Evaluation Of Effective Microorganisms (EM) In Solid Waste Management

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Organic manures are derived from plant, animal and human residues. In addition to supplying principal elements to the soil, they promote microbial activity in the soil and improve its structure, aeration, and water holding capacity, which in turn improves the soil capabilities to respond to inputs. This paper deals with the composting of kitchen wastes using effective microorganisms (EM), which results in a higher decomposition of organic matter and no odor during process. This produces a high quality compost, which contributes toward sustainable development.

KEYWORDS: organic matters, compost, effective microorganisms (EM).

A major problem facing municipalities throughout the world is the treatment, disposal and/or recycling of solid wastes. Generally solid waste from a municipality consists of biodegradable organic materials. At the present time, there are a number of methods being used to dispose of the solid wastes in a landfill. Although there are many methods used, it requires the selection of the correct method focusing on efficient and environmentally safe disposal. New technology is being produced to assist the organic waste treatment, conforming to strict environmental regulations. One of those new technologies being proposed is the use of effective microorganisms (EM).

The technology of EM was developed during the 1970s at the University of Ryukus, Okinawa, Japan (Sangakkara 2002). Studies have suggested that EM may have a number of applications including agriculture, livestock, gardening and landscaping, composting, bioremediation, cleaning septic tanks, algal control and household uses (Higa & Chinen, 1998) .

EM is a mixture of groups of organisms that has a reviving action on humans, animals and the natural environment (Higa 1995) and has also been described as a multi-culture of coexisting anaerobic and aerobic beneficial microorganisms (EM Trading 2000).

The main species involved in EM include:

* Lactic acid bacteria - Lactobacillus plantarum, L. Casei , Streptococcus lactis.

* Photosynthetic bacteria - Rhodopseudomonas palustrus, Rhodobacter spaeroides.
* Yeasts - Saccharomyces cereuisiae, Candida utilis.
* Acitinomycetes - Streptomyces albur, S. griseus.
* Fermenting fungi - Aspergillus oryzae, Mucor hiemalis. (Diver 2001)

The basis for using these EM species of microorganisms is that they contain various organic acids due to the presence of lactic acid bacteria, which is a strong sterilizing compound and suppresses harmful microorganisms and enhances decomposition of organic matter. Also they have the ability to suppress disease inducing microorganisms such as Fusarium, which occur in continuous cropping programs.

Materials And Methods

Sample

The sample that was used for composting was collected from the college campus, which includes the wastes from the canteen and hostels.

Activating the EM

EM is available in a dormant state and requires activation before application. Activation involves the addition of 20 liters of water and 2 kilograms of jaggery (pure cane sugar) to 1 liter of dormant EM. Pour the mixture into a clean airtight plastic container with no air left in the container. Store the container away from direct sunlight at ambient temperatures for 8 to 10 days. Release the gas everyday until fermentation complete.

During the period of activation, a white layer of Acitinomycetes forms on the top of the solution accompanied by a pleasant smell. The pH is also a determining factor; the pH of the EM should be below 4.0.

Experimentation

A solution was prepared by mixing 30 liters water and 1 liter activated EM in a plastic bucket and about 15 liters were sprayed on the clean 3 x 1 meter composting site. A 15 cm. thick base layer containing animal waste was spread over the site and the activated EM was sprayed over this layer. A second layer of solid waste, about 30 cm. thick, was spread over the previous and also sprayed with the EM solution. This layering process was repeated to a height of about 100 cm. The stack was completed with a final layer of 5 cm. of animal dung. The entire unit was kept moist by spraying it with activated EM solution at regular intervals. After about 25 to 30 days the volume of bed had dropped substantially and a sweet-smelling white mold appeared on the biomass. At this point, the finished compost was collected and sieved. The compost were analyzed for pH, organic content, nitrogen (N), phosphorous (P), and potassium (K).

Results and Discussion

The parameters (nutrients carbon, nitrogen, phosphorous and potassium, and pH) of the fresh waste and the compost are presented in Tables 1 and 2.

Table 1
Parameters of the Fresh Waste

S. No.	Parameters	% by Dry Mass
1.	Carbon (C)	32.16
2.	Nitrogen (N)	0.98
3.	Phosphorous (P)	1.02
4.	Potassium (K)	0.402
5.	C: N	28: 1
6.	pH	7.4

Table 2
Parameters of the Composted Waste

S. No.	Parameters	% by Dry Mass
1.	Carbon (C)	30.05
2.	Nitrogen (N)	1.21
3.	Phosphorous (P)	0.63
4.	Potassium (K)	0.40
5.	C: N	26: 1
6.	pH	8.4

The carbon content of the wastes decreased during composting indicating a higher mineralization of organic matter. However, the nitrogen content increased in the process of composting. This shows that the increased microbial activity continues in the casts and results in an increased mineralization rate of organic nitrogen and consequent further increase in concentration of NH_4^+.

In the present study the carbon and nitrogen (C: N) ratio measurement provided an indication of the degree of decomposition. The C: N ratio of the wastes was higher before composting than after. Enhanced organic matter decomposition in the presence of effective microorganisms results in lowering the C: N ratio. In general, a low C: N ratio accelerates the rate of decomposition but may cause a loss of nitrogen as ammonia gas and a rapid depletion of the available oxygen supply, leading to foul smelling conditions. But EM controls the foul smell and the process is free of odors.

During composting, the organic carbon is lost as CO_2 and total nitrogen increases as a result of carbon loss. The final nitrogen content of compost is dependent on the initial nitrogen present in the waste and the extent of decomposition (Crawford, 1983).

There was a shift in pH from the initial condition toward an acidic condition. The occurrence of acidic conditions may be attributed to the bioconversion of the organic material into various intermediate types of organic acid and higher mineralization of the nitrogen and phosphorous into nitrites/nitrates and orthophosphate respectively.

Conclusions

The study that revealed that

* Kitchen wastes provided a better environment for the effective microorganisms (EM) to grow and produced a higher quality of compost.

* Organic matter helps in soil management for sustainable cultivation of any crop.

* The adaptation of effective microorganisms (EM) leads to detoxification of our landfills, decontamination of our environment and promotes highly sustainable, closed-cycle agricultural and organic waste treatment.

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