Utilization of Domestic Waste through Composting Under Variable Sets of Biotic Combinations

[1]MANJULA R.THOMAS, [2]MAYANK VARUN and [3]S.WALKER

1,3Deptt. of Botany,St. John's College, Dr. B.R. Ambedkar University, Agra, India

[2]Deptt. of Botany, Hislop College, Nagpur, India

ABSTRACT - An attempt was made to investigate the feasibility of microbial conversion of domestic and kitchen waste to a multiple functional bio-fertilizer. Feed stocks were mixed with bulking material and inoculated with microbes in various combinations and a biotic set for each combination was made subsequently was subjected to incubation in pits and bins. Periodic mixing and churning of compost piles were maintained in an ambient temperature range of 45 - 60°C and an overall C:N ratio was maintained in the range of 35 - 40. Additional N input was made by adding poultry manure and urea. Moisture content was maintained at over 45%. NPK content was quite high compared to normal dung compost. Physical and chemical parameters (moisture, pH, EC, OM, C:N ratio, nutrient availability) were also analyzed for the quality assessment of prepared compost.

Keywords - Domestic waste, bulking agents, feedstock's, bio-fertilizer, microbial conversion, biotic sets, microbes.

I. INTRODUCTION

Domestic or kitchen waste forms a large portion of our household garbage. It mostly comprise of vegetable and fruit peelings, egg shells, tea bags, coffee grounds, spoiled or left over prepared food, packing paper etc and other discards from domestic and commercial kitchen. Beside this, yard and lawn trash also forms a major portion of domestic waste which include vegetative matter such as tree and shrub trimmings, hedge clippings, grass, leaves, stumps and garden trash. There are different methods to treat this waste such as dumping, burning or transfer to landfills etc. While dumping not only creates sanitation and environmental problem it is also a largest contributor to methane gas production. Burning also affects air quality and leaves no scope for resource recovery and lastly accumulation in landfill contributes to air and water pollution and impacts environmental and community health, However, recycling and composting can be a better and eco-friendly alternative for waste management, recycling of valuable nutrients and resource recovery. Composting provides an opportunity to generate a very valuable end product which can be used in agricultural and horticultural sector to improve soil's physical and biological properties by acting as a soil conditioner, as a supplier of nutrients and as a disease suppressant. Adding compost to field soil is a long term investment as it becomes a part of soil structure and helps soil to feed future plantings in years to come.

II. MATERIAL AND METHODS

The experiment was carried out in St. John's college premises during 2008 - 2009.

Pit size - 1x 3x 1 = 3 metre. (Rectangular)

Bin size - 20 litre (closed lid bin)

Domestic and kitchen waste was collected from various localities: Davis house hostel, St. John's College, Agra; From 15 marked households of Dev Nagar Colony, Agra and New Mandi Pareesar, Sikandra, Agra.

Transportation of feed stocks up to pit sites was managed for periodic filling.

Green waste was taken as base of feed stocks, with bulking agent to ensure sufficient porosity and moisture content. Overall 9 different biotic sets were prepared with all possible configurations of microbes, bulking agent and in terms of additional N supply and were separately subjected to both aerobic and anaerobic conditions in pits and closed lid bins.

After a span of 65-90 days, harvesting of prepared compost was done which include manual separation of matured and cured compost from the still unfinished or under composed parts. Prepared and matured compost become dark, loose and crumbly and doesn't reheat on turning.

BIOTIC SETS

S.No.	Bulk Feed Stock	Additional N types	Microbe
A.	Food waste + Eggshell	Cow dung	Nitrobacter
B.	FW + Eggshell	Poultry manure	Pseudomonas
C.	FW + Eggshell	Urea	T. viridi
D.	Fruit + Veg. peels	Cow dung	Nitrobacter
E.	Fruit + Veg. peels	Poultry manure	Pseudomonas
F.	Fruit + Veg. peels	Urea	T. viridi
G.	Grass/Lawn Trash	Cow dung manure	Nitrobacter
H.	Grass/Lawn Trash	Poultry manure	Pseudomonas
I.	Grass/Lawn Trash	Urea	T. viridi

III. RESULT AND DISCUSSION

Prepared compost was harvested after a period of 65-80 days and was assessed for nutrition availability and other physical and chemical parameters such as C: N ratio, pH, moisture content, bulk density and micro and macro nutrients. parameters are listed in table - 1.

Prepared Outcome was dark brown to earthy black in color with parent material is no more distinguishable. It was a fine mixture of small and medium sized particle and humic material, dark, crumbly and with deep organic odor. Moisture content was found in a range of 30 - 35%.

The pH value of prepared compost was slightly alkaline and falls in the range of 6.5 - 8.5. It is important to take care of pH ranges of prepared compost as it may alter the soil pH on addition and affect nutrient availability to plants. C: N ratio is a ratio of originally bound carbon to total N and it is the most promising indicator of compost richness and maturity. It indicates the rate of decomposition and most favorable range is from 17 - 30. Bulk density is referred as wt. per unit volume and a range of 120 - 370 g/L (Table - 1) is recommended.

Prepared compost was assessed for macro and micro nutrients and NPK nutrients which are most vital for plant physiology and are utilized in maximum quantities by plants. Therefore the knowledge of nutrient content of a compost type is not only crucial in terms of its standardization but also for the facility user to make appropriate and greatest possible use of it. Most prevalent range of N is in between 1.0 - 2.0% and 90% out of it is organically bound. Total phosphorous (TP) also falls in a range of 0.4 - 1% and it is expressed as % concentration per dry wt. Potassium is available in the form of K,O in prepared compost with an optimum range of 0.5 - 1.8% (Table - 2).

Similar results for total C and N, C: N ratio and water soluble NO2 - N had been found (cooperband 2003) in saw dust composting. Most favorable range was found between 30-40% and TN falls in a range of > 8mg NO3-N/Mg. A range of organic matter content from 30 - 58% dry wt. and CN ratio between 25 - 30% was obtained by composting process of biowaste and green waste (Herity, 2003). Other parameters were also found relative as pH, MC and bulk density. A range of organic carbon > 6 was found (Wuetal, 2000) in both ways of composting viz. piles and window methods. The pH, moisture content (MC), TKN (Total Kjeldahl nitrogen) and C. N ratio was taken as parameters of compost quality assessment.

Microbial conversion of food waste for biofertilizer production has been studied (Tsai shu et al, 2007) and a similar range of pH (55 - 8.0) and C: N ratio (20 - 25) and total nitrogen (1.0 - 2.0%) was found. The comparison of composting experiment reveals a significant reduction in organic C, C: N ratio after the inoculation of microbes, which enhanced the degradation of organic matter and in bulk density reduction also.

TABLE:1 - Various physical parameters for biotic sets

Parameter Biotic Set	C:N Ratio	pH Fresh wt.	Moisture % dry wt.	Organic matter % g/l fresh wt.	Bulk density
Aerobic Subjection					
A	28.2	7.4	44.4	37.5	228.1
B	20.2	8.0	52.1	40.8	320.6
C	17.8	6.9	57.1	50.9	404.3
D	24.2	8.5	42.8	48.9	253.8
E	19.0	8.2	48.0	36.5	309.1
F	27.2	7.1	55.8	45.6	317.8
Anaerobic Subjection					
G	28.0	6.5	60.8	44.8	356.0
H	28.4	6.9	60.4	39.6	269.1
I	30.1	7.0	58.7	41.0	415.9

TABLE : 2 - Micro and macro nutrient availability in various biotic sets

Set/ Parameters	Organic C%	Macronutrients %			Micronutrients			
		N	P	K	Ca%	Mg%	Cu	Zn
A	6.8	1.0%	0.42	0.92	1.53	0.4	18.8	85.7
B	7.4	1.7%	1.0	1.4%	1.73	0.4	14.9	-
C	7.8	2.1%	1.01	1.23	3.85	0.23	17.3	90.7
D	6.4	1.96%	0.74	1.67	2.26	0.31	18.3	92.1
E	7.2	1.77%	0.42	0.84	3.9	0.34	-	83.0
F	7.5	1.4%	0.97	0.87%	3.34	0.41	-	81.0
G	8.0	1.52	0.86	1.4	1.999	0.37	-	-
H	8.6	1.72%	0.73	1.64	2.8	0.29	-	-
I	7.0	1.80	0.59	1.59	2.97	0.40	15.1	-

IV. REFERENCES

[1]. Cooperband, L.R. (2003). Relative compost measures of stability and maturity to plant growth. Compost science utilization, 11 (2): 113-114.

[2]. Herity L., (2003). A study of quality of waste derived compost; Thesis for degree of M.Sc., Queens Univ. Belfast. pp135.

[3]. Wu, L.; L. Q. Ma and G.A. Martinez (2000). Comparison of methods for evaluating stability and maturity of biosolid compost. Journal of Environment Quality (29): 425 - 42.

[4]. Tsai Shu, Hsien, L. and Y. Shang shyng (2007). Microbial conversion of food waste for biofertilizer production with thermophillic lipolytic microbes; Renewable Energy, 32 (6): 904-915.

[5]. Verma, L.N.Rawal, A.K.Rathore, G.S. (1999)Composting process as influenced by the method of aeration. Journal of Indian Society of Sci. 47(2),368-371.