

Composting is a natural process that recycles nutrients and reduces the amount of food waste that ends up in a landfill.

Why should I vermicompost?

Most food waste in the United States is sent to landfills and makes up 20 percent of the weight of the landfill. When the food waste decomposes, it produces methane gas, which is a greenhouse gas. Vermicomposting is a natural process that recycles nutrients and reduces the amount of food waste that ends up in a landfill.

that traps heat in the atmosphere). Methane is about 20 times more potent than carbon dioxide, in terms of its warming potential.

Vermicomposting recycles organic waste that may otherwise end up in landfills. It is an easy process, compared to conventional composting, which requires frequent turning and the management of complex ratios of materials. Vermicomposting is also ideal for those who don't have a place for a regular compost bin (such as apartment dwellers). As a bonus, vermicast provides many beneficial microorganisms and nutrients to the soil, including beneficial bacteria, fungi, and protozoa as well as nitrogen, phosphorus, potassium, calcium, and magnesium.

What materials do I need for vermicomposting?

You need:

- 1/2 cubic foot of soil
- 1/2 cubic foot of worm castings
- 1/2 cubic foot of kitchen scraps
- 1/2 cubic foot of straw
- 1/2 cubic foot of wood shavings

On the following pages, you'll find details and steps to take to ensure that your vermicomposting setup is successful.

The Worm Bin

Where should I keep the worm bin?

Before you choose the type of bin you want to use, consider where you will place it.

Location

A well-tended worm bin is odorless. You can keep it in a pantry, utility room, or under the kitchen sink. A garage, basement, or carport is also a potential site.

Orientation

Protect it from extreme temperatures. The north side of a structure (such as a house, shed, or garage) is preferred, because temperatures there don't fluctuate as much. The bin also needs protection from rain and wind. Place it under the eaves or a deck, or build a cover that repels rain but still allows good air circulation. An outdoor bin must also be secured against rodents, raccoons, and other animals.

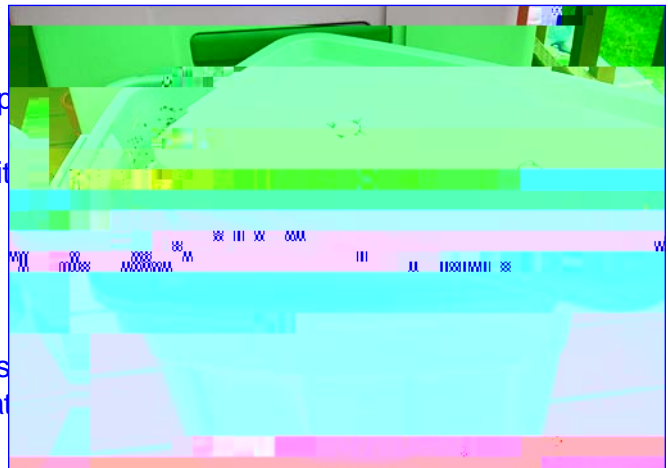
Depending on your local climate, you may choose to place your worm bin outside during the warmer months and bring it in under cover during the cooler months. Be sure to put the bin in a place you visit often!

What size worm bin should I have?

To figure out the bin size you need, you must first determine the amount of food waste your family generates in 1 week. Your worm bin must contain 1 cubic foot of space for each pound of kitchen waste. Note that this does not mean that the bin would always be full, but rather that it would provide ample space for worms to work at the right moisture and oxygen levels.

You'll need approximately 1 cubic foot of bin space and 1 pound of food waste for each pound of worms you maintain. (There are about 1,000 worms per pound.) Be sure to follow this rule to avoid an overloaded or undernourished system. Too much food may result in overfeeding and harmful anaerobic conditions for the worms. Too little food slows the worms' growth and reproduction and contributes to their demise.

A 14-gallon worm bin measuring 1 foot deep by 1 foot wide by 2 feet long (1' x 1' x 2') gives you 2 cubic feet of volume, space for 2 to 2½ pounds of worms (see figure 1). A system this size can process 2 pounds of kitchen waste per week, approximately what the average family of two or three produces. A family of four to six would need a larger bin—6 cubic feet (1' deep x 2' wide x 3' long)—and more



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worms (up to 6 pounds) to process about 6 pounds of kitchen waste per week.

Notice that in both cases the container depth stays the same. Because red wiggler worms dwell near the surface of the soil in nature, their survival in a worm bin requires that the bin space be no more than 1 foot deep. This allows for healthy aerobic conditions in the worm bin habitat.

Make sure to prepare the bin before your worms arrive. Don't worry if your measurements or methods are not exact. The worms won't notice!

What materials should I use to build it?

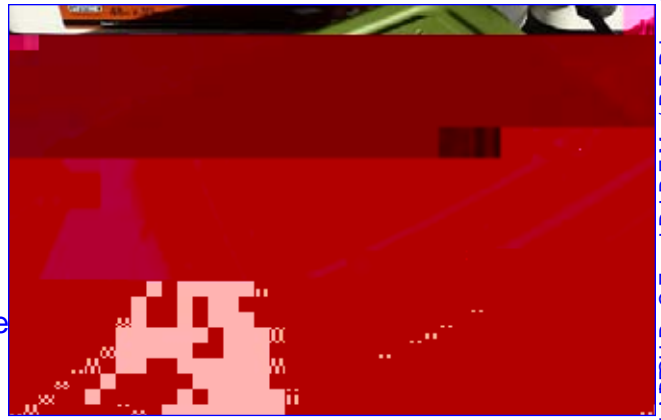
You can use a variety of materials to build a worm bin. Plastic totes, wooden bins, and commercial, stackable worm towers all are popular (Table 1). You also can use a shipping crate or food storage barrel—a great way to repurpose and recycle one. Just be sure that the wood was not treated with chemicals and that other toxic materials have not

of the second bin. ey keep the top bin from sticking and make it easy to li out. Use plastic for spacers. Wood and bricks are hard to clean.

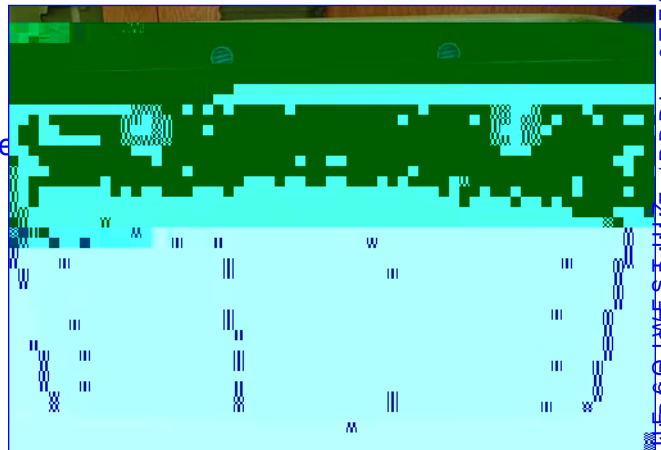
Drill up to 20 ¼-inch holes in the bottom of the rst tote (gure 4). ese holes allow for drainage. ;Xag ZShWa_ WUS^hWfe/ YgdWfiXds[d circulation, drill four (or more) 1-inch holes for them along the top edge of the rst bin. Otherwise, drill up to 10 ¼-inch holes on the sides, 2 to 3 inches below the lip of the tote (gure 6), for ventilation. You can drill up to ve 1-inch holes tted with vents on the lid of the vermicomposting bin (gure 2) to aid in air circulation. If you do this, be sure that the bin is not le out in the rain. If you wish, you can [dS^SVd[bY/ YgdWfia` fZVWA` VT[fa make it easier to drain the leachate.

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the stacking tray system operates on the fact that worms follow food. Put bedding and worms in the Taffa_ fdkS'a` Yi [fZ XaVeUSe/ YgdWfbSWfi. Once the food scraps are converted to compost, the worms look for a new source of food. Stack a new tray of fresh bedding and food scraps on top of the rst tray. e worms wriggle their way through small ZaW[fZVWaffa_ aXZVabfdk/ YgdWfbSYWfi to get to the food above. You harvest the compost in the rst tray, and keep stacking new trays on top. ? aefZShVSVd[SYWfSk/ YgdW#fbSYWfif fZW very bottom to collect leachate.

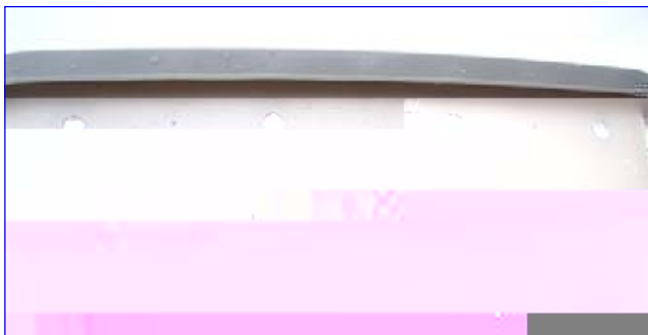


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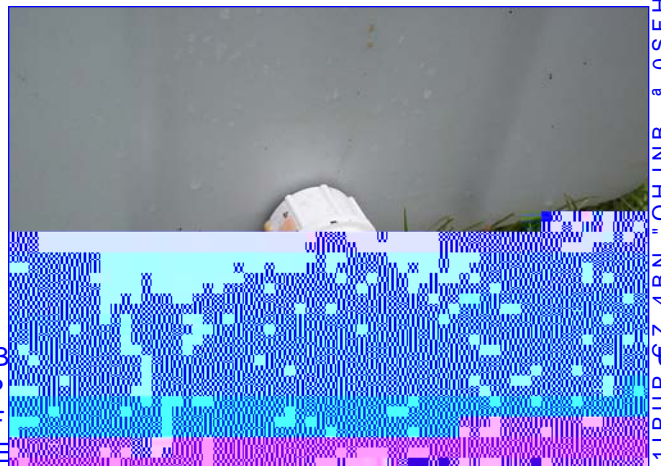


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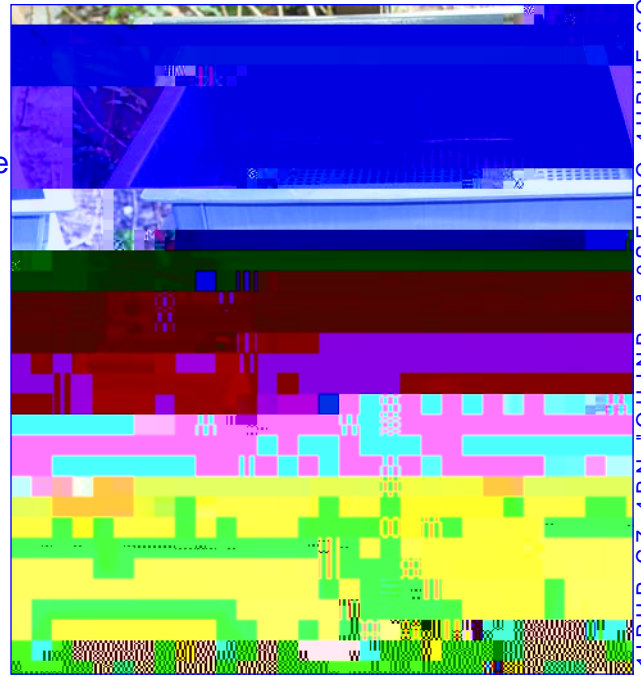
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Probably the most well-known type of worm bin is a wooden box (1 foot deep x 2 feet wide x 3 feet long) with drainage holes drilled in the bottom and a hinged lid for access. Wooden bins breathe and have few odor or excess moisture problems. The main drawback is their weight. Installing wheels on the bottom of wooden bins makes them easier to move.

You can find plans for home-built plastic and wooden bins from the University of Kentucky Extension Service at <http://www.uky.edu/~p112/entomology/>.

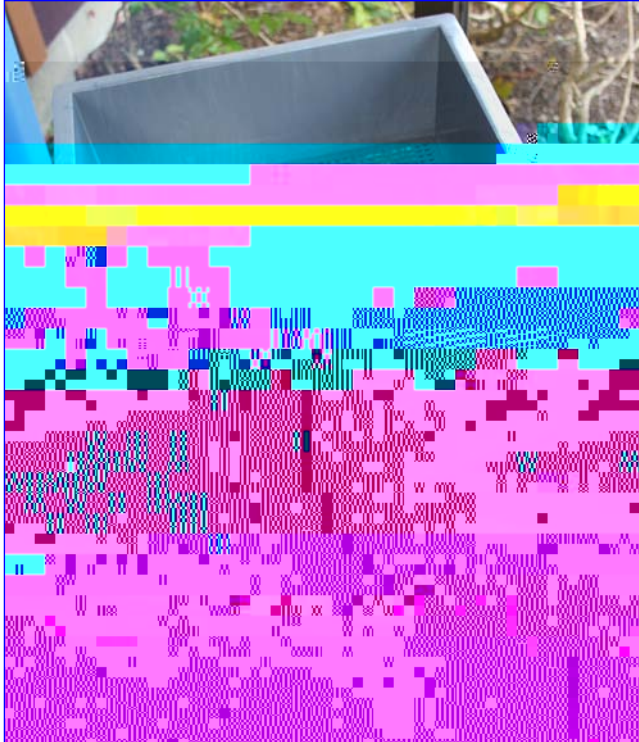
Do not use pressure-treated wood for worm bins. The chemicals are toxic to the worms. Suitable construction materials include exterior-grade plywood or construction-grade lumber. Wood that contains a natural pest deterrent (such as cedar, redwood, and cypress) may be toxic to worms.

If you paint the outside of your bin, leave the inside unpainted. White paint on the outside of the bin helps reflect light, keeping the worm bin cool in summer.

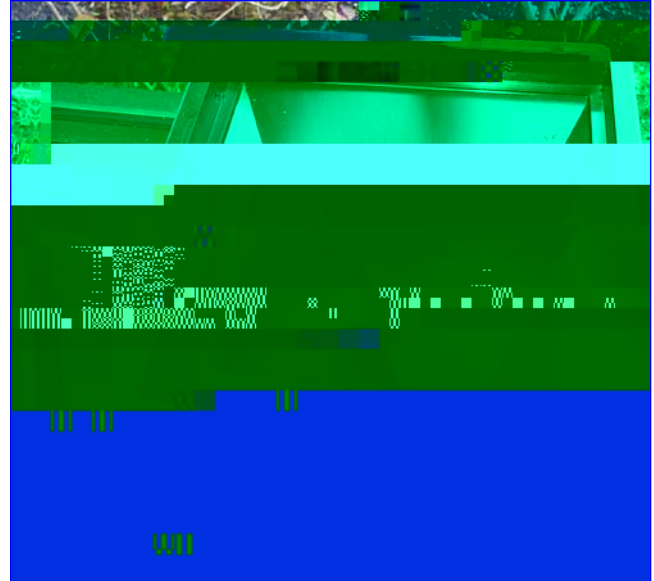


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The Worms

Worm biology and other important facts

The most effective worm for vermicomposting in a bin is the red wiggler worm (*Eisenia fetida*), also known as manure worm, red worm, or tiger worm. In nature, red wiggler worms are specialized surface dwellers (epigeic). They live in the upper layers of the very rich organic matter in decaying litter piles. They do not develop burrows and aren't found deep in the subsoil, as are common garden earthworms. These attributes make the red wiggler appropriate for worm bin composting. Earthworms will not survive in the environment of an indoor worm bin.

Red wiggler worms tolerate a temperature range of 40-80°F (5-30°C). They require a moist environment, with bedding that is 70-90% moisture by weight. Be sure to keep the right level of moist environment in the bedding so that the worms can breathe. Red worms breathe through their skin. Although they have no "eyes," their skin cells are very sensitive to light (photophobic). Use an opaque bin and lid that exclude light. Vent holes and a bed-up bedding provide ventilation and aerobic conditions.

E. fetida

Where do I get the worms?

You can get red wiggler worms from a variety of sources. You can find commercial worm growers (vermiculturists) online who provide a mail-order service. Whenever you buy worms, whether from a commercial or private source, be sure to check that they are selling the right species (you want *Eisenia fetida*); the seasonal availability (since worms are most active during spring, summer, and fall); and their shipping methods. Also be aware that the pound of worms you order may not contain 1,000 worms—some bedding will be in the mix. Order only from reputable suppliers, and be sure to research their cultural methods (such as how they raise the worms and what and how they feed them). Check whether other customers have been pleased with their products.

Other sources of worms you may consider include your outdoor compost or manure pile, a friend or neighbor's vermicompost bin, your local Extension Master Gardener program, or a local solid waste district. Remember that the common earthworm or European nightcrawler (*Lumbricus terrestris*) is a subterranean, burrowing worm and is not the worm you want for vermicomposting.

Adding the worms

Once you have set up your vermicompost bin and have your worms, there are at least three methods of introducing worms into their new environment.

- ‡ 3W] [fUZW dUS efa XWZ TW] Y and allow them to decompose for a few days before adding the worms.
- ‡ 3Wi ad_ efa XWZ TW] YS V allow them to acclimate for a few days before feeding.
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No matter which method you choose, be sure to observe the worms every day for a few weeks to see how they are feeding.

Bedding

The bedding in your worm bin provides a balanced diet and a damp, aerated home for your worms. You need enough bedding to cover the bottom of the worm bin to a depth of 4 to 6 inches.

Dry materials

It's best to include several different materials in the bedding. Mix at least two or three of the following materials for good bedding:

- ‡ Shredded newspaper or recycled printer paper. Do not use glossy paper. Shred paper by hand or machine (figure 12), but do not use cross-cut shredded paper. Cross-cut shreds are rectangular or diamond-shape and may increase compaction in the bin.
- ‡ Corrugated cardboard. Use small pieces.
- ‡ Straw. Don't use hay that has seed in it.
- ‡ Coir (coconut fiber). You can get this at nurseries and online.
- ‡ Shredded leaves. It's best to put in partially decomposed leaves. Check carefully for pests such as slugs and snails.
- ‡ Sawdust. Use sawdust only in small amounts, as it can become compacted.



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Some people have found that adding a handful of alfalfa meal or pellets helps stabilize the microorganisms that partially decompose food scraps. This helps the worms get established in their

appropriate to feed the worms because they attract pests, can be toxic to worms, or create unpleasant odors.

- ‡ Meat, poultry, or fish (bones, skin, or drippings). These develop odors and easily attract other pests.
- ‡ Oils (such as butter, salad dressing, or mayonnaise). These smother worms (they breathe through their skin).
- ‡ Dairy products. These products may cause anaerobic conditions and odors.
- ‡ Highly acidic or spicy foods, such as citrus (especially peels) or onions. These may

What should I feed them?

Red wiggler worms have amazing powers of digestion and will consume just about any organic matter you put in the worm bin. The following types of food are acceptable for feeding worms. Note: Chopping food items into small pieces (½ to 1 inch or smaller) ensures faster breakdown by microorganisms.

- ‡ Fruit and vegetable scraps and peels. Potato peels are okay, but worms tend to avoid them (figure 14).
- ‡ Eggshells or other source of grit (see page 8). These should be ground or pulverized.
- ‡ Coffee grounds, filters, and tea bags with staples removed. You can mix them into the worm bin at any time.
- ‡ Plain cereal, bread, and pasta. Use small amounts only, as they tend to clump up. Be sure to wet them first.
- ‡ Dryer lint (natural fibers only, such as cotton, linen, or wool). Lint provides the “fabric” for air circulation.

Food items that are NOT acceptable

Though your worms will eat just about any organic matter, some types of food may entice undesirable insects and animals to live in the worm bin, too. The foods in the list below are not

It generally takes about 3 to 6 months from initial bin setup to finished worm compost. It is ready to harvest if it looks like crumbly chocolate cake and smells earthy and fresh.

Can I touch worms with my bare hands?

It is okay to touch and handle worms with your bare hands as you work with them. Remember that they are photophobic (sensitive to light), so they will tend to move away from you as you add new food waste and new bedding, or when you harvest the vermicast. If you are not fond of touching worms, latex or vinyl gloves are appropriate to use. Be sure to wash your hands thoroughly with soap after handling worms or worm bins.

Repeat until all the worms in each bin are in the pile's center. Collect the worms and weigh them (you need to know space needs for your next composting project). Then, put them back in their bin with fresh bedding. If you have more worms than you need for your bin, start another worm bin or share your worms with someone else.

How do I harvest my vermicompost?

Harvesting involves removing the finished compost from the bin and separating it from the worms. After several months, worms need to be separated from their castings. At high concentrations, the castings create an unhealthy environment for them. To keep your worms healthy, harvest at least twice a year.

There are several methods to separate worms from the compost. Some worms are lost in the process, but there should be enough worms saved to restock the bin. (If you don't separate out the worms, you can still use the compost in the normal way. But, the worms in it will eventually die.)

Whichever method you choose, the compost you harvest will probably contain a worm or two, along with old food scraps and bedding. This is fine. If you use the compost outdoors, then (depending on moisture, temperature, and the composition of the soil) some worms might survive. If you use the compost for your indoor plants, it is best to remove all the worms. Conditions in pots are not beneficial for worms.

Dr. A. D. ...
(This is by far the most recommended method.)

Lay out a tarp in the sun or under a bright light (figure 16). Divide the contents of the bin into small, cone-shaped piles on the tarp. Wait 20 minutes. (You can use this time to clean bins and add fresh bedding.) The worms will move away from the light and into the center of each pile. Brush the compost off the top of each pile until most of the worms are

Water and cover only the new side of the bin. If light and lack of moisture will cause the old side to dry out and speed up worm migration. As it dries out, the worms will leave it for the new side. After the worms have moved, harvest the old section as vermicompost.

Plan to not feed your worms for at least 2 weeks before starting this harvest method. In any case, you can harvest much sooner.

Scrap Harvest

Simply take out the top third of the bin, which is comprised mainly of bedding, worms, and undigested food scraps. Scoop out what is left on the bottom for use in the garden. Return the other contents to the bin, and mix well with fresh bedding.

How should I use my vermicompost?

You can use worm compost straight from the worm bin or store it for later use as a soil amendment or a slow-release fertilizer. To use it as a soil amendment, blend the worm compost with potting soil at a ratio of 1 part worm compost to 4 parts soil. You can also add it to garden soil when planting annuals, perennials, vegetables, trees, and shrubs.

Use it as a fertilizer by lightly topdressing houseplants or spreading 1 to 2 inches around the base of flowers and vegetables. Avoid letting the worm castings come into direct contact with stems or trunks.

Check the worm bin often for leachate. You can safely use diluted leachate (ratio of 10:1 water to leachate) in the garden rather than throwing it away.

Worms don't digest seeds, nor is the worm bin environment hot enough to kill them. Because the developing vermicast is an ideal place for seeds to sprout, you may get volunteer seedlings (Figure 18) where you use your vermicompost.

More About Worm Health

What other creatures live in the worm bin?

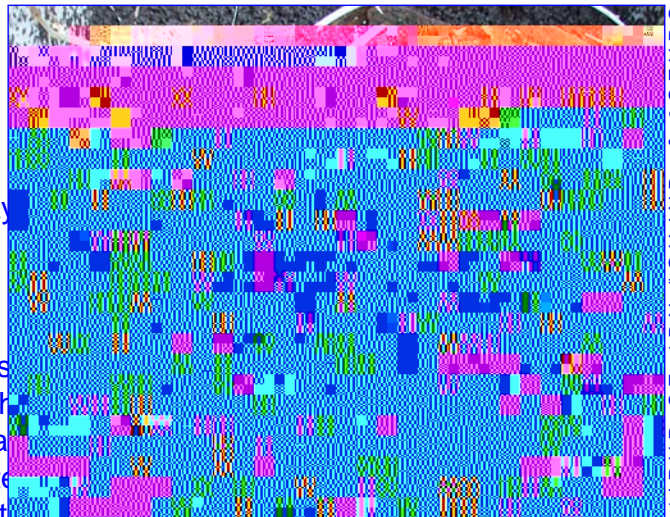
Many micro- and macroorganisms live with the worms in your healthy bin. Some are beneficial to the composting process and some are worm predators. Beneficial microorganisms and invertebrates (animals with no backbones) include:

- ‡ 3-way soil
- ‡ 8-way soil
- ‡ 7-way soil
- ‡ ?
- ‡ E-b
- ‡ E-b
- ‡ B-f
- ‡ 9-way soil
- ‡ 4-way soil

Are there worm pests or diseases I should be concerned about?

Some of the organisms that can harm worms and the vermicompost are:

- ‡ Anaerobic bacteria caused by poor drainage, especially if holes at the bottom of the bin are clogged. If there is too much moisture in the



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bin, the worms will not consume the food waste, and the bin may smell.

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