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Effect of Municipal Waste Compost on Some Chemical Characteristics of Clay Soils

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Abstract: The objective of this study was to determine the effect of different concentrations of municipal waste compost (0, 40, 80, 120 and 160 t ha^{-1}) on soil chemical properties of Vertisol and Non-calcareous Brown Soils. According to results of soil that sampled from pots, waste compost application to soil increased soil total nitrogen (TN), phosphorus (P_2O_5) and potassium (K_2O) compared to control. 160 t ha^{-1} compost application levels resulted in the highest organic matter, TN and K_2O among applied doses for both soil types.

Key words: Compost, nitrogen, phosphorus, vertisol

INTRODUCTION

In recent days consumption and production is resulted with some organic wastes. Their contents and amounts can change according to socio-economic conditions of the area and the season of the year. One of the methods to deal with municipal wastes is production waste compost. Composting municipal solid waste accelerates the biological decomposition of some of its organic components. The result is an organic product with potential benefits for agricultural soils. However, agricultural use of compost remains low. Reasons for that are first; the product is bulky, which can make transportation expensive. The nutrient value of compost is low compared to fertilizers. In addition, concerns rise regarding potential levels of heavy metals in compost. This concern is mitigated if compost is applied well in advance of planting. Many experiments examining the effects of MSW compost application on the physiochemical characteristics of soils have indicated positive results[1].

Soil organic matter (SOM) is one of the most important factors of the soil which positively effects on physical, chemical and biological properties of the soils. Soil chemical factors can be modified with inorganic fertilizers however physical factors of soils can be degraded. To obtain maximum yield soil physical factors must be considered as much as soil chemical factors because, physically degraded soils are not very productive. Generally organic matter contents of soil (SOM) of Turkey are considerably low. 21% of the soils have very low SOM and 54.6% of the soils have low SOM contents. According to this it can be concluded that 75.6% of our soils have inadequate SOM and only 4.3% have adequate SOM[2]. An important potential use of compost in the agricultural industry is its application as a soil amendment to eroded soils. Compost is a dent source of organic matter that can enrich soil and add biological diversity. When applied to eroded soils, compost can help to restore both organic content and the soil structure[3].

Researchers have evaluated various organic amendments and composts as an alternative to other chemical soil treatments. Results were varied because both composition of composted materials and research areas were different. Therefore it is difficult to characterize the benefits of the specific compost based on previous studies. Crecchio *et al.*[4] demonstrated that amendment with MSW compost increased the organic C and total N contents and dehydrogenase and nitrate reductase activities of soil. However, Manios and Syminis[5] showed that even after six month, application of MWC increased soil micro and macro elements and SOM contents. Several researchers demonstrated that compost application increased soil N, P, K, pH and soil organic carbon contents[1,6-9].

The objective of this study is to investigate the effects of waste compost on chemical properties of vertisol and non-calcareous brown soils.

MATERIALS AND METHODS

Non-calcareous brown soils were taken from Trakya University Tekirdag Agricultural Faculty fields and vertisol soils were taken from Kirkkepenekli village in Muratli County. Some chemical analyses data of these soils are presented in Table 1.

Waste composts were obtained from Izmir Municipality Halkapinar waste factory in Turkey. Some analyses data of waste compost are presented in Table 2.

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Table 1: Chemical characteristics of research soils

Soiltype	Organic matter %	EC mS/cm	pH	Lime %	N %	P_2O_5 kg ha^{-1}	K_2O kg ha^{-1}
Vertisol	1.82	0.20	6.85	1.88	0.08	200.60	475
Non-calcareous brown soil	1.21	0.20	8.05	2.26	0.06	28.60	360

Table 2: Chemical and physical characteristics of municipal waste compost used in experiment

pH	Organic matter (%)	Salt (%)	$CaCO_3$ (%)	Na (%)	K (%)	Ca (%)	Mg (%)	water content
7.59	24.5	0.65	18.4	0.08	1.1	2.8	0.42	47

Analyses of waste compost were conducted according to methods from EAWAG[15]. Soil texture was determined by hydrometer method[10], organic matter contents of soils were determined using Smith-Weldon method[11]. pH, EC and $CaCO_3$ were determined according to U.S. Salinity Lab. Staff[12].

Pots were established using randomized complete block design. Trial consisted of two different soil types, five levels of compost (including control) and four replications. Four kg air dry soils were put in pots with bottom drainage and pots received waste composts at the levels of 0, 40, 80, 120, 160 t ha^{-1}. Pots were placed outside to simulate natural conditions. Winter Barley (*Hordeum vulgare*) was grown and harvested two times in each pot during the experiment. After second harvest (about six month later) soils removed from the pots and prepared for analyses.

Statistical analysis: Soil parameters were analyzed by a PROC-GLM (General Linear Models) procedure using Statistical analysis system[13]. Duncan's LSD test was used to separate means of measurements. All significant tests were set at probability levels of at least 0.01.

RESULTS AND DISCUSSION

Soil organic matter: Additions of waste composts to soils increased SOM in both non-calcareous brown soils and Vertisols (Table 3). SOM level of control soil was %1.82 and it reached up to %2.31 at 160 t ha^{-1} waste compost application levels for Vertisol. SOM level of control soil was %1.21 at control treatment for non-calcareous brown soils and it reached up to %1.60 at 160 t ha^{-1} waste compost application levels.

Variance analysis showed that (data are not presented) treatments on SOM contents were found to be significant at the level of $p<0.01$ for vertisol and non-calcareous brown soils. Compost levels at the rate of 160 t ha^{-1} were the most effective treatments on soil SOM according to Duncan`s LSD test. Several researches indicated that application of waste compost increased soil organic matter contents[6-8].

Total Nitrogen (TN), Phosphorus (P_2O_5) and Potassium (K_2O): Increasing waste composts additions to soils also increased soil TN, P_2O_5 and K_2O values compared to control (Table 3). TN values were %0.091 in control soils of Vertisol and it increased to %0.116 with applications of 160 t ha^{-1} compost. Similarly TN values were %0.061 in control soils of Non-calcerous Brown soils and it increased to %0.080 with applications of 160 t ha^{-1} compost.

Variance analysis showed that compost application levels on TN found to be significant for both Vertisol and Non-calcerous Brown soils at the level of $p<0.01$. Compost levels at the rate of 160 t ha^{-1} was the most effective treatment to increase soil TN values according to Duncan`s LSD test.

P_2O_5 values of soil increased at all compost application rates compared to control (Table 3). P_2O_5 values were 200.40 kg ha^{-1} of control soils of Vertisol and it increased to 221.80 kg ha^{-1} with applications of 80 t ha^{-1} compost application levels. P_2O_5 values were 28 kg ha^{-1} in control soils of Non-calcerous Brown soils and it increased to 57.20 kg ha^{-1} with applications of 160 t ha^{-1} compost.

Variance analysis showed that compost application levels on P_2O_5 levels found to be significant for both vertisol and non-calcerous brown soils at the level of $p<0.05$ and 0.01 respectively. Compost levels at the rate of 40, 80 and 160 t ha^{-1} were the most effective treatments to increase soil P_2O_5 values according to Duncan`s LSD test. For Vertisols. Compost levels at the rate of 160 t ha$^{-1}$ was the most effective treatment to increase soil $P_2O_5$ values according to Duncan`s LSD test for non-calcareous brown soils.

K_2O values of soil increased at all compost application rates compared to control (Table 3). K_2O values were 475.50 kg ha^{-1} of control soils of Vertisol and it increased to 734.10 kg ha^{-1} with applications of 160 t ha^{-1} compost application levels. Similarly K_2O values were 363 kg ha^{-1} in control soils of Non-calcerous Brown soils and it increased to 544 kg ha^{-1} with applications of 160 t ha^{-1} compost.

Variance analysis showed that compost application levels on K_2O levels found to be significant for both

Table 3: Some chemical analyses results of research soils after compost applications

Soil		Compost levels t ha^{-1}	Organic matter% N%	P_2O_5 kg ha^{-1}	K_2O kg ha^{-1}
Vertisol soil	0	1.82e	0.09e	200.40b	475.50c
	40	1.90d	0.09d	216.40a	488.00c
	80	2.05c	0.10c	221.80a	580.80b
	120	2.17b	0.10b	219.20a	629.20b
	160	2.31a	0.11a	201.50b	734.10a
Non-calcareous brown soil	0	1.21e	0.06e	21.80c	363.00d
	40	1.28d	0.06d	35.50bc	387.20dc
	80	1.39c	0.07c	44.30ba	443.70bc
	120	1.47b	0.07b	44.40ba	504.20ba
	160	1.60a	0.08a	57.20a	544.50a

Results are means of four replications

vertisol and non-calcerous brown soils at the level of $p< 0.01$. Compost level at the rate of 160 t ha^{-1} was the most effective treatment to increase soil K_2O values according to Duncan`s LSD test for Vertisols and Non-calcareous Brown soils. Other researchers also demonstrated that application of waste compost on soil increased soil N, P and K values[6,14].

In general, additions of waste composts positively affected on soil chemical properties of non-calcareous brown soils and vertisol soils with high clay (smectite type). In this research benefits of municipal waste compost on chemical properties of clay soil was observed.

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