

Research Paper :

Effects of continuous use of sewage water on soil properties and plants

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ABSTRACT

Sewage water of Bhubaneswar city is being used as a source of irrigation in E-block of Central Farm, Orissa University of Agriculture and Technology, Bhubaneswar for cultivation of different crops since last three decades. A study was carried during 2005 to characterise sewage water (SW) and its impact on soil properties, essential nutrients and heavy metal content in leaf of crop plants. Sewage water samples, sewage water irrigated soils and leaf of plants of rice, mustard, sunflower, maize, tomato, grain amaranthus, cabbage, cauliflower, brinjal, lady's finger and water hyacinth (sewage channel) were collected and analysed for different plant nutrients and heavy metals. The data revealed that SW samples were non saline, acidic in reaction (pH 6.5-6.89) and had optimal level of BOD (48-55 mg l⁻¹) and COD (90 -105 mg l⁻¹). The concentration of cations were in the order of Ca > Mg > Na > K. Residual sodium carbonate was nil. Based on SAR and EC rating, SW belonged to C₁S₁ category. Concentration of NH₄-N, NO₃-N, PO₄, Zn and B ranged from 48.3-52.6, 8.1-8.3, 2.4-2.5, 1.5-2.5 and 0.7-0.75 mg l⁻¹, respectively. Concentration of heavy metals was in the order of As > Pb > Hg > Ni > Co > Cd > Se. Available N, P₂O₅, K₂O and SO₄-S content of sewage water irrigated soils were higher than normal soil. The DTPA extractable Fe, Mn, Zn, Cu, Mo and B ranged between 63.3 to 122.2, 13.4 to 62.6, 3.6 to 44.7, 2.4 to 11.6, 3.8 to 4.0 and 0.52 to 1.15 mg l⁻¹ in SW soils and 60.6, 15.1, 0.8, 0.8, 0.6 and 0.52 mg l⁻¹ in normal soil, respectively. DTPA extractable heavy metals in SW soils were in order of As > Se > Pb > Cr > Ni > Hg > Cd. The leaf of crop plants grown in SW soils had toxic amounts of Fe, B and Mo. Toxic concentration of Zn and Cu were present in cabbage and cauliflower only. The concentration of Cd, Pb and Cr in rice, mustard, sunflower, maize, tomato, grain amaranthus, cabbage, cauliflower, brinjal and lady's finger were below upper level of phytotoxicity. Maximum accumulation of Co and Hg was in cabbage and cauliflower. Grain amaranthus and water hyacinth contained higher amount of Ni and Se. Contents of heavy metals in leaf of crops grown in normal soils were lower than SW irrigated soils. Based on ISI standard, it is recommended to use sewage water of Bhubaneswar for irrigation after pre-treatment.

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In India, the domestic and waste water are being used for irrigation in peri-urban areas. Depending on the sources of the SW, it contains significant quantities of N, P and K (Dahatonde *et al.*, 1995), heavy metals and micronutrients (Rattan *et al.*, 2005). Long term application of the metal rich SW for irrigation of cultivated land may cause more accumulation of heavy metals in surface soil than the sub-surface soil (Kuhad *et al.*, 1989) and plants grown there on (Datta *et al.*, 2000; Rattan *et al.*, 2005). Consumption of metal rich crops plants raised on the metal-contaminated soils cause clinical problem in animals and human beings (Tiller, 1986).

The major emphasis has been directed towards the benefits and potential problems that can result from discharge of municipal sewage water on agricultural lands. Considerable attention has been given to determine the chemical composition of sewage water and its impact on soils and crops. Voluminous literatures are available on long range effects of sewage water irrigation on land and

crops in India and abroad. But no effort has been so far initiated in Orissa University of Agriculture and Technology, Bhubaneswar or State Pollution Control Board, Orissa to characterize sewage water of different cities of Orissa and its use as a source of irrigation for crops in peri-urban areas. Therefore, in this study an attempt was made to assess and characterize the of sewage water of Bhubaneswar city and long term impact of sewage irrigation on soil properties and crops.

MATERIALS AND METHODS

The sewage water of Bhubaneswar city is usually discharged by Gangua nalla through different primary and secondary drainage channels. One of the primary channels passes through E-block of central farm of Orissa University of Agriculture and Technology, Bhubaneswar. About 20 ha of cultivated land of E – block of this farm under rice (*kharif*/ summer), mustard, sunflower, maize, tomato, grain amaranthus, cabbage, cauliflower, brinjal