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EFFECT OF SEWAGE SLUDGE AND BIO-FERTILIZERS ON PHYSICO-CHEMICAL PROPERTIES OF ALLUVIAL SOIL

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ABSTRACT – An experiment was conducted at the research farm of Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad with sewage sludge, lime, recommended dose of fertilizer, phosphate solublizing bacteria (PSB) and plant growth promoting rhizobacteria (PGPR) on physico-chemical properties of alluvial soil. The bulk density of post harvest soil of radish grown plot in the treatment T_2 (1.33 Mgm^{-3}) tended to be lower while particle density (2.72 Mgm^{-3}) of post harvest soil tended to be higher than the remaining treatments. The pH and EC values in the treatment T_4 8.0 and 0.49(dS m^{-1}) tended to be lower than remaining treatments. In the treatment T_3 had significant effect on soil pH (8.4) status of soil while treatment T_{10} and T_{11} reduced the pH 8.2 and 8.1value status of post harvest soil. Treatment $T_{8,}$ T9 T_{10} and T_{11} had significant effect on EC. The percentage of organic carbon of post harvest soil of radish plot in T_2 (0.49%) is tended to be significant greater than remain treatments. In the treatment T_6, $T_{7,}$ $T_{8,}$ $T_{9,}$ $T_{10,}$ and T_{11} had significant effect of organic carbon status of soil after harvest radish as compared to control plot. Available nitrogen, phosphorous and potash Kg/ha of post harvest soil of radish grown plot in the treatment T_1 and T_2 had higher values than control plot. In the treatment $T_{6,}$ $T_{7,}$ T_8, T_9 T_{10}, T_{11} had significant effect on available nitrogen, phosphorous and potash as compared to control plot. The main focus of current research work to find out the effect of sewage sludge and fertilizer on soil health.

Key words : Sewage sludge, biofertilizers, alluvial soil.

INTRODUCTION

Increasing volume of sewage sludge, environmental constrains and cost associated with alternative methods are factors that what led to an increased interest in utilizing or disposing sewage sludge as fertilizer on agricultural land. (Alloway *et al,* 1991) The application of sewage sludge to land provide significant benefit through the addition of organic matter, nitrogen, phosphorus and certain essential trace elements to the soil. (Change *et al,* 1987) The practice of adding sewage sludge to agricultural land is well established now-a-days. As sewage output has increased, sewage sludge have been and is likely to become, more widely used on agricultural land.

Sewage sludge is a good soil conditioner, high water retention capacity, improves pH, buffer capacity and immobilizes certain toxic metals. Sewage sludge when applied to arable land increased agricultural productivity by supplying nutrients, especially nitrogen (N) and phosphorus (P) to crops, and its high organic matter content also makes it useful as a soil conditioner .

Bio-fertilizers are environmental friendly, low cost agriculture input playing a significant role in improving nutrients availability to crop plants. It is wide term including a divers categories of bio-inoculants such as nitrogen fixer (symbiotic and asymbiotic) phosphate solublizer and plant growth promoting rhizobacteria etc. The potential of biofertilizer to supply micronutrients is yet to be harnessed. Lesser use of biofertilizer such as phosphate solublizing bacteria and phosphate mobililizers are promising in supplying phosphorus and other micronutrients (Tilak and Singh 1994). Biofertilizers (PSB) are renewable, cheap and ecofriendly. They solublize insoluble soil phosphate produce plant growth substances in soil and improve physical properties of soil.

MATERIALS AND METHODS

The field work was conducted on research farm of soil science and agricultural chemistry, School of Forestry and Environment, SHIATS, Allahabad. The soil samples were collected from (0-15) cm depth with the help of a stainless steel tube auger. The representative soil samples were transferred into tight polythene bags and brought into laboratory for proper processing.

The bulk density and particle density determined by cylinder method (Muthuvel *et al,* 1992). The soil pH, EC, soil organic carbon, available nitrogen, available phosphorous, available potassium of soil were determined by using standard procedures such as soil organic carbon (Walkley and Black, 1947), Available nitrogen (Subbiah and Asija, 1956), Available phosphorous (Olsen et al., 1954), and Available potassium (Toth Prince, 1956).

The experiment was laid in randomized block design with 3 replications. The net cultivated area of each plot being 1m^2. The crop was sown in the second week of October and harvested after 45 days. The experiment included the following treatments combination. The statistical analysis as per method of "Analysis of variance" (Fisher 1950).the significant and non significant of treatment effect was judged with the help of 'F' variance ratio test calculated 'F' at 5% level of significance.

Treatment Combination

T_0. Control

T_1. S.S. @ 10 tha^{-1}

T_2. S.S. @ 20 tha^{-1}

T_3. S.S. @ 10 tha^{-1} + 20 kg lime ha^{-1}

T_4 S.S. @ 10 tha^{-1}+ NPK (RDF)

T_5. S.S. @ 20 tha^{-1}+ NPK (RDF)

T_6. S.S. @ 10 tha^{-1} + NPK + PSB @ 2kg ha^{-1}

T_7. S.S. @ 20 tha^{-1}+ NPK + PSB @ 2kg ha^{-1}

T_8. S.S. @ 10 tha^{-1} + NPK + PGPR@ 2kg ha^{-1}

T_9. S.S. @ 20 tha^{-1}+ NPK + PGPR @ 2kg ha^{-1}

T_{10}. S.S. @ 10 tha^{-1} + NPK + PSB@ 2kg ha^{-1} + PGPR@2kg ha^{-1}

T_{11}. S.S. @ 20 tha^{-1}+ NPK + PSB@2kg ha^{-1} + PGPR@2kg ha^{-1}

Note – S.S.A (Sewage Sludge) and RDF (120kgha^{-1} N.70kgha $^{-1}$ P and 70kgha^{-1} K)

RESULTS AND DISCUSSION

Bulk density

The bulk density of post harvest soil of radish grown plot in the treatment T_2 found to be significantly lower than other treatments. Bulk density of soil applied with sewage sludge was less than 0.2Mg/m^3 compared to applied with organic matter indicating light and porous portion nature of sewage sludge. Increase in sewage sludge application rate in treatment T_1 and T_2 (10t ha^{-1} and 20t ha^{-1}) significantly increased saturation percentage, porosity and organic matter content in sandy loam soil. This might be due to high organic matter content in sewage sludge. Sewage sludge application decreased the bulk density, may be due to homogenous distribution of manure constituents between soil particle and microorganism also produce many essential cementing materials that can link the soil particles and forming soil aggregates. Similar results were obtained by Mendoza *et al* (2006) and Paresh *et al* (2009). Treatment T_4 had significant effect on bulk density while treatment T_6 reduced the bulk density, this might be due to production of biomass form vegetable stables and residues, high in organic carbon. Similar result was obtained by Sarkar and Singh (1997).

Particle density

The particle density of post harvest soil of radish grown plot in the treatment T_2 have been found significantly higher than the remaining treatments. This is so because sewage sludge contain higher amount of organic materials, silt and clay particles. Similar finding was also reported by Malla and Totawat (2006). Treatment T_4 had no significant effect on bulk density but increase the particle density in treatment T_6. Similar result was obtained by Sarkar and Singh (1997).

Soil pH

The pH of treatment T_4 plot was lower than other treatments. Due to addition of heavy metals through sewage sludge, its decomposition rate not changed appreciably, it brings significant decrease in pH (Singh and Agarwal (2007) and Hussein (2009). Treatment T_3 had significant effect on soil pH status of soil after harvest of radish grown plot as compared to only sewage sludge applied soil (Zaniewicz – Bajkowask *et al* (2007) and Nwachokor *et al* (2009). Treatment T_{10} and T_{11} reduced the pH value status of

Table 1: Effect of sewage sludge, lime, fertilizers, PSB and PGPR on physic-chemical properties of post harvest soil of radish grown plot.

Treatments	Bulk Density (Mgm^{-3})	Particle Density (Mgm^{-3})	pH (1:2.5)	EC (dS m^{-1})	OC (%)
T_0	1.37	2.62	8.4	0.47	0.37
T_1	1.35	2.67	8.3	0.57	0.44
T_2	1.33	2.72	8.2	0.60	0.49
T_3	1.36	2.63	8.4	0.56	0.23
T_4	1.38	2.64	8.3	0.50	0.17
T_5	1.37	2.65	8.4	0.51	0.13
T_6	1.36	2.64	8.0	0.52	0.18
T_7	1.35	2.65	8.2	0.54	0.16
T_8	1.35	2.66	8.5	0.53	0.13
T_9	1.34	2.68	8.4	0.53	0.12
T_{10}	1.36	2.66	8.5	0.55	0.13
T_{11}	1.34	2.65	8.1	0.54	0.16
F- test	NS	NS	NS	NS	NS

Table 2 : Effect of sewage sludge, lime, fertilizers, PSB and PGPR on available NPK (Kg ha^{-1}) of post harvest soil of radish grown plot.

Treatment	Av. Nitrogen	Av. Phosphorus	Av. Potassium
T0	208.00	16.00	220.67
T1	222.00	15.00	230.67
T2	233.00	18.00	233.33
T3	209.00	15.00	244.33
T4	253.00	24.67	245.00
T5	253.67	18.00	248.33
T6	240.00	11.00	228.33
T7	245.00	15.00	231.50
T8	244.00	15.00	223.83
T9	245.00	13.00	246.00
T10	248.00	17.00	248.33
T11	250.00	15.00	248.00
F- test	S	S	S
S.Em(±)	7.39	0.65	1.26
C.D.(P=0.05)	18.05	1.59	3.08

post harvest soil as compared to single sewage sludge applied soil. This might be due to PSB produced the organic acid which is responsible for the reduction of soil pH.

Electrical Conductivity

The EC of T_4 treatment was lower compared to remaining treatments because sewage sludge contain higher amount of salt and other nutrients. Similar finding was also reported Singh and Agarwal (2007) and Hussein (2009). Treatment T_6 and T_7 reduced the EC values as compared only sewage sludge application while treatment (T_8 and T_9) and (T_{10} and T_{11}) had significant effect on EC status of soil after harvest of radish grown plot.

Soil organic carbon

The percentage of organic carbon of post harvest soil of radish plot in T_2 was significantly greater than rest of the treatments. Similar findings were reported by Singh and Verloo (1996). Treatment T_6 and T_7 had significant effect of organic carbon status of soil after harvest radish grown plot. The increase of organic carbon might be due to production of biomass of vegetables stables (Sarkar and Singh, 1997). Treatment (T_8 and T_9) and (T_{10} and T_{11}) had significant effect on organic carbon status of soil as compared to control plot.

Available NPK

Available nitrogen, phosphorus and potassium in the treatment T_1 (222, 15,230.67 kg/ha) and treatment T_2 (233, 18, 233.33 kg/ha) were higher than control plot (208, 16,220.67 kg/ha) because sewage sludge contain appreciable amount of nitrogen, phosphorous and potash. Similar results were observed by Ailincail *et al.* (2009). Treatment (T_6 and T_7), (T_8 and T_9) and (T_{10} and T_{11}) had significant effect on available nitrogen, phosphorus and potassium as compared to control plot. Similar finding was also reported by Alguacil *et al* (2003).

CONCLUSIONS

In the study of present research we find the application of sewage sludge and biofertilizer, to improve the physical properties such as bulk density and particle density, chemical properties soil pH, EC and organic carbon. It also increases the availability of nitrogen, phosphorous and potash as compared to without application of sewage sludge and biofertilizer.

REFERENCES

Ailincail C, Jitareanul G, Tsadilas C D, Ailincai D, Zbanþ M and Balanl A (2009) Effect of municipal sewage sludge on winter rape and soybean production and heavy metal contamination of soil *Cercetãri Agronomice în Moldova* **XLII** ,

Alguaci M M, Caravacal F, Azocan R, Pera J, Gdiaz and Koldan A (2003) improvment in soil quality and performance of microrhizal cistus albidus L. Seedling resulting from addition of microbiology treated sugarbeet residue to a degrated semiarid mediterraneein soil can *J. Microbiol.* **52,** 410-420.

Alloway B J and Jackson A P (1991) The behaviour of heavy metals in sewage sludge amended soil.*Sci. Total Environ* **100,** 151-176.

Chage A C, Page A L and Warneke J E (1987) Long term sewage sludge application on cadmium and zinc accumulation in swiss chard and radish. *J. Environ. Qual.* **16,** 217- 221.

Hussein A H A (2009) Impact of sewage sludge as organic manure on some soil properties, growth, yield and nutrients of cucumbe crop. *J. Applied Sci.* **9,** 1401-1411.

Malla R and Totawat K L (2006) Effect of municipal sewage on soil properties and chemical build up in vegetable crop grown on Hapulstepts of sum humid southern plain of Rajasthan. *J. Indian Society Soil Science* **54,** 226 -231.

Mendoza J, Tatiana G, Gabriela C and Nilsa S M (2006) Metal availability and uptake by sorghum plant grown in soils amended with sludge from different treatmets C*hemosphere* **65,** 2304-2312.

Nwachokor M A, Uzu F O and Molindo W A (2009) Variations in Physicochemical Properties and Productivity Implications for Four Soils in the Derived Savannah of Southern Nigeria *American-Eurasian J. Agronomy* **2,** 124-129**.**

Paresh H R, Jyotindra, Patel C, Shah M R and Jhala A J (2009) Recycling gamma irradiated sewage sludge as fertilizer: A case study using onion (*Alium cepa*) *Journal homepage*: www.elsevier.com/locate/apsoil

Sarkar S and Singh, SR (1997) Integrated nutrient managment in relation to soil fertility and yield sustainability under land farming soil, *J.*

Agriculture Sci. 431-433.

Singh S P and Verloo MG (1996) Accumulation and bioavailability of metals in semiarid soil irrigated with sewage effluents. Moded Fac. Land bouwkd. Toegep. *Biologywet University Lrent* **61,** 63-65.

Singh R P and Agrawal M (2007) Effects of sewage sludge amendment on heavy metal accumulation and consequent responses of Beta vulgaris plants *Chemosphere* **67,** 2229–2240

Tilak K V B R and Singh G (1994) Biofertilizer future gaps and future need . *Fertilizer News* **39,** 147.

Zaniewicz-Bajkowska A, Rosa R, Franczuk J and Kosterna E (2007) Direct and secondary effect of liming and organic fertilization on cadmium content in soil and in vegetables *Plant Soil Environ*. **53,** 473–481.