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Impact of Urban Sewage Water on Soil Properties in Guravarajupalle Village of Renigunta Mandal of Chittoor District in Andhra Pradesh, India

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ABSTRACT

A survey was undertaken during the year 2017 to study the soil properties of sewage water irrigated soils in Guravarajupalle village of Renigunta mandal of Chittor district in Andhra Pradesh. One hundred soil samples were collected at depth of 0-20 cm from Guravarajupalle village of Renigunta mandal by following random sampling method. The pH (6.05 to 9.26), EC (0.28 to 3.57 dSm^{-1}) and OC (0.21 to 0.92 per cent)values indicated that the soils were found to be slightly acidic to strongly alkaline in reaction, non-saline to slightly saline in nature and low to high in organic carbon. The macronutrients were found to be in the range of low to medium in available nitrogen (100.16 to 363.50 kg ha^{-1}), low to high in available P_2O_5 (3.06 to 308.28 kg ha^{-1}) and K_2O (42 to 515 kg ha^{-1}). The available calcium [3.20 to 11.80 cmol (p+) kg^{-1}] and magnesium [1.51 to 3.27 cmol (p+) kg^{-1}] were found to be sufficient.

Introduction

Water is becoming the most important limiting natural resource now-a-days and more than 70% of water is being utilized for irrigation. Shortage of surface and underground water could be partially overcome by reuse or recycling of sewage water and its multiple uses are becoming more and more important to meet the increased demand of agricultural production. Poor water quality degrades soil quality, results in the accumulation of heavy metals and alteration of soil physical, physico-chemical and chemical properties and influences the soil health to a great extent. However use of waste water as a supplemental source of irrigation is inevitable for increased agricultural production in many arid and semi-arid regions where irrigation supplies are insufficient to meet crop water needs. A huge quantity of waste water is being generated from cities and other industrial areas which is flowing, to a river or joined with streams, towards the village where most of the people are earning their lively hood through agriculture. Most of the farmers, who have fields near the banks of these sewage canals are using this as a source of irrigation and pumping / flooding water directly to their field. It is being increasingly used for irrigation. Sewage water irrigation was noticed in Guravarajupalle village of Renigunta mandal of Chittoor district. To find out the impact of sewage water on soil physic-chemical and chemical properties, the present investigation was taken up.

Materials and Methods

The study area Guravarajupalle village lies in between 13°38'6" to 13°38'45" of North latitudes and to 79°35'45" to 79°31'51" of East longitudes and the investigation was carried in the year 2017. One hundred samples were collected randomly from sewage irrigated soils of Guravarajupalle village of Renigunta mandal of Chittoor district. The soil samples after collection were air-dried, ground, screened through 2 mm sieve and stored in polythene covers for further analysis.

All the samples were analysed for pH, EC, organic carbon as per the standard procedures (Jackson, 1973). Available N was determined by alkaline permanganate method. The available P was extracted with the 0.5 M $NaHCO_3$ extractant and determined by using ascorbic acid as reducing agent and the available K and Na in the soils were extracted by employing neutral normal ammonium acetate and determined by aspirating the extract into the flame photometer whereas calcium and magnesium were extracted with neutral normal ammonium acetate and the content was determined by versenate titration method (Jackson, 1973).

Results and Discussion

Soil pH, EC and organic carbon

Soil reaction in the sewage water irrigated soils varied from slightly acidic to strongly alkaline ranging from 6.05 to 9.26 (Table 1). The variation in soil pH might be attributed by different factors like leaching action of water, soil nature and mechanical composition. The reason for low pH in some sewage water irrigated soils may be due to the decomposition of organic matter and production of organic acids (Alghobar and Suresha, 2016). The higher pH values could be ascribed to the large quantity of salts present in sewage effluents (Bhat *et al,* 2011).

The EC of the sewage water irrigated soils in Guravarajupalle village of Renigunta mandal in Chittoor district was ranged from 0.28 to 3.57 dSm^{-1} with the mean value of 2.28 dSm^{-1} (Table 1). The low EC in some soils may be due to flooding of fields. The fields when flooded continuously, there is downward movement of water to the lower horizons and soluble salts also move downward with this water, resulting in decrease of EC (Mehdi *et al*., 2003). High EC in some sewage water irrigated soils could be ascribed to the large amount of ionic substances and soluble salts, due to salt content of sewage water of domestic origin (Mojiri and Aziz, 2011).

The organic carbon content in the soils ranged from 0.21 to 0.92 per cent with a mean value of 0.54 per cent (Table 1). The low organic carbon of some soils could be ascribed to rapid decomposition of organic matter in semi-arid climatic conditions existing in the study area. The high organic carbon in most of the sewage irrigated soils is due to a very high organic load of sewage water (Singh *et al*., 2012) and also due to organic compounds of living beings in sewage effluent which are rapidly decomposed in the soil. Similar results were reported by and Salakinkop and Hunshal (2014).

Available N, P_2O_5 and K_2O

The available nitrogen in sewage water irrigated soils ranged from 100.16 to 363.50 kg ha^{-1} with the mean value of 205.25 kg ha^{-1} (Table 1). The reason for low nitrogen in most of the soils might be due to alkaline conditions which were responsible for loss of nitrogen through mechanism like ammonia volatilization. These findings were supported by Datta and Buresh (1989). In some soils medium amount of available nitrogen ascribed to use of sewage water, which contains high amount of N (Rai *et* al., 2011).

The sewage water irrigated soils were low to high (Table 1) in available P_2O_5 (3.06 to 308.28kg ha^{-1}) with the mean values of 148.18 kg ha^{-1}. The high amount of available P_2O_5 in majority of sewage irrigated soils might be due to continuous use of sewage water which contains phosphorous. This was corroborated with the findings of (Salakinkop and Hunshal 2014) Available potassium (K_2O) of the soils under investigation was ranged from 42 to 515 kg ha^{-1} with a mean value of 215 kg ha^{-1} (Table 1). The high amount of potassium in the soils might me due to continuous application of sewage water (Kharche *et al.*, 2011).

Table.1 Physico chemical properties of sewage irrigated soils of Guravarajupalle village of Renigunta mandal in Chittoor district

S. No	pH	EC(dS m^{-1})	OC (%)	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	Ca [cmol (p^+) kg^{-1}]	Mg [cmol (p^+) kg^{-1}]
1	8.63	0.72	0.79	200.48	307.73	579.53	7.00	3.60
2	8.23	1.67	0.80	225.56	256.42	325.92	9.60	4.40
3	8.70	2.18	0.78	288.26	221.38	311.94	7.90	3.80
4	8.37	1.29	0.77	175.40	275.75	298.23	8.20	3.90
5	7.91	1.89	0.85	213.02	236.45	263.83	7.10	3.00
6	8.47	2.09	0.76	238.10	308.28	312.48	8.80	4.20
7	9.01	2.10	0.82	162.86	213.52	316.24	8.00	4.00
8	8.68	1.79	0.89	187.94	149.01	458.71	3.60	2.50
9	8.93	2.01	0.98	162.86	138.75	309.66	4.50	3.20
10	9.12	2.24	0.78	187.94	262.32	337.88	5.30	3.40
11	8.65	1.41	0.76	137.78	199.77	444.86	4.60	2.60
12	8.31	2.36	0.57	162.86	130.34	395.00	5.00	2.80
13	6.99	3.29	0.71	150.32	181.10	513.00	8.10	4.20
14	9.03	2.25	0.69	200.48	169.20	367.18	7.60	3.50
15	6.62	3.31	0.56	175.40	301.73	417.58	9.10	4.30
16	6.41	3.25	0.53	137.78	124.23	355.22	4.40	2.00
17	6.37	3.45	0.56	213.02	197.80	432.23	5.60	2.90
18	7.04	3.48	0.52	162.86	195.73	279.01	4.10	1.80
19	8.51	2.50	0.47	162.86	158.40	349.84	3.50	1.60
20	8.86	2.05	0.75	187.94	296.05	406.29	7.10	3.30
21	9.07	1.81	0.80	175.40	149.99	343.53	5.90	3.70
22	9.09	2.60	0.52	238.10	95.52	361.94	7.50	3.60
23	9.11	2.83	0.84	200.48	197.69	371.88	6.20	2.70
24	9.00	2.19	0.84	175.40	164.95	413.82	5.40	2.80
25	8.77	2.42	0.76	150.32	89.73	426.45	4.90	3.10

26	9.17	2.07	0.55	275.72	59.49	554.40	5.10	2.40
27	9.03	2.33	0.76	300.80	199.55	333.58	9.40	4.10
28	8.66	2.39	0.79	313.34	90.71	539.21	10.20	4.50
29	8.92	2.48	0.80	288.26	209.59	498.89	9.00	3.70
30	8.30	1.08	0.81	275.72	209.59	488.14	10.50	4.60
31	6.05	0.46	0.81	288.26	93.88	451.18	9.20	6.30
32	8.22	1.99	0.76	338.42	175.75	299.44	5.40	2.10
33	8.12	1.18	1.05	263.18	150.21	462.60	8.90	5.00
34	6.98	0.94	0.76	250.64	167.78	347.02	4.80	2.20
35	8.24	2.57	0.77	238.10	217.78	318.80	5.10	1.60
36	8.15	0.58	0.83	275.72	113.53	440.97	8.60	4.80
37	6.65	1.09	0.78	225.56	145.84	421.08	9.00	4.70
38	6.80	0.85	0.77	112.70	160.58	385.32	4.60	2.50
39	8.91	1.59	0.58	275.72	46.61	336.13	6.40	3.30
40	8.79	3.00	0.52	200.48	124.12	466.77	3.20	1.80
41	6.52	1.24	0.59	325.88	112.77	478.73	4.00	1.10
42	8.40	2.46	0.49	150.32	206.86	383.17	11.00	5.60
43	8.85	2.79	0.82	288.26	170.62	295.28	6.10	2.70
44	8.48	1.71	0.73	112.70	291.47	351.72	11.50	7.00
45	8.73	0.64	0.57	288.26	181.43	325.38	9.90	6.10
46	8.55	0.28	0.76	263.18	133.72	351.72	7.90	4.10
47	8.51	2.53	0.79	213.02	45.41	405.35	11.80	6.50
48	8.77	1.05	0.79	275.72	164.29	379.68	10.20	5.90
49	8.54	2.40	0.83	363.50	124.88	307.91	5.20	1.90
50	8.49	0.34	1.12	263.18	18.67	415.56	6.30	2.80
51	8.47	1.85	0.77	150.32	194.42	400.11	10.50	5.10
52	8.60	1.91	0.46	125.24	183.28	297.16	9.70	4.00
53	8.16	0.37	0.45	200.48	21.40	326.32	7.40	3.90
54	8.41	2.94	0.54	288.26	110.15	277.13	11.20	5.20
55	8.90	2.16	0.85	175.40	123.79	339.63	9.10	4.80
56	8.50	2.21	0.53	187.94	166.04	338.28	10.10	5.30
57	8.31	1.38	0.49	162.86	131.32	407.64	7.00	4.30
58	8.09	1.76	0.48	137.78	248.24	258.45	6.50	4.20
59	8.10	2.28	0.51	150.32	76.52	289.77	7.20	3.00
60	8.17	1.95	0.58	325.88	68.23	418.92	8.10	4.50
61	8.19	1.12	0.57	213.02	3.06	295.81	5.90	2.20
62	8.03	2.17	0.56	200.48	109.16	267.05	8.00	4.40
63	8.06	1.34	0.46	225.56	186.56	252.27	6.70	3.10
64	9.25	3.15	0.46	275.72	45.85	155.23	6.00	4.30
65	9.23	3.21	0.83	275.72	156.43	241.52	6.50	4.90
66	8.56	2.65	0.69	137.78	162.54	424.44	8.30	5.00
67	8.72	2.37	0.45	263.18	52.40	286.94	10.80	5.80
68	9.02	3.06	1.08	125.24	148.90	446.61	9.90	5.40
69	8.95	3.41	1.00	200.48	154.79	298.10	10.40	5.70
70	7.97	2.34	0.46	162.86	67.68	245.41	9.50	5.30

71	7.92	2.32	0.56	213.02	39.74	442.04	6.30	2.80
72	8.93	2.75	0.51	137.78	28.38	274.44	6.40	3.20
73	8.99	2.54	0.57	225.56	33.62	258.59	6.20	3.30
74	8.76	3.35	0.88	275.72	47.49	203.35	7.70	4.80
75	9.10	3.39	0.86	300.80	50.00	417.45	6.60	3.50
76	9.26	3.52	0.94	250.64	161.45	225.52	7.30	3.80
77	9.08	3.57	0.91	150.32	239.18	220.95	9.20	4.30
78	8.78	2.67	0.59	238.10	247.04	306.70	5.80	2.80
79	8.80	2.58	0.53	112.70	148.13	358.44	9.30	4.70
80	9.11	2.85	0.78	162.86	264.28	374.84	7.10	4.00
81	8.90	2.82	0.78	175.40	254.68	232.78	5.80	2.20
82	8.65	2.47	0.53	338.42	239.18	378.34	6.90	3.50
83	9.08	2.92	0.79	200.48	105.89	254.96	7.20	4.10
84	8.94	2.49	0.93	300.80	44.10	258.05	6.90	3.40
85	9.04	2.99	0.87	288.26	261.23	306.57	6.80	3.70
86	8.99	2.98	1.10	275.72	101.63	137.22	10.40	6.00
87	8.83	2.91	0.41	112.70	52.29	245.41	7.80	4.20
88	9.02	2.89	0.42	125.24	45.96	205.90	8.50	5.40
89	9.13	3.07	0.45	137.78	183.18	193.00	8.00	5.00
90	9.09	2.69	0.54	162.86	177.94	233.18	9.20	4.30
91	9.10	2.56	0.50	100.16	97.05	205.77	5.80	2.80
92	8.91	3.05	0.61	125.24	85.69	215.17	5.90	2.90
93	8.8	2.29	0.43	162.86	58.73	204.96	10.00	5.30
94	8.76	3.18	0.39	137.78	37.22	195.55	5.80	2.40
95	9.05	3.06	0.34	150.32	28.49	188.43	6.60	3.80
96	8.92	3.12	0.40	175.40	128.81	182.11	7.40	3.60
97	7.49	3.02	0.34	112.70	89.84	138.30	8.20	4.10
98	8.52	3.19	0.35	162.86	234.92	166.12	5.70	2.80
99	9.01	2.84	0.38	137.78	142.89	149.45	5.40	3.40
100	8.42	2.95	0.52	125.24	141.69	187.35	4.90	2.90
Range	6.05-9.26	0.28-3.57	0.34-1.12	100.16-363.50	3.06-308.28	137.22-579.53	3.20-11.8	1.10-7.00
Mean	8.48	2.28	0.67	205.25	148.18	330.58	7.36	3.82

Available Ca and Mg

The available calcium in sewage irrigated soils of Guravarajupalle village was ranged from 3.20 to 11.80 cmol (p+) kg^{-1} soil (Table 1) with a mean value of 7.62 cmol (p+) kg^{-1} soil. The high amount of calcium might be due to high calcium content of sewage water. Alghobar *et al* (2014) reported that soil is a biofilter that can reduce a large part of domestic waste water pollutants, but this filtering increased calcium content of soil.The available magnesium in sewage irrigated soils of Guravarajupalle village of Renigunta mandal in Chittoor district varied from 1.51 to 3.27 cmol (p+) kg^{-1} soil with a mean value of 3.82 cmol (p+) kg^{-1} soil (Table 1). The high available magnesium in sewage irrigated soils of the study area might be ascribed to high amount of magnesium in the sewage water.

In conclusion, the sewage water irrigated soils of Guravarajupalle village of Renigunta mandal of Chittoor district varied from slightly acidic to strongly alkaline in reaction and non-saline to saline in nature, low to high in organic carbon. The macronutrients of analysed samples showed low to medium in available nitrogen, low to high in available P_2O_5 and K_2O. The available calcium and magnesium were found to be sufficient. Increased percentage of nutrients in soil can be noticed through sewage water irrigation in the study area.

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