MIRCOBIAL ASSISTED RAPID COMPOSTING OF AGRICULTURE RESIDUES

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Abstract— Waste composition depends a wide range of factors such as cultural traditions, lifestyle, climate, food habits and income etc. Composting is the controlled aerobic de-composition of organic matter into a stable, humus- like product called compost. It has certain benefits like reduced odor, fly and other vector problems: and reduced weed seeds and pathogens. Composting is easily adapted to agricultural operation as farms generally produce suitable amounts and types of waste for composting, have adequate land, will benefit from the application of compost to the soil, and have the necessary equipment already available. Rapid composting technology involves inoculating the plant substrates used for composting with cultures of Trichodermaharziamum, a cellulose decomposer fungus. There must be favorable conditions for the decay process, such as adequate moisture, an appropriate initial C: N ratio of substrates, and aeration.

Key Words—Rapid Composting, compost fungus activator, aerobic decomposition, Microbial assisted, Activator, Lignocellulosic, C:N Ratio

1. INTRODUCTION

The old method of composting was to pile organic materials and let them stand for a year, at which time the materials would be ready to use. The main advantage of this method is that little working time or effort is required from the composter. Disadvantages are that space is utilized for a whole year, some nutrients might be leached due to exposure to rainfall, and disease producing organisms, some weeds, weed seeds and insects are not controlled.

Recently a new method has been developed which corrects some of the problems associated with the old type of composting. With the process, compost can be made in 2-3 weeks.

Extra efforts on the part of the composter is required in exchange for this time saving, but for those who want large amounts of compost, or those who wish to convert materials which are usually wasted into useable compost, the effort is worthwhile.

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The production of a valuable soil amendment from many organic materials, which normally might be wasted. Compost can be made ready for use in as short a time as 14 to 21 days. Rapid composting kills all plant disease-producing organisms if done as described. It does not inactive heat resistant viruses such as tobacco mosaic virus. Insect do not survive the composting process. Though some may be attracted to the pile, if they lay their eggs in the compost they will destroy the process. Most weeds and weed seeds are killed. Some weeds such as oxalis bulbs, seeds of burr clover, and some amaranthus seeds and seeds of cheese weed are not killed by the high temperature in the pile.

In view of difficulties in management of the agriculture residue in India the need of organic fertilizer, in the present paper information on rapid composting and its applicability for agricultural waste is discussed.

2. METHODS OF RAPID COMPOSTING

BRC (Berkley Rapid Composting) advocates for shredding and frequent turning of composting material. This method suggests that any organic material can be composted best if it is between ½ to 1 ½ inches in size. "[8]"

Indigenous microorganisms naturally undertake organic matter break down in composting. Nevertheless, the inoculation of substrates with the effective lignolytic and cellulolytic microorganisms may speed up the degradation of recalcitrant lignocelluloses and leading to the rapid composting of MSW. White rot fungi are known as the

most efficient ligninolytic micro organisms. Phanerochaete chrysosporium is probably the best studied microorganism for lignino-cellulotic activity and is often used as reference

The EM based rapid composting process involves aerobic decomposition of lignocellulosic waste in pits as enabled through turnings and application of effective microorganisms as activator for expediting the decomposition process.

The activator increases the population of microbial cellulose decomposers. If the compost pile has adequate moisture content, enough nitrogenous materials and good aeration, these micro organisms multiply rapidly. The increase in the population of micro organisms raises the temperature inside the compost heap, which in turn hastens the decomposition process. The composting period is shortened to just four weeks. "[7]"

The technology basically consists of two parts: the production of the compost fungus activators, and the composting process.

Additives are usually mixtures of different amounts of variousmicroorganisms, mineral nutrients, or readily available forms ofcarbon, enzymes and pH-balancing compounds that are meant toenhance microbial activity when the additive is in contact withthe waste material "[5]"The effectschemical additives such as coal fly ash, wood ash, green liquordregs, bauxite, natural zeolites, and kaoline on composting of municipalsolid waste, green waste, sludge, catering waste have beenextensively studied by different researchers "[5]". Wong and Fang(2000) found a positive effect of lime on composting by increasingtemperature and CO2 evolution without any negative effects onmicrobial community. Himanen and Hanninen (2009) studied theeffect of commercial additives containing sulfates and oxides ofiron, magnesium, manganese, and calcium hydroxide on composting.Similarly, Yu and Huang, 2009 studied the effect of sodiumacetate on composting of food waste and found an increase inmicrobial activity as the result of sodium acetate application.Although various chemical additives have been tested for theirefficiency in composting, use of sugar as an additive in compostingprocess has not been explored so far. Sugar as a carbon source canpromote the growth of degrading microbes and hasten compostingprocess. Similarly, the role of surfactants on composting processalso needs to be explored further, although its role on cellulose activity has been studied extensively. Application of polyethyleneglycol in enzymatic hydrolysis of lignocellulose is studied by Borjesson et al. (2007), he found that polyethylene glycol increasedthe rate of enzymatic conversion of cellulose and decreased theamount of enzyme needed. However, its effects on compostingare not known.

3. Rapid Composting of agriculture waste: Protocol

The present work should be done on a raised platform of 1m x 1m dimension at suitable site. Agriculture waste (only biodegradable type) should be added over the platform after shredding it to ½ to 1 ½ inches. When the agriculture waste attains a height of about 150mm, the microbial activator prepared should be added. A very thin layer of soil should be spread over it (once a week) to avoid odor and fly nuisance. Agriculture waste should be continuously added every day. The above procedure should be repeated till the heap attains the height of 1m.After 3-4 days agriculture waste above platform should settle down .It should be plastered with soil. The heap is left for 30-60 days as it is for maturation. The compost should be taken out after 30-60 days and should be analyzed for quality parameters and compost maturity.

4. Conclusion

Compost can be made ready for use in as short a time as 14 to 21 days. Rapid composting kills all plant disease producing organisms if done as described. It does not inactivate heat resistant viruses such as tobacco mosaic virus. Insects do not survive the composting process. Though some may be attracted to the pile, ifthey laid their eggs in the compost the willdestroythem. Most weeds and weed seeds are killed. Some weeds such as oxalis bulbs, seeds of burrclover, some amaranthus seeds and seeds of cheese weed are not killed by the high temperatures in the pile. In addition to the above, outdoor exercise is an added benefit.

Therefore accelerators in rapid composting will improve its efficiency of producing compost and to increase the temperature and modify the C: Nratio. Continual research using this technology will improve its efficiency and will boost the speed of the composting, but new accelerating techniques can be used to predict many factors that will predict the effectiveness of treatment.

5. CHARACTERIZATION OF AGRICULTURE RESIDUE

Raw Material Characterization (Leaves)		
Sr. No	**Parameters**	**Value**
1	Total Organic Matter	84.43%
2	Ash Content	15.56%
3	Total Organic Carbon	48.97%
4	Cellulose	42.87%
5	Hemi Cellulose	24.63%
6	Lignin Content	43.73%
7	pH	10.14%

(Akshad Patle et., al. 2013)

Raw Material Characterization (Vegetable Waste)		
Sr. No	**Parameters**	**Value**
1	Total Organic Matter	80.92%
2	Ash Content	30.75%
3	Total Organic Carbon	34.46%
4	Cellulose	22.78%
5	Hemi Cellulose	24.51%
6	Lignin Content	18.01%
7	pH	6.27%

(Akshad Patle et., al. 2013)

6. REFERENCES

1. Leslie Cooperband, "The Art and Science of Composting," Center for Integrated Agricultural Systems March 29, 2002.
2. Robert D. Raabe, "The Rapid Composting Method," Vegetable Research and Information Center, 1988.
3. Virginia C. Cuevas, "Rapid composting technology in the Philippines: its role in producing good quality organic fertilizers," 1991.
4. Brito, E., Bustamante, M.A., Paredes, C., Moreno-Caselles, J., Perez-Murcia, M.D., Perez-Espinosa, A., Moral, R, "Composting of Brewery waste with agriculture and forest residues," Technologies/systems for different manure and organic waste treatment options, 2005.
5. "Environmental Engineering National Engineering Handbook," Natural Resource Conservation Service United States Department of Agriculture (210-VI-NEH), February 2000.
6. SPM. Prince William, "Rapid composting of municipal solid waste," Clean India Journal, 2010.
7. Beans T.P, Boopathy R. and Templet P, "Accelarated decomposition of sugarcane crop residue using a fungal-bacterial consortium," International Biodeterioration and Biodegradation 50:2002.
8. Raabe R.D., "The rapid composting method Cooperative extension," University of California
9. Jagdish Gabhane, SPM. Prince William, RajnikanthBidyadhar, PriyaBhilawe, DuraiswamyAnand, Atul N Vaidya, Satish R. Wate, "Additives aided composting of green waste: Effects on organic matter degradation, compost maturity, and quality of the finished compost," biosource technology 2012.