



Water Quality & Waste Management

Worms Can Recycle Your Garbage

North Carolina's estimated 420,000 tons of food waste are buried or burned each year at considerable financial and environmental cost. Instead of discarding your food scraps, you can recycle them with the help of worms. Vermicomposting (worm composting) turns many types of kitchen waste into a nutritious soil for plants. When worm compost is added to soil, it boosts the nutrients available to plants and enhances soil structure and drainage.

Using worms to decompose food waste offers several advantages:

- It reduces household garbage disposal costs;
- It produces less odor and attracts fewer pests than putting food wastes into a garbage container;
- It saves the water and electricity that kitchen sink garbage disposal units consume;
- It produces a free, high-quality soil amendment (compost);
- It requires little space, labor, or maintenance;
- It spawns free worms for fishing.

Equipment and Supplies

The materials needed to start a vermicomposting system are simple and inexpensive. All you will need are a worm bin, bedding, water, worms, and your food scraps.

Worm Bin. A suitable bin can be constructed of untreated, non aromatic wood, or plastic container to be purchased. A wooden box is better if you will keep the worms outdoors, because it will keep the worms cooler in the summer and warmer in the winter. An outdoor wooden bin can even serve double-duty as a bench. If a plastic container is used, it should be thoroughly washed and rinsed before the worms and bedding are added. The bin size depends on the amount of food produced by your household. The general rule of thumb is one square foot of surface area for each pound of garbage generated per week.

For two people (producing approximately 3 1/2 pounds of food scraps per week), a box 2 feet wide, 2 feet long, and 8 inches deep should be adequate. A 2-foot-by-3-foot box is suitable for four to six people (about 6 pounds of waste per week). Redworms (the type used for vermicomposting) thrive in

moist bedding in a bin with air holes on all sides. For aeration and drainage, drill nine 1/2-inch holes in the bottom of the 2-foot-by-2-foot bin or 12 holes in the 2-foot-by-3-foot bin. Place a plastic tray under the worm bin to collect any moisture that may seep out. Drilling holes on the upper sides of your bin will also help your worms get needed oxygen and prevent odors in your worm bin. Keep a lid on the bin, as worms like to work in the dark. Store the worm bin where the temperature remains between 55° and 77° F.

Bedding. The worms need bedding material in which to burrow and to bury the garbage. It should be a non toxic, fluffy material that holds moisture and allows air to circulate. Suitable materials include shredded paper (such as black-and-white newspapers, paper bags, computer paper, or cardboard); composted animal manure (cow, horse, or rabbit); shredded, decaying leaves; peat moss (which increases moisture retention); or any combination of these. Do not use glossy paper or magazines. Add two handfuls of soil to supply roughage for the worms. Adding crushed eggshells provides not only roughage but also calcium for the worms, and it lowers acidity in the bin. About 4 to 6 pounds of bedding is needed for a 2-foot-by-2-foot bin (for two people), and 9 to 14 pounds of bedding should be used in a 2-foot-by-3-foot bin (for four to six people). Worms will eat the bedding, so you will need to add more within a few months.

Water. The bedding must be kept moist to enable the worms to breathe. To keep bedding moist, add 3 pints of water for each pound of bedding. You will need about 1 1/2 to 2 1/4 gallons of water for 4 to 6 pounds of bedding. If the bedding dries out, use a plant mister to spritz some water on it.

Worms. It is important to get the type of worms that will thrive in a worm bin. Only redworms or "wrigglers" (*Eisenia foetida*) should be used (do not use night crawlers or other types of worms). Worms can be obtained from bait shops, nurseries, or by mail from commercial worm growers; the commercial growers are the most reliable source. A directory of sources is available from the author. Add 1 pound of worms to the 2-foot-by-2-foot bin or 2 pounds of worms to the 2-foot-by-3-foot bin.

Food Scraps. Feed your worms any non-meat organic waste such as vegetables, fruits, eggshells, tea bags, coffee grounds, paper coffee filters, and shredded garden waste. Worms especially like cantaloupe, watermelon, and pumpkin. Limit the amount of citrus fruits that you add to the bin to prevent it from becoming too acidic. Break or cut food scraps into small pieces so they break down easier. Do not add meat scraps or bones, fish, greasy or oily foods, fat, tobacco, or pet or human manure. Be sure to cover the food scraps completely with the bedding to discourage fruit flies and molds. One pound of worms will eat about four pounds of food scraps a week. If you add more food than your worms can handle, anaerobic conditions will set in and cause odor. This should dissipate shortly if you stop adding food for a while.

Temperature. Redworms will tolerate temperatures from 50° to 84°F, but 55° to 77°F is ideal.

Starting the Process

To start your vermicomposting system, first select a location for your worm bin. Popular indoor spots

are the kitchen, pantry, bathroom, mud room, laundry room, or basement. If you want to keep your worm bin outside, put it in the shade during the hot summer and shelter it from the cold in winter by placing it in a garage or carport, or putting hay bales around the bin to allow air to circulate around the bin, and keep it protected from flooding, because the worms can drown.

Next, prepare the bedding. If you want to use newspapers, fold a section in half and tear off long, half-inch to inch wide strips (go with the grain of the paper and it will tear neatly and easily). Soak the newspaper in water for a few minutes, then wring it out like a sponge and fluff it up as you add the newspaper to your worm bin. Aim for the bedding to be very damp, but not soaking wet (only two to three drops of water should come out when you squeeze the bedding material). Spread the bedding evenly until it fills about three-quarters of the bin. Sprinkle a couple of handfuls of soil (from outdoors or potting soil) into the bedding to introduce beneficial microorganisms and aid the worms' digestive process. Fluff up the bedding about once a week so the worms can get plenty of air and freedom of movement.

Gently place your worms on top of the bedding. Leave the bin lid off for a while so the worms will burrow into the bedding, away from the light. The worms will not try to crawl out of the bin if there is light overhead.

Once the worms have settled into their new home, add food scraps that you have been collecting in a leak-proof container. Dig a hole in the bedding (or pull the bedding aside), place the food scraps in the hole, and cover it with at least an inch of bedding. After this first feeding, wait a week before adding more food. Leave your worms alone during this time to allow them to get used to their new surroundings. Bury food scraps in a different area of the bin each time. Worms may be fed any time of the day. Do not worry if you must leave for a few days, as the worms can be fed as seldom as once a week. *Note:* Do not be surprised to see other creatures in your worm bin, as they help break down the organic material. Most of the organisms will be too small to see, but you may spot white worms, springtails, pill bugs, molds, and mites.

Harvesting the Worms and Compost

After about six weeks, you will begin to see *worm castings* (soil-like material that has moved through the worms' digestive tracts). The castings can be used to boost plant growth. In three or four months, it will be time to harvest the castings. Mixed in with the castings will be partially decomposed bedding and food scraps, in addition to worms; this is called *vermicompost*. You may harvest the vermicompost by one of two methods:

- Method 1: Place food scraps on only one side of your worm bin for several weeks, and most of the worms will migrate to that side of the bin. Then you can remove the vermicompost from the other side of the bin where you have not been adding food scraps, and add fresh bedding. Repeat this process on the other side of the bin. After both sides are harvested, you can begin adding food scraps to both sides of the bin again.

Worm Bin Troubleshooting

Problems	Causes	Solutions
Bin smells bad	Over feeding Non-compostables present Food scraps exposed Bin too wet Not enough air	Stop feeding for 2 weeks Remove non-compostables Bury food completely Mix in dry bedding; leave lid off Fluff bedding; drill holes in bin
Bin attracts flies	Food scraps exposed Rotten food Too much food; especially citrus	Bury food completely Avoid putting rotten food in bin Don't overfeed worms
Worms are dying	Bin too wet Bin too dry Extreme temperatures Not enough air Not enough food	Mix in dry bedding; leave lid off Thoroughly dampen bedding Move bin where temp. between 55 and 77° F Fluff bedding; drill holes in bin Add more bedding and food scraps
Worms crawling away	Bin conditions not right	See solutions above Leave lid off and worms will burrow back into bedding
Mold forming	Conditions too acidic	Cut back on citrus fruits
Bedding drying out	Too much ventilation	Dampen bedding; keep lid on
Water collecting in bottom	Poor ventilation Feeding too much watery scraps	Leave lid off for a couple of days; bin add dry bedding Cut back on coffee grounds and food scraps with high water content

- Method 2: Empty the contents of your worm bin onto a plastic sheet or used shower curtain where there is strong sunlight or artificial light. Wait 20-30 minutes, then scrape off the top layer of vermicompost. The worms will keep moving away from the light, so you can scrape more compost off every 20 minutes or so. After several scrapings, you will find worms in clusters; just pick up the worms and gently return them to the bin in fresh bedding.

Be on the lookout for worm eggs; they are lemon-shaped and about the size of a match head, with a shiny appearance, and light-brownish color. The eggs contain between two and twenty baby worms. Place the eggs back inside your bin so they can hatch and thrive in your bin system.

Using Worm Compost

You can either use your vermicompost immediately or store it and use it later. The material can be mulched or mixed into the soil in your garden and around your trees and yard plants. You can also use it as a top dressing on outdoor plants or sprinkle it on your lawn as a conditioner. For indoor plants, you can mix vermicompost with potting soil. For top dressing indoor plants, you may want to remove decaying bedding and food scraps from the castings. Make sure there are no worms or eggs in the castings, because conditions in a plant pot will not allow them to survive. You can also make a "compost tea" to feed to your plants. Simply add two tablespoons of vermicompost to one quart of water and allow it to steep for a day, mixing it occasionally. Water your plants with this "tea" to help make nutrients in the soil available to the plants.

Larger-Scale Vermicomposting

Vermicomposting can take place wherever food scraps are generated or delivered. Worm composting bins can be found in classrooms, apartments, offices, and other commercial locations. Large-scale worm farms are found in many states, including California, Rhode Island, Washington, and Oregon. Worms even compost the food waste produced at the Seattle Kingdome stadium. Vermicomposting is also being used to help solve North Carolina's hog waste problems.

Classrooms and outdoor centers are especially nice settings for worm composting. Children of all ages enjoy classroom activities involving worms. Several curricula on worms are available for classroom use, and activities in the books can be used in a multitude of disciplines, including science, mathematics, geography, language arts (vocabulary, poetry, and prose), and music.

Sources of Additional Information and Supplies

North Carolina Cooperative Extension Service

Contact your county Cooperative Extension Center or: Department of Biological & Agricultural Engineering North Carolina State University Box 7625 Raleigh, NC 27695-7625 Attention: Rhonda Sherman Telephone (919) 515-6770 e-mail: sherman@eos.ncsu.edu

Directory of Vermiculture Resources: Worms, Supplies, and Information

This guide lists resources nationwide and is available from Rhonda Sherman, address above.

North Carolina Worm Resources

This is a list of known worm suppliers in North Carolina. It is available from Rhonda Sherman, address above.

Division of Pollution Prevention and Environmental Assistance

North Carolina Department of Environment, Health, and Natural Resources
P.O. Box 29569
Raleigh, NC 27626-9569
(919) 715-6500
(800) 763-0136

Prepared by:

Rhonda Sherman, Extension Agricultural Engineering Specialist
E-mail: sherman@eos.ncsu.edu

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