



AN OVERVIEW ON SEWAGE SLUDGE AS A GREEN MANURE SUPPLEMENT IN AGRICULTURE

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ABSTRACT

Application of sewage sludge in the fields of agriculture can provide an economical way to dispose of an increasing amount of sludge generated in the metropolitan areas of the world. Direct benefits of sludge application to the agricultural land are the increase in the supply of major plant nutrients (such as N and P) and some of the essential micronutrients (Zn, Cu, Mo, Mn etc.) which are required by the plants in trace quantities. Also, some cases are reported which have shown improvement in the soil physical properties i.e., improved arrangement of soil, augmented water capability and enhanced water transmission characteristics on application of treated sewage sludge. Current paper reviews about the increase in productivity of different crops by the proper utilization of sewage sludge in the agriculture and its effect on the properties of soil.

KEYWORDS: Sewage sludge; Soil, Nutrients, Microbes, Productivity, Agriculture Supplement.

1. INTRODUCTION

Urbanization and industrialization have culminated in a spectacular growth in the volume of urbanite wastewater produced globally (Kroiss, 2003). Sewage waste contains all substances that are required for human body, such as food, beverages, pharmaceuticals, a great variety of household chemicals and the substances discharged from trade and industry to the sewer system.

Sewage sludge is an insoluble residue obtained from municipal wastewater treatment left after either aerobic or anaerobic digestion processes. The use of sewage sludge was increased considerably, because of increase in the costs of the commercial fertilizers and the large availability of the sewage sludge worldwide. Now, cropland application of this residue has become an attractive disposal action. It is used more commonly as supplement fertilizer in agriculture. Sewage sludge is used as an ameliorant in India. Various positive effects have been observed by the application of different rates of the sewage sludge as a green manure for increasing productivity (Sansoy, 2011). Sewage sludge can be utilized economically by using it only in the seedling growing media. Sewage sludge is attracting attention because of its advantages like having large quantity of the organic matter content, easily availability and low-cost. It is observed that the presence of the organic matter in sewage sludge enhances the water holding capacity, nutrient availability and soil fertility positively

by improving the physical and chemical features of soil. A number of experiments were conducted to study the effects of sewage sludge compost on crop yield and chemical properties of soil under field conditions (Ataman and Arcak, 2009). The results of four years of study indicated that there are no toxic effects from different heavy metals present in sewage sludge. Furthermore, the presence of heavy metals concentration present underneath the as mentioned in Spanish and the European legal limits (Delgado et al., 2002)

2. Characteristics Of Sewage Sludge

2.1 physical characteristics of sewage sludge

Addition of sewage sludge to soil increases the organic matter content of the soil. Similar results were observed in various literatures (Antoline et al., 2005 and Mendoza et al., 2006). The application of sludge to soil is to advance the soil physical properties as evidenced by surface crusting, increased soil aeration, increasing water content and greater permeability, increasing water retention, increased water infiltration and decreased enhanced aggregation. The sewage sludge significantly increases the porosity and saturation percentage of soil, while, bulk density extensively decreases with escalating sludge application to the soil (Hussein, 1991). Sewage sludge is characterized by a high content of nutrients, mainly of N and P (Skorbiłowicz, 2009b), thus contributing to high yields. Sewage sludge contains high quantities of organic carbon (Czekala, 2002) owing to

which it can increase the content of humus and improve the quality of soils, especially of those characterized by low contents of organic matter (Moreno et al., 2003).

2.2 chemical characteristics of sewage sludge

Land application of sewage sludge, improves chemical characteristics of the degraded soil, and thereby eliminate the use the mineral fertilizer. It was reported that sludge application to soil provides organic matter content and further improves chemical properties of soils (Bazegar et al., 2002 and Veeresh et al., 2003). As regards to soil pH, the reduction in its value was more pronounced at high rates of sludge application. Application of sewage sludge decreases soil pH and increases total soluble salts of the soil.

It is also, observed that application of sewage sludge increased soil DTPA-extractable heavy metals as Cd, Cu, Mn, Pd, Zn and increases N-NH_4^+ content of the soil (Antoline et al., 2005). A four-year study (1996-1999) was conducted in order to study the effect of sewage sludge on chemical properties of soil. The results showed maximum growth is observed in mixed II treatment (12000 kg/ha sewage sludge compost plus 350 kg/ha urea) with 20% more than mineral fertilization, followed by mixed I (8000 kg/ha sewage sludge compost plus 350 kg/ha urea) with 10% more than mineral fertilization. It is confirmed from the above results that sewage sludge has positive effect on the chemical properties of soil and can be used as a fertilizer in maize crops (Delgado et al., 2002).

3. Sewage Sludge as Organic Manure

A greater effort is needed to conserve and increase the organic matter in the agricultural soil (Berry, 1997). The application of sewage sludge was studied by integrating it with apex 30 cm earth cover. Sewage sludge may prove as an effective solution in this respect. Nowadays, sewage sludge recycling is one of the main alternatives adopted in the agriculture. Sewage sludge compost contains plenty of plant nutrients, especially N and P that are an efficient long-lasting treatment. Sewage sludge also contains both macro and micro nutrients required by the plants in vital amounts.

Several experiments were done to analyze the various effects of sewage sludge when applied in different concentrations to the soil. It was reported that sewage sludge addition to the soil improved soil properties, growth of the plant, nutrient content, yield, number of leaflets and number of fruits in cucumber plant. Also, it was observed that higher application of sewage sludge results in the higher yield in cucumber plants. More effective results were observed in respect of improving physical, chemical and fecundity environment of the soil. In addition, using sewage sludge as natural dung is believe to be a source of nutrients that are necessary for yield and growth of cucumber crop (Hussein, 2009). It is noted that the soils of dry and semi-arid regions have low organic carbon content and require organic amendments

to develop their physico-chemical and biological properties and hence their productivity. In such regions, natural fertility decreases because of the low organic content of the soil and sewage sludge addition to such soils may help to improve fertility of soil due to presence of high organic content (Pascual et al., 1997).

Sewage sludge application has both positive as well as negative impacts. Its application results in amplified organic carbon, cation exchange capacity of the soil and total soluble salts and decrease in soil pH (Antoline et al., 2005). The total coliform and heavy metal removal from sewage sludge can be controlled by using fly ash using as a stabilizing agent (Kharub et al., 2012a). Greenhouse experiments were carried out on broad bean supplemented with sewage sludge. The results showed that sewage sludge can be used for as a fertilizer for broad bean crop. The application of sewage sludge increased organic matter, soil salinity with decreased soil pH. Whereas the concentration of heavy metals observed were fewer than the accepted limit as allowed by the Council of European Communities (Ebrahim et al., 2018).

The level of organic matter and extractable heavy metals such as Ni, Pb, Cu, Zn, Fe and Mn has elevated on introduction of sludge to the soil whilst soil pH level decreased (Mendoza et al., 2006). It has been reported by (kharub et al., 2012b) that leaching of heavy metal ions can be controlled by using optimized dose of 4:1 FA/SS mixture. Several studies analyzed that addition of sewage sludge is also helpful in promoting plant growth higher than the growth received when any other commercial fertilizer is added. Addition of 77% sewage sludge to the soil increased higher maize height as compared with the soil supplied with 25% commercial fertilizer (Christodoulakis and Margaris, 1996).

Introduction of sewage sludge to the soil raised the yield of three crops (corn, sugar beet and cotton plants) drastically by increasing the amount of various nutrients such as Mg, K, Mn, Cu, Zn. The application of sewage sludge has increased the nitrogen and many heavy metals content such as Ni, Cu Zn, Cr, Mn, Pd and Cd in the grains of barely crop on application of sewage sludge. Similarly, application of sewage sludge to soil showed increased levels of Pb, Mn, Fe, Zn and Cu in leaves of sorghum.

3.1 sewage sludge effect on soils

The total microbiological activity depends on the enzymatic activity of the soil (Nannipieri et al., 2003). The enzymatic activity of soil depends on a number of factors such as temperature, presence of inhibitors and pH (Kizilkaya and Bayrakli, 2005). The enzymatic activity is dependent on organic content of soil demonstrated that addition of sewage sludge to soil increases the enzymatic activity of soil as it is coupled with organic compounds and mineral content present in the soil (Kucharski et al., 2000). Further, it was also

investigated by that a slow decrease in proteolytic activity after an initial increase was observed in the study which is due to reduction of organic compounds in soil supplied with sewage sludge (Zaman et al., 2004).

The positive effect of sewage sludge on the activity of dehydrogenases was demonstrated by a number of researchers (Pascual, 2007). It has been reported that after constant use of sewage sludge in the long field experiments the concentration of metal content was found condensed (Kirchmann et al., 2017). Not only this, but the repetitive use of sewage sludge in the field has inverted negative drifts of soil. The potential benefits of land application of sewage sludge depend on the characteristics of sewage sludge. It is reported that being rich in organic and inorganic plant nutrients sewage sludge can serve as a substitute for fertilizer. He analysed by experimentation that sewage sludge application resulted in increased plant germination and seedling growth (Singh, 2007). The application of sewage sludge showed positive effects by improving soil properties such as bulk density, soil productiveness, porosity, water retention and movement capacity (Silveria et al., 2003).

Application of sewage sludge increases Ni-metal content in the shoots of maize plants. A nine years successive study is done with application of sewage sludge and it was reported that Nickel- accumulated amount from sewage sludge did not affect soil Ni-concentration (Bonini et al., 2013). It is reported by a number of authors nickel is a heavy metal, and is considered one of the plant nutrients, (Rodrigues, 2009; Malavolta and Moares, 2007). Therefore, sewage sludge can be used as a fertilizer. Advanced yields in sludge-treated crops are generally due to development in the soil conditions, because of the presence of extra carbon content in sludge (Christie et al., 2001).

3.2 sewage sludge as an ameliorant for crop production

It has been reported by macro-nutrient contents (N, P, K, Ca, Mg) and micro-nutrient contents (Fe, Mn, Cu and Zn) of sunflower leaves increased gradually with increased application of organic matter that is composed of sludge (Hussein and Abdel Nasser, 2001).

The application of sewage sludge had a positive effect on the growth of emergence and seedling in cucumber (Sansoy, 2001). He observed that the lowest seedlings growth was 93.33% of cucumber when grown without sewage sludge and when supplied with sewage sludge application, the seedling growth was (100%). Sansoy, concluded that 30% sewage sludge application after removing heavy metals will achieve good results in cucumber seedlings production. The composted municipal solid waste (MSW) has been used to improve soil properties and to increase crop yield (Aydin et al., 2000). An experiment was done by mixing sewage sludge with soil for a period of four years and observed the results showed increased crop yield and improved

chemical properties. He also used this soil sewage sludge mixture on maize plants and reported improved soil properties and improved quality of maize production. After observing the positive effects of sewage sludge, it is confirmed that it (sewage sludge) can be used as fertilizer in maize plants (Delgado et al., 2002).

Sewage sludge compost application in soil increased the amounts of oxidisable carbon and humic acids in the soil (Smith et al., 2003). Sewage sludge includes all the necessary nutrients required for the plant growth. After several experiments it was observed that 30:50% soil-sewage sludge mixture proved good for the growth of *Abelmoschus esculentus*.

4. CONCLUSION

This literature review concludes that sewage sludge is a highly promising feedstock for the production of crops. This review noted that sewage sludge that contains heavy metal content in permissible limits has positive effects on cucumber seedling growth. It is advisable to determine the heavy metal content of sewage sludge before using it because the amount of heavy metal varies according to the source of sewage sludge. Moreover, different amounts of sewage sludge with the organic matters and mineral fertilizers can be studied in the other vegetables' seedling production in the future experiments.

Application of sewage sludge by mixing it with soil layer was found to be more effective in improving soil physical, chemical and fertility conditions of the soil. Moreover, using sewage sludge as organic manure is considered as a source of nutrient required for plant growth. Although sewage sludge is having positive effects and is good for the maximum productivity of crops, yet it may result in toxicity and other physiological effects because of appreciable content of heavy metals in it. So, while using sewage sludge in an environmentally friendly manner, the concentration of heavy metals is of utmost importance. An optimum concentration of heavy metals ions in sewage sludge enhances the productivity. In the near future, there is scope of future study on sewage sludge in relation to micro-bioactivity and physical textures of soil.

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