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Anita Kaushal and Umesh Bharti

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RESEARCH ARTICLE

MICROBIAL KITCHEN WASTE COMPOSTING: EFFECTIVE ENVIRONMENTALLY SOUND ALTERNATIVE OF SOLID WASTE MANAGEMENT

Anita Kaushal and Umesh Bharti*

PG Govt. College for Girls, Sector-11, Chandigarh

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ABSTRACT

Daily about 14% of vegetable and fruit peel solid waste is generated in each kitchen during preparation of food which is sealed in a plastic bag and taken to a landfill site by municipal corporations. It doesn't decompose properly but produces methane, the greenhouse gas.It is important to use these renewable resources to maximize yields and minimize the environmental hazards associated with chemical residues. Composting is an age old practice for the biological conversion of organic waste to a humus-like substance which can enhance physical, chemical and biological soil properties. Compost increases the water retention and drainage of soil. It helps keep weeds down and adds nutrients to the garden. The end results are nutrient rich soil additives that increase porosity and help hold important moisture in the soil.Smaller pieces compost fastest. Compost piles must be at the proper temperature and moisture balance to ensure break down of these types of items. There is a need to cover Composting kitchen scraps so that animals don't dig them up. If organic matter had not been present, 30% to 35% of the nitrogen, 20% to 30% of the phosphorus, and a lesser fraction of the potassium added as chemical fertilizer would have been leached beyond the root zone, and thus could not have contributed to soil fertility. Compost is an excellent soil conditioner and soil amendment.In this study role of soil microbes is harvested to transduce kitchen waste into environmentally sound compost and reduce the amount of material in landfills.

INTRODUCTION

The menace of solid waste in the urban sector has become a monstrous reality. Nothing substantial had been done in most of the towns and cities in the country. Very little effort had been made to train and build the capacity of all stakeholders. Although the nitrogen (N), phosphorus (P), and potassium (K) contents of organic waste typically were insufficient to permit the waste to be legally termed "fertilizer", the waste was a source of plant nutrients. When incorporated into the soil, the nutrients increased its fertility. In India, nearly 700 million tons of organic waste is generated annually, leading to challenges for its safe disposal, with the waste being usually either burned or land filled (Bhiday 1994; Nagavallemma *et al*. 2006; Zeinhom *et al*. 2010). However, there are several naturally occurring microorganisms that are able to convert organic waste into valuable resources such as plant nutrients, and reduce the C:N ratio to support soil productivity. These microorganisms are also important to maintain nutrient flows from one system to another and to minimize ecological imbalance (Novinsak *et al*. 2008; Umsakul *et al*. 2010; Kaushal A. and Bharti U.2015). Composting is a preferred and environmentally sound method whereby organic waste is reduced to organic fertilizer and soil conditioners through biological processes (Gautam *et al*. 2010; Alexander 1999).

Vegetable waste from the kitchen contained more water. The extra moisture greatly slowed decomposition because the piles never heated up to the same degree as dry piles. The foul odours produced will lead to numerous complaints. The access of insects and rodents further deteriorate the situation of kitchen waste composting. A variety of microbial populations develops in response to the different levels of temperature, moisture, oxygen, and pH within a compost pile. This microbial diversity enables the composting process to continue despite the constantly changing environmental and nutritional conditions within the pile. Not all of the micro-organisms present in the compost pile can produce these enzymes, particularly simple organisms, such as bacteria. Such decomposition requires more specialized organisms, such as fungi. After the polymeric material is hydrolyzed into smaller components by these specialized organisms, the resulting fragments can then be used by the nonspecialized organisms. Micro-organisms that inhabit a compost pile due to soil are in three classes: bacteria, fungi, and actinomycetes, a higher form

Corresponding author:* **Umesh Bharti
PG Govt. College for Girls, Sector-11, Chandigarh

of bacteria. This paper monitors the decomposition of common household organic waste with a microbial consortium to identify a suitable composting method.

Figure 1 Procedure Adopted for Composting

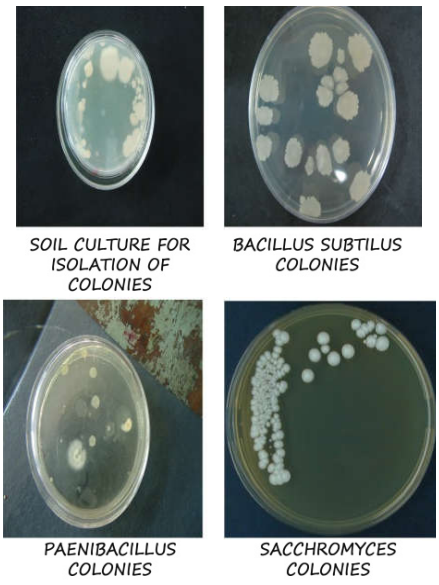

Figure 2 Microbes used for composting

MATERIAL AND METHODS

1. For Construction of compost pit for hostel waste, 2mX2m area near the hostel was identified (Figure-1) and a two feet deep pit was prepared..
2. Green jail was installed with the help of angle irons.
3. Five buckets of 25 liters capacity each, marked as 1, 2, 3, 4, 5 were kept near the pit area.
4. On first day hostel waste was added to bucket 1.To this 20 ml of microbial consortium was added. Then 1000 ml of lukewarm water was added and the bucket was covered with lid. Bucket was kept for one week and then was emptied into compost pit. Soil layer was added to it (Figure-1).
5. On the second day the same was repeated with bucket 2 and so on for all five buckets.
6. After a week the cycle was repeated.
7. Moisture content and temperature was frequently maintained.
8. Soil was tossed after 6 weeks.
9. Kitchen waste was converted into compost after 8-10 weeks.

Isolation of soil bacteria: Bacteria in soil occurred singly and in aggregates. To estimate the number of bacteria in a gram of soil, the soil must be both diluted and mixed thoroughly so that the aggregates were broken up such that a suspension of single cells was achieved. The cell suspension was then serially diluted so that from some dilutions a reasonable number of cells (30 to 300) were dispensed into Petri plates. The samples in Petri plates were then mixed with sterile, molten (liquid) nutrient agar medium which was then allowed to solidify. Later, isolated colonies were examined for the types of cells and one was re-streaked to obtain a pure culture. A pure culture was defined as the progeny from one cell. Proof of pure culture involved showed that all the colonies on the re-streak were identical and Gram staining these to demonstrated all the cells in the resulting colonies were identical and the same as those on the original plate.

Preparation of microbial consortium: Added 13 g of nutrient broth powder to 1 litre of distilled water. Mixed the solution well, dispensed as required and sterilized. To this added pure culture of isolated *Bacillus sp., Sacchromyces* sp. and *Paenibaccillus sp.* (Figure-2).

Plant growth testing: Two soil beds were made one with compost and other free from compost. To these beds five saplings each of Sunflower, Brinjal, Tomato and Green Chilli, purchased from Durga nursery, Manimajra were planted. Frequent record was maintained (Figure-5).

RESULTS AND DISCUSSION

Preparation of compost depended upon factors like Physical characteristics of the waste, whether or not the waste can be incorporated into the soil in its present state and Time lapse between generation and application of the waste (storage time). Particle size was one of the physical characteristics that served as a decisive factor in the determination of the feasibility of direct application. The product was dark brown to dark grey in colour. Unless the moisture content of the material was lower than 15%, decomposition continues. Decomposition was accompanied by change in appearance. If the compost product was stored sufficiently long, it eventually approached the consistency of a fine dust. The composting material took on an earthy odour toward the end of the processing phase, usually at the same time that fungi and actinomycetes made their appearance (Figure-3). Although the compost product did had a fertilizer value, as stated before, its nitrogen, phosphorus, and potassium (NPK) contents never met the usual legal definition of “fertilizer. Nutrients and soluble ions such as nitrate, ammonium, calcium, potassium, magnesium, chloride, sodium, carbonates, and bicarbonates contributed to the soluble salt

content of soil amendments and water. The presence of compost increased the efficiency of chemical NPK utilisation. The increased efficiency ultimately was the result of the conversion into microbial cellular mass of chemical fertiliser not used by the crop. NPK bound in microbial cellular mass was slowly released as the microbes die off. If organic matter had not been present, 30% to 35% of the nitrogen, 20% to 30% of the phosphorus, and a lesser fraction of the potassium added as chemical fertilizer would have been leached beyond the root zone, and thus could not have contributed to crop production (Figure-4). Compost was an excellent source of trace elements. Another major benefit of the use of compost was a substantial improvement of soil structure. The improvement in soil structure resulted from the tendency of compost to bring about soil aggregation. Aggregation was accomplished through the agency of various cellulose esters formed in microbial metabolism. Aggregation imparted a crumb-like texture to soil, i.e., made the soil friable. Friability was closely related with soil aeration and water-holding capacity. The more friable a soil became, the greater was its water-holding capacity and its state of aeration.

Figure 3 Kitchen waste change to compost

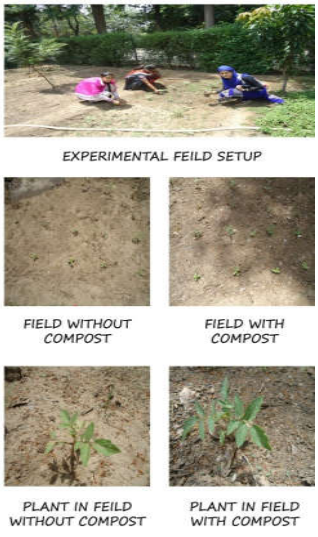

Figure 4 Setup of experimental field to correlate the growth of plants with compost

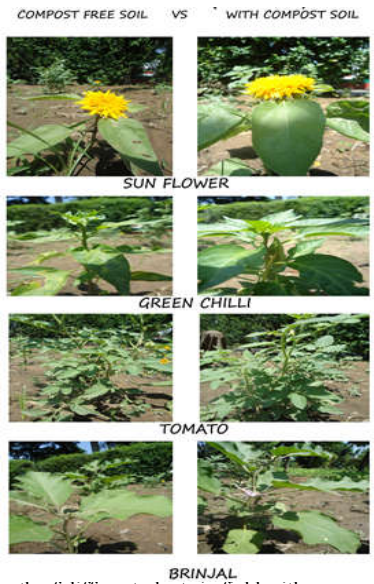

Figure 4 Growth of different plants in field with compost and without compost

Because aeration and moisture were important factors in root system development, plants grown in compost-enriched soils characteristically had well developed root systems. By managing kitchen waste on site, one can eliminate the costs of transport and fuel to landfill, making one a more responsible earth inhabitant.

CONCLUSION

Raw municipal organic wastes served not only as attractants but also as sources of nutrient and as shelters for rodents and vectors. The entire reproductive cycle of flies took place in decaying organic matter. Two other disadvantages of raw waste were objectionable odours and unpleasant sight. In a natural process, assuming no removal of nutrients, it would take 500 years or more to produce one inch of topsoil. This gave a sense of the enormity of the challenges that one faced in regenerating landscapes with destructive garden practices. Kitchen waste composting pits should be formed behind every mess or hostel and regular composting practices could save the environment and made it clean. Composting is like a biological fire. Microorganisms break down carbon from the kitchen waste, and in the presence of oxygen, carbon dioxide is released as a by-product. The bacteria and fungi responsible for composting are everywhere in our environment, so they need little special encouragement like oxygen, water and nutrients to do their job. Cities should ban to carry organic kitchen waste on trucks to landfills as cities are already running out of landfill sites, so filling them up with such waste is a very costly mistake. Composting is the need of the hour.

Education of all participants was critical to the success off composting operation. Every student involved in the project was made aware of the nutrients present on kitchen waste and what's Left in the Soil after Long-Term Removal of Nutrients and Inadequacy of Fertilization. Proper awareness drive was conducted in the college so that the stakeholders remain attached with organic waste management programme. All efforts were made to train and build the capacity of stakeholders. With commitment, zeal and hard work of researchers, this project was a boom to college and success of the project would be implemented to make Chandigarh more green and clean.

The relevant data is available with Ms.Umesh Bharti, P.G. Department of Zoology, P. G. Govt. College for Girls, Sector-11, Chandigarh

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