

Vermicomposting

Theory

Food waste currently accounts for about **15%** of municipal solid waste in America, in which only 2.1% is recovered through recycling efforts (EPA MSW FACT SHEET, 2013). Vermicomposting utilizes the ecology and biology of worms to help decompose organic materials like food wastes and various paper products. Vermicomposting is a sustainable and environmentally-conscious way to recycle valuable nutrients and energy that would otherwise be wasted in a landfill. There are many benefits to composting, including

- Enriching nutrient weak soils and facilitating the cleaning of contaminated soils
 - Suppressing plant disease and pests by reducing the need for chemical fertilizer
 - Extending the life of useful landfills by diverting organics to recycling
 - Economic benefits as an effective alternative to artificial soil amendments
- (Vincent, Wendy. 2012. "The Complete Guide to Working with Worms." Atlantic Publishing Group Inc. Print.)

Species Ecology & Biology

Epigeic species of earthworms, with their natural ability to colonize organic wastes, high rates of consumption, digestion, and assimilation of OM, tolerance to environmental factors, short life-cycles, high reproductive rates.

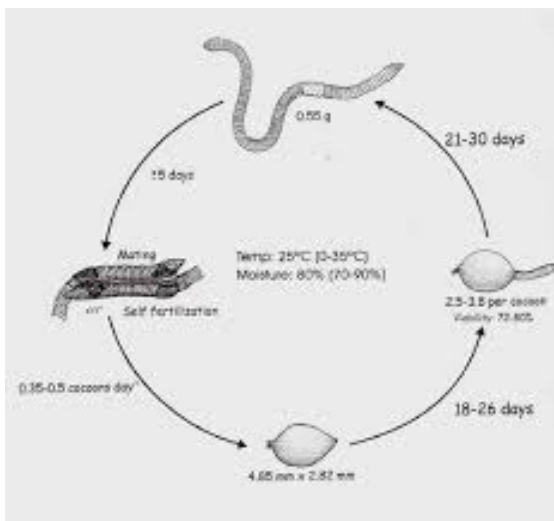
Eisenia andrei, *Eisenia fetida*, *Dendrobaena veneta*, *Perionyx excavatus*, and *Eudrilus eugeniae*
Eisenia andrei (Red Wigglers) *segmented worms

-Earthworm's brain is a mass of neurons called ganglion, and is connected to nerve cords that sense things about the environment. Earthworms breathe by bringing oxygen to the rest of their body by dissolving O₂ through the surface of their bodies. They use their setae (bristles) to hear vibrations though their main function is movement and nerve receptors detect light changes to help them "see."

-Worms pick up food with their mouth and pull it into the alimentary canal (tube-like structure that runs the length of the worm's body). Food that is not digested or absorbed is excreted as worm castings.

Lifecycle

Earthworms are hermaphrodite animals: reproduction occurs through cross-fertilization, following which each of the mated individuals processes cocoons containing 1-20 fertilized ova. Cocoons hatch after an incubation period that varies with species. With favorable conditions, they reach sexual maturity within several weeks after emergence (sexually mature worms can be identified by the swollen band, called clitellum, near the middle of the body).



Food Web Ecology

The primary consumers are the microorganisms (mainly bacteria, fungi, ciliates) that mineralize organic residues. Secondary and tertiary consumers are the invertebrate detritivores (worms) that feed on and disperse the microbes throughout the OM. As OM is excreted from the worms, microbes continue to degrade the ingested material.

- (a) Thermophilic stage: active stage (45-77 degrees C)
- (b) A maturing stage: decrease in temp to the mesophilic range (10-45 degrees C), slower rate
 - *duration of the active stage depends on the composition of the waste

What Worms Want

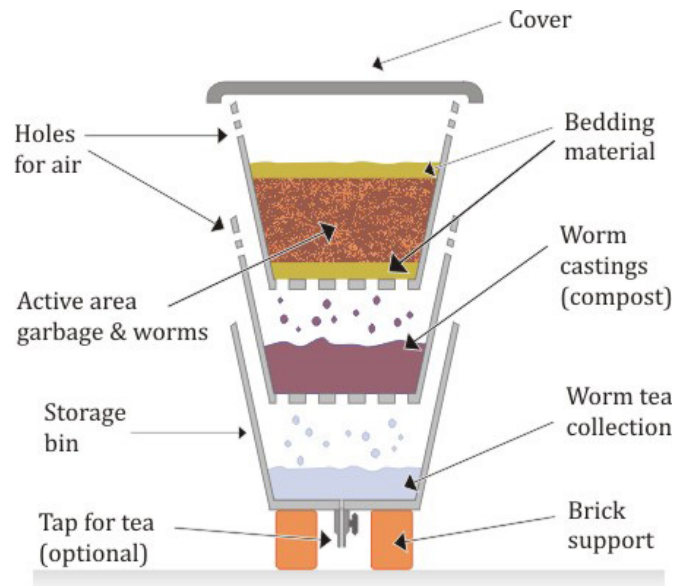
- Darkness
- Moderate Temperature
- Moist but not saturated environment
- NOT anaerobic
- Little to no ammonia
- Slightly acidic pH
- Low Soluble salts
- Food web of microorganisms

Controlled Conditions

- Moisture content (ideally about 80% moisture)
- Aeration (oxygen) Earthworms maintain aerobic conditions
- Temperature (ideal range between 59-77 degrees Fahrenheit)
- Proper C:N ratio (25-30:1)
- pH (between 4-7)

Overall System

- (1) Containment Unit
- (2) Worms & Biological Friends
- (3) Controlled environment with consideration of temp, ventilation, acidity
- (4) Maintenance procedure including changing worm bedding, burying wastes, separating worms from castings
- (5) Utilization of end product



Bedding

- a medium where the worms live
- a place to bury their wastes
- holds moisture * bedding must be damp
- adding a few cups of soil will inoculate the medium with diverse microorganism
- shredded newsprint, fine wood chips, leaf mold, *coir (coconut fiber)
- about half the bin should be filled with moist bedding

How many Worms?

800-100 worms = 1 lb of worms = ½ lb of OM per day
 For every lb of waste per week, you will need 1 cubic foot of bin space
 1-2 lbs of worms is ideal for each cubic foot
 *Shallow bin 12-18 inches deep. Worms feed upwards nibbling as they go. Bedding can get packed down easily in a deep container causing smell from lack of aeration

Raised Gantry-Fed Beds

Earthworms live in the top layers. The earthworm's processed OM is sieved through the floor of the containment unit through a mesh screen by the mechanical action of a breaker bar.