



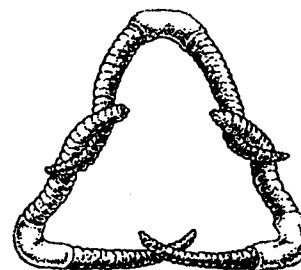
Waste Education Series

WORM COMPOSTING or Vermicomposting

by Ted May and Holly Johnson

Worm Composting?

Worm composting provides a convenient method for recycling kitchen scraps into valuable resources. It is the process of using earthworms and microorganisms (bacteria, protozoa and fungi) to convert organic waste into vermicompost or humus -- an excellent soil amendment for household or yard plants.



Worm composting can produce *compost* for plants, *worms* for fishing or both *worms and compost*. The same basic design works for each desired outcome, but the management strategies differ slightly. In any case, kitchen scraps are recycled into a nutrient rich product. Worm composting, *properly managed*, has very little smell, and can actually reduce the undesirable smells associated with kitchen scraps mixed in with garbage. Vermicomposting also provides an interesting topic of conversation for dinner guests and has served as a great science project for many school children.

This fact sheet provides assistance in constructing a home worm composting system. The process requires a container, bedding materials and redworms. These materials are set up to provide a controlled environment (mostly temperature and moisture). Worm food (kitchen scraps) is added on a regular basis, and the resulting products are harvested for use.

The Container (Worm Box)

Worm composting can take place in several types of containers. Old washtubs, plastic utility tubs, dresser drawers or used shipping crates can be adapted for worm composting. Containers can also be purchased at local stores, through mail-order sources or built at home.

Two important features of the container are size and construction. If you have a large household or generate a lot of food scraps (e.g. vegetarians), consider using more than one container. Larger containers can be heavy to move and clean when the worm castings are ready to harvest.

Sizing the Container - There are two methods for selecting worm box dimensions -- calculation or estimation. Either method is used for determining the length and width of the container. Since worms are surface feeders, an 8-16" depth will allow adequate space to bury scraps, regardless of horizontal dimensions. For occasional large volumes of scraps, consider composting these materials outside.

Calculation - space needed for each pound of scraps - Get out a scale and weigh kitchen scraps each week for several weeks. Try to select a time when usage is at a "normal" level. Then use a ratio often used in sizing

worm boxes: allow one square foot of surface for each pound of scraps per week.

Estimation - on the average, studies suggest two square feet of surface area per person. For 1-2 people, a box 2 feet on each side should do. For 3-6 people, try 2x3 feet. Modify dimensions based upon how often the contributors to the worm box eat out, do large amounts of canning or freezing, or discard leftovers and rotten food.

Location

Containers should be placed in a convenient location where the worms will not be subjected to temperature extremes. Worms do their best work at temperatures ranging between 55-77 °F. Many people store their worm containers in the basement to keep them out of the way. Other common locations include kitchens or heated garages and breezeways.

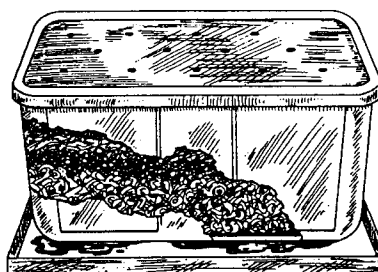
Containers can be placed outside during the summer, but they need to be brought in when the weather cools off. You run the risk of bringing unwanted insects into the house. The *design* of the worm bin should match its intended location. If it will be in a highly visible site, put more effort into construction aesthetics.

Constructing a Container

Worm boxes can be made out of plastic or wood. If recycled materials are used, be certain to avoid containers with possible

chemical residues such as pesticides or preservatives. New plastic containers should be scrubbed with strong detergent and rinsed with hot water.

If you select a plastic container, drill 14-20 holes (3/16"-1/4") in the bottom for aeration and drainage. Raise the bin on bricks or wooden blocks for air circulation. Place a tray underneath to catch excess liquid.



If you plan on using a home-built container, select 5/8" exterior grade plywood, with the "exterior" side inside. Other wooden boards or scrap lumber may be substituted. Use either nails with a spiral shape, or screws to increase holding power under alternating wet and dry conditions. Avoid using wood treated with preservatives that could leach under acidic composting conditions.

Materials for a wood bin - The dimensions of the wood suggested in the table below are presented with the assumption that each side has one end exposed.

Container Size	Sides	Ends	Bottom & Top
A 2-person box (2'x2'x10") -up to 4 lbs. scraps/week	23-3/8" x 10" each side	23-3/8" x 10" each end	24" x 24"
3-6 person box (2'x3'x12") - up to 6 lbs. scraps/week	35-5/8" x 12" each side	23-3/8" x 12" each end	24" x 36"

Additional Materials and Tools:

- 2"x2" boards for support in the corners and along the bottom edges (optional).
- Four small pieces of wood to put on the bottom to allow ventilation under the bin.
- 1½-2" nails or wood screws
- 4" gate hinges for the top
- Tools - a saw, hammer and a drill with a ¼" bit for ventilation holes.

Assembly - Nail or screw the sides together. Square and secure to the bottom with 5-7 nails or screws per side. Drill 9-12 drainage holes spaced evenly throughout the bottom surface. Add 2"x2"s to the corners and the bottom edges for support. Nail the wooden blocks to the bottom corners, or place the box on boards or casters for aeration and drainage. Keep a plastic sheet or tray underneath to capture excess moisture, bedding or worm castings.

You may be able to extend the life of your box if you finish it with a waterproof seal and allow it to dry thoroughly after harvesting a batch of worm composting -- prior to putting in fresh bedding. A continuously wet un-treated box may only last 2-3 years.

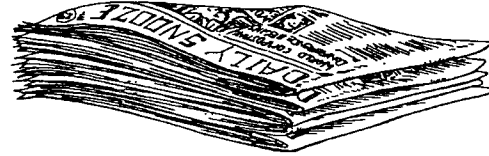
Bedding Materials

Bedding functions as a home for the worms and kitchen scraps, and helps to retain moisture. Since worms will be living their entire lives in the bedding, be certain it is free from fire retardants, pesticides, etc. Some suggestions for materials:

Machine-shredded newsprint or computer paper is one of the most effective bedding materials. It can be found at recycling centers and sold as animal bedding, or available at offices. *Avoid glossy papers.*

Hand-shredded newsprint is prepared by tearing newsprint into strips. While most readily available, it can mat down in layers,

making it difficult to bury kitchen scraps, and larger strips may dry out faster than machine-shredded newsprint. *Avoid glossy papers.*



Shredded cardboard, where available, is very desirable and has a high moisture-holding capacity. It can dry out on the tops and sides. *Avoid fire-retardants used in insulation.*

Leaves are natural habitat for worms, but may contain other animals such as centipedes that can eat worms. Leaves can mat together, making it difficult to bury kitchen scraps. *Avoid leaves from heavy-traffic areas; watch acidity.*

Additives - These materials can be mixed in with other bedding:

Peat moss will lighten other beddings, break up compaction and absorb excess moisture. Use from one-third to one-half peat moss in a container.

Soil or sand will add nutrients, and additional grit, an aid in digestion for worms. Use not more than a handful or two when initially preparing bedding.

Pulverized egg shells or ground limestone will add grit and calcium. Add small amounts periodically.

Worms

What Kind of Worms? - There are several kinds of earthworms. The best type for worm composting are redworms (*Eisenia foetida* or *Lumbricus rubellus*). Also known as red wigglers and manure worms, they consume large amounts of organic material in their natural habitats of manure and

decaying leaves. Nightcrawlers and other garden worms are great for the garden soil, but will die in the confined conditions necessary for worm composting.

How Many Worms? - Worms can reproduce rapidly, so regardless of the starting numbers, worm populations will eventually stabilize at about the amount that can be supported by amount of food scraps added. To have all garbage consumed from the starting set-up time, some estimation of "average garbage added" will be necessary.

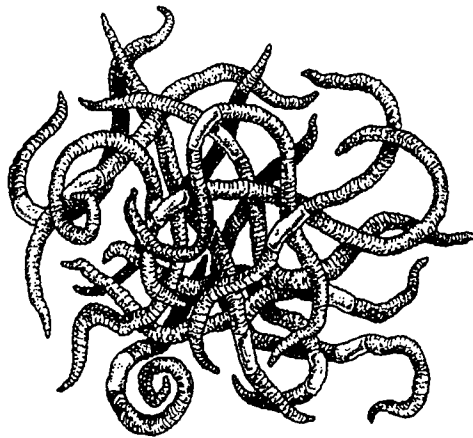
This calculation is similar to that used in sizing the container, but here the calculation is based upon average pounds of scraps *per day*. Worm suppliers typically measure redworms by the pound because vermicomposters usually want 1000-2000 worms to start with. The number of worms per pound varies depending on the maturity of the worms, but 1 pound consists of roughly 1000 worms. (Imagine counting out that many worms at a time for each customer.)

In general, add 2 pounds of worms per 1 pound of daily scraps, or a 2:1 ratio. The 2'x3'x1' bin is designed for approximately 7 pounds of kitchen scraps per week, or a pound per day -- so plan on 2 pounds of worms. For the 2'x2' bin, try about 1 pound of worms.

If you are unable to start with this many worms, reduce the amount of food waste put into the bin until the population increases. Redworms mature in 60-90 days and produce cocoons that take 21 days to hatch. Once worms start breeding, they can lay two to three cocoons per week with each cocoon hatching two to three worms. Worm

populations usually do not exceed the size of the container because they are limited by the availability of food and room to move and breed.

Where to Get Worms? - If you're fortunate, you may be able to get some worms from a friend who does vermicomposting. Adventuresome composters can find them in an old leaf or manure pile. Worm growers are an excellent source. Redworms are also available through bait dealers, though often at twice the price of growers.



The Care and Feeding of Redworms

Filling the Container

After setting up the worm box and finding a source for redworms, it's time to prepare their home. Plan on about 5-8 pounds of dry bedding for a 2'x2'x1' box; and 9-13 pounds of dry bedding for the 3'x2'x1' box. Mix 3 pounds of water per pound of dry bedding - a **3:1 ratio**. Remember, one gallon of water weighs 8 pounds.

The bedding throughout the container should be damp. Add 1-2 handfuls of soil or sand, a few pulverized egg shells and mix. Lift and fluff the bedding gently to create air spaces. Leave space on top for a piece of black plastic or 2-3 newspapers as a cover to retain moisture and keep out light. If you use a plastic container with a lid, you may want to leave the lid ajar to keep the container from getting too wet inside. Sprinkle redworms over the surface, breaking up any clumps. Place under a bright light and the worms will burrow into the bedding.

Adding Kitchen Scraps

What's OK, What's Not OK?

OK?	Examples and Suggestions
ALWAYS OK	Vegetable scraps such as potato, orange or apple peels, coffee grounds, etc.
	Miscellaneous food scraps such as spoiled food from the refrigerator, plate scrapings, etc.
	Egg shells are fine, but best if crushed first for smoother final compost.
	Cheese, deviled eggs, cake, etc., are okay for redworms.
CAUTION ITEMS	Excessive bones, fat or other material may putrefy. Smaller amounts of these are manageable, and grinding them up makes it easier for the worms to handle. Consider mixing with sawdust.
NOT OK	Cat litter, plastic bags, metal caps, rubber bands, sponges, glass, etc.

Putting Food Scraps into the Worm Box -

There are a number of alternatives, but the general idea is to bury food scraps under a few inches of bedding, then replace the cover. If done on a rotational basis, digging into unfinished material is avoided. Divide the bin into four or more imaginary sections and bury successive loads in different locations in the bin.

It can be helpful to have a temporary container (e.g., an ice cream bucket) for food scraps, to periodically empty into a part of the worm bin. Keeping a record of your contributions can be a fun task for a curious adult or an interested child.

How Much is Too Much? - A given quantity of worms can only eat so much. When "overloaded," the system may go anaerobic and start to smell. During canning or holiday times, when the volume of scraps exceeds worm box capacity, plan on setting up an interim bin, or finding another method to handle the material.

How Little is Not Enough? - While relatively easy to care for, worms will expire if neglected too long. Skipping one or two weeks is possible without any problems, but if you plan to be gone for a month or more,

you may want to find another family to feed and look after your worms.

Keeping Redworms Happy - Preventive measures can most readily be taken by careful observation each time material is added to the worm box. Some things to watch for:

Bedding seems dry - Sprinkle with water until slightly damp throughout - like a wrung out sponge.

Strong smell - If too much material is added over a short time span, anaerobic conditions can develop. If so, recover the worm box and allow the worms to work on the contents until further broken down.

Worms climbing up sides of container, or the population is declining - May indicate dying worms, check the following and correct:

Too hot - shade the box or move to a cooler location

Too wet - add fresh bedding and ventilation holes

Too acid or salty - add fresh bedding
Dead worms quickly decompose and are cleaned up by other organisms in the box.

You may not be able to recognize any dead worms.

Fruit flies - Try one or more of the following solutions to control fruit fly populations:

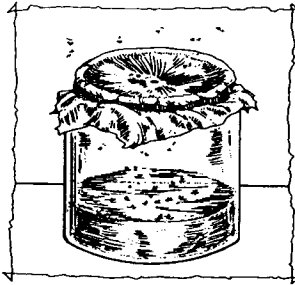


Remove banana peels and citrus materials

from the bin (until fruit fly population declines)

Change bedding material

Build a trap using a small jar, plastic bag, beer and a rubber band. Pour beer into the



jar. Make a small hole in the corner of the plastic bag and insert the bag into the jar. Fasten the bag to the jar with the rubber band. Fruit flies will be attracted to the beer and will not be able to find their way out.

Place a piece of remay or interfacing fabric on the top of the bedding material

Add a spider or two

Bury food waste

Harvesting Worms and Compost

Product Priorities - Worms or Compost

How often you harvest worm castings will depend on your goals for vermicomposting -- whether you are more interested in worms, the worm castings or having a continuous system.

Harvesting Products	How to Do It
Worms for fishing	Harvest every 2-3 months and transfer worms to fresh bedding. Less finished compost is produced.
Worm castings for plants	Bury food scraps for 4 months, then leave alone for a 3-4 additional months. You will have nice black worm compost, but the worm population will die off.
Continuous worms and compost	Harvest compost and prepare fresh bedding every 3-4 months.

Harvesting Alternatives

Worms move *away from* light, and from temperature and moisture extremes. They will also move *toward* a source of fresh food. Combine these factors with personal style, time, and product priorities from above, to select a preferred harvesting method. Some options:

Dump and hand sort - Dump the entire contents onto a large sheet of plastic. Sort the material into cone-shaped mounds. Use a bright light above the mounds to drive the worms toward the interior and bottom of each mound. Wait 5-10 minutes and then gently scrape off layers of vermicompost until all you have left is a mass of worms.

Place the worms into a temporary storage container or a worm box with fresh bedding. Watch out for tiny, lemon-shaped worm cocoons that contain baby worms. You may want to throw them in with your fresh bedding. *To prolong the life of a wooden worm box, rinse it out and set it aside to dry during the sorting process*

Divide and harvest - Move all the material to one side of the box, adding fresh bedding to the other side. Add fresh scraps to the new bedding for several weeks, covering only the new side to allow the other to dry out. Soon, most all worms will have migrated to the new side, and the old

compost can be harvested. Save the finished vermicompost for garden and houseplants.

Putting Worm Compost to Use

Worms are very effective at turning kitchen scraps into material high in available plant nutrients. Place it sparingly where plants can use the nutrients right away.

Where to Use Worm Compost

Seed beds - Sprinkle a layer down a row where seeds are to be planted.

Transplants - When starting plants in the garden from potted plants or flats, work a handful or more of worm compost into the hole before planting.

Top Dressing - For house or garden plants, put a thin layer of worm compost around the plant. The nutrients will work down for the roots with the next rains or watering. Avoid placing against plant stems.

Potting Soil - A fine mix for potting soil would be about 1/4 worm compost, and the other 3/4 a favorite potting mix. Equal amounts of peat moss, perlite and sand or garden soil work well.

Broadcasting - Simply scatter it over the garden and incorporate it into the soil.

How Much to Use?

In general, worm compost is preferably mixed with garden or potting soil mixes. 100% worm compost may contain salt concentrations which inhibit plant growth.

Sources for Vermicomposting Supplies

See UW-Extension *Solid and Hazardous Waste Education Center Waste Education Series Fact Sheet 125.HJ.9607A: Vermicomposting Supplies Source List*

References

Appelhof, Mary, 1982. *Worms Eat My Garbage*, Flower Press, Kalamazoo, MI 49002

Greater Vancouver Regional District, 1996. "Waste Reduction at Home" Fact Sheet on WWW. Address: <http://www.gvrd.bc.ca/waste/bro/swworm.html>

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