” approaching, virtually all municipal organic garbage was being collected and transported instead to composting facilities, where it was effectively being recycled. The organic material was checked for contaminants such as bottles and cans, run through a grinder, and finally shoved into a concrete compost bin. Within twenty-four to forty-eight hours, the temperature of the material would climb to 158°F (70°C). No inoculants were required. The thermophilic bacteria were already there.

Researchers have composted materials with and without inocula and found that, “although rich in bacteria, none of the inocula accelerated the composting process or improved the final product. . . . The failure of the inocula to alter the composting cycle is due to the adequacy of the indigenous microbial population already present and to the nature of the process itself. . . . The success of composting operations without the use of special inocula in the Netherlands, New Zealand, South Africa, India, China, the USA, and a great many other places, is convincing evidence that inocula and other additives are not essential in the composting of [organic] materials.”¹¹ In *The Science of Composting*, the topic is summed up by stating “no data in the literature indicate that the addition of inoculants, microbes, or enzymes accelerates the composting process.” Instead, “particle size, optimum moisture, and optimum C/N ratio. . . . appears to provide the best conditions for optimum composting.”¹² Other researchers have arrived at similar conclusions.¹³

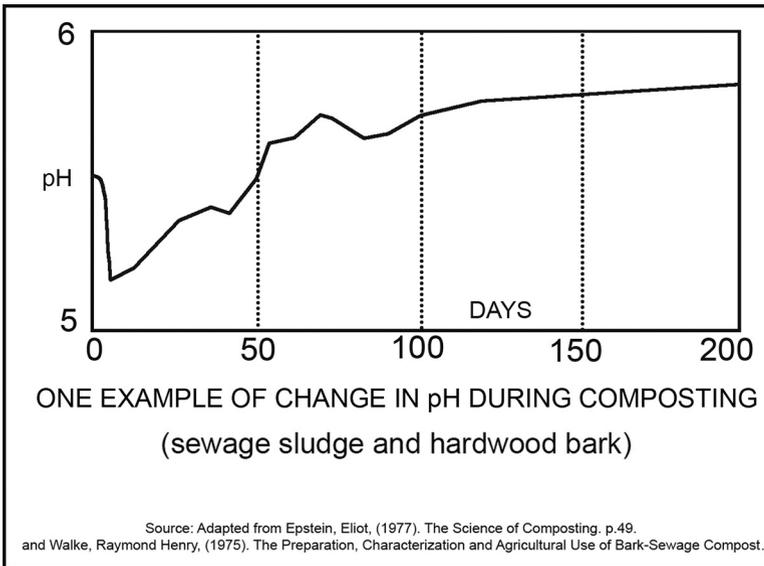
On the other hand, a 2017 study indicated that composting plants in China were beginning to use microbial inoculants. They concluded that the addition of an inoculant when composting pig manure “in-

creased the temperature at the early stage of composting and reduced the maturation time when compared to non-inoculant controls.”¹⁴

LIME

The belief that compost piles should be limed is a common misconception, probably dating back to Sir Albert Howard and the Indore process. Nor are other mineral additives needed in your compost. If your soil needs lime, put the lime in your soil, not your compost. Bacteria don't eat limestone; in fact lime is used to kill bacteria in sewage sludge — it's called lime-stabilized sludge.

Aged compost is not acidic. The pH of finished compost should slightly exceed 7 (neutral). What is pH? It's a measure of acidity and alkalinity that ranges from 1 to 14. Neutral is 7. Below 7 is acidic; above 7 is basic or alkaline. If the pH is too acidic or too alkaline, bacterial activity will be hindered or stopped completely. Lime and wood ashes raise the pH, but wood ashes should also go straight on the soil. The compost pile doesn't need them. It may seem logical that one should put into one's compost pile whatever one also wants to put into one's soil, as the compost will end up in the soil eventually, but what one



Scientists who were studying various commercial fertilizers found that agricultural plots to which composted sewage sludge had been added made better use of lime than plots without composted sludge. The lime in the composted plots changed the pH deeper in the soil, indicating that organic matter assists calcium movement through the soil *better than anything else*, according to research chemist Cecil Tester, Ph.D.¹⁸ The implications are that lime should be added to the soil *when compost is added to the soil*.

Gotaas sums it up best: “Some compost operators have suggested the addition of lime to improve composting. This should be done only under rare circumstances such as when the raw material to be composted has a high acidity due to acid industrial wastes or contains materials that give rise to highly acid conditions during composting.”¹⁹

WHAT NOT TO COMPOST

I get perturbed when I see compost educators telling their students that there is a long list of things “not to be composted!” This prohibition is always presented in such an authoritative and serious manner that novice composters become concerned at the thought of composting any of the banned materials. I can imagine naive composters armed with this misinformation carefully segregating their food scraps, so the wrong materials don’t end up in the compost pile. Those “banned” materials include meat, fish, milk, butter, cheese and other dairy products, bones, lard, mayonnaise, oils, peanut butter, salad dressing, sour cream, weeds with seeds, diseased plants, citrus peels, rhubarb leaves, crab grass, pet manures, bread products, rice, tea bags, and perhaps worst of all — human manure. Presumably, one must segregate half-eaten peanut butter sandwiches from the compost bucket, or any sandwich with mayonnaise or cheese, or any left-over salad with salad dressing, or spoiled milk, or orange peels, all of which must go to a landfill and be buried under tons of dirt instead of being composted.

The United States EPA lists the following materials they say should not be composted at home: dairy products, butter, milk, sour

cream, yogurt, eggs, diseased plants, fats, grease, lard, oils, meat, fish, bones, dog or cat feces, and soiled cat litter, among other things.²⁰

Luckily, I was never exposed to such instructions, and my family has composted everything on that list. Yes, all tea bags go into the compost, tags and strings attached. I often make fresh-squeezed citrus juice in the winter months and I put buckets of citrus peels in the compost. I composted menstrual pads for years, and probably have cycled at least fifty dead animals through my roughly one cubic meter home compost bin — so far. We’ve done this in our property for forty years with never a problem. Why would it work for us and not for anyone else? The answer, in a word, if I may hazard a guess, is *humanure*, a staple food for our compost microbes, and another forbidden compost material.

When compost heats up, much of the organic material is quickly degraded. This holds true for oils and fats, or in the words of scientists, “Based on evidence on the composting of grease trap wastes, lipids [fats] can be utilized rapidly by bacteria, including actinomycetes, under thermophilic conditions.”²¹ The problem with the materials on the “banned” list is that they may require thermophilic conditions for best results. Otherwise, they may just sit in the compost pile and look very attractive to the wandering dog, cat, raccoon, or rat. Ironically, when the forbidden materials, including humanure, are combined with other compost ingredients, thermophilic conditions will prevail. When humanure and the other controversial organic materials are segregated from compost, thermophilic conditions may not occur at all. This is a situation that is probably quite common in many backyard compost piles. The solution is not to segregate materials from the pile, but to add nitrogen and moisture, as are commonly found in manure.

Furthermore, it’s how you manage your compost that makes a difference, too. Never put anything *on* your compost pile, always add materials *into* your pile. And always keep a generous, clean, organic cover material on your compost, such as grass, hay, straw, weeds, or leaves. When you bury that leftover pork chop *inside* your active compost pile, then cover it over with a clean cover material, there’s no reason for a wandering dog or raccoon to have any interest in it at all.

Compost educators would provide a better service to their students if they told them the truth — almost any organic material will compost — rather than give them the false impression that some common food materials will not. Granted, some things do not compost very well. Bones are one of them, but they do no harm in a compost pile.

What not to compost: sawdust from CCA pressure-treated lumber, which is now largely prohibited by the EPA for residential use but is still available for commercial and agricultural use. Researchers in 2017, on the other hand, composted wood contaminated with arsenic, chromium, copper, and lead paint, along with sewage sludge, and concluded that “treated wood...will not significantly degrade the quality of biosolids compost products.”²² Other researchers have composted creosote treated wood and concluded that composting was “an extremely efficient and sustainable treatment for contaminated wood.”²³

Don't try to compost things that the microbes don't want to eat, such as ashes (wood or coal), ground minerals, heavy metals, plastics, rubber, glass, and synthetic fertilizers. Having a compost pile is like having a goat in your back yard. Keep it fed with what it likes to eat, and you'll keep it happy!

