Eco-Friendly Vermicompost with Paper Waste

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Abstract

Vermicompost is an eco-friendly fertilizer. This is the most useful factor for growing the plants. Emphasis in this paper is on vermicompost of paper waste in which paper waste is converted to vermicasts by the earthworms. The experiment deals with the stabilization through the action of anecics earth, Lampito mauritii *of mixtures containing paper waste, Rice straw and Cow dung. The vermicomposting results in significant reduction of total organic carbon and increase in total nitrogen. The mid gut analysis of the worm also proves the changes in microbial population during Vermicomposting.*

Keywords: Vermicomposting, earthworm, nitrogen, paper waste, fertilizer.

I. INTRODUCTION

Just a decade ago, most public officials and business owners thought of waste materials such as grass clippings, food scraps and sludge as a problem that they had to dispose off. But more and more often, public agencies and entrepreneurs are turning this former problem into a profit with environmental benefits. Once they are converted into compost, organic wastes which are the compostable portions of the solid waste stream can be used to mulch landscaping, to enhance crop growth, to enrich topsoil and to provide other benefits.

- The changed outlook about municipal organic wastes stems from many factors such as
- Municipal officials have realized that composting is an effective strategy for managing waste (organic up to 70%).
- States have banned certain organic materials such as cardboard and yard waste from landfills.
- Backyard composting has been readily accepted.
- More markets for compost have opened up.

The key to start a successful composting enterprise is to understand the basis, to include how composting works , what types of facilities can handle this process, which raw materials work best, how to manage odour, and how to produce the market.

Why compost?

Composting is an efficient method of breaking down organic materials into an end product that is beneficial to soil and plants.

Adding yards and garden wastes directly to the soil without composting them first have some undesirable effects. For example, if large quantities of uncomposted leaves are incorporated into the soil, the microbes that work to decompose the leaves will compete with plant roots for soil nitrogen. This competition can result in nitrogen deficiency and poor plant growth. Increased populations of the microbes can also deplete most of the organic matter in the soil, leaving the soil with less structure than before.

When materials such as leaves and grass clippings are composted, however, a microbial process converts them into a more usable organic material. Adding of composted material reduces the competition for nitrogen. Composted material is also much easier to handle and mix with soil than uncomposted material because of its finer texture. Furthermore, improvement

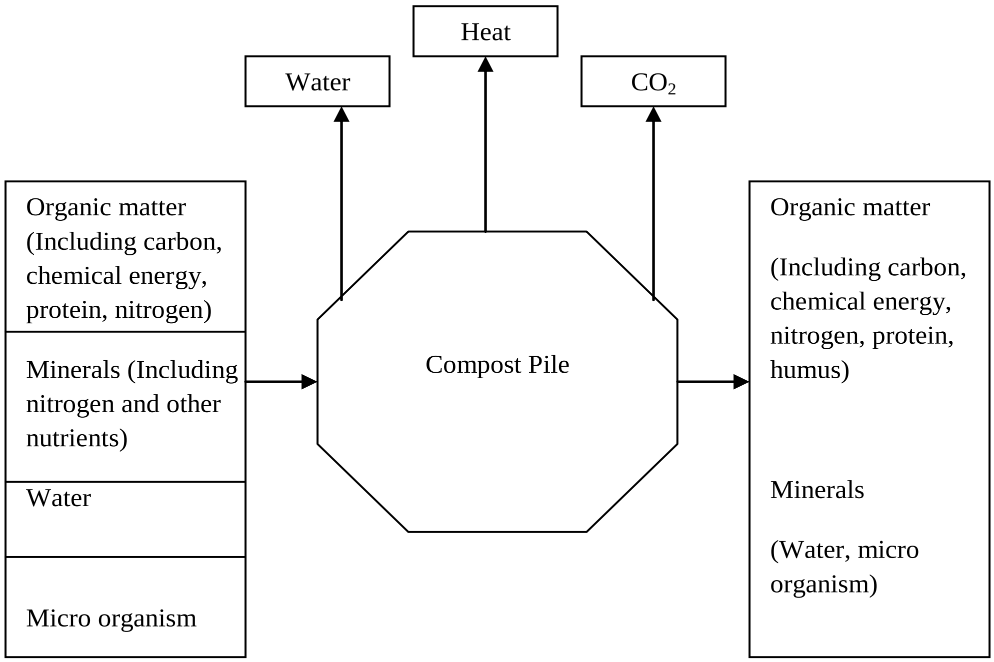

Fig.1 Process of composting

of the soil's physical properties such as increased infiltration, better drainage, and greater water holding capacity usually occur more rapidly when composted materials are added.

Vermicomposting, or worm composting, is considered an easy way to recycle solid or liquid wastes. When cared properly, worms progress quickly and transform wastes into nutrient-rich castings. Worm castings are an excellent soil amendment for gardens and potted plants. In the process of breaking down food waste, worms feed on micro organism, which grow on the surface of the waste, and excrete particles of smaller size, which are called worm casting. Since microbial growth is important to a successful vermicomposting operation, the carbon to nitrogen (C:N) ratio of the mix must be considered. Carbon provides energy for microbial growth. Nitrogen provides the building blocks for cell structure. Just as with conventional composting, the C:N ratio by weight should be around 30:1. This target ratio provides guidance for the types and proportions of waste to be used in vermiculture.

II. PROCESS OF COMPOSTING

Vermicomposting operations often involve the following steps like Collecting, mixing and shredding, pre-composting, digester loading, harvesting and storage. A step can be added for recycling a portion of the harvest material back into raw waste. The harvested material is rich in micro organism. Recycling a portion of the material at a rate of 10% to 1% of raw wastes to materials harvested helps to inoculate the fresh waste.

Collection: Food waste, newspaper, sawdust and other materials included in the mixture are collected and brought to a common location. Designated bins can be placed at appropriate locations within the facility to separate and collect the materials to be composted.

Composting basics: Composting is the aerobic decomposition of organic materials by micro organism under controlled conditions into a soil-like substance called compost. During composting, micro organism such as bacteria and fungi break down complex organic compounds into simpler substances and produce carbon dioxide, water, minerals and stabilized organic matter

ISSN: 2278-0181
Vol. 2 Issue 10, October - 2013

(compost). The process produces heat which can destroy pathogens (disease-causing micro organism) and weed seeds. Raw materials are composted fastest when conditions that encourage the growth of the micro organisms are established and maintained.

The most important conditions include the following.

- Organic materials are blended to provide the nutrients that support microbial activity and growth, including a balanced supply of carbon and nitrogen ratio.
- Sufficient oxygen to support aerobic organisms.
- Moisture levels that uphold biological activity without hindering aeration.
- Temperatures needed by micro organisms that grow best in a warm environment.

Mixing/ Shredding: Propagation of food waste, leaves, newspaper and other bulking agents are mixed together proportionally using either a scale or a bucket. As apart of the mixing process, the waste needs to be broken up or shredded.

Pre-composting: After mixing, the material experience a period of intense microbial activity, which causes the temperature inside the pile exceeds 100 degrees Fahrenheit. Pre-composting involves placing the mixed pile outside of the bin for a number of days to cool.

Digester loading: Preconditioned material is loaded into the digester at a depth of not greater than six inches per day. A shovel can be used for loading the material.

Harvesting: Worm-processed material is removed from the lowest portion of the digester through the force of a scraper bar, which is drawn across the bottom inch of material. It helps the material to fall through a supporting screen. This material is a mixture of vermicompost and worm casting. After being removed by the scraper, the material falls out from the bin by gravity where it can be collected for storage.

Storage: The mixture of vermicompost and casting is removed with either a wheelbarrow or front-end loader and is stored for a long-term. In storage, the material can be exposed to air dryer due to its fine particle size.

Spreading: Vermicomposting and worm casting are spread on gardens or used for other landscaping projects.

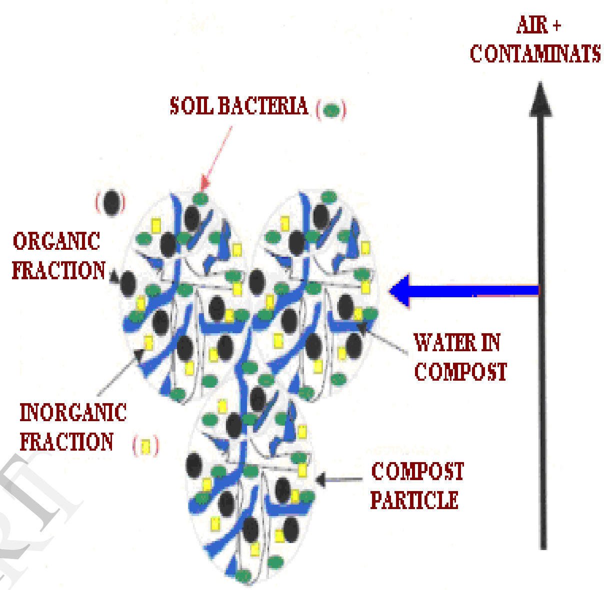

Fig.2 Vermicomposting Molecular Mechanism

III. BENIFITS OF VERMICOMPOSTING

- Improves soil structure, water infiltration, drought tolerance, nutrient-holding capacity, root growth and yields.
- Reduces fertilizer requirements, soil compaction and crushing.
- Increases microbial and earthworm population in soil and ease of cultivation.
- Protects plants from diseases and slowly releases nutrients to plants.
- It is being used to prevent erosion of hillsides, embankments and roadsides.
- Used in wetland damage mitigation, storm water filtration and bio filters.

Fig.3 Plant before treatment

Fig.4 Plant after treatment

IV. CONCLUSION

This paper shows the way by which the paper waste can be composted along with rice straw and cattle dung. The decomposition process is enhanced in the presence of earthworm and aerobic heterotrophic pollution. Moreover the paper also precisely pinpoints the reproductivity of earthworms in the reactor bed. The rice straw and cow dung facilitate the removal of organic carbon content of the sludge. Mineralization of the nitrogen's compounds is also facilitated in the presence of rice straw and cow dung. The resulting nutrient content of vermicomposting from paper waste is used as a fertilizer to a plant and compared that plant with a commercial plant growth medium which had inorganic nutrients added. The following nutrients are analyzed: nitrogen, phosphorus, potassium, calcium, magnesium and manganese. The nutrient content is much higher in the vermicompost for most elements except magnesium (a magnesium sulphate can be used to rectify this deficiency). The study noted that many of the nutrients in waste materials (including nitrogen, potassium, phosphorus, calcium and magnesium), when processed by earthworms, are changed into forms more readily taken up by the plants. Seeding emergence of tomatoes, cabbage and radish is better in vermicompost than in thermophilically composed animal wastes. And also it is better in vermicompost than in a commercial medium. In addition, early growth of ornamentals seeding is as good as or better in vermicompost mixtures than in the commercial plant growth medium. After the seedlings are transplanted into pots, the ornamentals grow better in vermicompost mixtures than in the commercial growth medium.

"Earth doesn't belong to man, but man belongs to earth; what he does to earth is done to him self;"

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