



# Women in Agriculture Training manual for female extension educators

## Earthworms and vermi-composting

### Introduction

Earthworms play a very important role in soil fertility. Although they are often confused with dangerous garden dwellers; they are actually very beneficial components of a healthy garden.

**Vermicomposting** is the process of using worms and micro-organisms to turn kitchen waste into nutrient-rich humus that can improve soil fertility and plant growth.

### Learning Objective

Provide information about the functions that worms perform in agriculture and their importance in building and preserving soil structure.

**Learning Outcome** - students will learn:

- how to promote earthworm life in the soil
- how to attract worms where they can be most useful in the garden
- how to start a small-scale vermi-composting bins for maximum benefit of their garden



### Materials

- two plastic containers (opaque, dark color, at least 30 cm deep), one with a lid
- two stones or pieces of clay brick
- one plastic basket slightly smaller than the containers, with big holes or a screen
- drill with small drilling bit
- newspaper and/or straw
- some soil
- vegetable scraps
- water
- burlap
- a handful (or more) of worms – *see preparation note*

### Preparation – gathering the worms

About one week before the training, place a small mound of chopped vegetable residues mixed with some soil, straw, grass clippings, or wet shredded newspaper next to some plants or to an almost ready compost heap. Make sure the mix stays moist and worm-appealing by covering it with straw, a carpet remnant or similar (worms like darkness). This will attract the correct type of composting worms. During class, collect the worms for the vermi-composting bin and show the students how to prepare similar “traps.”

## Lecture Notes and Lesson Plan

Earthworms are important for healthy soils.

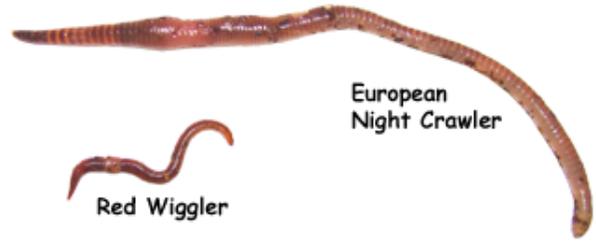
Earthworms are usually found in the top 3 to 20 cm of soil. Because they digest organic materials, their presence means the soil has a good amount of organic matter.

There are many different species of worms in the soil with different functions. Some worms live in permanent vertical burrows. Others move horizontally near the surface, filling their burrow with castings as they move.<sup>1</sup> Some live closer to the surface feeding on wet leaf debris and compost.

As worms feed and digest, they produce **humus** at a fast rate. Humus is the organic component of soil, formed through the decomposition of leaves and other plant material by soil microorganisms. It is the most stable form of

organic matter in the soil, and an indicator of soil fertility. Nutrients in humus are in a form that is available to plants.

Worm castings may contain 40% more humus than the top 23 cm of soil in which the worm are living.



Worms also feed on soil particles (their digestive system needs grit) and move continuously through different layers. While digesting they produce acids

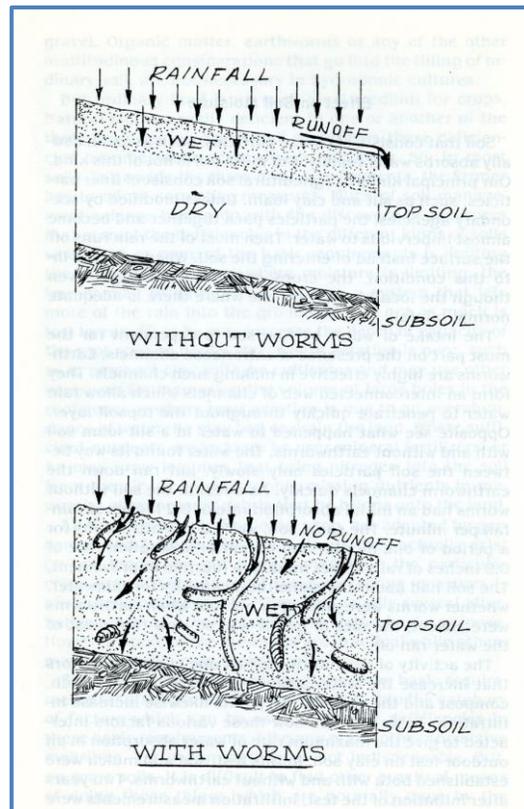
that mobilize minerals and release nutrients from the soil making them more available to plants, redistributing them from deeper soil layers to more superficial ones closer to the plant roots.

Earthworms form an intricate network of channels through the soil, greatly enhancing its aeration and drainage properties. Their bodies are covered in mucus to facilitate movements and digging. This substance helps in the formation of macro-aggregates and hence soil structure. Their castings are a great structure improver itself.

The tunnels formed by earthworms help to aerate and loosen compact soil. Plant roots can grow deeper, and allow

beneficial microorganisms to breathe. The loosened soil also helps water to reach plant roots, and create better water drainage and accumulation in deeper layers.

Earthworms are commonly present in compost piles as well, colonizing them from the bottom. If present in good quantity, they reduce the time required to produce finished compost.





Earthworm **castings** (the product of soil particles and organic matter ingested and processed by the worms) can contain up to 10 times the amount of plant-available nutrients as the

original soil.

Worm casting is odor free. It promotes a healthy soil environment by stimulating microbial and bacterial activity. It contains natural growth hormones for more developed roots. Its effects are long lasting and it can be used on any kind of plants.

**Vermi-composting** is the specialized composting technique that utilizes worms to convert organic waste products into fertilizer. Worms commonly found in our garden can be utilized for small composting bins, making castings ready for use when needed.

It is relatively simple to start vermi-composting bins or to encourage the migration of earthworms close to growing plants by abundantly using organic mulches (vermi-composting on site), especially in kitchen gardens.

Selecting the right type of worm for the composting bin is the first step. **Epigeic** worms live on the surface of the soil or in plant litter, such as wet leaves or compost piles. They are smaller and adapt well to moisture and temperature variations. They do not survive well deeper in the soil. Red worms, red wigglers or brandling worms are all *Epigeic*.

Other species (*Endogeic*) live in the soil and feed primarily on soil and associated organic matter (geophages). As they move through the soil, their channels become filled with castings, progressively passing it through their intestines. These worms improve soil structure and water movement and are valuable for plant growth, but they do not survive well in compost bins. There are also deep-burrowing (*Anecic*) species that live several meters into the soil and have permanent burrows in the soil. They are often called night crawlers.

You can add vermi-compost to seedbeds or planting holes or use it as a top dressing during the growing season for your favorite plants. Or try adding the vermi-compost to your potting mix for houseplants or outdoor container plants (1/4 by volume). Pure worm castings may have a high soluble salt content; use them sparingly and avoid direct contact with the roots of seedlings.

When adding nutrient rich worm castings to the garden, remember to:

- Avoid direct contact with seeds or seedling roots. Mix it with soil before sowing or transplanting.
- Use small amounts as side-dressing fertilizer
- Dilute your fertilizer tea from worm casting (you might have to test different dilutions for different uses)

### **Practical:**

#### **How to prepare a vermi-composting bin**

With the drill, or with a screwdriver made hot on a flame, make holes on the bottom of one of the plastic container and on the lower sides of it. The holes are for aeration, so they should be regularly distanced, abundant and not too big (otherwise the

earthworm can easily escape). If they are too big, the container can always be lined with burlap or shading net.

Now provide a mixture of some straw, shredded wet newspaper and cardboard, leaves, vegetable residues and similar, some soil, a little sand. This is called “**bedding.**” The bin should be filled from one-third to one-half with bedding. Earthworms prefer an environment that is about 75 percent water. Make sure the mixture is uniformly moist, but not dripping and then add more wet newspaper and some grass clippings on the top.

Do not add manure to the bedding. It is not necessary and in a small bin can actually cause problems, increasing the temperature or releasing gases.

Dig a hole in the center of the bedding and deposit the earthworms you have previously collected. They should naturally bury themselves, avoiding the light. Gently close the hole and cover the bin with the lid. Now place the bin inside the second using a small brick or some rocks under it so that there is space between the 2 bins. The second container is the collection container, where the excess water from the first bin will drain (leachate).

Worms do not like a lot of noise or vibrations. Keep them away from high traffic areas. The worms will need some time to settle. In about a week to ten days you can start feeding them.

It will take some time for a small colony to become bigger and active. In warmer weather the earthworms will become more active. A colony can double in number in 90 days. The worms will need to be protected by intense temperatures, because they cannot reach deeper and cooler layers of soil



as in nature. In hot weather, cover the bin with burlap (wet it occasionally) and place it in the shade. Most earthworm species can live in temperatures ranging between 4 – 27 °C. In the winter, you will need to move the bin inside or compost on a seasonal basis. (Or release your colony in the garden before it is too late).

The vermi-composting bin requires little work but regular attention, to make sure the moisture level remains constant and to feed the worms, depending on their needs. More abundant and active colonies require feeding more often. You can always divide the colony and release part of the worms in your garden. Start feeding the worms small amounts of chopped residues every week, or every other week. Make sure not to over-feed them: if the residues start rotting, diminish the quantity until the worms can consume it comfortably.

**Feeding:** Red worms require a steady supply of food scraps to grow and multiply. Use a container in

your kitchen to collect food scraps. Feed your worms 2-3 times each week by burying appropriate food scraps directly under the bedding in different locations. The smaller the food scraps, the quicker they will be digested by your red worms. Use the chart below in deciding what to put into your bin.

Add	Do NOT add
Coffee filters/grounds	Meat/fat/bones
Tea bags/leaves	Grease/oils
Fruits and vegetables	Dairy products
Egg shells (crushed)	Pet waste/litter
Cereal/bread	Plastic wrap/tin foil
	Chemicals, glass, metal

### Troubleshooting

- Fruit flies – bury food scraps beneath the bedding to avoid fruit fly problems. Try flypaper on the lid underside or a sticky yellow card placed next to the bin to attract fruit flies.
- Odors may arise if too many food scraps are added at one time. Discard rotting food; avoid adding scraps for a week.
- Too wet – bedding becomes compacted and smelly; air is unable to flow through bin. Check drainage holes, stir contents to increase airflow and add fresh, dry bedding.

**Harvesting:** When you observe abundant casting formation, it is harvest time. How long it takes for a good amount of casting to be harvested will depend on how many worms are in the bin.

**Screen Method:** Use the perforated basket or screen and place it on top of the worm bed, filling it partially with new soil and vegetable material. Keep in the dark for a few days. The worms will eventually migrate to the top, inside the basket where the fresh food is. At this point retrieve the basket and set it on the side on a newspaper for the

time needed to scoop the mature casting from the bin. The occasional earthworms can be put back into the bin. The last step is to gently replace the old bedding with the new one from the basket, where the majority of the earthworms have moved.

**Section Method:** If the plastic container is big enough, all the casting and old bedding can be moved to one half, while the other half is filled with fresh bedding and fresh food. After one week the earthworms will have mostly migrated to the new half. Collect the casting from the other portion of the bin, removing carefully the occasional worm and placing it back into the bin. Redistribute the fresh bedding in the entire space.

**Pile Method:** About every 3 to 4 months, dump your entire bin contents into several piles on a sheet of plastic in a brightly lit room or in the sun. The worms will dive to the pile bottoms. Remove finished compost from the tops and sides of the piles.

### Follow up activities

Have students set up “traps” for earthworms in their garden and to start their own compost bins. Organize a process so that students without worms can receive them from colleagues.

### Assessment Questions

- 1) Why are worms important to the garden?
- 2) Where do we find composting worms?
- 3) What do worms eat? Name things from our kitchen that we can feed them.
- 4) What are worm-castings?
- 5) How can we use them in our gardens?

## Glossary/Resources

- **Humus** - the organic component of soil, formed through the decomposition of leaves and other plant material by soil microorganisms
- **Leachate** - the excess water that drips through the worm bin and picks up undigested material. This should NOT be used in the garden.
- **Vermicomposting** from the Latin word *vermis* meaning worm - is the process of harvesting worm castings. It contains a mixture of worm castings, partially composted wastes, and any resistant materials that won't readily break down.
- **Worm castings**, also called worm manure, or worm humus, are the end product of the breakdown of organic matter by composting worms.
- **Worm tea** - compost tea that is made by soaking vermicompost in oxygenated, de-chlorinated water

### UMD Vermicomposting Video

<http://www.youtube.com/watch?v=1CTOvPlc8xk>

Parts of this factsheet are adapted from University of Maryland Extension, Home and Garden Information Center- <http://extension.umd.edu/hgic>

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Developed by Sophia Wilcox, Matilde Paino D'Urzo, and Becky Ramsing

*This document is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of University of Maryland and do not necessarily reflect the views of USAID or the United States Government.*



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