

THE SCIENCE OF VERMICULTURE: EARTHWORMS IN ORGANIC WASTE MANAGEMENT

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Abstract

Certain species of earthworms feed preferentially on organic matter and have been adopted for the vermiculture processing of organic wastes into vermicomposts. In the process, the earthworms use microorganisms growing on wastes for their nutrition but also promote microbial activity dramatically in the vermicomposts produced. The species of earthworms most commonly used in vermiculture are *Eisenia fetida*, *Dendrobaena veneta*, and *Lumbricus terrestris* in temperate climates, and *Eudrilus eugeniae*, *Perionyx excavatus* and *Pheretima hawanya* in the tropics.

All vermicomposting systems depend on maintaining a temperature of less than 35°C (95°F) in the system so it is important to avoid high temperatures through thermophilic composting occurring. The organic waste should be added in 2.5 cm (inch layers) at frequent intervals. It is important to maintain temperatures between 15-25°C (59-77°F) and moisture contents should be between 80%-90% (range 60%-90%). The ammonia content should be low (0.5mg/g) and the salt content should also be low (0.5%).

Systems of vermicomposting include: outdoor or indoor windrows, wedge systems, outdoor or indoor batch systems or continuous flow vermicomposting reactors. Vermicomposts can be used as plant growth media or soil amendments in greenhouse or field. They promote plant germination, growth, flowering, and yields dramatically. They can also be used as aqueous extracts termed 'teas' that can be watered or sprayed on to be plants. They promote plant growth, independent of nutrients because of the plant growth regulators produced by the microorganisms that became adsorbed by the humates (indole acetic acid, gibberellin, kinetin, humates and fulvates).

Earthworms can be used as sources of animal feed protein for fish, chickens, and suckling pigs. They contain essential amino acids (60-70%) fats, carbohydrates, and vitamins such as vitamin B₁₂. The earthworms are separated from the wastes mechanically and processed by freeze-drying, heat-drying or ensiling. The effectiveness and economics of using earthworm protein as animal feed in different parts of the world will be discussed in detail.

Vermicomposts can be used in pollutant bioremediation for organic contaminants and heavy metals. The microbial degradation of the organic pollutants is accelerated dramatically and the heavy metals become irreversibly bound into the humic materials that are formed, so they are not available to plants.

Earthworms have been used, mainly in China, as pharmaceuticals for the alleviation of animal and human diseases. As a result of their porous cuticles and mode of life in the soil environment, they produce enzymes as protective mechanisms, and some of these enzymes, when extracted, can influence the development of human diseases, particularly

cancer tumors, and cardiovascular diseases, such as blood clotting thus giving earthworm extracts considerable potential in medicine. This is discussed further elsewhere in the program (Sun Zhenjun).