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APPLICATION OF GREENCOMPOST FOR IMPROVEMENT IN SOIL CHEMICAL PROPERTIES AND FERTILITY STATUS

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ABSTARCT

Green compost is prepared from green wastes such as garden and farm wastes. This compost was analyzed (pH= 7.3 and C: N ratio = 10.19:1) before its application to soil. A pot experiment was conducted to assess the efficiency of green compost to improve chemical properties of soil. Three types of soils were used for this purpose. Green compost was applied to each soil type @ 5 and 10 % of soil volume. *Lolium perenne* grass was grown in all the pots those were replicated four times arranged in CRD factorial.. After harvesting the grass, soil samples were also taken from all the pots and analyzed for pH, EC, organic matter, N, C, C/N ratio and mineral nutrients (Ca, Mg, K, P & Cl). Results revealed that use of green compost at both the levels (5 and 10 %) increased soil pH and EC. Organic matter, N and C %age were enhanced with a net decrease in C/N ratio. Contents of mineral nutrients of the soil also increased by the addition of green compost. Resultantly, an improvement in soils chemical properties was noticed.

Key words: Green compost, soil pH, EC, organic matter, C/N ratio and mineral nutrients (Ca, Mg, K, P & Cl)

INTRODUCTION

The soils of Pakistan are low in organic matter due to which over all fertility status is not higher enough to give the enhanced yield of different crops (Zaka *et al*., 2004). Among the causes of low organic matter are high temperature, low rainfall and removal of almost all the crop residues except the roots. The mechanical harvesting and threshing of crops, especially rice and wheat have aggravated the situation because the rice and wheat straw are mostly burnt. To ensure the good productivity of crops, the organic matter contents have definitely to be raised. But after the introduction of chemical fertilizers, the conventional sources of organic matter like farmyard manure (FYM) and green manure have almost been left. Resultantly, the organic matter status of Pakistan soils has already reached the bare minimum.

In advanced countries, the compost is very good alternative supplement for increasing the organic matter content of soil. But in Pakistan, this very good alternative source has not been utilized so far. Huge amounts of leaves, grass clippings, plant stalks, wines, weeds, twigs and branches are burnt every day. If this material is piled at the farm level, composted and added into the soil, the fertility status can be improved and crop yields can significantly be increased (Sarwar, 2005). It has been reported that application of FYM, poultry manure or green manure along with N, P_2O_5 and K_2O at the respective rates of 150, 100 & 50-Kg ha^{-1} significantly increased the paddy yield as well as subsequent wheat yields. The N, P and K contents of soil were found to be significantly higher than chemical fertilizer alone even after the harvesting of two crops (Ahmad *et al*., 2001). The uptake of N, P, K and Zn by rice was enhanced when FYM (12 t ha^{-1}) was applied along with N, P, K and Zn fertilizers (Mehdi *et al.*, 2001). The combined application of both organic and inorganic fertilizers improved chemical properties of soil and enriched the fertility status of soil (Sarwar *et al*., 2008).

The role of compost in salt-affected soils is very vital because the organic source is ultimate opportunity to improve the physical properties of such soils which have been deteriorated to the extent that water and air passage become extremely difficult in such soils. Resultantly, the water stands on the surface of these soils for weeks long. The plants when grown under these conditions often die due to deficiency of root respiration. The compost can be a very good organic amendment in saline agriculture as well as for reclamation of salt-affected soils (Zaka *et al*., 2003).

Physical properties like bulk density, porosity, void ratio, water permeability and hydraulic conductivity were significantly improved when FYM (10 t ha^{-1}) was applied in combination with chemical amendments resulting enhanced rice and wheat yields in sodic soil (Hussain *et al*., 2001). Other organic materials like rice straw, wheat straw, rice husk and chopped salt grass also improved these physical properties of a saline sodic soil. The tillering, plant height, biomass and paddy yield were significantly increased (Hussain *et al*., 1998). Soil organic matter encourages granulation, increases cation exchange capacity (CEC) and is responsible for up to 90 % adsorbing power of the soils. Cations such as Ca^{2+}, Mg^{2+} and K^{+} are produced during decomposition (Brady and Weil, 2005).

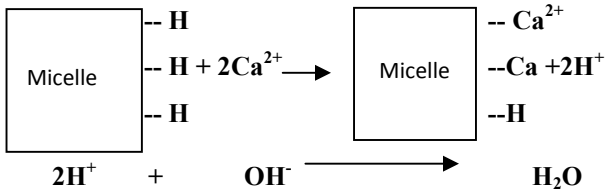
Greencompost is the form of compost prepared from green wastes such as garden and farm wastes and its effects were investigated for the improvement of soil parameters, especially the increase in organic matter content was observed by growing *Lolium perenne* grass as indicator plant. The main objective was to devise a workable strategy for increasing organic content of the depleted marginal soil and enhance its nutrient supplying capacity.

MATERIALS AND METHODS

This experiment was conducted in the Department of Landscape Ecology and Nature Conservation at University of Kassel, Germany. Three different types of soils were used in this research study: Normal cultivated soil, Nutrient deficient sandy soil and Soil from industrial area dominant in $CaSO_4$. Green compost made through hot method mainly from green wastes such as garden and farm wastes was applied to all three soil types @ 5 and 10 % of the soil volume with control treatment for each soil type. Before addition to the soil, compost was also analyzed for various chemical characteristics. Thus, experiment had 9 treatments with four replications: T1 = Soil A alone, T2 = Soil A + Greencompost @ 5 % of soil volume, T3 = Soil A + Greencompost @ 10 % of soil volume, T4 = Soil B alone, T5 = Soil B + Greencompost @ 5 % of soil volume, T6 = Soil B + Greencompost @ 10 % of soil volume, T7 = Soil C alone, T8 = Soil C + Greencompost @ 5 % of soil volume and T9 = Soil C + Greencompost @ 10 % of soil volume. *Lolium perenne* grass was sown in all the pots. All the pots were irrigated daily with ground water (pH = 7.75 and EC = 0.387 dS m^{-1}). After one month, grass was harvested from all the pots. Soil samples were obtained from all the pots and were analyzed for pH, EC, organic matter, N, C, C/N ratio, Ca, Mg, K, P and Cl contents. All the data were subjected to statistical analysis using completely randomized design with three factors.

RESULTS AND DISCUSSION

The impact of compost application (at both levels) on pH was non-significant in soil A (Table 2). However, increasing trend in pH of all three soils was noticed which became significant for soil B and C only. Both the compost levels had similar effects on soil C remaining non-significant to each other but significantly higher than control. Al^{3+}, Fe^{2+} and base forming cations (Ca^{2+} and Mg^{2+}) control the pH of a soil. The application of compost dissolved some of Ca and Mg (Table 4). These cations released $H^{+1}$from exchange site, which formed water. Resultantly, the pH was raised (Brady and Weil, 2005). This reaction can be indicated as follows:



In general, compost enhanced the EC of the soil (Table 2). The increase was more pronounced in soil A and B while in soil C it was negligible, however, differences remained non-significant. Organic matter content of all the three soils for both the levels and their interactions increased significantly due to compost application (Table 3). The C: N ratio narrowed down in the soils of the study but effect on soil B was very prominent (Table 3) because this soil was nutrient deficient. The differences created in soil C were only significant at 10 % level of applied compost.

The parameters of K and P were least affected with the application of compost (Table 3). The results were significant for all the three soils. The total P and K contents of applied compost were low (Table 1). Hence, the impact on soil parameters was not found to be significant. The Ca concentration of soil slightly increased due to compost application but response was non-significant. The differences among the soils were, however, appreciable indicating different original potentials of soils for these parameters (Table 4). The impact on soil Mg due to compost was significant among different types of soils.

Table 1: Composition of Green compost

Characteristic	Unit	Value
pH	-	7.3
EC	dS m^{-1}	3.12
Organic matter	%	40.9
Total Carbon	%	21.6
Total Nitrogen	%	2.1
C / N	-	10.19
Calcium	g. kg^{-1} compost	21.73
Magnesium	g. kg^{-1} compost	4.51
Potassium	g. kg^{-1} compost	20.65
Total Phosphorus	g. kg^{-1} compost	4.43
Chlorides	g. kg^{-1} compost	2.94

All weights are on oven dry basis.

In general, it may be concluded that compost application increased soil pH, EC, organic matter, Ca^{2+}, Mg^{2+}, K^{1+} and P while C: N ratio was narrowed in acidic soil. Hence, there was a general increase in nutrient supplying capacity of soils. The impact of various parameters was different in various soils. Generally, responses were poor in soil B and C due to their original lower potential. However, compost application was a good strategy for enhancing fertility status of depleted

Table 2: Effect of Green compost application on soil pH and EC

Treatments	Soil A	Soil B	Soil C	Mean
		pH		
0 Green compost (Control)	7.20[a]	5.14[d]	6.44[bc]	6.26[B]
5 % Green compost	7.27[a]	6.21[c]	6.90[ab]	6.79[A]
10 % Green compost	7.26[a]	7.00[ab]	7.12[a]	7.13[A]
Mean	7.24[A]	6.12[C]	6.82[B]	
		EC (dSm^{-1})		
0 Green compost	0.09265[b]	0.02795[d]	0.02220[d]	0.04760[A]
5 % Green compost	0.14200[a]	0.04433[cd]	0.02218[d]	0.06951[A]
10 % Green compost	0.12500[a]	0.06058[c]	0.02223[d]	0.06927[A]
Mean	0.11989[A]	0.04429[B]	0.02220[C]	

Table 3: Effect of Green compost application on soil organic matter, C: N ratio phosphorus and Potassium contents

Treatment	Soil A	Soil B	Soil C	Mean
		Organic matter (%)		
0 Green compost	3.98[c]	0.12[i]	1.22[f]	1.77[C]
5 % Green compost	4.25[b]	0.33[h]	1.67[e]	2.08[B]
10 % Green compost	4.99[a]	0.80[g]	2.14[d]	2.64[A]
Mean	4.41[A]	0.42[C]	1.68[B]	
		C: N Ratio		
0 Green compost	10.90[bc]	12.67[a]	11.96[ab]	11.84[A]
5 % Green compost	9.56[cd]	6.93[e]	11.01[bc]	9.17[B]
10 % Green compost	10.47[cd]	5.74[e]	9.19[d]	8.47[B]
Mean	10.31[A]	8.45[B]	10.72[A]	
		Phosphorus ($g\ Kg^{-1}$)		
0 Green compost	0.84	0.025	0.00	0.288
5 % Green compost	0.90	0.046	0.00	0.315
10 % Green compost	0.96	0.080	0.035	0.358
Mean	0.90 [A]	0.05[B]	0.012[C]	
		Potassium ($g\ Kg^{-1}$)		
0 Green compost	1.83	0.13	0.61	0.85
5 % Green compost	1.91	0.16	0.63	0.90
10 % Green compost	1.99	0.28	0.67	0.98
Mean	1.91[A]	0.19[C]	0.64[B]	

Table 4: Effect of Green compost on soil cations ($Ca^{2+}$and Mg^{2+})

Treatment	Soil A	Soil B	Soil C	Mean
		Calcium ($g\ Kg^{-1}$)		
0 Green compost	2.76	0.150	32.77	11.89
5 % Green compost	2.92	0.195	34.59	12.57
10 % Green compost	3.06	0.450	28.69	10.73
Mean	2.91 B	0.265[C]	32.02[A]	
		Magnesium ($g\ Kg^{-1}$)		
0 Green compost	1.88	0.20	0.46	0.85
5 % Green compost	1.99	0.24	0.47	0.90
10 % Green compost	2.07	0.31	0.51	0.96
Mean	1.98 A	0.25 C	0.48 B	

soils. Sarwar *et al*. (2003) in their study also observed that use of biocompost enhanced the soil pH, EC, organic matter, N and C % with a net decrease in C /N ratio.

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