VERMICOMPOSTING

The term vermicomposting means 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, e.g. 1 kg of worms can consume 1 kg of residues every day. The excreta (castings) of the worms are rich in nitrate, available forms of P, K, Ca and Mg. The passage of soil through earthworms promotes the growth of bacteria and actinomycetes. Actinomycetes thrive in the presence of worms and their content in worm casts is more than six times that in the original soil.

TYPES 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 where earthworms are present to do the mixing and aeration. The ideal environment for the worms is a shallow pit and the right sort of worm is necessary. Lumbricus rubellus (red worm) and Eisenia foetida are thermo-tolerant and so particularly useful. Field worms (Allolobophora caliginosa) and night crawlers (Lumbricus terrestris) 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 produced commercially and have been used successfully in most climates. These night crawlers grow to about 10–20 cm. The African night crawler (Eudrilus eugeniae), is a large, tropical worm species. It tolerates higher temperatures than Eisenia foetida does, provided there is ample humidity. However, it has a narrow temperature tolerance range, and it cannot survive at temperatures below 7 °C. Vermicomposting is in use in many countries.

VERMICULTURE IN INDIA

This approach uses the following materials: breeder worms, a wooden bed and organic wastes. The bed should be of the desired length and about 75 cm high × 120 cm wide. Worms should be applied for every part of waste.

Other steps in the process are:

- Sieving and shredding – decomposition can be accelerated by shredding raw materials into small pieces.
- Blending – carbonaceous substances such as sawdust, paper and straw can be mixed with N-rich materials such as sewage sludge, biogas slurry and fish scraps to obtain a near optimum C:N ratio. A varied mixture of substances produces good quality compost, rich in macronutrients and micronutrients.
- Half digestion – the raw materials should be kept in piles and the temperature allowed to reach 50–55 °C. The piles should remain at this temperature for seven to ten days.
- Maintaining moisture, temperature and pH – the optimum moisture level for maintaining aerobic conditions is 40–45 percent. Proper moisture and aeration can be maintained by mixing fibrous with N-rich materials. The temperature of the piles should be 28–30 °C. Higher or lower temperatures 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 6.5–7.

The compost is ready after about one month. It is black, granular, lightweight and humus rich. In order to facilitate the separating of the worms from the compost, watering should cease two to three days before emptying the beds. This forces about 80 percent of the worms to the bottom of the bed. The remaining worms can be removed by hand. The vermin compost is then ready for application.

Some entrepreneurs have made modifications, e.g. making the floor leak proof, and providing a covered shade in order to ensure temperature regulation and protection against accumulation of excessive water in the rainy season. Although this adds to the cost, the improved efficiency of vermicomposting and faster rate of growth of earthworms more than offsets this additional cost.

The excess water, which may be leached along with the earthworms extracts, is also collected from the concrete flooring and recirculated. This ensures high N content in the finished product and also better quality because of the preserved worm extracts.

The steps in this process are:

- Cattle dung is collected from cow shelters.
- The dung is kept for about 7–10 days to let it cool.
- Beds/rows of dung and crop residues/leaves, etc. are made about 1 m wide, 75 cm high and with a distance of 75 cm between two rows.
- In the beds/rows, crop waste such as leaves, straw etc. is layered alternatively with the dung to thus make a height of about 75 cm. The beds are kept as such for 4–5 days to cool.
- Water is sprinkled to let the compostable matter cool down.
- Earthworms are put on the top of the manure row/bed. About 1 kg worms in a metre-long manure row are inoculated.
- It is left undisturbed for 2–3 days after covering with banana leaves. Covering with jute bags or sacks is not recommended as it heats the manure bed.

- The bed is opened after 2–3 days. The upper portion of about 10 cm of manure is loosened with the help of a suitable hand tool.
- The bed is covered again. The worms feed on an upper bed of about 10 cm. This portion becomes vermicasted in about 7–10 days.
- This portion (vermicasted manure) is removed and collected near the bed. Another upper portion of 10 cm is loosened and covered again with the leaves.
- Moisture is maintained in the bed by regular sprinkling of water.
- The loosened portion of the manure is vermicasted in another 7–10 days and is removed again
- Thus, in about 40 days, about 60 cm of the bed is converted into vermicompost and is collected on 3–4 occasions.
- The remaining bed of about 10 cm in height contains earthworm mixed manure.
- Fresh manure mixture/organic residues, etc. are again put on the residual bed containing earthworms of about 10 cm and the composting process is restarted.
- The manure collected from the bed is freed of worms through sieving. Uncomposted or foreign matter is also removed in this way.
- The screened manure is bagged and used or sold as required

ENHANCING VERMICOMPOST PRODUCTION

Vermicompost production using epigeic compost worms such as Eisenia foetida, Lumbricus rubellus and Eudrilus eugeniaecan be enhanced effectively by supplementing the organic wastes used for vermicomposting with cow urine. Undiluted urine can be used for moistening organic wastes during the preliminary composting period (before the addition of worms.). After the initiation of worm activity, urine can be diluted with an equal quantity of water. No problems have been observed with daily use of diluted cow urine for moistening the vermicomposting bed. This simple technique can yield vermicompost with a higher

Nitrogen content. Moreover, worms have been found to become very active and vermicompost can be harvested at least 10 days early.

INTEGRATING TRADITIONAL COMPOSTING AND VERMICOMPOSTING

Problems associated with traditional thermophilic composting relate to: long duration of the process, frequent turning of the material, material size reduction to enhance the surface area, loss of nutrients during the prolonged process, and the heterogeneous resultant product. However, the main advantage of thermophilic composting is that the temperatures reached during the process are high enough for an adequate pathogen kill.

In vermicomposting, the earthworms take over both the roles of turning and maintaining the material in an aerobic condition, thereby reducing the need for mechanical operations. In addition, the product (vermicompost) is homogenous. However, the major drawback of the vermicomposting process is that the temperature is not high enough for an acceptable pathogen kill. Whereas in traditional thermophilic composting the temperatures exceed 70 °C, the vermicomposting processes must be maintained at less than 35 °C.

A study has examined the possibility of integrating traditional thermophilic composting and vermicomposting. The work involved combining pertinent attributes from each of the two processes to enhance the overall process and improve the product qualities. The two approaches investigated in the study related to: (i) pre-composting followed by vermicomposting; and (ii) pre-vermicomposting followed by composting. The duration of each of the combined operations viz. composting and vermicomposting was four weeks. A comparison was made with vermicomposting alone (duration: 56 days). The results indicated that the combination of the two processes shortened the stabilization time and improved product quality. Furthermore, the resultant product was more stable and consistent, had less potential impact on the environment, and met pathogen reduction requirements.

ADVANTAGES OF COMPOSTING

- Compost has an abundance of nutrients and is suitable for a wide variety of end uses, such as landscaping, topsoil blending, and growth media.
- Compost increases the water content and retention of sandy soils.
- Compost increases aeration and water infiltration of clay soils.
- Windrow and aerated static pile processes have the flexibility to handle changing feed characteristics and peak loads, require relatively simple mechanical equipment, and are simple to operate.
- In-vessel processes require relatively small areas and have the ability to control odours
- Enriches soil, helping retain moisture and suppress plant diseases and pests.
- Reduces the need for chemical fertilizers.
- Encourages the production of beneficial bacteria and fungi that break down organic matter to create humus, a rich nutrient-filled material.
- Reduces methane emissions from landfills and lowers your carbon footprint.

DISADVANTAGES OF COMPOSTING

- Windrow and aerated static pile composting require relatively large areas, and odour control is a common problem.
- Ambient temperatures and weather conditions influence windrow and aerated static pile composting.
- In-vessel reactors have limited flexibility to handle changing conditions and are maintenance intensive.

MARKETING CONSIDERATIONS

Marketing places additional managerial demands on the composting operation that may outweigh the potential revenues. However, when a waste must be utilized off-farm, marketing it as compost will be less difficult than marketing the raw material. The main challenges in marketing compost are to establish a market and then consistently meet the quality demands of that market. The successful sale of compost depends on the establishment of an adequate clientele base and then consistently meeting their expectations in both volume and quality.

Many retail stores sell compost produced by large, commercial operations that can produce high quality compost less expensively than smaller agricultural operations. Nurseries and landscapers are also beginning to branch out into composting yard waste and trimmings. The compost market for their products is mostly other landscapers and nurseries. The market for agricultural compost is generally home gardeners. This market is generally local with the compost sold onsite, through local stores, or in bulk to certain buyers. Selling the compost onsite or to selected parties also saves on packaging, advertising, and promotion.

The sale of compost produced on the farm provides an opportunity for another source of revenue. The advisability of selling compost, however, must be carefully evaluated because the additional demands it places on the farm operation may not result in profit when all the costs are considered. In addition, regulations may require the compost to meet certain requirements, especially if it is to be sold as a fertilizer. In some cases nitrogen may be added to the final compost product to increase its fertilizer value.

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