Recent Research in Science and Technology 2014, 6(1): 241-244
ISSN: 2076-5061
Available Online: http://recent-science.com/

Valuable black gold as a result of utilization of municipal solid waste

Shweta Choubey

Professor Applied Chemistry and Centre for Environmental Science and Engineering Bhilai Institute of Technology Durg C .G., India.

Abstract
Municipal solid waste (MSW) compost is increasingly used in agriculture as a soil conditioner but also as a fertilizer. Municipal solid waste (MSW) is an unwanted byproduct of modern civilization. Composting is the simultaneous means of conversion of organic waste into valuable fertilizer. Compost is "black gold" in agriculture. Compost has the potential of being fertilizer thus it is increasingly used in agriculture as a soil amendment improving the physical and chemical properties of soil. Proponents of this practice consider it an important recycling tool since MSW would otherwise be landfilled and critics are concerned with its often elevated metal concentrations. Large amounts of MSW compost are frequently used in agriculture to meet crop nitrogen requirements and for the addition of organic matter. Municipal solid waste compost has also been reported to have high salt concentrations, which can inhibit plant growth and negatively affect soil structure. A review of relevant agricultural studies is presented as well as recommendations for improving MSW compost quality.

Keywords: Municipal Solid Waste (MSW), composting, soil amendment

INTRODUCTION

Due to rapid population growth and economic development in the country there has been significant increase in municipal solid waste (MSW). MSW includes both domestic and commercial waste account for a relatively small part of the total solid waste sin developed countries [1]. The MSW amount is expected to increase significantly in the near future as the country strives to attain an industrialized nation status by the year 2020 [2]. The organic content of Municipal Solid Waste (MSW) tends to decompose leading to various smell and odour problems. It also leads to pollution of the environment. Solid waste management is considered to be one of the most serious environmental problems confronting urban areas in developing countries. It involves activities associated with generation, storage, collection, transfer and transport, processing and disposal of solid wastes. Composting is one of the important technologies for disposal of solid waste.

Composting is an aerobic process by which organic materials are degraded through the activities of successive groups of microorganisms; it is an environmentally sound way to reduce organic wastes and produce organic fertilizer or soil conditioner [3]. During composting, microorganisms such as bacteria and fungi break down complex organic compounds into simpler substances and produce carbon dioxide, water, minerals, and stabilized organic matter (compost). The process produces heat, which can destroy pathogens (disease-causing microorganisms) and weed seeds. With rising interest in organic agriculture, the production of organic-grade MSW compost for agriculture is also gaining popularity because of its positive effect on biological, physical, and chemical soil properties [4].

*Corresponding Author

Shweta Choubey
Professor Applied Chemistry and Centre for Environmental Science and Engineering Bhilai Institute of Technology Durg C .G., India.

Email: shwetachouey77@yahoo. co.in

Compost has the potential of being a fertilizer and can thus be environmentally beneficial by substituting artificial fertilizers [5]. Composting passes through several stages, each of which is characterized by activity of different microbial groups [6]. Composting satisfies the health and aesthetic aspects of waste disposal. Compost has high organic matter content. By incorporating compost into soil, Soil Organic Matter (SOM) is increased, making the soil healthier.

The viability of composting depends on the availability of markets for composts. Compost contains many essential nutrients and improves soil physical and chemical properties. It without a doubt is a valuable product as compost improves soil organic matter content, nutrient availability soil aeration, and water holding capacity, and reduces soil bulk density. Compost, if properly prepared, is beneficial to the productivity of field and container crops.

METHODS AND MATERIAL

Source material for composting

Table 1. Materials of various sources suitable for composting [7]

Organic waste from Households	Organic waste from commercial horticulture and agriculture	Organic waste from commercial and industrial sectors
• Fruit and vegetable waste • Egg and nut shells • Tea leaves and coffee • Ground (with filters) Hair, feathers, wool, cotton, • Leather • Wood ash • Flowers, garden plants, plant • Mould • Toilet paper, kitchen roll, • Paper tissues • Pet droppings and litter	• Leaves • Grass cuttings • Tree and bush prunings • Weeds • Windfall fruit • Market waste • Remains of plants and harvested crops (e.g. roots, stems) • Wood chippings and shavings • Straw • Green cuttings and waste from public parks etc	• Agro-industrial waste (e.g. from breweries, tobacco and cotton industries) • Waste from commercial ponds (algae, water hyacinths), sludge and dredged sediment

Composting methods

According to Gautam-et-al [8], an investigation was done in Jabalpur city of Madhya Pradesh, solid waste were collected from 3 different sites on the basis of social economic areas and segregated following their disposal by composting method. The compost samples were drawn and analyzed in the laboratory for the parameters such as pH, Organic matter and moisture. Spinach a very famous vegetable called "sarson the saag" of Punjab [9] were disposed by composting and vermicomposting and it was found that that fresh vegetable sample of spinach showed higher contents of sodium , magnesium and potassium (16.883 mg/g) as compared to its composted and vermicomposted forms respectively. All the other parameters like calcium, nitrates, phosphates and pH were found to be enhanced in composted sample. Jatropha which is used for making biodiesel were collected from Alangudi Mahajanam, Lalguditaluk, Tamilnadu [10], and compost was prepared in a particular proportion of solid waste and cow dung in a plastic tubs. Compost was moistened once in a week and allowed to composting for 30 - 60 days and then analyzed for chemical parameters. The pH and electrical conductivity (EC) of the samples were measured by preparing suspension of 20 g matter in 100 mL of deionised water, using pH meter and conductivity meter. Making use of a flame photometer the percentage of total sodium and potassium were determined [11]. The percentage of phosphorous was determined with the help of photo electric colorimeter. Estimation of nitrogen, calcium, magnesium and organic carbon was carried out by usual methods. Dead birds and Caged Layer Manure (CLM) were composted [12], using paddy straw and sorghum hay as a source of carbon. The tannery sludge was mixed with sawdust (50kg), chicken manure (30kg), and rice bran (20kg) in a pile 3m long and 1.5 m high on a composting windrow type with the aim of maintaining aerobic conditions during the process, the pile was turned manually every10 days [13]. Compost was prepared through hot method using different organic materials like rice and wheat residues, flowers, leaves and soft parts of different trees, vegetable and fruit wastes and was subsequently applied to the normal field [14].

Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworms are used to enhance the process of waste conversion and produce a better end product. According to Gandhi et al, Vermicomposting differs from composting in several ways [15]. It is a mesophilic process [31], utilizing microorganisms and earthworms that are active at 10–32°C (not ambient temperature but temperature within the pile of moist organic material). The process is faster than composting because the material passes through the earthworm gut, a significant but not yet fully understood transformation takes place, whereby the resulting earthworm castings (worm manure) are rich in microbial activity and plant growth regulators, and fortified with pest repellence attributes as well. In short, earthworms, through a type of biological alchemy, are capable of transforming garbage into 'gold' [16].

RESULTS AND DISCUSSIONS

Presence of significant amount of biodegradable organic and inorganic materials in comparison of those of standard value has been shown in following table:

Table 2. Chemical Parameters of Compost

	Moisture content	pH	Conductivity	C: N Ratio	C	N	Organic Matter	Na	K	P	Ca	Mg	Reference
Standard Value	<50%	5.5 - 8.0	-	25-50:1	30 - 40 %	>0.6 %	>20 %	-	-	-	-	-	Anon (1987)
Jabalpur (India)	36%	7.8	-	40:1	32	0.05	45%	4.8	0.35	0.002	–	–	Gautam-et-al (2010)
Punjab (India)	–	7.96	–	–	–	0.0412	–	143.38 (mg/g)	7.056 (mg/g)	2.530 (mg/g)	0.400 (mg/g)	18.265 (mg/g)	Sharma-et-al (2010)
Tiruchirappalli (India)	17.20 %	7.306	10.18	-	-	1.32 %	-	0.283%	1.760%	0.361%	-	0.4 %	Jankiram-et-a (2010)
Malyasia	60.1 %	6.6	2.0	-	-	8.2 (mg kg-1)	19.8 %	50	2.5 (mg kg-1)	-	45 (mg kg-1)	10	Ahmed-et-al (2007)

Compost as a soil amendment

Composting is a mean of simultaneous conversion of organic waste into a valuable product. Because of this reason it is known as sustainable component of agriculture [29]. Composting of municipal solid waste has potential as a beneficial recycling tool. Uses of compost in agriculture, however, depend on the production of good quality compost. Composting MSW reduces the volume of the waste, kills pathogens that may be present, decreases germination of weeds in agricultural fields, and destroys malodorous compounds. Most plant nutrients in compost are in an organic form. Compost is a black gold and intensively used as soil amendment. Although compost is not high in nitrogen, phosphorous, or potassium, (it contains approximately 2% of each) these nutrients are released slowly over a long period of time. Nutrients become available to plant roots at a slower rate with compost compared to inorganic fertilizers, therefore the nutrients are less likely to leach out of the soil. Only a fraction of the nitrogen, phosphorus, and potassium applied as

compost is usable by the crop the first year with more becoming available in the years that follow [17]. On applying compost in soil shows increase in pH. It was slightly neutral to alkaline for the surface horizons and slightly acidic to neutral for the deeper horizon [18]. Soil water holding capacity depends on two factors: 1) the number and size of pores in the soil and 2) the surface area of the soil particles. Porosity controls water holding capacity at lower moisture tension (wetter soil), whereas surface area controls water holding capacity at higher moisture tension (drier soil) [30]. Soil water retention capacity increases at after the compost addition [19]. The increase of total nitrogen during composting was caused by the decrease of substrate carbon resulting from the loss of CO_2 (because of the decomposition of the organic matter which is chemically bound with Nitrogen) [20]. For nutrient availability, Compost expected to show an increase nutrient content in amended soil. Compost application increased total nitrogen content in the 0-15 cm of the soil. Increase water holding capacity decrease in bulk density was observed in the compost amended soils [21]. Humic substances had a capacity to interact with metal ions, buffer pH, and to act as a potential source of nutrients for plants [22]. Microbial activity was 2.23 times greater in compost amended soils. Soil respiration significantly increases in the soil that received the total cumulative compost applications of 168 and 224 Mg ha [23]. Repeated application of MSW compost consistently increased soil organic matter content and soil C/N ratio to levels greater than those of unamended soil [24-28].

CONCLUSION

This paper has shown that, composting constitutes an effective method not only to reduce the volume of wastes generated, but also, and especially, to obtain added-value composts with future potential uses in agriculture field because of additional properties. In this strategy cost of production is also reduced. Thus fertility and productivity of soil both increases simultaneously by the successive use of compost. Hence, municipal solid waste is suitable for composting because of the presence of high percentage of biodegradable organic matter, acceptable moisture content and C/N ration in the waste. Compost creates healthy soil conditions, thus enabling productive, efficient plant growth without the use of chemical fertilizers.

REFERENCES

[1] White, P.R., M. Franke and P. Hindle, 1995. A lifecycle prevent erosion, supplies slow release of nutrients and Inventory, Chapman and hall, London.

[2] Sharma, S., Shah, K.W., 2005. Generation and disposal of solid waste in Hoshangabad, In Book of Proceedings of the Second International Congress of Chemistry and Environment, Indore, India, 749–751.

[3] Gajdos R, 1992. The use of organic waste materials as organic fertilisers-recycling of plant nutrients., Acta Hortic, Vol. 302, 325-331.

[4] Iglesias-Jimenez, E., Alvarez, C., 1993. Apparent availability of nitrogen in composted municipal refuse, Biol. Fert. Soils Vol. 16, 313–318.

[5] Goldstein, N., Steuteville, R. and Farrell, M., 1993. MSW composting in the United States municipal yard trimmings, Biocycle Vol. 37, 46–53.

[6] Gray, K.R. , Sherman, K. and Biddlestone, A.J., 1971. A review of composting Part 1", Process Biochemistry, Vol. 6(6), 32-36.

[7] GTZ, 1998. Utilization of organic waste in (peri-) urban centers, GFA-Umwelt and Gesellschaft fürTechnische Zusammenarbeit, Eschborn, Germany.

[8] Gautam, S.P., Bundela P.S., Pandey, A.K. Awasthi, M.K., and Sarsaiya, S., 2010. Composting of Municipal Solid Waste of Jabalpur City, Global Journal of Environmental Research Vol. 4 (1), 43-46.

[9] Sharma, D., Katnoria, J.K., and Vig, A.P., 2011. Chemical changes of spinach waste during compostingand vermicomposting, African Journal of Biotechnology Vol. 10(16), 3124-3127.

[10] T. Janakiram and K. Sridevi, 2010. A Study in Solid Waste Management, E-Journal of Chemistry Vol. 7(4), 1340-1345.

[11] Kumar,V.R.S, Sivakumar,K. ,Purushothaman, M.R.Natarajan,A . and Amanullah, A.M., 2010. Chemical Changes During Composting of Dead Birds with Caged Layer Manure, Journal of Applied Sciences Research, Vol. 3(10), 1100-1104.

[12] Ahmed, M., Idris,A., Omar, S.R.S. 2007. Physicochemical characterization of compost of the industrial tannery sludge , Journal of Engineering Science and Technology Vol. 2 (1), 81-94.

[13] Sarwar,G., Schmeisky, H., Tahir, M.A., Iftikhar, Y. and Sabah. N.U., 2010. Application of green compost for improvement in soil chemical properties and fertility status, The Journal of Animal & Plant Sciences, Vol. 20(4), 258-260.

[14] Gandhi M, Sangwan V, Kapoor KK and Dilbaghi N., 1997. Composting of household wastes with and without earthworms , Environment and Ecology, Vol. 15(2), 432–434.

[15] Tara Crescent, 2003. Vermicomposting. Development Alternatives (DA) Sustainable Livelihoods.

[16] Maynard, A. A. & Hill, D. E., 1994. Impact of compost on vegetable yields, Biocycle, Vol.35(3), 66-67.

[17] Rahman,G.A., 2009. Impact of compost on soil properties and crop productivity In the Sahel North Burkina Faso, American Eurasian J. Agric. And Environ. Sci., Vol. 6(2), 220-226.

[18] Albaladejo, J., Garcia,C., Ruiz-Navarro, A., Garcia-Franco,N. and Barbera,G.G., 2009. Effects of organic composts on soil properties: Comparative evaluation of source- seperated and non-source separated composts**.**

[19] Zorpas, A.A., Arapoglou, D., & Panagiotis, K., 2003. Waste paper and clinoptilolite as a bulking material with dewatered an aerobically stabilized primary sewage sludge (DASPSS) for compost production, Waste Manage, Vol. 23, 27-35.

[20] Brown,S., Cotton, M., 2011. Changes in physical properties of soil and carbon content following compost application: Results of on farm sampling", Compost science and utilization, Vol. 19 (1), 88-97.

[21] Ahmed, M., Idris,A., Omar, S.R.S., 2007. Physicochemical characterization of compost of the industrial tannery sludge, Journal of Engineering Science and Technology Vol. 2 (1), 81-94.

[22] Brown,S., Cotton, M., 2011. Changes in physical properties of soil and carbon content following compost application: Results of on farm sampling", Compost science and utilization, Vol. 19 (1), 88-97.

[23] Perucci, P., 1990. Effect of the addition of municipal soild-waste compost on microbial biomass and enzyme activities in soil, Biol. Fertil. Soils Vol. 10,221–226.

[24]Crecchio, C., Curci, M., Pizzigallo, M., Ricciuti, P., Ruggiero, P., 2004. Effects of municipal solid waste compost amendments on soil enzyme activities and bacterial genetic diversity, Soil Biol. Biochem. Vol. 36, 1595–1605.

[25]Garcia-Gil, J.C., Ceppi, S., Velasca, M., Polo, A., Senesi, N., 2004. Longterm effects of amendment with municipal solid waste compost on the elemental and acid functional group composition and pH-buffer capacity of soil humic acid, Geoderma, Vol. 121, 135–142.

[26]Montemurro, F., Maiorana, M., Convertini, G., Ferri, D., 2006,: "Compost organic amendments in fodder crops: effects on yield, nitrogen utilization and soil characteristics", Compost Sci. Util. Vol. 14 (2), 114–123.

[27]Walter, I., Martinez, F., Cuevas, G., 2006. Plant and soil responses to the application of composted MSW in a degraded, semiarid shrubland in central Spain, Compost Sci. Util. Vol. 14 (2), 147–154.

[28]Edwards, L., Burney, J. R., Richter, G. and Macrae, A. H. 2000. Evaluation of compost and straw mulching on soil-loss characteristics in erosion plots of potatoes in Prince Edwards Island, Canada", Agriculture, Ecosystems and Environment. Vol. 81,217-222.

[29]Cogger, C.G., 2005. Potential Compost Benefits for Restoration Of Soils Disturbed by Urban Development, Compost Science & Utilization, Vol. 13, (4), 243-251.

[30]Jadia, C.D. and Fulekar, M.H., 2008. Vermicomposting of vegetable waste: A biophysicochemical process based on hydro-operating bioreactor, African Journal of Biotechnology, Vol. 7 (20), 3723-3730.