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Rapid composting methods: Vermicomposting

SUMMARY:
The potential of composting to turn on-farm waste materials into a farm resource makes it an attractive proposition. Composting offers several benefits such as enhanced soil fertility and soil health, thereby increased agricultural productivity, improved soil biodiversity, reduced ecological risks and a better environment. While traditional composting procedures take as long as 4-8 months to produce finished compost, rapid composting methods offer possibilities for reducing the processing period up to three weeks.

KEYWORDS:
soil fertility [1]
Composting [2]
Decomposition [3]
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earthworms [5]
Fermentation [6]

CATEGORY:
Crop production [7]
Natural Resources Management [8]

COUNTRIES:
Cuba
India
Philippines

DESCRIPTION:

Use of Worms: Vermicomposting

The term "vermicomposting" had recently been coined to mean the use of earthworms for composting organic residues. Earthworms can consume practically all kinds of organic matter and they can eat their own body weight per day; thus, for example, one kilogram of worms can consume one kilogram of residues every day. The excreta or castings of the worms are rich in nitrate, available forms of phosphorus, potassium, calcium and magnesium.
The passage of soil through earthworms promotes bacterial and actinomycetes growth; actinomycetes thrive well in the presence of worms and their content in worm casts is over six times more than in the original soil.

Kind of worms

A moist compost heap of 2.4 m by 1.2 m and 0.6 m high can support a population of more than 50 000 worms. The introduction of worms into a compost heap has been found to mix the materials, aerate the heap and hasten decomposition. Turning the heaps is not necessary if earthworms are present to do the mixing and aeration. The ideal environment for the worms is a shallow pit and the right sort of worms are necessary. *Lumbricus rubellus* (the red worm) and *Eisenia foetida* are thermo-tolerant and so particularly useful. Field worms *Allolobophora caliginosa* and night crawlers (*Lumbricus terrestris*) will attack organic matter from below but the latter do not thrive during active composting, being killed more easily than the others at high temperature. European Night Crawlers (*Dendrabaena veneta* or *Eisenia hortensis*) are commercially

produced as well and have been successfully used in most climates. This night crawler grows to about 4 inches and up to about 8 inches. The African Night crawler (*Eudrilus eugeniae*), is a large, tropical worm species. It does tolerate heats a bit higher than does *E. foetida*, provided there is ample humidity, but has a narrow temperature tolerance range. However, it cannot survive at temperatures below 45 degrees F.

Vermicomposting in Philippines

The worms used are *Lumbricus rubellus* and/or *Perionyx excavator*. The worms are reared and multiplied from a commercially-obtained breeder stock in shallow wooden boxes stored in a shed. The boxes are approximately 45 cm x 60 cm x 20 cm and have drainage holes; they are stored on shelves in rows and tiers. A bedding material is compounded from miscellaneous organic residues such as sawdust, cereal straw, rice husks, bagasse, cardboard and so on, and is moistened well with water. The wet mixture is stored for about one month, being covered with a damp sack to minimize evaporation, and is thoroughly mixed several times. When fermentation is complete, chicken manure and green matter such as ipil ipil leaves or water hyacinth is added.

The material is placed in the boxes and should be sufficiently loose for the worms to burrow and should be able to retain moisture. The proportions of the different materials will vary according to the nature of the material but a final protein content of about 15% should be aimed at. A pH value as near neutral as possible is necessary and the boxes should be kept at temperatures between 20^{o}C and 27^{o}C. At higher temperatures, the worms will aestivate and, at lower temperatures, they hibernate. In spite of their being able to eat the bedding material, the worms at this stage are fed regularly; for every kilogram of worms a kilogram of feed is given every 24 hours. For each 0.1 m^2 of surface area, 100 g of breeder worms are added to the boxes. The feedstuffs used are again various and include chicken manure, ipil ipil, vegetable wastes and so on. At one farm, water hyacinth is grown specifically and used fresh (chopped up) as the sole source of feed. Some form of protection against predators is necessary; predators can include birds, ants, leeches, rats, frogs and centipedes.

Composting procedure

A series of pits (the number depending on available space) are dug approximately 3 m x 4 m x 1 m deep, with sloping sides. Bamboo poles are laid in a parallel row on the pit floor and covered with a lattice of wood strips. This provides the necessary drainage as the worms cannot survive in a waterlogged environment. The pit is then lined with a suitable material to keep the worms from escaping into the surrounding soil (although, with the abundant feed provided in the compost heap, this may not happen) and yet permit drainage of excess water. At the farm under consideration, old animal feedstuff sacks were used. The pit can now be filled with rural organic residues such as straw and other crop residues, animal manure, green weeds, leaves and so on. The filled pit is covered loosely with soil and kept moist for a week or so. During this period, another pit can be filled as necessary.

One or two spots on the heap are then well watered and worms from the breeding boxes are place on top; the worms immediately burrow down into the damp soil. To harvest the worms from the boxes, two-thirds of the box is emptied into a new box lined with banana leaf or old newspaper. The original box can now be provided with fresh bedding material and those worms remaining will again multiply. The worms emptied from the box are picked out by hand for adding to the heap. The compost pit is left for a period of two months; ideally it should be shaded from hot sunshine and it must be kept moist. Within two months, about 10 kg of castings will have been produced per kilogramme of worms. The pit is then excavated to anextent of about two-thirds to three-quarters and the bulk of the worms removed by hand or by sieving. This leaves sufficient worms in the pit for further composting and the pit can be refilled with fresh organic residues. The compost can be sun-dried and sieved to give a very good quality material. A typical analysis is: Organic matter 9.3%, Nitrogen 8.3%, Phosphorus 4.5%, Potassium 1.0% (water-soluble), Calcium 0.4%, Magnesium 0.1%. The excess worms that have been harvested from the pit can be used in other pits, sold to other farmers for the same purpose, used or sold for use as animal feed supplement, used or sold for use as fish food or, if there is no social taboo, used in certain human food preparations.

Vermicomposting in Cuba

In Cuba, different methods are used for worm propagation and vermicomposting.

Worm troughs in a row: The first and most common is cement troughs, two feet wide and six feet long, much like livestock watering troughs, used to raise worms and create worm compost. Because of the climate, they are watered by hand every day. In these beds, the only feedstock for the worms is manure, which is aged for about one week before being added to the trough. First, a layer of three to four inches of manure is placed in the empty trough, then worms are added. As the worms consume the manure, more manure is layered on top, roughly every ten days, until the worm compost reaches within a couple inches of the top of the trough, about two months. Then the worms are separated from the compost and transferred to another trough.

Windrows: The second method of vermicomposting is windrows. Cow manure is piled about three feet across and three feet wide. Then it is seeded with worms. As the worms work their way through it, fresh manure is added to the end of the row, and the worms move forward. The rows are covered with fronds or palm leaves to keep them shaded and cool. Some of these rows have a drip system - a hose running alongside the row with holes in it. But mostly, the rows are watered by hand. Some of these rows are hundreds of feet long. The compost is gathered from the opposite end when the worms have moved forward. Then it is bagged and sold. Fresh manure, seeded with worms, begins the row and the process again. Some of the windrows have bricks running along their sides, but most are simply piles of manure without sides or protection. Manure is static composted for 30 days, then transferred to rows for worms to be added. After 90 days, the piles reach three feet high. Worm populations, they say, can double in 60 to 90 days. Windrows are also used to compost rice hulls and sugar cake (cake is what is left after sugar cane is processed), but this too is mixed with animal manure. Sometimes food scraps added to worm beds.

Vermiculture in India

Preparing vermicompost:

Materials - breeder worms, a wooden bed and organic wastes.
The bed should be 2 1/2 ft. high x 4 ft. wide x any length desired. Apply worms for every part of waste.
Sieving and shredding- Decomposition can be accelerated by shredding raw materials into small pieces.
Blending- Carbonaceous substances like sawdust, paper and straw can be mixed with nitrogen rich materials such as sewage sludge, biogas slurry and fish scraps to obtain a near optimum C/N ratio of 30:1 / 40:1. A varied mixture of substances produces good quality compost, rich in major and micro nutrients.
Half digestion- The raw materials should be kept in piles and the temperature allowed to reach 50-55^{o}C. The piles should remain at this temperature for 7 to 10 days.

Moisture, temperature and pH- The optimum moisture level for maintaining aerobic conditions is 40-45%. Proper moisture and aeration can be maintained by mixing fibrous with nitrogen rich materials. The temperature of the piles should be within 28-30^{o}C. Higher or lower temperatures will reduce the activity of micro flora and earthworms. The height of the bed can help control the rise in temperature. The pH of the raw material should not exceed 6.5 to 7.

After about a month the compost is ready. It will be black, granular, lightweight and humusrich. To facilitate separating the worms from the compost, stop watering two to three days before emptying the beds. This will force about 80% of the worms to the bottom of the bed. The rest of the worms can be removed by hand. The vermicompost is then ready for application.

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