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Assessment of Municipal Solid Waste Compost for Agricultural Application: A Case Study in Vijayawada City, Andhra Pradesh

Keywords: *Municipal solid waste compost, solid waste and trace elements.*

The aim of this study was to evaluate the composts produced from the municipal solid waste of Vijayawada city, Andhra Pradesh. Three compost samples were collected from the three different composting units and were analysed for the physical, physico- chemical and chemical properties. All the three compost were neutral in nature with high organic matter and were suitable for the soil application. Among all the three samples, Kabela unit compost showed the best results in the nutrient aspect. The trace elements which were present in the samples were within the standard limits of Indian Compost Standards, 2000.

Waste generated from industrial sector, commercial, domestic, institutional and municipal services are included in municipal solid waste (MSW). MSW management is a grave problem in most of the urban cities in India due to generation of its huge quantity and non-availability of suitable and cost-effective technologies for treatment and disposal. Urban India generates about 48 million tonnes of MSW per annum. The per capita national MSW generation ranges between 200 and 600 g (CPCB, 2010).

Generally, waste management technique takes place in many ways viz., landfill, incineration, pyrolysis and gasification, composting and anaerobic digestion. Waste recovery such as recycling and composting is the best and sustainable option of managing the disposed waste. Composting of MSW is seen as a method of diverting organic waste materials from landfills, while creating a product, at relatively low-cost, that is suitable for agricultural purposes and composting also reduces the volume of the wastes, kills pathogens, decreases germination of weeds in agricultural fields and destroys malodorous compounds and final product contains agricultural and horticultural benefits as a soil conditioner and fertilizer. Municipal solid waste from Indian cities estimated to have 40% - 60% organic matter, which could be recycled as compost (Rawat *et al*., 2013). The quality of compost and its suitability for application depend on its physical and chemical properties. The aim of this study is to examine the nutrient content of the MSW composts collected from Vijayawada city, Andhra Pradesh for application in agricultural fields which serves as an alternative way of MSW management and employment generation in the city.

In the study, a total of three compost samples were collected from three different composting units of Vijayawada city. The three units were APIIC Autonagar unit, Kabela and Gandhi market unit respectively. The samples were collected in the polythene covers and were shade dried. They were passed through 2 mm sieve and were used for estimation of pH, EC, organic carbon, macronutrients, micronutrients, heavy metals and moisture percentage.

Compost samples were kept in the moisture tins and then placed in the hot air oven at 105 ^{o}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). 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).

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 7.45 to 7.63. EC values were high and were ranged from 3.32 to 4.21 dSm^{-1}. The higher EC values were 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). Moisture content was in the range of 28.20 to 29.70%. The organic carbon was more in the compost samples which ranged from 11.88 to 18.11% with an average value of 15.63%.

Table 1. Properties of the three composts

Parameters	APIIC	Kabela	Gandhi
Physico-Chemical Properties			
pH	7.59	7.45	7.63
Electrical Conductivity (dSm^{-1})	3.32	4.16	4.21
Physical Properties			
Moisture Content (%)	29.70	28.70	28.20
Chemical Properties			
Organic Carbon (%)	11.88	16.6	18.11
Nitrogen (%)	1.16	1.48	1.71
Phosphorus (%)	0.42	0.65	0.79
Potassium (%)	0.79	0.88	0.91
Sulphur (%)	0.28	0.54	0.61
Calcium (%)	1.49	1.86	1.58
Magnesium (%)	0.59	0.73	0.97
Micronutrients			
Iron ($mg\ kg^{-1}$)	204.70	175.80	124.40
Copper ($mg\ kg^{-1}$)	17.80	10.40	15.30
Zinc ($mg\ kg^{-1}$)	29.60	38.20	20.50
Manganese ($mg\ kg^{-1}$)	10.20	29.70	18.30
Heavy metals			
Lead ($mg\ kg^{-1}$)	12.95	42.32	22.19
Cadmium ($mg\ kg^{-1}$)	0.76	1.52	2.31
Chromium ($mg\ kg^{-1}$)	13.18	25.42	19.67
Nickel ($mg\ kg^{-1}$)	30.42	25.21	31.27

The primary nutrients in the compost samples *viz.,* nitrogen, phosphorus and potassium were 1.16, 0.42 and 0.79% in APIIC unit, 1.48, 0.65 and 0.88% in Kabela unit and 1.71, 0.79 and 0.91% in Gandhi unit respectively. Secondary nutrients in the compost were sulphur, calcium and magnesium were ranged from 0.28 to 0.61%, 1.49 to 1.86% and 0.59 to 0.97% respectively. Trace elements present in the three compost samples were iron, copper, zinc, manganese, lead, cadmium, chromium and nickel were 204.70, 17.80, 29.60, 10.20, 12.95, 0.76, 13.18 and 30.42 mg kg^{-1} in APIIC unit, 175.80, 10.40, 38.20, 29.70, 42.32, 1.52, 25.42 and 25.21 mg kg^{-1} in Kabela unit and 124.40, 15.30, 20.50, 18.30, 22.19, 2.31, 19.67 and 31.27 mg kg^{-1} in the Gandhi unit respectively. All the trace elements were within the Indian Compost Standards, 2000.

The results of the study clearly indicate that, the biodegradation and recycling of municipal solid wastes can transform garbage to enriched composts. Based on the findings, it can be concluded that composts made from MSW were collected suitable for the soil application which improves sandy soil fertility, soil texture and water holding capacity and decrease the volume of MSW in Viajayawada. It was felt that the heavy metal content in the compost could be kept within limits when only organic waste material of plant origin is fed to the composting plant and the impact of heavy metals on landfill site was found to be less when MSW was pre-treated under aerobic composting.

Using this compost to amend the soil could not only improve soil quality but also serve as an environmentally safe and economically sound method of MSW disposal. The compost was nutrient rich and cost effective which helps to improve the physical, biochemical and microbial properties of the soil resulting improved soil fertility and productivity. With the use of municipal solid waste compost as source of organic manure may reduce dependency on inorganic fertilizers and promote organic farming.

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