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SOIL AND PLANT HEALTH IRRIGATED WITH PAHARANG DRAIN SEWAGE EFFLUENTS AT FAISALABAD

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Quality of the Paharang drain effluents at Faisalabad and its surrounding industrial units with respect to EC, SAR, RSC, macro- and micro-nutrients and impact on soils as well as plants was assessed. It was found that all the contributing industrial effluents have higher concentration of solutes than that of the main drain at Marzipura and Uchkera villages though all were unfit for irrigation. The effluents from the Walayat flour mills were of much better quality than the others. The fields under cauliflower and Chinese squash contained higher concentrations of Na, Ca, Mg, Cl, S04' Fe, Mn, Cu, Zn, Ni ions and total soluble salts than those in the canal irrigated fields in the same locality. Solute concentration was high at 0 to IS cm soil depth in fields receiving sewage water but decreased with soil depth. The concentrations of P, Fe, Mn, and Zn ions were much higher in soil compared to common observation and belief that makes further studies imperative. The fields receiving sewage water for 8 to 10 years were still not salinized/sodicated. The concentrations of N, P, K, Ca , Mg and Cl in leaves and fruits of both the vegetables were almost within safe limits but leaves contained higher levels of these ions compared to those in their respective fruits.

Kry words: plant health, Paharang drain. sewage effluents

INTRODUCTION

Supplies of good quality Irrigation water are expected to decrease in future because the development of new water resources will not keep pace with increasing water needs of agriculture. industries and municipalities. Some of these future water needs can be met by using available water supplies more efficiently, but in many cases it will be necessary to make increased use of municipal waste waters and agricultural drainage water. TI1is strategy will help solve disposal problems of effluents as well. However, aside from high NPK or heavy metal contents. EC and SAR of sewage effluents will be higher than those of the canal water (Miyarnoto , 1993; Ghafoor *et al.,* 1(95).

Fanners near big cities of Pakistan are applying sewage water fix growing vegetables and other crops for the last many years. In previous studies (Ibrahim and Salmon, 1992a,b) only temporal and spatial variability in quality of main drains effluents was monitored. In a few studies, soil and plant health was evaluated (Bhatti cl al., 1978; Ghafoor et al., 19(5). In the present studies. it was planned to assess the quality of effluents from the individual industrial units situated along the Paharang drain from Nisharabad to Uchkera, Faisalabad with respect to EC, SAR. RSC and heavy metals. In addition, chemistry of soils and plants receiving Paharang drain sewage for irrigation was studied.

MATERIALS AND METHODS

The studies wen: conducted in four fields under each of the cauliflower and Chinese squash receiving sewage water for irrigation located at Marzipura and Uchkera villages near the Faisalabad city. One canal water irrigated field for each crop was also selected for comparison.

Composite soil samples from 0 to 15, IS to 30, 30 to 60, 60 to 90 and 90 to 120 cm soil depths were drawn during the months of November and December, 1993. The sewage water samples from different establishments and at the experiment sites were also collected for chemical analysis. Fully expanded and developed leaves and fruits of both the vegetables were analysed after washing thoroughly with distilled water. The methods of analysis used were those of Page et al. (1982) for saturated soil paste extract, Jackson (1962) for N, Lindsay and Norvell (1978) for Fe, Mn, Zn, Cu, Pb and Ni from soil and sewage water. The plant analysis was accomplished using di-acid (I-INO, + I-ICI0_4) wet digestion. The Cl in plants were determined by the method of Pitman (1965).

RESULTS AND DISCUSSION

Quality of Scwagc Watcr: Waste effluents from different industries and main drain as shown by data given in Table I were untit for irrigation with respect to EC. SAR, RSC and Cl. However, values of these parameters were relatively low for the Walayat flour mills. All the other chemical species such as P, K, Fe, Mn, Cu, Pb and Ni were found well below the critical levels (lames, 1971; Ayers and Westcot, 1989). It is worth mentioning that if such waters are treated for controlling the adverse effects of EC, and SAR", on soil and plant health as well as their consumers, consequent concentration of nutrients in sewage water would have cost-effectiveness in the crop husbandry instead of creating problems of toxicity. Management of sewage water for irrigation may include blending, cyclic or rotational use of sewage effluents with canal water (Rhoades , 19(0).

Experimental Soils: The experimental soils were sandy clay

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Experimental Soils: The experimental soils were sandy clay

Table [illegible]. [illegible]position of sewage effluents in Ghulam Muhammad Abad area (Paharang [illegible])

[illegible]	Kashmir Ghee Mills	A. Sattar Dying	Walayat Flour Mills	Chenab Fabrics	[illegible]	[illegible]	Main drain Marzipura	[illegible] Uchkera
EC (dS [illegible]$^{-1}$)	[illegible]	5.29	2.81	8.78	[illegible]	[illegible]	3.36	2.88
pH	[illegible]	7.84	7.17	7.73	[illegible]	[illegible]	7.32	7.18
SAR	[illegible]	12.03	5.93	20.28	[illegible]	[illegible]	10.21	9.54
RSC(me [illegible]$^{-1}$)	[illegible]	7.65	12.83	15.90	[illegible]	[illegible]	10.73	10.05
Cl "	[illegible]	29.01	12.41	51.88	[illegible]	[illegible]	19.58	16.93
SO_4 "	[illegible]	12.97	0.56	30.83	[illegible]	[illegible]	0.23	Traces
K "	[illegible]	1.18	3.39	0.65	[illegible]	[illegible]	0.63	0.60
P (mg L^{-1})	[illegible]	0.16	0.32	0.17	[illegible]	[illegible]	0.69	0.59
Fe "	[illegible]	0.50	0.69	0.70	[illegible]	[illegible]	0.86	0.36
Mn "	[illegible]	0.38	0.53	0.22	[illegible]	Traces	0.24	0.31
Cu "	[illegible]	Traces	Traces	Traces	Traces	Traces	Traces	Traces
Pb "	[illegible]	0.33	Traces	Traces	Traces	Traces	Traces	Traces
Ni "	[illegible]	0.16	Traces	Traces	Traces	Traces	Traces	Traces

loam in texture having good internal drainage with deep soil development and were located in the Old Flood Plain. The soils belong to coarse loamy, mixed, calcareous. Hyperthermic Ustalfic Haplargids family, In this locality soils irrigated with canal water were found free of salinity/sodicity (EC, < [,53 dS m^{-1}. SAR < 6.50. pH, < 8,20) but did contain high concentrations of DTPA extractable Fe (11,32 mg L^{-1}), Mn' (10.78 mg L^{-1}) and Zn (14.20 mg L^{-1}) at 0 to 15 cm which gradually decreased with increasing soil depth. Such high levels of Fe, Mn and Zn in the canal irrigated soil were apparently confusing but could be due to the application of municipal solid wastes which the farmers usually use in such areas.

The fields under caulitlower and Chinese squash were also found free of salinity/sodicity (Table 2) in spite of receiving sewage water for irrigation for the last 8-10 years. These low values of EC<, SAR and pH, in these fields seemed due to monsoon rains, and due to about 5 to 6 canal water irrigations to each crop (as the farmers reported) which appeared to help arrest both the problems of salination and sodication.

Concentrations of P. Fe. Mn. Zn, Cu and Pb were high throughout the soil profile and are expected to cause toxicities as well as antagonism for nutrient uptake by plants. High P levels could be due to higher application rates of fertilizers than their removal by crops. But throughout the soil profile, Olson-P > 7.0 mg L^{-1} also suggested to have some soil material containing potentially high amount of P-compounds rendering the site an odd one and could be considered not representative of the experimental area. The micro-nutrients had the highest concentrations at 0 to 15 cm but decreased gradually further down. Again at 90 to 120 cm soil depth. there was some tendency of metal accumulation. This appeared the result of accumulation from irrigation water since these micro-nutrients are less mobile in soils due to formation of oxides (Grass. 1969) and/or due to formation of complexes with organic matter (Kau, 1981) under alkaline soil conditions (Ellis et al.. 1981).

Chemical Composition of Plants: Both the vegetables consistently retained N. P. K., Ca, Mg and Cl at higher concentration in their leaves compared to that in the respective fruits except P (Table 3). Slightly higher P in leaves and fruits of both (he vegetables seemed due to P application and that which was added with sewage irrigation water (Ibrahim and Salmon. 1992a: Ghafoor et al.. 1995). However. in spite of very high concentration of these nutrients in the growth medium. their concentrations in plant fruits were within the safe limits, This tended to reflect some sort of selective mechanism of nutrient absorption and transport within plant which required further elaborate studies under controlled conditions followed by field investigations

Table 2. Chemical analysis of soils irrigated with Paharang drain water at Faisalabad

Determination	Fields under cauliflower: soil depth (cm)					Fields under Chinese squash: soil depth (cm)				
	0-15	15-30	30-60	60-90	90-120	0-15	15-30	30-60	60-90	90-1~0
pH,	7.9	8.2	8.2	8.1	8.1	8.1	8.2	8.3	8.3	8.2
EC_e (dS m')	2.6	2.2	2.2	2.1	2.3	2,4	2,4	2.6	2.2	2.3
SAR	7.6	7.8	8.1	7.8	9.2	6.6	6.3	8.0	7.3	7,4
Ca (me L')	-	-	-	-	-	10,4	8.0	6.5	6.7	6.2
Na "	-	-	-	-	-	15.0	12,4	14.2	13.3	12.0
Cl "	10.6	11.0	13.9	13.5	11,5	17.1	13.8	16.1	14,4	16.1
S04 "	15.1	9.6	7.2	4.1	9.8	12,4	8.7	8,4	6.9	9,4
K(mg L')	282.0	93.0	117.0	82.0	69.0	262.0	120.0	90.0	53.0	39.0
P "	14.2	10.0	6.6	6.9	7.2	7.6	23,4	24.9	4.0	5.7
Fe "	110.0	69.0	46.0	33.0	51,0	55.0	46.0	32.0	31,0	31,0
Mn "	62.0	31,0	29.0	14.0	13.0	20.0	46.0	38.0	24.0	13.0
Zn "	117.0	86.0	43.0	35.0	97.0	130.0	47.0	29.0	44.0	50.0
Cu "	12.6	3.3	1,2	1,6	4.7	8.9	8,4	1,9	2.0	4.8
Pb "	4.5	2.0	1,4	1,0	1,1	3.3	1,1	0.6	2.6	0.5
Ni "	1,1	0.7	0,4	0,2	Traces	0.2	Traces	Traces	Traces	Traces

Table 3. Chemical composition of cauliflower and Chinese squash irrigated with Paharang sewage water at Faisalabad (Av. of four fields)

Determination (% dry wt.)	Cauliflower		Chinese squash	
	Leaf	Head	Leaf	Fruit
N	4.00	4.76	4.09	5.10
P	0.52	0.64	0.60	0.74
K	1,18	1,29	1,75	1,57
Ca	1,19	0.18	0.75	0.22
Mg	0.52	0.14	0.37	0.14
Cl	1,52	0.55	1,47	0.85

to draw clear cut conclusions.

Conclusions: Fruits of vegetables grown with Paharang drain effluent did not accumulate N, P, K, Ca, Mg and Cl in toxic concentrations though in soils this happened. Similarly, very high EC, SAR and RSC of the sewage water did not result in soil salination and sodication within a period of about 8 to 10 years where management seemed the key factor but needs further investigations. Under the conditions of the experiment, sewage water could be considered a potential source of plant food nutrients.

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