Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 4, Issue, 08, pp.006-011, August, 2012

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

COMPOSTING OF MUNICIPAL SOLID WASTE (VIZ. KITCHEN WASTE): A TOOL FOR IMPROVING SOIL QUALITY IN BUNDELKHAND REGION

[a]Pathak, A. K., [a]Vinit Kumar and [b]Singh, M.M.

[a]Institute of Environment and Development Studies, Bundelkhand University, Jhansi (U.P.) India
[b]Department of Geology, Bundelkhand University, Jhansi (U.P.)India

ARTICLE INFO

Article History:
Received 15th May, 2012
Received in revised form
18th June, 2012
Accepted 26th July, 2012
Published online 28th August, 2012

Key words:

Municipal solid waste (MSW),
Composting,
C/N Ratio,
Physico-chemical.

ABSTRACT

Composting of municipal solid waste (MSW) has been considered an attractive waste management tool for effective reduction of waste volume and beneficial utilization of MSW compost (MSWC) can eventually turn waste into a resource. Jhansi is well known district of Bundelkhand region of Uttar Pradesh with a geographical area of 502.75 thousand hectare. The district is situated in the South West corner of the region at 24º11' - 25º57' N latitude and 78º10' - 79º23' E longitudes. The soils of Bundelkhand region can be divided into two broad groups namely red and black soils with three distinct soil associations (i) Bundelkhand coarse grained radish brown soils, (ii) Bundelkhand coarse grained grey to grayish brown soils and (iii) Bundelkhand clay loam black soils. In local parlance these soils are termed as Rakar, Parwa and Kabar, respectively. Horizon differentiation is almost absent. Soils are slightly acidic to neutral in nature with presence of $CaCO_3$ granules in lower depths. Most of the soils are low in organic matter, available N and P and medium in available K. Municipal solid waste compost is increasingly used in agriculture as a soil conditioner but also as a fertilizer. In the present study we have applied the Municipal Solid Waste (Viz. Kitchen Waste) Compost in soils of Bundelkhand Region in four consecutive years and found that the soil of bundelkhand region is increased nutrient contents which are beneficial for crops. Physico-chemical properties of Municipal Solid Waste (Viz. Kitchen Waste) Compost are analyzed in laboratory and results are significantly affect in respect to control environment.

INTRODUCTION

Composting is a microbiological process, little is known about microorganisms involved and their activities during specific phases of the composting process. Defining the diversity and structure of microbial communities of compost through their constituent populations has been of considerable interest to compost researchers in order to address basic ecological questions such as how similar are microbial communities in mature compost that were made from different feedstocks and using different composting methods (Tiquia and Michel, 2002). Composting is a spontaneous biological decomposition process of organic materials in a predominantly aerobic environment. During the process bacteria, fungi and other microorganisms, including micro arthropods, break down organic materials to stable, usable organic substances called compost Bernal *et al.* (2008). It is also known as a biological reduction of organic wastes to humus or humus like substances (Gautam *et al.,* 2010). Municipal solid waste (MSW) is largely made-up of kitchen and yard waste, and its composting has been adopted by many municipalities (Otten, 2001). Composting 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 (Eriksen *et al.,* 1999; Wolkowski, 2003). Soil organic matter plays a major role in maintaining soil quality Pedra *et al.* (2007). In addition to supplying plant nutrients, the type and amount of soil organic matter influences several soil properties Arau´jo *et al.,* (2008). Utilization of MSWC in agricultural land Increase the soil organic matter improves soil properties, enhances soil quality, reduces soil erosion, increases plant productivity and soil microbial biomass. Thus, in the regions where organic matter content of the soil is low, agricultural use of organic compost is recommended for increasing soil organic matter content and consequently to improve and maintain soil quality. In ecologically fragile zones like Bundelkhand, which has traditionally been a pastoral belt, the problem of land degradation is much severe. The objective of this work threfore are to find the suitability of compost which was prepared from Municipal Solid waste (Viz. Kitchen Waste) as soil amendments and appropriate timing necessary for the its incorporation into soil and its benefits.

MATERIALS AND METHODS

Municipal Solid Waste (Viz. Kitchen Waste) Compost was prepared at Jhansi city U.P. India using different organic materials like rice and wheat residues, flowers, leaves and

***Corresponding author:** pathakawadhesh@gmail.com

other kitchen waste, vegetable and fruit wastes and was subsequently applied to the normal field. After 135 days of decomposition of Municipal Solid Waste (Viz. Kitchen Waste) Compost (for every monthly turnings aerobic compost samples were collected intermittently) samples were collected, dried and ground to pass through 1 mm sieve and used for chemical analysis. Carbon content was determined as wet digestion method by Walkley and Black as described by Jackson 1973, CEC by Bower method Richards, 1954. Total N content in the compost samples was determined by Micro jehldal method. Total P & K content was extracted by digestion with diacid and estimated the total P colorimetrically as Vanado-molybdophosphophosphate yellow colour complex and K by using Flame photometer. PH & EC was determined in 1:50 waste water extract after 30 minutes stirring by using digital pH and EC meters.

Pot Experiment

Pot experiments conducted to evaluate the Municipal Solid Waste (Viz. Kitchen Waste) Compost as an organic fertilizer. Soil used in this study was collected from a surface layer (0-15 cm) and oven dried at 105° C temperatures. Following parameters viz. pH, Organic carbon, available P, K, N and micro nutrients (Zn, Fe, Mn, Cu, S) have been considered for analysis. Soil pH was measured in 1:2 soil-water suspensions; Organic carbon was determined by Walkley and Black's wet digestion method. Available nitrogen (Alkaline Potassium Permanganate Hydrolysable) was determined by the method of Subbian and Asija. Available potassium was extracted by neutral normal ammonium acetate solution and was determined flame photometrically (FP 114, Chemito flame photometer). Olsen 's method was followed to determine available phosphorus in the soil. Available micro nutrients (Zn, Fe, Mn, Cu and S) have been analyzed by DTPA method with the help of Atomic absorption spectrophotometer (203 D, Chemito).

The soil and Municipal Solid Waste (Viz. Kitchen Waste) Compost were primarily characterized pot experiments were conducted to study the soil quality after four consecutive year treatment of Municipal Solid Waste (Viz. Kitchen Waste) Compost. In present study Municipal Solid Waste (Viz. Kitchen Waste) Compost were mixed with soil and experiment was started with *Lycopersicum esculentum* and *solanum melongena*. Compost was incorporated one month before transplanting *Lycopersicum esculentum* and *solanum melongena* in the field. *Lycopersicum esculentum* and *solanum melongena* was harvested at maturity. After harvesting *Lycopersicum esculentum* and *solanum melongena*, soil samples were collected from all the treatment plots, brought to the laboratory, prepared and analyzed accordingly.

RESULTS AND DISCUSSION

The present investigation was conducted consecutively in the year 2008 (season I), 2009 (season II), 2010 (season III) and 2011 (season IV). In this study, an attempt has been made to ascertain the efficacy of different Municipal Solid Waste (Viz. Kitchen Waste) compost amendment on the Brinjal (*Solanum melongena* L.), Tomato (*Lycopersicon esculentum* Mill.), on properties of soil, yield and yield attributing character, nutrient uptake by this crop, and encourage the economic, environmental and sustainable use of agricultural land status of rural areas as well as farmers in Bundelkhand region. Physico-chemical characteristics of mature Municipal Solid waste (Viz. Kitchen Waste) compost are shown in Table 3.1. The pH of mature Municipal Solid waste (Viz. Kitchen Waste) compost are 7.51, 7.63, 7.10 and 7.79 in 2008, 2009, 2010 and 2011 respectively. EC (µS/cm) of mature Municipal Solid waste (Viz. Kitchen Waste) compost are 1288.0, 1324.0, 1277, and 1251.0 in 2008, 2009, 2010, and 2011 respectively. As with many properties of Municipal Solid waste compost, the EC content of MSW compost is likely related to the feed stock used in the compost and compost facility procedure (Hicklenton *et al.*, 2001). Organic carbon (%) of mature Municipal Solid waste (Viz. Kitchen Waste) compost are 23.0, 24.0, 26.0 and 21.0 in 2008, 2009, 2010 and 2011 respectively. The range of nitrogen concentrations that have been reported to be present in mature Municipal Solid waste (Viz. Kitchen Waste) compost is shown in Table 1. While some studies showed that MSW compost increased soil N content, MSW compost is often reported to be less effective in supplying less available N in the first year of application to the soil-plant system than inorganic mineral fertilizars (Iglesias-Jimenez and Alvarez, 1993; Warman and Rodd, 1998; Eriksen *et al.*, 1999). The range of phosphorus that has been found in MSW composts is shown in Table 1. Municipal solid waste compost has been reported to effectively supply P to soil with soil P concentration increasing with increasing application rates (Iglesias-Jimenez *et al.*, 1993; Zhang *et al.*, 2006). Some reports observed that MSW compost provided equivalent amounts of P to soil as mineral fertilizers (Iglesias-Jimenez *et al.*, 1993). The range of K found in MSW compost in the literature is shown in table 3.1. Of the total K in MSW compost, 36–48% was found to be plant available (deHaan, 1981; Soumare *et al.*, 2003).

Mn concentration in mature Municipal Solid waste (Viz. Kitchen Waste) compost are 212.1, 210.03, 208.47 and 213.07 in 2008, 2009, 2010 and 2011 respectively. Total soil Mn concentrations tended to increase with addition of MSW compost (Giusquiani *et al.*, 1988; Murphy and Warman, 2001; Zheljazkov and Warman, 2004a,b). The largest portion of Mn in soil treated with MSW compost was found to be bound in the iron manganese fraction, which is unavailable to plants (Zheljazkov and Warman, 2004a). Maftoun et al. (2004) also reported interactions between Fe and Mn availability.

Cu concentrations in mature Municipal Solid waste (Viz. Kitchen Waste) compost is shown in table 3.1. Total and extractable soil Cu concentrations have been reported to increase when soil was amended with MSW compost and Cu has the potential to move down the soil profile (Ozores-Hampton and Hanlon, 1997; Warman *et al.*, 2004; Zheljazkov and Warman, 2004a; Walter *et al.*, 2006; Zhang *et al.*, 2006).

Zn concentrations in mature Municipal Solid waste (Viz. Kitchen Waste) compost is shown in table 3.1. Municipal solid waste compost tended to increase total soil Zn concentrations when compared to unamended controls (Giusquiani *et al.*, 1988; Pinamonti *et al.*, 1999; Walter *et al.*, 2006; Zhang *et al.*, 2006).

Fe concentrations in mature Municipal Solid waste (Viz. Kitchen Waste) compost is shown in table 3.1. The application

Table 1: Physico-chemical properties of Municipal Solid Waste (Viz. Kitchen Waste) Compost

Parameters	Years				SE (d)	C. Difference (P=0.05)*
	2008	2009	2010	2011		
pH	7.51±0.01	7.63±0.01	7.10±0.01	7.79±0.01	0.0202	2.3060
Electrical Conductivity (μS/cm)	1287.67±3.17	1324.0±3.21	1276.67±1.20	1251.33±3.17	4.000	9.223
Organic Carbon (%)	23.0±0.57	24.0±0.57	26.0±0.57	21.0±0.57	0.816	2.306
Nitrogen (%)	1.17±0.01	1.19±0.01	1.20±0.005	1.18±0.01	0.017	2.306
Phosphorus (%)	0.04±0.005	0.03±0.005	0.05±0.003	0.04±0.008	0.008	0.202
Potassium (%)	0.30±0.01	0.34±0.005	0.340.01	0.38±0.003	0.012	0.029
Sodium (%)	2.89±0.01	2.76±0.01	2.75±0.02	2.81±0.005	0.022	0.052
Chromium (mg/kg)	17.70±0.10	17.36±0.03	15.35±0.14	16.79±0.09	0.141	0.327
Cupper (mg/kg)	47.12±0.11	45.25±0.09	48.39±0.25	47.44±0.26	0.283	2.306
C/N Ratio	24.0v1.15	21.0±0.557	22.0±0.55	20.0±1.15	1.290	2.977
Cadmium (mg/kg)	0.16±0.005	0.13±0.008	0.17±008	0.15±0.01	0.012	0.029
Iron (mg/kg)	1134.82±4.80	1246.56±3.78	1274.23±2.08	1329.47±3.68	5.259	12.129
Zinc (mg/kg)	51.08±1.06	53.37±0.62	52.53±0.37	54.40±0.83	1.089	2.511
Lead (mg/kg)	12.83±0.17	13.40±0.20	12.61±0.24	13.47±0.17	0.287	0.663
Manganese (mg/kg)	212.0±0.08	210.03±0.40	208.47±0.49	213.07±0.43	0.587	1.354

Values are Mean ± SE

Table 2: Physico-chemical properties of Soil before the application of Municipal Solid Waste (Viz. Kitchen Waste) Compost

Parameters	Red Soil					Black Soil				
	2008	2009	2010	2011	Mean	2008	2009	2010	2011	Mean
pH	6.47±0.04	6.77±0.04	6.89±0.02	6.76±0.03	6.72±0.03	7.15±0.03	7.20±0.02	6.97±0.02	7.09±0.04	7.10±0.03
Electrical Conductivity (μmhos/cm)	156.33±0.58	167.66±1.53	146.00±1.00	175.00±1.73	161.25±1.66	255.00±1.00	275.00±1.00	268.67±0.58	271.33±0.58	267.50±1.64
Organic Carbon (%)	0.42±0.01	0.45±0.01	0.51±0.01	0.48±0.01	0.47±0.31	0.55±0.01	0.62±0.02	0.68±0.01	0.59±0.01	0.61±0.41
Water Holding Capacity (%)	36.66±1.15	38.00±1.00	41.33±0.58	37.66±0.58	38.41±0.53	45.00±1.00	47.33±0.58	52.33±0.58	55.00±1.00	49.92±0.57
Cation Exchange Capacity (cmol/Kg)	11.40±0.10	12.57±0.06	13.06±0.06	12.86±0.06	12.47±0.03	11.50±0.10	11.87±0.06	12.17±0.06	13.17±0.06	12.18±0.04
Total Nitrogen (kg/ha)	201.33±0.58	214.33±0.58	218.66±0.58	221.33±0.58	213.91±0.56	285.67±0.58	291.33±0.58	296.00±1.00	302.00±1.00	293.75±0.59
Available Phosphorus (kg/ha)	7.73±0.21	8.40±0.10	8.23±0.06	8.63±0.06	8.25±0.14	9.43±0.12	9.43±0.06	9.47±0.06	9.50±0.10	9.46±0.13
Available Potassium (kg/ha)	77.33±0.58	81.66±0.58	85.33±0.58	87.33±0.58	82.91±0.63	111.33±0.58	115.67±0.58	121.33±0.58	124.33±0.58	118.17±0.65
Sulphate (ppm)	1.63±0.06	1.76±0.06	1.53±0.06	1.73±0.06	1.66±0.05	2.03±0.02	2.20±0.10	2.33±0.06	2.47±0.06	2.26±0.05
Magnesium (ppm)	51.33±0.58	55.00±1.00	52.33±0.58	58.00±1.53	54.17±0.55	66.33±1.53	65.00±1.00	72.00±1.00	75.00±1.00	69.58±0.65
Iron (ppm)	7.26±0.06	7.46±0.06	7.86±0.06	7.65±0.01	7.56±0.01	9.26±0.02	9.98±0.01	9.78±0.03	8.88±0.01	9.48±0.01
Manganese (ppm)	8.63±0.01	8.63±0.01	8.98±0.01	8.77±0.01	8.75±0.01	8.88±0.01	9.98±0.01	9.78±0.03	9.98±0.01	9.66±0.01
Zinc (ppm)	0.82±0.01	0.92±0.02	0.98±0.01	0.95±0.01	0.92±0.01	1.20±0.10	1.21±0.08	1.35±0.01	1.29±0.01	1.26±0.01
Copper (ppm)	1.37±0.01	1.42±0.01	1.39±0.01	1.46±0.01	1.41±0.01	1.25±0.08	1.40±0.10	1.25±0.01	1.43±0.15	1.33±0.00

Values are Mean ± SE

Table 3: Physico-chemical properties of Soil after the application of Municipal Solid Waste (Viz. Kitchen Waste) Compost

Parameters	Red Soil					Black Soil				
	2008	2009	2010	2011	Control Mean)	2008	2009	2010	2011	Control Mean
pH	7.22±0.01	7.34±0.015	7.36±0.01	7.41±0.006	6.72±0.03	7.6±0.01	7.7±0.01	7.41±0.01	7.55±0.01	7.10±0.03
Electrical Conductivity (μmhos/cm)	226±1	238.3±0.577	215.3±0.58	255.3±1.155	161.25±1.66	311.7±0.58	341.7±0.577	325±1	344.3±2.082	267.50±1.64
Organic Carbon (%)	0.98±0.01	1.063±0.064	1.13±0.01	1.21±0.01	0.47±0.31	1.32±0.01	1.23±0.02	1.28±0.01	1.32±0.01	0.61±0.41
Water Holding Capacity (%)	45±1	48±1	57±1	52.67±1.155	38.41±0.53	52.67±0.58	56.67±0.58	58.33±1.15	60.33±0.58	49.92±0.57
Cation Exchange Capacity (cmol/Kg)	13.56±0.058	14.2±0.1	14.43±0.15	14.83±0.058	12.47±0.03	13.87±0.06	14.5±0.1	14.83±0.06	15.13±0.06	12.18±0.04
Total Nitrogen (kg/ha)	311±1	325.7±0.577	320±1	325.3±0.577	213.91±0.56	353.7±2.08	415±1	388.7±0.58	395.7±0.58	293.75±0.59
Available Phosphorus (kg/ha)	10.2±0.1	10.5±0.1	11.23±0.06	11.4±0.2	8.25±0.14	12.17±0.12	12.83±0.06	12.5±0.1	12.73±0.06	9.46±0.13
Available Potassium (kg/ha)	117±1.732	125±1	122.7±0.58	146.3±1.528	82.91±0.63	166.3±1.53	175±1	186.3±0.58	196.3±1.53	118.17±0.65
Sulphate (ppm)	1.98±0.01	2.95±0.006	2.62±0.01	2.15±0.01	1.66±0.05	2.34±0.03	2.95±0.01	3.25±0.06	3.25±0.01	2.26±0.05
Magnesium (ppm)	64.66±1.528	68±1	64±1	68.33±0.577	54.17±0.55	73.33±0.58	72.67±0.58	82±1	88±1.73	69.58±0.65
Iron (ppm)	8.56±0.058	8.7±0.1	8.86±0.06	8.75±0.006	7.56±0.01	10.29±0.06	11.05±0.04	10.88±0.01	9.98±0.01	9.48±0.01
Manganese (ppm)	9.22±0.015	9.48±0.127	9.34±0.02	9.15±0.01	8.75±0.01	9.36±0.01	10.34±0.02	10.67±0.02	10.98±0.01	9.66±0.01
Zinc (ppm)	1.13±0.058	1.25±0.01	1.35±0.01	1.3±0.012	0.92±0.01	1.183±0.01	1.49±0.27	1.68±0.01	1.98±0.01	1.26±0.01
Copper (ppm)	2.13±0.012	2.32±0.01	2.32±0.01	2.32±0.01	1.41±0.01	2.247±0.02	2.14±0.02	2.18±0.01	2.14±0.02	1.33±0.00

Values are Mean ± SE

of MSW compost did not tend to increase soil and plant Fe concentrations. Municipal solid waste compost applied at 100 and 35–140 Mg ha1 did not increase available soil Fe concentrations nor did clover and blueberry leaves, respectively, show increased Fe concentrations compared to a control (Murillo and Cabrera, 1997; Warman, 2001). The concentrations of other trace elements in MSW compost are shown in table 3.1. MSW compost can increase soil trace element concentrations as per agreement with Pinamonti *et al.*, 1999; Zheljazkov and Warman, 2004a.

Soil Analysis

1Effect on Physico-chemical properties of soil after the application of municipal solid waste (viz. Kitchen Waste) compost:

The physico-chemical characteristic of soil after the application of municipal solid waste (viz. kitchen waste) compost are significantly improvement for all four seasons were reported in Table 3.2-3.4 (a-b).

Effect on pH & Electrical Conductivity (μmhos/cm)

The data regarding pH & EC after harvesting in different amendment of municipal solid waste (viz. kitchen waste) compost and soil types were analyzed statistically and the results have been presented in table 3.2-3.4 (a-b) for all the four seasons. Result table- 3.2-3.4 (a-b) showed that the application of different amendment of municipal solid waste (viz. kitchen waste) compost found significant effect the pH may be due to the mineralization of carbon and subsequent production of OH^- ions by ligand exchange as well as the introduction of basic cations, such as K^+, Ca^{+2}, and Mg^{+2}. These results are also suggested by Mkhabela and Warman,

Table 4. (a-b) Comparison between physico-chemical parameters and different soil before and after the application of municipal solid waste (viz. Kitchen Waste) compost

(a) Initial Stage

Parameters	Red Soil		Black Soil	
	SE(d)	CD (P=0.05)*	SE(d)	CD (P=0.05)*
pH	0.0063	0.0101	0.0053	0.012
Electrical Conductivity (µmhos/cm)	0.29	0.57	0.28	0.013
Organic Carbon (%)	0.0048	0.096	0.0044	0.093
Water Holding Capacity (%)	0.2	0.4	0.21	0.41
Cation Exchange Capacity (cmol/Kg)	0.022	0.045	0.023	0.041
Total Nitrogen (kg/ha)	0.271	0.642	0.27	0.641
Available Phosphorus (kg/ha)	0.0299	0.059	0.0221	0.055
Available Potassium (kg/ha)	0.43	0.86	0.42	0.82
Sulphate (ppm)	0.0176	0.035	0.0152	0.78
Magnesium (ppm)	0.393	0.785	0.391	0.751
Iron (ppm)	0.0288	0.0577	0.0278	0.0566
Manganese (ppm)	0.0289	0.0517	0.028	0.0512
Zinc (ppm)	0.0188	0.037	0.016	0.035
Copper (ppm)	0.0131	0.0263	0.0128	0.0259

b) After harvesting of Vegetable crops

Parameters	Red Soil		Black Soil	
	SE(d)	CD (P=0.05)*	SE(d)	CD (P=0.05)*
pH	0.0033	0.01	0.0043	0.011
Electrical Conductivity (µmhos/cm)	0.19	0.52	0.18	0.011
Organic Carbon (%)	0.0028	0.086	0.0034	0.043
Water Holding Capacity (%)	0.145	0.36	0.2	0.31
Cation Exchange Capacity (cmol/Kg)	0.012	0.035	0.013	0.031
Total Nitrogen (kg/ha)	0.241	0.612	0.17	0.441
Available Phosphorus (kg/ha)	0.0269	0.049	0.0211	0.045
Available Potassium (kg/ha)	0.23	0.76	0.22	0.62
Sulphate (ppm)	0.0126	0.025	0.0132	0.68
Magnesium (ppm)	0.293	0.685	0.331	0.651
Iron (ppm)	0.0228	0.0547	0.0248	0.0466
Manganese (ppm)	0.0239	0.0507	0.018	0.0412
Zinc (ppm)	0.0148	0.027	0.014	0.025
Copper (ppm)	0.0111	0.0163	0.0121	0.0239

2005. Plants are negatively affected by excess salts in soils and Na can be detrimental to soil structure. Electrical conductivity (EC) of the soil solution is related to the dissolved solutes content of soil and is often used as a measurement of soil salt content (Brady and Weil, 1996).

Effect on Organic Carbon

The data regarding organic carbon (%) at initial stage and after harvesting in different amendment of municipal solid waste (viz. kitchen waste) compost and soil types were analyzed statistically and the results have been presented in table 3.2-3.4 (a-b)) for all the four seasons. Table3.2-3.4 (a-b) showed that after application of different amendment of municipal solid waste (viz. kitchen waste) compost found significant effect and increase the Organic carbon content in all the years in red & black soil. Maximum & minimum OC (%) in red soil were 1.13 (2010) & 0.98(2008) respectively. Maximum & minimum OC (%) in Black soil were 1.32 (2008) & 1.23 (2009) respectively.

Effect on Nitrogen, phosphorus and Potassium

The data regarding Nitrogen, phosphorus and Potassium at initial stage and after harvesting in different amendment of municipal solid waste (viz. kitchen waste) compost and soil types were analyzed statistically and the results have been presented in table 3.2-3.4 (a-b) for all the four seasons.

Table- 3.2-3.4 (a-b) showed that after application of different amendment of municipal solid waste (viz. kitchen waste) compost found significant effect to nitrogen content. Maximum & minimum Nitrogen content (kg/ha) were 325.7 (2009) & 311 (2008) respectively in red soil. In black soil it was 415 (2009) & 353.7 (2008) respectively. It may be due to the Mineralization of organic N in compost is dependent on many factors including C/N ratio of raw material, composting conditions, compost maturity, time of application, and compost quality (i.e., C/N ratio and C- and N-fractions) (Amlinger *et al.*, 2003).

Table3.2-3.4 (a-b) showed that after application of different amendment of municipal solid waste (viz. kitchen waste) compost found significant effect to phosphorus (kg/ha). Maximum & Minimum P content were 11.4 (2011) & 10.2 (2008) respectively in red soil. In black soil it was 11.4 (2011) & 10.2 (2008) respectively. It may be due to the competition between organic ligand and phosphate for sites on metallic oxides as well as the formation of phosphohumic complexes which can increase P mobility. The same result is also agreement with (Giusquiani *et al.*, 1988; Iglesias-Jimenez *et al.*, 1993). Soil K concentrations are increased in all the season and significantly affect the soil potassium when different rates of MSW (viz.KW) compost are used the same pattern are agreement with (Giusquiani *et al.*, 1988). Increased K content of the following was reported for soils treated with MSW (Viz. KW) compost (Warman *et al.*, 2004; Rodd *et al.*, 2002;

Zheljazkov and Warman, 2004a; Montemurro *et al.*, 2006; Zheljazkov *et al.*, 2006).

Effect on other essential elements

The data related to Magnesium, Manganese, Copper, Zinc and Iron at initial stage and after harvesting in different amendment of municipal solid waste (viz. kitchen waste) compost and soil types were analyzed statistically and the results have been presented in table 3.2-3.4 (a-b) for all the four seasons. With the application of municipal solid waste (viz. kitchen waste) compost on soil upto 240 t/ha significantly affect the concentration of Magnesium, Manganese, Copper, Zinc and Iron and increase Mg (66.25), Mn (9.3), Cu (2.27), Zn (1.127), and Fe (8.72) with compare to control environment in red soil type in all season and Mg (79.0), Mn (10.34), Cu (2.18), Zn (1.59), and Fe (10.55) with compare to control environment in black soil type in all season.

REFERENCES

Amlinger, F., Gotz, B., Dreher, P., Geszti, J.,Weissteiner, C., 2003. Nitrogen in biowaste and yard waste compost: dynamics of mobilization and availability—a review. Eur. J. Soil Biol. 39, 107–116.

Arau´jo, A.S.F., Santos, V.B., Monteiro, R.T.R., 2008,: “Responses of soil microbial biomass and activity for practices of organic and conventional farming systems in Piauı´ state”, Brazil. Eur J Soil Biol., 44, pp 25–30.

Bernal, M.P., J.A. Albuquereque, R. Moral. 2008. “Composting of animal manures and chemical criteria for compost maturity assessment: a review”, Bioresour Technol, 99, pp 3372– 3380.

Bernal, M.P., J.A. Albuquereque, R. Moral. 2008. “Composting of animal manures and chemical criteria for compost maturity assessment: a review”, Bioresour Technol, 99, pp 3372– 3380.

Brady, N., Weil, R., 1996. The Nature and Properties of Soils, 12th ed. Prentice, New Jersey, USA, pp. 385, 495.

deHaan, S., 1981. Results of municipal waste compost research over more than fifty years at the Institute for Soil Fertility at Haren/Groningen, the Netherlands. Neth. J. Agric. 29, 49–61.

Eriksen, G., Coale, F., Bollero, G., 1999. Soil nitrogen dynamics and maize production in municipal solid waste amended soil. Agron. J. 91, 1009– 1016.

Eriksen, G., Coale, F., Bollero, G., 1999. Soil nitrogen dynamics and maize production in municipal solid waste amended soil. Agron. J. 91, 1009– 1016.

Gautam S.P., P.S. Bundela, A.K. Pandey, M.K. Awasthy, S. Sarsaiya, 2010. evolution of the Municipal Solid Waste Compost Phytotoxicity, and Maturation for ecofriendly organic forming system. Journal of applied science in environmental sanitation, 5 (4) : 397-402.

Giusquiani, P., Marucchini, C., Businelli, M., 1988. Chemical properties of soils amended with compost of urban waste. Plant Soil 109, 73–78.

Hicklenton, P., Rodd, V., Warman, P.R., 2001. The effectiveness and consistency of source-separated municipal solid waste and bard composts as components of container growing media. Sci. Hort. 91, 365–378.

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

Maftoun, M., Moshiri, F., Karimian, N., Ronaghi, A., 2004. Effects of two organic wastes in combination with phosphorus on growth and chemical composition of spinach and soil properties. J. Plant Nutr. 27 (9), 1635–1651.

Mkhabela, M.,Warman, P.R., 2005. The influence of municipal solid waste compost on yield, soil phosphorus availability and uptake by two vegetable crops, grown in a Pugwash sandy loam soil in Nova Scotia. Agric. Ecosyst. Environ. 106, 57–67.

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. 14 (2), 114–123.

Murillo, J., Cabrera, F., 1997. Response of clover Trifolium fragiferum cv Salina to a heavy urban compost application. Compost Sci. Util. 5 (4), 15–26.

Murphy, C., Warman, P.R., 2001. Effect of MSW compost applications on low-bush blueberry soil and leaf tissue trace elements. In: Proceedings of the 6th International Conference on the Biogeochemistry of Trace Elements, Guelph, ON, p. 166.

Otten, L., 2001. Wet–dry composting of organic municipal solid waste: current status in Canada. Can. J. Civil Eng. 28 (Suppl. 1), 124–130.

Ozores-Hampton, M., Hanlon, E., 1997. Cadmium, copper, lead, nickel and zinc concentrations in tomato and squash grown in MSW compost amended calcareous soil. Compost Sci. Util. 5 (4), 40–46.

Pedra, F., Polo, A., Ribeiro, A., Domingues, H., 2007, : “Effects of municipal solid waste compost and sewage sludge onmineralization of soil organic matter”, Soil Biol Biochem 39, pp 1375–1382.

Pinamonti, F., Nicolini, G., Dalpiaz, A., Stringari, G., Zorzi, G., 1999. Compost use in viticulture: effects on heavy metal levels in soil and plants. Commun. Soil Sci. Plan. 30 (9–10), 1531–1549.

Rodd, A., Warman, P.R., Hicklenton, P., Webb, K., 2002. Comparison of N fertilizer, source-separated municipal solid waste compost and semisolid beef manure on the nutrient concentration in boot-stage barley and wheat tissue. Can. J. Soil Sci. 82, 33–43.

Soumare, M., Tack, F., Verloo, M., 2003. Characterisation of Malian and Belgian solid waste composts with respect to fertility and suitability for land application. Waste Manag. 23, 517–522.

Tiquia SM., Michel FC Jr. 2002. Bacterial Diversity in Livestock manure compost as characterized by terminal restriction fragment length polymorphisms (T-RFLP) of PCRamplified16S rRNA gene sequences.

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. 14 (2), 147–154.

Warman, P.R., 2001. Municipal solid waste compost effects tomato leaf tissue: essential plant nutrients and trace elements. In: Proceedings of the 6th International Conference on the Biogeochemistry of Trace Elements, Guelph, ON, p. 167.

Warman, P.R., Murphy, C., Burnham, J., Eaton, L., 2004. Soil and plant response to MSW compost applications on lowbush blueberry fields in 2000 and 2001. Small Fruit Rev. 3 (1/2), 19–31.

Warman, P.R., Rodd, V., 1998. Influence of source-separated MSW compost on vegetable crop growth and soil properties: year 3. In: Proceedings of the 8th Annual Meeting of the Composting Council of Canada, Ottawa, Ontario, November 3–5, pp. 263–273.

Wolkowski, R., 2003. Nitrogen management considerations for landspreading municipal solid waste compost. J. Environ. Qual. 32, 1844–1850.

Zhang, M., Heaney, D., Henriquez, B., Solberg, E., Bittner, E., 2006. A four year study on influence of biosolids/MSW cocompost application in less productive soils in Alberta: nutrient dynamics. Compost Sci. Util. 14 (1), 68–80.

Zheljazkov, V., Warman, P.R., 2004a. Source-separated municipal soil waste compost application to Swiss chard and basil. J. Environ. Qual. 33, 542–552.

Zheljazkov, V.,Warman, P.R., 2004b. Phytoavailability and fractionation of copper, manganese, and zinc in soil following application of two composts to four crops. Environ. Pollut. 131, 187–195.

Zia, M.S. 1993. Soil Fertility Evaluation and Management for Flooded lowland rice soils of Pakistan. Ph.D. Dissertation, Kyoto University, Japan.

****