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Composting Your Organic Kitchen Wastes with Worms

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Introduction

Every home kitchen generates food scraps for disposal. Throwing these scraps in the garbage can create odor problems and adds to the volume of waste going to the landfill. Disposing of kitchen scraps in a garbage disposal is convenient, but it adds to the burden of the waste-treatment system and throws away a potentially valuable resource. Furthermore, garbage disposals are not recommended for homes that rely on a septic system for waste disposal. A viable alternative to disposing of food scraps in the landfill or the sewer system is to compost them. The resulting material is a useful addition to gardens and potted plants.

What Is Composting?

Composting is a process by which organic materials, such as kitchen scraps and lawn trimmings are converted from an unstable product, which is likely to further decompose and create objectionable odors, to an increasingly more stable product that will store well without being offensive. A diverse population of microorganisms and invertebrates, called decomposers, performs this process. Various decomposers have different temperature and food requirements, thus the makeup of the population present in a compost system continuously changes as conditions change. Most people think of composting as a pile of organic materials that slowly decomposes and creates heat. This is called *thermophilic* composting because it relies primarily on high-temperature tolerant microorganisms. Another form of composting is called vermicomposting.

Vermicomposting

In vermicomposting, the primary agents of decomposition are worms. They convert raw organic wastes to a nearly stable humus-like material. The main process by which organic materials are converted occurs as the wastes pass through a worm's gut and are digested by the worm. Worms stir and aerate the waste pile, so that turning is not required. Worms can stabilize organic materials faster than microorganisms because they grind the material, thus increasing its surface area and speeding decomposition by microorganisms. The material that results from the vermicomposting process is called vermicompost. Material that actually passes through the gut of a worm is called castings. Vermicompost contains a large fraction of castings, but some of the material will have decomposed from microorganisms alone, without passing through a worm.

The most common composting worm species in North America is *Eisenia fetida*. Common names for this worm include tiger worm, brandling worm, red wiggler, and manure worm. This worm is a litter dweller; i.e. it likes to live in piles of organic matter such as leaf litter. Earthworms, such as the night crawler, are burrowing worms that live deeper in the earth. They are not composting worms.

Creating the Correct Environment for *Eisenia fetida*

Successful vermicomposting requires a worm bin that provides the appropriate environmental conditions for worms. Worms breathe through their skin and require an environment that is moist, but not so wet that they drown. The material in which they live should feel like a damp sponge and release a few drops of water when squeezed.

Various worm species have different temperature requirements. *Eisenia fetida*, the one recommended for a composting worm bin, can survive at temperatures between 35° and 100°F but performs best between 65° and 78°F.

Worms do not have eyes, but they do have light receptors on their skin. They do not like light, and will quickly dig down into a bin to avoid it. For this reason, it is a good idea to provide a cover for your worm bin.

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Building a Worm Bin

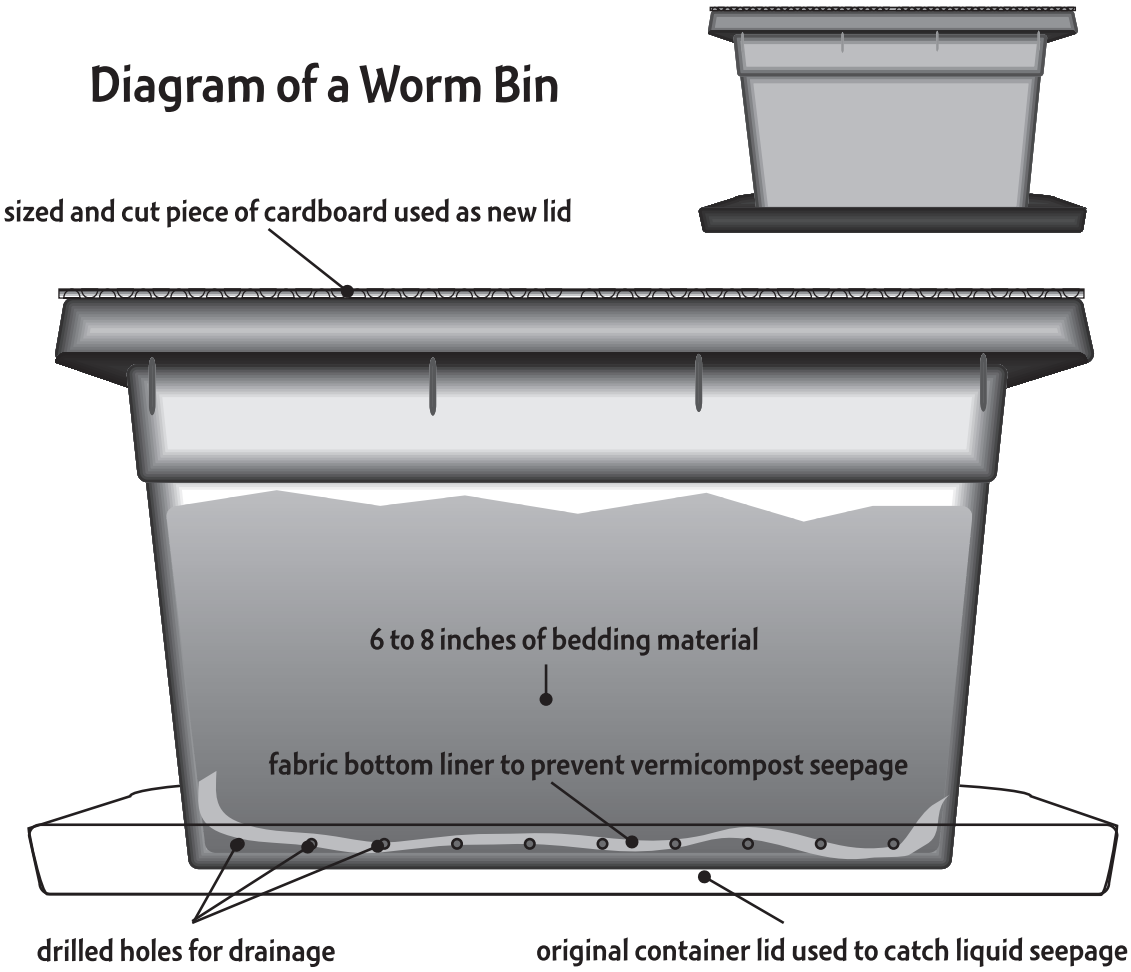
You can purchase a worm bin or you can build your own. Two things to consider when selecting a bin design are the amount of food scraps you generate and where the bin will be located. Amount of food scraps will determine the size bin you need, and location will determine whether or not the bin needs to be insulated.

A good rule of thumb for sizing a worm bin is this: you can process one-half pound of food scraps per day for each square foot of worm bin surface area. For example, a bin that is 18 inches by 24 inches (18/12 x 24/12) is 3 square feet in surface area and can process about 10.5 pounds of food a week (3 sq ft x 1/2 lb/ft sq/day x 7 days/week = 10.5 lbs).

Worms can survive over a wide range of temperatures, but temperatures below freezing or above 100°F can kill them. If your worm bin will be in a location where the temperature is moderated such as a garage, mudroom, basement, pantry, or under a sink, then you do not need to worry about insulating it. If the bin is to be out doors all winter, it is a good idea to insulate it or bury it in the ground to help prevent it from freezing.

A worm bin must be open enough to allow for good aeration. The bin should include a cover to minimize the attraction of fruit flies and other pests, but if a plastic lid is used, be sure and drill holes in it so air can get in. If the bin is inside or in a location where seepage would be a problem, it should include provisions to catch any liquid that might drain through. Bins can be made of a variety of materials—wood and plastic are common.

The simplest way to construct a bin is to purchase a plastic storage container, drill holes in the bottom and lay down a piece of fabric, e.g. nylon, inside the container to prevent the vermicompost from falling through the holes. The container can be placed on top of its lid with the lid turned up to catch any liquid that might seep out through the bin. If you use the lid as a catchment tray, then a piece of cardboard cut to fit directly on the top surface of the bin will make an excellent cover for the bed. If you want to use the original storage container cover for the lid to your worm bin and devise something else to use as the liquid catchment tray, be sure and drill holes in the lid to allow air into the bin. Even if you use the plastic container lid with holes on top of the bin, it is still a good idea to place a piece of cardboard



directly on top of the worm bin surface to discourage fruit flies from entering the bin.

Setting Up a Worm Bin

Place a six- to eight-inch layer of bedding material in the bin. Suitable bedding materials include any non-toxic, pH-neutral material that holds water and allows air to circulate. Shredded paper, including office paper and newspaper, cardboard, and well-composted horse or cow manure all make good bedding. Glossy paper does not make good bedding. Paper and cardboard should be shredded into two-inch or narrower strips.

The bedding must be moist but it should not be dripping wet. Moisten the bedding material by soaking it in water, then drain it and squeeze out the excess moisture. The material should feel like a damp sponge. Fluff up the material to assure that it is well aerated.

Add one-half to one pound of worms for each square foot of surface area of worm bed. Because composting worms tend to live in the upper layers where the food is being added, it is the surface area of the bed, not the bed depth, that determines the worm population. Give the worms time to burrow into the bedding material before you feed them.

To discourage worms from leaving the bed, it is a good idea to leave a light on near the bin the first few days. Worms do not like light, and will not leave the bin if a light is on. It is not uncommon for worms that have been disturbed and relocated, to crawl out of a worm bin, if it is in the dark. It can be very disconcerting to see a large population of dead worms on the floor the day after you start your bin! After a week, the worms should be settled in the bin, and it is fine to turn off the light.

Worm Food

Worms can process a wide range of organic materials as long as the materials are not too salty or too acidic. Fruits, vegetables, coffee grounds and filters, and tea bags all make good worm food. Citrus fruit and peels should only be applied in small amounts because of their high acidity. Worms and microorganisms will process chopped or ground food scraps more rapidly than they will process large-sized pieces of food, but, given time, whole foods will break down. Meat, bones, dairy products, fatty or greasy foods, and pet manure should not be placed in worm beds due to odor and pathogen concerns.

To feed the worms, bury the food in clumps, putting each feeding into one small space within the bin. Feeding once or twice a week is recommended. Just place the food in a new place each time. The bin should remain covered with the cardboard except when you are feeding.

Under optimum conditions, worms can process their body weight in food each day, that is, a pound of worms can process a pound of kitchen scraps each day. Typically, however, processing rates are not that high. An over-fed worm bed can create odor problems, so it is best not to over apply. After the worms are established and reproducing, the population density in a well-operated bin should be about one pound of worms per square foot of surface area of worm bin.

Maintaining your Worm Bin

Adding Bedding: Worms need very little attention. It is a good idea to add new bedding material to the bin about every two months. This will replace the bedding that the worms have processed. A new layer of moist bedding three to four inches thick should be placed on top of the bin.

Harvesting the Vermicompost: Every three to six months or when the bin begins to fill, the worms should be separated from the vermicompost if your objective is to generate more worms. Remove the worms from the vermicompost relatively early (after two to three months), and divide the worms into new bins. Giving the worms extra room will encourage high reproductive rates.

One method for separating worms from vermicompost is to push the existing material to one side of the bin and add new bedding and food to the other side. Continue to add food only to the newly bedded side. Eventually, the worms will leave the older bedding and migrate to the side where the food is being added. At this point, the vermicompost can be removed from the older side, and additional bedding added to fill back in the empty space.

Another method for separating worms from vermicompost involves dumping the entire bed onto a sheet of plastic and sorting through the mass. Separate the material into several piles and shine a light on the area. This will cause the worms to burrow down into it the castings and the top layer can be removed by hand. The worms will burrow down again, and within a few minutes, the top layer can be removed. This process is repeated until the worms concentrate in each pile and most of the vermicompost has been removed. At this point, new bedding is added to the bin and the worms with the remaining vermicompost are returned to the bin.

Troubleshooting a Worm Bin

Foul Odors

A well-functioning worm bin is virtually odorless. Vermicompost has a faint earthy odor. If your bin has a foul odor it is most likely due to one of the following causes:

The bin is too wet. Do not add excessively wet food, such as watermelon rind, squashes, etc., to the bin. Mix in dry bedding and/or leave the top off to increase drying.

Overfeeding. Stop feeding the bin for one to two weeks and see if the problem is solved.

Food is exposed. Try burying the food under a one-inch layer of bedding. Alternatively, you can add moist bedding on top of the feed.

Not enough air. Make sure there are adequate holes in the bin for ventilation. Fluff the bedding or add additional bedding.

Bin Attracts Flies

A vermicomposter contains living organisms other than worms. Fruit flies cause the most complaints. To avoid flies, bury the food in the bin and do not over feed it. Keeping the bin covered will also reduce fruit flies.

Bedding Is Drying Out

Too much ventilation and/or a hot, dry room can cause a worm bed to dry out. Keep a lid on the vermicomposter and/or add water to the system.

Worms Are Crawling away from the Bin

When a worm bin is drastically disturbed, such as at start up or when vermicompost is removed from the bin, it is not unusual for the worms to crawl out. This can be prevented by leaving the bin in a lit area because worms will not crawl into the light. It is unusual for the worms to crawl out of an established bin if the environmental conditions are correct.

Worms Are Dying

If the bin smells like dead fish, the worms may be dying. Typically, the bin may be too wet, too dry, too hot, or too cold or it may need more air.

Sources for Worms

An Internet search can identify many commercial worm producers that will sell you worms. It is also possible to purchase worms at a freshwater bait shop. However, remember that the typical bait worm is not a composting worm. It is recommended that you purchase *Eisenia fetida*.

References

Noncommercial Web-based resources

http://www.bae.ncsu.edu/people/faculty/sherman/ This site, maintained by Dr. Rhonda Sherman, Extension Specialist, Solid Waste Management, University of North Carolina, contains extensive information on vermicomposting.

http://www.cfe.cornell.edu/compost/worms/basics. html This site was created by the Cornell University Composting Team.

http://www.recyclemore.org/article.asp?key=49 This site is maintained by the California Integrated Waste Management Authority. It offers information on vermicomposting, plus links to other sites.

Nonprofit Web-based resources

http://www.wormdigest.org/ This site is maintained by Worm Digest, a magazine dedicated to vermicomposting that is published four times a year. The Web site contains articles from back issues, as well as links to commercial worm producers. The magazine is based in Oregon, so most of the contacts listed are on the West Coast. However, there is a great deal of information on worm bin designs available in the back articles.

Books

Appelhof, Mary. 1997. *Worms Eat My Garbage*. Flower Press, Kalamazoo, Mich.

Hand, Julia. 1995. *Wonderful World of Wigglers*. Food Works, Montpelier, Vt.

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