Effect of Sewage on Physical and Chemical Properties of Soil in Unnao District (U.P.)

Abstract

This study was carried out during 2021-22 considering various vegetable growing farmers in Unnao District (U.P.) to find out the effect of using sewage as the only source of irrigation to their crops.250surface soil samples collected from farmer's field were analyzed for Physical as well as Chemical parameters. The physical properties of soils improved due to sewage application; Bulkdensity ranged from 1.04 to 1.42 Mg m^{-3}andparticle density ranged between 2.61 to 2.88 Mg $m^{-3}$and Porosity ranged between 53.4 to 61.85 with mean of 56.87 percent.Chemical Parameters such as pH, E.C., O.C., Available N,P &K were also analyzed and the results indicated that soils had a mean normal pHof 7.2, E.C. of 0.76 dSm^{-1}, O.C. of 56.80.Available nitrogen ranged from 565 – 1217 kg ha^{-1} with mean of 879.56kg ha^{-1}.The Phosphorus availability was found rangingfrom 14.40 – 33.5 kg $ha^{-1}$with a mean of 23.98 kg ha^{-1}, while Potassium was found with a mean of 205.30 kg ha^{-1} in rangeof174 – 235 kg ha^{-1}.

Key words: Bulk density, Particle density, pH, Nitrogen, Phosphorous and Potassium

INTRODUCTION

Water and nutrients are the major inputs for crop production. It is predicted that most of the Asian countries will face severe problem related to water availability by 2025 (Singh, 1999). With the rapid growth in industrialization in different countries, the pollution problem is also on the increase, which have resulted in utilization of significant quantities of fresh water available for agriculture. Application of Sewage water to agricultural soil is a useful source of plant nutrients, particularly nitrogen and phosphorous and also organic matter that can potentially improve soil fertility and physical properties. However, in addition to these beneficial effects, effluents often contain appreciable amounts of both organic and inorganic toxic materials. Many organic pollutants, being biodegradable, are less persistent, and presumably have transient and less serious effects as they are eventually metabolized to carbon dioxide and other inorganic substances.

In many areas of developing countries, untreated wastewater flows through channels into rivers where it is diverted by subsistence farmers to small plots of vegetables including tomato, cabbage, beetroot and others which are easily consumed as salad.The public health risks of using such contaminated streams for irrigation are obvious(Mead and Griffin, 1998; WHO 2004).However, treated effluents can be used for irrigation under controlled conditions to minimize the transfer of pathogenic and toxic contaminants into agricultural products, soil surfaces and groundwater (Batarseh *et al*. 1989).

Since, industrial effluent is a pool of various elements, it may be beneficial in enhancing the fertility status of soil as it contains appreciable amount of essential plant nutrients that are taken up by crops during plant growth and development. Amount of available nitrogen, phosphorus and other nutrients also increase in the soil but excess of them can leach and pollute groundwater under continuous effluent use for long periods (Chaney, 1990).

Materials and methods

One of the main industrial cities near Kanpur is Unnao, which is home to the majority of the cotton, leather, pharmaceutical, steel, and other industries. More than 50 industrial facilities, mostly tanneries, may be found in the Unnao industrial area, which is close to Kanpur on the northern bank of the Ganga River. The effluents released by the industries are ultimately dumped into the Ganga River after passing through a common effluent treatment plant with approximately 70% treating capacity. Unnao is a second township across the Ganga, located between the rivers Ganga and Sai, roughly 20 km from Jammu. The District is located between Latitudes 26°8' and 27°2' North and 80°3' and 81°3' east. It is divided from Kanpur and Fatehpur by the Ganga on the west, Lucknow on the east, Rae Bareli on the south, and Hardoi on the north. It covers 4589 sq. km of land.

In the present investigation total 250 soil samples (0-20cm) were collected from farmer's field with the help of tube auger randomly from field during *rabi* season nearby sewage outlet who engage in irrigating their crops with industrial effluents.

Result and discussion:

The bulk density of soils irrigated with sewage was decreased due to addition of organic matter through sewage irrigation. Particle density was not changed in sewage irrigated soil (Mathan, 1994). This can be attributed to improvement in total porosity and aggregate stability in the sewage irrigated soils due to addition of organic matter which plays an important role in improving soil physical environment. Rattan *et al.* (2001) observed enhanced available water content in the soils due to continuous application of sewage. Rai *et al.* (2011).

The pH of soils irrigated with sewage effluents was not much influenced with irrigated soils. The electrical conductivity in sewage irrigated soils was high due to salt content of sewage of domestic origin (Khurana *et al.* 2004). However, it was below the threshold limit to cause salinity hazard to the soil. The mean organic carbon (OC) content in sewage irrigated soils was higher and was 1.05%. The organic carbon content of sewage irrigated soils was high which is ascribed to the addition of organic matter through long-term application of sewage. Improvement in soil quality is also evident from the improved physical properties of sewage-fed soils. This also corroborate the farmers view in this peri-urban area who express that the sewage application is useful for improving soil quality, good crop growth and higher crop yields in absence of addition of any organic manures in these soils. The carbon sequestration resulting due to increase in soil organic carbon (SOC) on long-term sewage use is thus beneficial not only in mitigating the greenhouse effect but also in improving the soil quality (Rattan *et al.* 2001).

The amount of available N content in sewage irrigated soils 879.6 Kg ha^{-1} respectively and it was higher than amount of available N in normal water irrigated soil due to abundant presence of raw organic matter content in the effluent/sewage irrigated soil. The available P_2O_5 in industrial sewage irrigated soils were 23.9 Kg ha^{-1} respectively, and it was in high category as per fertility ratting. The tannery effluent contains decomposed bone materials which is the constituent of raw bone meal phosphoric fertilizer. Potassium content in industrial sewage irrigated soils was 205.3, kg ha^{-1} respectively. Similar findings are supported by Mitra and Gupta (1999) and Kharche *et al.* (2011).

Table-1: Effect of sewage on physical properties of soil

Bulk Density (Mg/m^3)					**Particle Density (Mg/m^3)**					**Porosity (%)**				
E_1	**E_2**	**E_3**	**E_4**	**E_5**	**E_1**	**E_2**	**E_3**	**E_4**	**E_5**	**E_1**	**E_2**	**E_3**	**E_4**	**E_5**
1.24	1.13	1.17	1.09	1.17	2.62	2.65	2.64	2.63	2.61	54.28	55.23	56.78	56.28	53.45

1.37	1.28	1.25	1.17	1.25	2.78	2.82	2.72	2.77	2.83	56.75	56.78	58.32	61.85	58.63
1.29	1.15	1.38	1.13	1.13	2.65	2.68	2.86	2.82	2.77	55.39	54.35	55.89	58.63	54.89
1.33	1.32	1.22	1.08	1.28	2.71	2.77	2.77	2.69	2.85	54.71	55.78	56.43	59.58	55.36
1.26	1.17	1.35	1.15	1.16	2.83	2.63	2.69	2.85	2.81	55.84	58.42	58.97	57.25	53.92
1.38	1.24	1.19	1.04	1.21	2.77	2.85	2.74	2.71	2.68	57.28	56.29	56.45	60.69	57.18
1.42	1.37	1.24	1.11	1.18	2.85	2.79	2.81	2.88	2.72	56.19	58.85	57.83	56.93	53.88
1.31	1.29	1.32	1.08	1.24	2.81	2.81	2.78	2.64	2.85	54.23	54.78	56.79	61.44	56.25
1.38	1.25	1.18	1.23	1.19	2.78	2.74	2.75	2.82	2.69	57.85	57.63	55.43	58.29	58.54
1.35	1.18	1.26	1.16	1.23	2.69	2.86	2.68	2.85	2.65	58.03	56.45	57.28	57.65	57.92

Table-2: Effect of sewage on chemical properties of soil

pH					Electrical Conductivity (dS/m)					Organic Carbon (%)				
E_1	E_2	E_3	E_4	E_5	E_1	E_2	E_3	E_4	E_5	E_1	E_2	E_3	E_4	E_5
7.24	7.42	7.06	7.04	6.76	0.92	0.73	0.52	0.48	0.63	54.39	53.28	55.39	54.78	53.85
7.38	7.55	7.13	7.13	6.92	1.15	0.88	0.68	0.55	0.77	56.82	55.42	58.74	58.35	58.62
7.33	7.63	7.08	7.09	6.85	0.98	0.76	0.56	0.43	0.64	55.27	53.85	56.45	61.54	55.48
7.29	7.49	7.11	7.22	6.98	1.06	0.91	0.63	0.68	0.71	58.43	54.69	59.62	59.37	57.95
7.42	7.52	7.15	7.17	6.83	1.13	0.85	0.59	0.52	0.69	54.78	55.74	57.28	55.82	54.23
7.38	7.68	7.09	7.08	6.95	0.98	0.79	0.64	0.49	0.75	56.19	56.22	55.83	60.45	56.89
7.27	7.47	7.18	7.21	6.88	1.09	0.84	0.77	0.61	0.78	58.95	54.85	57.58	56.28	58.26
7.35	7.54	7.05	7.16	6.94	1.12	0.93	0.73	0.57	0.65	57.63	56.69	56.94	59.84	57.35
7.43	7.61	7.13	7.25	6.79	0.97	0.89	0.58	0.54	0.73	54.78	53.95	58.26	61.53	54.87
7.37	7.58	7.17	7.19	6.87	1.14	0.95	0.65	0.66	0.71	56.25	54.33	59.44	60.79	55.63

Table-3: Effect of sewage on chemical properties of soil

Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available potassium (kg/ha)

E_1	E_2	E_3	E_4	E_5	E_1	E_2	E_3	E_4	E_5	E_1	E_2	E_3	E_4	E_5
653	565	613	876	945	22.8	24.6	17.4	14.4	18.8	222	213	174	183	198
678	574	687	915	1027	28.3	29.4	22.7	20.9	21.5	228	217	188	198	205
694	637	807	943	1056	27.5	31.9	21.5	17.3	24.9	225	225	183	185	199
686	702	698	967	978	24.9	32.5	19.3	18.8	19.3	224	219	179	193	203
702	757	836	989	1013	26.4	28.3	24.8	21.5	22.7	229	221	185	189	201
679	782	723	992	1105	28.8	32.8	19.5	19.2	28.1	234	215	178	197	194
713	795	756	1023	1178	25.5	27.2	20.7	21.6	26.8	231	228	181	191	208
708	803	654	978	1094	29.2	33.5	23.2	18.4	25.4	227	232	186	188	211
725	727	845	1015	1203	27.8	25.8	18.8	16.7	27.7	233	235	175	192	197
668	764	789	984	1217	23.54	30.7	21.5	20.5	23.5	227	229	188	198	204

Conclusion:

Continuous use of sewage irrigation recorded improvement in soil physical properties like bulk density, water retention, organic carbon and build-up of soil available N, P, K, and micronutrient status. The industrial sewage irrigated soils had higher electrical conductivity and organic carbon as compared to the ground water alternate irrigated soils. The electrical conductivity although increased due to effluent/sewage, it was within the tolerance limit to cause any soil salinity hazard. This warrants the potential hazard to soil and plant health suggesting necessity of their safe use after pre-treatment in order to make use of sewage as a cheap potential alternative source of plant nutrients in agriculture.

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