APPLICATION OF VERMICOMPOSTING FOR THE BIODEGRADATION OF MSW AND CROP IMPROVEMENT

Dr. B. Hemalatha

Address for Correspondence
M.E (Env), Ph.D)
Head of the Department, Dept of civil Engg, Sree Sastha Institute of Engg & Technology
Chembarambakkam, Chennai-600123

ABSTRACT
The industrial revolution followed by the urbanization in temperate countries, concentrated people in very high density and added new sources of wastes. The disposal methods followed presently causes serious impacts on the environment and public health. Vermicomposting is being increasingly accepted as the most efficient and safe method for converting organic waste into plant food.

An experimental study was conducted to obtain vermicompost using partially decomposed organic wastes by using the Eudrillus euginea earthworm species. The process was carried out with the use of municipal solid waste to stabilize the feed composition. Water was added to provide the necessary moisture content. In this process the partially decomposed organic wastes was broken down and fragmented rapidly by earthworm, resulting in a stable, less toxic material which has a high economic value as a soil conditioner for plant growth. The castings was obtained within 30 days on the top surface which was collected, sieved, dried, tested and used as manure. The trial plants were planted in two different fields. The plants were ladies finger and fenugreek. The plants were grown with the addition of vermicompost in one field and natural compost in other field.

The result shows that the increased nutrient content was for organic wastes and better growth in the vermicompost added plants than the natural compost plants. This experimental study proves that the vermicomposting process can be employed to treat the wastes in an environmentally safe manner.

KEY WORDS: Earth worms, decomposition, crop production, MSW

INTRODUCTION
Urbanization is a world wide phenomenon. This process of urbanization is very rapid; the urban population of India is likely to be 30 million in 2001 and 395 million by 2011 AD. These high-density communities create challenge in the provision of potable water supply, clean air, and waste disposal. The industrial revolution followed by the urbanization in the temperature countries, concentrated people in very high density and added new sources of wastes. These wastes are normally solid and result in landscape pollution. The term ‘refuse’ is often used interchangeably with the term ‘solid-wastes’. The term solid waste encompasses the highly heterogenous mars of discarded materials or throwaways from the urban community (i.e. residential and commercial activities) as well as the more homogenous accumulation of wastes generated by agricultural and Industrial activities.

Solid waste management is an obligatory function of urban local bodies (ULBs) in India. However this service is poorly performed resulted in problems of health, sanitation and environmental degradation with over 3.6% annual growth in urban population and the rapid pace of urbanization, the situation is becoming mores more critical with the passage of time. Infrastructure development is not in a position to keep pace with population growth owing to the poor financial health of most of the urban local bodies. Due to the population explosion huge quantities of SW are being research in to the environment. It is estimated that every human being released 500 – 1000 g of SW per day. SW manager is one amount the essential service, which suffers the most in such a situation. Lack of financial resource, institution weakness, and improper choice of tech & public and pathy to wards solid waste manager have made this service far from satisfactory.

SOLID WASTE
Solid waste is the term now used internationally to describe non liquid waste material arising from domestic trade, commercial, hospital, industrial, agricultural and mining activities. Solid waste comprises countless different materials, dust, food wastes, paper, metals, plastics or glass, discarded clothing, garden wastes. Construction wastes, factory off cuts and process wastes, hospital wastes etc. The complex in character of solid waste and its volume has greatly increased due to rising of living standard and population density.

Solid waste can be classified in to two major categories.
1. Organic and Municipal solid wastes
2. Industrial waste

MUNICIPAL SOLID WASTES (MSW)
Organic wastes are easily biodegradable. Organic wastes are decomposed by Micro organisms. Example – grains, card board, wax board, hay, metals (some), pasta, grass, wood fish flowers, milk cartons, fruits, leaves and paper.

Municipal wastes all are organic wastes municipal solid waste is a mixed waste from residential commercial, institutional and industrial sources. Municipal solid waste has a comfortable potential of 60-90%. Its typical composition includes paper, glass, wood, plastics, reusable goods, soil, chemicals, food waste, plant debris, metals, textiles and rock with organic materials making up 50-70% of all municipal solid waste. In general, the fewer non comfortable materials in the feed stock, the better the finished compost will be for agricultural use.

COMPOSTING
Composting is a controlled process of decay, which is effected by Microorganisms that are indigenous to the waste themselves. It is a natural process in which the organic matter decomposes in to a dark nutrient rich soil amendment. The product of composting process can be stored or used in agriculture only when it has been adequately stabilized through the process of composting.

TYPES OF COMPOSTING
There are 3 types of composting they are
1. Aerobic composting
2. Anaerobic composting
3. Vermi composting

VERMI COMPOSTING

Vermi is Latin for worm. Therefore vermin composting simply means worm composting. Earthworms are used to convert organic waste into dark brown nutrient-rich humus. This rapid form of decomposition is possible anywhere. While reducing your weekly amount of garbage, you will have a source of fertilizer for all your plants. Vermicomposting can be defined as “the combination of biological processes, design and techniques to systematical and intensively cultured large quantities of one or more species of earth worms to speed up stabilization of organic waste materials, which are eaten, ground and digested with the help of other micro organisms like bacteria, fungi and other smaller animals”.

VALUE OF WORM CASTINGS (SOIL)

The humus produced in vermicomposting provides binding sites for plant nutrients helps control plant diseases and stimulates plant growth. Humus also increases water permeability, and water retention, contributing to better plant health and more efficient use of soil moisture. Cuban researchers have found that nitrogen concentrations are higher in vermicompost than in aerobic compost piles. Earthworm castings are 1.5-2.2% nitrogen. 1.8-2.2% phosphorous and 1.0-1.5% potassium and remain in the soil for up to five years. Worm populations under vermiculuture can double in 60-90 days.

SPECIES SELECTION FOR VERMICOMPOSTING

The Earthworm Eudrillus eugeniae an efficient organic waste converter and highly adaptable to any given dead and decayed organic waste was used for working on the distillery waste (sludge). Eudrillus eugeniae is the species used for vermicomposting. The excrement /castings of earthworms, which consist largely of digested soil and particles of organic matter is more chemically neutral than the surrounding soil.

POTENTIAL BENEFITS FROM VERMICOMPOSTING

- Cost effective and efficient organic system.
- Earthworm cultivation provides useful conditions of pH and oxygen for bacterial and actinomycetes growth which in turn enhance the degradation activity.
- Aerobic conditions created by earthworm cultivation prevent anaerobes and thereby prevent formation of foul smelling compounds like HS and mercaptans.
- Earthworms convert 20-40% of its arrimilated energy in to high quality proteins.
- Earthworm’s participation enhances decomposition by 25% with 25% reduction in time for comporting.
- Vermicomposting can maintain sanitation in urban and rural areas.
- It is a potential biological resource for organic farming.
- It improves the soil aggregates which in turn maintain the long term soil fertility.

MATERIALS AND METHODS

Sample Collection

The municipal solid waste was collected from Podanur municipal disposal yard in Coimbatore city.
aerobic gut, the predominance of aerobic bacteria harbored by earthworms ensures maximum energy utilization resulting in more biomass production, which in turn speeds up waste decomposition to a higher rate. The skin of the worm reacts to light and they will immediately work their way down into the bedding to get away from the light. After about 13–45 days, the volume of materials has dropped substantially and the original bedding is no longer recognizable. At this point, the finished compost is obtained on the top surface, which is collected and sieved through a 2.5 mm sieve to separate the cocoons and young one. These cocoons and young ones can be introduced into other fresh culture beds. This castings looks like minuscule black pellets. The casts are then dried and tested for its micro and macronutrients, which can be used as manure.

CROP PRODUCTION

The trial plants like ladies finger and fenugreek seeds were planted in the two different fields. One with the addition of vermicompost and the other with the addition of natural compost. The trial plants grown soil was tested and the mineral content of the soil with vermicompost and natural compost were compared. The growth of the plants was measured by their root length, shoot length and fresh, dry weight of plant with and without vermicompost added plants.

RESULTS AND DISCUSSION

The technical feasibility study of adopting vermicomposting is conducted to convert MSW to manure. The studies are carried out to laboratory scale reactor of 15kg capacity. The reactor is loaded

Table 3: Initial Characteristics of MSW

<table>
<thead>
<tr>
<th>Composition</th>
<th>Municipal solid waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.10</td>
</tr>
<tr>
<td>Nitrogen (%)</td>
<td>0.58</td>
</tr>
<tr>
<td>Phosphorus (%)</td>
<td>0.20</td>
</tr>
<tr>
<td>Potassium (%)</td>
<td>0.41</td>
</tr>
<tr>
<td>Total Solids (%)</td>
<td>61.0</td>
</tr>
<tr>
<td>Volatile Solids (%)</td>
<td>55.0</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>0.20</td>
</tr>
<tr>
<td>Magnesium (%)</td>
<td>0.11</td>
</tr>
<tr>
<td>Chlorides (%)</td>
<td>0.70</td>
</tr>
<tr>
<td>Sulphates (%)</td>
<td>0.10</td>
</tr>
<tr>
<td>Carbon (%)</td>
<td>25.5</td>
</tr>
</tbody>
</table>

CONCLUSIONS

Based on the observation and results obtained from the study, the conclusions drawn are:

- The Municipal solid waste can be treated by vermicomposting method.
- Similarly the Dairy industrial Sludge’s can also be treated by this method.
- The Vermicomposting technique does not require energy.
- The processing time is less by using vermicomposting method.
- It is a cost effective, fast and eco-friendly method of waste disposal. The municipal solid waste can be processed by vermicomposting technology.
- Effective disposal and reuse of waste are possible.
- This process does not result any odour problem.
- A Significant result of this study is that the municipal solid waste could be effectively degraded by earthworms in vermicomposting process and thus results in the production of manure, which is free from pathogens.
- The plants like ladies finger and fenugreek could have grown with vermicompost and natural compost.
- The root length and shoot length of the two trials were compared. The results revealed the plants grown with vermicompost shows the better growth than natural compost.
- The trial plants grown soil was tested and the mineral content of the soil with vermicompost and natural compost were compared.
- The growth of the plants was measured by their root length, shoot length and fresh, dry weight of plant with and without vermicompost added plants.
REFERENCES
2. N.B. Singh, Dr. A.K. Khare, Dr. D.S. Bhargava, Dr. (Ms) S. Agarwal, 2003, “Vermicomposting of Tomato Skin and Seed Waste”, Indian Environmental Journal, pg : 30-34.
3. Anitha Subash, Parvatham. R and Deepa, K.K, 2001, “Comparison of the leaves of minerals and heavy metals in VERMI COMPOST and NATURAL COMPOST from Tannery solid waste and this effects on selected plants, proceedings of ENVIRO 2001, PSG, OBI.