LONG TERM EFFECTS OF IRRIGATION WITH SEWAGE EFFLUENT ON SOME SOIL PROPERTIES

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ABSTRACT

Compost soil samples(236 samples) on grid 50 m apart have been collected (at two depths)from three farms for forage crop production projects at Al-Hair, 30 km south of Riyadh. Results showed that the EC values where higher in subsurface compared to surface in all farms, depending upon the source of irrigation. These values were (3.48, 2.20 and 2.21 dSm^{-1}) in the surface layers of the 1^{st} , 2^{nd} and 3^{rd} farms respectively, while the respective values in the subsurface layers reached (4.53, 3.23 and 2.60 dSm^{-1}) respectively. The concentrations of Zn, Cu, Fe and Ni were higher at the sewage treated farms than the well irrigated ones. The values of Zn, Cu, Fe. Ni were 28.87, 16.95, 4225, and 72.26 $mg.kg^{-1}$ for in first farm and 42.4, 60.5, 11215, and 180 $mg.kg^{-1}$ for the second farm. While for Pb in the surface layer of the soil at the first, second and third farms were 63.01, 37.10 and 27.69 $mg.kg^{-1}$ soil, respectively. Results of geostatistic showed the spatial variation for soil properties were very minimum and the calculated enrichment factor did not show any contamination in soils of the studying farms with exception of As.

Key Words: Sewage effluent, Soil properties, heavy metals, geostatistic

INTRODUCTION

The increase demand on water for agricultural production has forced farmers to use treated municipal wastewater in Saudi Arabia and many other countries located in arid or semiarid regions (Al Omran et al., 2011). The use of wastewater in agriculture may result in deterioration of the quality of the soil, in particular, creating sodic soils which adversely affect soil physical properties and consequently reduction in yield. The effects of the long use of wastewater on soil properties have been documented with regard to heavy metals and soil physical and chemical properties (Tabari and Salehi, 2009). Abedi-Koupai et al. (2006) showed that accumulation of Pb, Mn, Ni and Co in the soil increased significantly in the wastewater treatment as compared to the groundwater treatment. Geostatistical technique is applicable throughout soil science area to measurable properties that vary continuously in space (Iqbal et al., 2005; Cemek et al., 2007; Karanlik et al., 2010).The objectives of this study were to investigate the effect of irrigation for long periods with treated sewage effluents on some soil properties, as well as its relation to the spatial variability for some soil characteristics using geo statistical methods like krigging and covariance.

MATERIALS AND METHODS

Composite soil samples (236 samples) were collected (in two different depths (i.e. 0-20 cm and 20 - 50 cm) from three farms at Al Haier projects used for feed production (about 30 km south of Riyadh). Some of these farms, irrigated with the underground well water while the others irrigated for long time with the treated sewage effluents. Soil samples were air-dried and gently crushed and sieved through a 2 mm sieve, and stored for chemical and physical analysis by the slandered method described in (Sparks et al., 1996).Also, total concentrations of Fe, Cu, Zn, Pd, and Cd, As, Cr, Ni and Hg in soil samples were determined using ICP (Perkin Elmer, Model 4300 DV). A classical statistics, with mean, variance and coefficient of variation (CV), range .etc, were computed for each soil properties with the assumption that the data are spatially independent using SPSS (2000) and Manugistic Inc. (2000). Geostatistical software (GS +9.1, 2005) was used to construct semi variograms and spatial structure analysis for the data.

RESULTS AND DISCUSSION

Results indicated that the Na and Cl ions were the main dominant ions found either in the well water or in the sewage effluent water. On the other hand, the soil of the 1^{st} farm was loamy sand to sandy Loam in texture. The EC values in the surface layers of the 1^{st}, 2^{nd} and 3^{rd} farms were (3.48, 2.20 and 2.21 dSm^{-1}) respectively, while the respective EC values in the sub surface layers reached 4.53, 3.23 and 2.60 dSm^{-1} respectively. The concentration of zinc in the soil of the 1^{st} farm which irrigated with well water was relatively low in the surface or sub surface layer (28.87 and 15.87 mg kg^{-1}, respectively) compared with the concentration of zinc in the surface layers or subsurface (45.96 and 41.79 mg kg^{-1}), (19.51 and 25.25 mg kg^{-1}) of soil of the 2^{nd} and 3^{rd} farms, respectively. The same trends were obtained with Zn, Cu, Fe, Pb and Ni The spatial variability of the pH values of the surface and subsurface layers at a range equal to 50.60, 69.90 meters, respectively. Results of geostatistic showed the spatial variations for soil properties were very low and the calculated enrichment factor did not show any contamination in soils of the studying farms with exception of As. Results also showed that the spatial changes of pollution sites in the farms are only present in specific locations. It is therefore concluded that a study on the spatial variability of sampling sites will lead to reaching a proper understanding of the situation existing farm soils by making it easier to have good management and maintaining the sustainability of productivity.

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