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Characterization of different Organic Sources for Soil Improvement

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ABSTRACT: Organic amendments provide organic matter and valuable nutrients to agricultural soil, improve soil structure, increase water holding capacity, and stimulate soil microbial communities. Organic materials must be characterized in order to predict and comprehend their chemistry and behaviour. Numerous studies have attempted to determine its structure and chemical composition; however, due to sample heterogeneity, there is no definitive structure for organic matter, despite the fact that many structural models have been proposed. Farm yard manure (FYM) also improves the soil's ability to retain water. Vermicompost (VC) are materials derived from earthworms and microorganisms promoting the biological deterioration of organic wastes. Sewage sludge is an undesirable by-product of methods for wastewater treatment. Here characterization of four organic sources were done which are FYM, Sewage sludge (SS), Vermicompost (VC) and Poultry manure (PM). The result of the chemical analysis showed that all the organic sources has neutral pH value, while organic carbon content was highest in (VC) and other nutrient analysis showed that the nitrogen, phosphorus, potassium and sulphur varied in different organic sources. Similar results for micronutrient reported.

Keywords: Vermicompost, FYM, Poultry manure, Sewage sludge.

INTRODUCTION

Many agricultural soils contain little organic matter (OM), making them more vulnerable to erosion, desertification, and climate change (Diacono and Montemurro 2011). Organic sources applied to agricultural soil may be a viable option for mitigating these negative effects. Furthermore, organic sources can improve soil structure, aggregation and increase soil fertility. Organic materials must be characterized in order to predict and comprehend their chemistry and behaviour. Numerous studies have attempted to determine its structure and chemical composition; however, due to sample heterogeneity, there is no definitive structure for organic matter, despite the fact that many structural models have been proposed (Meinelt *et al*., 2004). Recently, the expansion of sustainable agriculture and the establishment of organic farms has resulted in an increase in the use of organic sources. An increase in soil organic content improves aeration, soil structure, and the soil's water holding capacity (Mangrich *et al*., 2000). Organic sources used for improvement of soil are Vermicompost, sewage sludge, farm yard manure and poultry manure.

Organic carbon, total and organic nitrogen, C/N relationship, P_2O_5, K_2O, and other physicochemical properties of organic sources are frequently determined in order to assess their suitability for agricultural use (Decree, 2017). Determining parameters related to microbial activity, biomass, and diversity of organic amendments is much less common. Farmers, particularly those involved in organic agriculture, require appropriate organic sources that have been exhaustively characterized in terms of both benefits and risks, in addition to meeting current legal requirements (Epelde *et al*. 2018). FYM is the most widely used natural fertilizer and one of the most effective soil fertilizers (Slowinska-Jurkiewicz *et al*., 2013). Mineral, organic, and natural fertilization also encourages the growth of microorganisms, which are an important source of nutrient conversion enzymes in soils (Bielinska and Mocek-Plociniak 2012; George *et al*., 2002; Kramer and Green 2000). FYM also improves the soil's ability to retain water. Vermicomposts are materials derived from earthworms and microorganisms promoting the biological deterioration of organic wastes. Earthworms eat and break organic waste into finer particles through a grinding gizzard and derive their food from microorganisms which develop on them. Scientific research has identified the viability of using earthworms as a treatment technique for many

waste stream. Sewage sludge is an undesirable by-product of methods for wastewater treatment. Biotreatment of wastewater before and after sedimentation creates sewage sludge. A significant amount of industrial and municipal waste has been generated annually in India and its disposal has now become a serious problem. Municipal governments around the world are concerned to establish a clean, efficient and feasible disposal process. The present study was undertaken to characterize this organic source in terms of their physico-chemical analysis. So, we characterized four organic sources used in organic farming, in order to evaluate the effect of these organic sources on soil improvement.

MATERIALS AND METHOD

A. Collection of organic sources

Four organic material samples were chosen for this work. FYM and Vermicompost was collected from the Agricultural Research Farm, BHU, Varanasi. The bulk of sewage sludge collected from Sewage Treatment Plant, Bhagwanpur was air dried in the glass house. Poultry manure was collected from Ramna poultry farm, Varanasi.

B. Organic sources analysis

Four studied organic samples were analyzed for chemical characteristics. The chemical analysis includes pH determined by the method of Sparks (1996); Electrical conductivity (Richards, 1954); Organic Carbon (Walkley and Black 1934). Total macronutrients (N, P and K) micronutrients (Fe, Mn, Zn and Cu) and heavy metals (Pb, Cd, Co and Ni) were digested and measured as described by (Page *et al.* 1982).

RESULTS AND DISCUSSION

A. Poultry manure (PM)

The result presented in the Table 1 showed that the pH of poultry manure was 7.03, it indicated that the nature of poultry manure was neutral, while organic carbon content was found to be 9.97 percent indicating more organic carbon than FYM and Vermicompost. The total nitrogen, phosphorus, potassium and sulphur content was found to be 1.14 percent, 1.28 percent, 0.93 percent and 0.19 percent. The result indicated that the poultry manure can also be used as a source of nutrient for the crop plant. The total Fe, Cu, Mn and Zn in the farm yard manure was found to be 117.81 mg kg^{-1}, 8.27 mg kg^{-1}, 91.23 mg kg^{-1} and 14.27 mg kg^{-1}. These all results indicated that the poultry manure can act as source of nutrient as well as good source of organic matter to the soil. These results are in agreement with those obtained by Dehvari and Sadeghi (2015).

B Sewage Sludge (SS)

In Table 1 it was depicted that the pH of Sewage sludge obtained from sewage treatment Plant, Bhagwanpur, was recorded to be 6.51, while its organic carbon content was 8.53 percent, slightly lower than FYM, Vermicompost and Poultry manure. The total nitrogen, phosphorus, potassium and sulphur content was found to be 0.82 percent, 1.09 percent, 0.79 percent and 0.65 percent. This result indicated that the Sewage sludge can also be used as a source of nutrient for the crop plant. The total Fe, Cu, Mn and Zn in the sewage sludge was found to be 113.38 mg kg^{-1}, 17.34 mg kg^{-1}, 46.61mg kg^{-1} and 23.16 mg kg^{-1}. These all results indicated that the sewage sludge can act as source of nutrient as well as good source of organic matter to the soil. This view point is in agreement with (Siuris, 2011).

C. Farm Yard Manure (FYM)

The result presented in the Table 2 showed that the pH of FYM was 6. 43, it indicated that the nature of FYM was neutral, while organic carbon content was found to be 9.71 percent indicating the high organic potential. The total nitrogen, phosphorus, potassium and sulphur content was found to be 0.43 percent, 0.29 percent, 0.52 percent and 0.08 percent. This result indicate that the farm yard manure can also be used as a source of nutrient for the crop plant. The total Fe, Cu, Mn and Zn in the farm yard manure was found to be 97.71 mg kg^{-1}, 8.19 mg kg^{-1}, 19.42 mg kg^{-1} and 13.86 mg kg^{-1}. Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. These all results indicated that the farm yard manure can act as source of nutrient as well as good source of organic matter to the soil. These results are in agreement with those obtained by Kumar *et al.* (2021).

D. Vermicompost (VC)

In Table 2 it was depicted that the pH of Vermicompost obtained from Agricultural research farm, BHU, was recorded to be 6.78, while its organic carbon content was 4.27 percent, slightly higher than FYM. The total nitrogen, phosphorus, potassium and sulphur content was found to be 1.20 percent, 0.78 percent, 1.05 percent and 0.31 percent. This result indicated that the Vermicompost can also be used as a source of nutrient for the crop plant. The total Fe, Cu, Mn and Zn in the Vermicompost was found to be 162.36 mg kg^{-1}, 10.78 mg kg^{-1}, 112.27 mg kg^{-1} and 18.27 mg kg^{-1}. These all results indicated that the Vermicompost can act as source of nutrient as well as good source of organic matter to the soil. These results are in agreement with those obtained by Zhang *et al.* (2009).

Table 1: Chemical Characterization of Poultry manure and Sewage Sludge.

Properties	PM	SS
pH	7.03	6.51
EC (dS m^{-1})	3.47	2.67
OC (%)	9.97	8.53
N (%)	1.14	0.82
P (%)	1.28	1.09
K (%)	0.93	0.79
S (%)	0.19	0.65
Zn (mg kg^{-1})	14.71	23.16
Fe (mg kg^{-1})	117.81	113.38
Mn (mg kg^{-1})	91.23	46.61
Cu (mg kg^{-1})	8.27	17.34

Table 2: Chemical Characterization of FYM and Vermicompost.

Properties	FYM	VC
pH	6.43	6.78
EC (dS m^{-1})	3.39	4.27
OC (%)	9.71	10.43
N (%)	0.43	1.20
P (%)	0.29	0.78
K (%)	0.52	1.05
S (%)	0.08	0.31
Zn (mg kg^{-1})	13.86	18.27
Fe (mg kg^{-1})	97.71	162.36
Mn (mg kg^{-1})	19.42	112.27
Cu (mg kg^{-1})	8.19	10.78

CONCLUSIONS

Organic sources characterization leads to the knowledge of how these sources will affects the soil fertility status. As all of these sources has some nutrient such as nitrogen, potassium, phosphorus, sulphur and micronutrients. So, current characterization of these organic sources will help one to understand their role in the soil system when we applied them. Vermicompost contains more organic carbon compared to other organic sources. Use of FYM, poultry manure and Sewage sludge in long term application can enhance the fertility status of soil as well as improves the biological properties of soil. So, their characterization is essential on that aspect. Therefore, all these information of organic sources reduce the dependence on fertilizers resulting in less pollution to the soil and environment, which on further improve the yield of different crop.

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Conflict of Interest. None.

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