ORIGINAL RESEARCH PAPER

Environmental Science

EFFECT OF MUNICIPAL SEWAGE EFFLUENT ON SOIL AND CROPS ON A HYPER-ARID ZONE SANDY SOIL BIKANER CITY OF RAJASTHAN.

KEY WORDS: Municipal sewage effluent, irrigation hyper zone, Sandy soil

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ABSTRACT

Effects of municipal Sewage effluent from Bikaner city Municipal area in Rajasthan of India on selected physical and chemical properties for hyper arid zone sandy soil and two selected crops were studied. Soil was treated daily with 25, 50, 75 and 100% effluent and Wheat and mustard were grown in the soil. soil samples tested for electrical conductivity, water soluble salts, cation exchange capacity ,PH, organic matter, potassium, sodium and phosphorus. Effluent concentration was analysed and soil samples and properties were tested. Significant changes were observed with hundred percent effluent. The soil which support crop having low concentration nutrients, dry matter production increased by help of effluent treated soils. Results indicate that sewage effluent can be considered as possible and alternate sources of irrigation water.

Introduction

The application sewage sludge and effluent and agricultural soil is increasingly receiving attention at the present time since las of few decads. In this respect waste disposal program with substantial recreational and ecological benefits are rising significantly as an important routine.

Use of seawage water irrigation is a positive way for the best dispose of municipal sewage. A large volume of sewage water in any country with persistent droughts and unreliable rainfall can be of big agronomic and economic importance. Sewage water irrigation can enhance the water supply for alternative use. Also the important contribution is done by utilisation of sewage water in environment cleaning, as the water is not discharged in water bodies directly for precaution in polluting water. For addition to these direct economic effects that conserve natural resources, water contains nutrients that serve as alternative source to chemical fertilisers because these are more expensive. It was observed that sewage water which comes from household and other municipal domestic sources also supply high volume of plant nutrients to agricultural crop production (FAQ, 1992).

The effect of sewage effllluents on the chemical properties of the soils and its effect on germination of seeds and growth and dovelopment of crop plants has been observed widely. The reports revels significant effects of various industrial and sewage effluents on the soils chemical composition of variety of siols and seed germination and growth of different crop plants.(Ajmel et al., 1984 ; Aganga et al., 2005; Ajmel and Khan, 1984). Depending on some qualities of the soil as permeability, cation exchange and anion exchange capacities, infilteration capacity, texture and water holding capacity the receiving of waste water without deterioration of such parameters increasing widely according to the match of soil .(Brady and Weil, 1999; Erickson and Schneider, 1972). Irrigation of sandy soils mainly in desert areas is increasing because where ground water is only natural water resource available so due to incrasing water demand it is necessary to recyclising of treated municipal waste water for sandy soils irrigation. This study for two cultivated crops in western Rajasthan , Bikaner Municipal area is designed to assess the effects of sewage effluent on a hyper arid soil.

MATERIALS AND METHODS

Soil Characterisation and Sewage Effluent

Municipal sewage effluent was obtained form the Bikaner municipal waste water treatment plant located at jorbir, Bikaner for the present study purpose.

On the basis of standard methods (standard methods for the Examination of water and wastewater, 1975) some physical and chemical properties of the effluent was analysed. In table 1 results and parameters are mentioed.

From the surrounding of the treatment plant the soil of uncultivated fields from the surface layer (0-15cm) was taken for the study and analysis. For the removing of large particles the soil after drying and passed through a 2-mm plastic sieve. For the pot culture experiment soil was used and characterised and prepared and represented. By using a 1:1 (w.v) soil:solution ratio and CaCo3 content the electrical conductivity and pH were measured using deionized water by the standard HCL neutralization test (Jackson, 1974).

In the soil, organic matter was examined by a Walkley – Black procedure (Sommers and Nelson, 1982). Cation exchange capacity (CEC) by the following methods of Rhoades (1982) and by pipette method soil texture was determined by (Alexander and Kilmer, 1949). By the help of flame photometer concentration of potassium and sodium were examined with extraction of I mole ammonium acetate aquous solution (ph7). Physiochemical properties of the soil are given in table 2.

POT CULTURE EXPERIMENT

To excess the impact of sewage effluent on the chemical changes of soil pot culture experiments were conducted with diluted and undiluted effluent. These experiments were conducted and after cultivation for this purpose an amount of 2kg dry soil was put into each of distithe 30 pots with 18 cm diameter and 16 cm height. 100 ml of 25, 50,75 and 100% treated sewage water was used for the irrigation purpose. Distilled water was used for the same pupose for the controlled experiments. Seeds of both of the selected plants were sown in the each of the pot, and one pot was left without the sowing for the find out the effect of the sewage irrigation on the soil.the experiment was performed in random manner in three replications.

Plants were harvested after 50 days and shoots were washed and dried at 70 degree centigrade for 24 hrs and dry matter was determined. The Dried plant sample were grounded and digested in mixture of perchloric acid and nitric acid.The various parameters were analysed for the dried soil obtained from the pots under concern.

Duncan's multiple range test (LSD) and analysis of variance (ANOVA) were taken out on soil properties in the treated soils to test significant vriation for the pots. Dry matter production datas was analysed by t-test. By using the SPSS version 6.0 all the statistical tests were carried out.

Results and discussion

Effects of effluent treatment on pot soils

In table 1 and 2 some characteristics of the effluent and soil studyare presented respectively.

Table 1 : some characteristics of the sewage effluent used in the experiment

PH	5.90
TDS(mg l^{-1})	2880
Mg^{2+} (mg l^{-1})	16.80
Ca^{2+} (mg l^{-1})	58.1
cl^{-1} (mg l^{-1})	235.9
$So4^{2-}$ (mg l^{-1})	2.69
EC (MMHOS CM^{-1})	1.99
Organic p (mg l^{-1})	2.26
Total p (mg l^{-1})	2.50
Hydralysble p (mg l-^{1})	1.42

Table 2 : some physical and chemical properties of the experimental soil

Soil Texture	**sandy**
Ph (1:1 H2O)	8.9
Organic Matter (%)	0.17
CEC meq 100g-1	1.98
EC mhos cm-1	0.95
CaCO3 (%)	0.33
Clay (%)	4.1
Silt (%)	3.41
Sand (%)	92.22

It was found that the effluent had very low biological demand (BOD) and was brown coloured.

In table 3 the effects of different dilutions such as 25,50,75 and 100% of the effluent on certain chemical properties of the pot soils after 50 days are shown.

The significant effects on all the parameters tested and results indicated and was found that increase in potassium and sodium ($p<0.001$), water soluble salts ($p<0.001$), ph($p<0.001$), and electrical conductivity ($p<0.001$), cation exchange capacity ($p<0.001$), ammonium acetate (ph=7).

when the soil was irrigated with 100 % of the effluent followed by 75,50,25% these causes various changes were recorded in soil composition. The soil of pot helps wheat and mustard plants which are irrigated with many effluent concentrations and results are presented in table 4.

With increasing effluent concentration the concentration of tested parameters increased significantly ($p<0.001$) but the amount of nutrients were lower in the soils and these support more as compared to the pot plants without plant irrigated with effluent concentration which is same.

Table 3: effects of different dilutions of treated sewage effluent on certain properties of pot soils

TREATMENT EFFLUENT (%)	**PH** (1:1 H_2O)	**CEC** meq100 g^{-1}	**SOLUBLE SALTS** mgl^{-1}	**EC** mhos cm^{-1}	**ORGANIC MATTER(%)**	**Na** µg g^{-1}	**K** µg g^{-1}	**TOTAL** µg g^{-1}
0	7.69	2.38	585.7	0.82	0.188	164.2	191.2	92.38
25	8.00	2.69	722.5	1.11	0.193	223.3	214.1	93.39
50	8.03	3.22	788.6	1.22	0.212	241.2	204.3	94.52
75	8.05	3.78	985.5	1.48	0.221	235.4	215.1	95.65
100	8.06	3.58	2288.5	1.72	0.347	291.1	225.2	110.86

Table 4: effects of different dilutions of sewage effluent on certain properties of pot soils supporting different crops

TREATMENT EFFLUENT (%)	**PH (1:1 H_2O) Wheat/Mustard**	**CEC meq100 g^{-1} Wheat/Mustard**	**SOLUBLE SALTS mgl^{-1} Wheat/Mustard**	**EC mhos cm^{-1} Wheat/Mustard**	**ORGANIC MATTER(%) Wheat/Mustard**	**Na µg g^{-1} Wheat/Mustard**	**K µg g^{-1} Wheat/Mustard**	**TOTAL µg g^{-1} Wheat/Mustard**
0	7.56/7.82	2.23/1.81	534.5/512.3	0.76/0.90	0.179/0.199	160.1/164.30	156.1/164.30	90.24/100.0
25	8.00/8.09	2.59/1.88	700.7/673.2	1.10/1.20	0.189/0.177	202.0/212.3	217.0/202.3	89.32/90.20
50	8.03/8.00	3.12/2.90	740.1/727.7	1.19/1.80	0.203/0.199	220.0/198.2	199.2/156.5	93.48/90.05
75	7.05/7.00	3.20/2.98	950.8/870.4	1.39/1.26	0.210/0.203	223.2/200.0	200.2/199.	93.60/92.40
100	7.06/6.98	3.42/2.22	1065.5/1056.4	1.40/1.60	0.328/0.320	282.2/232.4	226.0/22.4	100.78/99.78

The plants by the help of soil uptake water soluble salts and nutrients which are available from the effluent and these results are indicated.

And the same results are given by some other authors.(Ajmel and Khan, 1984; Emongor et al., 2005; igbounamba, 1972).

In table 5 the average production of dry matter is represented.

In this study of dry matter production shoot weight was considerd as a measure.

According to the result it was found that the plants which are grown in effluent irrigated soil produced some higher dry matter yield ($p<0.001$) than the plants which are grown in contol soil.

The largest dry matter per pot for both the crops is produced the effluent which is highest in concentration. Mustard have significantly ($p<0.001$) higher shoot weight than wheat. This is shown in table 5. And the increase in dry matter is attributed to the nutrients contained in the effluent.

Table 5: Comparison of dry matter production by beans and barley shoots

TREATMENT (% EFFLENT)	SHOOT WEIGHT(g) WHEAT	SHOOT WEIGHT(g) MUSTARD
0	0.82	0.31
25	1.09	0.52
50	1.20	0.63
75	1.76	0.82
100	2.40	0.88

The relationship between effluent concentration and dry matter datas are illustrated in fig.1.

The linear increase in weight of the shoot is found as the effluent concentration is increased.

For wheat, the equation was y= 0.00158x + 0.6984 with r2 of 0.08396; and for barley the equation was y= 0.0059+ 0.3629 with r2 of 0.09232.

According the results of this study the sewage water is one of the possible and alternate source of the irrigation water. And in case of crop plants it was found that no sumptoms of toxicity was found during this research in plants after uptaking of heavy metals which is present in irrigated water.

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