International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 2234-2236

Received: 04-05-2019
Accepted: 06-06-2019

K Vasundhara
Department of Environmental Sciences, Advanced Post Graduate Centre, ANGRAU, LAM, Guntur, Andhra Pradesh, India

GV Lakshmi
Department of Environmental Sciences, Advanced Post Graduate Centre, ANGRAU, LAM, Guntur, Andhra Pradesh, India

G Ramachandra Rao
Department of Environmental Sciences, Advanced Post Graduate Centre, ANGRAU, LAM, Guntur, Andhra Pradesh, India

G Kishore Babu
Department of Environmental Sciences, Advanced Post Graduate Centre, ANGRAU, LAM, Guntur, Andhra Pradesh, India

Correspondence
K Vasundhara
Department of Environmental Sciences, Advanced Post Graduate Centre, ANGRAU, LAM, Guntur, Andhra Pradesh, India

Characterization of Guntur urban compost and its suitability to different crops

K Vasundhara, GV Lakshmi, G Ramachandra Rao and G Kishore Babu

Abstract
In the present study, compost samples were collected from the Guntur municipal composting site, Andhra Pradesh. The physical and chemical properties of the compost were characterised and its suitability was tested on black gram, green gram and maize crops. The compost was neutral in reaction, rich in nutrients and can be used for soil application. Treatment with 10 t ha^{-1} of compost was recorded highest germination percentage, shoot length and dry weight in all three crops and FYM treatment was statistically on par with T_4 (compost @ 10 t ha^{-1}).

Keywords: Urban compost, Guntur and incubation studies

Introduction
India is rapidly shifting from agricultural based nation to industrial and services oriented country. Rapid industrialization and population explosion in India has led to the migration of people from villages to cities. This have accelerated the generation rate of urban solid waste causing its management to be a major worldwide challenge (Seo *et al*., 2004) [9] and its waste management is a critical element towards sustainable metropolitan development.
The population of India was 1252 million in 2013, which generates approximately 133760 tonnes of solid waste per day, of which 91152 tonnes is collected and 25884 tonnes is treated. Various studies reveal that about 90% of MSW is disposed of unscientifically in open dumps and landfills, creating problems to public health and the environment (Sharholy *et al*., 2008) [10]. These wastes are traditionally being disposed in the landfill sites or send for gasification which causes a serious soil and air pollution due to release of pollutants in the environment. Though, there are many negative issues related to solid waste, it also provides many opportunities that not only mitigates its negative impact but also helps in meeting the demand for energy and employment generation as well as in soil health improvement.
Composting of waste is the best method for waste management in Indian cities which can be used for various crops (Pathak *et al*., 2011) [6]. Composting is the natural biological process in which degradable part of waste is transformed to a stable material with excellent characteristics for application to soils. Municipal solid waste from Indian cities estimated to have 40% - 60% organic matter, which could be recycled as compost (Rawat *et al*., 2013) [7]. The quality of compost and its suitability for application depend on its physical and chemical properties. The main objective of this study is to characterize the physical and chemical properties of Guntur urban compost as it is most populated city generating a huge amounts of solid waste and its suitability is tested to different crops

Materials and Methods
A total of three compost samples were collected from Guntur municipal composting unit in polythene covers and were shade dried. The samples were passed through 2 mm sieve and were used for estimation of pH, EC, organic carbon, macronutrients, secondary nutrients, micronutrients, heavy metals and moisture percentage.
Compost samples were kept in the moisture tins and then placed in the hot air oven at 105 ˚C for 4 hours and after cooling the moisture percentage was calculated. pH was determined in 1:2.5 ratio compost water extract *i.e.*, 20 g of compost in 50 ml of distilled water using combined glass electrode and pH meter and Electrical Conductivity was measured in the supernatant collected from 1:2.5 ratio compost water suspension with EC bridge. Organic Carbon content of the compost was estimated by wet digestion method (Walkey and Black,

1934) [13]. Nitrogen content determined by kelplus- analyser distillation method by destroying the organic matter by digestion process using kelplus digestion unit. Phosphorous, potassium, sulphur, calcium, magnesium, micronutrients (Zn, Fe, Cu and Mn) and heavy metals (Pd, Cr, Ni and Cd) were estimated by di-acid digestion procedure (9:4 of HNO_3: $HClO_4$) (Tandon, 2017) [11].

Incubation studies were conducted in the cement pots to test the suitability of compost on three different crops *viz.*, Black gram, Green gram and Maize with five treatments (T_1- No compost, T_2- Compost @ 2 t ha^{-1}, T_3- Compost @ 5 t ha^{-1}, T_4- Compost @ 10 t ha^{-1} and T_5- FYM @ 5 t ha^{-1}) and four replications. Before sowing of seeds in the pots, germination percent was calculated by between paper method in the laboratory and in the study it was calculated at 5-6 DAS and the seedlings were harvested at 21 DAS for recording the shoot length and dry weight. The data obtained from the incubation studies were subjected to statistical analysis using Completely Randomized Design (CRD) at 5% level of significance and was tested by 'F' test.

Results and Discussion

Characteristics of the Compost

The physical and chemical properties of the three compost samples were illustrated in Table 1. The pH of samples was neutral in reaction within the range of 7.04 to 7.29 with a mean value of 7.15. EC values were high and were ranged from 3.52 to 3.68 dSm^{-1} with average value of 3.64 dSm^{-1}. The value of EC was more due to organic matter degradation processes, which generate the production of inorganic compounds and the increasing relative concentration of potassium ions due to the mass loss of the pile (Paredes *et al*., 2001) [4]. Moisture content was in the range of 28.6 to 30.40% with a mean value of 29.57%. The organic carbon was more in the compost samples ranged from 14.7 to 16.2% with an average value of 15.63%.

The primary nutrients in the compost samples *viz.*, nitrogen, phosphorus and potassium were in the range of 1.47 to 1.90, 0.59 to 0.72 and 0.73 to 0.85 % with a mean value of 1.67, 0.65 and 0.86% respectively. Secondary nutrients in the compost were sulphur, calcium and magnesium were ranged from 0.13 to 0.16, 1.17 to 1.21 and 0.28 to 0.34% with an average value of 0.15, 1.19 and 0.31% respectively.

Trace elements present in the compost samples were iron, copper, zinc, manganese, lead, cadmium, chromium and nickel were in the range of 179.4 to 191.2, 11.2 to 12.3, 33.7 to 35.6, 17.9 to 19.4, 34.1 to 35.3, 1.24 to 1.39, 9.54 to 10.1 and 21.7 to 22.84 mg kg^{-1} with an average value of 186.30, 11.67, 34.60, 18.53, 34.70, 1.30, 9.91 and 22.31 mg kg^{-1} respectively. Heavy metals do not degrade throughout the composting process, and frequently become more concentrated due to the microbial degradation and loss of carbon and water from the compost. (Richard, 1992) [8]. Better compost quality and lower potential for lower toxicity of heavy metals can be obtained by continuously aerated the composting materials (Cai *et al*., 2007) [1].

Table 1: Physical and chemical properties of urban compost

Parameters	Sample-1	Sample-2	Sample-3	Mean
Ph	7.04	7.29	7.12	7.15
Electrical Conductivity (dSm^{-1})	3.52	3.73	3.68	3.64
Moisture Content (%)	28.6	30.4	29.7	29.57
Organic Carbon (%)	14.7	16.2	15.98	15.63
Nitrogen (%)	1.9	1.47	1.63	1.67
Phosphorus (%)	0.72	0.59	0.64	0.65
Potassium (%)	0.81	0.73	0.85	0.80
Sulphur (%)	0.15	0.13	0.16	0.15
Calcium (%)	1.21	1.19	1.17	1.19
Magnesium (%)	0.34	0.28	0.32	0.31
Iron (mg kg^{-1})	191.2	179.4	188.3	186.3
Copper (mg kg^{-1})	12.3	11.2	11.5	11.67
Zinc (mg kg^{-1})	35.6	34.5	33.7	34.60
Manganese (mg kg^{-1})	19.4	18.3	17.9	18.53
Lead (mg kg^{-1})	35.3	34.1	34.7	34.70
Cadmium (mg kg^{-1})	1.39	1.27	1.24	1.30
Chromium (mg kg^{-1})	9.54	10.1	10.09	9.91
Nickel (mg kg^{-1})	22.4	21.7	22.84	22.31

Incubation Studies to Test the Suitability of Urabn Compost

There was a significance difference among the five different treatments in all parameters of all the three crops. In all crops of all the parameters highest value was recorded in T_4 (10 t ha^{-1} compost) whereas lowest was recorded in the T_1 (no compost) (Table 2). Application of solid waste compost to soil significantly enhanced plant growth and yield especially when 80 t ha^{-1} of compost was applied than 40 t ha^{-1} (Lakhdar *et al.*, 2015) [3].

The germination percent of black gram, green gram and maize was 95%, 95% and 97% respectively in the laboratory (between paper method). In the study, germination percent of black gram was significantly superior in T_4 (92.38%) in compost followed by T_5 (89.95%), T_3 (87.38%), T_2 (84.88%) and lowest value was recorded in T_1 (82.15%). In green gram, it was significantly higher in T_4 (92.53%) followed by T_5 (90.08%), T_3 (84.90%), T_2 (82.30%) and lowest value was recorded in T_1 (80.75%). In maize, it was significantly higher in T_4 (99.58%) followed by T_5 (99.00%), T_3 (98.48%), T_2 (97.33%) and lowest value was recorded in T_1 (97.15%). The increasing order of germination percent in all crops was $T_1 < T_2 < T_3 < T_5 < T_4$. Pascual *et al*. (1997) [5] conducted germination experiments with barley seeds on water extracts of different organic materials and reported that germination rates were highest with mature composts extracts as they were free from phytotoxic materials than the fresh composts.

Shoot length of black gram was significantly higher in T_4 (21.82 cm) followed by T_5 (19.02 cm), T_3 (17.42 cm), T_2 (15.40 cm) and lowest value was recorded in T_1 (14.15 cm). In green gram, it was significantly superior in T_4 (20.32 cm) followed by T_3 (18.57 cm), T_5 (17.37 cm), T_2 (16.52 cm) and

lowest value was recorded in T_1 (12.90 cm). In maize, it was significantly higher in T_4 (76.00 cm) followed by T_5 (68.52 cm), T_3 (64.85 cm), T_2 (61.20 cm) and lowest value was recorded in T_1 (58.80 cm). The increasing order of shoot length was $T_1 < T_2 < T_3 < T_5 < T_4$ for black gram and maize and was $T_1 < T_2 < T_5 < T_3 < T_4$ for green gram.

Dry weight of black gram was significantly higher in T_4 (0.51 g) but statistically on par with T_5 (0.50 g) and followed by T_3 (0.33 g), T_2 (0.32 g) and lowest value was recorded in T_1 (0.21 g). In green gram, it was significantly higher in T_4 (0.29 g) followed by T_3 (0.25 g), T_5 (0.24 g), T_2 (0.20 g) and lowest value was recorded in T_1 (0.18 g). Dry weight of maize was significantly higher in T_4 (1.73 g) followed by T_3 (1.45 g), T_5 (1.42 g) and lowest value was recorded in T_1 (0.74 g) followed by T_2 (1.20 g). The increasing order of dry weight was $T_1 < T_2 < T_3 < T_5 < T_4$ for black gram and $T_1 < T_2 < T_5 < T_3 < T_4$ for green gram and maize. Chefetz *et al*. (1996) [2] reported that the highest dry weight of cucumber plants was recorded in the mature composts (112 and 132 days old) and least was recorded in the plants grown in the fresh compost (14 days).

Conclusions

The compost collected was very rich in the nutrients and was neutral in nature with more organic carbon content and can be suitable to the soil application. All the trace elements were present in the compost but all were within the limits of USEPA, 1997.

In the incubation studies, T_4 (compost @ 10 t ha^{-1}) was significantly showed the best performance but it was statistically on par with the results of T_5 (FYM @ 5 t ha^{-1}) in all the three crops. From the study, it can be concluded that urban waste can be converted into nutrient rich urban compost and can used to the agricultural crops. Currently, urban wastes are generating enormously and dumping sites are being filled rapidly, this problem can.

Table 2: Effect of urban compost on percent germination, shoot length and dry weight

Treatments	Percent Germination (%)			Shoot length (cm)			Dry weight (g)		
	Black gram	Green gram	Maize	Black gram	Green gram	Maize	Black gram	Green gram	Maize
T1- No compost	82.15 (64.98)	80.75 (63.95)	97.15 (80.32)	14.15	12.9	58.8	0.21	0.18	0.74
T2- Compost @ 2 t ha^{-1}	84.88 (67.09)	82.30 (65.09)	97.33 (80.66)	15.4	16.52	61.2	0.32	0.2	1.2
T3- Compost @ 5 t ha^{-1}	87.38 (69.16)	84.90 (67.10)	98.48 (83.10)	17.42	18.57	64.85	0.33	0.25	1.45
T4- Compost @ 10 t ha^{-1}	92.38 (73.95)	92.53 (74.12)	99.58 (87.04)	21.82	20.32	76	0.51	0.29	1.73
T5- FYM @ 5 t ha^{-1}	89.95 (71.50)	90.08 (71.62)	99.00 (84.53)	19.02	17.37	68.52	0.5	0.24	1.42
Mean	87.35 (69.34)	86.11 (68.38)	98.30 (83.13)	17.56	17.14	65.87	0.37	0.23	1.3
Maximum	92.38	92.53	99.58	21.82	20.32	76	0.51	0.29	1.73
Minimum	82.15	80.75	97.15	14.15	12.9	58.8	0.21	0.18	0.74
S Em ±	0.44	0.35	1.03	0.34	0.42	0.58	0.01	0.01	0.03
CD (5%)	1.31	1.05	3.09	1.03	1.26	1.73	0.02	0.01	0.09
CV (%)	1.25	1.02	2.47	3.89	4.91	1.74	4.8	4.68	4.68

Overcome by converting the wastes into compost.

References

1. Cai Q, Mo C, Wu Q, Zeng Q, Kastsoyiannis A. Concentration and speciation of heavy metals in six different sewage sludge compost. Journal of Hazardous Materials. 2007; 147:1063-1072.
2. Chefetz B, Hatcher PG, Hadar Y, Chen Y. Chemical and Biological Characterization of Organic Matter during Composting of Municipal Solid Waste. Journal of Environmental Quality. 1996; 25:776-785.
3. Lakhdar A, Achiba WB, Montemurro F, Jedidi N, Abdelly C. Effect of Municipal Solid Waste compost and farmyard manure application on heavy-metal uptake in wheat. Communications in Soil Science and Plant Analysis. 2015; 40:3524-3538.
4. Paredes C, Bernal MP, Roig A, Cegarra J. Effects of olive mill wastewater addition in composting of agro industrial and urban wastes. Biodegradation. 2001; 12:225-234.
5. Pascual JA, Ayuso M, Garcia C, Hernandez T. Characterization of urban wastes according to fertility and phytotoxicity parameters. Waste Management and Research. 1997; 15:103-112.
6. Pathak AK, Singh MM, Kumar V. Composting of municipal solid waste: a sustainable waste management technique in Indian cities - a review. International Journal of Current Research. 2011; 3(12):339-346.
7. Rawat M, Ramanathan AL, Kuriakose T. Characterisation of municipal solid waste compost (MSWC) from selected Indian cities-a case study for its sustainable utilisation. Journal of Environmental Protection. 2013; 4:163-171.
8. Richard TL. Municipal solid waste composting: physical and biological processing. Journal of Biomass and Bioenergy. 1992; 3:163-180.
9. Seo S, Aramaki T, Hwang Y, Hanaki K. Environmental impact of solid waste treatment methods in Korea. Journal of Environmental Engineering Division. 2004; 130(1):81-89.
10. Sharholy M, Ahmad K, Mahmood G, Trivedi RC. Municipal solid waste management in Indian cities- A review. Waste Management. 2008; 28:459-467.
11. Tandon HLS. Methods of Analysis of Soils, Plants, Water and Fertilizers. Fertilizer Development and Consultation Organisation, New Delhi, India. 2017; 204+xii.
12. US Composting Council, Test methods for the examination of composting and compost (Interim Draft), Bethesda, Maryland, 1997.
13. Walkley A, Black CA. An examination of different methods for determining soil organic matter and a proposed modifications of the chromic acid titration method. Soil Science. 1934; 37:29-38.